RENOVATING THE OLD HINESBURG POLICE STATION TO NET-ZERO ENERGY

Better Buildings by Design - February 2, 2017

Richard Faesy, David Pill, Chuck Reiss, Andy Shapiro

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Presentation Overview

1. Project Team
2. Session Goals
3. Project Introduction
4. Participating in Efficiency Vermont's Commercial New Construction Program
5. Design Elements
6. Energy Focus to Achieve Net Zero
7. Construction
8. Lessons Learned and Next Steps

Project Team

- Richard Faesy (Chris Neme & Glenn Reed)
  - Energy Futures Group
  - Owners
- David Pill
  - Pill-Maharam Architects
- Chuck Reiss
  - Reiss Building and Renovation
  - General Contractor
  - Mechanicals, David Cole
  - Ventilation, David Hansen
- Andy Shapiro
  - Energy Balance, Inc.
  - Energy Modeling, Mechanical Systems and Envelope Commissioning

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Session Goals

1. Understanding the process of getting an old building to net zero
2. Design decisions and details
3. Some lessons learned along the way

Project Introduction

- Energy Futures Group (EFG)
  - Hinesburg-based energy consulting firm since 2010
  - Running out of room in current rental space
- Project Goals
  - Stay in Hinesburg
  - Private offices
  - Room to grow
  - Investment property
  - Energy showcase building to match firm's values and serve as an model for others

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The Old Police Station

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- Vacant building
- Commercial use only
- Small lot (footprint + 10')
- Deconstruction restrictions
- Eliminate on-site parking
- For sale with no permits
- 16 month purchase process
- Closed October 2016
- Construction started in Nov.

10298 VT Route 116 , Hinesburg

$125,000

MLS: 4419358

Property Type:	Residential	Year Built:	1900	Total Rooms:	7	Garage:	Attached
School District:	Champlain Valley UHSD 15	Total Fin SqFt:	1,467	Bedrooms:	2	Waterfront:	
Gross Taxes:	$ .00	Approx. Acres:	.10	Total Baths:	2	Water Type:	
Taxes TBD:	Yes	Basement:	Yes / Interior	Apx Ttl Below Grd:	700		

Style:	Cape , Farmhouse	Construction:	Existing , Wood Frame	Foundation:	Stone
Exterior:	Wood	Roof:	Shingle-Other	Basement:	Crawl Space , Dirt , Gravel , Interior Stairs
Electric:	Circuit Breaker(s)	Heating/Cool:	Baseboard	Water Heater:	Other
Heat Fuel:	None	Sewer:	Public	Water:	Public

Disability: 1st Floor Full Bathrm , 1st Flr Hard Surface Flr. , Zero-Step Entry/Ramp

APPROXIMATE ROOM DIMENSIONS

Full Bath		1/2 Bath		3/4 Bath		Den	
Dining Rm		Family Rm		Kitchen	11x10	Living Rm	18.5x11.5
Master BR	18.5x13	2nd BR	14.5x13	3rd BR		4th BR	
Other Rm 1		Other Rm 2		Other Rm 3			

Public Rems: High visibility opportunity to run a small business in the Heart of Hinesburg with over 11,000 automobiles passing by daily. Formerly used as the town's police station and prior to that, the Lyman estate, this historic farmhouse cape offers over 1400 square foot of space awaiting your customization. Building is situated on a corner with future plans to preserve the open space direct behind as the Hinesburg Town Common. With village location, pedestrian traffic and surrounding successful businesses, this is the perfect opportunity for light service industry.

Directions: In the heart of Hinesburg Village, across from Commerce Park and adjacent to the Bristol Bakery.

PREPARED BY

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The Process

- Selecting the team
  - Architect led the effort
  - Energy consultant
  - Builder selection process
- Getting over the "integrated design" challenge
  - Vs. putting the project out to bid
- Dragging everyone along over 1.5 years
- Weekly involvement and nearly daily interactions
- Collaborative design decision process
  - Builder, architect, energy consultant, engineer, budget

Energy Goals

- All-electric
  - Avoid the natural gas line that runs out front and all fossil fuels
- Model project:
  - Tight: 1.0 ACH50 (440 CFM50) (vs. 4000+ CFM50 to start)
  - R-5 windows
  - R-20 foundation
  - R-40 walls
  - R-60 ceilings
  - Cold climate heat pumps
  - Energy recovery ventilation, high efficiency, EC motors
  - On-site renewables
  - Green, healthy and re-used materials
- Participate in Efficiency Vermont's Commercial New Construction Program and achieve Net Zero standard

Efficiency Vermont's Commercial N.C. Program – Net Zero

- Equipment incentives
- Energy charrette ($2500)
- Energy simulation (50% of cost)
- Energy monitoring equipment (50% of cost)
- Commissioning (25% of cost)
- Performance incentive (up to 25% of equipment incentives, based on building operation for one year)
- Incentives worth > $8700 for EFG, but costs are quite a bit more
- Recognition Pre- and Post-occupancy
- Practicing what we preach…

Efficiency Vermont's Commercial N.C. Program – Net Zero

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- EFG wanted to participate but encountered challenges
  - Guidelines vs applying it in the field on a small project
- Commissioning
  - Energy Balance
  - Cx Associates
- Challenges for a small building to fit into a bigger building program
  - Modeling costs vs needs for small building
  - Commissioning requirements and costs for a small building
- Lessons learned
- Program suggestions
  - Adopt program for smaller buildings
  - Flexibility
  - Performance based: incentives for achieving net zero when proven?

Design Elements

- Design process based on client goals
- Integrated design process
  - Involvement of the builder in the design and decision process
    - Slab foundation vs. basement or crawlspace
    - Roof trusses vs. working with the existing rafters
- Challenges and opportunities
- Plans and specs…

Design

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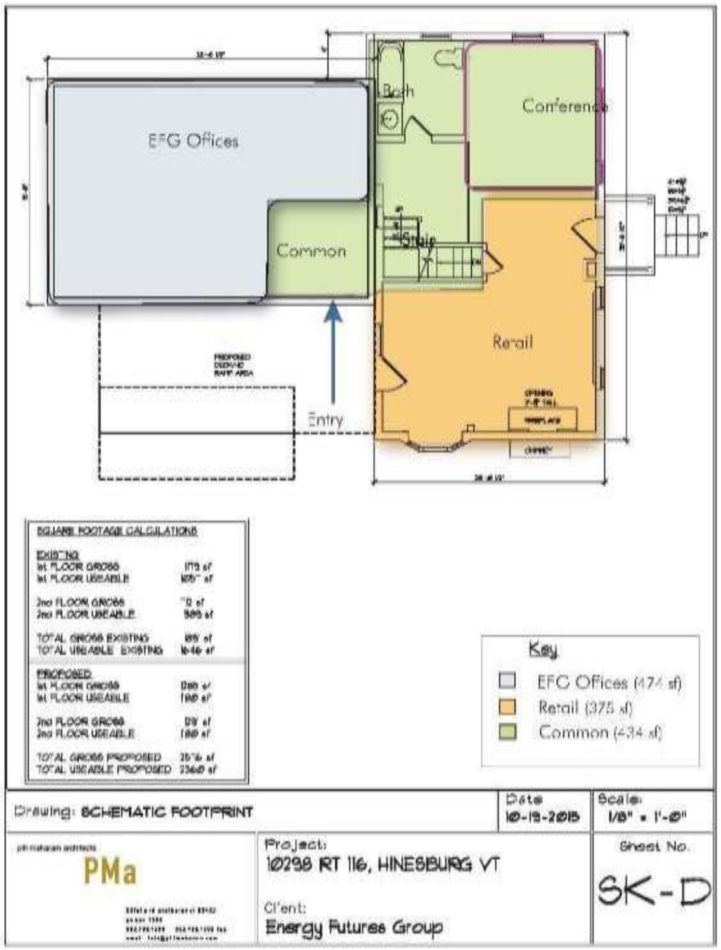
Design



