

# The Green School



*Presentation by Jim Moran*

**ADVANCED ENERGY GROUP, LLC**

*Thursday, August 10<sup>th</sup>*

**ASES SOLAR 2023**

Grid Track: Microgrids

for a More Resilient and Equitable Future

# Reduce Before You Produce (2008)

## Overview of AEG's 15 Yr. Resilient Renewable Energy Program



### 1. Envelope Upgrades

- Insulation, New Windows, and "Tighter" Building Envelope
- Reduces Heating and Cooling Loads



### 2. Geothermal Heating and Cooling

- 60% Savings in Heating & Cooling
- Significant Maintenance Savings



- ### 3. Solar Thermal Domestic Hot Water
- DHW Accounts for 19% of Residential Energy Use



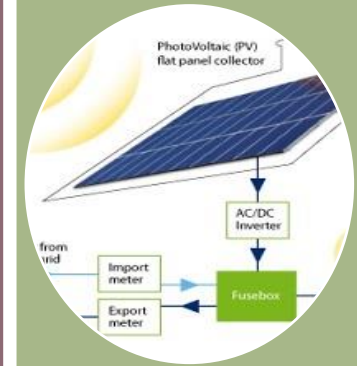
### 4. Energy Efficient Lighting

- All Energy Star Fixtures with Compact Florescent bulbs



### 5. Energy Star Appliances

- 25% Savings Compared to Conventional



### 6. Solar PV

- 9.75KW of Luma, Integrated Solar Roofing Panels
- Meet Majority of Buildings Energy Needs



# Selection from \$600M in AEG/MHA CT Rehab Projects: 2012-2024

**Yale Acres Model Building: 2014**



Geo-HVAC, Windows/Insulation, BIPV Solar PV, Thermal, Appliances, Cut Energy 82%; Cost 72%

**Chamberlain Heights 2012**



148 abandoned units rebuilt won Best LEED multi-family housing CT.

**Meriden Commons 2018/19**

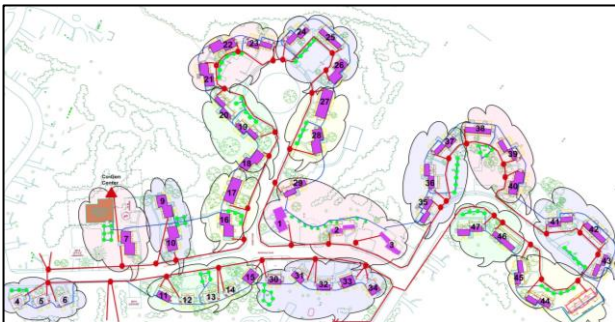


\$32M LIHTC project; 76 new mixed-rate units & separate town-houses.

**Historic Bingham School 2015-22**



**Full Yale Acres: 2015-20; 172 units**



**Meriden Commons 1 2017/18**



\$30M LIHTC project; 75 units mixed-rate housing, 14,000SF retail: solar/geo.

**Community Towers 2014-25**



221 Unit Senior high-rise; Cogen Electricity/Hot Water, some AC. Geo-thermal HVAC, Solar Carports and some Rooftop. BIPV awnings wall treatments for 2024/5

**Historic O'Connell School 2015-22**



2 Schools converted to 95 Affordable Senior units. Geo HVAC, Co-Gen Solar Back-up/Hot Water, Solar Carports, Some Rooftop PV (HST). Both building Solar Aquaponic Greenhouses in 2024.

