IEc

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TO Sandrine Thibault, Burlington Department of Planning & Zoning

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SUBJECT Task 4: Implementation Recommendations

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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 a plan that actively promotes climate-conscious development and transportation strategies. As a part of that process, the City's Department of Planning & Zoning (DPZ) contracted Industrial Economics, Incorporated (IEc) to conduct a Climate, Energy and Green Infrastructure Analysis. This analysis consisted of:

- Task 1: IEc assessed 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.
- Task 2: IEc developed information helpful for assessing potential greenhouse gas (GHG) emissions reductions that could be realized by promoting additional development in downtown Burlington, rather than at the suburban fringe.
- Task 3: IEc prepared three case studies of successful or promising strategies employed in other cities, focused on transportation, building energy efficiency, and green infrastructure.

IEc's work on the above tasks included a review of Burlington's key planning documents, literature review, identification of relevant programs in other cities, and interviews with Burlington officials as well as officials in other cities.[1]

IEc found that Burlington is already making great strides on sustainability and is at the forefront of local government response to climate change. The City developed a Legacy Project Action Plan in 2000 to provide a 30-year road map to becoming a sustainable community, and since that time, Burlington has laid a solid foundation for advancing a robust sustainability and livability agenda.[2] Specifically, IEc found that Burlington's holistic and comprehensive approach to sustainability, which encompasses complementary strategies on transportation, land use, building energy, and green infrastructure, is a wise approach. As discussed in the Task 2 memorandum, changes in density alone are unlikely to have a

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[1] As a foundation for this work, IEc reviewed a number of key planning documents selected by DPZ, including: Burlington's Comprehensive Development Ordinance; The 2006 Municipal Development Plan; A draft set of actions and descriptions from the City's Climate Action Plan (CAP);Chapter 26 Wastewater, Stormwater, and Pollution Control; Department of Public Works Stormwater Credit Manual; Phase II Stormwater 2010 Annual Report; Moving Forward Together: Transportation Plan for the City of Burlington; Burlington Downtown and Waterfront Plan Transportation Study; Land Use Inventory and Buildout Analysis. See Task 1 memo for citations.

[2] The Burlington Legacy Project. "Burlington Legacy Project Action Plan: Becoming a Sustainable Community." June 2000. Available at: http://burlingtonlegacyproject.org/files/2009/07/LegacyActionPlan.pdf

significant impact on citywide GHG emissions; the literature suggests that doubling residential density will result in only a five percent decrease in vehicle miles traveled (VMT) and corresponding GHG emissions.[3,4] However, a comprehensive approach that combines 1) several aspects of compact development, including enhanced pedestrian orientation, a robust mix of land uses, increased public transportation accessibility, with 2) building energy use reduction strategies, deployment of renewable energy, and green infrastructure strategies, can have a much more significant environmental impact over the long run. Such a multifaceted approach will be necessary to meet the City's sustainability and GHG reduction goals. However, IEc understands that Burlington already has many sustainability and climate change policies and programs underway. Thus, the City needs to ensure that current policies and programs have the resources needed to succeed. Burlington should be careful to undertake only those policy changes or new programs that can make a clear contribution to the City's goals, and can be sustained over time.

To this end, IEc provides a set of recommendations in this memorandum for the City to consider as it moves forward with its sustainability agenda. These recommendations are based on IEc's understanding of Burlington's context, project research, and institutional knowledge of planning and sustainability best practices. We have organized the memorandum by providing key recommendations first, followed by secondary recommendations in each of four topic areas: green building and energy efficiency, renewable energy, green infrastructure, and transportation. Our intention is for DPZ to use the recommendations provided in this memorandum as an input into the City's ongoing master planning process.

KEY RECOMMENDATIONS

Land Use Planning and Policy Recommendations

Although land use planning and policy issues were not called out specifically as one of the four topic areas for IEc to assess, we found that Burlington's land use planning and policy framework is an area where current policies may be undermining the City's climate change strategy and GHG goals. Thus, IEc provides the following recommendations in this area:

Adopt a form-based code (FBC). IEc found that on balance, Burlington's policy and planning framework allows for a mix of uses in the downtown/waterfront area. The Municipal Development Plan (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 Comprehensive Development Ordinance (CDO) permits building 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.

However, IEc recommends that Burlington shift its zoning code from conventional use-based zoning to a form-base code (FBC) to facilitate future development that conforms to the City's sustainability plans. 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 and features of development desired by the community at specific locations, in contrast with conventional zoning, which use a less precise approach to regulating land use.

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[3] Ewing, Reid and Robert Cervero. "Travel and the Built Environment: A Meta-Analysis." Journal of the American Planning Association 76(3), Summer 2010. P. 275.

[4] Walters, Jerry and Reid Ewing. "Measuring the Benefits of Compact Development on Vehicle Miles and Climate Change." Environmental Practice 11(3), September 2009. P. 205.

FBCs are typically organized by transects that travel from the most dense (e.g., downtown) to the least dense areas (e.g., exurban/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.[5] Typically organized with visual displays and concise, plain language descriptions, FBCs are easier to understand than conventional zoning, 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.[6]

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.[7] 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.[8]

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."[9]

FBCs can also be crafted to include provisions that prescribe the location and development of renewable energy installations, transportation nodes, and green infrastructure measures, which are all important features of Burlington's plans. 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. Flagstaff conducted extensive studies to understand the optimal locations for renewable energy installations (primarily wind and solar) and the types of systems (e.g., 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.[10,11] IEc recommends that Burlington consider codifying allowable locations and types of renewable energy

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

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

[7] Brad Broberg. "New Kind of Zoning, Cities of All Kinds Adopting Form-Based Codes." *On Common Ground*, a publication of National Association of Realtors, Winter 2010. See also Bill Spikowski. "Form-Based Codes." *Florida Planning*, Winter 2010.

[8] John Barry, "Form-Based Codes: Measured Success Through Both Mandatory and Optional Implementation," *Connecticut Law Review*, Fall 2008. Available at: http://connecticutlawreview.org/archive/v41n1/barry305.pdf

[9] Alan Massomer. "The Frontier of Form-Based Codes." APA *Journal of Regional and Intergovernmental Planning*, Fall 2010. Available at: http://www.formbasedcodes.org/files/APAregional_newsletter_Win2011.pdf

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

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

installations in particular within an FBC. In addition, we recommend that the FBC indicate that green infrastructure installations and green roofs in particular are allowed and encouraged in the downtown/ waterfront area in particular, which is serviced by an older combined sewer system.

