Sustainability and Energy Efficiency in East Lyme

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Introduction:

Communities around the world are taking slow but definitive action of switching to sustainable practices. These communities are beginning to acknowledge climate change and adjustments they need to make. "Sustainability," for the purpose of this report, refers to long-term management of resources. That is, how can the town of East Lyme use its resources as efficiently as possible, reduce its dependency on external resources, and do so in environmentally friendly way. This report aims to assist in understanding East Lyme's current practices and how they could be improved to be more sustainable, with a specific focus on energy efficiency.

Energy efficiency has two components: 1. creating equal or more power with less energy/raw material use, and 2. maximizing the use of power and minimizing waste. The latter applies to landscaping, construction, HVAC, water heating, pumping, electricity, lighting, appliances, and more (California Center for Sustainable Energy). It can also be extended to include renewable energy sources, such as solar, wind, tidal, etc. With greater energy production and efficiency comes greater sustainability.

Project Goals

General Goal: Evaluate sustainable options for East Lyme.

Specific Goals: 1. Consider efficiency actions.

2. Review sources of renewable energy.

Secondary Goal: Create a sustainable culture in East Lyme.

Background:

How Electricity is Bought and Sold in CT

Before discussing the sustainable practices themselves, it is important to understand power sources and the trade of electricity. All electricity is generated by third parties, some in CT and some outside. After utilities purchase electricity, all suppliers bid for power through the Independent System Operator of New England (ISO-NE), which helps to set the prices. Electricity in CT is currently purchased under a laddering system, which means that portions are bought each year over the course of three years (with set

prices). According to DEEP's Power Procurement Manager, Mr. Jeff Gaudiosi, Public Utilities Regulatory Authority (PURA) is creating a new plan for 2013, in which purchasing is only done a year in advance, thus removing the laddering system. The standard offer price has dropped from $.097/kWh to $.083/kWh within the past year. It is anticipated that the price will continue to drop, possibly to $.06/kWh. The drop in price is largely due to the switch from oil-generated electrical power to natural gas. As an aside, the decommission of Millstone in the future will likely not impact the region's electrical costs.

Connecticut is predicted to rely heavily on natural gas for energy in the future. New York and Pennsylvania, projected to be "gold mines" of the regional natural gas industry, will be the main suppliers to Connecticut (Gaudiosi). Natural gas is cheaper than renewable resources at the moment. Unfortunately, the extraction process of natural gas, called fracking, is can be detrimental to the environment and public health. The state includes a Renewable Portfolio Standard under this laddering system. Generators buy renewable energy credits, which support renewable efforts in other areas of the United States. One goal of the RPS is to increase from 11% to 20% by 2020. Taken together, it is expected that the removal of the laddering system and the increasing use of natural gas to generate cheap power will drop the price of electricity by ~30% over the next few years.

Energy Efficiency Initiatives in East Lyme

As part of the research process, the efficiency initiatives in East Lyme were also examined. These are best summarized in recent reports from ECG Engineering, kindly provided by Mr. Ron Bence.

