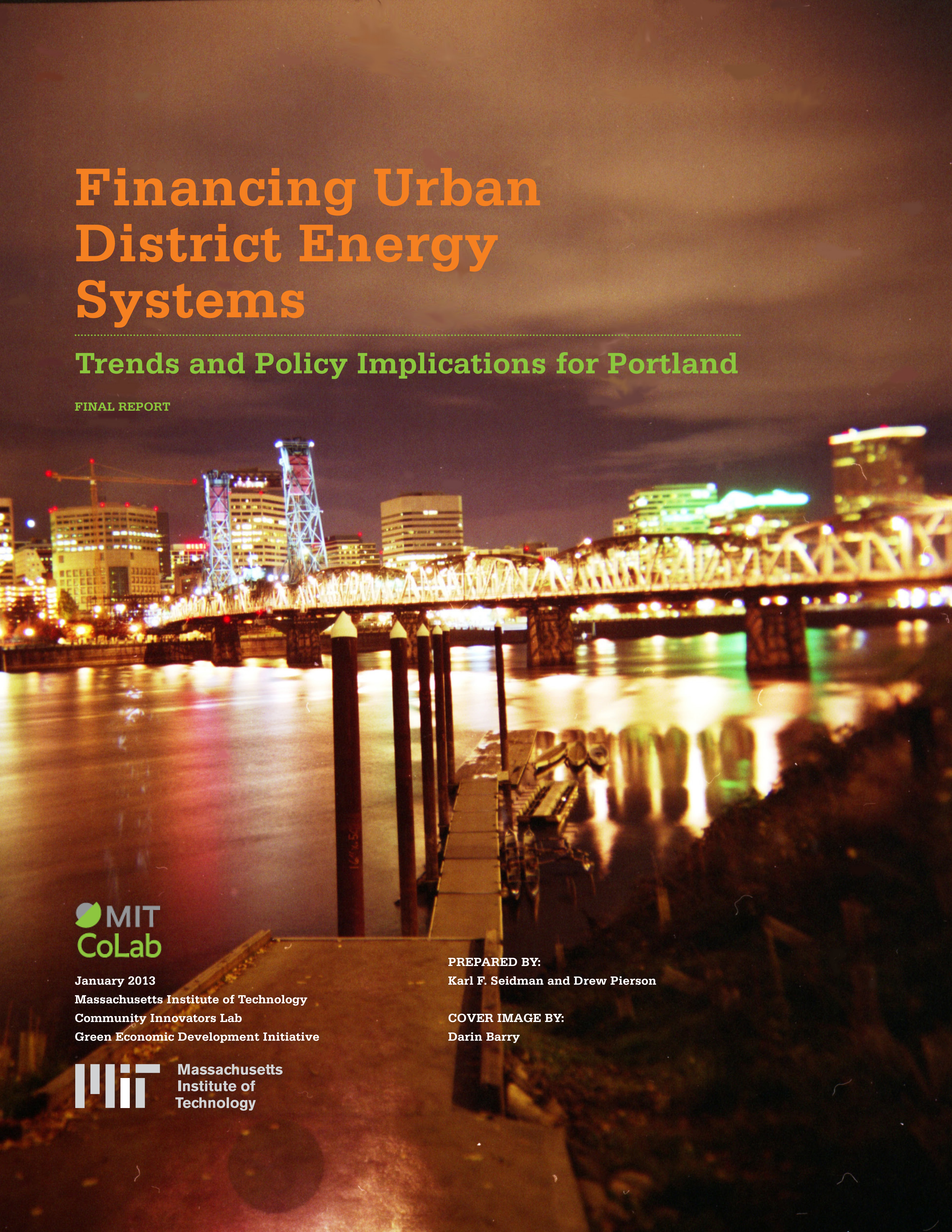

Financing Urban District Energy Systems

Trends and Policy Implications for Portland

FINAL REPORT

MIT CoLab

January 2013

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I. Introduction

This report presents initial findings from a collaborative research project between the MIT Department of Urban Studies and Planning under CoLab's Green Economic Development Initiative and the Portland Sustainability Institute on the financing of urban district energy systems. The purpose of this research is threefold; (1) to understand how district scale energy projects are being financing; (2) determine what financing gaps Portland and other cities are likely to encounter in implementing such projects; and (3) identify policies and financing roles that cities and development intermediaries can use to address these financing gaps.

To complete this report, the research team conducted a literature search for research on the financing of urban district energy systems, reviewed existing reports, studies and selected conference proceedings on the development and financing of district scale energy systems, and collected more detailed information through phone interviews with professionals in the field as well as from presentations at the October 2011 Portland Sustainability Institute EcoDistricts Summit. Since the development of new urban district energy systems is an emerging area of infrastructure investment, this report relied on a small set of projects and interviews. As a result, the findings are preliminary in nature. Through on-going research to track trends and identify and analyze additional projects, the research team intends to update, verify, and expand on the initial findings presented in this report.

Research findings are presented in four sections. First, an overview of trends in the development of district energy systems and their financing is provided. Next, the process used to finance these systems is reviewed, along with the financing associated with each phase of the process. The third section summarizes key financing gaps to address to facilitate the development of urban district energy systems and discusses the application of these gaps to projects in Portland. In the final section, some implications and policy options to address these gaps are discussed.

The Green Economic Development Initiative (GEDI) supports economic development organizations pursuing the triple bottom line of environmental sustainability, social justice and economic opportunity. GEDI's goal is to have this triple bottom approach broadly applied in the economic development field. For more information, please visit http://web.mit.edu/colab/work-project-gedi.html.

II. Trends in District Energy Development and Finance

Impetus

Recent market dynamics are creating a growing demand for district utility systems in a variety of development contexts. As environmental regulations and aging infrastructure further restrict the role of conventional sources of electricity (i.e. coal), new opportunities are emerging to establish district energy as a platform for local, more efficient co-generated electricity. Bolstered by national, state, and local policies focused on mitigating greenhouse gas emissions and improving energy efficiency – as well as local efforts to cut energy costs and enhance energy security – many consider the "district level" as the optimal scale for piloting new technologies and realizing greater energy efficiency than is possible through individual building energy systems. This interest is resulting in evolving development models, financing strategies, and partnerships that are changing the landscape of the district energy market.

Development Trends

On the demand side, five district energy systems "development types" are apparent:

- Retrofitting, upgrading, and expanding existing institutional or multi-user district energy systems (i.e. "legacy systems").
- Establishing single-user institutional systems (e.g. for university or medical center campuses).
- Upgrading and expanding existing single-user institutional systems to encompass surrounding development (to capture additional economies of scale and integration).
- Building new systems for new large-scale developments (both greenfield and brownfield projects).
- Installing new systems in existing developed areas.

First, owners of legacy systems are upgrading production facilities, investing in new technologies and improvements (e.g. steam to hot water conversions at major campuses around the country), acquiring new projects, expanding distribution networks to incorporate new buildings, and improving system efficiencies to take advantage of emerging market opportunities from refurbishing aging district utility infrastructure. Given the many legacy systems throughout North America, the refurbishment and acquisition market is drawing significant attention from start-up companies and international engineering firms alike. Predicated on effective due diligence, this market requires an in-depth understanding of existing district utility infrastructure on a variety of operational, technical, and financial levels.

