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TO Sandrine Thibault, Burlington Department of Planning & Zoning

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SUBJECT Task 1: Challenges and Opportunities for Green Development in the Downtown/Waterfront Area

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INTRODUCTION

The City of Burlington, Vermont is currently in the process of developing a land use and development master plan for its downtown/waterfront area. The City envisions an aggressive plan that actively promotes climate-conscious development and transportation strategies. As a part of that process, identified as Task 1 of the Climate, Energy and Green Infrastructure Analysis, the City's Department of Planning & Zoning (DPZ) has contracted Industrial Economics, Inc. (IEc) to evaluate the City's current practices and future plans to identify potential opportunities and challenges associated with enhancing energy efficiency and green buildings, renewable energy, green infrastructure, and transportation in the downtown/waterfront area.

Under this task, IEc evaluated a number of key planning documents selected by DPZ, including:

- Burlington's Comprehensive Development Ordinance;[1]
- The 2006 Municipal Development Plan;[2]
- A draft set of actions and descriptions from the City's Climate Action Plan (CAP);[3]
- Chapter 26 Wastewater, Stormwater, and Pollution Control;[4]
- Department of Public Works Stormwater Credit Manual;[5]
- Phase II Stormwater 2010 Annual Report;[6]
- Moving Forward Together: Transportation Plan for the City of Burlington;[7]

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[1] City of Burlington, Vermont. Comprehensive Development Ordinance. January 2008. Available at: http://library.municode.com/index.aspx?nomobile=1&clientid=13987http://library.municode.com/index.aspx?nomobile=1&clientid=13987.

[2] City of Burlington, Vermont. 2006 Municipal Development Plan. May 2006. Available at: http://www.ci.burlington.vt.us/planning/comp_plan/municipal_development_plan/2006/mdp_2006_toc.php.

[3] "Climate Action Plan Descriptions." Provided by Sandrine Thibault, Burlington Department of Planning and Zoning, June 2011.

[4] City of Burlington, Vermont Code of Ordinances, Chapter 26 Wastewater, Stormwater, and Pollution Control. December 2008. Available at: http://library.municode.com/index.aspx?nomobile=1&clientid=13987.

[5] City of Burlington, Vermont, Department of Public Works. Stormwater Credit Manual. May 2009. Available at: http://www.dpw.ci.burlington.vt.us/docs/stormwater_credit_manual_051309.pdf

[6] City of Burlington, Department of Public Works. Phase II Stormwater 2010 Annual Report. April 2011. Available at: http://www.ci.burlington.vt.us/docs/4101.pdf.

- Burlington Downtown and Waterfront Plan Transportation Study;[8] and
- Land Use Inventory and Buildout Analysis.[9]

To better capture the context and circumstances that could pose challenges for successful implementation of specific policy actions in Burlington, IEc also participated in conference calls with several key city officials from DPZ, the Department of Public Works (DPW), Burlington Electric Department (BED), and the Parks and Recreation Department. Finally, we supplemented our research by consulting the broader literature to identify opportunities and challenges that Burlington may face during implementation.

This memorandum is organized as follows. We first present the results of our general evaluation of Burlington's existing regulatory framework and provide a brief discussion of how form-based codes could potentially facilitate the City's efforts to improve performance with respect to energy use, green infrastructure, and transportation. This is followed by specific discussions of the four focus areas of this task: energy efficiency and green buildings, renewable energy; green infrastructure; and transportation.

BURLINGTON'S DEVELOPMENT POLICY AND PLANNING FRAMEWORK

IEc reviewed the Burlington Municipal Development Plan (MDP) and the Burlington Comprehensive Development Ordinance (CDO) and other documents with a focus on the downtown/waterfront area. Together, these documents form the basic policy and planning framework for development in Burlington. The MDP serves as the City's master plan and sets the strategic vision for development. The CDO codifies the vision set forth in the MDP into development regulations. While our review targeted the provisions focused on energy, green buildings, green infrastructure, and transportation, we believe it is worthwhile to provide a brief review of the framework with respect to sustainable development in the downtown and waterfront areas. Overall, we found:

- **On balance, Burlington's policy and planning framework allows for a mix of uses in the downtown/waterfront area.** The MDP sets a strong vision for a sustainable Burlington and recognizes that the economic and cultural strength of the downtown area relies on compact, mixed-use development reflective of the City's architectural and historic heritage. The CDO permits uses and prescribes set-backs and building heights that are generally consistent with this vision. The MDP and buildout analysis suggest that opportunities exist to increase density in the downtown/waterfront area.
- **The MDP action plans (e.g., Energy Action Plan) provide a set of tangible action items to facilitate achieving the City's goals.** The scope and depth of the policy planning framework shows Burlington to be progressive with respect to sustainable development. The City is well-positioned to be a national leader on the subject, provided that the community continues follow-through on the many action plan items designated throughout out the policy documents.
- **The documents recognize the importance of housing in the downtown and waterfront areas, but may overly restrict housing development.** The CDO generally prohibits residential dwellings on the first floor and requires that no more than 50 percent of the gross floor area developed can be residential in the downtown/waterfront area.[10] Results from the Task 2 analysis suggest that increasing housing availability in the downtown/waterfront area would

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[7] City of Burlington, Vermont, Department of Public Works, Department of Planning and Zoning, Community and Economic Development Office. Moving Forward Together: Transportation Plan for the City of Burlington. March 2011.

[8] RSG, Inc. Burlington Downtown and Waterfront Plan Transportation Study: Synthesis of Prior Plans and Studies. Draft June 2011.

[9] Milone and MacBroom, Inc. Land Use Inventory and Buildout Analysis of Downtown & Waterfront Area Burlington, Vermont. 2011.

[10] CDO. 4.4.1(d)1.B Residential/Nonresidential Mix Required.

provide greater opportunities for residents to reduce household-level environmental impacts and transportation costs. However, the current housing restrictions may limit the extent of potential household-level improvements, and could be in conflict with the City's greenhouse gas (GHG) reduction goals. The City may wish to reconsider the restrictions on housing in the downtown/waterfront area.

During the forthcoming master planning process for the downtown/waterfront area, Burlington will have an opportunity to further strengthen its planning and policy framework to facilitate for an even more robust commitment to sustainable development. Specifically, the City has an opportunity to shift its zoning code from conventional use-based zoning to a form-base code (FBC). FBCs use physical form rather the separation of uses as the organizing principle for development. They are prescriptive solutions that focus on identifying the types of development desired by the community at specific locations.

