NET ZERO
WILLIAMSTOWN

Gracie Guidotti, Maria Avrantini, Alana Lopez Barro Rivera
Background
Clients
Williamstown COOL Committee

Nancy Nylen

Wendy Penner
Net Zero Resolution

The Resolution to reach net zero greenhouse gas (GHG) emissions goal by 2050

- Passed June 2021
- Requires a comprehensive climate action plan by 2023
What is Net Zero?

Net zero means that on average, a building, town, country or other type of entity, is balancing their greenhouse gas emissions with the amount removed and stored by carbon sinks.

Source: https://perkinswill.com/insights/on-our-way-to-net-zero/
Project Goal:
To create a clear roadmap for the decarbonization of Williamstown Municipal buildings and fleet to contribute to the Net Zero Carbon Emissions Action Plan
Methodology
### Methods

#### Primary Research
- Interviews
  - 4 with experts
  - 7 with building managers
- Site Visits

#### Secondary Research
- Internal Sources
  - Reports provided by the clients
- External Sources
  - EPA
  - EnergyStar
  - Acton, MA sources

#### Data Analysis
- Data from MassEnergyInsights and energy bills
- Calculations of thermal profiles, EUIs, etc.
Electricity in Massachusetts

Figure 1: ISO New England Energy Resource Mix
Electric Grid in Williamstown

- 0 available hosting capacity
- MA needs to upgrade the electrical grid

Figure: Borders and National Grid of Williamstown
In 2021, the Town Solar Field produced 2,046 mwh of electricity
Findings
Main Findings

1. Existing Buildings Systems

2. Energy Profiles
   Based on 2021 energy usage

3. Energy Efficiency and Conservation Measures

4. Decarbonization Options
Existing Buildings Systems

- **Town Hall**
- **Department of Public Works**
- **Harper Center**
- **Milne Library**
Building Energy Audits
# Buildings’ Profile

<table>
<thead>
<tr>
<th>Building</th>
<th>Age</th>
<th>Size (sq. ft.)</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Town Hall</td>
<td>1927</td>
<td>14,222</td>
<td>Office</td>
</tr>
<tr>
<td>Harper Center/Council on Aging</td>
<td>1985</td>
<td>4,298</td>
<td>Social/Meeting Hall</td>
</tr>
<tr>
<td>Dept. of public works</td>
<td>1985</td>
<td>25,800</td>
<td>Office</td>
</tr>
<tr>
<td>Milne Library</td>
<td>1967</td>
<td>18,833</td>
<td>Library</td>
</tr>
<tr>
<td>Parks &amp; Cemetery - Office &amp; Shop</td>
<td>1966</td>
<td>2,042</td>
<td>Office</td>
</tr>
<tr>
<td>Parks &amp; Cemetery - Sherman Chapel</td>
<td>1936</td>
<td>1,100</td>
<td>Church</td>
</tr>
<tr>
<td>Police Department</td>
<td>2019</td>
<td>12,000</td>
<td>Police Station</td>
</tr>
<tr>
<td>Elementary School</td>
<td>2003</td>
<td>89,000</td>
<td>School</td>
</tr>
</tbody>
</table>

Source: COOL Committee
Buildings’ Thermal Load Profiles

Town Hall Thermal Load Profile

- Heating
- Cooling

Energy Use (mmbtu) vs. Month

Source: MassEnergyInsight
## Buildings’ Profile

<table>
<thead>
<tr>
<th>Building</th>
<th>Lighting</th>
<th>Window Type</th>
<th>Insulated?</th>
<th>Heating/Cooling System</th>
<th>Other notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Town Hall</td>
<td>T8 Fluorescent Bulbs</td>
<td>Double Glazed (Town Manager Office Single Glazed Window with Storm Panels)</td>
<td>Yes</td>
<td>Window AC Units Natural Gas Boiler Heating</td>
<td></td>
</tr>
<tr>
<td>Department of Public Works</td>
<td>T5 Fluorescent Bulbs</td>
<td>Double Paned (Installed in 1999)</td>
<td>Yes</td>
<td>Wood / Oil Boiler Heating and Cooling</td>
<td>Existing 16.56 kw Solar Array</td>
</tr>
<tr>
<td>Milne Library</td>
<td>T8 Bulbs</td>
<td>Double Paned (Outdated)</td>
<td>No</td>
<td>Mini Split Cooling Hot Water Radiant Heating</td>
<td>Existing 2.4 kw Solar Array</td>
</tr>
<tr>
<td>Police Department</td>
<td>LED</td>
<td>Double Paned</td>
<td>Yes</td>
<td>Heat Pump Cooling and Heating Natural Gas Water Heating</td>
<td></td>
</tr>
</tbody>
</table>