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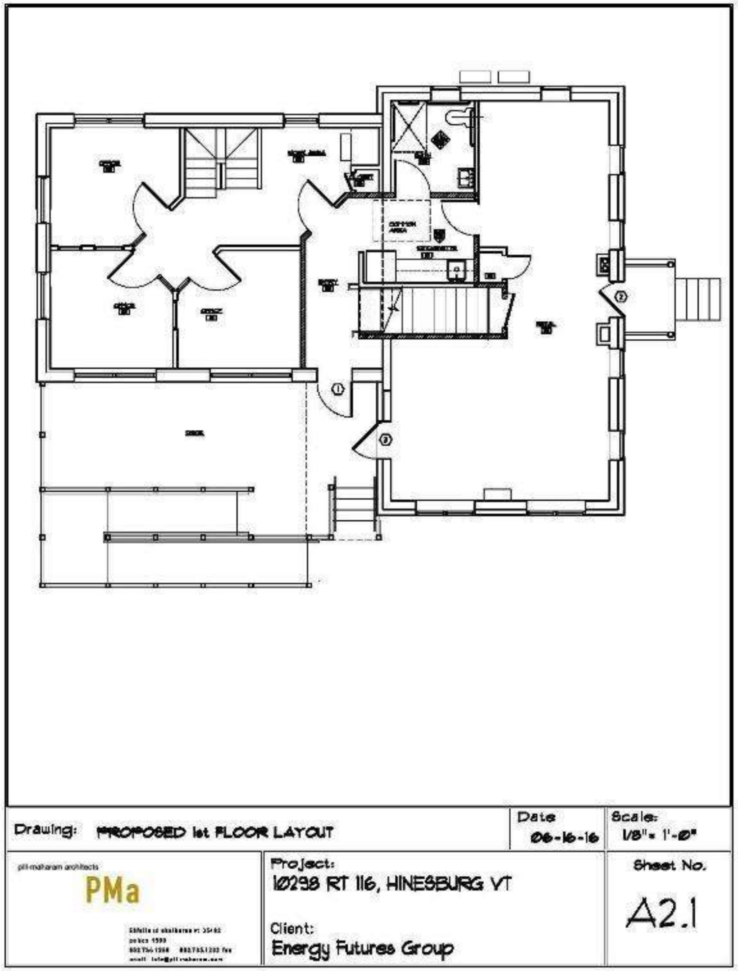

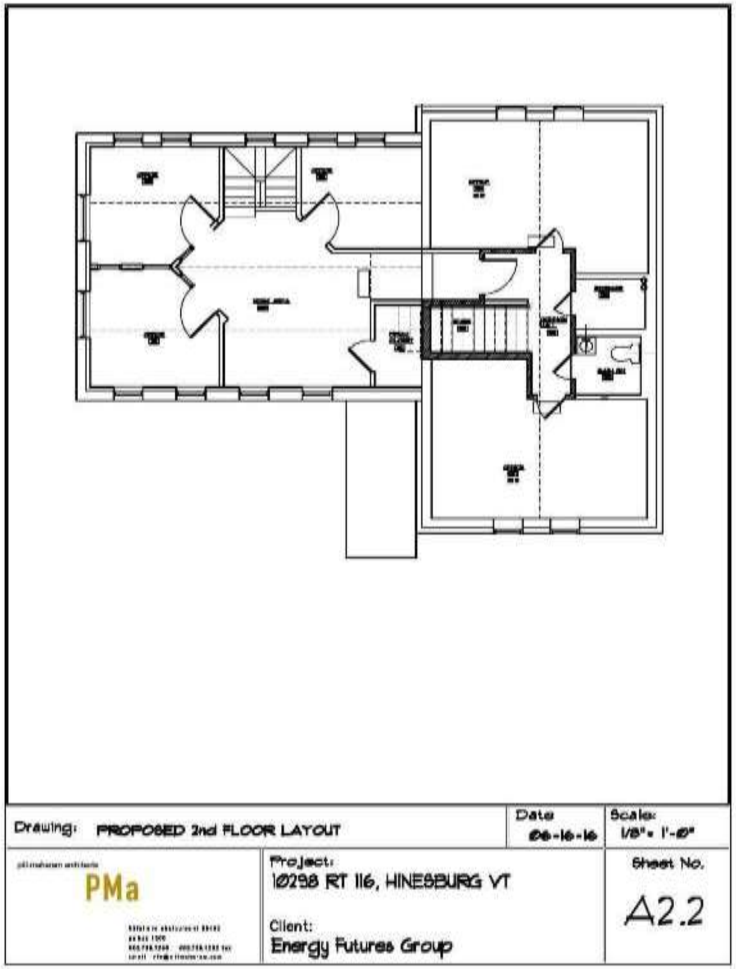

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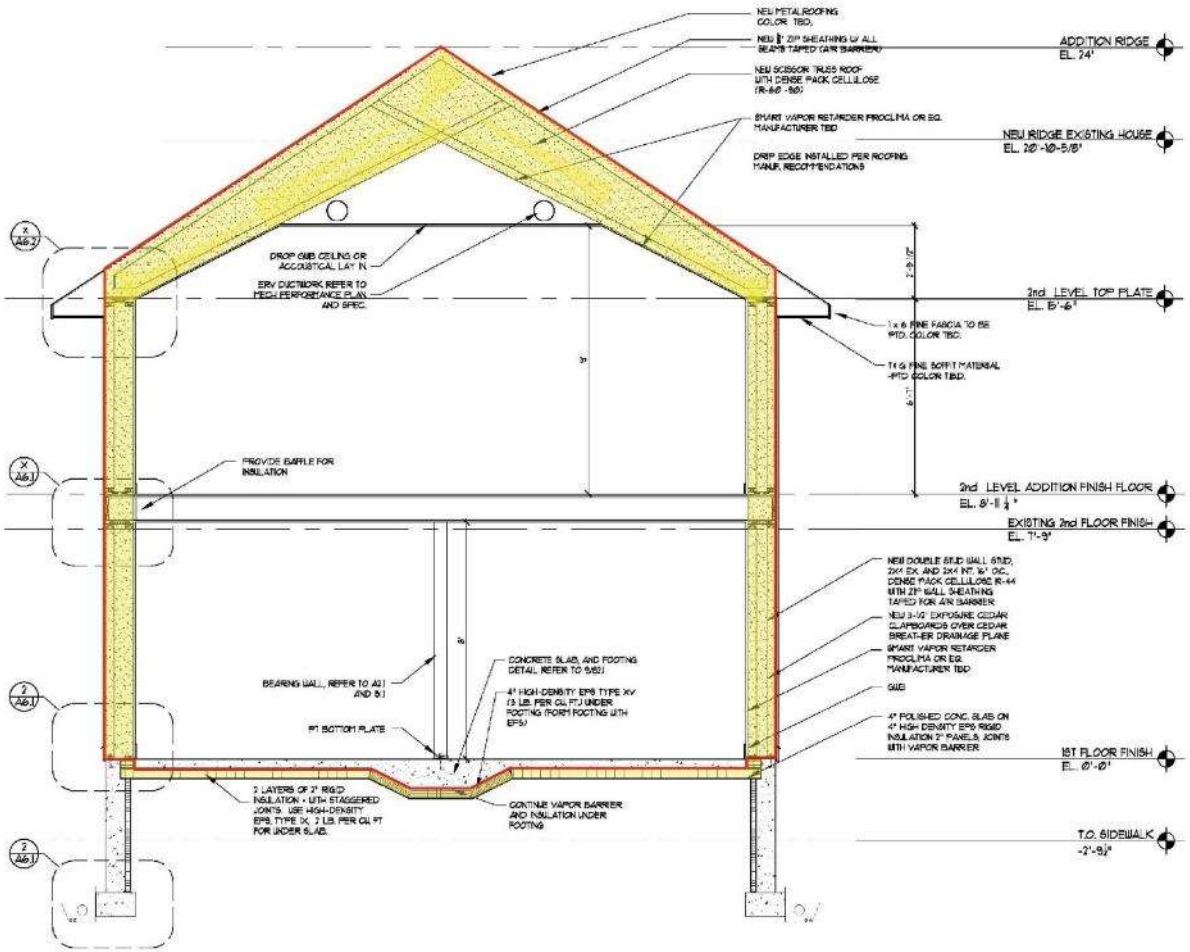
Construction Details



