Deep Energy Retrofits
Full Value Proposition

NESEA , BE-14

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Timeless Architecture, Milton MA

Timearch.com

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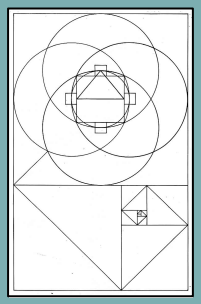
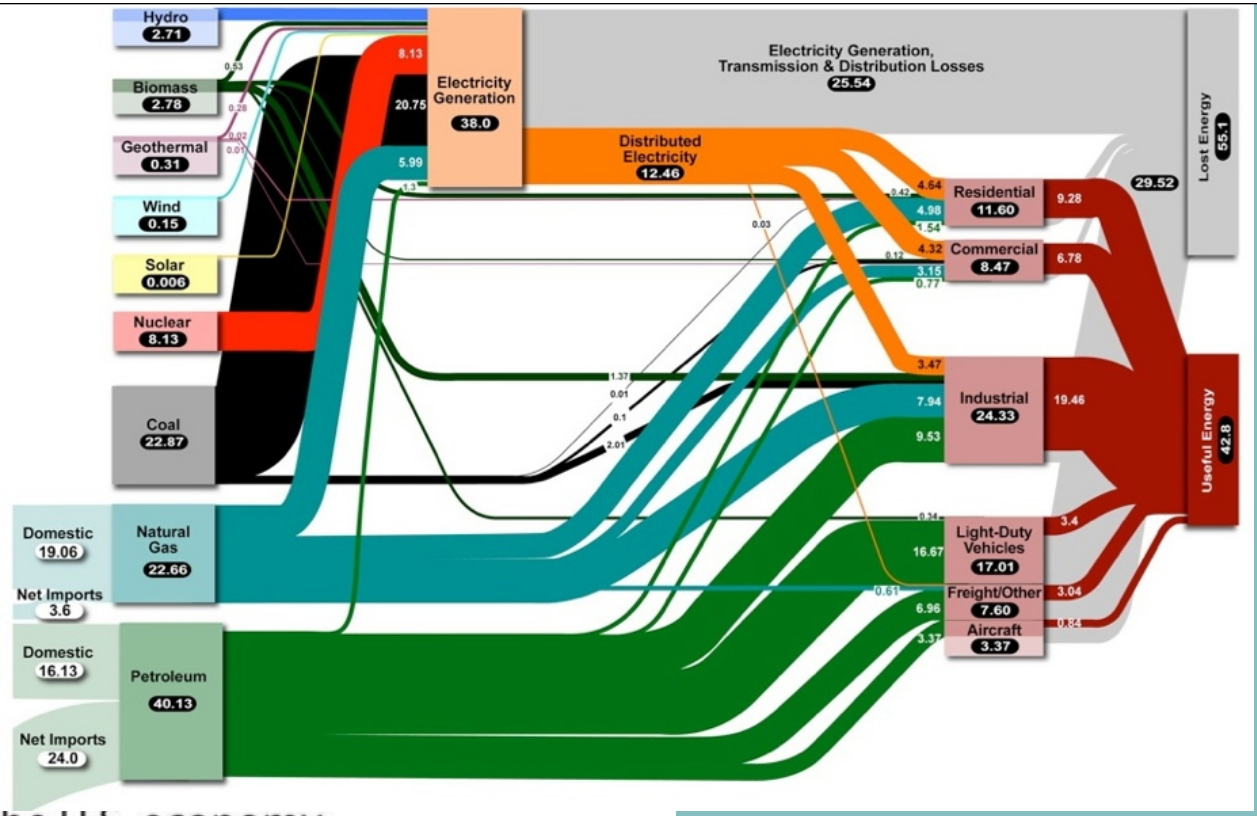
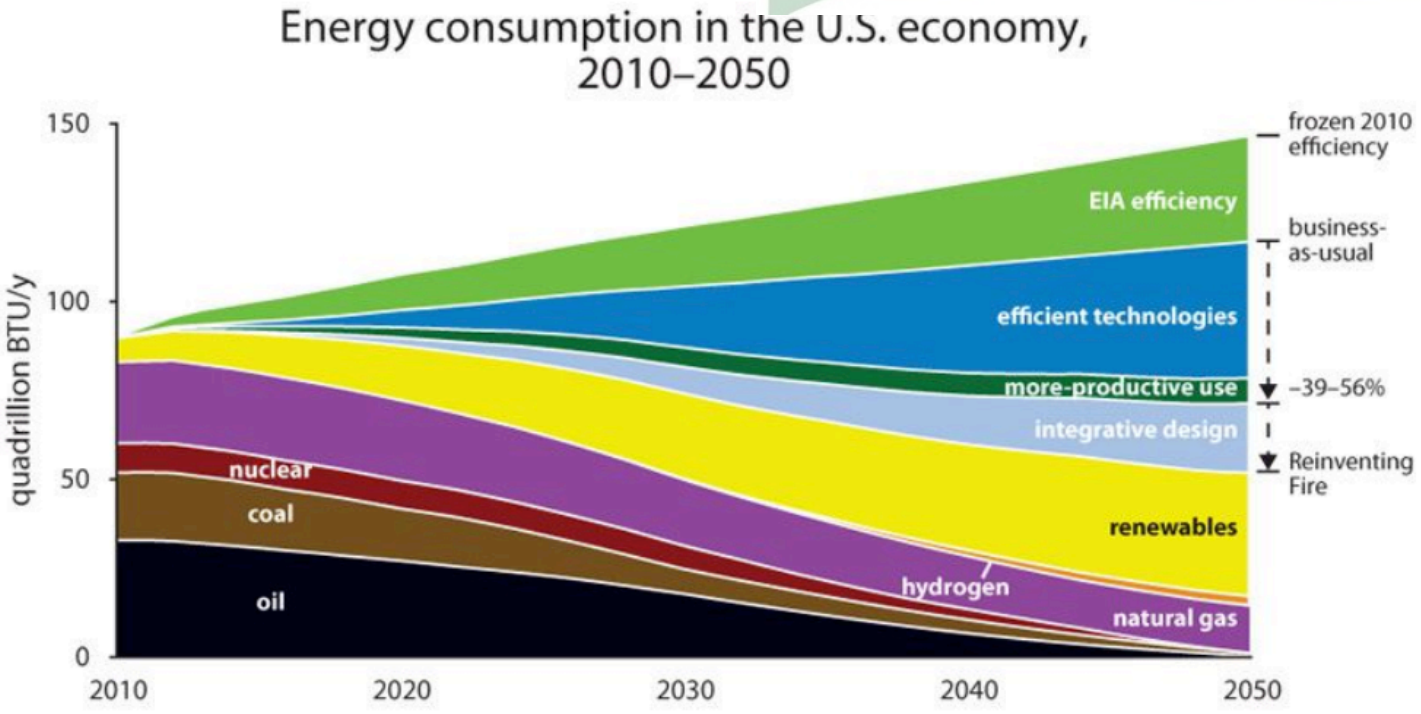