The development of FBCs will require an extensive overhaul of the City's policy and planning framework documents, and will likely require 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 a certain measure of political will.

Revisit restrictions on housing in the downtown/waterfront area. Burlington's current planning framework recognizes the importance of housing in the downtown and waterfront areas, but overly restricts housing development. Most importantly, the CDO states that no more than 50 percent of the gross floor area developed can be residential in the downtown/waterfront area.[12] Limiting housing in the downtown area conflicts with the goal of making Burlington's downtown a more vibrant, livable place that continues to attract new residents. Planning research suggests an optimal ratio of approximately 1.5 jobs per housing unit; by contrast, Burlington's downtown currently has a much higher ratio of about 5 to 1.[13,14] This suggests that significantly more housing is needed to bring Burlington's downtown into balance. As such, IEc recommends eliminating the restrictive housing policy.

Results from the Task 2 analysis suggest that increasing housing availability in the downtown/waterfront area is an important strategy for reducing household-level environmental impacts and transportation costs, because living closer to work cuts commuting distances and emissions, and because living in a walkable area (i.e., close to retail and other key destinations) reduces non-commuting driving as well. A major meta-analysis estimated that overall, residents living twice as close to downtown have 22 percent lower VMT.[15] This suggests that increasing housing availability in downtown could result in dramatic reductions in driving.

Moreover, IEc's Task 2 analysis also indicates that urban housing tends to use less energy for heating than suburban housing, because households tend to downsize in square footage when moving into an urban area, and because urban, multi-family housing requires less heating due to shared walls as well as the urban heat island effect. For example, one study estimated that a family moving from a 2,400 sq. ft. detached single-family home to a modestly smaller 2,000 sq. ft. apartment would save an average of 37 percent of total energy use,[16] worth about $766 annually at Burlington's current energy costs and consumption levels.[17]

IEc understands that to retain the character of the downtown area, Burlington may want to restrict housing form in some way, such as the current prohibition of residential dwellings on the first floor of a building.

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

[13] Weitz, Jerry. "Jobs-Housing Balance." American Planning Association Planning Advisory Service, Report Number 516. November 2003. Available at: http://www.planning.org/pas/reports/subscribers/pdf/PAS516.pdf

[14] Personal communication, David White, Burlington Department of Planning & Zoning. August 17, 2011.

[15] Ewing, Reid and Robert Cervero. "Travel and the Built Environment: A Meta-Analysis." Journal of the American Planning Association 76(3), Summer 2010. P. 275.

[16] Kockelman, K. et al. "GHG Emissions Control Options: Opportunities for Conservation." University of Texas, Austin, 2009. Available at: http://onlinpubs.trb.org/Onlinepubs/sr/sr298kockelman.pdf. Cited in Transportation Research Board 2009, pp. 175, 199.

[17] For energy costs, see https://www.burlingtonelectric.com/page.php?pid=11&name=residential_rates and http://www.vermontgas.com/residential/res_rates.html Consumption data is from personal correspondence with Chris Burns, Burlington Electric Department, and Scott Harrington, Vermont Gas, June 28 and 29, 2011.

This type of restriction does not conflict with City's sustainability plans because it affects the form of residential development but does not unduly limit quantity.

Reconsider current parking policies. Burlington should reconsider its parking policies, for a number of reasons. First, Burlington's no net loss parking policy and off-street parking minimums in the downtown/waterfront area are in conflict with the City's sustainability goals. To move City residents towards public transportation for commuting and walking in the downtown area, both of which are necessary for realizing the City's GHG emission goals, the cost of parking needs to rise. Otherwise, many residents will not have sufficient incentive to consider transportation alternatives. Once the cost of parking rises, however, demand for parking should decrease to a certain degree, and Burlington should naturally need less parking than it does today. Thus, Burlington should consider increasing parking meter rates and garage rates. We also note that the City provides most downtown municipal employees with free parking passes; charging for these passes or providing flexible passes rather than giving away full-time passes could further help to reduce parking demand.[18] In addition, if Burlington limits parking through conversions of existing parking lots to other uses, then the market rate of parking may rise, and may naturally help to reduce demand.

Secondly, the current low cost of parking in downtown Burlington represents a missed opportunity to raise revenues that the City could use for parking and transportation improvements. Increased meter and garage rates will generate additional revenue. The City should also consider allowing cash-in-lieu of parking to create additional revenue. The revenues collected through cash-in-lieu of parking and higher parking fees could fund more strategically located garage parking (the locations of which should be identified by the master plan and reflected in the FBC), and/or street design and traffic control improvements. Alternatively, Burlington could use the parking funds to promote other aspects of its sustainability vision, such as pedestrian improvements or even green building or green infrastructure.

Boulder, Colorado, which recently implemented a comprehensive transportation and parking plan, provides an example of a city that raised parking rates without negatively affecting the economic growth and vitality of its downtown area. While the City's sales tax revenue decreased in 2009 due to the nationwide economic downturn, it has since recovered, indicating that local businesses are performing well. Redevelopment projects in the downtown area indicate a continuing high demand for commercial real estate there. City officials believe that businesses continue to locate in the downtown area due to its lively atmosphere and its ready accessibility by foot, bike, or bus; higher parking fees have not had any noticeable effect in discouraging businesses from locating downtown or reducing customer traffic.[19]

Changes to parking policy could be coupled with piloting innovations such as demand-responsive meter rates and shared parking. The Technical Appendix to the City's transportation plan makes a strong case for a market-based approach, advocating setting prices to ensure that utilization during peak periods reaches 85 percent.[20] 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

[18] Burlington Sustainability Action Team. Memorandum Re: Employee Commute Downtown Pilot Program. June 11, 2011.

[19] Personal communication, Chris Hagelin, GO Boulder. August 16, 2011.

[20] 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.

greater access for more shoppers and visitors.[21] For an example of shared parking, the City of Monrovia, California has a six-by-two block "old town" downtown area. It previously had approximately 1,200 free surface and on-street parking spaces, which were underutilized. When the City developed a new movie theater complex in 1997, it implemented a shared parking system to be shared by daytime and evening uses. This approach allowed the City to cut the number of spaces while accommodating new parking demand from the theater complex.[22]

Other Key Recommendations

IEc provides the following additional recommendations in areas including transportation, building energy, green infrastructure, and outreach and communications.