FBCs are typically organized by transects that travel from the most dense areas (e.g., downtown) to the least dense areas (e.g., ex-urban/agricultural areas). Each block along the transect is assigned prescribed forms for building height and character. Uses can be designated, but are secondary to the form designations. Since FBCs regulate development at the scale of an individual building or lot, they encourage independent development by multiple property owners. This eliminates the need for complex land assemblies that large projects frequently require under conventional zoning.[11] Typically organized with visual displays and concise, plain language descriptions, FBCs encourage participation of nonprofessionals in the development process. Also, FBC core elements of accessibility and transparency help foster active public participation in the planning process.[12]

Through the use of FBCs, Burlington would have more control over land use than conventional zoning, allowing the City to predictably and effectively implement policies and programs that are crucial for reducing GHG emissions and realizing the City's sustainability and livability goals. FBCs have been shown in many communities to be more effective than conventional zoning in realizing densities and better pedestrian orientation, and a reduction in auto dependency. For example, Petaluma, California used a form-based code adopted in 2003 to revitalize its downtown area of approximately four hundred acres. The City adopted the FBC specifically to respect the heritage of the city while bringing more pedestrian and economic activity into underutilized areas.

In contrast, the problem with conventional zoning is that it is a comparatively abstract and imprecise tool for realizing a community's vision, which often results in development that is uncoordinated, unintended, and lacking in adherence to a community's land use planning and sustainability goals. A recent American Planning Association article summarized the power of form-based codes by stating: "Form based codes are proving indispensable for communities that want a broad application of walkable urbanism, to make new auto dependent areas the exception rather than the norm."

FBCs can be also crafted to include provisions that prescribe the location and development of renewable energy resources, transportation nodes, and green infrastructure measures. For example, the City of Flagstaff, Arizona recently conducted a city-wide code update, in which it transformed its conventional use-based zoning to a FBC. The community expressed a strong desire for sustainability to drive the code development process. To that end, the City conducted extensive studies to understand the optimal locations for renewable energy installations (primarily wind and solar) and the types of systems (e.g.,

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[11] Form Based Codes Institute. http://www.formbasedcodes.org/. Accessed July 18, 2011.

[12] Katz. P. "Form First: The New Urban Solution Conventional Zoning." Form Based Codes Institute. November 2004. http://formbasedcodes.org/articles?page=2.

ground versus roof-based) that were appropriate along each section of the transect. A similar process was carried out with regard to stormwater management and green infrastructure, determining the appropriate locations for specific stormwater best management practices (BMPs). The studies' results were incorporated directly into the FBCs, which will reduce the need for time-consuming variance procedures and/or zoning changes to construct these installations.[13,14] Through the use of FBCs, Burlington could develop similar prescriptive zoning for a host of sustainability measures, including climate appropriate architecture, renewable energy, green buildings, transportation choices, affordable housing, and green infrastructure.

The development of FBCs will require an extensive overhaul of the City's policy and planning framework documents, and likely requires changes to processes and procedures that have been in place for decades. The City should plan on educating community members about FBCs and their benefits. Extensive outreach will be necessary to communicate these changes to residents, business owners, and the development community. It will also take patience and certain measure of political will.

CHALLENGES AND OPPORTUNITIES FOR GREEN DEVELOPMENT

The remainder of this memorandum focuses on the four areas specified under Task 1: green building/energy efficiency, renewable energy, green infrastructure, and transportation. For each topic area, we provide:

- A brief overview and evaluation of current conditions, policies, and future planning;
- A discussion of potential barriers and challenges associated with promoting sustainability in the topic area; and
- A discussion of potential opportunities for improvement within the topic area, including, where applicable, examples of communities that have attempted such changes.

Green Building/Energy Efficiency

The Burlington Electric Department (BED) is a publicly-owned electric utility that is responsible for power distribution throughout Burlington. While highly regulated by the State, BED has been given broad authority to support energy efficiency programs measures throughout the City. BED collaborates with Efficiency Vermont to provide technical assistance and financial incentives to reduce the upfront costs of energy efficiency measures.[15] BED funds its energy efficiency programs through a ratepayer Energy Efficiency Charge (EEC).

BED works closely with developers to conduct energy code compliance, offer technical assistance, and provide incentives for energy efficiency. Funded by the EEC, BED uses rebates as an incentive for developers to implement energy efficiency measures. These measures can be drawn from a standard list of preapproved products or through customized program developed with BED's assistance.[16, 17] BED incentives can extend well past 50 percent of the upfront costs of energy efficiency measures. BED also uses the energy efficiency rebate to support the development of green buildings. In several cases, BED

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[13] Parolek, D. "Form-Based Codes and Sustainability: Two Case Studies." Presentation at the New Partners for Smart Growth Workshop. Charlotte, NC. February 3, 2011.

[14] For more information on the Flagstaff form-based code, see http://www.flagstaff.az.gov/index.aspx?NID=1416.

[15] For more information on Efficiency Vermont, see http://www.efficiencyvermont.com.

[16] Burlington Electric Department. "Energy Efficiency Incentives, Rebates and Information." Available at: https://www.burlingtonelectric.com/page.php?pid=62&name=ee_incentives.

[17] Personal Communication, Chris Burns, Burlington Electric Department, July 25, 2011.

has forgone traditional rebates and pooled funds to pay for a LEED AP to shepherd a building through the LEED accreditation process.[18, 19]

In addition to energy efficiency rebates, the BED is in the process of implementing a number of actions from the Climate Action Plan (CAP). These include, but are not limited to:[20]

- Installing "smart meters" that can help influence user-behavior to reduce peak-electricity use, costs, and associated emissions. BED expects the program to start in 2012.
- Implementing the Property Owners Win with Efficiency and Renewables (POWER) program which allows for loans funded through special tax assessments; property owners pay for energy efficiency improvements through their property taxes over time. The program is now looking for funding sources with the goal to be up and running in 2012.[21]
- Replacing existing street lights with LEDs over a 10-year period. A pilot project is already underway.

Despite a heavy commitment to financial incentives and these other energy efficiency programs, BED still faces challenges in convincing developers to seek green building certification or implement energy efficiency measures. It can still be difficult to convince builders to spend extra money on energy efficiency and green buildings, especially if they do not plan on owning the building for the long term. Historic buildings, which are prominent in the downtown/waterfront area, also present significant challenges to efficiency upgrades, since it can difficult to upgrade a building without affecting its character.

Based on IEc's discussions with BED and review of the policy documents, we identified several opportunities for the City to continue its substantial progress on energy efficiency and green building, including:

- **Ensure that Burlington's energy code is state of the art with regard to efficiency.** The City's energy code requires that all new commercial and significantly renovated building meet 2005 Vermont Guidelines for Energy Efficient Commercial Construction.[22] These guidelines are based on the International Energy Conservation Code (IECC) 2004 Supplement, with amendments.[23] The Vermont legislature has recently passed legislation to update the guidelines based on the 2009 version of IECC.[24] BED is awaiting a final rulemaking to formalize the update; it is expected in January 2012.[25] Thus lag has resulted in the City being slow to mandate the most up-to-date energy code. Massachusetts has confronted this problem with two

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[18] Personal Communication, Chris Burns, Burlington Electric Department, July 11, 2011.