1 BUILDING SECTION @ ADDITION
SCALE: 1/2" = 1'-0"

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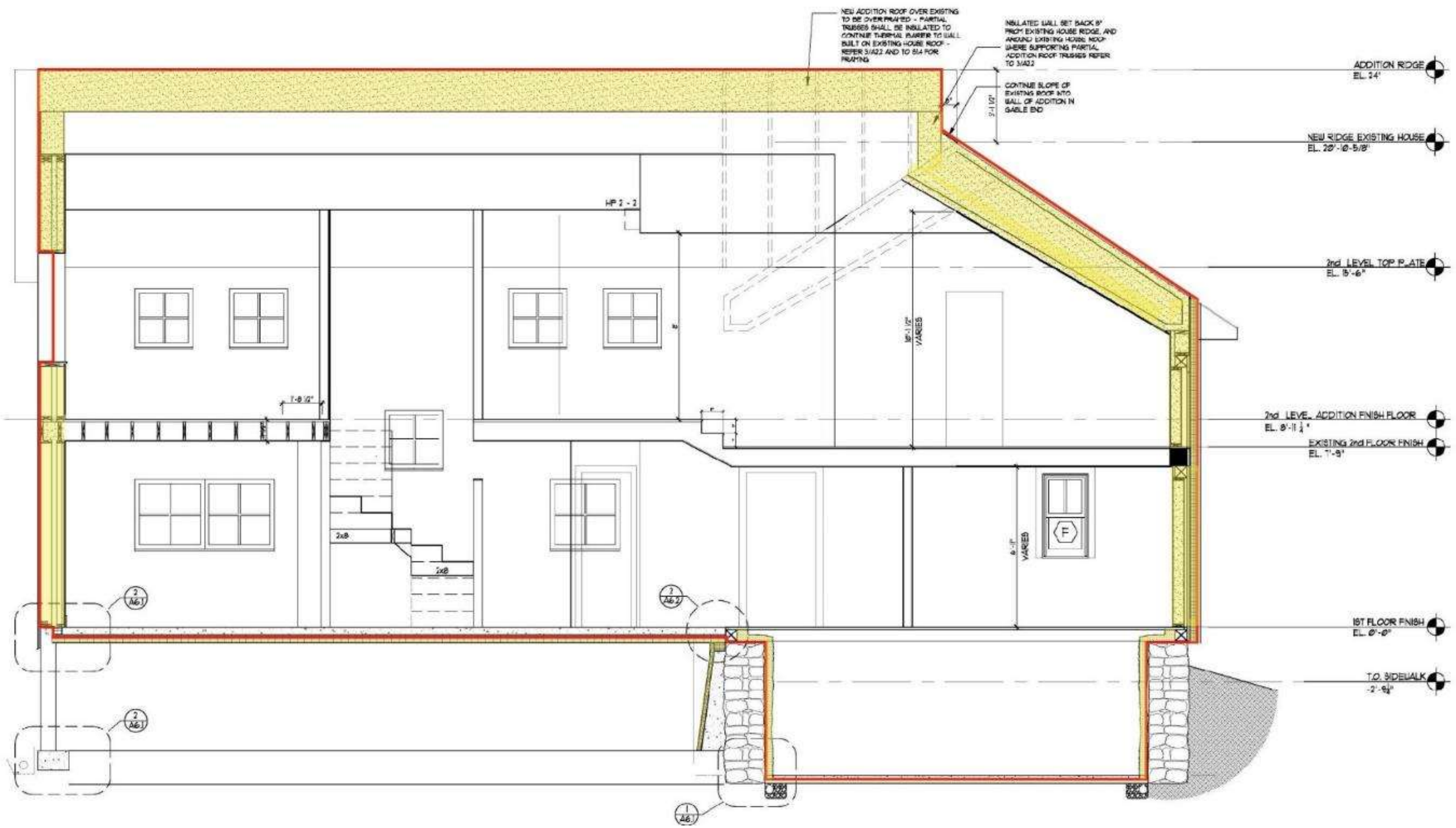

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Construction Details

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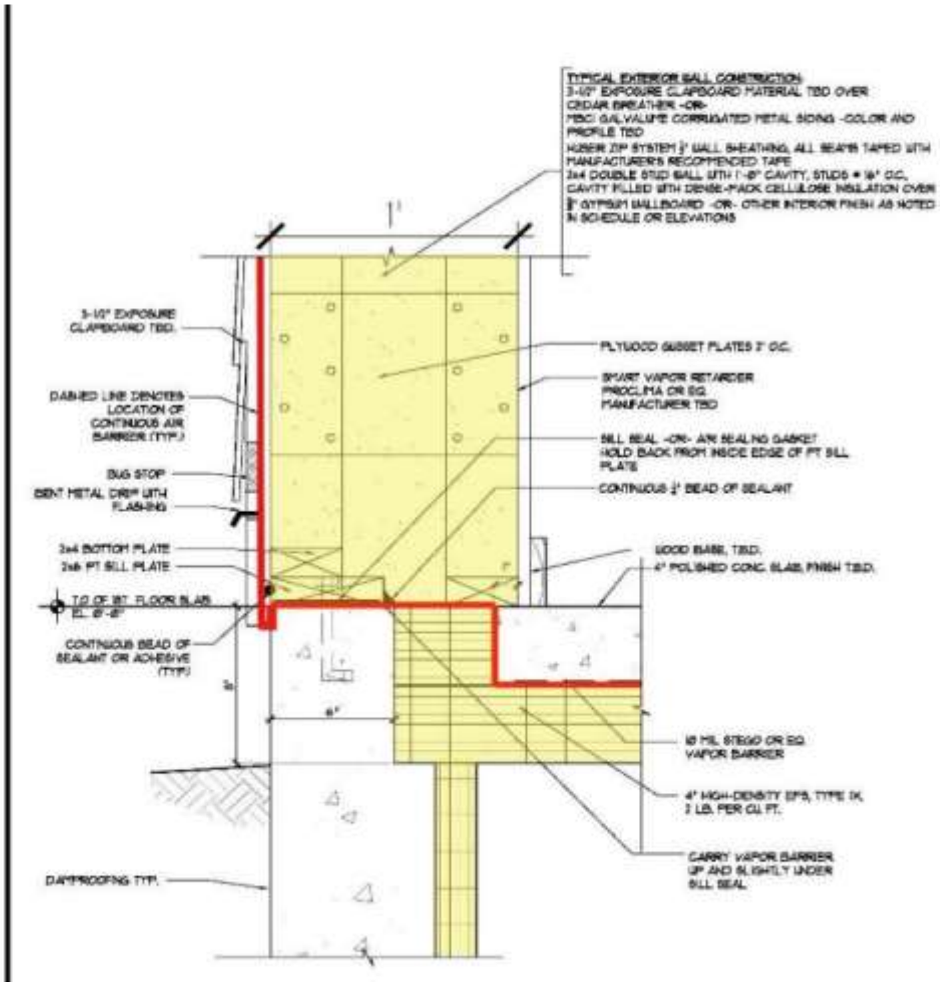

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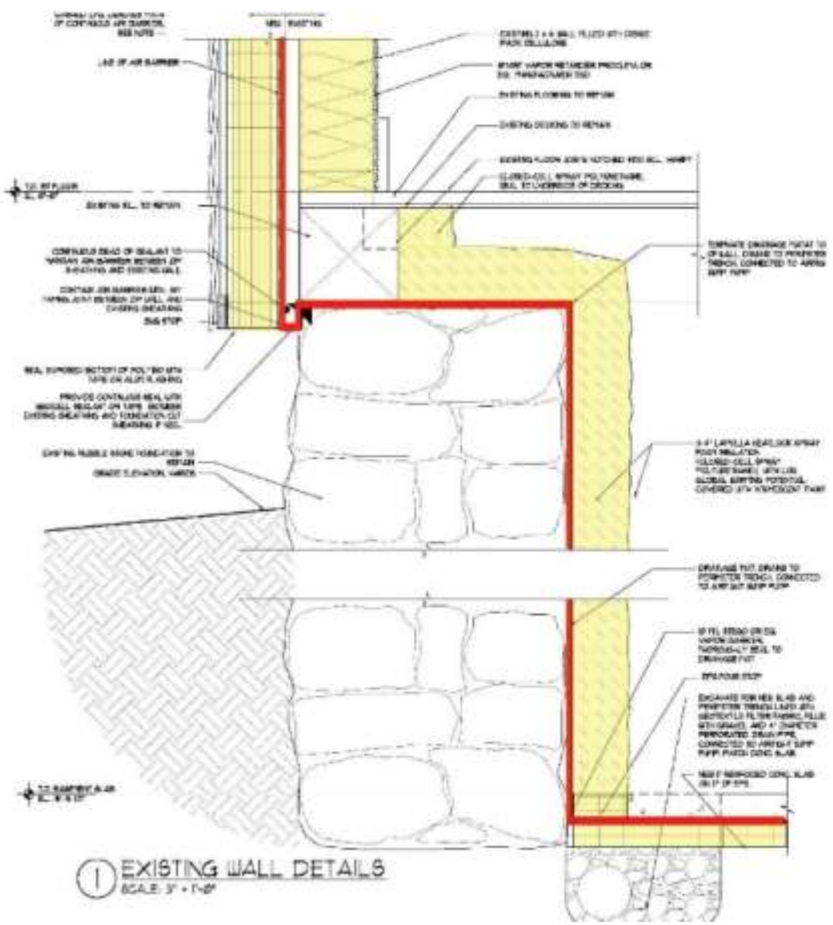

