

Middletown Springs Municipal Bldg
Efficiency Vermont Energy Charrette
May 31, 2017
COMBINED NOTES

List of Attendees:

Building Committee: Patty Kenyon, Dave Muniyak, Tom Hurcomb, Kimberly Mathewson, Kristal Heir, Robin Chesnut-Tangerman, Fred Bradley

Architect: Michael Beattie

MEP Engineer and Energy modeler: John Penney

Commissioning Agents: Elizabeth Ford Wilkins and Jon Haehnel.

Structural Engineer: Greg Sellers

Cost Estimator: Henry Erickson

Contractor Consultant: John Johnston

Efficiency VT Engineer and Facilitator: Nick Thiltgen

Meeting notes by Michael Beattie

(indicates action items)*

Background:

We have a near-non functional town office: just getting by.

The Library usage could expand dramatically (like Manchester) , offering new services.

We've visited numerous town offices.

**BC should update our list and include what we learned at each visit.*

Commissioning: Our building is called "small and simple" by the Cx agents

~at 0%, 50%, 100% and one year later, every three years after that. Report each time.

~systems manual should be a user friendly operating manual

~Envelope: optimize it for efficiency and durability

~they keep a log: "what did we find? What did we do about it?"

~Construction Documents phase: hold one meeting at beginning to coordinate all disciplines.

~Building operation and maintenance: town will need to hire someone to look after the building. Also enter maintenance contracts for Heating/cooling, ventilation, elevator, pumping of wastewater tanks.

MEP: All agree that ASHP's need no backup heat because of:

high R-value envelope

low air change rate (ACH)

low building surface-to-volume ratio (simple rectangle)

**Make a schedule of how building will be occupied 7 days/ week for JFPCS*

**Research composting toilet experience - Vt law school, Putney field house*

**Research incinerating toilets*

**list actual plug loads anticipated: number of computers, appliances, desk lamps, etc. .*

**JFPCS: how much do we save by not operating heat pumps during appropriate hours?*

Meeting notes by Michael Beattie continued...

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- ~Should windows open? How many, which ones? What kind of control? Red light, green light system: windows can be opened when green light is on=favorable conditions outside re: cooling/heating. A paid employee could sweep the building each evening to close windows.
- ~Passive cooling, esp. night cooling, through automatic vents rather than windows. Night flush thru roof monitor.
- ~Maybe use electric heat in ventilation stream for really cold days.
- ~Optimize plumbing system element locations for short runs
- ~Design as is saves 30-40% over energy code.
- ~10' x 10' HRV room over children's library

Lighting:

- **Optimize window areas and sizes, tune glazing*
- **JFPCS: include savings from daylighting in model*
- **Would partial DC lighting or power be a useful strategy?*
- ~Controls: manual "on" vacancy "off" with daylight dimmers

Envelope:

- **Get three options to Henry Erickson of roof structure and insulation
metal plate trusses, SIPs, Flat ceiling w/ attic truss over children's library*
- ~Fully adhered spray-on WRB recommended in conjunction with tape at windows

Monitoring:

- ~submeter major electrical loads
- ~"e-Gauge" product recommended by JJ (Breadloaf) as effective and economical as an energy dashboard and recording system. Produce a report each month.

Renewables:

- **Discuss our project with Dan Mackey of GMP*
- **What level of electric car charging should we install?*
- ~GMP has a fairly new project to create resilient power centers in municipal buildings. They offer financial assistance for pv array, batteries, ASHHP, value of RECs. A Brownfield site has higher priority.
- ~We need to find out the monetary return on power we feed into the grid.
- ~Is there a role for a community solar project here?
- ~"Islanding" is a term to denote a pv system that disconnects from the grid in times of grid power failure, and is able to work on its own, powering the building and storing energy in batteries.
- ~"Pika Energy" sells hardware and software to manage pv systems, islanding and storage.

Meeting notes by Michael Beattie continued...

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Efficiency Vermont Comments:

- ~Best charrette Nick has attended so far in the program.
- ~Good OPR, well prepared, especially the building goals from town visioning session, which were really helpful.
- ~Good use of time; All participants contributed in an effective way; good conversations all around.

Meeting Notes by David Munyak

Background:

Had introductions. Site tour.

Discuss Owners Project Requirements and scope of project. Review the goals from the Middletown Springs Visioning Session.

