

Small-scale CHP for Resilience

Challenges and Opportunities

Chris Lotspeich

Celtic Energy Inc.

NESEA Building Energy 16

March 9th, 2016

Combined heat & power (CHP)

Advantages:

- Onsite generation of electricity, heating and cooling
- Significant sustained energy output, economical, relatively clean

Limitations:

- Constant fuel supply: gas pipeline, site storage capacity
- Challenge: economical use for heat in critical facilities
 - Office-type loads in 4 season climates are not a great fit
 - Power output can be constrained by thermal applications
- The smaller the CHP system, the longer the payback
- Business case less compelling with low electricity costs

CHP strategies

- Identify base load thermal applications
- Heating applications: multifamily housing, wastewater treatment, swimming pools, hospitals
- Cooling applications: data centers, refrigeration
- Size smaller systems to serve critical loads only during outages, shed non-essential loads
- Large systems with diverse loads: campuses, microgrids
- Considerations: siting, permitting, noise, vibration

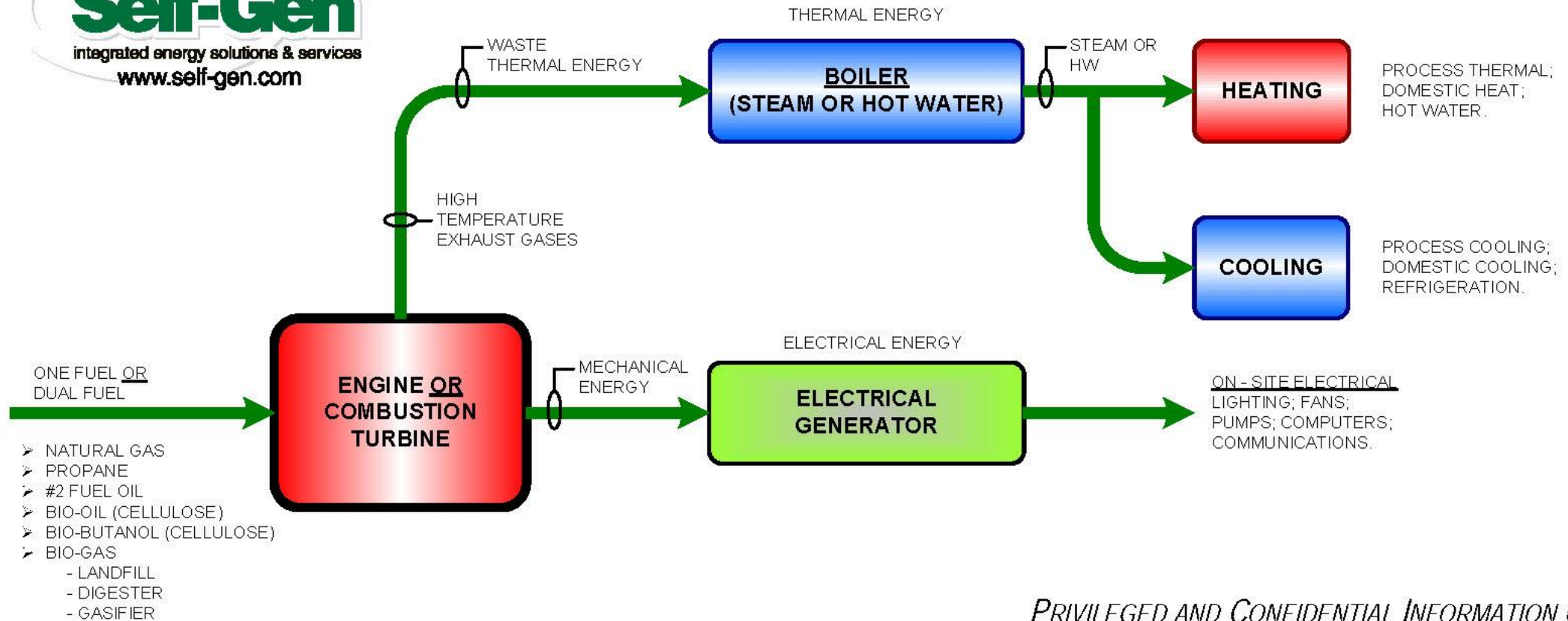
Small CHP issues

- New construction vs. retrofits
- Are there electrical and thermal loads to serve?
- Use annual electrical, heating cooling load profile as sizing parameter
- Size for baseload 24/7 or enough of the year
- Size for critical loads during outages, set up load shedding
- Need to capture >50% of the heat to sell thermal RECs (if available)
- Do cost offsets and revenue (if any) provide acceptable payback?
- Sub-MW systems cost challenges, appurtenances costs extend SPB

Small CHP issues – resilience retrofits

- Typical municipal critical facilities in 4 season climate not a great fit
- Can you use the heat? Steam, high temp HW, low temp HW
- Is the building heated with steam or hot water?
- Large numbers of residential units (100+) help
 - Owner selling power & heat can be source of revenue in some jurisdictions
- Do you need to provide cooling?
- Where do you locate the equipment?
- Can your prime mover follow the required loads in island mode?
 - Some technologies serve dynamic loads better than others