Basement Details

Window Choices

- Wood vs. vinyl vs. fiberglass
  - Performance
    - Similar
  - Cost
    - $12k vs. $21k
    - White vs. color
  - Wood vs. sheetrock returns
- European, NY, ME
- Local availability and service
- Paradigm Windows
  - Portland, ME
  - U-.22
  - SHGC .22

Construction Details

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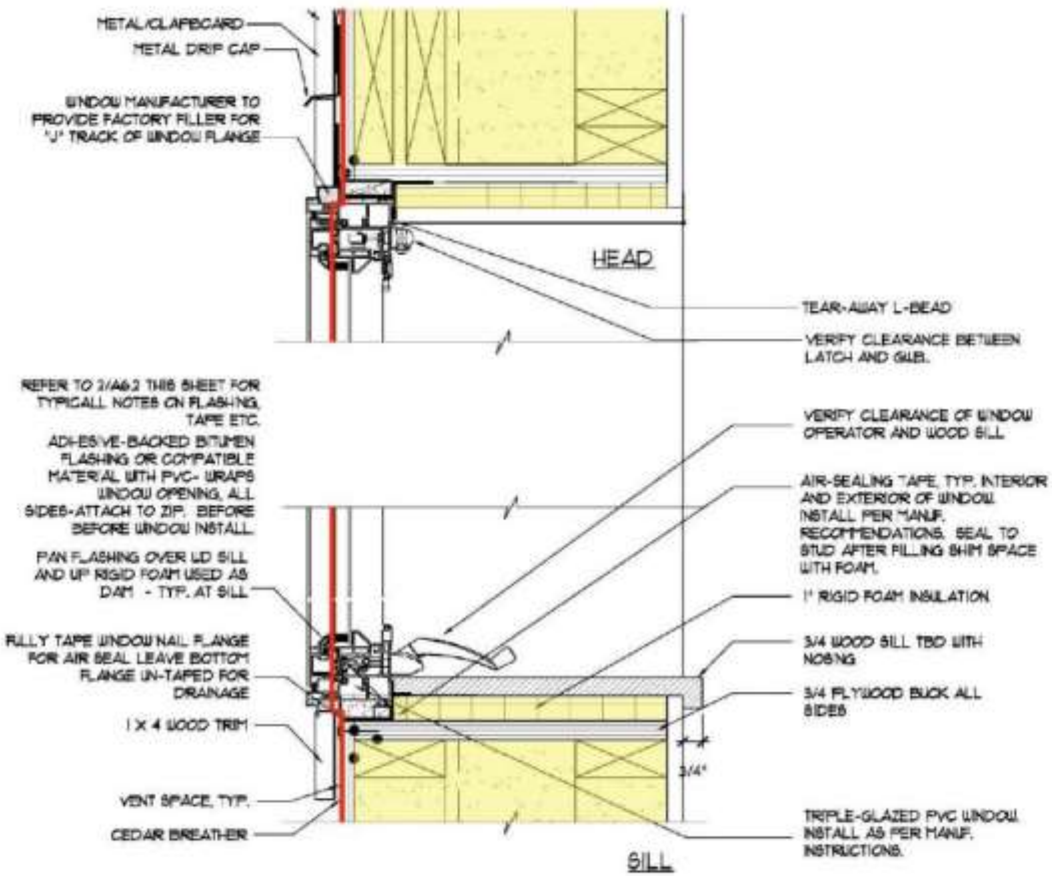


1 TYPICAL WINDOW HEAD AND SILL DETAIL FOR CLAPBOARD/METAL IN ADDITION

SCALE: 3" = 1'-0"

Mechanical System Challenges

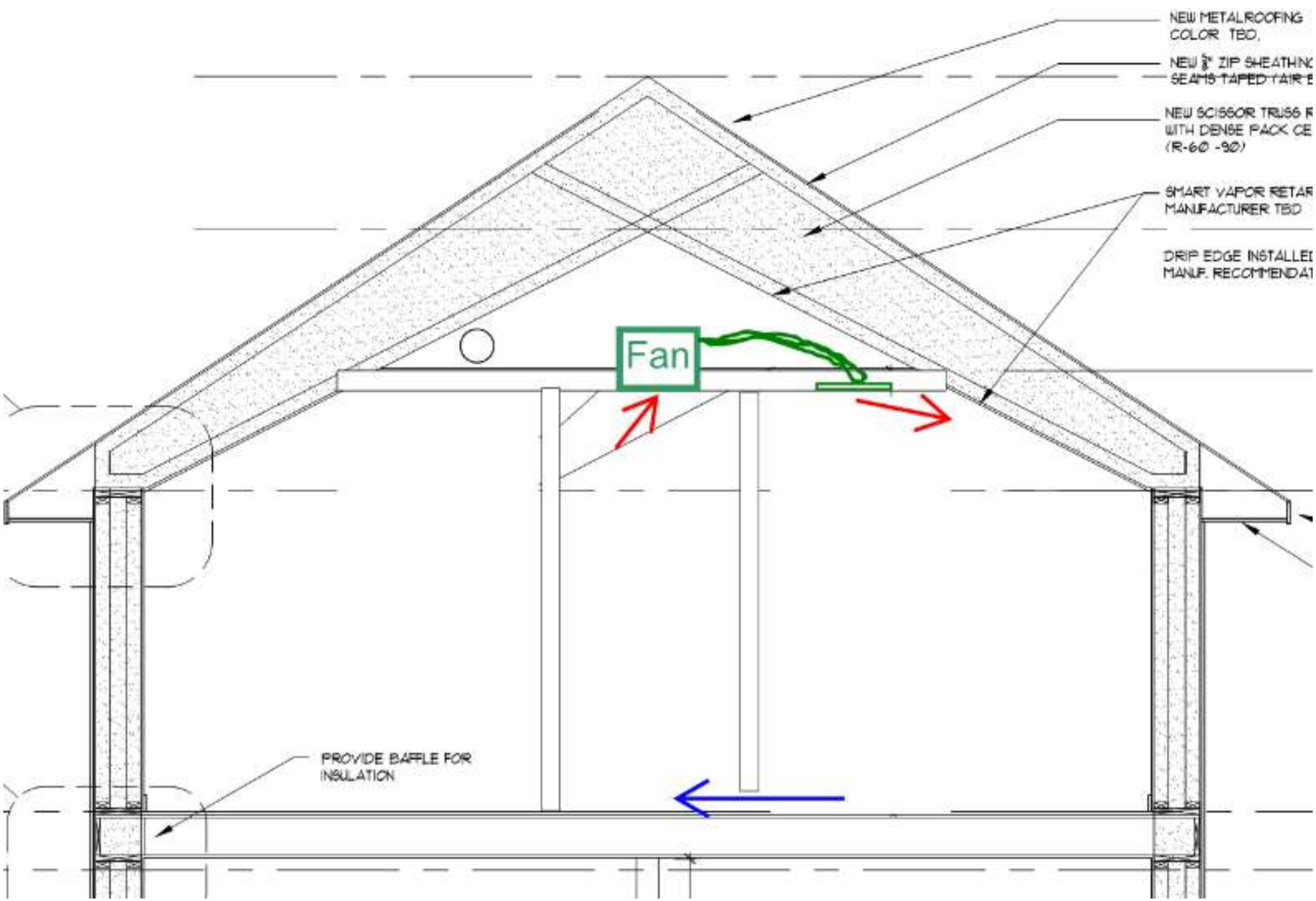
- Zoned approach
- Heating and cooling
- All-electric cold climate heat pumps
- Ducted vs wall mount – cost difference and comfort difference and uncertainties
  - Ducted System for new offices
  - Wall-Mount system for new offices
- Cost Savings - ~$5,000 (mechanical + construction)
- Less transfer fan costs ~$400 x 6 = $2400