Discuss schedule and budget- the need to keep costs down and how the inclusion of Net Zero can reduce long term costs.

Henry Erickson (estimator) thinks this town office layout is quite minimalist in terms of space.

Commissioning: Elizabeth Wilkins- Good for commissioners to be involved from the outset to inform design decisions prior to construction. Eliminates the need for later redesign and potential costs.

Jon Haehnel- shell is difficult to modify in the future so it needs to be optimized for efficiency and durability. He works with contractors during construction.

All agree we are at the schematic or early schematic phase. They will have input at the design development phase, perhaps several times. They will do a review and then a backcheck to see what comments and ideas were incorporated. Also an issues log which documents all the interaction and what things were incorporated and what was not. Jon Haehnel says the backcheck could be simplified for this because it is a small and simple building.

Should have someone recommission the building every 3 to 5 years to be sure that everything is still functioning properly.

MEP:

John Penny: energy use is dependent on how long people are in the building rather than just how "many" are there on a given day. How much is the ventilation run? Is it run at 100% when the building is open or does it vary depending on the use and occupant load?

Meeting Notes by David Munyak continued...

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Affects the energy cost and the equipment cost because the more control there is, the more it will cost.

John Johnson says Putney has a composting toilet but the state will not allow them to put the compost on their fields. They must truck it away. He says there are incinerating toilets that burn up the waste.

Gray water could be filtered and reused in the toilets. John Johnson says the filtering is not cost efficient according to his recent experience. Possibly a waterless urinal.

Operable windows- they are fine if the systems are off or on at the appropriate time. Breadloaf has a red-light / green-light system to signal when the windows can be opened/closed. Discussion on how things might work.

Perhaps something other than windows that open in the monitor. Mechanically operated louvers for instance. Cam latch casements can lock down to be almost the same as a fixed pane. For double hung, having a fixed top panel is more efficient. Jon Haehnel says mechanically operated windows in the monitor often fail to operate properly after several years. They read as closed but do not close tightly.

Point is made that the systems will be very efficient and so don't use much energy when running, and that there will be a ventilation system which will provide filtered air at all times. Discuss the noise and dust issues with having operable windows. We should ask Jackie and Jana about having windows open.

John says the exhaust fan could run and pull air in from an operable window rather than having the entire ventilation system running all the time.

Nick says EV feels that automatic lighting sensors are **not** cost efficient for small spaces with low energy use led lighting.

Discuss lighting and how lights get turned on and off. Automatic vs manual. Manual on, auto off vs full auto.

Window blinds on south side will affect lighting use and HVAC. Manually operated. Low cost with good return.

Equipment should have an annual maintenance contract that provides a technician to service it. Installation contractors and maintenance people should be certified by the manufacturer of that equipment.

Nick: Site energy vs source energy. Source energy is what EV uses. It is possible to use fossil fuel in a Net Zero building if it is offset by renewables. John P. Easier to get to net zero with a single energy source such as electric.

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Meeting Notes by David Munyak continued...

John Penny reviews his preliminary energy model which has three scenarios - proposed vs base vs just an equipment change.

Economizer cooling uses cool outdoor air pumped directly into the building. With heat pumps, there is no economizer.

Nick mentions finding a "sweet spot" for the insulation that, while maybe not the "ideal" amount, might still provide an adequate savings. John thinks it's interesting and will consider it.

John Johnson has monitored his Hartford and Middlebury projects for five years or so and they have had a few time where the systems or power were down and the buildings maintained 64 degrees for three days in very cold weather.

Jon H. says R values and air tightness and exterior exposure all affect the building's ability to coast during really cold times.

John P. says this could be all electric. Small electric water heater or point of use water heaters are sufficient for this bldg because of low use. Heat recovery ventilators and ducted heat pumps will work. Maybe some electric resistance heat in the recovery system to temper the air before it gets to the heat pump during really cold times. Not practical to put a heat pump in a stairway, but we may not need it. Possibly electric resistance heat there for emergency situations. But we may not.

Plumbing fixtures- conserving vs ultra-conserving fixtures. John will put a package together on these and we will review later.

PEX tubing - hard to insulate if it's snaked through.