Second, district energy is regarded as a preferred heating and cooling method, with potential for electricity cogeneration, for many major institutional campuses, such as universities and medical centers. These institutions are well positioned to cut long-term energy costs and meet policy-driven environmental goals because of high building densities and a consistency in building ownership that allows for a more efficient implementation of district energy projects. Despite high initial capital costs, many are moving forward with district energy projects through tools such as energy service contracts, third party financing, grants, reserve funds, "green funds", and loans. Some of these institutional systems are also looking at ways to better capture synergies and scale associated with surrounding development, either through provision of commercial services to third parties or by outsourcing existing systems to another partner to pursue larger integration opportunities (in addition to upgrade and expansion of on-campus systems).

Third, developers are using DE systems to anchor new construction projects, (i.e. "greenfields") particularly for mixed-use developments that combine residential, commercial, and office space. By eliminating on-site heating and cooling equipment used in conventional buildings, developers are viewing district energy as a means to free up square footage that can be used to generate revenue, improve project economics, and reduce energy use and costs. According to industry professionals, this approach is more cost effective than "building retrofit strategies" that attempt to integrate DE systems into the existing building stock.

However, despite this difference, cities are dedicating attention and resources to strategies focused on installing district systems in existing developed areas. These strategies employ a mix of financial and programmatic tools that:

- Categorize potential upgrades for community-wide and building-specific infrastructure
- Evaluate the return on investment (ROI) for infrastructure upgrades coupled with proposed district energy systems
- Incentivize building owners to upgrade existing buildings without having to bear the full upfront cost premium.

This report emphasizes the last two categories: the introduction of new district energy systems into newly developed (or redeveloped areas) and already built urban areas; since these are the type of projects that the City of Portland and Portland Sustainability Institute are most likely to implement through its EcoDistrict Initiative. These trends are discussed in further detail as they relate to the issues and challenges associated with financing urban district energy projects.

Trends in System Finance

The role of private firms in financing and operating district energy systems is growing, which has created new financing options. While earlier district energy systems often relied on project-based financing that used debt backed by the system's fee revenue, there is increasing use of balance sheet financing by private utility and energy service firms to fund these systems. Large international energy service firms with experience in Canada and Europe, such as Corix and Veolia Energy North America, have increased their presence in the United States. These firms are acquiring and operating existing district energy systems and, in some cases, building new ones. For example, Veolia operates the Medical Area Total Energy Plant (MATEP) that provides electricity, heating, cooling and specialized medical energy services to six hospitals in Boston's Longwood Medical Area[*]. In 2008, it purchased a district heating and cooling system that serves 130 customers in downtown Grand Rapids from Kent County, Michigan[†]. Corix was selected to operate the University of Oklahoma's multiple district energy systems under a 50-year contract[‡]. It is also a partner with an Alaskan Native American owned company to design, build, own and operate 12 utility systems to serve three US military bases in Alaska[§].

These firms have the expertise to design, develop and operate systems. Moreover, they have created large pools of capital that allow them to finance projects internally without having to borrow on a

* http://www.veoliaenergyna.com/veolia-energy-north-america/locations/boston-cambridge.htm

† http://www.bloomberg.com/apps/news?pid=newsarchive&sid=ay2P9iNQZ.hQ

‡ http://www.corix.com/news/2010/2010-08-05.aspx

§ http://www.corix.com/corix-companies/utilities/documents/CU_PP11_Alaska.pdf project-by-project basis. While these firms evaluate projects individually and treat each system as a profit center, they rely on their overall corporate revenues and balance sheet to raise the capital for system acquisition and development. This trend promises to simplify and reduce the transaction costs to finance district energy systems since much of the capital can be provided by a single corporate source that has considerable expertise in district energy. And financing costs may be lowered in part through diversification across multiple systems.

In some cases, entrepreneurial cities are developing and financing district heating systems themselves through their capital budgets or public utilities. For example, Vancouver developed and financed the Southeast False Creek Neighborhood Energy Utility to provide district heating and hot water to the Olympic Village and surrounding areas. Although publicly owned, energy rates were set to match the expected returns and capital structure for a private utility system, financed with 60% debt and 40% equity, to provide Vancouver an option to sell the system to a private energy company in the future.

Smaller scale systems are challenging to finance through either a private energy firm or project- level debt. They need more customized arrangements and often rely heavily on grant funds. One example is West Union, Iowa which installed a $2.4 million geothermal system to serve 60 buildings in its downtown commercial district. The cost was entirely covered by three separate grants*.

* Preservation Green Lab, District Energy in West Union Iowa.

III. Financing Process and Structure

This section expands upon the discussion of financing strategies and requirements for the five types of district energy systems in the prior section to detail the process used to undertake these projects and associated financing issues. Existing systems have an established user base, long-term contracts or tariff structure, and in some cases a regulatory framework that facilitates access to financing for system improvements: upgrades can be built into their capital budgets and recovered through energy rate charges to their existing and anticipated customers. Similarly, single-user systems rely on the economic value and enhanced reliability of the energy project to the user; the revenue paid by the user for energy services covers the cost of district system investments, either directly or through a power purchase agreement with the owner of the system. When a developer or energy services firm builds a district energy system for a single user, the firm and user negotiate the required energy prices, contract terms and any capital contributions by the user to ensure that the project is feasible for both parties, i.e., it meets the energy firm's required return on investment and provides cost and risk competitive energy to the user.

The development of new multi-user district energy systems poses a greater financing challenge since both the number and timing of users for the new system is uncertain. When systems are built for new development projects, the market for the project and build out timing is uncertain. For systems introduced into an existing built environment, the comparable risk is the number and pace at which existing building owners will convert from individual building systems to the new district scale system. Energy system developers and governmental partners have managed these risks in a number of ways:

- Undertaking detailed feasibility studies to ensure that a strong business case exists for a district energy system, determine the required rate structure to compete with alternative energy costs, and assess what subsidies, if any, are required.
- Phasing investment in both the central energy plant and construction of the distribution system.
- Requiring new buildings in an area served by a district heating system to include the connecting infrastructure for the district system, and, in some cases, requiring that they connect to and use the district system (or providing financial and non-financial incentives to do so).
- Providing financial or non-financial incentives for existing building owners to connect to the district system, e.g., grants to reduce the initial conversion cost or expedited building permits for retrofits.

Decision and Development Process

Multiuser systems that serve either newly developed areas or already built districts typically use a similar decision and financing process that applies to both publicly or privately owned systems. This decision and development process involves seven key steps:

1. Completing a preliminary or pre-feasibility study to determine if there is good likelihood that feasible business case for district energy system exists

These studies cost from $25,000 to $50,000 and are typically paid for by the public sector. Some cities, such as Seattle, completed a pre-feasibility study to identify and evaluate multiple projects.

2. Preparing a detailed feasibility study to determine the required capital and operating costs for a system, the expected level of energy use over time and the rate need to ensure competitive pricing

This study may also determine if any project subsidies are appropriate in exchange for public benefits that cannot be recovered directly in rates such as greenhouse gas reductions, long-term energy security, etc.). The cost for these more extensive studies are in the range of $250,000. Funding for these studies comes from a variety of sources, depending on the nature and scale of the project. Sources include municipalities, private property owners served by the system, and utilities or energy service companies that will develop and/or operate the system. For most regulated utilities, these costs are treated as a capital cost and can be recouped over time in the energy rates established for the new system.

3. Deciding on how the system will be owned and operated

This decision may precede or follow the detailed feasibility study, depending upon the specific context. Options include public sector ownership and operation; public sector ownership but operated by a private energy company or utility; cooperative ownership; and private sector ownership and operation through either an existing energy utility or a new energy services firm. This choice will impact how the system is financed and possibly its cost of capital. Capital costs vary depending on the type of energy provided, system capacity, fuel sources and size of the distribution network. The smallest systems, comparable to West Union, Iowa, have capital costs of a few million dollars while the largest systems, like that serving the three Alaskan military bases cost several billion dollars. According to Corix, their most common systems are in the $30 to $60 million range.