Mechanical System Challenges

Challenges with wall mount:

- Heating and cooling offices with doors closed
- Comfort difference and uncertainties
- Transfer fan solution and uncertainties
- Peak loads driven by cooling in some rooms and heating in others

Heating and Cooling Transfer Fan



Mechanical System Challenges

- Very low peak loads

EFG Office and Retail		
Indoor and Outdoor Unit Loads		
Outdoor unit number	1	2
Total Peak Load Heating	16,410	16,575
Total Peak Load Cooling	8,880	16,627

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Mechanical System Challenges

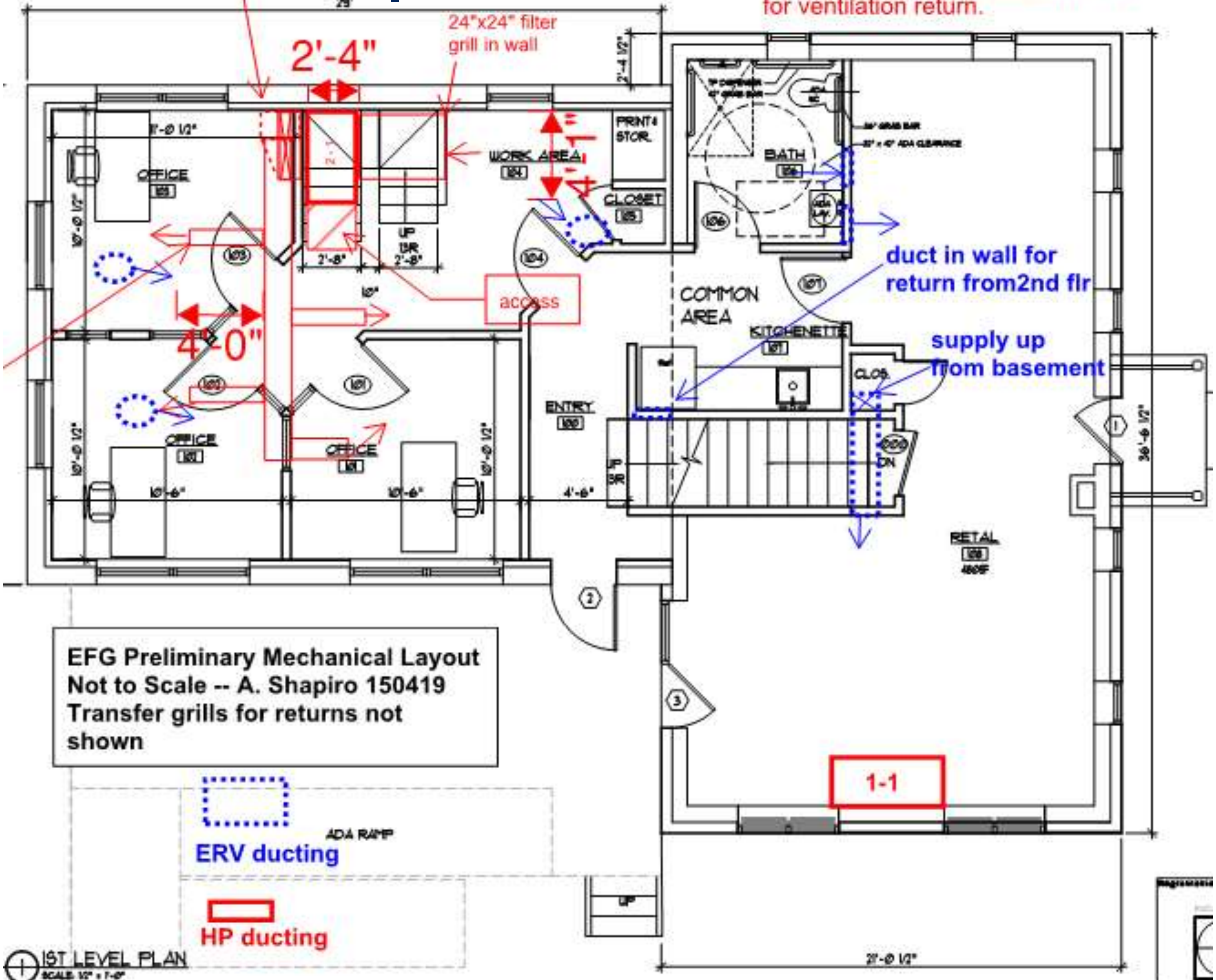
Room Peak Loads -- First Floor						
Room	Retail 108	Bathroom 106	Office SW 102	Office NW 103	Work area/stair 104	
Outdoor Unit Number	1	1	2	2	2	
Zone Name	1-1	1-1	2-1	2-1	2-1	
Peak Heating Load (with 15%), Btu/hr	**10,041**	995	2,399	**2,290**	**1,574**	
Peak Cooling Load, Btu/hr	5,063	275	**2,760**	2,167	648	

Room Peak Loads -- Second Floor						
Room	Office rental S 207	Office rental N 204	EFG Common 200	Office SW 201	Office NW 220	Office NE 203
Outdoor Unit Number	1	1	2	2	2	2
Zone Name	1-2	1-3	2-2	2-2	2-2	2-2
Peak Heating Load (with 15%), Btu/hr	**2,293**	**2,331**	2,299	1,841	1,768	**1,135**
Peak Cooling Load, Btu/hr	2,056	1,042	**2,551**	**2,129**	**2,122**	899

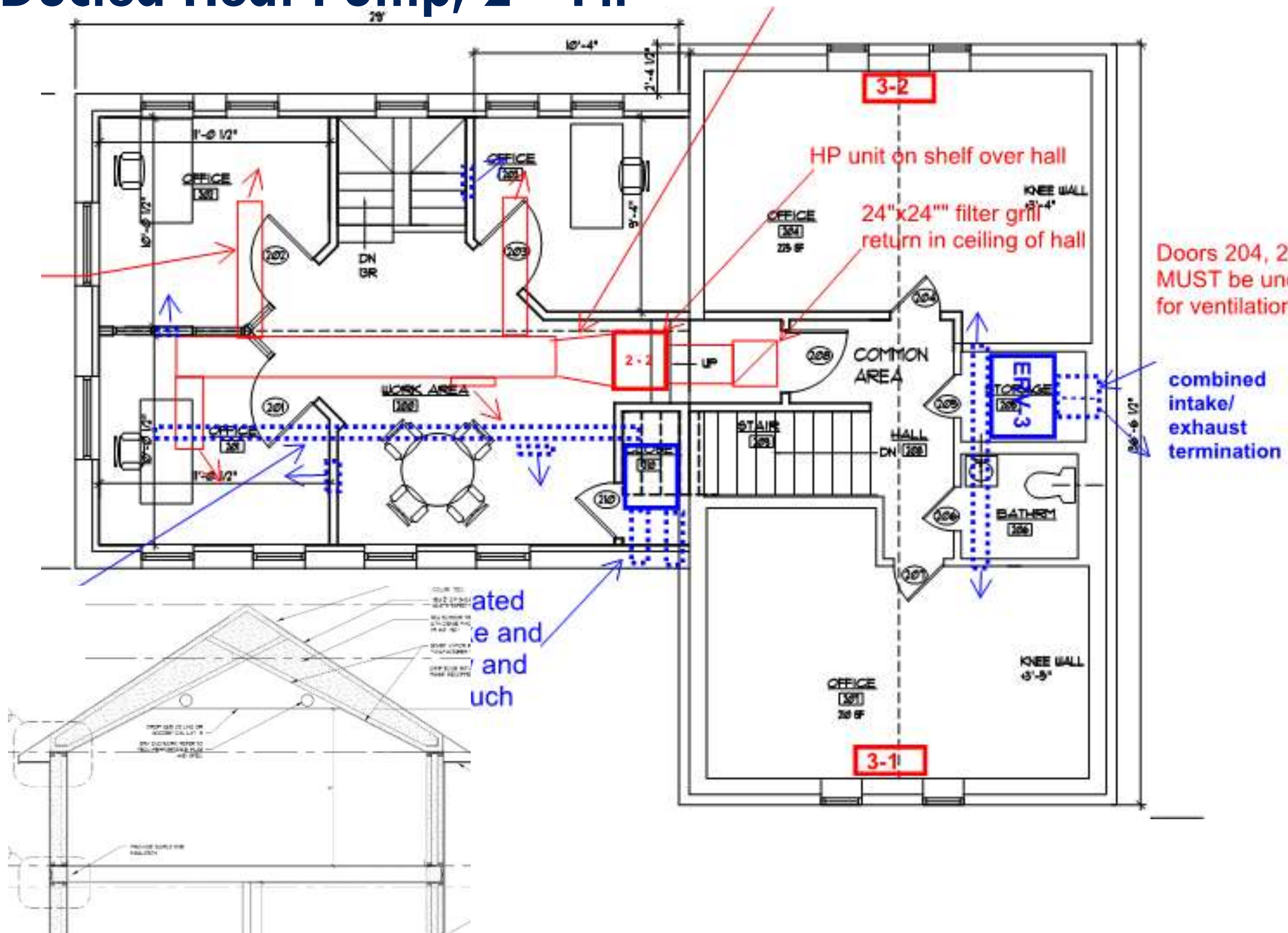
- Can’t get small enough wall mount units