Take steps to ensure the success of the new transportation plan. Burlington's Transportation Plan sets a preliminary goal to increase annual transit ridership by five percent annually. With the implementation of the additional transit services advocated by the Plan, transit ridership will increase gradually over time. IEc recommends that the City take steps to ensure that this ridership goal is met coupled with the expected environmental benefits.

The Chittenden County Transportation Authority (CCTA) is starting from a position of relatively infrequent bus service, and thus increasing service frequency on key routes is an appropriate first step towards increasing ridership. In its 2010 Transit Development Plan, the CCTA notes that most of its buses provide service every 30 minutes. The plan states that:

> "In the transit industry, 30-minute service is considered unattractive to choice riders, while 15-minute service in the peak periods is considered a significant threshold to make transit competitive with driving. Establishing 15-minute peak service on all four of the major corridors into Burlington – North Ave., Colchester Ave./Pearl Street (VT 15), Williston Road/Main Street (US 2), and Shelburne Road (US 7) – is likely to be the most cost-effective investment in new service that CCTA can make. This is the central transit recommendation in the Burlington Transportation Plan."[23]

While increased frequency may be necessary, it might not be sufficient to increase ridership by five percent annually; incentives to use transit (and/or disincentives to drive) will also be important to spur additional ridership. Indeed, our literature review in Task 2 suggests that after a certain point, increased service frequency is not likely to have much effect on increasing ridership. 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. Boulder's effort has been quite successful, and could provide a useful model for Burlington. The EcoPass is an unlimited-use bus pass for yearly access to all area transit services, offered at a group discount rate. EcoPasses are available to employers to purchase for their employees to provide an incentive for taking public transit. Employers in the downtown area do not need to provide EcoPasses; downtown employees receive them for free. A second type of EcoPass, the "Neighborhood EcoPass," provides a group of residents (a neighborhood) with a group rate for the EcoPass, without having to receive the pass from an employer.

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[21] 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.

[22] Victoria Transport Policy Institute, "Shared Parking: Shared Parking Facilities among Multiple Users," Victoria Transport Policy Institute, http://www.vtpi.org/tdm/tdm89.htm.

[23] Chittenden County Transportation Authority. "Transit Development Plan: Executive Summary." September 20 10. Available at: http://www.cctaride.org/pdf/Documents/ExecutiveSummary.pdf

GO Boulder provides additional benefits beyond the group discount rate, including a 50 percent subsidy for the first year in the EcoPass program and a 25 percent subsidy in the second year (for both businesses and neighborhoods). The EcoPass program also offers a "Guaranteed Ride Home," which provides EcoPass holders with a free taxi ride home in an emergency (if they have used any transportation option other than driving to get to work).[24]

Surveys by the Boulder 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; other options are less generous. The program also includes a guaranteed ride home in case of emergency.[25] The City should lead the way in providing Smart Business incentives to municipal employees, which would promote awareness and could drive increased demand for Smart Business passes among other employers. Although Burlington's City government has enrolled in this program, it has done little to encourage staff members to participate.[26]

An aggressive communications and outreach effort would help Burlington promote awareness of transit incentive programs initiated in the City. These efforts could also discuss the environmental and financial benefits of transit use. We discuss recommendations for outreach and communications in greater detail below.

In addition to providing incentives for using transit, we also encourage Burlington to provide disincentives to driving. We discussed potential changes to Burlington's parking policy above. We do not repeat that entire discussion here, but it bears repeating that a reduction in the number of parking spaces, or an increase in the price of parking, would have the effect of discouraging driving and encouraging alternative means of transportation. By the same token, making parking cheaper or more abundant will encourage driving and discourage transit use. Thus, Burlington's current policy of no net parking loss is at odds with the City's aim of increased ridership.

Once Burlington has begun implementing its transportation plan, we recommend the City monitor key performance metrics to evaluate implementation and make changes as needed. As discussed in the Task 2 memorandum, increased transit ridership should not be considered an end in itself; rather, it should be viewed as a means to reduce energy use and GHG emissions, as well as to reduce traffic. Also as discussed in the Task 2 memorandum, the average U.S. bus running on diesel fuel needs to carry 11.7 passengers (at all times) to achieve any GHG emissions reductions over automobiles; below this level, buses actually emit more GHG emissions than cars.[27,28] (The break-even point would be lower for buses using a lower-emission fuel, such as natural gas or a biodiesel blend.) Thus, if the City's underlying motivation is environmental protection, Burlington should measure transportation fuel use and GHG

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[24] An overview of the EcoPass program is available at: http://www.rtd-denver.com/EcoPass.shtml

[25] Chittenden County Transportation Authority. "Program Overview for Employers: CCTA Smart Business." No date. Available at: http://www.cctaride.org/pdf/smartbusiness/smartbiz-employers.pdf

[26] Personal communication, Jennifer Green, Burlington Community and Economic Development Office. August 11, 2011.

[27] Department of Energy Center for Transportation Analysis. "Transportation Energy Data Book." Edition 29, June 30, 2010. Table 2-12. Available at: http://cta.ornl.gov/data/index.shtml

[28] I.e., 39,906 Btu per vehicle-mile / (5,465 Btu per vehicle-mile / 1.6 passengers) = 11.7 passengers.

emissions, rather than focusing exclusively on transit ridership. We discuss specific transportation-related performance metrics and data sources in greater detail below.

As a final note, we recommend that Burlington use its transit system to guide decisions on where to promote further development, rather than vice versa. This aim is already reflected in the City's transportation plan, which states that "Transit services should be provided where higher-density, mixed-use development is anticipated well in advance, rather than re-routed in response to new development proposals after that fact."[29] A proactive approach is likely to be more effective over the long term in encouraging both more compact development and greater transit usage.