[19] A LEED AP is a trained professional that helps guide developers through the LEED certification process. For more information on LEED green building rate systems, see http://www.usgbc.org/DisplayPage.aspx?CategoryID=19.

[20] "Climate Action Plan Descriptions". Provided by Sandrine Thibault, Burlington Department of Planning and Zoning, June 2011.

[21] For an extensive discussion on the POWER program, see https://www.burlingtonelectric.com/page.php?pid=141&name=Burlington%20POWER%20Program%20(CEAD).

[22] City of Burlington Code of Ordinances, 8-101 Conservation Standards.

[23] Database of State Incentives for Renewables & Efficiency. "Vermont Building Energy Standards." Available at: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=VT07R&re=1&ee=1.

[24] Overall, the 2009 IECC standard has higher insulation requirements and higher energy efficiency requirements for heating, ventilating and air-conditioning (HVAC) equipment. Huang, Y. and K. Gowri. "Analysis of IECC (2003, 2006, 2009) and ASHRAE 90.1-2007 Commercial Energy Code Requirements for Mesa, AZ." Prepared for the US Department of Energy. February 2011. Available at: http://www.mesaaz.gov/sustainability/pdf/MesaFinalCommercialReportFeb2011.pdf.

[25] Personal Communication, Chris Burns, Burlington Electric Department, July 25, 2011.

approaches that Burlington could consider to keep the City on the leading edge of energy efficiency:

- *Keep Burlington's energy code state-of-the-art.* Rather than wait for legislative action, the City could amend the code to pin to the latest version of IECC. An updated version of IECC is expected in 2012 (they typically run in 3-year cycles). Similarly, the Massachusetts Green Communities Act of 2008 requires that the State update its building code every three years to be consistent with the most recent version of IECC.[26]
- *Implement a "stretch" code.* Stretch codes provide an avenue to improve efficiency by emphasizing energy performance, as opposed to the prescriptive mandates. Typically, a stretch code requires performance that goes beyond performance under existing code. In Massachusetts, communities that choose to employ the stretch code must build 20 percent more energy efficient than the base energy code.[27] The State estimates that the additional construction costs resulting from the stretch code runs approximately $3,000 for a typical single-family home and 1 to 3 percent of total costs for commercial buildings.[28]

- **Require buildings in the downtown/waterfront area meet LEED standards.** Current green building incentives allow for bonus height if the building is certified as LEED Silver or higher. Buildings that achieve LEED Silver can attain an extra floor (10-feet of height); LEED Gold or Platinum receives an extra two floors (20-feet of height). While this incentive is significant, the City may wish to push beyond the incentive stage and require that new or renovated buildings of significant size meet LEED standards in the downtown/waterfront area.[29] Numerous communities throughout the U.S. have taken this approach. Examples include Boston, Los Angeles, Dallas, and Washington, DC. Given the expense associated with certification, these cities opted not to require formal certification; rather, city code officials typically evaluate documentation of a building's LEED characteristics before granting final occupancy permits. Some cities, such as Los Angeles, expressed concern that requiring formal certification could create legal challenges and open them up to lawsuits, since building permits or occupancy certificates would be contingent on judgments made by the U.S. Green Building Council (USGBC), which administers LEED. [30] Alternatively, City could also choose a more stringent route and require formal LEED certification. This approach is less commonly employed, and

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[26] Massachusetts Executive Office of Energy and Environmental Affairs. "Building Energy Codes." Available at: http://www.mass.gov/?pageID=eoeeaterminal&L=4&L0=Home&L1=Energy%2c+Utilities+%26+Clean+Technologies&L2=Energy+Efficiency&L3=Policies+and+Regulations+for+Energy+Efficiency&sid=Eoeea&b=terminalcontent&f=doer_Energy_Efficiency_Building_energy_Codes&csid=Eoeea.

[27] Massachusetts Executive Office of Energy and Environmental Affairs. "Building Energy Codes." Available at: http://www.mass.gov/?pageID=eoeeaterminal&L=4&L0=Home&L1=Energy%2c+Utilities+%26+Clean+Technologies&L2=Energy+Efficiency&L3=Policies+and+Regulations+for+Energy+Efficiency&sid=Eoeea&b=terminalcontent&f=doer_Energy_Efficiency_Building_energy_Codes&csid=Eoeea.

[28] Massachusetts Executive Office of Energy and Environmental Affairs. "Stretch Appendix to the Building Energy Code in Massachusetts Question and Answer (Q&A) – October 2010. " October 2010. Available at: http://www.mass.gov/Eeops/docs/dps/inf/stretch_energy_code_qa_oct11_10.pdf.

[29] Note that, in this memorandum, we discuss LEED certification as it is the most well-known green building certification program in the United States. The City, if it desires, could investigate other green building certification options, such as International Green Construction Code (IgCC). The Task 4 memorandum provides the advantages and disadvantages associated with LEED and several other green building standards.

[30] Wendt, A. "Cities Mandate LEED But Not Certification. GreenSource. July 30, 2008. Available at: http://greensource.construction.com/news/080730CitiesMandateLEED.asp.

typically has been applied to municipal buildings.[31] If the City moves forward with either of these approaches, it may face opposition from the development community, particular those builders that are unfamiliar with the LEED process. Furthermore, the additional costs associated with meeting LEED standards could drive some potential developers out the market.

- **Implement innovative green building incentives.** As a stand-alone program, or in conjunction with a green building standards requirement (see above), the City may consider implementing additional incentives for green building development beyond the density bonus. The U.S. Green Building Council (USGBC), administrators of the LEED standards, has compiled list of innovative incentives used by cities to encourage building to the LEED standards. Notable examples of green building incentives include: expedited permitting, property tax credits and abatements, grants and low interest loans, fee reductions and waivers, and free technical assistance.[32] Note that the City could apply many of these same techniques to encourage renewable energy development.
- **Develop a re-commissioning program.** Another challenge associated with green building and energy efficiency programs is maintaining building performance over time. The City's current energy efficiency programs primarily focus on achieving efficiencies at the time of construction and commissioning. Over time, systems operations may cease to work in peak condition due to typical wear and tear, human error, weather conditions, or other reasons. Re-commissioning (also known as retro-commissioning) includes testing and adjusting building systems to meet the original design intent and/or optimizing systems to satisfy current operational needs.[33] The process can yield significant energy and cost savings at the building level. For example, in 2004, Xcel Energy conducted a re-commissioning of a 500,000 square-foot older hotel in Bloomington, Minnesota. The process, which cost $340,000, found a number of ways to improve the efficiency of the HVAC system, earning $40,000 in energy efficiency rebates. Those rebates, along with estimated energy savings of 495,000 kilowatt-hours per year, resulted in a relatively short payback period of 2.3 years.[34] The City may wish to consider developing a program that provides incentives for or requires re-commissioning.
- **Investigate the potential for creating an energy efficiency program for historic buildings.** The downtown/waterfront area features many historic buildings. BED faces significant hurdles, as the energy code exempts historic buildings from energy efficiency requirements.[35] The U.S. EPA and others have created initiatives that could provide insight on potential strategies for retrofitting historic buildings. These include:
    - EPA, HUD, and DOT are providing technical assistance to Concord, New Hampshire to work with community officials, local developers, and other stakeholders to determine how historic preservation and green building approaches can best be integrated into existing building codes. One goal of the project is to

[31] USGBC. "Summary of Government LEED® Incentives" March 2009. Available at: http://www.usgbc.org/ShowFile.aspx?DocumentID=2021.