Our current energy flows leave us with 55% in lost energy.

US Energy Sources & Uses, DOE





The new challenge is to forecast the wedges to get us to 2050.

Reinventing Fire
Amory Lovins, RMI

Three Numbers From Hanson & Mckibben

#1. 2 ° Centigrade of Warming

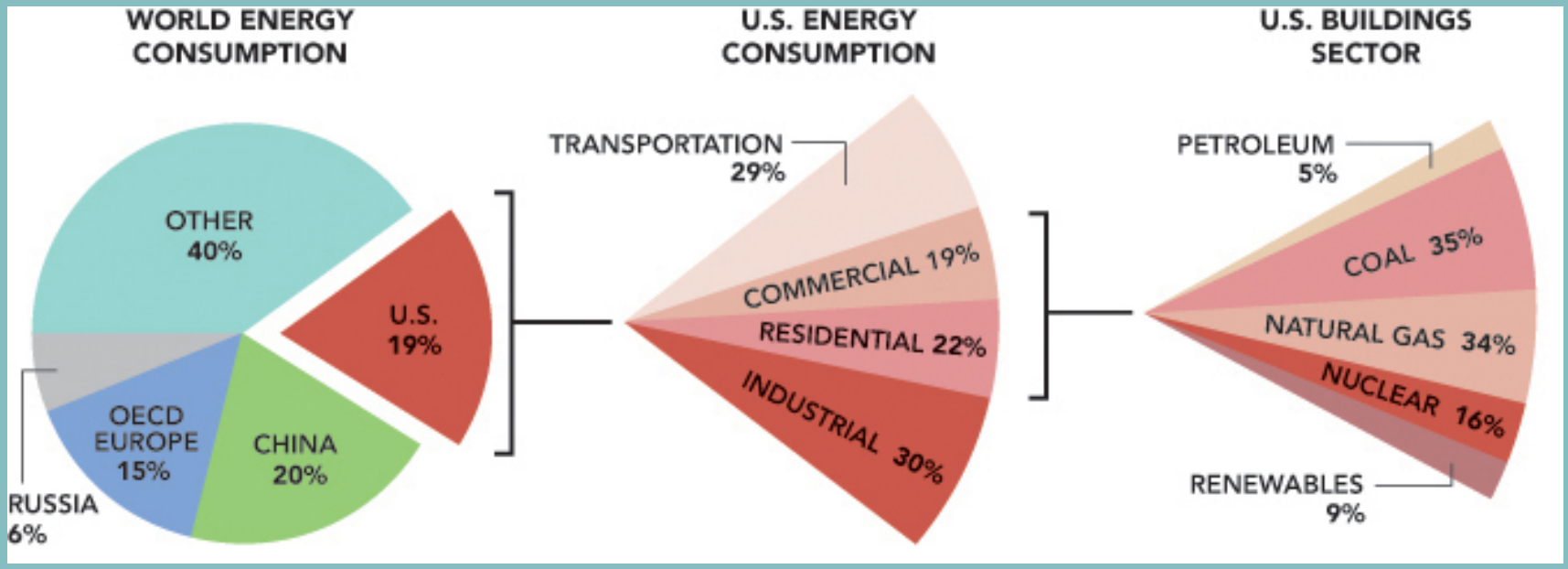
Countries producing 87% of carbon emissions endorse the 2° target. We are now 80% of the way there.