4. Setting the energy rate structure, negotiating long-term contracts and any required capital or operating subsidies

Rate structures come in a variety of forms, including bilateral long-term contracts between building owners and system operators; tariff-based approaches that aggregate individual charges for specific costs ; or hybrid-contracts that incorporate elements of both bi-lateral agreements and tariff-referenced pricing. The key goal driving the rate systems is to provide energy load security. Long-term contracts are typically used to address loan risks posed by voluntary interconnection conditions, in the case of both public and private ownership. Consequently, these contracts typically range from 20 to 50 years to ensure that the upfront capital investment will be repaid. However, multiple bilateral contracts can pose risks when they create variability in rates that pose problems in situations in which project owners are seeking to sell a system and have to contend with many individual bi-lateral contracts in the process.

5. Raising the required financing

This may be straight-forward if the project does not require subsidies and the public or private system developer has existing capital to fund the project. It will be more complex and time consuming if grants or other subsidy sources must be secured and debt backed by the system revenues needs to be raised.

6. Project construction and implementation, including adding existing and new buildings to the system

This usually occurs in phases for systems serving a large area and may require detailed plans for staging the capital investments.

7. Energy system operation, revenue collection and repayment of debt and any owner return on investment, if privately owned

This is typically conducted by a third party owner and/or operating business, or the managing utility.

8. Anticipating future changes to the business plan

These systems are not operated as mere engineering projects, but as dynamic businesses that is subject to growth, change, and innovation. Once established, the district energy system's business plan will be continuously updated. Ongoing expansion, transformation and renewal may be anticipated relative to the initial business case.

Often times, public and privately owned multiuser district systems are based on financial structures similar to regulated energy utilities; although the exact capital structure varies depending on jurisdiction and regulatory environment. While some systems are entirely debt financed[*], others use internal funds, reserves, or grants to make equity or equity-like investments at the onset. One function of these internal funds and reserves is to allow for more stable and level energy rates over time, as the system load grows. In this capacity, they fund revenue gaps from a low load in the initial years and are then repaid by ratepayers in later years as the system load matures. In the case of the publicly-financed Southeast False Creek district energy system in Vancouver, British Columbia, regulators set rates to generate a return structure mimicking debt-equity ratios (DTE) commonly sought by private investors; in this case, a 60/40 DTE. Designed with an implied return to equity, this rate structure is intended to generate sufficient revenue to repay 60% of the project's capital costs at prevailing interest rates for debt, while also providing a market return on equity for the other 40%[†]. This approach has given the City an option of selling the system at a later date to a private investor with similar return requirements without a rate shock from the sale. It also means that the taxpayers, as de-facto investors in the system, may receive a comparable return on their investment as private utility shareholders, as is the case with the Southeast False Creek system in Vancouver. Privately owned systems typically use this 60/40 DTE to finance projects, although it may vary it based on the developer's view of underlying project risk

The review of district energy cases and interviews with private energy firms indicated many district energy projects are relying on some level of initial grant capital or subsidy.

When subsidies are provided, it should support realizing important public benefits, such as greenhouse gas reductions or increased energy reliability and security, rather than reducing user energy rates. In certain instances, as noted in the above paragraph, initial grants or public sector capital with a deferred return is provided to reduce energy costs in the early years and achieve more level energy costs over the life of the project. In these cases, there is an expectation that this capital will be repaid with a fair return from rate revenue in the system's later years[‡]. A reserve account may be established to track the "under recovery of revenue" from reduced rates in the early years to be repaid in future years, along with a return on investment for this revenue gap.

* This is feasible with very secure customers that can provide long-term loan security.

† In the case of Southeast False Creek system an after tax return on equity was used.

‡ This situation often occurs with district energy infrastructure is built in advance of expected growth in the user base and rate load.

III. District Energy System Financing Needs and Gaps

Based on the interviews with public officials, consultants and energy firms and financing information for several projects, district energy systems face three financing needs that are not readily supplied by either private energy firms or private financial markets:

1. Funding for pre-feasibility studies and detailed system level feasibility studies

Since pre-feasibility are undertaken early in the process to help convince stakeholders that a viable project exists, the potential for repayment is limited and few private loan or equity sources exists. Since these studies need to be funded with direct grant or perhaps contingent loan in which the cost is recovered from future capital costs if the district system is built, a combination of government appropriations or philanthropic grants are need to fund this stage of the process. Detailed system level studies are more costly but there is greater potential to share the cost of these studies with other stakeholders and to recoup the cost in future energy rates. Since repayment through energy rates occurs over many years and does not begin until the system is operational , any funding for these studies needs to be flexible and patient with initial repayment deferred for several years. While some level of debt could fund these feasibility studies, the source of the loan capital would need to from governmental or philanthropic sources to accommodate the flexible repayment terms. Assuming demand to complete four pre-feasibility studies and one detailed feasibility study each year, with the cost of later shared with private partners, the City of Portland will need $225,000 to $350,000 in annual funding to meet this demand.

2. Addressing capital funding gaps

Since the capital costs for many district energy systems are not fully supported by their initial energy rates, funding sources to address these gaps will be needed for some projects. These project subsidies may be justified by reductions in pollution and carbon emissions, greater system reliability and reduced vulnerability to future energy costs or supply disruptions. These capital gaps can be addressed through direct grants to offset the investment that must be repaid by energy rates, tax credits that provide an alternative source investment returns, and loans with deferred repayment terms*. This last option allows for the recovery on initial capital subsides as district energy rates increase over time, especially if the use base or future energy prices grow at rates higher than initially forecast and thus generate increased revenue from district energy services.

3.Financing improvements needed to connect properties to a new district system

When a new system is introduced into a developed district with individual building heating, cooling or hot water systems, building owners need to adapt their building to connect to district system and possibly retrofit the building's internal distribution

* In some cases, these loans take the form of a line of credit to fill the gap between revenue and operating costs in the early years of system and/or to allow for more stable energy rates over time.

system[*]. Ideally, these costs are considered as part of the business case for the district energy, funded through the district utility and recovered in the energy rates. However, in practice, this is not always the case and the cost of building retrofit fall on the property owners. When this occurs, the cost of building conversion to district energy may be uneconomical for some building owners. However, the benefits of having the building owner connect to the system and accelerate the scaling up of the system may justify some subsidy to offset conversion costs. Even when these costs are justified by energy cost savings, some building owners may lack funds to retrofit their building and be unable to secure a loan due to the property's existing debt and mortgages and/or lenders' perception of the repayment risk. This situation is most likely to exist for non-profit and smaller private building owners. Building conversion costs were a significant barrier when the St. Paul, Minnesota district energy system was developed in the 1980s, which led to the creation of a $2.6 million fund to help finance to building conversions costs (see the case study in Appendix C). Consequently, a capital pool to address building conversion capital needs may be needed to facilitate connection and utilization of district energy systems targeted to existing buildings, when these costs cannot be financed through the district energy rate base. This pool can be structured as a revolving loan fund with many conversions funded with debt and used to support sequential district energy systems.