Source: Interviews with building managers and site visits

Energy Efficiency:
- least energy efficient
- most energy efficient
## Buildings’ Profile

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<th>Window Type</th>
<th>Insulated?</th>
<th>Heating/Cooling System</th>
<th>Other Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary School</td>
<td>LED</td>
<td>Double Paned</td>
<td>Yes</td>
<td>Natural Gas Boiler Heating Electric Cooling</td>
<td>Existing 20 kw Solar Array Heat Recovery Unit</td>
</tr>
<tr>
<td>Cemetery Office &amp; Shop</td>
<td>T8 Fluorescent Bulbs (Installed in 2021)</td>
<td>Double Paned (Installed in 2021)</td>
<td>Yes (Two walls not insulated)</td>
<td>Oil boiler Window Unit Cooling</td>
<td>Existing 9.75 kw Solar Array 10 Fossil Fuel Mowers 2 Fossil Fuel Trimmers 1 Electric Mower 1 Electric Trimmer</td>
</tr>
<tr>
<td>Sherman Burbank Memorial Chapel</td>
<td>LED</td>
<td>Single Paned</td>
<td>No</td>
<td>Oil Boiler and Backup Natural Gas Boiler</td>
<td></td>
</tr>
<tr>
<td>Harper Center</td>
<td>T8 Fluorescent Bulbs</td>
<td>Double Paned</td>
<td>Yes</td>
<td>Heat Pump Cooling and Heating</td>
<td></td>
</tr>
</tbody>
</table>

Source: Interviews with building managers and site visits
Buildings’ Greenhouse Gas Emissions

Source: MassEnergyInsight and Police Department energy bills
Buildings’ Energy Use Intensity

Energy Use Intensity:
A measure of a building’s total energy use per square foot of area for each year

Goal
Reduce EUI to 20% below median EUI for the associated building type to become “net zero ready”

Source: MassEnergyInsight and Police Department energy bills, Median EUI from Energy Star
Williamstown Fleet

Emissions (MTCO2) vs. Vehicle Type

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Emissions (MTCO2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Duty Pickup</td>
<td>44</td>
</tr>
<tr>
<td>Other</td>
<td>73</td>
</tr>
<tr>
<td>Med-Duty Pickup</td>
<td>11</td>
</tr>
<tr>
<td>Street Sweeper</td>
<td>1</td>
</tr>
<tr>
<td>Med-Duty Vocational</td>
<td>12</td>
</tr>
<tr>
<td>Heavy Truck</td>
<td>3</td>
</tr>
<tr>
<td>SUV</td>
<td>8</td>
</tr>
<tr>
<td>Sedan</td>
<td>2</td>
</tr>
<tr>
<td>Van</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: National Grid Fleet Audit & Recommendations
Recommendations
Recommendations

1. Fleet Recommendations

2. Building by Building Recommendations

3. Electrification Options

4. General Recommendations
<table>
<thead>
<tr>
<th>Car Type</th>
<th>Alternative Option</th>
<th>Notes</th>
</tr>
</thead>
</table>
| Snow Plow and Maintenance Trucks | Optimus Technology Biodiesel Fuel (B20-B100)            | Can be used in any diesel engine but blends above 20% require engine upgrades  
  - payback period <1 year     |
| Light-Duty Pickup             | Ford F-150 Lightning                                    | Difficulty acquiring vehicles due to long wait times                 |
| Police Cruisers               | Ford - Mustang Mach-E Select RWD Standard Range         |                                                                      |
## Building Recommendations

<table>
<thead>
<tr>
<th>Building</th>
<th>ECM</th>
<th>Decarbonization Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Townhall</strong></td>
<td>Replace fluorescent light bulbs with LEDs</td>
<td>1. Implement Heat Pump AC system to replace window AC</td>
</tr>
<tr>
<td></td>
<td>Envelope Improvements (Air Sealing, Improve Insulation)</td>
<td>2. Heat pump heating replacement</td>
</tr>
<tr>
<td></td>
<td>Replace fluorescent light bulbs with LEDs</td>
<td>1. Heat Pump Heating/Cooling in Office</td>
</tr>
<tr>
<td>Dept. of Public Works</td>
<td>Envelope Improvements (Add Storm Window, Insulation, Air Sealing)</td>
<td>2. Upgrade Wood Boiler</td>
</tr>
<tr>
<td></td>
<td>Replace fluorescent light bulbs with LEDs</td>
<td>3. Eventually Replace Wood Boiler with emerging technologies</td>
</tr>
<tr>
<td>Milne Library</td>
<td>Envelope Improvements (Building Insulation, Window Replacement, Air Sealing) HVAC Tune-Up and Upgrades Reconnect online tracking for solar array</td>
<td>1. Heat Pump Heating Replacement</td>
</tr>
<tr>
<td></td>
<td>2. Exploration of Expansion of Solar Array</td>
<td></td>
</tr>
<tr>
<td>Police Department</td>
<td>Additional Temperature Controls</td>
<td>1. Exploration of rooftop solar installation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Electric Water Heating Systems</td>
</tr>
</tbody>
</table>