#2. 565 Billion tons of C02

We can burn 565 more Gigatons of CO2 and stay below 2°C of warming. Any more risks catastrophe for life on earth.

#3. 2,795 Billion tons of C02

There are 2,795 Gigatons in Fossil Fuel reserves, 5 X safe limit.
(80% of 2,765 GT is $ 20 trillion stranded assets for fossil fuels)



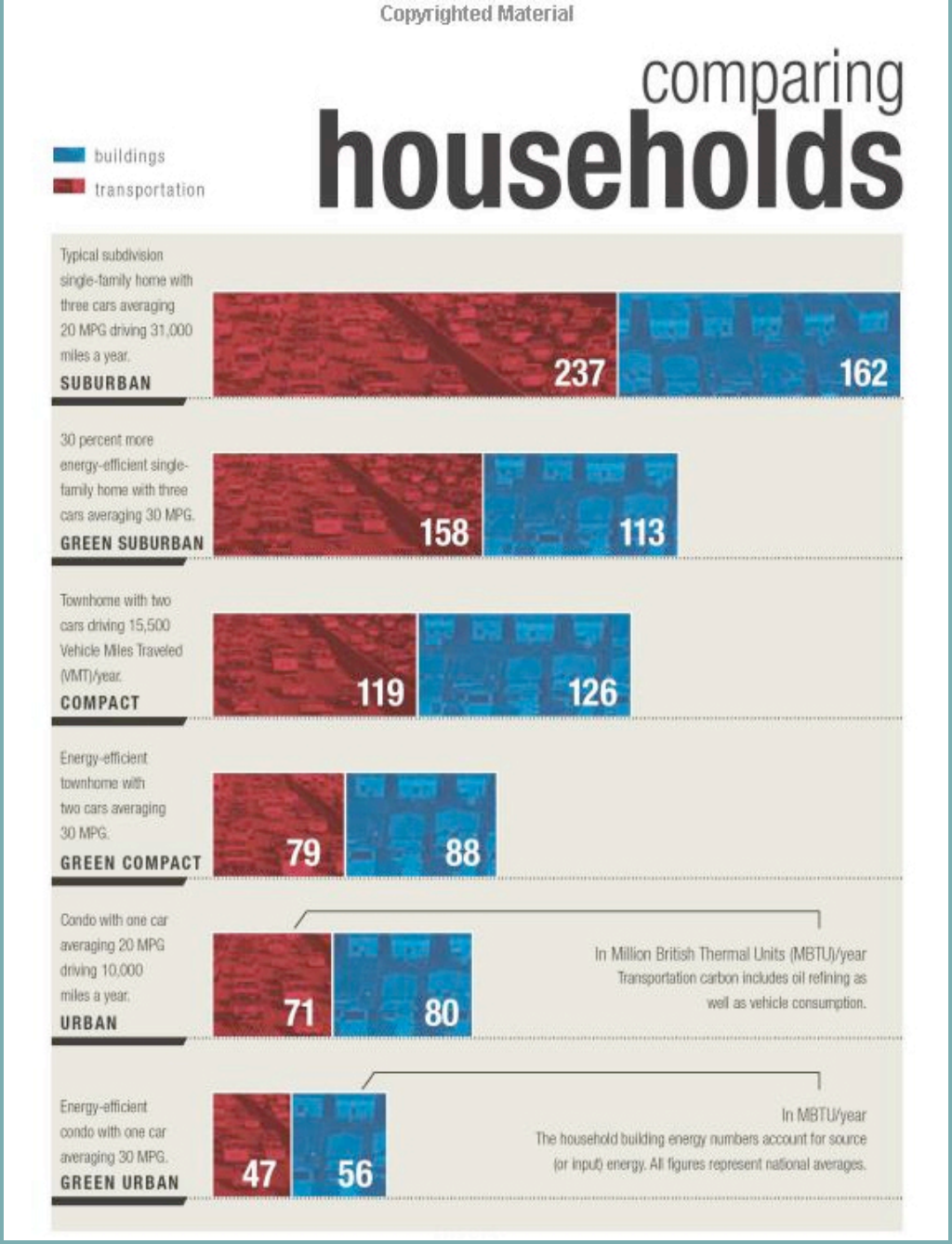
Who is conspiring?

