Section IV: Future of the Norwich Community

Town Facilities and Operations–Greenhouse Gas Emissions

Energy efficiency of Facilities, Transportation and Processes and Their Fuel Sources

What We Have

Overview – The Intergovernmental Panel on Climate Change (IPCC), a scientific body under the auspices of the United Nations, has published several warnings about the effect of human-generated greenhouse gases (GHGs) from fossil fuels and other sources on global climate change.

The municipality of Norwich, Vermont consumes energy for three separate purposes: facilities, transportation and processes. In 2011, it consumed approximately 5% of its total energy in the form of electricity; the rest is in fossil fuels. In the same year, the fossil fuels were applied to the following uses:

- Heating of buildings: 34% of fossil fuels
- Transportation (primarily police vehicles): 12% of fossil fuels
- Process energy (road machinery): 58% of fossil fuels

Note that municipally contracted services, such as paving, are not included in these totals.

As of 2014, the Town had adopted the use of biofuel blends in its DPW fleet, had acquired a fleet of more fuel-efficient police vehicles, was using solar heat for wash water at its public works facility, and had implemented a net-metering solar energy program.

Electricity – As of 2011, Norwich facilities used approximately 134,000 kilowatt-hours of electricity, annually. Table 1 shows the evolution in the energy sources from the town's electricity utility, Green Mountain Power.

Table 1. Green Mountain Power Energy Sources

Source	2006[1]	2014[2]
Hydro	50.4%	46.9%
Nuclear	43.0%	7.0%
From the grid	0.0%	30.5%
Wood	4.3%	4.9%
Methane/Oil	2.2%	1.0%
Wind	0.1%	8.1%
Other	0.0%	1.6%

[1] http://news.greenmountainpower.com/manual-releases/2007/GREEN-MOUNTAIN-POWER-GENERATING-SOURCES-AMONG-LOWE?feed=d51ec270-a483-4f6c-a55e-8e5fbe2238c2

[2] http://www.greenmountainpower.com/fuel-mix/

This represented a very small carbon footprint in 2005, but with Vermont Yankee ceasing operation in 2014, the nuclear component of GMP's portfolio will be replaced by other sources. After GMP's merger with CVPS, its energy portfolio has changed, substantially to approximately 30% energy from the grid.

By the end of 2014, 90% of Norwich's electricity will come from photovoltaic arrays, using a net-metering arrangement.

Heating of buildings – The municipality uses two types of fuel for heat: fuel oil and propane. The estimated CO_2 contribution of fuel oil is 10.2 kg/gallon or 73.2 kg/10^6 Btu. The estimated CO_2 contribution of propane is 5.8 kg/gallon or 63.1 kg/10^6 Btu.[3] So, in 2011, the municipal contribution to CO_2 from heating was 98,000 kg.

Transportation – The town's primary use of energy is for the police fleet[4]—the public works director has a diesel-powered pickup and the fire chief has a gasoline-powered SUV. The estimated CO_2 contribution of gasoline oil is 8.9 kg/gallon or 71.3 kg/10^6 Btu.[5] So, in 2011, the municipal contribution to CO_2 from transportation was 35,000 kg.

Process energy – The town's road machinery are the primary consumers of diesel fuel in the course of repairing roadways and plowing snow. [6] The fire department's vehicles also consume diesel fuel—also process energy for fighting fires. The estimated CO_2 contribution of diesel fuel is 10.2 kg/gallon or 73.2 kg/10^6 Btu. So, in 2011, the municipal contribution to CO_2 from process energy was 187,000 kg.

What We Want

The Town of Norwich will reduce annual net greenhouse gas emissions from energy consumption by all municipal sources relative to the 2012 baseline, contingent on no more than 10% additional life-cycle cost over conventional options, by:

- 25% by 2026
- 50% by 2038
- 75% by 2050

SWOT Analysis

The "SWOT" analysis, shown in Table 2, weighs favorable and unfavorable influences that come from our own abilities and outside forces, and helps understanding of the above goal as:

- *Strengths* – The town tracks municipal energy use; it has used expert engineering consultants for advice; it is considering renewing or replacing aging facilities.

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[3] US Energy Information Administration— Carbon Dioxide Emissions Coefficients: http://www.eia.gov/environment/emissions/co2_vol_mass.cfm

[4] 4 vehicles

[5] Ibid.