C - CHP MODEL ONE - A



*PRIVILEGED AND CONFIDENTIAL INFORMATION OF
SELF-GEN, INC.*

Scarborough Town Hall, ME CHP

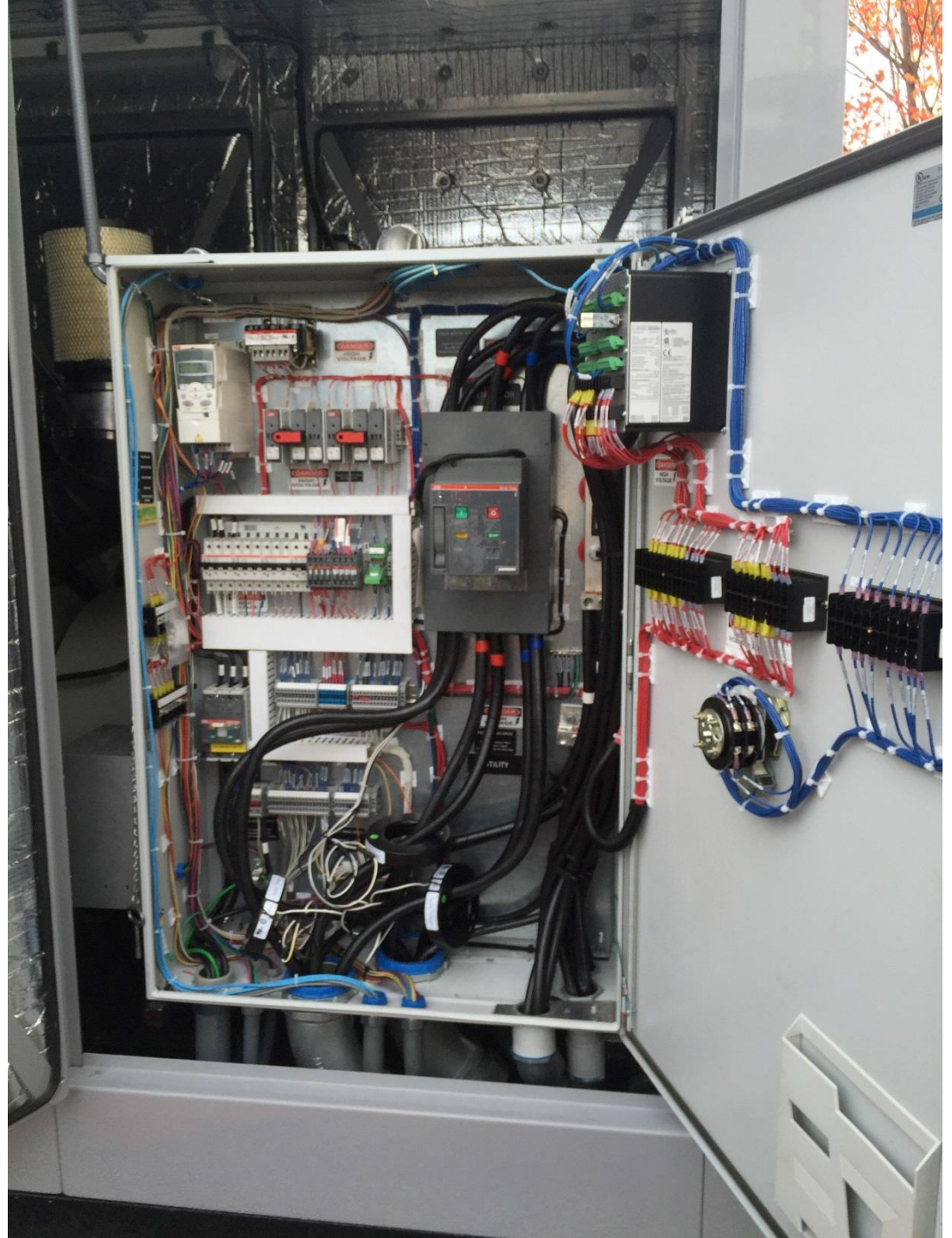
- CHP for resilience at Town Hall and planned Public Safety Building (PSB)
- Provide power and heat for both buildings
- \$830,000 project, \$220,000 Efficiency Maine grant, ~6.5 yr SPB
- Project cost more than it had to serve Town Hall alone (~5 yr SPB)
- \$300,000-\$400,000 in avoided cost at planned Public Safety Building
 - Avoided / downsized electrical & HVAC infrastructure