Ducted Heat Pump, 1st Flr

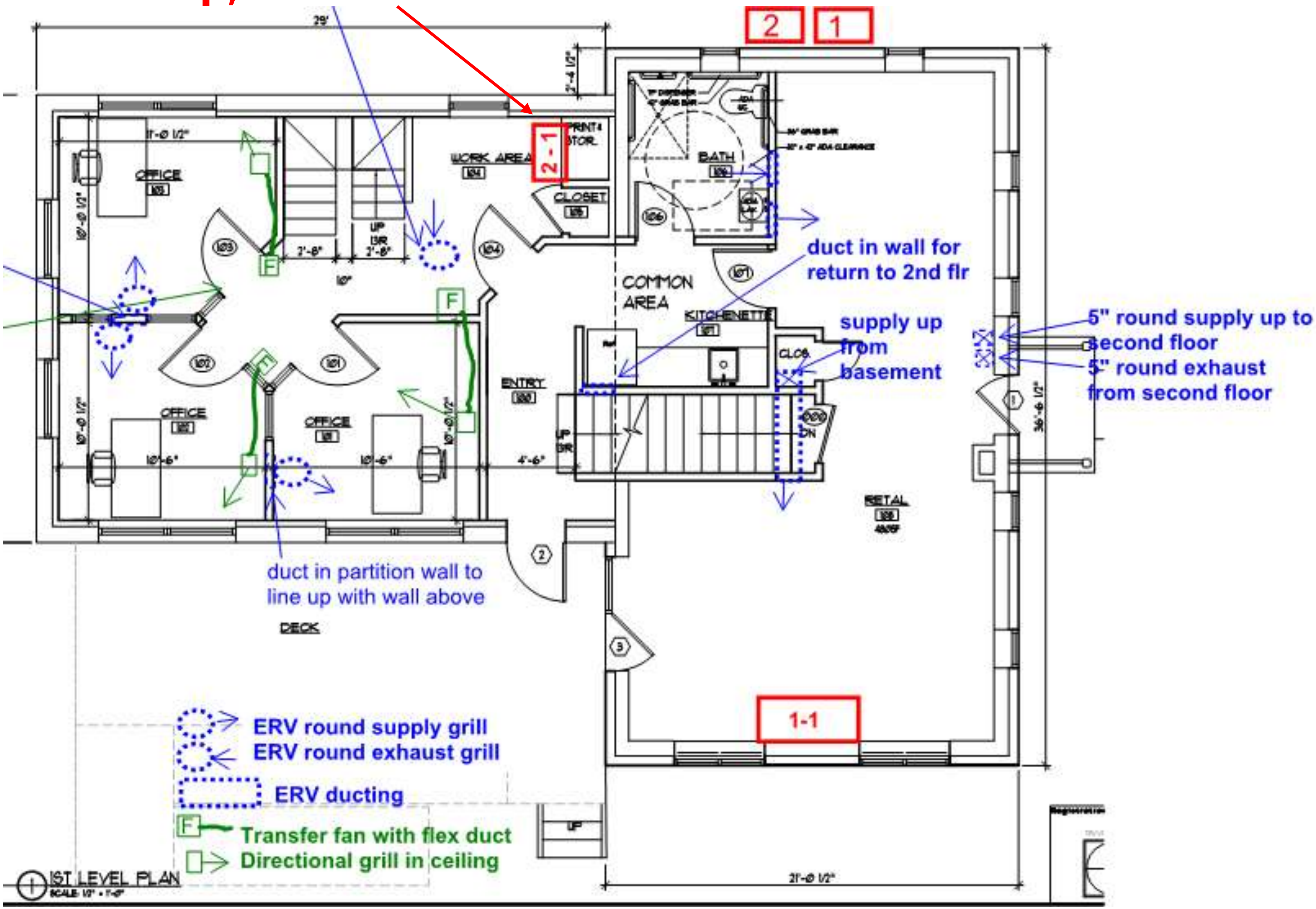
All doors in Common Area 100 and 101 MUST be undercut 1" AFF for ventilation return.