[6] Diesel – 5 dump trucks, 2 graders, 1 backhoe, 1 loader and sidewalk plow. Gasoline – various utility vehicles and maintenance equipment.

- *Weaknesses* – Much of the town's energy use is from processes; first-cost versus life-cycle costing can be difficult to assess; voters may not opt for facility renewal.
- *Opportunities* – New technologies are becoming more affordable and available, both in the near and long term..
- *Threats* – Each promising technology has substantial drawbacks.

Implementation Plan

Means – The town will draw on an engineering analysis to identify paths for GHG reduction in its energy use. The analysis will include strategies to be followed, plus engineering economics tools, such as spreadsheets to assess further options, as they become available over time. The town will assess the degree to which planning for energy efficiency can be built into its construction projects and equipment capital replacements. Identify and record a GHG-reduction "glide path" for each type of equipment and each facility.

Implementation Team – The implementation team will comprise future selectboards supported by the town manager and any engineering experts that he/she may hire.

Metrics – Use town records to track fuel and electricity usage. Use current U.S. Energy Information Agency statistics on CO_2 content of fuels to assess goals.[7] It's beyond the capability of Norwich to assess the upstream generation of CO_2. Instead, Norwich must rely on national policy and its implementation by the energy sector to address its own CO_2 generation issues.

[7] US Energy Information Administration— Carbon Dioxide Emissions Coefficients: http://www.eia.gov/environment/emissions/co2_vol_mass.cfm

Table 2. SWOT analysis for municipal energy goal.

Abilities: Things that we may do for ourselves.

Positive	*Negative*
Strengths	**Weaknesses**
• Norwich has been tracking the municipality's energy use, since 2004. • The town uses expert engineering consultants to advise on practical options. • Replacing aging facilities with new offers the prospect of improved energy use.	• Process energy cannot be reduced below the intrinsic energy requirement of the task to be completed. • Capital investments may require higher initial costs in order to lower life-cycle costs. • Life-cycle costs are less certain than initial costs. • Tracy Hall may be difficult to upgrade economically. • The voters may opt not to upgrade aging facilities.

Trends: Things that others may do to/for us.

Positive	*Negative*
Opportunities	**Threats**
• Natural gas production offers the prospect of reducing CO_2 production from combustion in the near term. • Improved heat pump technologies offer the prospect of capturing ambient energy for building HVAC. • Lowering costs of photovoltaic cells offer the prospect of supplying heat pumps with solar energy. • Increasing use of hybrid technology offers the prospect of more efficient transportation power. • Other technologies may become more affordable as climate change becomes a more compelling issue.	• New energy-saving technologies may be too expensive or unavailable. • Natural gas production offers problems with collateral GHG emissions in production, which are hard to compare with petroleum oil production. • Hydro-Québec hydro power has negative land impact, power lines • Solar energy: requires a large area per unit energy harvested; not continuously available. • Wind energy: projects face local opposition; not continuously available. • Biofuels are not yet sustainable and can have cold-weather issues. • National policy may be too little, too late in facilitating the economic implementation of GHG reduction technologies.

Strategies and Tasks – Table 3 shows the individual steps and timeframes to achieve the municipal greenhouse reduction goals, using 2012 as a baseline. Most of them are for future town managers to investigate and for future selectboards to recommend as part of the town budget.

Table 3 Strategies and Tasks

	2011	**2026**	**2038**	**2050**
Reduction goal	0%	25%	50%	75%
Total CO2 (kg)	299,170	224,377	149,585	74,792
End Use	**Potential Strategies**			
Heating	Envelope tightening, propane heating	New facilities, Natural gas, woodchips, heat pumps	Energy conservation retrofit of Tracy Hall with solar heat pump	Solar heat pump for all facilities with fuel backup.
Transportation	Smaller police vehicles	Hybrid plug-in vehicles	Automated traffic monitoring to reduce vehicle use.	Remote surveillance of main routes to minimize vehicle use.
Process	Biodiesel, solar heated water	CNG conversion	Possible hybrid vehicles	Possible plug-in hybrid vehicles
Electricity	Sustainable	Solar	Solar	Solar

Obstacles – Employ a public information campaign, using all available media and citizen participation to highlight the importance of GHG mitigation and Norwich's options for addressing it. Employ the town's representatives at the state and national levels to advocate for needed policy changes and pertinent funding.