Develop a re-commissioning program for the City's older building stock. The City's current energy efficiency programs primarily focus on achieving efficiencies at the time of construction and initial commissioning. Over time, systems operations may cease to work in peak condition due to typical wear and tear, human error, changes in building operations, 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.[30] Re-commissioning is particularly important for older building stock in climate zones that experience extreme heat or cold (such as Burlington). The re-commissioning process can yield significant energy and cost savings at the building level. For example, in 2004, Xcel Energy conducted a re-commissioning of an older 500,000 square-foot 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.[31]

The City should consider developing a program that provides incentives for or requires building re-commissioning. Burlington should require City buildings and schools to undergo re-commissioning on a fixed schedule, such as every five years. For privately-owned buildings, Burlington could require or incentivize re-commissioning at the point of sale. The California Commissioning Collaborative is currently testing an approach of integrating commissioning and disclosure of energy performance at the point of sale. The Collaborative is using a building walk-through to assess energy savings potential of assets and operations, and develop cost and energy savings estimates. The idea is for this energy information to be provided to a building's current and future owners prior to finalizing sale of the property.[32]

Develop a strategic plan for Burlington's green infrastructure initiatives, and ensure available resources to support it. Burlington is currently engaged in several efforts to reduce stormwater impacts and promote green infrastructure. IEc recommends that Burlington develop a strategic plan to guide future investments in this area. As discussed in the Task 1 memorandum, current staffing is inadequate to

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[29] City of Burlington Department of Public Works, Department of Planning and Zoning, and Community Economic Development Office. "Moving Forward Together: Transportation Plan for the City of Burlington." Adopted March 28, 2011, p.15. Available at: http://www.ci.burlington.vt.us/docs/4593.pdf

[30] 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.

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

[32] California Commissioning Collaborative. "Energy Transparency in Commercial Real Estate Transactions." Available at: http://www.cacx.org/PIER/realestate.html

support the program, and the stormwater fee does not provide an adequate incentive for installing green infrastructure. To develop a strategic plan, City officials should:

- Develop a few scenarios for the potential size and scope of a long-term municipal green infrastructure program. For example, program size parameters could include the annual number of green infrastructure technical assistance engagements that the City takes on. Program scope parameters could include assumptions about Burlington's responsibilities for maintaining green infrastructure facilities over time.
- Analyze funding needs in terms of staffing and other operating costs for each scenario over time.
- Analyze the potential for stormwater fees and other potential revenues to meet the funding needs estimated under each scenario.

Portland, Oregon, a recognized leader in stormwater management and green infrastructure, undertook a similar review in the 1990s when it began developing its stormwater management plan.[33] This type of analysis will help to identify a sustainable green infrastructure program size and scope for Burlington. As part of this analysis, the City should examine the potential impacts of raising its stormwater fee. The current monthly user fee is $1.17 per thousand square feet of impervious surface.[34] The owner of a typical 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 to date. 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 substantially higher than those in Burlington. For example, Portland, Oregon charges $9.97 per thousand square feet of impervious surface for non-residential properties.[35] If the City raises the user fee, it could consider adding waivers or discounts to assist those with financial difficulties.

The City could also 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.

In addition, the Sustainable Cities Institute advocates that cities consider public-private partnerships for funding and maintaining green infrastructure. Private revenue or in-kind assistance options include 'Friends Of" programs, contributions to greenspace programs or funds, and donation of land or easements by private property owners.[36] For example, as discussed in the Task 3 memorandum, the Portland Green

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[33] Water Environment Research Foundation (WERF). "Portland, Oregon: Building a Nationally Recognized Program Through Innovation and Research." 2009. Available at: http://www.werf.org/livablecommunities/studies_port_or.htm

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

[35] 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.

[36] Sustainable Cities Institute. "Green Infrastructure Overview." Available at: http://www.sustainablecitiesinstitute.org/view/page.basic/class/tag.topic/community_support and http://www.sustainablecitiesinstitute.org/view/page.home/home;jsessionid=C0D6ECAA73256832D9995997B34B48B8

Streets programs is using a volunteer program, the Green Streets Steward Program, to maintain green infrastructure installations; the Stewards take responsibility for weed removal, plant trimming, and trash cleanup.

Develop an outreach and communication strategy. Burlington should invest in communication and outreach to for its sustainability programs, to market the concept of a Sustainable Burlington to stakeholders, including the local business community, existing and potential community members, and sister agencies. The Legacy Project Action Plan, which is scheduled to be updated in 2012, could provide a useful framework for discussion, linking the City's various sustainability-related policies and programs to broader issues of the City's long-term sustainability vision.

All stakeholders will benefit from Burlington centralizing information on its climate change and sustainability plan onto one well-designed, branded website (e.g., "LivableBurlington.gov"). Currently, to learn about related initiatives, one must go to different sites (e.g., DPZ's site and BED's site). Furthermore, the information presented on the DPZ site on the Climate Action Plan is not presented in an intuitive manner. The City's sustainability home page should explain what the City is trying to accomplish with its sustainability plan and should provide a compelling, concise argument about how climate action, livability, and economic stability are intrinsically linked for Burlington. The home page should provide links for more detailed information relevant to different stakeholders, much like the City's homepage does for residents, businesses and visitors. We recommend that Burlington hire a professional web design firm to develop this site. Burlington should also develop and post a pdf version of the Climate Action Plan for constituents who want to download the entire plan. Boulder County, Colorado has an effective sustainability homepage that Burlington could use as a template for this undertaking.[37] Seattle, Washington, which has a dedicated Office of Sustainability and Environment, is another example.[38]

Burlington's different stakeholder groups may need different types of information on the City's sustainability program:

- *Local business community:* Local businesses, especially those in the downtown/waterfront area, may want information on how sustainability initiatives can benefit their bottom lines by creating a more livable, vibrant, and economically stable downtown. Also, information on sustainability programs targeted at businesses, such as green building programs, should be organized in one spot on the website. Burlington may want to consider designating one City staff person as a liaison for businesses seeking information on sustainability programs, to act as a "one-stop-shop" for information.

  Local businesses will also benefit from reassurance that a lack of on-site parking will not negatively impact customer traffic. Prospectively, we suggest that Burlington provide case studies of other cities that have implemented similar parking plans. Also, businesses may be interested in information on residents' preferences for walking and transit; data showing that Burlington residents prefer a walkable downtown, and transit options may help to address concerns about parking. The City should contact the City of Boulder's GO Boulder staff to understand how they collect data underlying the program's annual report, which contains local data on walking, biking, and transit use (contacts are provided under separate cover).