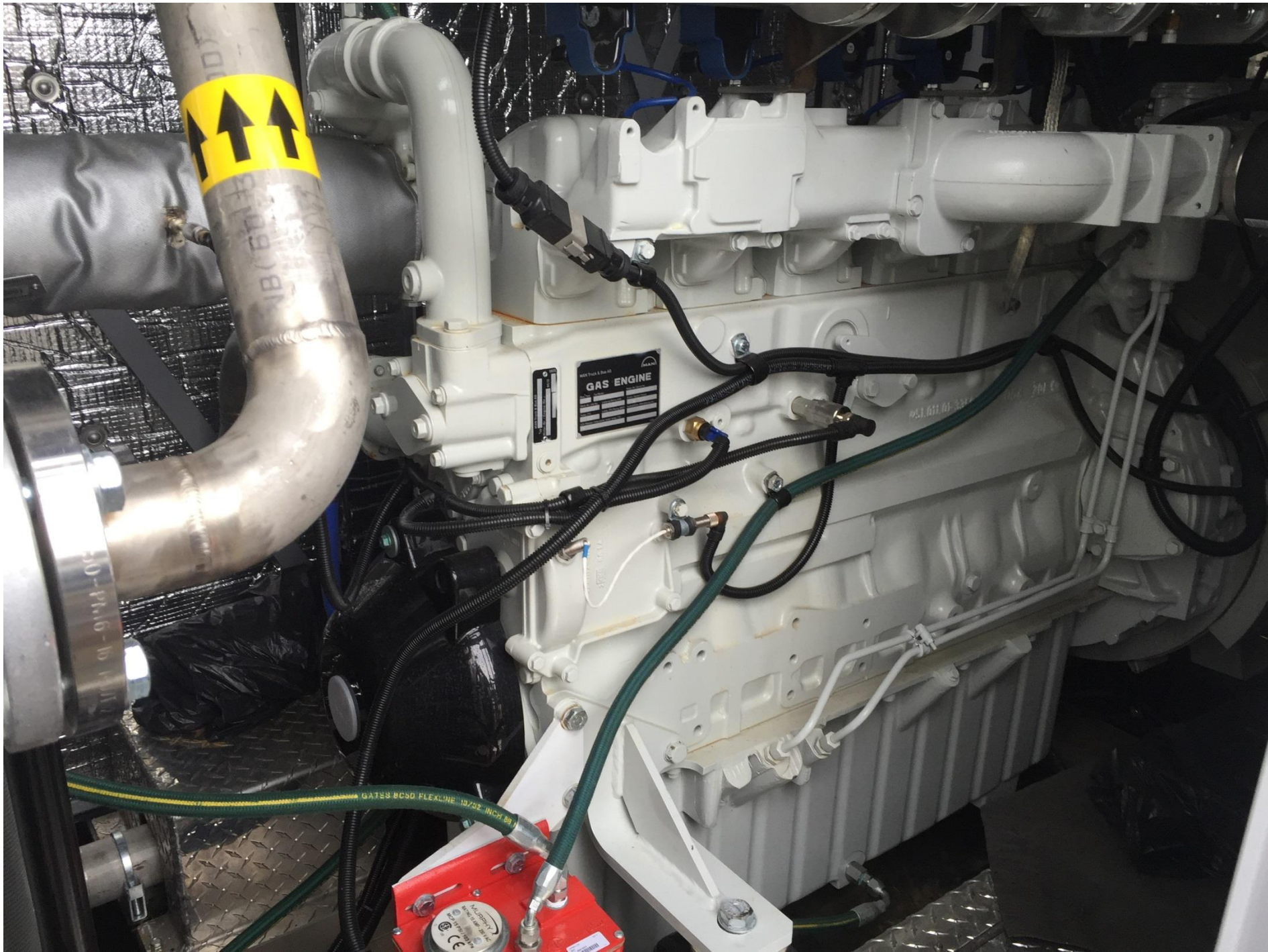
Scarborough Town Hall, ME CHP

- 150kW natural gas fired engine/generator with exhaust heat recovery
- MAN E2876E302 312 natural gas engine
- Marathon 431RSL4007 electrical generator, exhaust and jacket heat recovery equipment
- Yasaki WFC-SC50 single stage 50 ton absorption chiller
- Associated mechanical, electrical, and control components and appurtenances, and package enclosures





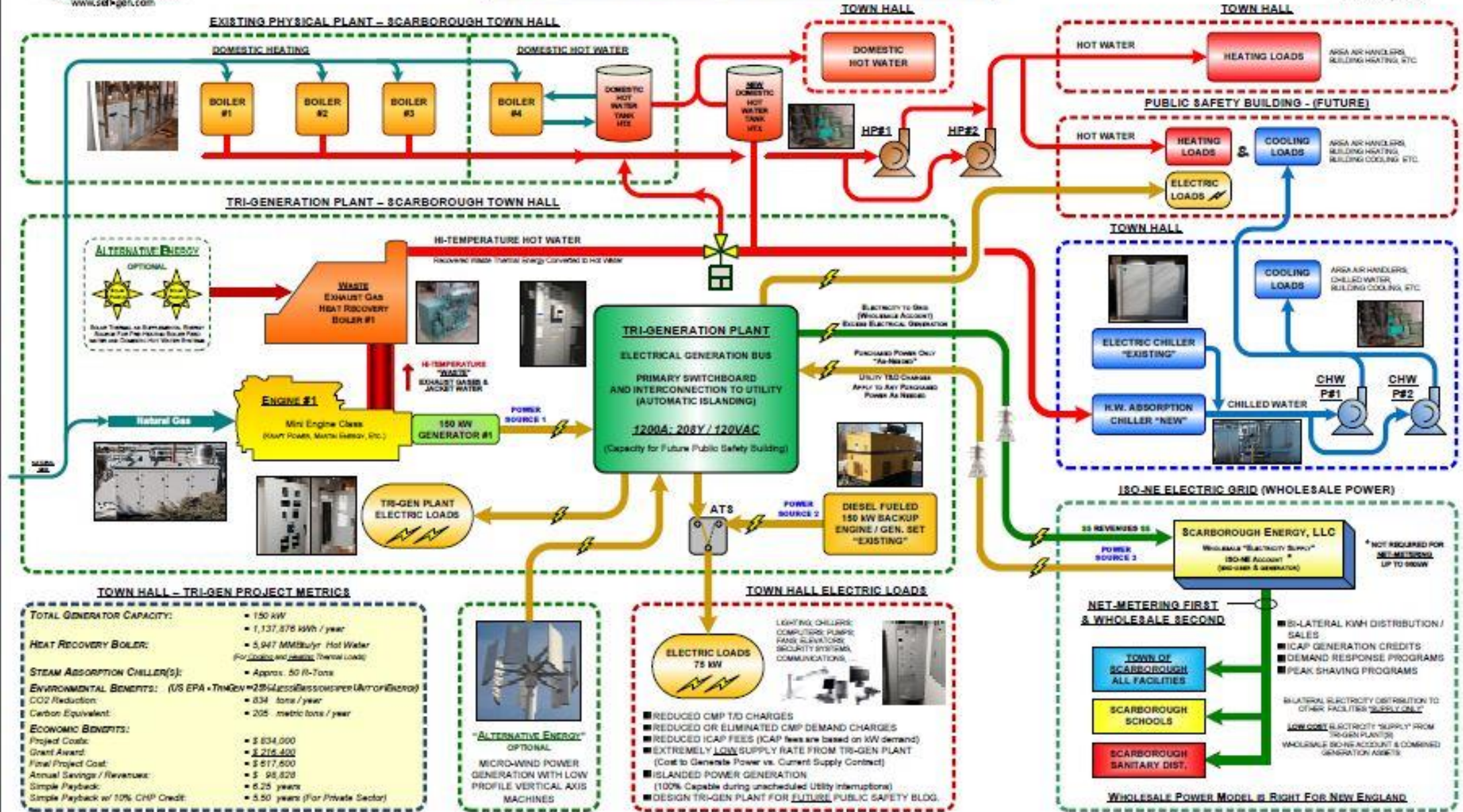






SCARBOROUGH, MAINE – TRI-GENERATION ENERGY MODEL SCARBOROUGH TOWN HALL

Per U.S. EPA 26% Reduction in Harmful Emissions With the Tri-Generation Energy Model