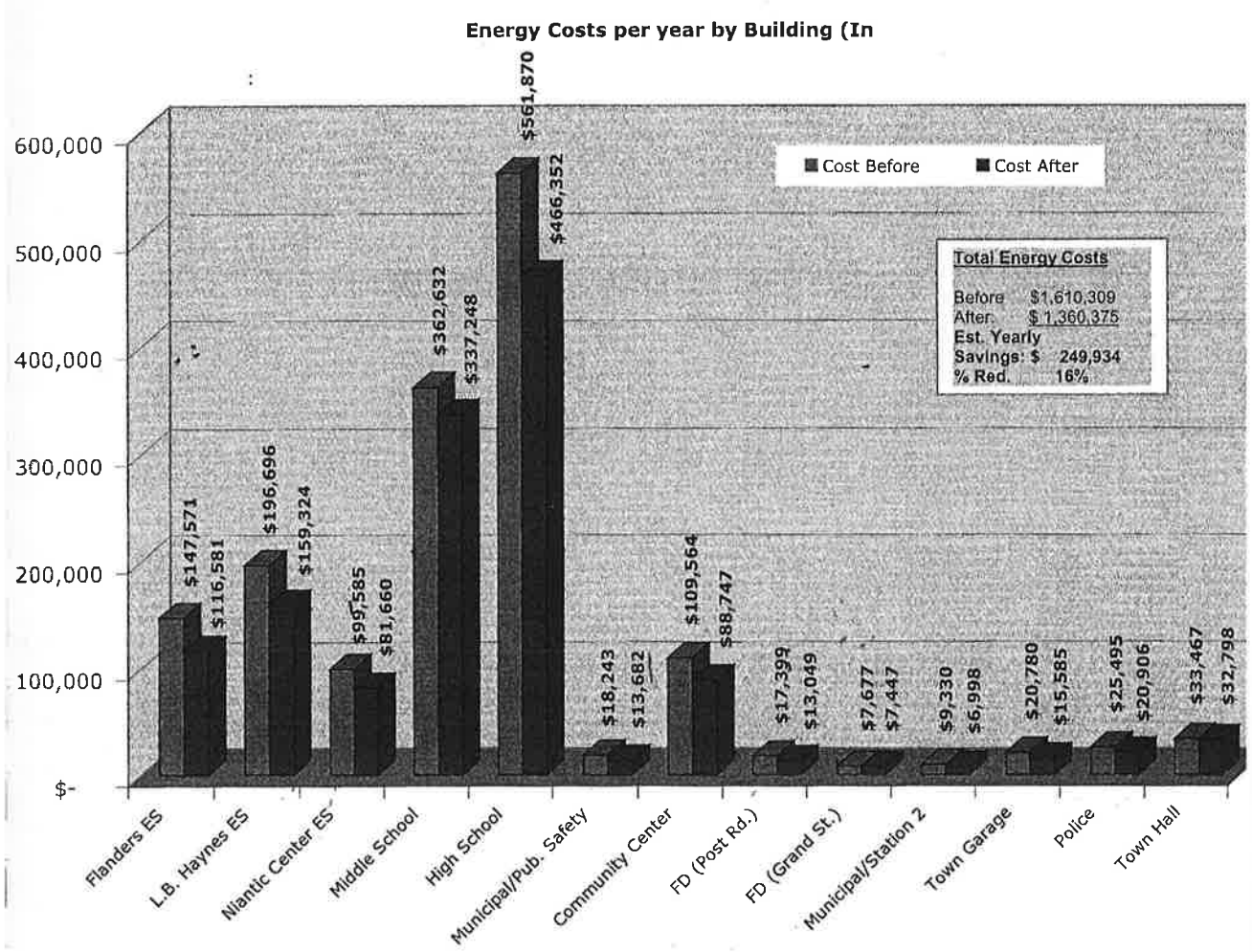
Preliminary Energy Assessment Completed by ECG Engineering, LLC

ECG Engineering completed a Preliminary Energy Assessment for the Town and Public School District of East Lyme in November 2011. Based on each building's Energy Usage Intensity score, they were given a label of "Very inefficient", "Inefficient", "Less Efficient", "Moderately Efficient", or "Efficient". Of the schools, they found Flanders Elementary, L.B. Haynes Elementary and Niantic Center Elementary to be "Inefficient",

the high school to be "Less Efficient", and the middle school to be "Efficient". Of the town buildings, they found the Municipal/Public Safety, Fire Dept. (Post Rd.), Municipal/Station 2 and Town Garage to be "Very Inefficient", the Community Center and Police Station to be "Inefficient", and the Fire Department (Grand St.) to be "Efficient". The Town and School District Overall was labeled "Less Efficient".

ECG made general suggestions of possible projects. They divided them up into two categories: fast payback and slow payback. ("Payback" means the speed of the return of the investment.) A couple of slow payback measures suggested are renewable energy technologies and replacing "old, inefficient boiler plants and/or boiler burner heads with modern high-efficiency or gas-condensing units". Some fast payback measures include many lighting changes (including street-lighting), which can be quicker fixes, according to Mr. Ron Bence.