[32] USGBC. "Summary of Government LEED® Incentives" March 2009. Available at: http://www.usgbc.org/ShowFile.aspx?DocumentID=2021.

[33] Similarly, continuous commissioning™, a more costly option, utilizes integrated equipment and computers to constantly monitor and adjust building operations to meet peak performance. U.S. Department of Energy. "Federal Energy Management Program." Available at: http://www1.eere.energy.gov/femp/program/om_comtypes.html.

[34] Xcel Energy, Inc. "Recommissioning." January 2010. Available at: http://www.xcelenergy.com/staticfiles/xe/Marketing/Case-Study-RCx-hotel.pdf.

[35] Personal Communication, Chris Burns, Burlington Electric Department, July 11, 2011.

provide guidance on the how to design a regulatory framework that supports the sustainable, green redevelopment of historic buildings. Outcomes from this project could assist Burlington in amending its code to account for historic properties.[36]

- EPA conducts an annual symposium with government agencies, nonprofit organizations, academic institutions, and experts in the fields of historic preservation and green building to discuss how to sustainably retrofit existing buildings. The outcomes of the symposia (to be available on EPA's Region 5 website) could provide policy and implementation strategies that combine green building and historic preservation.[37]
- The Advisory Council of Historic Preservation has developed guidance on integrating sustainability with historic preservation for federal buildings. The guidance document provides a wealth of strategies, case studies, and other sources from which Burlington could draw lessons.[38]
- The City of Boulder, Colorado has developed a suite of materials targeting energy efficiency in historic buildings, with detailed technical guidance. Burlington may wish to investigate Boulder's approach to determine whether it could be translated to Burlington.[39]

Renewable Energy

BED has established an ambitious goal of 100 percent of its generation needs from renewable sources by 2012.[40] Thus far, Burlington has achieved modest success with regard to the use of renewable energy, with the notable achievement being the McNeil biomass plant. The City has placed increased renewables as important action item in both MDP and CAP.[41] The MDP energy action plan calls for BED to conduct a study evaluating the citywide potential for, constraints of, and impacts associated with renewable energy generation, including fuel cell, cogeneration, biomass, solar, geothermal, hydro, wind, and methane.[42] BED has not formally conducted these studies; however, information regarding market impacts of renewables is available through BED's latest integrated resource plan (IRP).[43] The CAP actions specifically call for the implementation of several initiatives that could affect the downtown/waterfront area, including, but not limited to:

- A "Solar on Schools" program that seeks to place solar panels on seven schools, in partnership with a private, third-party developer that can take advantage of federal and state tax credits.

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[36] U.S. Environmental Protection Agency. "Smart Growth and Sustainable Preservation of Existing and Historic Buildings." Available at: http://www.epa.gov/smartgrowth/topics/historic_pres.htm.

[37] U.S. Environmental Protection Agency. "Region 5 Brownfields." Available at: http://www.epa.gov/R5Brownfields/.

[38] Advisory Council on Historic Preservation. "Sustainability and Historic Buildings. May 2011. Available at: http://www.achp.gov/docs/SustainabilityAndHP.pdf.

[39] City of Boulder, Colorado. "Historic Building Energy Efficiency Guide." Available at: http://www.bouldercolorado.gov/index.php?option=com_content&task=view&id=8217&Itemid=22.

[40] Burlington Electric Department. "Power Supply: BED's Power Supply for 2010." July 14, 2011. Available at: https://www.burlingtonelectric.com/page.php?pid=128&name=BED%27s%20Power%20Supply

[41] Note that the CDO is relatively silent regarding the development of renewable resources at the building level. Section 6.2.2(e) of the CDO provides language in the review standards that support the use of renewable resources and calls for site planning to take advantage of potential wind, water, or solar resources. Additionally, Section 12.1.3 provides specific variance procedures to allow renewable resource structures.

[42] MDP VIII-8 Energy Action Plan

[43] Burlington Electric Department. "2008 Integrated Resource Plan." 2008. Available at: https://www.burlingtonelectric.com/ELBO/assets/BURLINGTON%20IRP%202008%20REPORT.pdf.

- A renewable resource rider that would set stable rates above the retail cost of electricity to encourage the net metering of solar-generated electricity.
- A "Solar City" project that aims to install solar panels on municipal buildings.

Aside from the Solar on Schools program, which in progress, many of the suggested CAP actions associated with renewables are in the very early stages.[44]

As suggested above, the City could develop FBCs to guide the placement and installation of renewables at the property level. A key challenge to incorporating renewables into FBCs is developing a deep understanding of the energy resources and equipment types that makes economic and physical sense for the area. Without this information, the City could potentially permit improper siting of renewables. With this in mind, IEc examined the physical and economic factors that may affect the siting of renewable energy resources in Burlington, and specifically those resources that have been identified as having potential applications in the downtown/waterfront area – solar, wind, and geothermal energy. We based our evaluations on a high-level literature review. The City may wish to consider a more extensive review to determine the site locations, technologies, and renewable resources that are most viable for renewable energy production.

- **Solar has shown some potential in the downtown/waterfront area.** The National Renewable Energy Laboratory estimates that the solar potential in Burlington is approximately 1,500 kilowatt-hours per square meter per year. While this output is relatively low compared to many parts of the nation, it still allows for successful solar installation under the right conditions.[45] Sites that make good candidates for solar typically have access to sunshine for all or most of the day, and have the available roof or ground space adequate to house a PV array large enough to supply energy to the building.[46] Thus far, based on the CAP actions, the City has shown the most interest in the installation of solar power. BED has also indicated that the net-metering of solar power may help reduce peak loads during the summer.[47] The City has had success with the installation of solar photovoltaic (PV) arrays and solar hot water heaters, with at least 28 solar roofs installed – some of which are the downtown/waterfront area.While installation and generation costs fluctuate due geography, technology, and installation requirements, once estimate places the cost of installed solar panels range from $7 to $9 per watt (including installation); therefore a 5 kilowatt system would cost between $35,000 and $45,000. Payback on solar varies, based on rebates, tax credits, the amount electricity generated by the system, and current average price of electricity; however, it is not uncommon for periods to extend beyond 10 years.[48] Depending on incentives offered by BED, this type of system may be out of reach for many in downtown/waterfront area.
- **Wind energy is unlikely to be economically viable in the downtown/waterfront area.** The City has expressed some interest in exploring the viability of local wind energy within the

[44] Personal Communication, Chris Burns, Burlington Electric Department, July 11, 2011.