- *Community members:* Existing and potential community members will need to understand the livability benefits of a more vibrant, pedestrian-friendly downtown, such as the ability to walk to

[37] Boulder County. "About Sustainability." 2011. Available at: http://www.bouldercounty.org/sustain/initiative/pages/aboutsustain.aspx

[38] City of Seattle Office of Sustainability and Environment website. 2011. Available at: http://www.seattle.gov/environment/

work, services, and recreational amenities. Community members may be interested in the environmental benefits of sustainability initiatives, but the City should post such information in a way that resonates for average citizens. For example, in addition to reporting that the City's green building program will save a certain amount of energy, the City could add contextual information that the program will save enough energy to power a certain number of homes in Burlington for a year. Burlington may also want to summarize and present key findings from the growing body of literature on the connection between the built environmental and health, which indicates that people who live in walkable areas or take public transit tend to be healthier. Also, community members may also be interested in how sustainability initiatives position Burlington competitively, and may contribute to increased property values.

Similarly to businesses, some community members may have concerns with higher costs of parking resulting from Burlington's sustainability plans. The City should clearly explain on its website that it is using funds from parking revenues to make improvements in strategic parking facilities, public transportation, and any other sustainability programs funded by parking revenues.

- *Sister agencies:* Other agencies within City government may require information on how Burlington's sustainability initiatives fit into existing structures and procedures, how they are paid for, what the environmental benefits will be, and how sustainability initiatives position Burlington competitively vis-à-vis other cities. While some of this information may be appropriate for the City's sustainability website, other information needs from sister agencies may be more appropriately communicated over the City's intranet or another internal communication mechanism. In addition, DPZ and BED staff may want to hold meetings with other agencies to discuss the City's sustainability plans and provide requested details.

SECONDARY RECOMMENDATIONS

In addition to the major recommendations detailed above, we have also developed several additional recommendations for Burlington to consider. Below, we discuss additional recommendations for the four major issue areas: green buildings and energy efficiency, renewable energy, green infrastructure, and transportation.

Green Building and Energy Efficiency Recommendations

Implement and maintain stricter green building standards. Burlington's energy code requires that all new commercial and significantly renovated buildings meet 2005 Vermont Guidelines for Energy Efficient Commercial Construction.[39] These guidelines are based on the International Energy Conservation Code (IECC) 2004 Supplement, with amendments.[40] The Vermont legislature has recently passed legislation to update the guidelines based on the 2009 version of IECC and the 2007 version of ASHRAE 90.1.[41] BED is awaiting a final rulemaking to formalize the update, expected in January 2012.[42]

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

[40] 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.

[41] 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.

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

This lag at the state level has resulted in Burlington and other cities in Vermont waiting to adopt the most up-to-date energy code. We recommend Burlington take action to avoid this problem and keep the City on the leading edge of energy efficiency. Massachusetts has confronted this problem with two approaches that Burlington could consider:

- *Keep Burlington's energy code state-of-the-art*. 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.[43] Similarly, rather than wait for legislative action, Burlington could amend its code to pin to the latest version of IECC and ASHRAE 90.1. Both IECC and ASHRAE 90.1 are being updated every three years.

  One of the Spring Hill Solutions' key recommendations regarding Burlington's Climate Action Plan was to require new commercial construction to meet the requirements of Core Performance, an energy efficiency program established by Efficiency Vermont. Core Performance is a prescriptive set of measures intended to reduce energy use in commercial buildings 20 – 30 percent below ASHRAE 90.1-2004.[44] Following Spring Hill Solutions' recommendation could raise the baseline for energy efficiency beyond the current requirements of IECC or ASHRAE. However, requiring both Core Performance and the most recent version of IECC and ASHRAE may be needlessly burdensome, and the City may want to choose one approach over the other. It is unclear how often, if at all, the Core Performance requirements will be revised. Thus, an approach based on IECC and ASHRAE may produce more efficiency gains over the long term.

- *Implement a "stretch" code.* Stretch codes provide an avenue to improve efficiency by emphasizing energy performance, as opposed to the prescriptive requirements common in building energy codes. Typically, a stretch code requires performance that goes beyond existing code. In Massachusetts, communities that choose to employ the stretch code must build 20 percent more energy efficient than the base energy code.[45] The State estimates that the additional construction costs resulting from the stretch code runs approximately $3,000 for a typical single-family home, and one to three percent of total costs for commercial buildings.[46]

As an alternative to the either of the above options, Burlington could require new commercial construction to meet more broad-based green building standards. Again, it may be overly burdensome to require a green building standard in addition to strict energy efficiency guidelines, and Burlington may want to choose one strategy over the other. The decision should be guided by whether the City is concerned primarily with energy efficiency or with the broader range of building environmental impacts. If Burlington is interested in adopting a green building standard, we recommend either LEED or the International Green Construction Code (IgCC). LEED for New Construction is the most widely used

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[43] 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.

[44] Advanced Buildings and Efficiency Vermont. "Core Performance Guide: Vermont Edition." January 2008. Available at: http://www.efficiencyvermont.com/docs/for_my_business/new_construction/CorePeformance_VermontEdition.pdf

[45] 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.

[46] 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.

green building standard in the U.S., and is generally regarded as a robust set of requirements. In addition, Burlington already has some experience, albeit limited, with LEED; current incentives allow for bonus height if the building is certified as LEED Silver or higher. Numerous communities throughout the U.S. have required new construction to meet LEED standards, including 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.[47] 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.[48]

Among the numerous competing systems, we believe the IgCC is likely to be the dominant alternative to LEED in the future, especially for policy actions. At this point, IgCC is still in draft form; the first public version was released in 2010, and the ICC expects to publish the first approved version in March 2012. Some local governments have adopted the draft version of the code within the last year. The fact that the requirements of the code are still in flux, and that there is little implementation experience, means that adopting the IgCC may be somewhat riskier than LEED for Burlington. In general, IgCC and LEED appear to have similar levels of stringency, but the two do have some distinguishing characteristics. Most notably, as a point-based system, LEED places a greater emphasis on optional practices, whereas IgCC is driven more by requirements.[49] This allows building projects greater flexibility under LEED than IgCC, but it also means LEED buildings may have less uniform energy performance. Both systems allow either prescriptive measures or a performance-based approach to energy efficiency. However, where LEED's requirements are geared off the ASHRAE 90.1 standard, IgCC references the International Energy Conservation Code (IECC). Nevertheless, IgCC also provides for alternative means of compliance (e.g., the ASHRAE standard discussed below, or being in the top 10 percent of existing buildings using EPA's Target Finder).