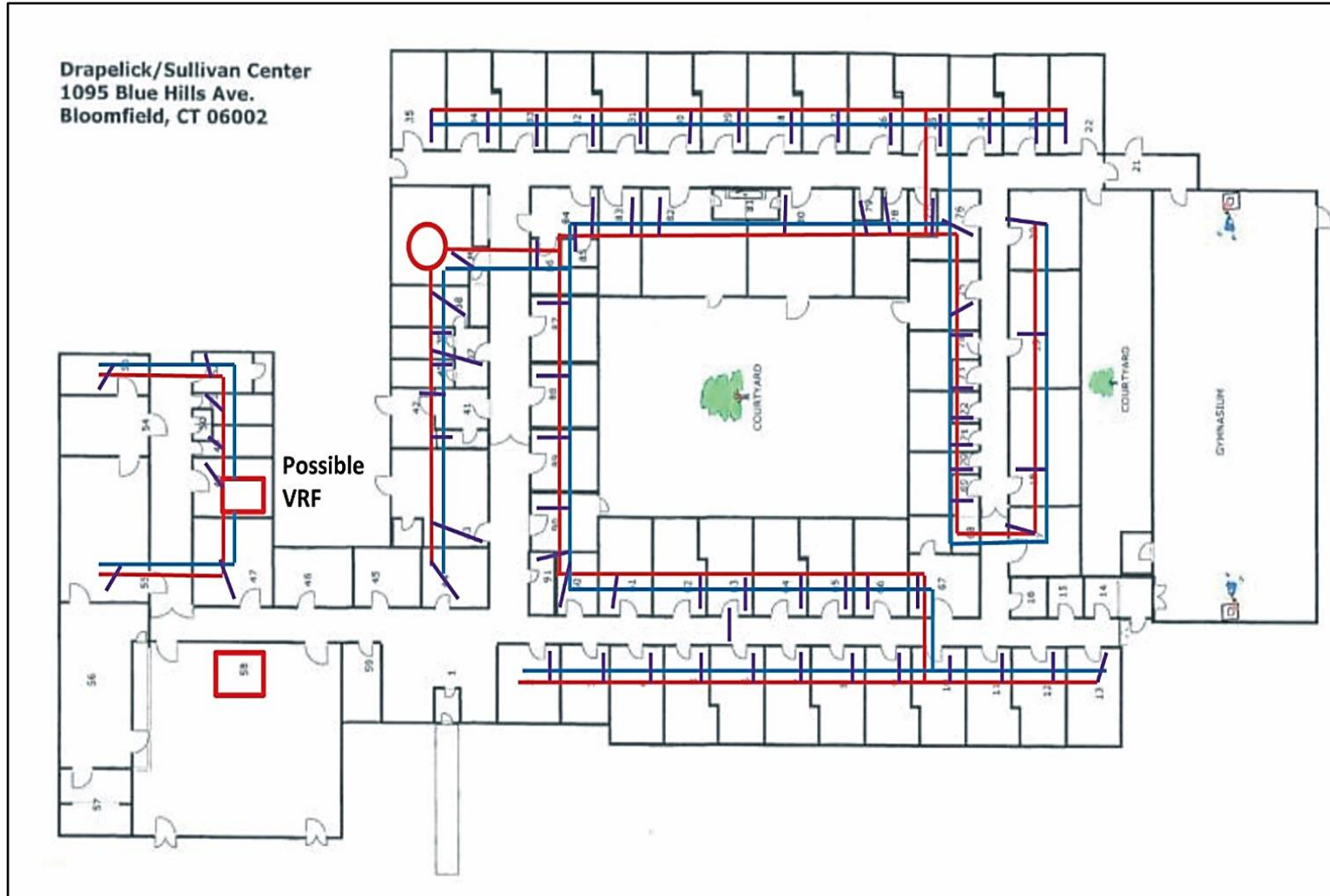
**24 Colony St. 2016/17**



63 mixed rate housing; 11,000SF retail: Geo/Solar



# The Draeplick Center – Bloomfield, CT



Former small school the AEG team is currently working on:

- Converting into a resilient, renewable energy halfway-house.
- Receiving ALL the energy services that will be shown here
- Will eliminate \$310,000 in Yr. 1 Energy & Maintenance costs

**Most importantly, energy and maintenance savings along with the new federal, state and utility company subsidies, completely pay for the \$5.1M project financing. (See Last Slide)**