[45] National Renewable Energy Laboratory. "Photovoltaic Solar Potential in the United States." 2008. Available at: http://www.nrel.gov/gis/solar.html.

[46] U.S. Department of Energy. "Considering a Small Solar System." 2011. Available at: http://www.energysavers.gov/your_home/electricity/index.cfm/mytopic=10750.

[47] Personal Communication, Chris Burns, Burlington Electric Department, July 11, 2011.

[48] Devlin, L. "How Much Does It Cost to Install Solar on an Average US House?" Solar Power Authority. January 30, 2008. Available at: http://solarpowerauthority.com/how-much-does-it-cost-to-install-solar-on-an-average-us-house/.

downtown/waterfront area. A debate exists in the literature regarding the effectiveness of small urban wind projects. A recent study conducted by the Carbon Trust found that small urban wind turbines are typically mounted at relatively low heights and are not usually in a position to catch enough wind to generate a substantial amount of electricity. At low generation rates, the cost of electricity becomes very high. The researchers also found that the carbon footprint associated with manufacturing, shipping, installing, and maintaining small urban wind turbines can be greater than GHG emissions from energy production at local power stations.[49, 50]

The average annual wind speed at 80 meters above ground in Burlington is about 5.0 to 5.5 meters per second, while a wind speed of 6.5 meters per second is typically needed for effective turbines.[51] At Burlington's wind speeds, it is likely that any wind project would have a very long payback period, unless significant grants or rebates are available. A number of new small wind turbine technologies have emerged in recent years, but few studies measure their effectiveness in urban settings. It may be beneficial for Burlington to defer the pursuit of wind energy until it can be reliably demonstrated in urban settings similar to the downtown/waterfront area.

- **Geothermal requires additional study to determine whether it is viable in the downtown/waterfront area.** Geothermal energy is the heat energy from the Earth's core. It can be used in place of fossil fuels for heating and cooling, or generating electricity. In the United States, most of the geothermal capacity lies in the western states due to the convergence of tectonic plates in that region. However, high, steady temperatures can be found anywhere from 10 to a few hundred feet underground. For Burlington's purposes, ground source heat pumps may be the most applicable use of geothermal energy, which only requires drilling a few feet into the ground to reach areas that maintain a temperature of 50-55 degrees Fahrenheit. Ground source heat pumps are used to heat and cool buildings by pumping air or anti-freeze liquid through underground pipes situated in loops. In the summer, the heat from buildings is transported underground and in the winter, heat is brought back into the building.[52]

  The upfront costs of geothermal energy vary greatly, depending on a number of factors, including site geology, property size, building size, system type, well depth, and the potential updates necessary to make the building capable of handling geothermal energy (typically older buildings need new insulation).[53] Drilling is typically the highest expense, depending whether the system requires a vertically deep well (common for small properties) or whether the loops can be arranged horizontally in a shallow well (requires more area). The cost of drilling also

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[49] Page, L. "Carbon Trust: Rooftop windmills are eco own-goal." The Register. August 7, 2008. Available at: http://www.theregister.co.uk/2008/08/07/rooftop_wind_turbines_eco_own_goal/page2.html.

[50] Researchers at the Wind Energy Integration in the Urban Environment (WINEUR) have demonstrated that under the right conditions, small-scale urban wind can produce economically viable power; however, they call for turbine mast or building height that are 50 percent taller than the surrounding buildings. These conditions are unlikely in the downtown/waterfront area of Burlington. Wind Energy Integration in the Urban Environment. "Urban Wind Turbines: Guidelines for Small Wind Turbines in the Built Environment." February 2007. Available at: http://www.urbanwind.net/pdf/SMALL_WIND_TURBINES_GUIDE_final.pdf.

[51] California Energy Commission Consumer Energy Center. "Geothermal or Ground Source Heat Pumps. Available at: http://www.consumerenergycenter.org/home/heating_cooling/geothermal.html.

[52] Union of Concerned Scientists. "How Geothermal Works." Available at: http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-geothermal-energy-works.html.

[53] A brief internet search showed costs of geothermal for a single-family home ranging from $4,000 upwards of $30,000.

varies depending on the terrain and other local conditions.[54] The U.S. Department of Energy found that typical payback periods on geothermal ranges from 8 to 12 years, although tax credits and other incentives can reduce the payback period to 5 years or less.[55] Given the importance of local geology, the potential for installation of geothermal in Burlington is likely site specific. If the City is interested in promoting geothermal energy, BED may wish to consider conducting a formal study to better understand the potential of geothermal resources in Burlington.

Another renewable energy resource that has been considered in Burlington is the potential development of district heating from the McNeil Generating Station. The station is jointly owned by BED, Central Vermont Public Service, Vermont Public Power Supply Authority, and Green Mountain Power. The district heating system would distribute waste heat from the wood-burning electricity plant to businesses and residences in the downtown/waterfront area. District heating for Burlington would reducing fossil fuel burning (99 percent of heating in the City comes from burning natural gas) and corresponding GHG emissions.[56] Successful district heating projects have been built across the country including St. Paul, Minnesota and Jamestown, NY.[57] Notably, Montpelier, Vermont recently received a large U.S. Department of Energy grant to extend district heating from a similar wood-fired plant to its downtown area.

A number of district heating feasibility studies have been conducted during the last 20 years, as interest in the project has ebbed and flowed over time. Recently, public interest in district heating has peaked, and a new feasibility report is nearly complete. The report will look at economic viability of several alternative distribution systems. If the City determines to move forward with the concept, it will need to contend with the following challenges:

- Raising capital, as the project promises significant initial costs.
- Long-term economic viability (i.e., costs of the cogenerated heat distribution versus natural gas).
- The logistics associated with installing and maintaining the distribution system and building-level heating equipment in the downtown/waterfront area.
- The development of management entity to run the system. It is anticipated that non-profit entity will be formed to interface with plant managers, oversee the distribution network, market the program, and carry out maintenance.