Envelope: Michael refers to his three wall systems on the handout. Jon H. says Henry or Carlisle or WR Meadows have spray and transition fluid applied membranes. Can be vapor open or vapor closed. Jon H. prefers the top system over the zip ones. ZIP relies on the tape for the lifespan of the building but Jon H. feels that it's risky for water and moisture management. If tape is part of the system, it should be sandwiched.

Jon H. says all three systems could be vapor open. Rocksul could be two 2" layers with staggered joints or a 4" layer, cut a little big and jammed in which compresses it and eliminates the problem of open joints.

Discuss the roof framing. Possible scissor trusses. Possible attic trusses over the childrens' reading room to allow for a mechanical space for the heat recovery vent system. Discuss the insulation that is needed. SIPS vs spray foam vs some other kind of insulation.

Discuss concrete with foam inside for foundation.

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Meeting Notes by David Munyak continued...

Monitoring:

E-gauge is a good system for \$1500 with three panels says John J. Has a Dashboard that could be displayed in the building.

Renewables:

Estimate about 60 solar panels to meet the proposed power load. The amount you get for power is incentivized differently depending on where the panels are. Roof and brownfield locations provide additional money. GMP also will give money for heat pumps so talk to them.

John J. says to touch base with GMP about batteries that could be a backup in the building and they may underwrite it.

Renewable Energy Credits. We need to retain them to officially call it a net zero building. If we sell them, we get a higher return.

Tax credits- 30% but the town cannot take advantage of it so we need to find someone else to own them.

Possible EV charging station on site.
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Meeting Notes by Nick Thiltgen

- PK - Patty Kenyon
- DM - David Munyak
- KH - Kristal Hier
- TH - Tom Hurcomb
- MB - Michael Beattie
- JP - John Penney
- JH - John Haehnel
- EF - Elizabeth Ford Wilkins
- GS - Greg Sellers
- HE - Henry Erickson
- JJ - John Johnston
- NT - Nick Thiltgen

Background:

PK - Town is currently paying \$450/mo for rent at Town Office

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Meeting Notes by Nick Thiltgen continued...

DM - Library is currently at a separate building, needs renovation/addition. Parking is already tight, and addition seems difficult, if even possible. Bottom line is existing facilities are not meeting Town needs.

PK - Town is currently saving \$50,000/yr in preparation for new building

Commissioning:

JP - Recommend that town hire contractor for continuous maintenance of building (mechanical systems particularly)

MEP:

JP - Energy model includes certain building occupancy schedules. Town to follow up with JP with more detailed information.

MB - For various reasons, pump tank will be utilized for wastewater rather than septic system. Plumbing fixtures must be most efficient. Are there other options for wastewater? Greywater reuse to flush toilets? Composting? May be requirement that compost must be removed as trash.

Lighting controls should have vacancy rather than occupancy sensors. Occupants need to manually turn on, and the sensors will automatically turn off.

DM - Hard to imagine not having operable windows in a place where the outdoor air temperature is so comfortable much of the summer. Although, understood that this building is much different than the average home in terms of mechanical ventilation. This building will have a central ventilation system that provides filtered air; the average home has no mechanical ventilation.

Much discussion about operable windows. Positives are occupant direct access to fresh air, potential passive cooling rather than mechanical. Negatives are leakier windows, difficulty with control integration of mechanical ventilation system, potential for increased energy use due to poor occupant control. May be best to have a limited amount of windows be operable, particularly in spaces where someone is directly responsible for their operation.

MB - What is the optimal size of windows? JP - From a daylighting standpoint, will discuss with the electrical engineer, Bob Kiscko who has software to analyze this.

DM - Windows need to have appearance of double-hung. JH - Windows in order of leakiest to less leaky: double-hung, single-hung, casement or awning, fixed. Double-hung are always leaky around edges and in center where two windows meet. Using single-hung rather

DM - How to manage solar heat gain? JP - energy model assumes that interior blinds will be used on south-facing windows.

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Meeting Notes by Nick Thiltgen continued...

NT - The national standard is to measure a building by source-energy. This takes into account the inefficiency of power stations that feed the grid, and the grid itself. Source energy is the most accurate to use when comparing different energy sources (particularly electricity vs. fossil fuel).

JP - Energy model was completed for three scenarios. One for “baseline” building, which meets all minimum Energy Code requirements, one for the “proposed” efficient building, and another with a baseline envelope and efficient lighting and HVAC. With the efficiency measures proposed, the building is expected to reduce energy use by about 50% (site energy) and reduce annual energy costs from \$8,000 to \$5,000. Lighting energy use is assumed to be reduced by 50%.