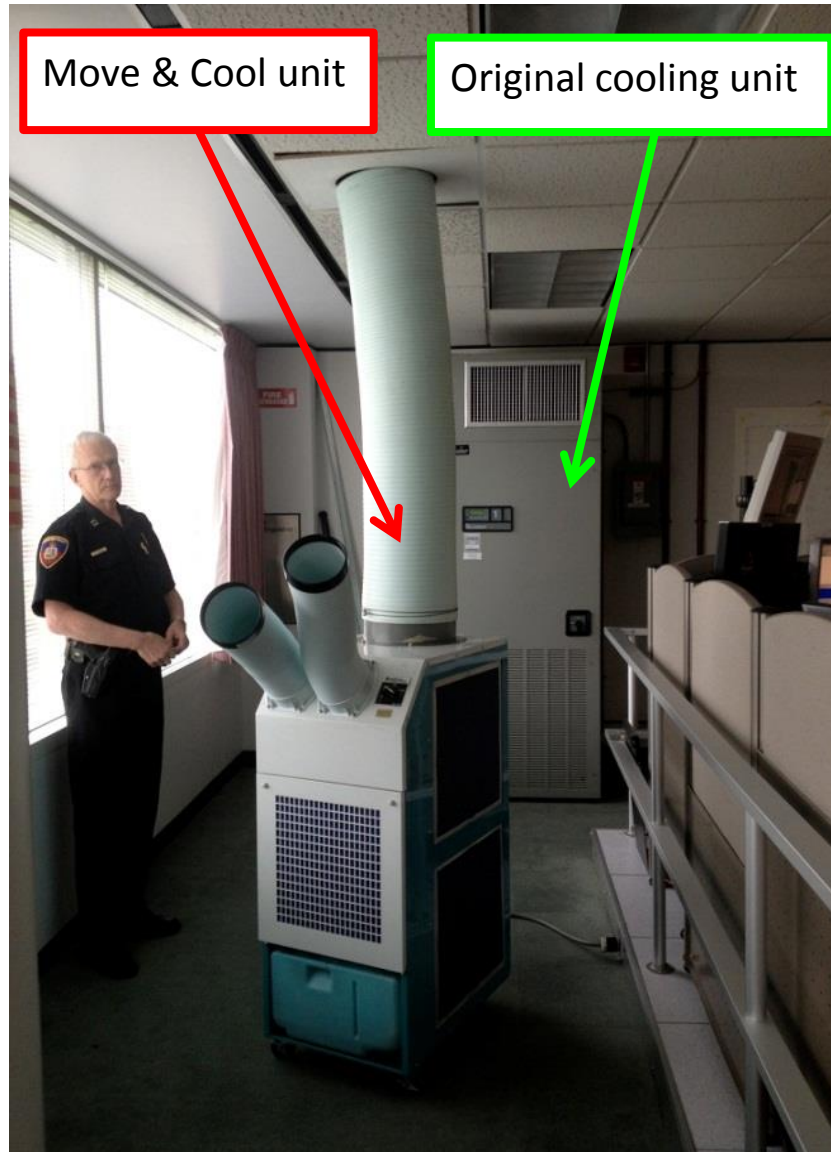


Stamford's Government Center (SGC)

- 10 stories, 272,000 SF, built in 1985
- 1.2–1.4 MW summer peak, ~800 kW winter peak demand



SGC energy challenges



- Designed as corporate HQ, not critical facility
- Aging HVAC, cooling maxed out
- Power & cooling challenges interfere with 911 emergency communications
- No efficiency upgrades
- Diesel backup generators
- Resilience improvements

Sixth floor is a key focus for this project

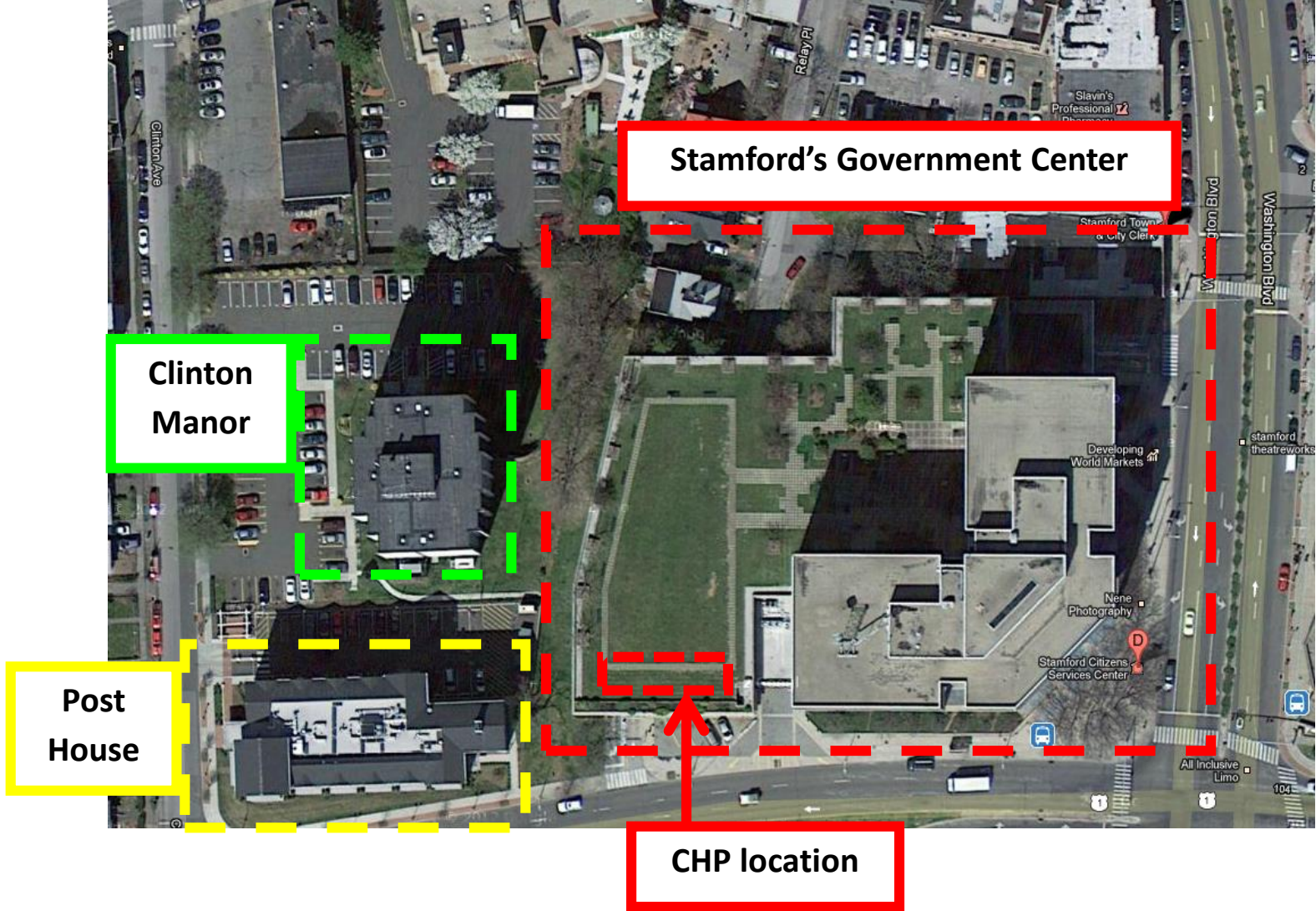
- Hosts ECC, EOC, City servers, State emergency communications equipment
- Power & cooling challenges have interfered with operations
- Dedicated supplemental CHW system serves servers only
- Dedicated ECC 100 kW backup generator upgrades needed
- ESPC & CHP can help address these issues