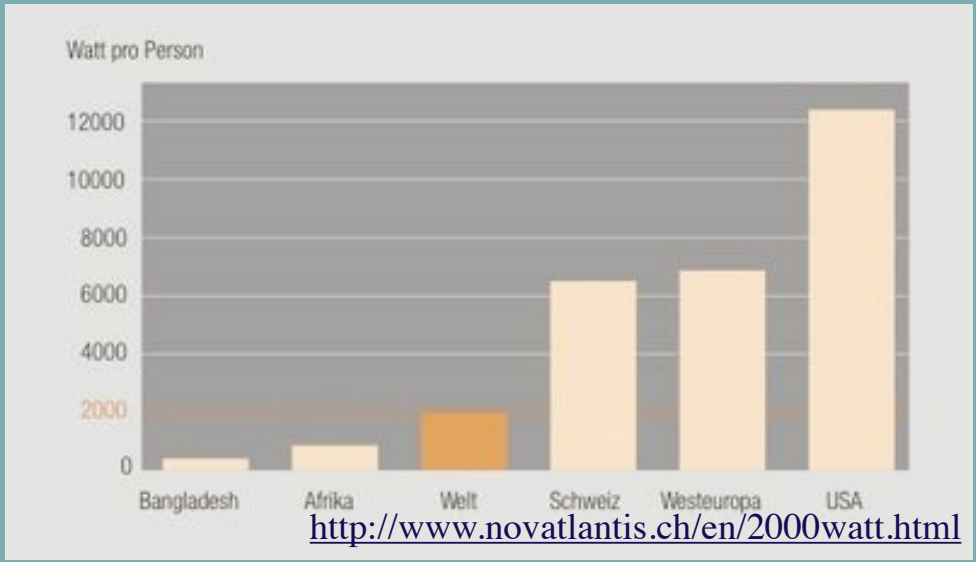
con·spire
verb
To make secret plans jointly to commit an unlawful or harmful act.

Our building Community is engaged in 41% of the problem, & potential solutions!

Peter Calthorpe, Urbanism in the age of Climate Change
http://www.calthorpe.com/publications/urbanism-age-climate-change

The 2000-Watt Society



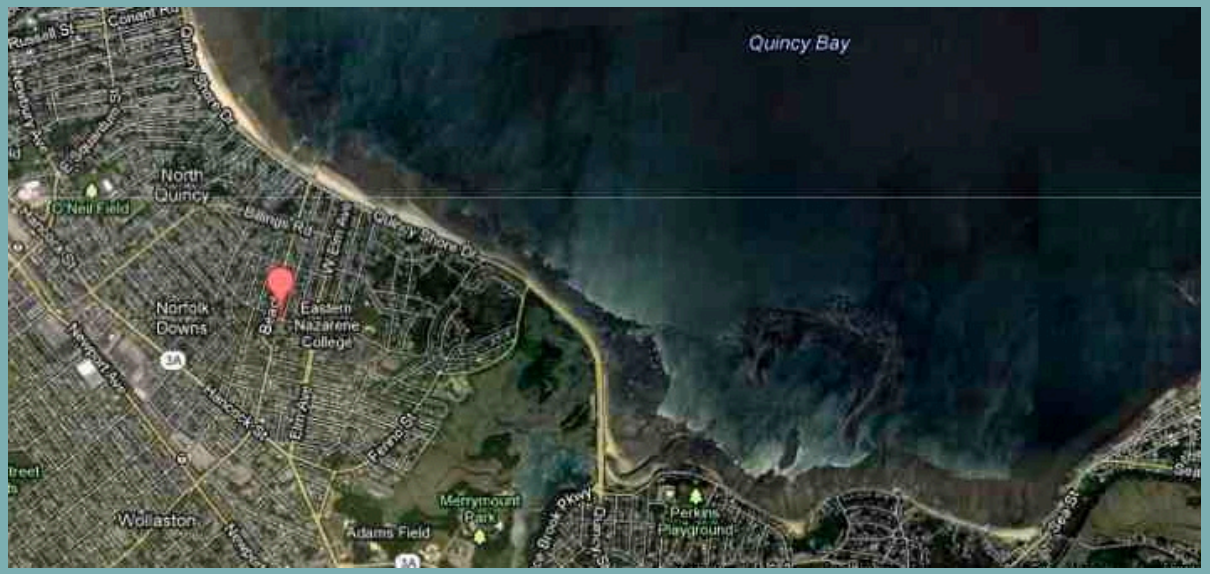


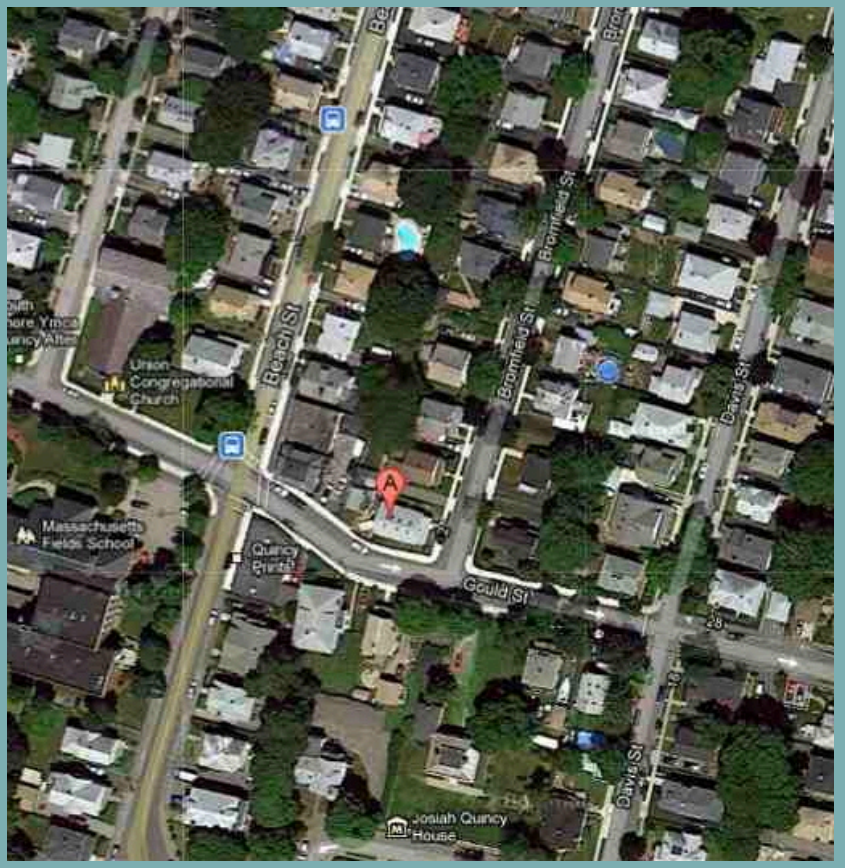
http://www.novatlantis.ch/en/2000watt.html