Budget – Scoping budget to estimate cost of implementation. Budgeting of implementation.

Impact on the Future of Norwich

The execution of a plan to mitigate municipal GHG emissions will likely affect levels of taxation, which may have the following effects on growth, demographics, and other factors

- *Growth* – Any added tax burden from implementation of GHG mitigation technologies will make Norwich less affordable than localities that do not take these measures, and thereby impede population growth. At the same time, the

implementation of GHG mitigation may make the community more attractive for supporters of ecological responsibility.

- *Demographics* – Any added tax burden from implementation of GHG mitigation technologies will make Norwich less affordable than localities that do not take these measures, and thereby retain and attract residents with higher incomes than elsewhere, who are more committed to GHG reduction than people residing elsewhere.
- *Other* – Norwich has the potential to become a noted leader in New England for implementing GHG mitigation.

Section IV: Future of the Norwich Community

Energy Efficiency and Sustainability

Sustainable Development: higher density, energy-efficient development; energy-efficient transportation; energy efficient new buildings; upgrade older buildings for energy efficiency; small-scale energy generation.

What We Have

Climate change and the cost of fuels, both fossil and renewable, are driving factors inducing greater energy efficiency and sustainability. The scientific consensus is that current climate change is primarily driven by human activities. Generations to come will feel the effects of this change.

A report prepared for the Vermont Director of the Air Pollution Control Division suggests that: [8]

> If current high emissions continue, Vermont's summer climate by 2080 will feel similar to the climate of northwest Georgia for the period 1961-1990. However, if emissions are greatly reduced, the climate of Vermont will more closely resemble the climate of southeastern Ohio.

The report suggested a series of effects that include, a late arrival of winter with milder temperatures and precipitation that trends more towards ice and rain than snow, a greater tendency of flooding year-round, more frequent and prolonged droughts, hotter summers, and more frequent heavy precipitation events. According to sources cited in the *New York Times*, severe storms are becoming more frequent. [9]

Vermont's Comprehensive Energy Plan sets a goal of obtaining 90% of our energy needs from renewable sources by 2050. [10] It is based on the following strategy to virtually eliminate Vermont's reliance upon oil by mid-century:

- Increase efficiency measures
- Greater use of clean, renewable sources for electricity, heating, and transportation, and electric vehicle adoption
- Increasing use of natural gas and biofuel blends where nonrenewable fuels remain necessary

The Town of Norwich and certain enterprising residents have embarked on residential and community-scale building efficiency and solar energy projects. In addition, Norwich has become a Property Assessed Clean Energy (PACE) district. PACE is a method of financing energy improvements, which allows homeowners to

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[8] Betts, Alan K. "Climate Change in Vermont". June 2011

[9] Wald, Matthew L. and Schwartz, John. "Weather Extremes Leave Parts of U.S. Grid Buckling". *New York Times*: July 25, 2012.

[10] Vermont Department of Public Service, December 2011, Comprehensive Energy Plan 2011—Vermont's Energy Future, http://publicservice.vermont.gov/publications/energy_plan, P. 3

invest in efficiency or renewable energy improvements to their homes through on a special assessment tied to the property.[11]

Another aspect of sustainability is solid waste. Vermont's solid waste law, Universal Recycling (Act 148), encourages the diversion of recyclables and organic waste material from landfills into sustainable options, including re-use and composting.[12]

What We Want

Residents and property owners of the Town of Norwich will reduce annual net greenhouse gas emissions from energy consumption by all municipal sources relative to the 2012 baseline, within the economic constraints of individual residents and property owners, by:

- 25% by 2026
- 50% by 2038
- 75% by 2050

Note that meeting 90% of Norwich's overall energy needs from renewable sources by 2050 is a strategy endorsed by the Vermont Energy Plan. [13]

SWOT Analysis

The "SWOT" analysis, shown in Table 4, weighs favorable and unfavorable influences that come from our own abilities and outside forces, and helps understanding of the above goal as:

- *Strengths* – The town has an active energy committee, drawn from its well-educated and relatively affluent population, supported by its Town Plan and PACE funding.
- *Weaknesses* – To date property owners have shown no widespread tendency to implement energy upgrades, nor is there a centralized means for tracking their efforts.
- *Opportunities* – New technologies are becoming more affordable and available, both in the near and long term. Norwich has multiple sources of expertise to draw upon from local support agencies.
- *Threats* – Subsidies and incentives for energy conservation have expiration dates and action at the national level to provide new ones is uncertain; energy saving technologies may be too expensive to reach the later goals.