The figure below summarizes ECG Engineering's estimates of the impact of improving efficiency in multiple town buildings, shown as dollars saved. It can be seen that savings may be very large, depending on the project. These are net savings, including the cost of efficiency measures.



Recent Energy Efficiency Efforts in East Lyme

The Connecticut Energy Efficiency Fund "supports a variety of programs that provide financial incentives to help you reduce the amount of energy used in your home or business". They fund vendors similar to ECG Engineering. The following are data from their 2011 Report for East Lyme (CT Energy Efficiency Fund 31). It is unclear from this report what was done that created the following data. However, this would need follow-up.

Energy Incentives=$310.988

Annual kWh Savings=$789,392

Lifetime kWh Savings=$9,101,757

Peak Demand kW=95

Annual CCF Savings=0

Lifetime CCF Savings=0

Annual Gallons Oil=8,830

Lifetime Gallons Oil=140,612

Annual Dollar Saved=$154,992

Lifetime Dollar Saved=$1,935,665

Annual CO2 (Tons) Saved=511

Current Expenditures on Electricity in East Lyme

Based on estimates provided by CL&P's Tom Morano, the Town (including residential) consumes approximately 78,960,000 kW over the course of a year. Data provided by the Town's Director of Finance, Anna Johnson, indicated that East Lyme pays an average of $.24/kWh per month, obtained from two sources, CL&P and TransCanada. The total kWh used for 2010/2011 by the Town buildings amounted to 1,870,382. Data provided by the Board of Education's Business/Facility Director, Don Meltabarger, indicated an average of $.187/kWh per month. The sum of the two is $.427/kWh. It is unclear at this time why the Town price is higher than the BOE price. It may be due to inclusion of solar power costs.

Renewable Energy

From the entirely solar-powered country of Tokelau, off the coast of New Zealand, to large-scale wind farms all over the United States, renewable energy is making its way into the power market. In 2009, the town of East Lyme sponsored a Plan of Conservation and Development (POCD). In it, POCD recommends many different options of renewable energy. Renewable sources of energy are a way to reduce our energy consumption as a town. These sources include wind, solar (PV and CSP), tidal, fuel cells, geothermal, and biomass.

Wind Power

Pros +	Cons -	Cost
+Not as expensive +Resistant to damage from earthquakes and tsunamis +Requires little water, no cooling water	-Inconsistent -Needs a back-up -Noise (within a few hundred feet) -Appearance -Avian mortalities -Requires a large area	$.07/kWh (operating) $.15-.19/kWh for plant Capital Cost not available

- Need wind speed to be 34-47 knots
- Shuts off at 48-63 knots (storm winds) for protection of machine parts
- POCD recommends a wind turbine "on the former landfill facility off Roxbury Road" (194).

Solar Power

Pros +	Cons -	Cost
+Highest power density of all renewable energy sources +Quiet +Reduce need for long transmission lines, power loss over these lines, and lessens likelihood of wide outages due to storms	-Not always available -Produces harmful greenhouse gases in manufacturing process -Expensive, but works long-term -Space (depending on type and size) -Needs a back-up (Thermal might not) -Requires a large area	CSP $.16/kWh PV $.224/kWh Capital Cost CSP = 3,300 $/kW

- Two types: Photovoltaic panels (PV) and Concentrated Solar Power Plants (CSP)
- Cheapest method is to combine them. Then there are fewer restrictions and lower energy cost.