Financing Gaps and Portland District Energy Projects

PoSI and other Portland stakeholders have worked to incorporate district energy into several projects. Although at different stages of planning and implementation, these projects encompass the different types of district energy development and thus a valuable lens through which to view DE financing gaps. Five projects in which DE has been deployed or is being considered are:

1. The Brewery Blocks

This private mixed-use development of a former brewery complex along five contiguous blocks in the Pearl District installed a new district cooling system with central chillers on the roof of a renovated building on Block 1. The cooling system provides chilled water to the entire Brewery Blocks development, and beginning in 2008, expanded the distribution system to serve other buildings in the Pearl District. The district cooling system was originally developed and financed by Portland Energy Solutions, a subsidiary of Enron, at a cost of approximately $7 million, The project ran into financing problems due to Enron's bankruptcy and received a $2 million loan from Portland General Electric (PGE) to complete the project and cover initial operating costs. The system was later acquired by and is now owned and operated by Portland District Cooling Company (PDCC), an affiliate of Veolia Energy North America. The district cooling system had been privately financed without subsidies for the system infrastructure, operating losses, or building modifications. This result reflects the system's installation as part of a major development/reuse project that created a large user base in several years and involved the adaptive reuse and new construction of buildings to connect to the system. The system has excess capacity and Veolia is actively pursuing growth opportunities, which were on hold through several changes in ownership after the Enron bankruptcy.

2. North Pearl District

As part of its preparation of the North Pearl District Plan, the City of Portland commissioned a study to assess the business feasibility of establishing a district energy system and utility for the area at a cost of $100,000. The study, completed in March 2009, concluded that a DE system would provide a fair market investment return under most scenarios. Part of the proposed loads would be existing

* For example, older buildings with steam heating systems need to convert to accommodate circulating hot water used by most district heating systems

hydronic buildings in the neighborhood. Part of the system cost, as is common for district energy projects in already developed areas, included an estimated $1million to address building retrofits to connect to a new system.

3. Rose Quarter

The City of Portland is studying the feasibility of a shared heating system among several large municipal buildings that include the Rose Garden Arena, Veteran's Memorial Coliseum (VMC) and Oregon Convention Center (OCC). A key impetus for the system is the need to replace current heating and cooling systems at the city-owned Veteran's Memorial Coliseum. As an alternative to installing new systems at the VMC, the city contracted with Corix to evaluate the feasibility of a shared thermal energy system (STES) among the three facilities. A phased plan is being considered that would first connect the VMC to an expanded boiler and chiller at the Rose Garden. The second phase would add the OCC to the system. Over time, a third phase might build a central thermal energy plant that could also serve buildings and new development in the adjacent Lloyd District. While the first phase project is financially sound based on full lifecycle costs, split responsibility for capital and operating costs pose a challenge to capturing the full financial benefits required for new investment by the Rose Garden.

4. Southeast Waterfront District

The South Waterfront District involves the wholesale redevelopment of a large brownfield site into a mixed use district anchored by the Oregon Health and Sciences University (OHSU) campus. The density of development, mix of uses and opportunity to install district energy distribution pipes as part of building new infrastructure suggest the potential for a financially feasible district energy utility. A preliminary analysis suggested two scenarios for a feasible DE system: (1) one serving the OHSU campus alone; and (2) an extended system for the campus and adjacent development area. A larger system would be more complex, given the need to negotiate with multiple developers, but could benefit from greater scale and load diversity. Future steps include selecting an energy utility partner and further business feasibility analysis.

5. Portland State University

Portland State University has an existing central low pressure steam system that provides district heating to its campus and several chillers that service multiple buildings. A 2008 campus Master Plan called for expansion and upgrading of the campus heating and cooling systems to address university needs but did not evaluate the potential to connect the campus system to serve buildings and/or new planned development in the adjacent community. A 2010 scan of potential ecodistrict infrastructure projects recommended undertaking a full feasibility study on expansion of the PSU campus heating and cooling systems to serve an adjacent district and to utilize renewable energy sources. This study has not yet been undertaken.

Since several projects are still in early planning stages, the full costs, feasibility and financing gaps across all five projects are not yet defined. Nonetheless, some financing needs are apparent (see Table 1) and the work to date on these five projects indicates that each of the three financing gaps discussed above exists for at least one project. The most common and pressing financing need is to incentivize prospective customers to undertake both initial screening studies and more advanced feasibility studies for projects. All projects except the Brewery Blocks have required (or are awaiting) some level of early stage funding or financial assistance to pay for these studies, coming from a variety public, private, and institutional partners. A dedicated fund, perhaps capitalized from several sources would help advance these studies and create a deferred loan mechanism with the potential to recapture and recycle these investment dollars.

In addition to funding for early screening and feasibility studies, several projects (North Brewery Blocks, PSU expansion and a third-phase expansion of a Rose Quarter) suggest a potential need for building retrofit financing. Although building retrofits are typically considered in the business case for a district energy system and should represent an economic investment for property owners in conjunction with energy rates, institutional barriers may impair retrofit investments. This may occur when tenants pay for energy costs and landlords are responsible for retrofit capital costs or when existing debt levels or the financial condition of a property owner preclude borrowing needed to achieve the retrofit. In other cases, long term public benefits, such as greenhouse gas reductions, may justify subsidizing a retrofit investment that is not justified from private returns alone. In these cases, the availability of loans or incentives to help buildings connect to a new system may be needed and warranted. The need for upfront system-level capital or a reserve account to equalize energy rates over time in anticipation of load growth is the most uncertain financial need, as two projects are still awaiting detailed feasibility analysis. For the other three projects, this capital subsidy does not appear necessary.

TABLE 1. POTENTIAL FINANCING GAPS FOR PORTLAND DISTRICT ENERGY PROJECTS

PROJECT NAME	DEVELOPMENT TYPE	STATUS	FINANCING NEEDS/GAPS
Brewery Blocks	Portland State University	Completed and expanded	None: privately financed by utility and energy firm
North Pearl District	New system for existing area and new development	Preliminary business study completed	Funding provided for initial study.
North Pearl District	New system in developed area	Feasibility study completed	Need to address split incentives between VMC and Rose Garden re: capital investment and operating cost savings.
South Waterfront District	New system for redevelopment that includes a single user campus.	Screening completed. Initial business feasibility study underway.	Full feasibility study underway; financing needs to be determined.
Portland State University	Upgrade of existing systems and expansion to serve adjacent neighborhood.	Campus Master Plan complete; study to assess expansion beyond PSU needed.	Feasibility study; financing needs to be determined.

IV. Policy Implications for Advancing District Energy

Although several trends are improving the policy and market environment for developing new district scale energy systems, financing these systems remains challenging and will benefit from special tools to complement capital available from private firms and capital markets. Developing creative approaches to address these financing challenges will contribute to a holistic strategy to advance the use of district energy systems in Portland, and may have application to other Ecodistrict infrastructure. As elaborated in the prior section, Portland should focus on options to address three financing gaps: (1) early-stage pre-feasibility and feasibility studies; (2) initial system capital investment; and (3) building retrofits to connect to new district systems (when these costs are not incorporated into district energy capital costs and energy rates).