Green Infrastructure/Stormwater Management

As detailed in Chapter 26 of the Burlington Code of Ordinances, the City created a dedicated stormwater management plan in 2009. The plan establishes minimum stormwater runoff requirements and erosion controls to protect the public, Lake Champlain, and its tributaries.[58] The stormwater program is responsible for wastewater disposal permitting, project review, technical assistance, assessing user fees

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[54] Union of Concerned Scientists. "How Geothermal Works." Available at: http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-geothermal-energy-works.html.

[55] U.S. Department of Energy – Oak Ridge National Laboratory. "Geothermal (Ground-Source) Heat Pumps: Market Status, Barriers to Adoption, and Action to Overcome Barriers." December 2008. #ORNL/TM-2008/232.

[56] Personal Communication, Chris Burns, Burlington Electric Department, July 25, 2011.

[57] Montpelier, Vermont. "District Energy Project." June 2011. Available at: http://www.montpelier-vt.org/community/99.html.

[58] City of Burlington, Department of Public Works. Phase II Stormwater 2010 Annual Report Section 26-1. April 2011. Available at: http://www.ci.burlington.vt.us/docs/4101.pdf.

and credits, code enforcement, and education and outreach.[59] Burlington funds the stormwater program through a user fee added to property owners' water and sewer bills. The fee has been set to a parcel's impervious surface area (per thousand square feet) times a rate determined by the Burlington City Council.[60] Property owners can gain credits against the user fee for implementing stormwater and pollutant management techniques that meet specified thresholds for water retention and/or water quality improvements.[61] Both traditional stormwater BMPs (e.g., retention basins) and green infrastructure techniques (e.g., rain barrels, green roofs, infiltration, and water reuse) can be employed to earn credit.[62]

The new ordinance was developed through a public process that carefully considered existing Vermont law and opportunities to improve environmental protection.[63] By creating a dedicated and separately funded stormwater and erosion program, the City has taken an important step to improve its stormwater management. The ordinance provides protections that are consistent with best management practices for stormwater and erosion control. The Stormwater Management Program Administrator is now in the process of implementing the regulations. The implementation of the program continues as a learning experience, as the City expects to adapt the program over time. [64]

Thus far, stormwater management efforts in the downtown/waterfront area have focused on slowing runoff and reducing pollutant loadings to Lake Champlain and tributaries. This goal is appropriate as the downtown/waterfront area already contains a significant quantity of impervious surface from roads, sidewalks, and roofs. With the potential for increased density resulting from the downtown and waterfront master plan, slowing runoff will continue to be a challenge for the program.[65] The stormwater program also faces significant challenges in convincing developers and property owners throughout the downtown/waterfront area to install green infrastructure measures.

Based on IEc's discussions with the Stormwater Management Program Administrator and our review of the regulations and supporting documents, we identified several opportunities that could improve the program and increase the application of green infrastructure in the downtown/waterfront area, including:

- **Hire additional Stormwater Management Program staff.** Currently, the program is staffed by the Administrator and occasional assistance from DPW staff. The Administrator is responsible for strategic planning, project review, NPDES permitting, technical assistance, regulatory enforcement, approving credits, and additional administrative responsibilities. By assigning all of these functions to one person, the City is likely limiting the potential reach of the stormwater program. Discussions with the Administrator indicate that dedicating time to enforcement has been difficult. In some cases, the heavy workload on the Administrator has made it necessary to prioritize the development projects that receive technical assistance;

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[59] City of Burlington, Department of Public Works. Phase II Stormwater 2010 Annual Report. April 2011. Available at: http://www.ci.burlington.vt.us/docs/4101.pdf.

[60] Detached single-, two-, and three-family homes are allocated imperious surface based on the average within each category. For example, the average detached single-family home in Burlington has 2,670 square feet of impervious surface; therefore, users pay 2.67 times the user fee rate. See Section 26-172 for more information.

[61] City of Burlington, Department of Public Works. Phase II Stormwater 2010 Annual Report Section 26-173. April 2011. Available at: http://www.ci.burlington.vt.us/docs/4101.pdf.

[62] City of Burlington, Vermont, Department of Public Works. Stormwater Credit Manual. May 2009. Available at: http://www.dpw.ci.burlington.vt.us/docs/stormwater_credit_manual_051309.pdf.

[63] Personal communication, Megan Moir, Burlington Department of Public Works. July 25, 2011.

[64] Personal communication, Megan Moir, Burlington Department of Public Works. July 25, 2011.

[65] Note that increased densification in the downtown/waterfront area does not necessarily mean an increase in impervious surface and stormwater runoff will occur. If the master plan results in taller buildings (with similar footprints) on previously developed lots, rather than increases in pavement, the quantity of impervious surface should remain similar.

therefore, the City may have missed opportunities to apply creative solutions to stormwater issues at lower priority sites.66 The City may wish to consider adding a full-time staff person with technical qualifications to oversee technical assistance, project review, and permitting processes. This arrangement could free the Administrator to focus on strategic planning, outreach, program implementation, enforcement, and other responsibilities. Adding a new staff member likely requires additional program funding, which could be generated through an increase in the user fee (discussed further below). As green infrastructure involves several City departments beyond DPW, additional staff member from other departments (e.g., Parks and Recreation) may also be useful to support the Stormwater Management Program.

- **Increase user fees to generate additional funding and stimulate interest in green infrastructure credits.** The current monthly stormwater user fee is $1.17 per thousand square feet of impervious surface.[67] A typical owner of a commercial lot with 20,000 square-feet of impervious surface pays a fee of $23.40 per month. This relatively small fee gets buried within the larger water and sewer bill. As constructed, the user fee is too low to stimulate significant interest in earning green infrastructure credits, as evidenced by the lack of credits awarded by the program. As of the time of writing, only four green infrastructure credits have been awarded, and none have been granted in the downtown/waterfront area. Increasing the user fee would likely make credits a more attractive option for property owners, particularly if it was paired with additional outreach to ensure that property owners understand the credit process. A number of cities have implemented stormwater use fees that are substantially higher than those in Burlington. For example, Portland, Oregon charges $9.97 per thousand square feet of impervious surface for non-residential properties.[68] Note that raising the user fee would likely spawn some level of opposition from residents and business owners concerned about rising costs. If the City raises the user fee, it could consider additional waivers or discounts to assist those with financial difficulties.
- **Develop additional funding opportunities for green infrastructure.** The City could consider developing cost-sharing opportunities or low-interest loan programs to help fund green infrastructure projects. For example, Task 3 presents a short case study on Philadelphia's Stormwater Management Incentives Program (SMIP), where commercial property owners can receive low-interest loans for stormwater management projects. Funded by the local water utility, loan amounts range from $75,000 to $1,000,000 with a one percent fixed interest rate. The loan term is up to 15 years, consistent with the payback period for stormwater management measures.
- **Create a green roofs initiative.** Green roofs are made of dense vegetation planted on the roofs of buildings. They are designed to reduce the stormwater impacts of development through the detention and retention of stormwater. A recent EPA study indicates that the green roofs are capable of removing 50 percent of the annual rainfall volume from a roof through retention and evapotranspiration. Rainfall not retained by green roofs is detained, effectively increasing the

[66] Personal communication, Megan Moir, Burlington Department of Public Works. July 25, 2011.