Source: Interviews with building managers, site visits and secondary research
# Building Recommendations

<table>
<thead>
<tr>
<th>Building</th>
<th>ECM</th>
<th>Decarbonization Measures</th>
</tr>
</thead>
</table>
| Harper Center                | Changing the T8 fluorescent lights for LEDs  
|                              | Tighten building envelope                  | Explore adding a rooftop solar array           |
| Elementary School            | Fixing the inverter so that the solar panels work  
|                              |                                         | Explore expansion of solar array  
|                              |                                         | Long term: installation of heat pumps         |
| Cemetery                     | Increase insulation                       | Replace heating/cooling system with heat pumps |
| Sherman Burbank Memorial Chapel | Tighten Building envelope (add insulation where possible and insulate windows)  
|                              |                                         | Explore installation of heat pump system      |

Source: Interviews with building managers, site visits and secondary research
Heat Pumps

**Air Source**
- Transfers heat to and from the outdoor air
- Can be used in forced air and radiant HVAC systems
- Much lower upfront cost than ground source heat pumps

**Ground Source**
- Transfers heat to and from the ground
- Higher upfront costs
Air Source Heat Pumps

Source: Ameren Electric, Dandelion Energy
Ground Source Heat Pumps

WINTER: GEOTHERMAL HEATING

SUMMER: GEOTHERMAL COOLING

Source: Ameren Electric, Dandelion Energy
# Heat Pumps

<table>
<thead>
<tr>
<th></th>
<th>Estimated Cost</th>
<th>Efficiency</th>
<th>Service Life</th>
<th>Average Payback Period</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air Source Heat Pumps</strong></td>
<td>$3,300-$7,500</td>
<td>High</td>
<td>15-20 years</td>
<td>4.7 years</td>
<td>Easy installation</td>
</tr>
<tr>
<td><strong>Ground Source Heat Pumps</strong></td>
<td>$13,000-$36,000</td>
<td>High</td>
<td><strong>Heat Pump</strong>: 20+ years</td>
<td>5-10 years</td>
<td>High Performance in Cold Temperatures</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Ground Infrastructure</strong>: 25-50 years</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: see final report
Additional Recommendations

**Energy Manager**
Responsible for coordinating the town’s energy efficiency efforts and overseeing the process of making the town net-zero.

**Annual Check Ins**
With all building managers to be able to keep updated knowledge regarding the state of all buildings, within the context of sustainability.

**Building Rating System**
A system that will allow for comparison of municipal buildings in terms of energy efficiency, transparency as well as remind of the commitment of Williamtown to reach Net Zero.
Additional Recommendations
Next Steps
Next Steps

1. Funding Prospects

2. Roadmap Summary
Green Communities Competitive Grants
To cover energy conservation measures, the purchase of electric vehicles, the replacement of heating systems, etc.

Massachusetts Energy Vehicle Incentive Program
To buy or lease EVs and buy electric fleet vehicle charging stations.

Municipal Energy Technical Assistance Grants
To develop energy projects or conduct feasibility studies

MassSave Rebate Incentives or Community Grants

Source: see final report
Through our work we have examined the existing building systems and energy use to identify the appropriate pathway to net zero.

Improving efficiency in order to lower overall electric demand as buildings are transitioned to electric heating and cooling.

**Building Priority Rankings:**
1. Department of Public Works
2. Police Station, Elementary, Library, Cemetery Office & Shop
3. Sherman Chapel, Harper Center, Town Hall

Installing solar systems on viable rooftops can help to reduce any emissions from electric sources.
Immediate Action Items

- Fix Elementary School Solar Inverter
- Check in on Milne Library solar array tracking
- DPW and Library Window Replacement
- Evaluate replacement options for DPW heating system
Special Thanks

Building and Facilities Managers:
- Pat McLeod at the Milne Library
- Kenny McAlpine at the Town Hall
- Brian O’Grady at the Harper Center
- Chris Lemoine at the DPW
- Justin Olansky at the Parks & Cemetery
- Michael Ziemba at the Police Station
- Jim O’Brien at the Elementary School

Professor Sarah Gardner
Bob Menicocci, Tanja Srebotnjak, Jason Moran, and Todd Holland
Our Clients, Nancy Nylen and Wendy Penner
Questions?