Additional planning and research will be needed to determine the exact contours of the financial products and delivery system to address these capital needs and the best way to capitalize it. These needs and appropriate financing strategies will become clearer as more district energy projects emerge in Portland and other cities. However, any strategy will require a pool of flexible and patient capital to finance feasibility studies and long-term system capital investment; these investments cannot typically be repaid on a predictable fixed payment schedule, and may need to be forgiven for some feasibility studies. Consequently, a significant part of the funds will need to be from sources that allow for long-term (or no) return of capital with partial deferral of repayment and potential forgiveness of some capital. Public sector funds supplemented with foundation grants and program related investments are the most likely sources to capitalize this type of flexible investment vehicle. Once a track record of financing district energy projects and associated investments is established, it may be possible to draw from additional private sector capital sources. As part of this effort, Portland can explore three broad institutional strategies to develop a sustained capacity to raise and manage capital to finance district energy infrastructure:

- Creating a specialized intermediary to raise, manage and supply financing for district energy projects on a city, regional or statewide basis. This could be a new entity or a specialized unit within an existing public development finance entity.
- Establishing a partnership with an existing CDFI or financial institution to provide some of these financing roles.
- Work with the Portland Development Commission to use Portland's extensive tax-increment financing resources and their experience with financing redevelopment infrastructure to help finance district energy projects in redevelopment areas.

In pursuing this financing strategy, flexible debt tools should be used, as opposed to providing direct grants and local tax subsidies, especially for system capital investments and building retrofits. Flexible debt has several advantages over grants and tax incentives. It provides the potential to recapture and recycle funds invested in advancing district energy projects, and thus can finance a larger number of projects with a given amount of funds. Secondly, it creates the potential to access to a larger range of funding sources, especially sources of debt capital, rather than relying solely on the limited sources of grant funds that exist. Finally, relying on debt to finance projects, especially if they provide financial benefits to private businesses and building owners, recognizes the need for prudent use of governmental and philanthropic resources.

Table 2 lists several funding resources sources that Portland may be able to utilize as it works to capitalize a fund to finance district energy projects. The ultimate selection of funding sources will depend on the final strategy selected by Portland stakeholders and the policies, funding priorities and appropriation levels among the potential funders.

TABLE 2. POTENTIAL FUNDING SOURCES FOR DISTRICT ENERGY FUND

POTENTIAL SOURCE	NEW SPECIALIZED INTERMEDIARY	CDFI PARTNERSHIP	PDC
Federal Programs	Emerging CDFI Program	CDFI Fund Core Funding	US EDA Economic Adjustment or Public Works Programs *
Foundations (national ones with energy or sustainability focus—e.g., Energy Foundation, Kresge, Surdna plus local and regional ones)	Program grants Program related investments	Program Grant Program Related Investments	N/A
Financial Institutions (Chase, Bank of American, US Bank, etc.)	Grants from associated foundations Below market loans	Grants from associated foundations Below market loans	N/A
Utilities	Underwrite or match funds for feasibility studies Incentives for building retrofits	Underwrite or match funds for feasibility studies Incentives for building retrofits	Underwrite or match funds for feasibility studies Incentives for building retrofits
City Government	City grant or loan funded from sources in far right column	City grant or loan funded from sources in far right column	TIF for redevelopment areas City appropriations Community Development Block (CDBD) Grants † Qualified energy efficiency bond (QECB) proceeds

* EDA funding would need to be linked to projects and investments that would general employment, economic diversification or other economic development benefits.

† Use of CDBG funds would need to generate benefits to low/moderate-income residents, eliminate blight or address a pressing community need.

Appendix A: Southeast False Creek District Energy System Case Study*

Olympic Village Development, Vancouver, British Columbia, Canada

* Based on interviews with Interviewees: Trent Berry, Compass Resource Management and Chris Baber, City of Vancouver along with supporting documents, and various sources of online research.

Introduction

Compass Resource Management (CRM), a consulting company based out of Vancouver, British Columbia, specializes in technical and financial modeling and analysis, project management, and structured decision-making services for clients in the energy and environmental management sectors. This interview focused on financing lessons from the Southeast False Creek (SFC) district energy project owned by the City of Vancouver. CRM helped to design and conduct a feasibility analysis and financing plan for the city. A second interview was also conducted with a staff person from the City of Vancouver (CoV) who was familiar with the project's design and development.

Project Background

Covering approximately 6.5 million square feet of developed buildings, the Southeast False Creek development is located in the heart of Vancouver, British Columbia. It encompasses a mix of public and private real estate, with the City of Vancouver owning approximately 25% of the developed building floor area. The City prioritized district energy as a means to promote a cohesive and sustainable energy supply for the whole neighborhood.

Consisting of two main components – the False Creek District Energy Center and its related distribution network – the system is owned and operated by the Neighborhood Energy Utility (NEU), an entity managed by the City of Vancouver Engineering Department. Specifically, Vancouver is focusing on reducing project risk through zoning and density standards designed to enable sufficient energy demand among newly constructed and existing buildings in the project area, and to require connection. The system has recently added voluntary loads outside the initial bylaw area (based on an individual business case) and Council recently approved expanding the bylaw area to a new large development area to the east of the initial service area.

Financing Structure

The CoV used its credit to finance the project with debt supplemented by grants from higher levels of government. The CoV-managed "Property Endow-

TABLE 3. KEY FINANCING NEEDS AND SOLUTIONS USED IN THE SOUTHEAST FALSE CREEK DISTRICT

OWNER	**City of Vancouver**
KEY FINANCING NEEDS	**Project Pre-Feasibility Study** – evaluated potential of district energy system based on (i) proposed system footprint, (ii) building density, (iii) potential aggregated demand, and (iv) system performance benchmarks. Funded by City of Vancouver's Property Endowment Fund (PEF) with the costs later recovered via rate design.
	Engineering Feasibility Study – technology analysis evaluating permitting and design issues for approximately eight different energy resources to power the system. Funded by PEF, costs recovered via rate design.
	Phase 1 Capital Costs – $30.5 million for the NEU charged to connected users over the 25 year asset life
	Ongoing System Expansion – distribution piping energy transfer stations, and generating capacity that is added as the connected floor area grows (results in additional costs)
SOLUTIONS USED	**Rate Structure** – revenue collected from energy users to repay system capital investment, operating costs and investment return.
	Capital Financing Fund – a City of Vancouver internal fund used to finance capital projects. Provided $17.5 M since the start of project at a rate of 5.0% interest. Business case was started at 6%, the low interest loan came in at below prime, and the City leveraged its long term interest rate for the remainder of the costs.
	Rate Stabilization Reserve – a "revolving line of credit" used to fund system subsides in early years and ensure stable rates. It addresses the NEU's cumulative financial losses in its early years that are to be repaid from revenues in later years.
	Provincial Grant – $10.2 million provided by the Government of Canada's federal Gas Tax Fund
	Low Interest Loan – $5.0 million 20 year loan provided by the Federation of Canadian Municipalities (FCM) Green Municipal Fund (GMF) at 1.7% interest rate

ment Fund" (PEF) provided a loan for part of the costs. All of the system capital costs, excluding the government grants are being recovered through energy rates. Lastly, the rate structure and financial plan is designed such that projected revenue will yield a rate of return of mimicking a 60% debt / 40% equity scenario over the life of the project. This debt to equity ratio reflected what regulators allowed for comparable energy utilities in the province. According to CRM, this is an amenable structure for attracting potential investors should the CoV decide to sell the system in the future.

The allowable Return on Equity (ROE) for the project was set at 10%, which is a benchmark rate for private utilities set by the British Columbia Utilities Commission and was reviewed by an independent third party review board established for the NEU . This rate consists of a baseline ROE of 8.47%, as set by the British Columbia Utilities Commission for low-risk benchmark utilities, and a 1.53% risk premium determined according to the NEU's construction risk, operating risk, financial risk, revenue risk, and capital structure. This particularly considers demand risk borne by the NEU on the project, which required a significant equity component in its capital structure to ensure that the project could secure debt financing from the private market if necessary*.