Mayor Martin leads hurricane drill in EOC, June 24th, 2014. Photo: Stamford Advocate / Keelin Daly

- ESPC can reduce loads, upgrade cooling systems, support emergency generation upgrades
- CHP can provide constant power & space conditioning
- Cafeteria (4th fl) is arguably next most critical facility for continuity of operations
- These are primary loads to be served by on site CHP

Government Center microgrid concept



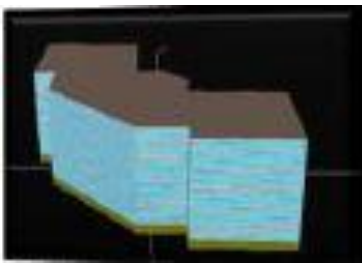
Charter Oak Communities housing authority



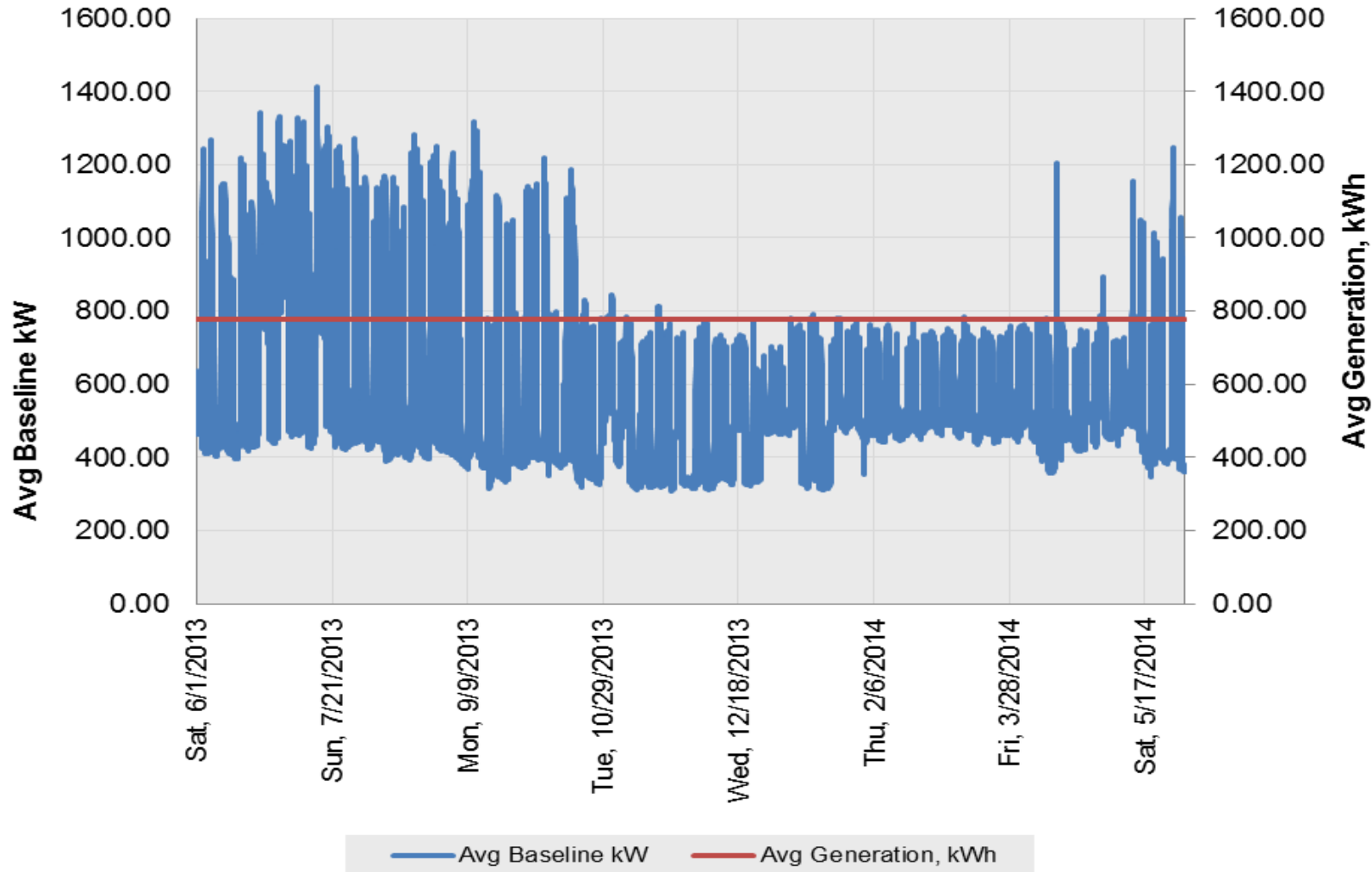
Post House

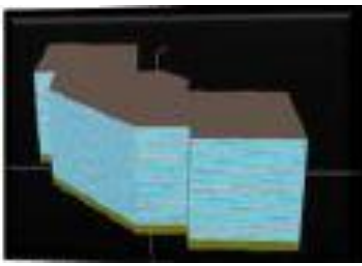
Clinton Manor

SGC parking garage deck

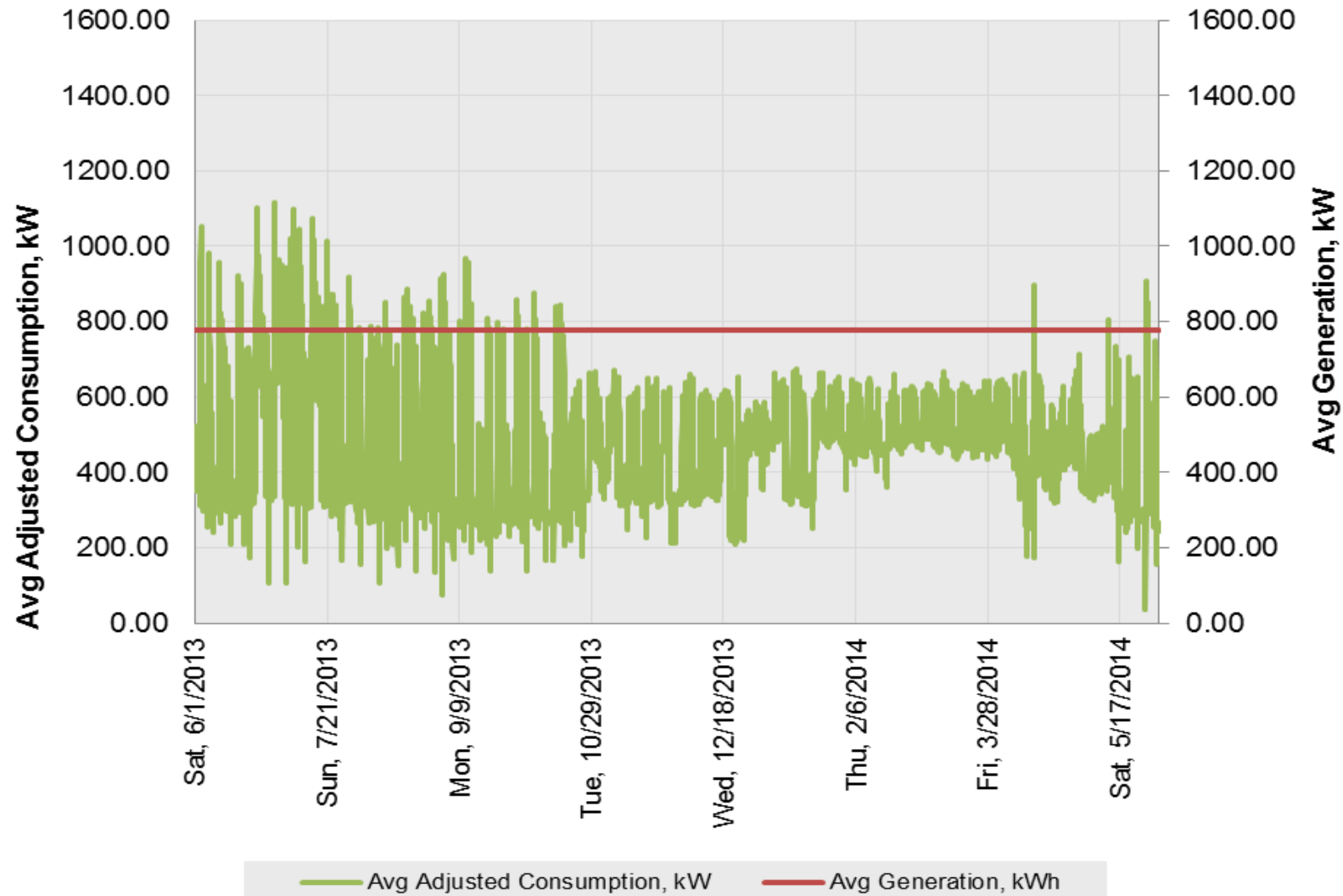


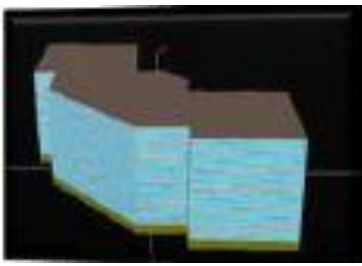
SGC annual electric load profile: existing conditions