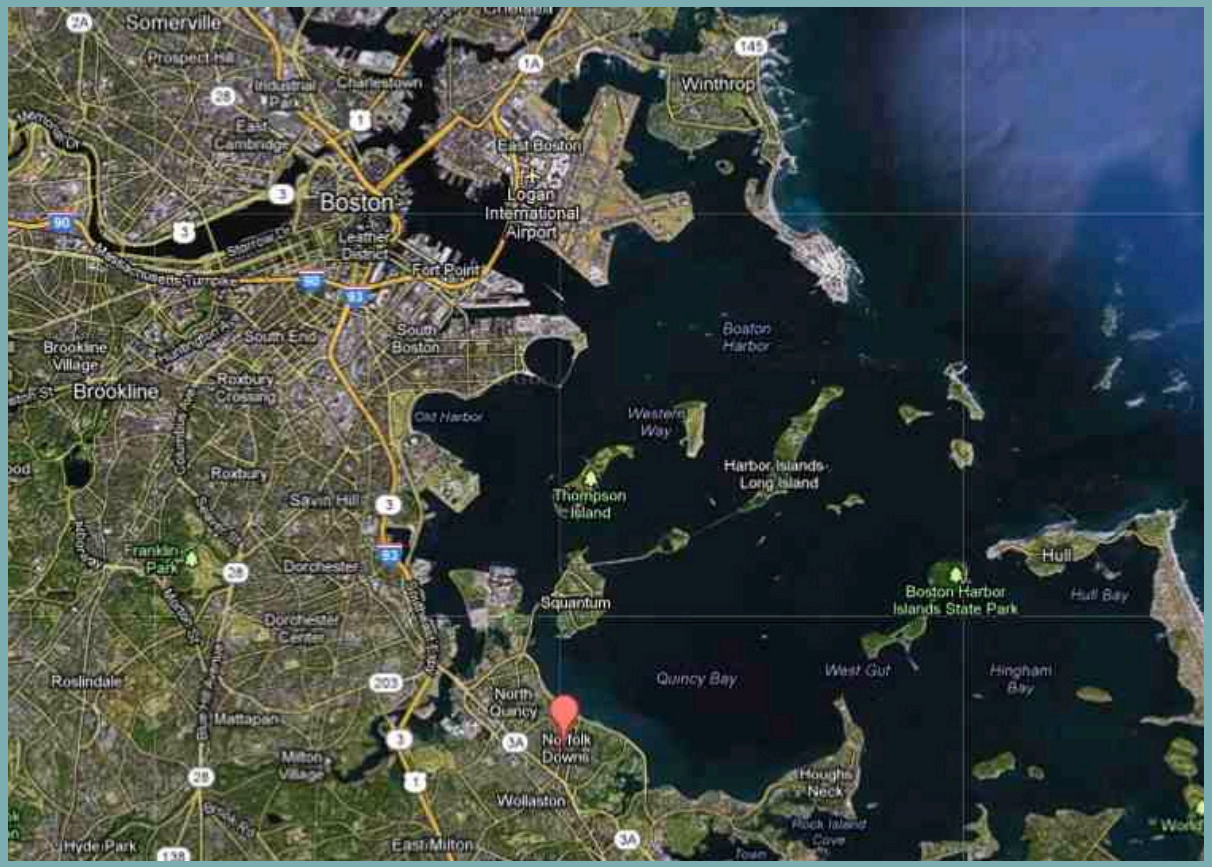
The average person on the planet uses about 17,500 kWh of energy a year for all his or her needs, which is 59.7 MBTU, or a continuous use of 2,000 watts. In Switzerland the figure is three times higher, or 6,000 watts, 180 MBTU, and in the US people use closer to 12,000 watts, or 360 MBTU. The 2000 Watt Society recommends that Americans drop their use by close to 84%, from 12 to 2,000, which is roughly in line with what is now recommended by government, an 80% reduction in carbon by 2050.