Financing Mechanisms

Rate Structure. Energy rates were designed to recover pre-development and capital financing costs of the system. The NEU used a linear levelized rate recovery structure that under-recovers capital costs in the early years of the amortization period and over-recovers during the later years. This approach is used to manage the fact that considerable infrastructure is installed in advance of loads. Charging initial customers for infrastructure installed for future loads would result in a high burden for initial customers. This is financed by a Rate Stabilization Reserve, a revolving line of credit used by the CoV to backstop operating cash shortfalls during early years of the project. This mechanism is capped at a maximum of $8.0 million. The rate is comprised of two components. First, a Fixed-Capacity Charge that is calculated from the fixed capital and operating costs of the NEU This charge is based on the floor area of each building and charged monthly to owners. Second, a Variable Energy Use Charge that is based on the actual energy consumed by individual buildings and intended to recover variable costs of the NEU. These variable costs include the natural gas purchased for boilers, electricity purchased for heat pumps, and other non-fuel variable costs†.

Capital Financing Fund (CFF). A CoV fund used to capitalize the Rate Stabilization Reserve as a line of credit to backstop operating cash shortfalls during early years of the NEU. It is supplemented, in part, by the CoV Property Endowment Fund, which is capitalized from income producing assets such as commercial and residential real estate owned and managed by the CoV‡. According to the "Annual Financial Report 2010" for the City, the CFF held $5.03 billion in assets and provided $3.5 million directly to the NEU.

Ownership Structure

The City of Vancouver will own and operate the system directly for the first three years. At the end of this period, the City Council will conduct an ownership review to evaluate the financial feasibility of (i) continued ownership and/or operation of the facility or (ii) selling the system to an alternative, private entity. This strategy allows the City to manage financial uncertainties over the long-term by reserving the right to sell the system off to highly capitalized firms in the private sector.

* Integrated Community Energy System Business Case Study: Southeast False Creek NEU (Oct. 2011)

† Integrated Community Energy System Business Case Study: Southeast False Creek NEU (Oct. 2011)

‡ City of Vancouver, British Columbia, 'Annual Financial Report 2010'

Appendix B: Corix Utilities Case Study*

Vancouver, British Columbia, Canada

Based on interviews with Eric van Roon, Corix Utilities Trent Berry, Compass Resource Management (CRM)

Introduction

Corix Utilities is a private company that develops customized water, wastewater, and energy systems on the community-scale with a special focus on utility systems integration. With over 220 projects in its portfolio, Corix utilizes a variety of project delivery models to help clients improve the cost efficiency of managing basic utility infrastructure. By leveraging private capital markets, Corix can help government with tight fiscal constraints access third-party financing to address utility capital investment needs. This interview sought to clarify Corix Utilities' business model as it relates to project development trends and aspects of project finance and delivery.

Development Trends: Greenfield vs. Legacy Systems

Currently, Corix Utilities has few greenfield systems in its portfolio (i.e. those newly built without pre-existing, supporting infrastructure in place). This is because of stated challenges in setting up viable and attractive projects and financing structures that manage the increased development risks and uncertain timetables from establishing the new infrastructure for new building developments. The table to the right outlines some of the underlying risks and perceptions associated with greenfield projects.

Considering these risks, Corix believes that acquiring and improving existing systems, or installing systems within an existing built area, is a more attractive strategy. Legacy systems and, to a degree, new systems built within an area with existing building stock have the advantages of: (i) an established right of way; (ii) building infrastructure; (iii) customer base; and (iv) electricity loads. As such, companies may consider projects that have aspects of these factors in place as more favorable than greenfield district energy projects. Nonetheless, tables 4 and 5 outlines several risk-mitigating factors and suggested solutions that may improve the favorability of developing systems in greenfield settings*.

Financing Background

Corix provides private third party financing for district utility projects, in part, by:

- Leveraging debt from a syndicate of banks through credit largely backed by revenue from new and existing projects and its internal balance sheet, and by creating favorable investment profiles for new projects
- Engaging financial partners such as pension funds who are looking for long-term, stable project debt and equity opportunities
- Directly deploying cash available from a $100 MM internal revolving loan fund established by revenue from its internal project portfolio and funds raised on capital markets.

* The table above outlines suggested solutions and risk-mitigating factors based on conversations with Corix and CRM.

TABLE 4. GENERAL PERCEPTIONS OF RISKS FOR GREENFIELD DISTRICT ENERGY PROJECTS

GREENFIELD PROJECT RISKS	GENERAL PERCEPTIONS
Lack of Project Vision and Coordination	In greenfield projects there are numerous players (i.e. developers, building owners, City, utility, community members etc.) and the prospective utility is often left "herding cats". If there is no master developer vision/community plan in place to coordinate and commit long-term action, it is difficult for developers to achieve or ensure substantive development progress and energy demand under such speculative and long-term conditions. Project responsibilities may also sit on the desks of multiple organizations in the community, jeopardizing consistent and timely coordination. The main exceptions are master planned developments by developers who maintain tight and consistent control over project vision and implementation.
Inconsistent Leadership	Greenfield projects may encounter frequent turnover in community leadership and political support, leading to possible hiccups in momentum and futile initial efforts.
Extended Development Timelines	Long development timelines required for establishing the initial building infrastructure may increase financial uncertainty and overall implementation risk.
Uncommitted Building Owners	Dual risks of (i) waiting for development to occur in "favorable zones" over the life of the project and (ii) ensuring that buildings actually connect to the system when they are developed, which jeopardizes sufficient energy demand to cover system capital and operating costs.
Improper or Impatient Capital Planning	Despite the favored industry approach of strategically phasing both infrastructure and loads, some communities are averse to deploying capital patiently and prudently because of political pressure to install "green features" upfront, concern over LEED points, or other reasons. This may result in permanent and expensive capital installation too early in the project.

Pre-Development Studies and Feasibility

Corix typically finances project pre-development studies internally through series of filters and analytical benchmarks that indicate whether a particular project is a good investment. They typically stage this process in phases with the expectation that not all projects will ultimately be worth pursuing. Nonetheless, to the extent that due diligence warrants approval from the company board on individual project opportunities, Corix will move incrementally toward more definitive agreements with end-users and clients. Under an utility model that typically provides the basis for setting rates and providing for recovery and returns on investment capital, these due diligence costs are regarded as an "allowable expense" that can be recouped later through rates. If these are not addressed through rate-recovery, however, then revenue from Corix's broader project portfolio will do so regardless of the project's ultimate viability.

Beyond this strategy, policy tools such as "honorariums" (in Canada) allow Corix and other companies to recover the costs of pre-feasibility studies should they participate in a PPP that mandates fair compensation to all companies that bid on a project (source). In some cases, Corix may pool money from individual property owners to pay or the costs of pre-development studies. Lastly, and although more seldom, municipalities and community partners will also raise grant money to pay the costs of pre-development studies, leaving Corix without the responsibility.