[67] Personal communication, Megan Moir, Burlington Department of Public Works. July 8, 2011.

[68] City of Portland, Oregon, Portland Bureau of Environmental Services. "Drainage/Stormwater Management User Service Charges and Discounts." Available at: http://www.portlandonline.com/bes/index.cfm?a=354259&c=55059.

time to peak, and slowing peak flows for a watershed.[69] Section 26-157 of the Burlington City Ordinance encourages green infrastructure practices, including green roofs. However, the regulations are silent with regard to appropriate use and application of green roofs in the City. Currently, the City approves green roofs (along with several other green infrastructure measures) on a case-by-case basis.[70] Local property owners have expressed in interest in green roofs, with over a dozen built in the City to date.

General impediments to green roofs in Burlington include the lack of familiarity with the technique, difficulty locating technical expertise, and installation and maintenance costs.[71, 72] A green roofs initiative could help bridge some of the information gaps, bring together interested parties with experts and advocates, and provide incentives through user fee credits/abatement or other green infrastructure funding mechanisms (such as loans and grants). For example, Cincinnati has dedicated an estimated $5 million per year in below-market-rate loans from the U.S. Environmental Protection Agency's Clean Water State Revolving Fund to cover the incremental cost of adding a green roof to a new or existing building.[73]

- **Consider urban forestry as green infrastructure.** Urban street trees provide significant stormwater management benefits.[74] They also face tremendous stress from inadequate soils, pollution, and human interference, which can dramatically reduce life span. They require regular maintenance and attention which can be resource intensive and time consuming. Burlington's urban forestry program is the responsibility of the Parks and Recreation Department, and is funded through the general fund and a dedicated tax built into local property taxes at $0.0026 per $1.00.[75] The Department is in the midst of conducting a new urban tree inventory, which will identify the location, ages, species, health of Burlington's nearly 10,000 trees, including those in the downtown/waterfront area. This inventory is the first step in the updating the urban forestry master plan and street tree planting plan.[76] The Stormwater Management Program could leverage and provide input into these plans to ensure that the planting strategies maximize stormwater retention in the downtown/waterfront area. This option would require close collaboration between DPZ and Parks and Recreation, including sharing GIS data on the street tree inventory and existing stormwater management measures.

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[69] U.S. EPA. "Green Roofs for Stormwater Runoff Control." February 2009. EPA/600/R-09/026. Available at http://www.epa.gov/nrmrl/pubs/600r09026/600r09026.pdf.

[70] City of Burlington, Vermont. Comprehensive Development Ordinance. January 2008. Available at: http://library.municode.com/index.aspx?nomobile=1&clientid=13987http://library.municode.com/index.aspx?nomobile=1&clientid=13987.

[71] Cost estimates for green roofs range widely, ranging from $6 per square-foot to over $40 square-foot, based on the size of the roof, new construction versus an existing building, method of installation, and roof type. U.S. EPA. "Green Roofs for Stormwater Runoff Control." February 2009. EPA/600/R-09/026. Available at http://www.epa.gov/nrmrl/pubs/600r09026/600r09026.pdf.

[72] Personal communication, Mark Eldridge, Green roof advocate, July 8, 2011.

[73] City of Cincinnati. Office of the City Manager. Green Roof Program. Available at: http://www.cincinnati-oh.gov/cmgr/pages/-38098-/.

[74] Street trees also provide additional benefits, including pollutant removal, cooling, wildlife habitat, safety, and aesthetics. The USDA estimates that over a 50-year lifetime, a street tree generates $31,250 worth of oxygen, provides $62,000 worth of air pollution control, recycles $37,500 worth of water, and controls $31,250 worth of soil erosion. USDA Forest Service Pamphlet #R1-92-100. For a thorough discussion on the benefits of street trees, see Burdan, Dan. "22 Benefits of Urban Street Trees." May, 2006. Available at: http://www.ufei.org/files/pubs/22BenefitsofUrbanStreetTrees.pdf.

[75] City of Burlington, Vermont. "Resolution Relating to Annual Tax Assessments on the Property Grand List of the City for the Purposes therein Set Forth for the Fiscal Year Beginning July 1, 2011." Available at: http://www.ci.burlington.vt.us/docs/4846.pdf.

[76] Personal communication, Warren Spinner, Burlington Parks and Recreation Department, July 25, 2011.

Transportation

In March 2011, the City adopted a new transportation plan. The plan reaffirms the community's vision for the Burlington transportation system and recognizes the connections among transportation, economic vitality, active living, the environment, and safety. The plan reinforces the concept of Complete Streets, a multi-modal approach that provides for transit, pedestrian access, biking, and automobiles. The plan also identifies a policy agenda and specific capital needs in its five-year plan. Innovative ideas for the downtown/waterfront area captured in the plan include, but are not limited to:[77]

- Prioritizing maintenance over new road construction.
- Supporting alternative funding sources for public transit.
- Advocating the development of a downtown transportation management association (TMA) to practice Transportation Demand Management (TDM).[78]
- Introduce market pricing concepts to the downtown/waterfront area through pricing pilot program.

The Transportation Plan required public input and careful consideration of the City's needs. Given its recent adoption, it is too early to critically evaluate the extent to which the plan has resulted in positive changes to the transportation system. Since follow-through on its policy and planning objectives is critical, the City has developed a series of performance metrics against which its progress can be measured over time.[79] Overall, the plan appears to be well-conceived, and should serve as guidepost as the City attempts to modernize and transform its transportation network over the next few years.

The Transportation Plan sets a preliminary goal to increase annual transit ridership by five percent.[80] With the implementation of the additional transit services advocated by the Plan, the goal will increase gradually over time. Beyond extra service, the City could consider incentive programs to spur additional ridership through subsidies and discounts. Under Task 3, IEc details Boulder, Colorado's efforts to increase transit ridership through its EcoPass program, which provides discount bus passes and additional perks for employees and neighborhood groups. Surveys by the transit operator have shown that an employee or resident with an EcoPass is five to nine times more likely to take public transit compared to an individual without an EcoPass. Also, when an employer provides an EcoPass to its employees, about 38 percent of the employees will drive to work in a single occupancy vehicle (SOV), down from 70 percent of employees when EcoPass is not provided. In Burlington, the CCTA's Smart Business program could be a useful tool for encouraging transit ridership. Similar to Boulder's employee EcoPass program, one current option of the Smart Business program is for businesses to purchase monthly passes for their employees for all CCTA buses. The program also includes a guaranteed ride home in case of emergency. Our research suggests that the City does not actively promote this program.