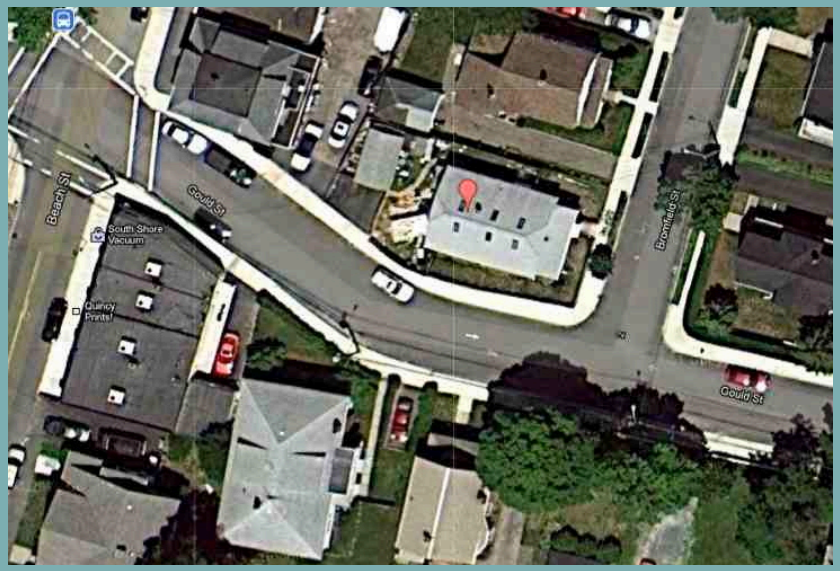
Energy Benchmarks for 2,400 SF Home in Boston Area

Type Home	KBTU /sf/yr	MM/BTU/yr	Energy costs/yr	HERS score
Average Existing	70	168	+/- $5,000	130
House Built to Code	54	130	+/- $4,000	100
Energy Star Home	45	108	+/- $3,000	75
Deep Energy Retrofit (DER)	17	41	+/- $1,300	46
DER w/ Solar	8.5	21	+/- $ 950	25
Passive House	7.4	17	+/- $ 800	35
Net Zero Energy Home	0	0	$ 0	0
Energy Plus Home	- ??	- ??	+ $	- ??


Quincy Bay
North Quincy
O'Neil Field
Norfolk Downs
Eastern Nazarene College
Wollaston
Adams Field
Merrymount Park
Perkins Playground


Union Congregational Church
Beach St
Bromfield St
Massachusetts Fields School
Quincy Printing
Gould St
Davis St
Josiah Quincy House

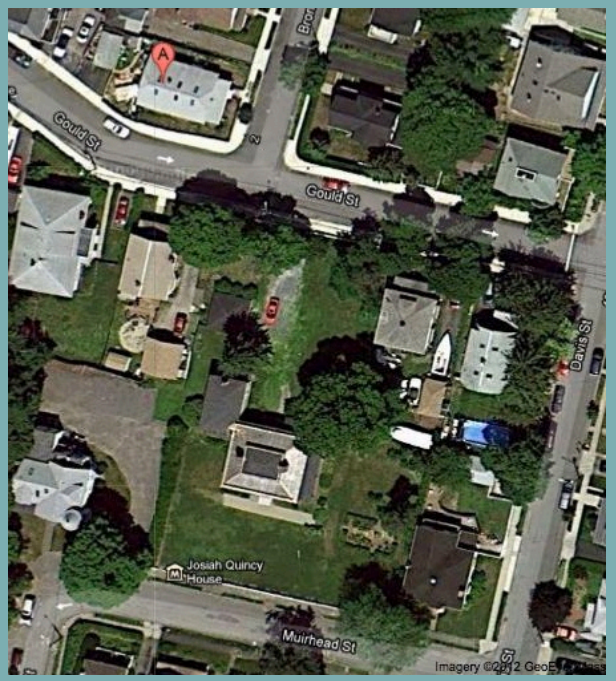

Somerville
Prospect Hill
Charlestown
Winthrop
East Cambridge
East Boston
Logan International Airport
Boston
Leather District
Fort Point
Brookline Village
Brookline
South End
South Boston
Roxbury Crossing
Roxbury
Old Harbor
Western Way
Boston Harbor
Harbor Islands Long Island
Thompson Island
Savin Hill
Franklin Park
Dorchester
Dorchester Center
Squantum
Boston Harbor Islands State Park
Hull
Hull Bay
Roslindale
Quincy Bay
West Gut
Hingham Bay
North Quincy
Norfolk Downs
Mattapan
Milton Village
Houghs Neck
Wollaston
Hyde Park
East Milton


Beach St
Gould St
South Shore Vacuum
Quincy Printing
Bromfield St

A transformation of a 1905 bungalow to a 4 story, state-of-the-art 21st century home operating with a carbon footprint of 15% of the average home in the Boston area.

Respecting the scale and context of the neighborhood, the Owners are engaged with their community and showcasing green design.

Historic Neighbor



Looking South past Quincy House to South face of new Quincy DER

Josiah Quincy House
A National Historic Landmark

Created by Revolutionary War leader Colonel Josiah Quincy this home was built as a country estate in 1770. The Quincy House was originally surrounded by fields and pasture overlooking Quincy Bay. The family produced three mayors of Boston and a president of Harvard.


Proposed View and Mock Up from Southeast

Proposed Cutaway from Southeast

Proposed Cutaway from Northeast

National Grid Deep Energy Retrofit Pilot Program

Home is producing close to 60% of its annual fuel needs with Solar Electric and Solar Thermal panels. With combined focus on energy efficiency & renewables project received a (HERS) of 25 from Conservation Services Group.