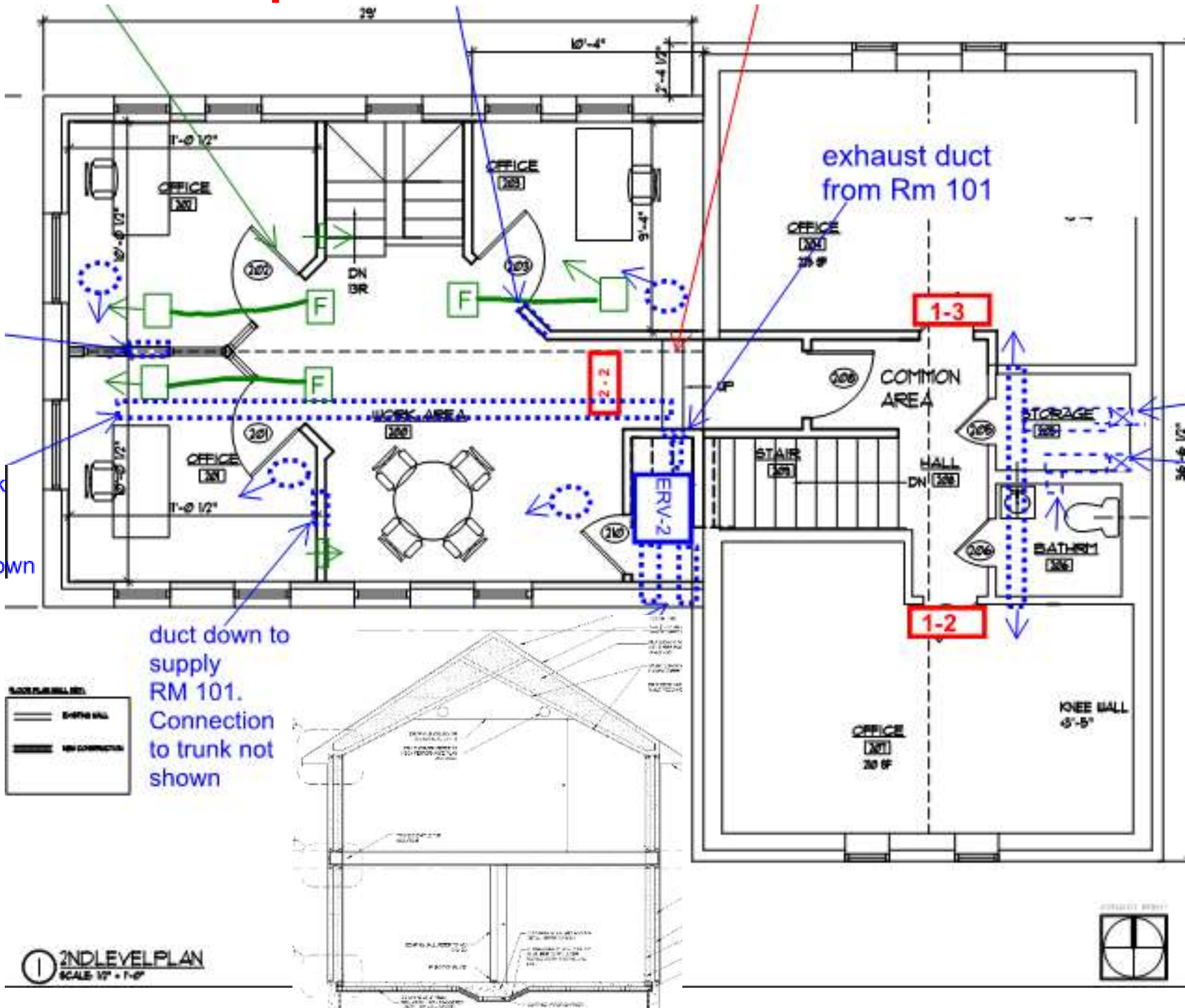
Ducted Heat Pump, 2nd Flr



Wall Mount Heat Pump, 1st Flr



Wall Mount Heat Pump, 2nd Flr



Final Heat Pump System

- Wall mount in retail and rental offices
- Transfer fans in closed EFG offices
  - With thermostats and on/off switch
- Wireless remote thermostats
  - Vs. hand-held remotes
- Fix air direction vanes on wall mount units
- Set indoor unit fans to run only on call for heat/cool

Ventilation System

- ERV to reduce summer humidity and increase winter humidity
- Dedicated ductwork for ventilation
- Broan ERV140TE (was Venmar)
- One for EFG office; one for rental spaces
  - Ducting simpler and units more efficient
- Run on 7-day schedule from ERV controller with boost in bathrooms

EFG Office and Retail		1/31/2017
Building Enclosure -- 2015 Energy Code and Proposed		
	Code	Proposed Net Zero Ready
Roof, new and old	R-49	18" cellulose, R-60
Walls above grade	R-20	Existing Bldg:5.5" cellulose + 4" polyiso rigid, R-40; New 12" double-wall cellulose
Sub slab, new construction	R-10 to 48" from edge of slab [3]	4" EPS
Slab edge, new construction	R-10 vertical, to 48" from top of slab [3]	4" EPS slab edge plus 2" vertical to footing
Basement Walls	R-10 vertical, to footing	Zero GWP Spray foam, taper from 6" at sill to 2" at floor
Basement Floor	no insulation	2" EPS continuous
Windows, R-value fixed [4]	2.8	R-5 tripane windows
Windows, R-value operable [4]	2.3	R-5 tripane windows
Window SHGC [4]	<=0.40	0.27
Opaque doors (includes doors with some glass)	R-2.7 -- solid doors insulated	R-4.5 insulated door w/low-e glass and full glass storm with hard-coat low-e on inswing. Outswing, R-3 (no storm door)
Air leakage	0.50 cfm50/sq.ft.-shell; 0.47 Natural ACH; 5.8 ACH50; 2,200 cfm50	0.10 cfm50/sq/ft/ shell; 0.09 Natural ACH; 1.15 ACH50; 440 cfm50
Air leakage natural including 300 cfm ventilation at 0.65 ASRE code/0.74 ASRE NZR	.66 ACH (natural + ventilation)	.21 ACH (natural + ventilation)

Energy Modeling Assumptions

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Systems -- 2015 Energy Code and Proposed		
	Code	Proposed Net Zero Ready
Heat	Warm air natural gas furnace, AFUE=0.78	VRF air-air HP with effective annual COP=2.3
Cooling	SEER 13	SEER 19
Hot Water	0.97 EF tank-type	Heat Pump Water Heater -- COP - 2
Ventilation	heat recovery not required at 50% run time and low cfm for this building; however, modeled with ERV with 65% ASRE	74% apparent heat recovery; 70% sensible recovery efficiency; latent 46% [a]
Lighting	0.82 wsf	0.82 wsf*

* wattage will be lower than code, but internal gains + lighting is modeled based on existing low usage

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Domestic Hot Water

- 12 gallons/day average

Domestic Hot Water, Annual load and fuel use			
	Resistance	Heat Pump	
Annual Load	1.8	1.8	MMBtu/yr
Annual Load, usage	524	524	kWh/yr
Annual load, standby and piping losses	623	623	kWh/yr
Annual Load, Total	1,147	1,147	kWh/yr
	Resistance	Heat Pump	
COP of water heating	1.00	2.0	COP
Annual Consumption	**1,147**	**574**	kWh/yr

Domestic Hot Water Choice

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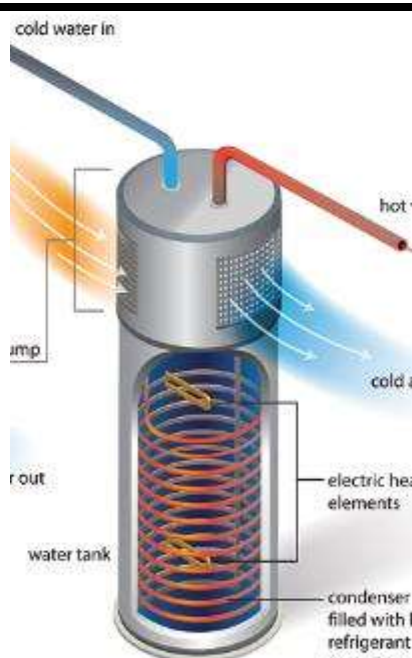
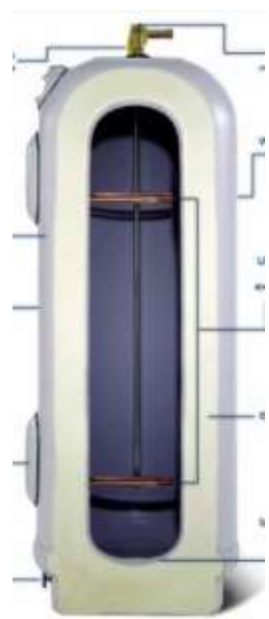
	Resistance	Heat Pump	
Annual Consumption	**1,147**	**574**	kWh/yr
Savings of Heat Pump over Resistance		574	kWh/yr
PV's required for added kWh for Resistance		499	Wp of PV
Cost per watt, net		$ 2.00	
Add cost for PV for Resistance DHW		$ 1,000	





Energy Modeling to Achieve Net Zero

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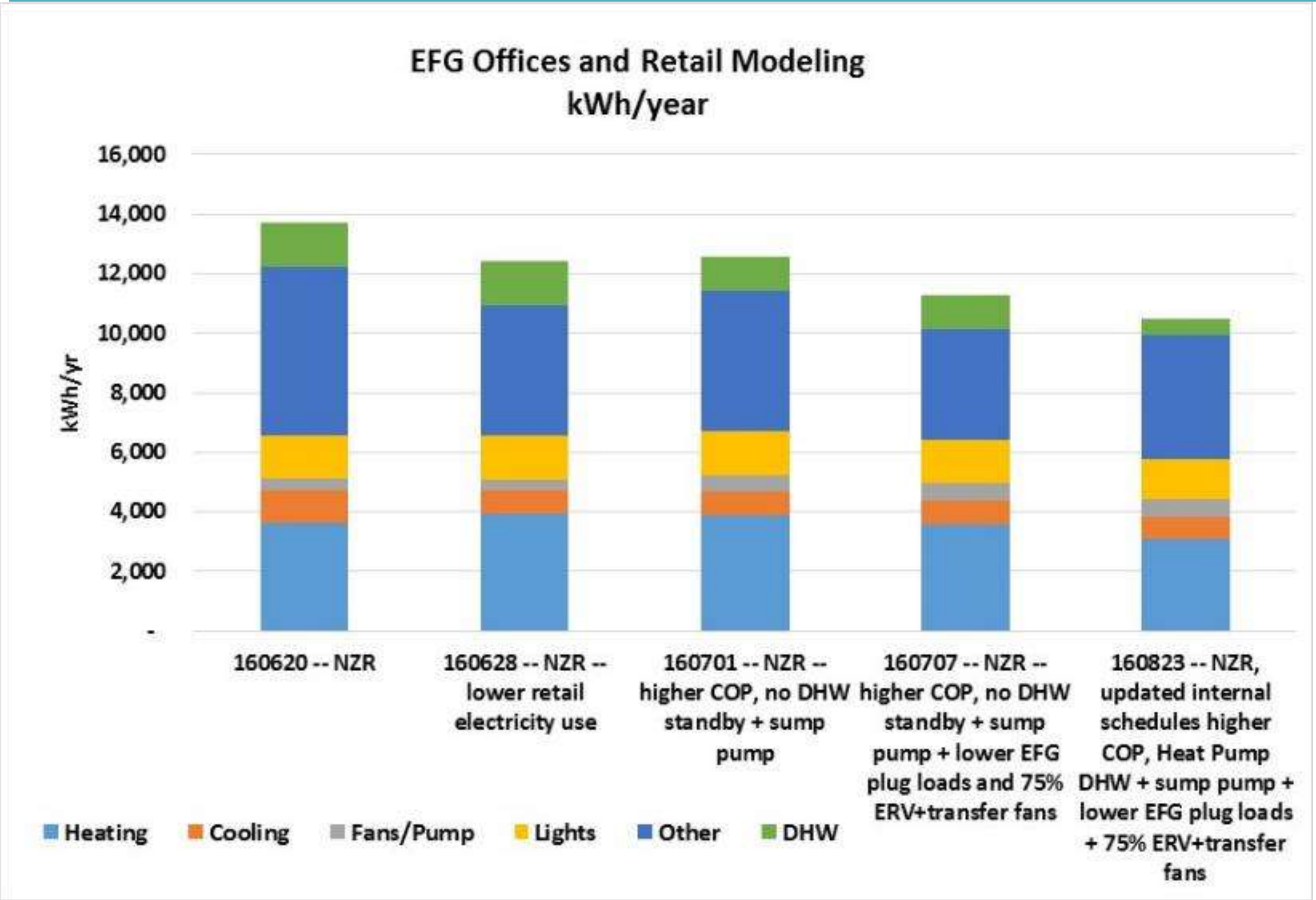