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[11] Efficiency Vermont, 2014, Resources for PACE Town Administrators, https://www.efficiencyvermont.com/for-our-partners/PACE-For-Town-Administrators/General-Info/Overview

[12] Vermont Department of Environmental Conservation, Act 148, Vermont's Universal Recycling Law, http://www.anr.state.vt.us/dec/wastediv/solid/Act148.htm

[13] Vermont Department of Public Service, December 2011, Comprehensive Energy Plan 2011—Vermont's Energy Future, http://publicservice.vermont.gov/publications/energy_plan, P. 3

Table 4. SWOT analysis for municipal energy goal.

Abilities: Things that we may do for ourselves. (See also Table 2.)

Positive	***Negative***
Strengths	**Weaknesses**
• Educated, comparatively affluent population. • Norwich has an active citizen-based energy committee that can tap support from expertise from residents and other groups. • Town Plan supports energy conservation and efficiency. • PACE funding is available in Norwich. • Active public transit service from downtown to other area towns. • Campaigns for energy conservation and solar energy are increasing participation by building owners.	• There is no centralized capability for tracking energy consumption in the community. • Energy may not be a high priority for personal spending among property owners. • Citizen energy activism can have only limited scope and impact by itself. • Town institutions have been slow to make energy a priority. • Spread-out nature of town diminishes economics of public transit.

Trends: Things that others may do to/for us.

Positive	***Negative***
Opportunities	**Threats**
• Energy service providers may be able to provide data for the 05055 footprint. • Norwich can avail itself of technologies from local energy companies. • Norwich's electrical energy utility has supported energy conservation, renewables and efficiency. • Natural gas production offers the prospect of reducing CO_2 production from combustion in the near term. • Improved heat pump technologies for building HVAC and lowering costs of photovoltaic cells offer synergy. • Increasing use of hybrid technology offers the prospect of more efficient transportation power. • Multiple support agencies are available regionally.	• Subsidies on Electric Vehicles and solar installations to expire at the end of 2016. • New energy-saving technologies may be too expensive or unavailable. • With the merger of Vermont's electric utilities the provenance of its electricity supply may become difficult to characterize for GHG content • National policy may be too little, too late in providing incentives for the implementation of GHG reduction technologies. • Vermont statute does not support energy conservation in the manner that it supports solar energy.

Implementation Plan

Means – Town volunteers, town commissions and boards, and contracted subject matter experts will draw on best practices to identify pathways for GHG reduction in its energy use. The pathways will encompass sustainable development, energy-efficient buildings and small-scale energy generation. Identify and record a GHG-reduction "glide path" for each pathway.

Implementation Team – The implementation team will comprise the Norwich Energy Committee, the Norwich Planning Commission, the Design Review Board and contracted subject-matter experts, supported by town policies and funding for local advisory agencies, provided by Norwich voters.

Metrics – The most direct method for acquiring building energy use data would be to request of those electrical and fuel vendors, serving Norwich. They may be able to provide current and historical data for the 05055 footprint.

If the first approach doesn't succeed, use estimation techniques to compare future states with 2012. Use the database from the town grand list data to create an energy use model. Use traffic counts and a profile of vehicles using the town roads to create an estimate of vehicular energy consumed.

Use current U.S. Energy Information Agency statistics on CO_2 content of fuels to assess goals.[14] It's beyond the capability of Norwich to assess the upstream generation of CO_2. Instead, Norwich must rely on national policy and its implementation by the energy sector to address its own CO_2 generation issues.

Strategies and Tasks – The Norwich Town Plan addresses sustainable development with higher density settlement patterns, improving the building stock with energy efficient new buildings the upgrading of older buildings for energy efficiency, the use of small-scale energy generation and promotion of energy-efficient transportation;.