Owners also participated in the National ACI 1000 Homes Challenge, from July 2011 thru July 2012.

Threshold established for this particular home was 11,007 kWh a year for all energy needs, adjusted to 11,522 kWh at the end of the program, equal to 8,564 BTU/ SF/YR, or 1.39 BTU/ SF/DD/ YR.

The Project Team

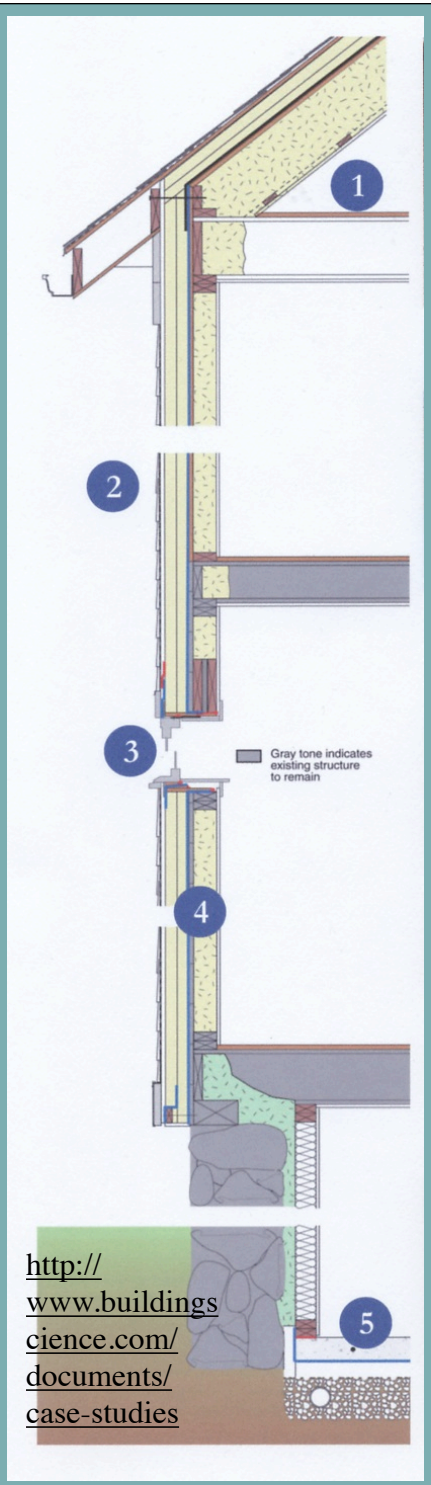
The team includes G.C. Grifcon Construction, Building Science Corp. (Building Science & DER Specialists), Conservation Services Group (Energy Performance and Verification), Ondrick Engineering (Structural), Drew Gillette (Mechanical Engineering), Alteris/Real Goods Solar, (Solar Systems), Boston Green Building (DER Consulting), with Solar Wave Inc. and Powerhouse Dynamics providing ongoing monitoring, with Timeless Architecture and National Grid DER team.

Taylor and Bailey Framers (framing, DER skin and finish work) Anderson Insulation, Jordan Woodworking (cabinetry) , DL Services (HVAC and Plumbing), AMC Electric (Electrical), Yale Appliances (Appliances and Lighting), Ferguson Plumbing (Plumbing Fixtures), Jackson Lumber (Windows and Doors), SRW Supply, and Bradco Inc. Additional Mechanical review and maintenance w/ Country Comfort Cooling and Heating.