Energy Modeling to Achieve Net Zero

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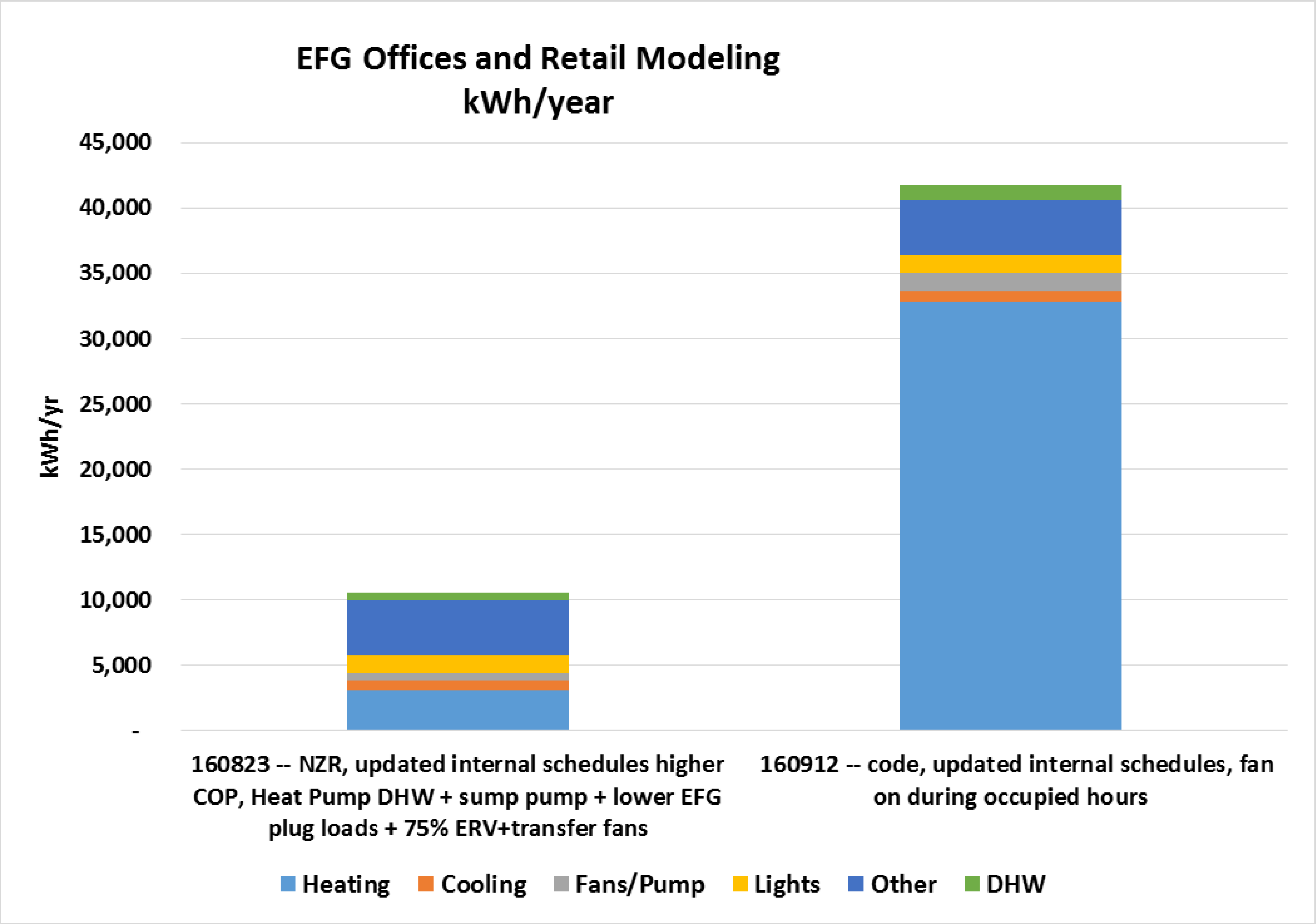

Photovoltaics

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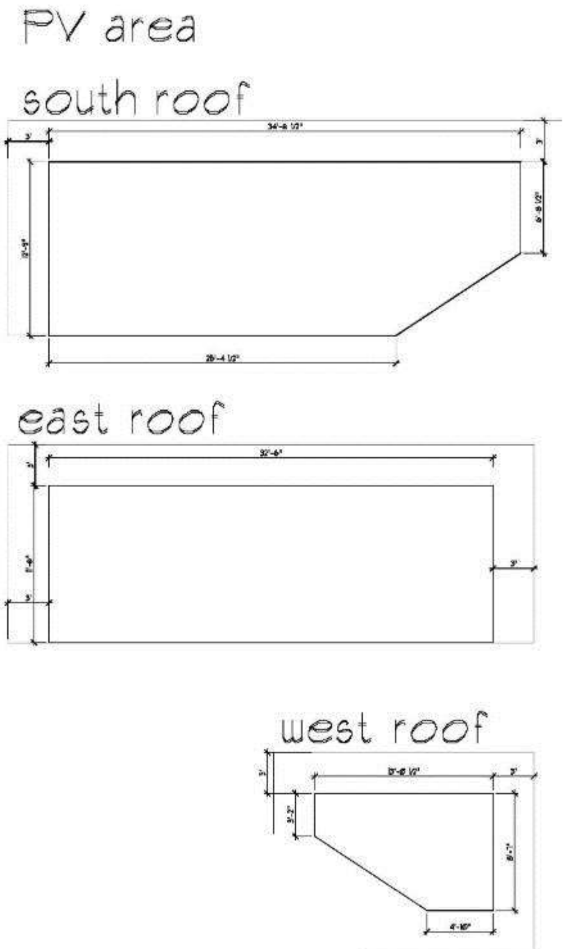

Photovoltaics

	# of panels	Watts / panel	Total watts	KWH/yr
South facing roof	20	310	6200	7440
West facing roof	4	310	1240	1240
East facing roof	10	310	3100	3100
Totals	**34**		**10,540**	**11,780**

The Construction Process


10298


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AdvanTech


CRAIN

Construction Process Movie

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Lesson Learned

- Work with Efficiency Vermont to meet your needs
- Multiple competing priorities pull in different directions and require balance between:
  - Efficiency and PV production
  - Comfort and system cost (HVAC)
  - Performance and "greenness" (vinyl windows)
  - Zero energy goals and budget
- A truly "integrated design approach" is hard to achieve
- It helps to have all team players oriented towards the same project goals
- Wait for next year to see the final results

Q&A

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