- **PV plants** cannot control or store fluctuations in energy because of risk to damaging the system, which results in a lot of wasted energy.
- **CSP Plants** (high-temperature solar thermal collector) and Solar-Thermal Energy Storage (TES) (instead of "expensive conventional spinning reserves") can store thermal energy up to 15 hours.
    - Types
        - Linear Concentrator
            - Less expensive and easier to track the sun
            - Fresnel Reflector System, Parabolic Trough
        - Solar dish engine/collector
            - Smaller than linear
            - Has a thermal receiver and a heat engine
                - Steam engine
                - Gas turbine
                - Stirling engine
                    - Can be heated by any kind of energy source
                    - Cleaner and possibly cheaper (than fossil fuels)
        - Power tower/Point-focus central receiver system
            - Similar to dish, but has one central engine surrounded by many dishes all focus on to it
            - Molten salt used for energy storage and transfer (in Spain)
            - Company Abengoa
- Solar Thermal companies: eSolar (CA), Brightsource (Israel)
- "PV systems…as a distributed energy resource available nearby load centers, solar energy could reduce transmission and distribution costs and also line losses…can ease constraints on local T&D systems…also protect consumers from power outages." (Timilsina, Kurdgelashvili, Narbel 17)

Tidal Turbine Energy

Pros +	Cons -	Cost
+Predictable +Inexpensive operation costs +Does not affect fish migration	-Affects fish life (water levels, velocity, shelter and access to food) -Impacts aquatic ecology (Energy Report 23) -Expensive construction costs -Need a high flow (might not be available) -Silt build-up -Electricity generation and energy prices are affected by droughts	$0.07-0.10/kWh Commercial Plant Capital Cost Breakdown: Total Installed Cost 2,378 $/kW 1,969,155 $/Turbine 500,000 $/Farm *(For 250 dual 18-m diameter rotor*

	-Evaporation (Energy Report 20)	*modules)* Total Capital Cost $485 million

- A 15-meter diameter tidal turbine can generate as much energy as a 60-meter diameter wind turbine
- POCD recommends a tidal turbine in the "Niantic River Channel under the railroad bridge. The current reaches a maximum speed of approximately 2.3 knots in this location." (194).

Fuel Cells

Pros +	Cons -	Cost
+Provides base load power (good complement to renewables) +Can use renewable fuels +Can run continuously +Can be run in reverse for energy storage	-Very expensive -Durability? -Hydrogen is dangerous to work with	$.15/kWh

Geothermal

Pros +	Cons -	Cost
+Reliable-consistent flow of energy +Have a high capacity factor	-Hydraulic fracturing ("fracking") -Carbon footprint ("minimal" but still exists) -Greenhouse gases (released from underground) -Surface instability -Expensive	About $.05/kWh $3000-5000/kW for building of power plant $.01-.03/kWh for O&M

Biomass

Pros +	Cons -	Cost
+No carbon footprint because burning natural resources +Cost-effective (usage)	-Expensive -Requires space -Requires enough land from which resources are taken -Can impact air quality -Could ruin land -If feedstock is corn or soy, requires large water consumption (Energy Report 21)	$.07-.09/kWh

There are a few key factors to keep in mind when choosing a sustainable, renewable source of energy.

Cost

With cheaper energy sources on the market, such as natural gas, renewable sources of energy become very expensive. That is, power generated from a renewable source, like a solar farm, could be sold to the power suppliers. However, it would be sold at prices likely far less than what it cost to generate it. In addition, excess electrical power generated by small plants may not be purchased. Without a way to store this power, it may go unsold. This is true for individual owners of solar-powered homes, or potentially larger operators of solar (or other source) farms. Even homes that generate excess electricity cannot always sell it back to the grid (Gaudiosi). Furthermore, some projects have high building costs but low operation and maintenance costs. The $/kWh in the tables above are influenced by the price of oil, natural gas, and other non-renewable fuels, as they are the competitors to renewable sources. Cost also depends upon state taxes, grant availability, and the demand for renewable energy. On the positive side, the renewable energy industry is growing, and prices are predicted to drop in the future. According to the U.S. Department of Energy, demand for renewable energy supplies is projected to increase by 58% by 2030 (14).

Size

Some projects require a great deal of space. Size depends on the desired amount of energy generated. The Lands of Unique Value Study completed in 2009 has indicated small areas of open space, which would need to be investigated for renewable resources. Most of the projects must be strategically placed to optimize the source of energy.