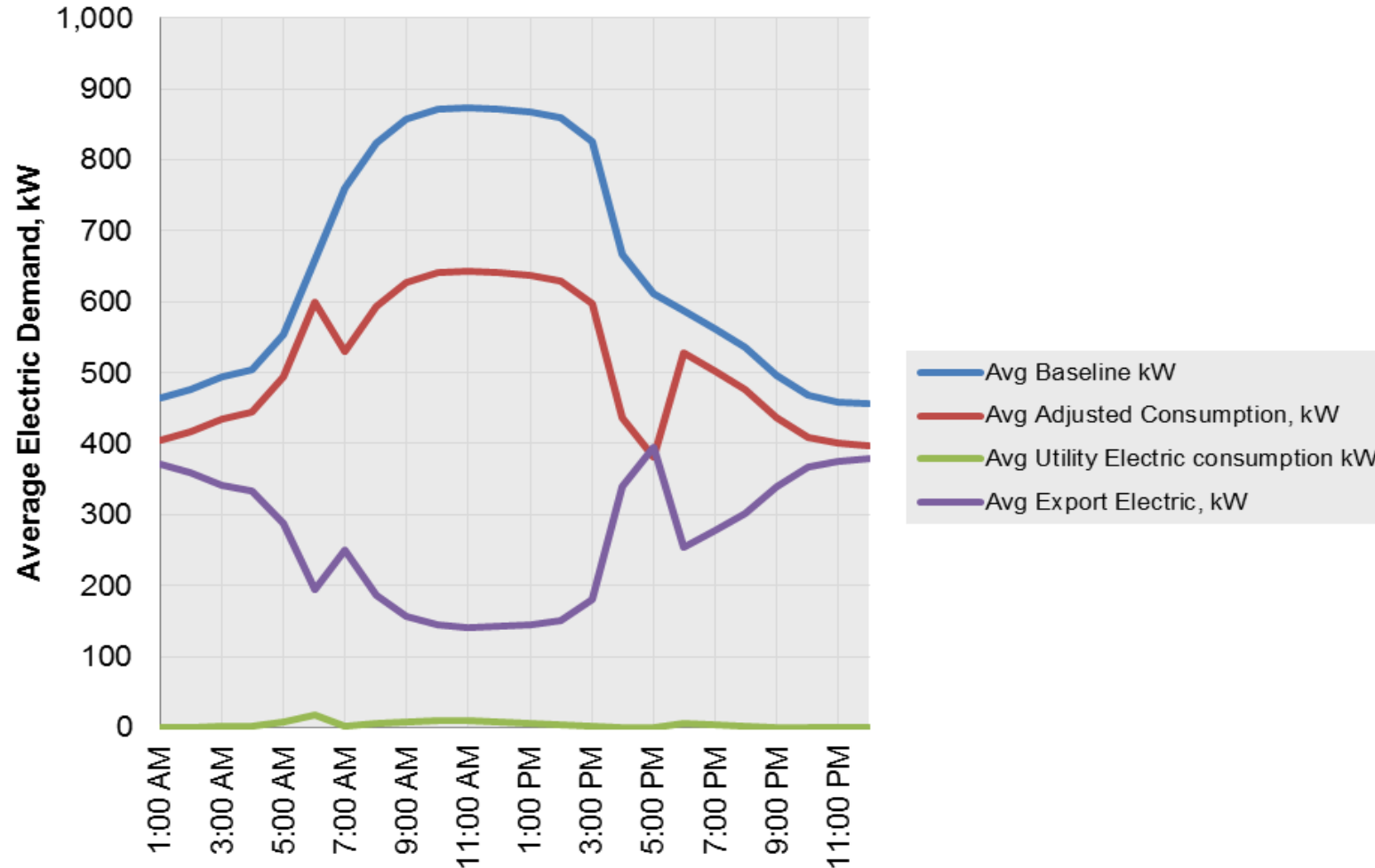


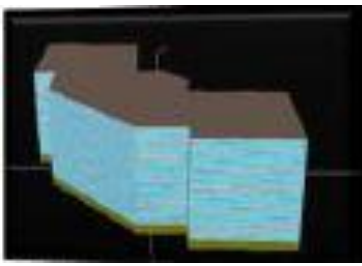
SGC annual electric load profile: Post-retrofit estimate