Other well-known green building standards include the National Association of Homebuilders (NAHB) and ASHRAE 189.1. The NAHB standard is not as stringent in all areas as LEED or IgCC. For instance, in a comparison of NAHB to LEED for Homes (the most directly comparable LEED standard), the Cincinnati chapter of AIA found that one of the key differences between the two standards was that LEED had more stringent minimum performance requirements with respect to energy. The researchers also found LEED to have more rigorous documentation requirements and definitions of key terms, resulting in more clearly defined requirements.[50] In addition, the NAHB standard applies only to residential buildings. Thus, relying on NAHB alone would therefore leave Burlington without an effective way to evaluate commercial or mixed-use buildings. As such, we do not recommend using the NAHB standard. ASHRAE 189.1, another relatively new system, is roughly on par with IgCC with respect to stringency, and similarly focuses on requirements rather than optional practices. However, since IgCC

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

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

[49] IgCC does contain some optional practices, but these are mostly *jurisdictional requirements,* i.e., practices that adopting jurisdictions (cities and states) decide whether or not to require for all buildings.

[50] AIA Cincinnati. "Comparison of United States Green Building Council's LEED for Homes First Edition 2008 and National Association of Home Builders' National Green Building Standard ICC 700-2008. January 2010. Available at: http://www.aiacincinnati.org/community/LEED_NAHB_Final.pdf

allows ASHRAE 189.1 as an alternative compliance pathway, adopting IgCC would allow builders the option to use ASHRAE 189.1 if they so choose.

Green historic preservation. Burlington's downtown/waterfront area features many historic buildings. While these buildings are important to the character of the area, they pose particular challenges with respect to energy use, especially because Vermont's energy code exempts historic buildings from energy efficiency requirements.[51] EPA and others have undertaken initiatives to yield potential strategies for retrofitting historic buildings for energy efficiency. Burlington officials should contact experts from these programs to obtain guidance on implementing a green historic preservation program in Burlington. Connecting with experts with this area will be particularly important given that a large proportion of planned POWER projects in the City could be at historic buildings.

Of particular note, EPA, HUD, and DOT are providing technical assistance to Concord, New Hampshire, working with community officials, developers, and other stakeholders to determine how historic preservation and green building approaches can best be integrated into existing codes. One goal of the project is to provide guidance on the how to design a regulatory framework that supports the sustainable, green redevelopment of historic buildings. Given the similarities between the two cities, outcomes from this project could assist Burlington in amending its code to account for historic properties.[52]

Other resources that could aid Burlington in developing a green historic preservation initiative include:

- EPA hosts an annual symposium to discuss how to sustainably retrofit existing buildings.[53]
- The Advisory Council of Historic Preservation has developed guidance on integrating sustainability with historic preservation for federal buildings.[54]
- The City of Boulder, Colorado has developed a suite of materials targeting energy efficiency in historic buildings, with detailed technical guidance.[55]

Integrate energy efficiency into the capital planning process. We have discussed above the potential value of a concerted effort to re-commission older buildings to ensure optimal energy performance. One means of achieving this would be for City officials to work to include energy efficiency considerations as an integral part of the capital planning process for municipal buildings. We understand that the Department of Public Works (DPW) is already engaging with BED on a limited basis to address efficiency improvements to municipal buildings, but we recommend that the City consider a more systematic approach that makes use of existing maintenance plans and procedures.

As discussed in the Task 3 memorandum, the City of Berkeley, California may provide a useful model for Burlington in this regard. In Berkeley, the Office of Energy and Sustainable Development (OESD) has placed a high priority on making municipal buildings more energy efficient. When OESD first began undertaking efficiency retrofits of municipal buildings in the 1990s, there was little communication with other departments about these projects. Over the years, OESD realized that coordination with the

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

[52] 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.

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

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

[55] 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.

Department of Public Works (DPW) was particularly beneficial, and as a result, maintenance projects now routinely include consideration of energy efficiency upgrade opportunities. OESD works cooperatively with the DPW to identify opportunities to incorporate energy efficiency measures into already-scheduled building maintenance activities. Examples of retrofits include updated lighting and occupancy sensors for lights, more efficient heating and ventilation systems, and better control systems.

To implement this recommendation, Burlington should identify key experts, potentially in BED and/or DPZ, to work with DPW on an ongoing basis to integrate efficiency improvements into existing building maintenance plans. Within the capital planning process, building investment decisions should be guided by clear criteria that will advance the City's sustainability policy. Criteria should include the potential for energy and greenhouse gas reductions, technical ease of implementation, flexibility to adapt to different conditions over time, and lifecycle cost. In many organizations, budgeting decisions are made predominantly based on capital costs, with little or no consideration given to operating costs; this approach inevitably leads to missed opportunities for long-term savings. In contrast, investments should be evaluated on a lifecycle cost basis. One method to mitigate potential capital constraints, at least after an initial startup period, would be to redirect utility bill savings from efficiency improvements into a dedicated fund for future efficiency measures; this would help to bridge the divide between capital and operating budget impacts.

Renewable Energy Recommendations

Focus on efficiency first. For several reasons, we recommend that Burlington use renewable energy generation as a secondary strategy to energy efficiency. In most cases, renewable energy generation is not as cost-effective as energy efficiency measures in reducing GHG emissions. This is especially true in locations such as Burlington with an older building stock. Furthermore, while superior to fossil fuels, renewable energy sources have their own environmental impacts, primarily associated with the manufacturing and end-of-life stages. Renewables can also be more logistically challenging to implement on a distributed (i.e., non-utility scale) basis, since they may require greater coordination with the electric utility or with regulators. While BED has stated its goal of meeting 100 percent of its generation needs from renewable sources by 2012, meeting this goal will be more feasible and affordable if the City first takes aggressive steps to reduce electricity demand.[56]

Burlington's Climate Action Plan appears to reflect this prioritization. Several renewable energy items are included in the plan, but in Spring Hill Solutions' final ranking of the proposed actions, the highest-priority actions are primarily efficiency-related. These proposed efficiency measures focus on setting strict efficiency standards for new construction and incentivizing residential efficiency renovations. While certain renewables programs, such as the proposed "Solar on Schools" initiative, could play a role in reducing Burlington's environmental impacts, we support the general approach promoted by Spring Hill Solutions of emphasizing efficiency first.