Parking is core issue with respect to transportation and energy use, as low-cost or free parking tends to encourage automobile use and deemphasizes the use alternative transportation. In addition, surface

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[77] City of Burlington, Vermont, Department of Public Works, Department of Planning and Zoning, Community and Economic Development Office. Moving Forward Together: Transportation Plan for the City of Burlington. March 2011.

[78] TDMs aim to reduce congestion by promoting strategies to reduce single-occupancy vehicle trips, shift automobile traffic to non-peak periods, and/or reduce automobile trips altogether.

[79] City of Burlington, Vermont, Department of Public Works, Department of Planning and Zoning, Community and Economic Development Office. Moving Forward Together: Transportation Plan for the City of Burlington. March 2011.

[80] City of Burlington, Vermont, Department of Public Works, Department of Planning and Zoning, Community and Economic Development Office. Moving Forward Together: Transportation Plan for the City of Burlington. Technical Appendix. March 2011.

parking results in increases to stormwater runoff and nonpoint source pollution. Developing and maintaining downtown/waterfront parking is a consistent theme that runs through many of the policy and planning documents.

The Transportation Plan plainly states, "Parking in the downtown core is currently inadequate and action should be taken to address the issue."[81] The Technical Appendix to the Transportation Plan provides a well-constructed discussion about the City's ongoing debate regarding the appropriate amount of parking to successfully support the downtown/waterfront area.[82] Currently the CDO sets minimum off-street parking requirements for the downtown/waterfront area. Critics of minimum parking requirements contend that they:[83]

- Raise the costs of goods and housing;[84]
- Reduce the land available for development and increase urban sprawl;
- Have negative effects on the character of community;
- Subsidize the cost of operating an automobile;
- Reduce the viability of transit; and
- Results in unpleasant and dysfunctional design.

Business owners often contest these notions and express deep concern that a lack of parking will serve as a deterrent to people using the business district, particularly during the busiest times of year like the holidays. The City has recognized both sides of the debate by substantially reducing minimum parking requirements in the downtown/waterfront area in the latest update of the CDO. The CDO also implemented parking maximums. However, Burlington remains committed to a no net loss policy; therefore, any development occurring on existing parking will need to replace lost parking. The Technical Appendix also reflects on the challenges associated with this policy noting that many sites in the area simply cannot accommodate the replacement of lost parking spots.

The Technical Appendix details that the Steering Committee was unable to come to consensus on whether to keep the current system, strongly limit parking to lower demand, or shift to a market-based approach. It makes strong case for a market-based approach, advocating setting prices to ensure that utilization during peak periods reaches 85 percent.[85] IEc's research indicates that cities have been successful with this approach. For example, Redwood City, California uses demand-responsive meter rates that produce an average 18 percent availability rate in the downtown area. The average parking stay is 72 minutes. Before program implementation, these spaces were always occupied by day-long employees. Now, the program provides greater access for more shoppers and visitors.[86] Ultimately, the Transportation Plan

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[81] City of Burlington, Vermont, Department of Public Works, Department of Planning and Zoning, Community and Economic Development Office. Moving Forward Together: Transportation Plan for the City of Burlington. March 2011. Page 5.

[82] City of Burlington, Vermont, Department of Public Works, Department of Planning and Zoning, Community and Economic Development Office. Moving Forward Together: Transportation Plan for the City of Burlington. Technical Appendix. March 2011.

[83] For an excellent summary of the parking requirement debate, see Sherman, A. "The Effects of Residential Off-Street Parking Availability on Travel Behavior in San Francisco." San Jose State University Department of Urban and Regional Planning. May 2010. Available at: http://www.sjsu.edu/urbanplanning/docs/URBP298Docs/urbp298_HonorsReport_Sherman.pdf. This discussion is adapted from this paper.

[84] Developers and business pass the costs of parking construction and maintenance to homebuyers and consumers. This can lead to a decrease in affordable housing, as developers need to sell more expensive units to offset the cost parking requirements.

[85] City of Burlington, Vermont, Department of Public Works, Department of Planning and Zoning, Community and Economic Development Office. Moving Forward Together: Transportation Plan for the City of Burlington. Technical Appendix. March 2011.

[86] Seattle Department of Transportation. "Best Practices in Transportation Demand Management." Seattle Urban Mobility Plan. January 2008. Available at: http://www.seattle.gov/transportation/docs/ump/07%20SEATTLE%20Best%20Practices%20in%20Transportation%20Demand%20Management.pdf.

recommended a gradual approach that calls for a pilot pricing strategy in the downtown/waterfront area. The plan also calls for study of the expansion of parking a several areas.

As Burlington moves forward with its downtown/waterfront master plan, the City and participating public will need to carefully consider how to best utilize and manage its parking assets in the area, and how to identify the balance between parking and development. As part of this discussion, the City may wish to consider the effectiveness of the no net loss policy and its potential to impede development in the downtown/waterfront area. The Technical Appendix references payment-in-lieu or impact fees as potential alternatives to on-site parking. These strategies could fund more efficient parking in strategic locations throughout downtown/waterfront area.[87] For example, in Coconut Grove, Florida, businesses and residents have paid in-lieu of 938 downtown parking spaces, yielding $3 million in revenue. The funds helped construct a 416-space public parking garage with ground floor retail.[88]

Finally, as this City continues this debate, it could consider additional parking management measures, including:

- **Unbundling parking from real estate.** Selling parking spaces separately from the rent or sale of property provides incentive for homeowners to drive less or own fewer cars. It can also help reduce the cost of housing in the downtown/waterfront area.[89]
- **Increasing shared parking.** The City could consider promoting shared parking between businesses and residents. It may be possible for apartments and offices to share parking facilities, since the peak demand for the office occurs during the weekday, while the apartment peaks during evenings and weekends.[90]

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[87] City of Burlington, Vermont, Department of Public Works, Department of Planning and Zoning, Community and Economic Development Office. Moving Forward Together: Transportation Plan for the City of Burlington. Technical Appendix. March 2011.

[88] Seattle Department of Transportation. "Best Practices in Transportation Demand Management." Seattle Urban Mobility Plan. January 2008. Available at: http://www.seattle.gov/transportation/docs/ump/07%20SEATTLE%20Best%20Practices%20in%20Transportation%20Demand%20Management.pdf.

[89] Litman, T. "Parking Requirement Impacts on Housing Affordability." Victoria Transport Policy Institute. February 18, 2011. Available at: http://www.vtpi.org/park-hou.pdf.

[90] Litman, T. "Parking Requirement Impacts on Housing Affordability." Victoria Transport Policy Institute. February 18, 2011. Available at: http://www.vtpi.org/park-hou.pdf.