Water Usage in Relation to Energy Sources

One component of energy efficiency is water usage and consumption. Water and energy are directly related. For instance, by saving water in the home, we save energy because there is less pumping required. According to the Southeastern CT Regional Supply Plan's Supplemental Report, "The Southeastern Connecticut Water Authority reported in 2003 that the region would begin experiencing a water deficit by 2010. That prediction was accurate. In 2004 they reported that we will experience a 10-million-gallon-per-day water shortfall by 2040. This is a public and private sector crisis that is here now and is worsening." (8). As a part of the region, it is East Lyme's duty to consider water consumption by energy sources. The Union of Concerned Scientists states that "Producing energy from fossil fuels, nuclear, power, and some renewable energy sources often involves substantial amounts of water…might withdraw about 400 million gallons of water a day from local lakes, rivers, or aquifers, and lose several million gallons of that water to evaporation." Petroleum refining, geothermal/natural gas processing and operations (fracking) consume billions of gallons of water per day across the United States, or thousands of gallons for one site (U.S. Department of Energy). Fracking can also contaminate groundwater if there is a crack in the concrete (Soraghan).

Assessment/Recommendations:

As budgets are tightened, it is difficult to invest in projects that have a slow payback or might actually lose money. Instead of investing in renewable sources at this time, therefore, a better investment for the Town of East Lyme is to invest in efficiency. As stated (paraphrased) by Gaudiosi (PURA), "efforts at efficiency are much better investments today and should allow for planning for renewable sources in the future." By working on energy efficiency, such as lighting or boilers, which we might be able to

currently afford, can make a difference and have a faster payback. The Town might want to take Gaudiosi's suggestion into consideration, which is to work on energy efficiency now (or smaller-scale projects) and begin planning larger-scale projects (such as renewable energy) for when PURA's new power plan is put into place. Based on his recommendations, this seems like the most economical approach to sustainability at this time.

The Energy Efficiency Fund and CEFIA are aiming to improve towns' sustainability across the state:

> The Energy Efficiency Fund and the Clean Energy Finance and Investment Authority (CEFIA) joined forces and in 2012 will begin to provide a more streamlined and efficient program for communities in CT. The program starts with communities taking a pledge to commit to reducing municipal building energy consumption by 20% by 2018-consistent with the state's new Lead by Example initiative. The community also works with CEFIA to make a commitment to purchase 30% of its energy needs from clean sources by 2018. (CT Energy Efficiency Fund).

So how do we achieve this goal?

1. *Move forward with smaller projects.*

It is important not to put sustainability on the backburner. The Town needs to show itself and its citizens that it is committed to sustainability by regularly investing in projects. While we plan larger projects for the future, we should make use of the means we currently have as a town and continue our energy efficiency efforts, even if they are as simple as lighting changes. Some Requests for Proposals have already been created, such as Mr. Bence's Children's Library lighting proposal. The town should aim to conduct at least one efficiency project per year and regularly assess its impact

In regards to larger-scale projects, we might further investigate Walnut Hill as a location for a solar farm.

2. *Create a Sustainability Committee.*

This committee will be made up of both local representatives as well as seek members of the Energy Efficiency Fund and PURA. The committee should help stimulate, evaluate, and facilitate efficiency projects in the Town.

3. *Foster a sustainable community culture.*

In order to have a successfully sustainable town, the community needs to have the same mission as the Town regarding sustainability. Education can be very effective, including advertising through different methods of town communication (Town television channel, fliers, EL Town Hall website, newspapers, etc.). Energy efficiency relies on educating our citizens about their energy production and usage. Many everyday actions fall under the category of "energy" and directly influence sustainability, including the items we purchase (what materials they are made out of, where they come from, and how long they take to break down), the items we recycle, our means and frequency of transportation, water consumption, home heating and cooling, lighting, and more. If the citizens of East Lyme can understand their individual energy efficiency and sustainability in general, then it is possible to gain their support on Town projects.

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