Conduct additional feasibility analyses on renewable energy, and integrate the results of these analyses into the form-based code. An emphasis on efficiency notwithstanding, to the extent that efficiency strategies alone are insufficient to meet the City's goals, Burlington should undertake additional feasibility analyses to determine which renewable energy resources are most appropriate for deployment in the downtown/waterfront area. As suggested above, the City could use form-based codes (FBCs) as a

[56] 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

means to guide the placement and installation of renewables at the property level. A key challenge to incorporating renewables into FBCs is the need to develop a deep understanding of the energy resources and equipment types that makes economic and physical sense for the area. The City should aim to understand the best locations for renewable energy installations and the types of systems that are best suited to each geographic area. Without this information, the City could potentially permit improper siting of renewables. The City should therefore consider an extensive review, focusing on highly localized characteristics, to determine the site locations, technologies, and renewable resources that are most viable for renewable energy production. As discussed in our Task 1 memorandum, Flagstaff, Arizona undertook such a review when developing its own FBC that could serve as a model for Burlington.[57,58]

Thus far, the City has shown the most interest in the installation of solar power. 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.[59] 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. Geothermal energy is another potential renewable resource for the City to consider. 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). For both geothermal and solar power, additional feasibility analyses would be necessary for the City to develop FBCs that effectively guide the location and characteristics of renewable energy installations.

While the City has also expressed interest in wind energy, it does not appear that wind installations will be economically viable in the downtown/waterfront area. 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.[60,61] We recommend that Burlington to defer pursuing wind energy until it can be reliably demonstrated in urban settings similar to the downtown/waterfront area.

Green Infrastructure Recommendations

Create a green roofs program. 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, and can be particularly useful in highly urbanized areas with high levels of impervious surface. A recent EPA study indicates that green roofs are capable of removing 50 percent of

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

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

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

[60] 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.

[61] 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.

the annual rainfall volume from a roof through retention and evapotranspiration. Rainfall not retained by green roofs is detained, increasing the time to peak and slowing peak flows for a watershed.[62] Burlington's city code encourages green infrastructure practices, including green roofs, but the code is silent with regard to appropriate use and application of green roofs in the City.[63] Currently, the City approves green roofs (along with several other green infrastructure measures) on a case-by-case basis.

Impediments to green roofs in Burlington include the lack of familiarity with the technique, difficulty locating technical expertise, and installation and maintenance costs.[64, 65] 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 or other green infrastructure funding mechanisms (such as loans and grants). As one model of such a program, 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.[66]

Consider urban forestry a form of green infrastructure. Urban street trees provide significant stormwater management benefits.[67] 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. Despite these benefits and maintenance requirements, Burlington's urban forestry is not managed as a green infrastructure resource. Rather, the 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 in assessed value.[68]

The Department is currently 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.[69] The City's 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 broader view of what constitutes green infrastructure would require close collaboration between DPZ and Parks and Recreation, including sharing GIS data on the tree inventory and existing stormwater management measures, and potentially some redefinition of program goals.

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[62] 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.

[63] City of Burlington Code of Ordinances, Section 26-157: Use of alternative stormwater management practices. Available at: http://library.municode.com/index.aspx?nomobile=1&clientid=13987

[64] 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.

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

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

[67] 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.

[68] 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.

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

Transportation Recommendations

Review existing transportation assumptions and performance metrics. In the Task 2 memorandum, IEc reviewed the literature to evaluate the potential energy and GHG emission reduction benefits that Burlington could realize through more compact development and lower vehicle miles traveled (VMT). It was not within the scope of this project for IEc to perform a detailed analysis of the assumptions underpinning Burlington's Climate Action Plan or Transportation Plan to ascertain whether they are consistent with the results we found from the literature. However, we recommend that Burlington undertake such a review and, if necessary, amend its policy efforts accordingly. For example, as noted previously, the literature indicates that changes in residential density alone are not likely to drive significant reductions in VMT; other community characteristics, such as distance to key destinations, street design, and transit access appear to be more important. Burlington should verify that its climate and energy efforts incorporate the best data currently available in the literature on this issue.

The Task 2 memorandum also provided recommendations on metrics and data sources that the City can use to measure environmental impacts, summarized in Exhibit 1 below. Burlington's recently adopted Transportation Plan includes several progress indicators intended to track the City's performance over time; however, it does not provide any details on how this information will be collected. These indicators include the following:

- Transit ridership;
- Traffic volumes into and out of the City;
- Transportation Management Association (TMA) employee mode shares; and
- Energy use/GHG emissions.[70]

From an environmental perspective, energy use and GHG emissions are the most important metrics among those listed. The others are secondary indicators that provide additional detail on particular strategies to reduce transportation energy use. We recommend using the Vermont sample from the National Household Travel Survey (NHTS) as a data source for VMT. Continuing to measure this over time will help City officials gauge success in reducing overall levels of driving. Translating this into more direct environmental impacts, the literature suggests that every one VMT decreased should result in a net decrease of 0.86 – 0.93 lb. CO_2.

[70] City of Burlington Department of Public Works, Department of Planning and Zoning, and Community Economic Development Office. "Moving Forward Together: Transportation Plan for the City of Burlington." Adopted March 28, 2011, p. 11. Available at: http://www.ci.burlington.vt.us/docs/4593.pdf