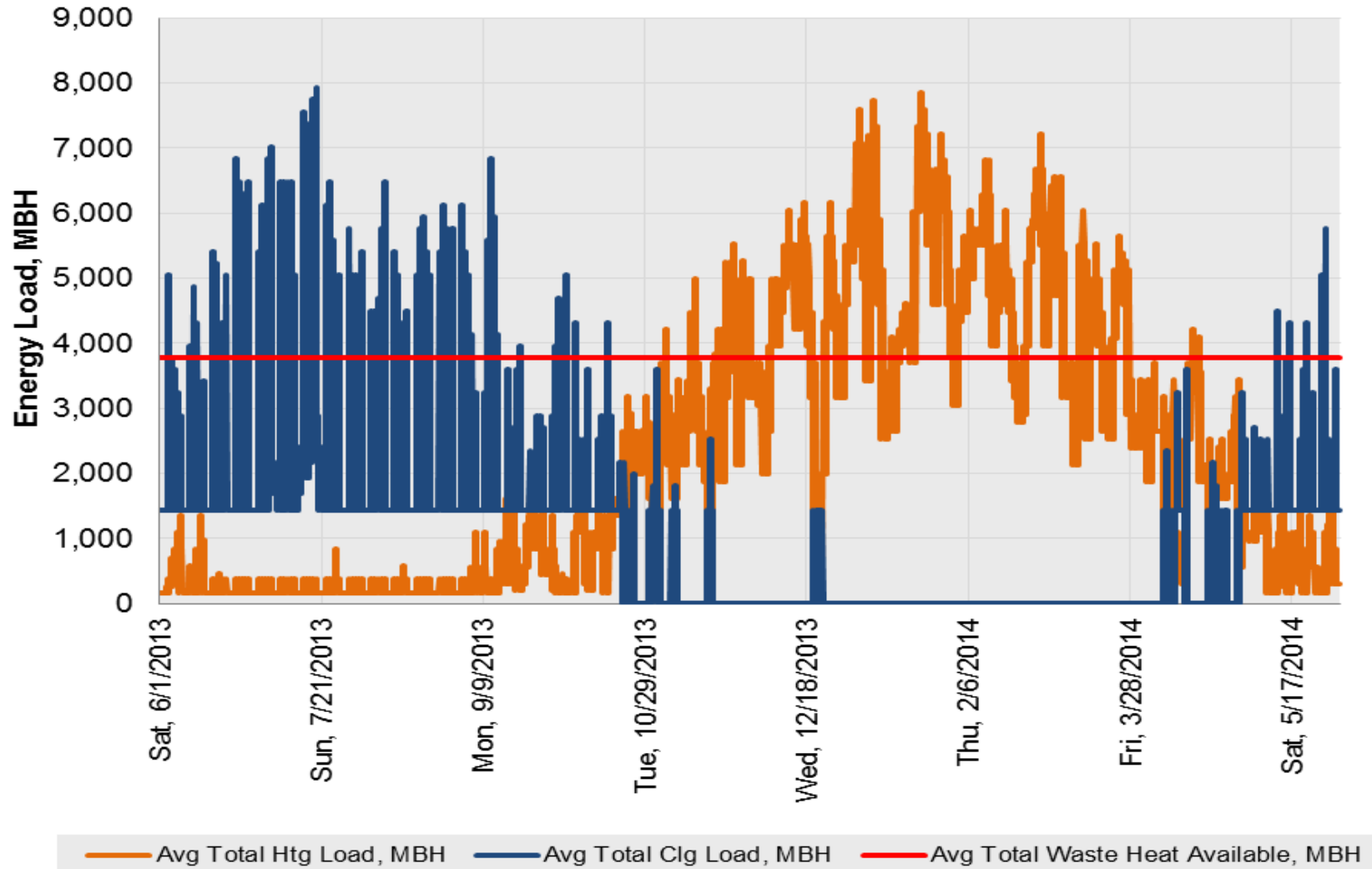


SGC daily electric load profile and CHP generation estimate

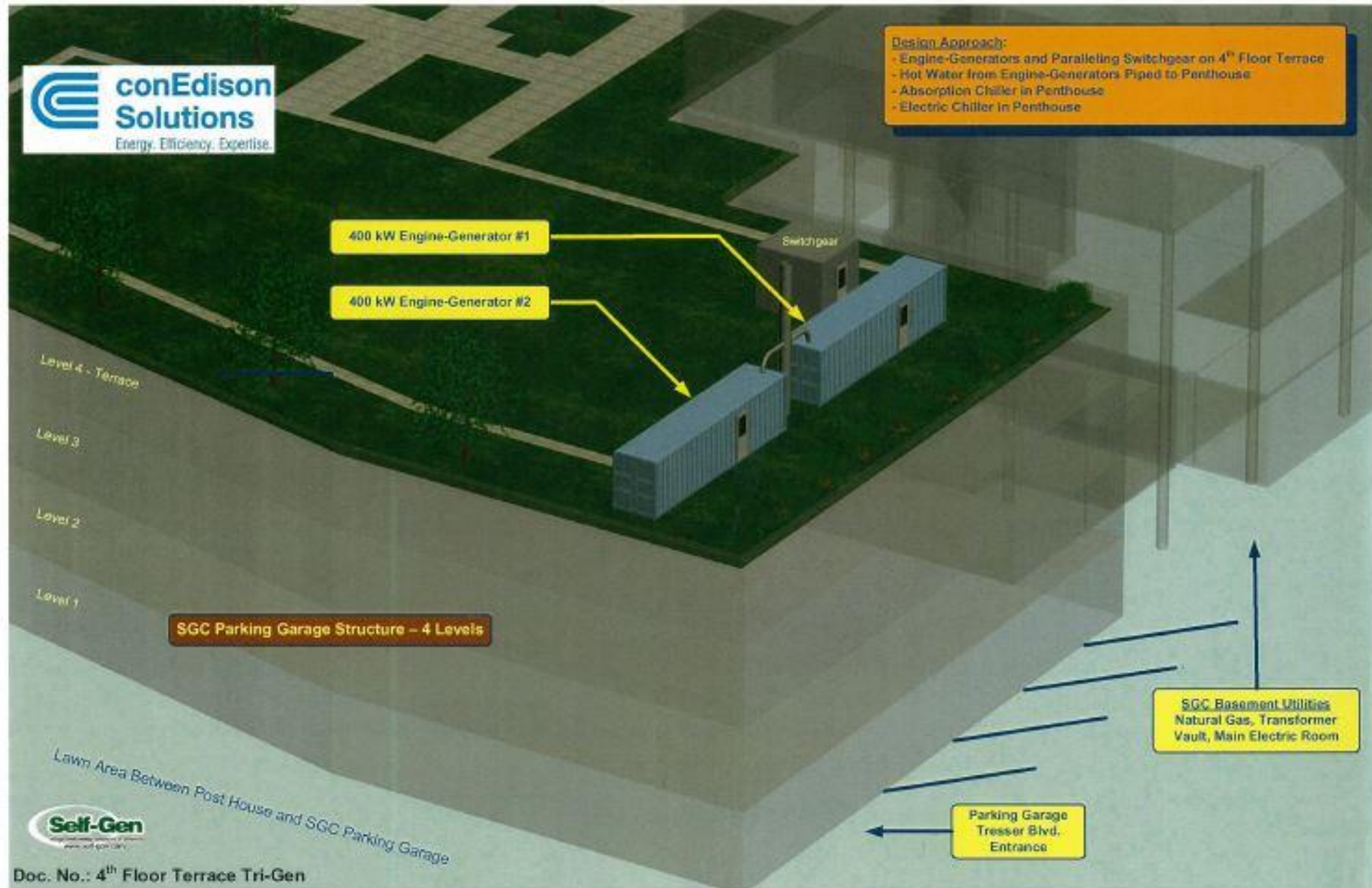




SGC + Charter Oak buildings annual thermal load profile



SGC combined heat and power plan



One supermarket's experience

- “We believe in CHP for a number of reasons”
 - Economics: Avoided energy costs, use heat for refrigeration
 - Sustainability: CHP can beat the grid's thermal efficiency and carbon footprint
 - Resilience value during grid outages: Avoid spoilage, stay open, device charging
 - EV charging
- Mixed experience: some systems worked well, others had problems

Recommendations:

- Keep it simple
- Better, more predictable incentives
 - CHP provides many benefits, somewhat in a class of its own, many incentives
 - But would work better if we could combine incentives from different programs
- Better utility cooperation

Thank you for your time...

QUESTIONS?

Chris Lotspeich, MBA, MES, CEM (pending)

**Director of Sustainability Services
Celtic Energy, Inc.**

**437 Naubuc Avenue, Suite 106
Glastonbury, CT 06033
(860) 882-1515
chrislot@celticenergy.com
www.celticenergy.com**