TABLE 6. SUGGESTED SOLUTIONS AND RISK-MITIGATING FACTORS FOR GREENFIELD PROJECTS*

GREENFIELD PROJECT RISKS	RISK MITIGATING SOLUTIONS
Inconsistent Leadership	Introduce institutional support in the form of an established "neighborhood planning agency" with less frequent turnover in leadership as well as clearly defined mandate to steer through an entire neighborhood development project.
Uncommitted Building Owners	(i) Establish "district energy zones" with clearly delineated boundaries and a definition in comprehensive community plan. (ii) Provide clear policy framework in the form of mandates and/or incentives that encourage developers to incorporate necessary design considerations and improvements to connect new buildings to the district system.
Payback Risk	Explore alternative cost-recovery tools that "back in financing" through property tax supported mechanisms, assessments, and similar methods. This mitigates risk since some revenue does not depend on individual building owners connecting to the system. Other methods that rely on "upfront development contributions" in lieu of "public benefits charges" may also be helpful in paying down the initial costs of capital. However, to the extent these approach reduce buildings' use of the district energy system, they can reduce environmental and energy saving benefits.
Improper or Impatient Capital Planning	(i) Implement cheaper, distributed, and more temporary infrastructure (i.e. lower cost gas fired boilers that will ultimately be required for peaking and back-up before installing more expensive alternative energy capacity) to conservatively approach capital outlays during the early years of the project. (ii) Wait until there are sufficient loads to ensure higher levels of utilization before building (and financing) expensive alternative energy or large capacity equipment in later project phases.

* Based on conversations with Corix and CRM

Equity vs. Debt Financing

Except for very large projects, Corix Utilities does raise debt on an individual project basis, i.e., debt repaid solely from the revenue of a single district energy project or other local utility. Instead, they have typically borrowed from a syndicate of banks and other investment partners (i.e. pension funds) who are provide long-term debt to Corix as a corporate entity. When Corix does rely on project based debt, it seeks to repay the debt over a five to ten year period, and will supplements the debt with the company's direct equity investment in the project. While the size of Corix's district utility projects have varied from as little as $1 million to as much as several billion dollars, Eric van Roon reported that Corix's most common, and perhaps most favorable, project size is in the $30 to 60 million range. In the majority of instances, Corix favors the standard utility investment model that uses 40% equity /60% debt to finance projects, although they will adjust this ratio based on the realities of the investment environment, risk profile, or amount of customers involved in a given project. Corix reports that it has been able to raise all the debt and equity that it has needed to implement its business model and finance the utility projects it undertakes. Although Corix has seen some contraction in credit markets in recent years, it has not affected their activities.

Financing Challenges

District energy systems tend to be more capital-intensive upfront due to the significant infrastructure investments that are required to establish the initial system at the onset and to prepare buildings to connect to the system. For companies like Corix, this is particularly challenging because of a need to balance:

- Significant debt loads at the beginning of a project and long-term opportunity cost of capital
- Long gaps in time until there are enough customers to provide adequate revenue to support debt payments (used to finance fixed capital costs), pay operating costs and provide the required rate of return
- Ability to maintain palatable rates over time

As such, this challenge requires a risk profile from investors that can absorb some financial loss for a period of time where projected revenues are less than debt payments and operating expenses. According to Trent Berry at CRM, this period may last anywhere from 4 to 10 years.

Project-Subsidy Gaps

As a well-capitalized private company, Corix indicated that project financing gaps are typically of minimal concern given that they will not move forward on a deal unless it is (i) well-vetted and (ii) capable of generating sufficient revenue to repay the upfront capital that Corix invests. However, project subsidies may be needed to reduce the level of Corix's debt and equity investment such that it will earn an adequate return and competitive energy rates. In these instances, project partners such as municipal governments, non-profits, or others will take care of the necessary grants and loans required to reduce Corix's investment and ensure that required utility rates are at reasonable and competitive levels. According to van Roon, these subsidies vary between different types of utility infrastructure.

For example, district energy projects often see subsidy levels of anywhere between 10% to 50% of capital costs whereas water projects may encounter more volatile financing gaps since water rates have historically distorted the true replacement cost of capital. Alternative energy projects in particular are still require more subsidy than other energy sources given the high capital costs required to commission them. Conversely, gas fired systems (with low upfront capital costs) tend to require less of a subsidy, although volatile commodity pricing makes them more prone to fuel price risk over the long term.

Rate Design and Contract Length

Corix views appropriate rate design as an essential component that allows clients to compare and contrast advantages in fuel sources. For example, when using a biomass energy source versus gas fired district energy generator, Corix may need a long-term contract to amortize the upfront capital costs in ways that match fluctuating fuel prices over the life of the project. Corix may enter into such a project with the full expectation that there will be little to no profit at the beginning of a project's lifetime, but the long-term contract and concessions of anywhere from 20 years and above will allow it to properly amortize costs and earn returns over the life of the concession. For example, one contract with a First Nation runs 99 years – which falls just short of their longest term of 114 years. From their experience, van Roon indicated that 50 year contracts tend to be the norm for large projects.

Public-Private Collaboration

In Corix's view, public-private collaboration on district utility projects is the appropriate policy for several reasons. First, the public sector often lacks the funds and expertise to implement projects of the magnitude, complexity, and unconventional nature as district energy. These projects require a great tolerance for technological risk that, in their view, the private sector is more suited for managing given (i) their alliances with investors looking to back projects of this type, (ii) in-house expertise, and (iii) a business models built on experimentation and innovation. Corix also believes that it adds value by providing operational synergies that improve the financial performance of a district level system. For example, by managing multiple utility types through one contract and a more integrated infrastructure and business model, Corix can realize operational savings that the public sector would have a more difficult time achieving.

Analytical Tools and Recommendations

Concluding the interview, van Roon offered ideas on ways that project managers, investors, governmental officials and others might be able to think critically when evaluating the feasibility of a district utility project. This centered on the notion of reconciling cost differentials between "stand-alone" systems and those on the district scale. Namely; which types require more capital? Is either cheaper than the other in the short vs. long-term? Can you quantify the value of being able to easily switch fuel sources under a district energy system? In this vein, van Roon asserted that several clients saw great value in this "fuel-switching" option, yet on premises that were perhaps more qualitative than quantitative (climate change mitigation, perceived yet uncertain long-term fuel risk etc.). Therefore, Corix sees value and is interest in ways to quantify the benefits of having a fuel switching option.

Appendix C: District Energy St. Paul Case Study

St. Paul, Minnesota

Introduction

Built as a demonstration plant in 1983, the District Energy St. Paul (DESP) project ("the Project") provides valuable lessons for developers seeking to integrate district utility systems into an existing building stock. This case study examines key aspects of the Project's initial implementation with respect to:

MARKETING:

- Converting existing buildings
- Creating financial analysis Tools

FINANCING:

- Summary of revenue sources and expenditures
- Attracting customers to build a revenue base
- Role of financial intermediaries
- Creating flexible repayment plans (?)

Background

In the late 1970's, a public-private partnership formed between the City of St. Paul, the State of Minnesota, the U.S. Department of Energy, and downtown businesses in an effort to replace St. Paul's aging district steam and heating system. The resulting non-profit entity, first named District Heating Development Corporation and later known as District Energy St. Paul, produced a detailed feasibility study on how a hot-water district heating system could connect to convert buildings fitted for steam heat, oil-burning furnaces, or natural gas boilers. Since its 1983 inception, the system has grown to encompass much of downtown St. Paul and adjacent neighborhoods, expanding from basic heating services to cooling in 1993 and renewable energy in 2003. After 30 years of continuous operation, it currently:

- Heats 185 buildings and 300 single-family homes (31.8 million sq. ft.)
- Cools 100 buildings (18.8 million sq. ft.)
- Provides 65 megawatts of thermal energy directly to customers
- Sells 25 megawatts of renewable energy through the local utility

Phases

The current system was built in three phases: (1) the original coal-fired demonstration heating system built in 1983; (2) the distributed cooling system built and expanded from 1993 through 2007; and (3) a combined heat and power (CHP) system fueled by municipal biomass waste built in 2003. DESP created and partnered with affiliate organizations to implement these phases through various financing sources*:

* Source: Canadian District Energy Association

COAL-FIRED HOT-WATER DISTRICT HEATING SYSTEM (1983): A $45.8 million project funded by $30.5 million in 30 year tax-exempt variable rate revenue bonds, $9.8 million in 20 year loans from various government agencies, and a $5.5 million equity loan from the City of St. Paul.