EXHIBIT 1: SUMMARY OF LOCAL-LEVEL METRICS FOR BURLINGTON

GENERAL ENVIRONMENTAL BENEFIT	BURLINGTON BASELINE DATA	POTENTIAL BURLINGTON ENVIRONMENTAL BENEFIT	BURLINGTON DATA SOURCE
20 – 40 percent household-level VMT reduction from compact development	9,500 VMT per person per year (total)	1,900 – 3,800 VMT per person per year	Chittenden County/Vermont NHTS add-on sample
	0.86 – 0.93 lb. CO_2 per VMT	1,634 – 3,534 lb. CO_2 per person per year	N/A (value from literature)
Total CO_2 reduction from bus ridership	Unknown	Calculated per Exhibit 2	CCTA
4.4 percent residential energy savings from moving from a larger detached home to a smaller detached home	5,190 kWh electricity per residence per year (total)	228 kWh electricity per residence per year	Burlington Electric Department
	0.497 lb. CO_2 per kWh	113 lb. CO_2 per residence per year from electricity	Burlington Electric Department (fuel mix); EPA (emissions factors)
	900 ccf gas per residence per year (total)	40 ccf gas per residence per year	Vermont Gas
	12 lb. CO_2 per ccf gas	480 lb. CO_2 per residence per year from gas	N/A (value from literature)
20 - 37 percent residential energy savings from moving from a larger detached home to smaller apartment	5,190 kWh electricity per residence per year (total)	1,038 – 1,920 kWh electricity per residence per year	Burlington Electric Department
	0.497 lb. CO_2 per kWh	516 – 954 lb. CO_2 per residence per year from electricity	Burlington Electric Department (fuel mix); EPA (emissions factors)
	900 ccf gas per residence per year (total)	180 - 333 ccf gas per residence per year	Vermont Gas
	12 lb. CO_2 per ccf gas	2,160 – 3,996 lb. CO_2 per residence per year from gas	N/A (value from literature)

We also provide a method for estimating environmental benefits from increased transit ridership in the Task 2 memorandum, reproduced below in Exhibit 2. That calculation requires an estimate of total passenger-miles per year from CCTA.

EXHIBIT 2: CALCULATING ENVIRONMENTAL GAINS FROM PUBLIC TRANSPORTATION

ROW	CALCULATION STEP	CURRENT VALUE	DATA SOURCE
[1]	Total Bus Gallons (Diesel) Consumed	372,534	CCTA
[2]	/ Total Bus Passenger-Miles	Unknown	CCTA
[3]	= Bus Gallons (Diesel) per Person-Mile	[1] / [2]	Calculated
[4]	x CO_2 per Gallon (Diesel)	22.2 lb.	EPA
[5]	= Bus CO_2 per Person-Mile	[3] x [4]	Calculated
[6]	Automobile Gallons (Gasoline) per Person-Mile	0.03	U.S. Average
[7]	x CO_2 per Gallon (Gasoline)	19.4 lb.	EPA
[8]	= Automobile CO_2 per Person-Mile	[6] x [7] = 0.582 lb.	Calculated
[9]	Net CO_2 Reduction per Passenger-Mile from Riding Bus	[8] – [5]	Calculated
[10]	Total CO_2 Reduction from Riding Bus	[9] x [2]	Calculated

Increase service frequency for City Loop bus route. As noted above, the CCTA plans to increase service frequency on the four major bus routes bringing passengers into Burlington. The organization may also want to consider increasing the frequency of the City Loop route in particular. The City Loop route had 99,146 riders in FY2010. This made it the CCTA's ninth-most popular route out of 26, suggesting it is a significant but not a dominant aspect of the city's transit service.[71] Improving the service frequency of the other bus routes noted above may increase the number of commuters that choose to use public transit rather than driving into downtown from surrounding areas, but it may not have much influence on the behavior of downtown residents, who may have little reason to take the bus to outlying areas. Increasing service frequency on the City Loop route, on the other hand, could have a greater impact on reducing levels of automobile ownership and use among downtown/waterfront residents. More importantly, in addition to the direct effect on the travel patterns of current residents, the added convenience of more frequent bus service within the downtown/waterfront area could be an important selling point in persuading potential residents to choose to live downtown.

In Boulder, the Community Transit Network buses (i.e., the HOP, SKIP, and JUMP), which run so frequently that schedules are not needed, are a critical part of that city's transit strategy. Emulating the Boulder model for the City Loop could help Burlington to achieve greater levels of transit ridership. In Boulder, as in Burlington, the main bus system is not operated by the city. Boulder supplemented the Regional Transportation District (RTD) buses with its own system, because RTD would not provide increased service on the downtown loop. If feasible, a better method would be for Burlington to work with CCTA and/or provide incentives for CCTA to increase service on the existing City Loop route.

Consider switching the CCTA bus fleet to biodiesel. Finally, we suggest that Burlington work with CCTA to reduce the GHG emissions of its fleet by switching to biodiesel, either as a blend with conventional diesel or as a replacement. Biodiesel could be used by existing buses with little or no modification. Natural gas would also be an option, but given that CCTA has replaced half of its fleet since 2007,[72] retrofits to natural gas are unlikely to be cost-effective at this time.

CCTA began using a 20 percent biodiesel blend in 2007 but suspended its use in February 2011 due to concerns about the high price of diesel fuel; the agency's fuel costs were higher than budgeted, and the biodiesel blend had been costing an additional $0.11 per gallon above conventional Ultra-Low Sulfur Diesel (ULSD). Nevertheless, the agency has indicated that it would prefer to resume using biodiesel if possible.[73] In FY2011, CCTA buses consumed a total of 372,534 gallons of fuel. This implies a total cost premium of about $41,000 annually for the 20 percent biodiesel blend.[74]

A National Renewable Energy Laboratory study found that, over its lifecycle, pure biodiesel has CO_2 emissions 78.5 percent lower than petroleum-based diesel. A 20 percent blend reduces emissions by 15.7 percent.[75] Burlington should evaluate the cost of such emissions reductions relative to other proposed activities in its Climate Action Plan. If the cost of emissions reductions from biodiesel is favorable, the City may want to consider subsidizing CCTA or providing other incentives to resume biodiesel use.

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[71] Chittenden County Transportation Authority. Ridership Summary for FY10. Provided by Jon Moore, Transit Planner, Chittenden County Transportation Authority, July 6, 2011.

[72] Chittenden County Transportation Authority. "Transit Development Plan: Executive Summary." September 2010. Available at: http://www.cctaride.org/pdf/Documents/ExecutiveSummary.pdf

[73] Chittenden County Transportation Authority. "Chittenden County Transportation Authority Suspends Use of Biodiesel to Cut Costs." February 25, 2011. Available at: www.**ccta**ride.org/pdf/press-releases/**CCTA**SavesonFuelCosts.pdf

[74] Data provided by Jon Moore, Chittenden County Transportation Authority, July 19, 2011.

[75] National Renewable Energy Laboratory. "An Overview of Biodiesel and Petroleum Diesel Life Cycles." NREL/TP-580-24772. May 1998. Available at: http://www.nrel.gov/vehiclesandfuels/npbf/pdfs/24772.pdf