# 9. Multiple Purposes of AEG's Green School

1. Greatly reduce energy use, energy & maintenance costs, so the total green school energy retrofit financing cost is paid back from the Energy and Maintenance savings and the Federal, State, Local and Utility Subsidies.
2. Greatly reduce the environmental impact of current energy systems; particularly PFOAs (forever chemicals).
3. A cleaner, safer, more comfortable learning environments for education or school uses; particularly with low cost, high quality Energy Recovery Ventilation (ERV) for each individual classroom.
4. Helps the school's operations through a) significant lowered operating costs, and b) by reclaiming substantial space, and creating new space for the building to meet its real needs.
5. Prepares a school for greater present or future use for more hours and days, in all seasons, for educational work, school services to families, or for family, community and neighborhood use.
6. Assists in developing the space and resources for **“Program Directed” or “Work-Based Learning” & Curricula.**
7. Creates a Micro-grid, so the school and all its energy and services can remain on in any weather based, or other blackout, and for the school to act as a neighborhood or community Warming/Cooling Center.
8. Reinforces school resources, such as the kitchen, to be able to better serve the modern uses above.
9. Enables this valuable community resource (the school) to be more integrated into, and be of service to its community.

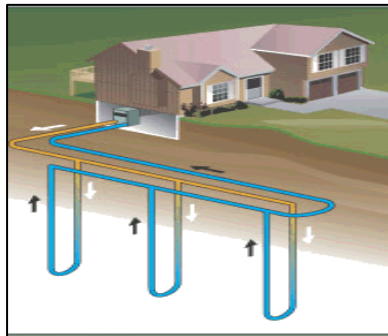
# The 7 Items on the Green School Menu

1. Tighten the Envelope (Window/Insulation Cost Payback is **Immediate**, (if it cuts the size/cost of your HVAC system by 20-30%). Replaces any non-energy saving lighting.
2. Advanced Integrated Geothermal-HVAC is the Founder of the Energy Savings Feast
  - Cuts energy 80%, cost 70%; maintenance by 40%; doubles the HVAC system's lifespan
  - NO Heat Pumps on the Roof
    - Solar canopies (with HVAC under them) up there, so the teachers and kids can use that valuable space (classes, music/art, study, events, fun)
  - Geo Water is run to heat pumps, best placed high in corridors, through wall: 1 per classroom\*
  - With Individual ERV, each classroom will now have superior individual ventilation.
  - *Heat Pumps are the ONLY HVAC source that creates NO PFOAs (the forever chemicals).*

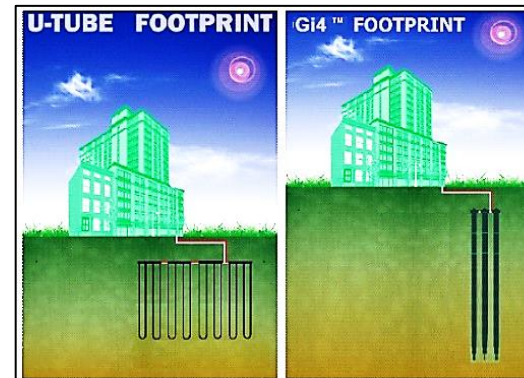
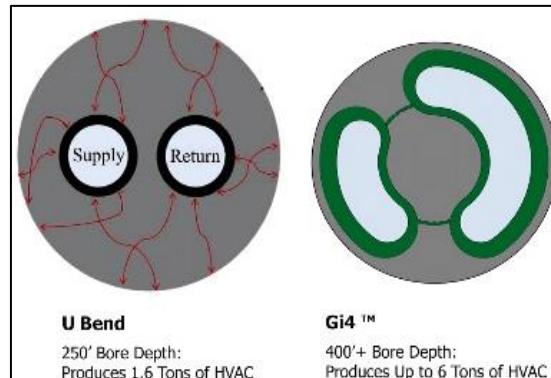


## Traditional Geo-HVAC

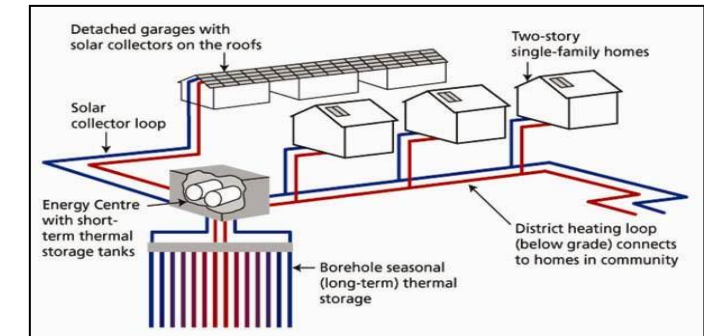
We Cool & Heat as Plants Do - by Putting "Roots" into the Earth