CLOSED-LOOP DISTRICT COOLING SYSTEM (1993-2007): A $55 million project funded through revenue bonds plus a $3.0 million subordinated loan from the St. Paul Housing and Redevelopment Authority*.

COMBINED HEAT AND POWER (CHP) SYSTEM (2003): A $75 million investment privately financed by St. Paul Cogeneration, company formed by Trigen-Cinergy Solutions and Market Street Energy Company, LLC, an affiliate of DESP. The facility sells power through a 20-year contract with Xcel Energy.

Marketing the Project

At the onset, developers faced a major challenge of marketing the project to property owners who faced high initial capital costs to convert their buildings to connect to the district heating system. Several studies were performed to determine the total cost and feasibility of these connections for the entire project area based on factors such as building type, building age, and status of existing heating equipment. Given the great discrepancy in building conditions, the cost of building conversion was a key economic and marketing issue for the initial district heating project. Since long-term sales contracts were required from building owners to secure financing, DESP responded with a comprehensive marketing program to educate owners about the wide range of design, cost, and logistical issues associated with connecting each individual building to the district heating system.

* Bonds require a letter of credit (LOC) backing to guarantee repayment and earn an investment grade bond rating that provides liquidity for investor. A LOC can also lower the interest rate on the bond, although the LOC fee offsets these interest savings. DESP used a combination of variable tax-exempt and taxable bonds, and fixed rate bonds for various phases of the project. Source: http://www.chpcentermw.org/minnesotaDECHP2010/Smith.pdf

Creating Tools for Financial Analysis and Implementation

This strategy focused on three areas of financial analysis: (i) life-cycle cost analysis of potential equipment upgrades, (ii) cumulative cash-flow analysis of the buildings after installing equipment, connecting to the system, and realizing cost savings, (iii) and financial incentives to encourage building owners to upgrade their equipment.†

LIFE-CYCLE COST ANALYSIS: Focused on achieving the best life-cycle cost for the system rather than minimizing the upfront costs of connection. DESP analyzed two options: a high-temperature system with lower initial connection costs, higher O&M costs, and less efficient operation; and a medium-temperature system with higher upfront connection costs, lower O&M costs, and more efficient operation. DESP ultimately decided on the medium-temperature system because of long-term savings and reliability.

CUMULATIVE CASH FLOW ANALYSIS: A computer program was used to compare the cumulative cash flow for current customers of steam and natural gas to cumulative cash flows after hooking up to the DESP system. It was found that customers evaluating the investment risk of building conversion, based on payback periods where positive cumulative cash flow could occur, considered five- to seven-year payback periods as "favorable".

CREATION OF FINANCIAL INCENTIVES: Preliminary feasibility studies indicated the need for a loan program to provide a low-cost option for converting buildings. Two loan programs were explored:

- **BUILDING CONVERSION LOAN PROGRAM:** A revolving loan fund was al to assist building owners with building conversion to be funded via bonds issues by the St. Paul Port Authority. It was rejected due to high bond interest rates and bad economic conditions that had issuing the bonds more difficult.

† Source: "District Heating and Cooling in the United States: Prospects and Issues" (1985)

- **ENERGY REINVESTMENT REVOLVING LOAN FUND:** This fund was established by the St. Paul Foundation at the request of St. Paul's mayor to assist non-profit customers with paying for building retrofits. It was funded by $2.6 million in grants and long-term loans from a variety of foundation and corporate donors*.

Engaging Building Owners

A major challenge was the transfer of financial risk to building owners under initial plans that required building owners enter into long-term contracts for district energy. The original proposal called for 30-year sales contracts directly to building tenants in an effort to secure the credit ratings required for project financing. However, this proved to be unsuccessful as building owners were averse to assuming such substantial risk, particularly in an environment with volatile fuel pricing and uncertain hot water demand. As a result, DESP pursued other means to reduce the debt's cost and credit support, including the use of floating rate bonds that reduced the interest rate and funding 1/3rd of the project with grant sources that allowed for more flexible repayment terms, including deferred principal payments and contingent repayment based on project revenues.

* Under this program, non-profits signing hot water contracts could receive funding to ensure that their cash positions were at least as favorable after conversion as if they had not converted

Financing Mechanics†

While floating-rate, tax-exempt revenue bonds ultimately played a large role in financing the initial demonstration project, other financing tools were important to the completing the financing and reducing interest rate on the project's debt. The following chart outlines the mechanical details of those used:

† Source: "District Heating and Cooling in the United States: Prospects and Issues" (1985)

TABLE 6. FINANCING MECHANISMS FOR DISTRICT ENERGY FUND

FLOATING RATE REVENUE BOND	GRANT FUNDING	"EQUITY LOAN"
TOTAL: $30.5 MILLION	TOTAL: $9.8 MILLION	TOTAL: $5.5 MILLION
Set at target interest rate of 8.625% Traded on market like a short-term investment, producing effective 5% rate Bond payments carved into two portions: (i) payment to bondholders and (ii) remainder to partnering insurance company Excess is paid by insurance company if interest rate ever exceeds 8.625%	Federal grants of $7.5 million matched by $2.3 million in local public funds Loaned to DESP at 5% interest Interest compounds for 10 years before repayment is required to begin Term of repayment lengthened to 20 years to enhance competitiveness of rates	Funding replaces equity, bears no interest, and is flexibly repaid as Project revenue allows Helps to reduce short-term cost pressures on system rates while bolstering competitiveness

TABLE 7. OVERVIEW OF DISTRICT ENERGY ST. PAUL DEMONSTRATION PROJECT COSTS AND FUNDING SOURCES

USE OF FUNDS: SOFT COSTS

System Design	$957,000	31.37%
Personnel	$218,000	7.15%
Interest	$88,000	2.88%
Depreciation	$289,000	9.47%
Administrative Costs	$170,000	5.57%
Management, Legal & Other Consultants	$912,000	29.89%
Economics	$165,000	5.41%
Building Conversion	$252,000	8.26%
Total	**$3,051,000**	**100%**

SOFT COST FUNDING SOURCES

NSP Cash Grant	$111,000	3.64%
In-Kind Contributions	$500,000	16.39%
Interest Income and Misc.	$180,000	5.90%
Lease Revenues	$46,000	1.51%
City and State Loans	$252,000	8.26%
Management, Legal & Other Consultants	$960,000	31.48%
State Grant	$1,001,000	32.82%
Total	**$3,050,000**	**100%**

USE OF FUNDS: HARD COSTS

Piping System	$24,510,000	53.52%
Heat Sources	$6,640,000	14.50%
Equipment	$740,000	1.62%
Financing Costs and Reserves	$6,180,000	13.49%
Interest During Construction	$3,750,000	8.19%
Other Development and Startup Costs	$3,980,000	8.69%
Total	**$45,800,000**	**100%**

HARD COST FUNDING SOURCES

Revenue Bonds	$30,500,000	66.59%
HUD/City UDAG Loan	$9,800,000	21.40%
City Equity Loan	$5,500,000	12.01%
Total	**$45,800,000**	**100%**