- *Sustainable development* – Assemble information on sustainable development best practices with an emphasis on energy conservation for developers to use when drafting proposals. Identify areas that would support sustainable development. Provide information to realtors and developers.
- *Energy-efficient buildings* – Identify technologies and corresponding funding mechanisms that can be applied to upgrading the energy efficiency of Norwich's current private building stock and also for new buildings in town.
    - Appropriate funds for, competitively bid and contract for an energy auditing service that delivers audits to property owners, based on the value of the property. Develop a database that provides a record for each participating property owner.
    - Provide equivalent temporary tax exemption for energy improvements to new and existing properties on the documented cost for the energy retrofit or a flat fee for types of upgrade over existing practice per unit of installation.

[14] US Energy Information Administration— Carbon Dioxide Emissions Coefficients: http://www.eia.gov/environment/emissions/co2_vol_mass.cfm

Beneficiaries participate in the centralized database for the properties involved. This would require a change in Vermont statute.
    - For existing buildings, develop an outreach program that harvests the information gained in assessments to alert property owners to the potential for voluntary energy efficiency improvement of each property. Identify and record a GHG-reduction "glide path" for each building. Identify 2012 datum for each.
    - For designers and builders of new buildings, assemble information on best practices to use when developing projects. Prepare companion information for prospect new building owners.
    - Mobilize the Norwich Energy Committee and other community resources to provide outreach on building energy efficiency through list server postings, workshops, information tables, informal discussions, and other means.
- *Small-scale energy generation* – As provenance of electricity difficult to identify as being from non-GHG sources, identify sites for off-property solar installations, zone accordingly, and provide temporary tax exemption for installations.

Table 5 shows the individual steps and timeframes to achieve the municipal greenhouse reduction goals. Most of them are for future town managers to investigate and for future selectboards to recommend as part of the town budget.

Table 5 Strategies and Tasks

	2012	2026	2038	2050
Reduction goal	0%	25%	50%	75%
Total CO2 (kg)	Per property, data to be estimated, then collected for database.	Use database: 25% of buildings	Use database: 50% of buildings	Use database: 75% of buildings
End Use	**Potential Strategies**			
Building energy	Primarily fuel oil and propane	Energy conservation emphasis. Conversions to natural gas, woodchips, heat pumps	New construction using sustainable practices with incentives	New construction using net zero practices with incentives
Transportation	Prevalent use of gasoline, individual vehicles with high traffic volume at rush hours.	Plug-ins for electric vehicles. Expanded bicycle routes in town and beyond.	Prototype public transit routes and parking for commuters.	Expanded public transit network and parking for commuters.
Sustainable development	Individual projects	Identification of favorable sites	Development uses sustainable practices	Development uses net zero practices tied to public transportation
Electricity	Sustainable	Sustainable	Sustainable	Sustainable

- *Energy-efficient transportation* – Develop strategies to minimize commuting trips with a ride-sharing, public transit, or synergy with school transportation for traffic at peak times. Incorporate park-and-ride lots for commuters coming from outlying communities. Enhance pedestrian and bicycle routes.

Obstacles – Employ a public information campaign, using all available media and citizen participation to highlight the importance of GHG mitigation and Norwich's options for addressing it.

Employ temporary tax exemption incentives for energy upgrades of individual properties. Employ voter-approved appropriations to co-fund energy conservation assessment services for: 1) properties in town and 2) public transportation options.

Employ the town's representatives at the state and national levels to advocate for needed policy changes and pertinent funding. Allowing temporary tax exemption for energy upgrades to real property should receive statutory support.

Budget – Scoping budget to estimate cost of implementation. Budgeting of implementation.

Impact on the Future of Norwich

The execution of a plan to mitigate community-wide GHG emissions may affect levels of taxation, owing to additional engineering and construction costs for infrastructure; the added livability of the town could make it more attractive; each of which may have the following effects on growth, demographics, and other factors:

- *Growth* – Any added cost applied to development of new sustainably designed building stock is likely to suppress growth of new buildings. Any added tax burden from implementation of GHG mitigation technologies will make Norwich less affordable than localities that do not take these measures, and thereby impede population growth.
- *Demographics* – The improvement of the building stock will make Norwich more desirable than communities that do not take these measures and therefore more valuable, driving up prices. Any added tax burden from implementation of GHG mitigation technologies will make Norwich less affordable than localities that do not take these measures, and thereby retain and attract residents with higher incomes than elsewhere, who are more committed to GHG reduction than people residing elsewhere.
- *Other* – Reduction of downtown traffic at rush hour and other times will make the village of Norwich a more attractive place to enjoy.