## Advanced Geo Reduces Geofield by 60%; Cost by 30%



## Integrated Geo Adds Heat to Field



EPA: Geo-HVAC Saves 60%

Can Reduce Operational Cost 40-50%

# 3. Install Co-Generation (Co-Gen)

Sized To Support Solar PV To Power a School In Blackouts

## A 35kW Co-Gen Unit:

- 30" wide; 60" long; 70" High
- Provides: 280,000 kWh of electricity/ Year
- Provides: 2.6M Gal of 160° water/ Year
- Provides hot water for kitchen, bathrooms/ showers & for the winter Geo-field
- All winter sidewalks/driveways any parking not covered by carports have HEATED snow-melt
- Now runs on natural gas or propane, but CAN run on Hydrogen in the "Hydro Economy"



**Raising Winter Geo-Field Temperature Means a Smaller Geo-Field & Much Lower Operating Costs for Heat Pumps. Can now increase cost savings to 80+%.**



# 4. Remodel a Geo-Kitchen with a Café

A Green School is a Community Resource. Its kitchen cafe is for smaller before/after school, weekend, holiday, summer meals, when the gym or cafeteria may be used. It can also be cool.

## The Kitchen is a school's biggest energy user:

- Freezers/Coolers run 24 hrs. all day, all night, all year.
- Geo-Freezers/coolers can save 80%.
- Geo can also simultaneously service the heat tables serving food and the ice machines.

## Usually a fantastically underused resource, now used for:

- Cooking Classes/Dietary Classes during school; after school for community classes.
- Make it available for all sports/neighborhood/community after-school uses.
- Make it a place that kids like to go after school, weekends or holidays, or after basketball, football or soccer games.



This indoor/outdoor dining area with a solar roof can be closed-in for year-round use.



## 5. Reclaim Space for School Needs

- Remove old furnaces, boilers, hot water heaters, condensate systems & ductwork runs.
- Newer schools add 500-1,500SF; older schools can add as much as 3,000SF. for educational needs ... or for storage.
- EVR (Energy Recovery Ventilation) will run down the halls, & old HVAC units and ductwork will come off the roof.
- There will be some protrusions but be Ideal for solar.



## 6. Calculate kWh Needed to Run the School

- Not just for classes, but as neighborhood center used regularly by non-profits, for sports, clubs, for internet use, even entertainment, etc.
- As a neighborhood warming/cooling center in blackouts.
- In a world with more frequent weather and other disasters, and more frequent utility brown-outs and blackouts, the Green School has working energy, food, most can even have showers, and significant amounts of space for temporary sleeping in emergencies.

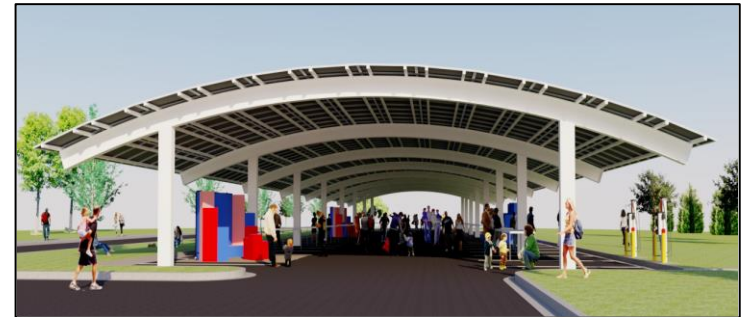
# 7. And ... Finally ... Solar PV

The Green School solar, backed by Co-gen baseline power for blackouts, can also address other problems as well

- Solar Carports reduce the need for winter snow melt ... or plowing.
- Solar Carport EV Charging, while teachers are at work for the day, should be free for them. Others can pay with a credit card.
- Solar Awnings will cut heat entering in well-windowed classrooms
  - Uses CIGS Panels for awnings/other BIPV facing north, or under lights.