NT - For the baseline and proposed building scenarios, plug loads and domestic hot water are calculated to use very little energy; makes sense. HVAC uses the most energy, particularly heating, and lighting uses a significant amount as well. Curious of the energy use of the proposed building, without the high levels of envelope insulation. Essentially, high performance lighting and HVAC, efficient windows, and airtight envelope.

JP - Recommend using air-source VRF heat pump system to heat and cool building. Below -18°F, the units will not operate. However, this location on average, experiences 38 hrs/yr below -18°F. Only 5 of those hours occur during occupied times. Using ASHP would allow building to eliminate fossil fuel usage.

JJ- Experience with losing heat over three-day weekend on Hartford Town Office. Temperature inside of building did not drop significantly, presumably due to high air-tightness and insulation of building envelope.

JP - Recommend using central ventilation system with energy-recovery unit.

JP - Some kind of additional heat is required for ventilation unit defrost. Because the building will not have a boiler and hot water, an electric resistance coil would be best. While electric resistance heat is inefficient/costly, this application requires minimal heating. Additional heating is also required for stairwells and vestibules. MB - Heating could be excluded from vestibules, NT, JP, JJ agreed. Either small electric resistance heater or heat pump indoor unit could be used in stairway.

JP - Domestic hot water use is very small. Only for hand washing in bathrooms and kitchen sink. Either tankless electric resistance point-of-use heaters or small electric resistance tank would be sufficient and most cost effective.

TH - Could there be a potential issue with water quality affecting operation/life of tankless water heaters? JP - In general, that is a concern, but don't foresee a problem with this building.

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Meeting Notes by Nick Thiltgen continued...

JP - Toilets have the option of being tank-type or flush valve-type. The latter requires less maintenance and is easier to clean around, however the building water pressure is not sufficient. Tank-type will work for this building, just need to pay attention to leaking.

JP - For domestic water piping, option is PEX or copper. PEX requires special fittings, some of which are better than others. For some buildings, there can be construction cost savings using PEX, but the piping building is so small, it wouldn't amount to much. Sometimes more difficult to do a good job insulating PEX rather than copper. Would recommend using copper.

Envelope:

MB - Exterior of building will be either wood siding or cement board.

MB - Basement wall insulation strategy will be interior polyiso. No good solution for exterior, always gets damaged. Polyiso can be used on the interior, rather than XPS, which has a higher manufacturing environmental footprint. Another option is the Thermomass system, which could be installed by a local contractor at no labor cost. Rigid insulation is sandwiched between concrete.

MB - Above-grade wall insulation strategy is not yet determined. Three different options proposed. Two options without exterior continuous insulation are more risky from a moisture management perspective.

HE - Advanced framing is desired to be used.

GS - Metal plate-connected wood trusses are most cost effective solution for roof framing

GS - SIPS are another option, but are more costly. If they are used, their structural capabilities should be taken advantage of, using wider truss spacing.

MB - Roof monitor provides certain aesthetic value, potential for natural ventilation, and daylighting.

NT - Attic wall leading to monitor will require different insulation strategy than rest of attic. Most significant value of monitor may be aesthetic.

JP - Mechanical space is desired in attic for ventilation unit. Need to consider access in order to change ventilation unit air filters.

MB - Simplest and most cost effective way to insulate attic is blown cellulose on attic floor. Would need different strategy for space around mechanical equipment.

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Meeting Notes by Nick Thiltgen continued...

Renewables:

PK - Town is interested in integrating battery storage into building, paired with solar PV. Would like to have building be able to power itself without the use of a fossil fuel backup generator. Town to follow up with GMP on how they can assist.

NT - Based on JP's modeling, it appears that south-facing roof on building could roughly support a solar PV array that would generate the same amount of energy that the building uses annually. JP and JJ agreed. Cost effectiveness and potential for solar is significantly affected by current GMP offerings. Town to contact GMP for more information.

PK - Town is interested in incorporating electric vehicle charging stations in parking lot. NT will follow up with more information on options.

Monitoring:

JJ - Energy monitoring was incorporated at Middlebury Town Office. Basic E-Gauge system is a few thousand dollars, and has its own interface. External interface and programming adds significant cost and is not recommended.