Schools always need more space; solar can create space

- Schoolyard Solar Playscapes allow outdoor activities even on rain or snow days; can even be used for classes occasionally.
- Roofs are now usable areas everywhere, so with secured edges, stairs & elevator access, Solar Canopies should make up a good portion of a school's roof, to create usable space.
- An Agri-solar garden (middle image at right) is also a learning tool.
- BIPV Solar Roofs (e.g. LUMA SOLAR (lower left), a 50-year steel roof, could be used on sloped roofs.
- In the near future excess solar can be stored as hydrogen, not in batteries, for use in the Co-gen unit to produce solar Co-gen power.





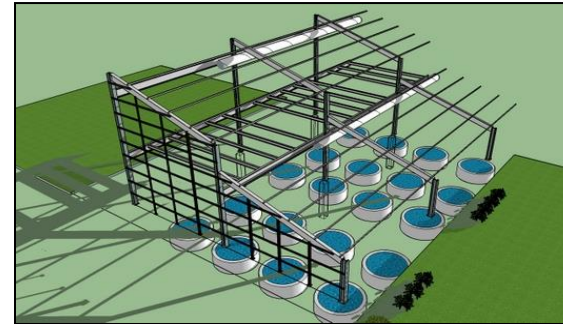
# Solar Aquaponic Greenhouse Provides Vital kWh



**Built next to a school, facing south, it can supply 950,000 kWhs /Yr.**

120'x 72' has 800kW of Solar with LUMA Solar Roof; Standard front panels; CIGS side and interior panels make power from 24/365 intensive interior lighting.

- Baseline Power (Fuel Cell/Co-Gen) adds 720kWh
- Secures a Micro-grid with 1.5MWh of total power
- Uses 550,000 kWh; 950kWh available for school
- Provides fresh produce & seafood in a food desert
- 20-30 part time jobs for teens, full time in summer





# How Energy & Maintenance Pays for the Financing

Using a former school being converted to a resilient, energy efficient halfway house. Its budget is for all the same services shown here, and is based on 2023/24 costs and subsidies.

<b>Full Budget</b>	<b>2023/24</b>	
Geo-HVAC -	72 Ton Rooftop system	\$1,263,700
Solar Thermal	600 Tubes	\$323,070
Solar PV	412kW	\$1,475,002
Integraed Controls		
Windows/Roof/Insulation/Lighting		\$851,900
Parking Lot/Sidewalks		\$164,625
Snow Melt		\$144,000
Kitchen Remodleing	85,000	
Kitcgen Geo-Cooling Freezing	<u>35,800</u>	\$120,800
Utility Room		\$12,500
Environmental Education & Training		\$9,000
Architecture & Engineering		\$256,772
Construction Management		\$109,258
Energy Services Project Management		\$281,825
Contingency		<u>\$102,548</u>
<b>Total Full Cost</b>		<b>\$5,115,000</b>
* Facility already has a generator to qualify as Micro-grid		

<b>Total Full Cost</b>	<b>\$5,115,000</b>
Subsidies without Solar RECs	\$2,489,392
Net Costs	\$2,625,608
Financing 75% of Full Project Cost	\$3,750,000
Annual Financing Cost at 25Yr. 5.5%:	-\$276,000
Yr. 1 Energy & Maintenance Savings	<u>\$310,000</u>
<b>School's Positive Balance Yr. 1</b>	<b>\$34,000</b>
<b>25 Years of Energy/Maintenance Cost</b>	
@ 2%/Yr Increase	\$9,430,777
Financing Payment Over 5 Years	<u>-\$6,900,000</u>
<b>Accumulated 25 Yr. Positive Balance</b>	<b>\$2,530,777</b>

# CONTACT

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A detailed Summary Development Plan is available on request.

Please contact us by email with any questions or interest.

*Thanks for Your Participation & Interest*