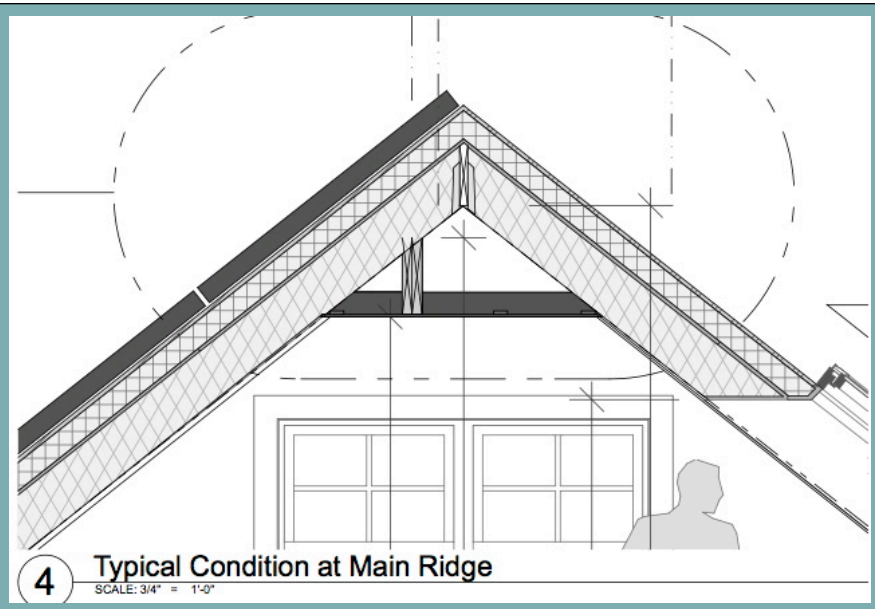
Building Shell

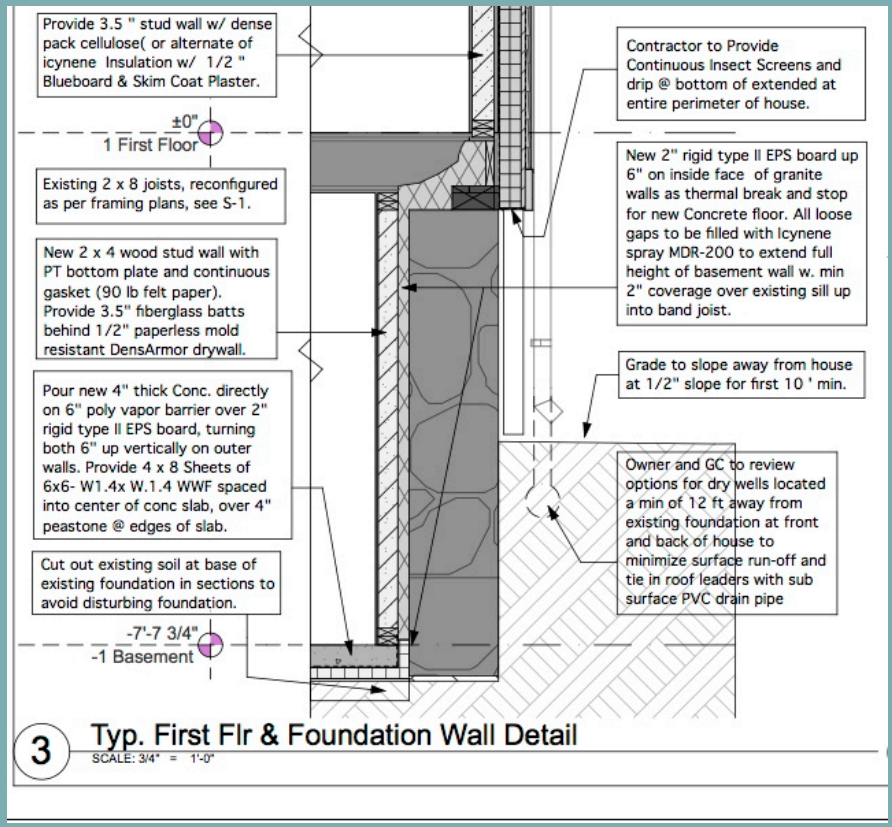
762 CFM 50 or 1.26ACH
from
5500 CFM 50 or 18.5 ACH

- **Attic, Roof:** R-60 10”Icynene w/ 4” Rigid Polyiso Foam added to exterior
- **Walls:** R-40 4” Rigid Polyiso Foam added to exterior, Grace Tri-Flex 30 on Roof over Typar fully taped, 2 layers interwoven for no thermal breaks
- **Windows:** R-5 (U 0.2 - .26) Paradigm triple glazed, low E, krypton blend or argon filled, SHGC =.23-
- **Basement/ Foundation:** 2” closed cell over sill and foundation: 3.5” fiberglass in framing, poly vapor retarder under new insulated radiant conc. slab.

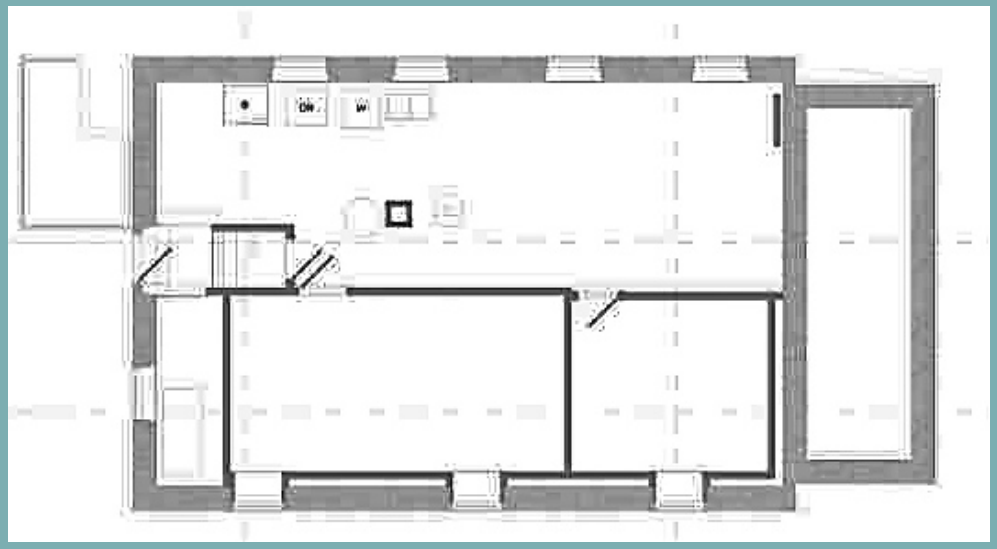


http://www.buildingscience.com/documents/case-studies



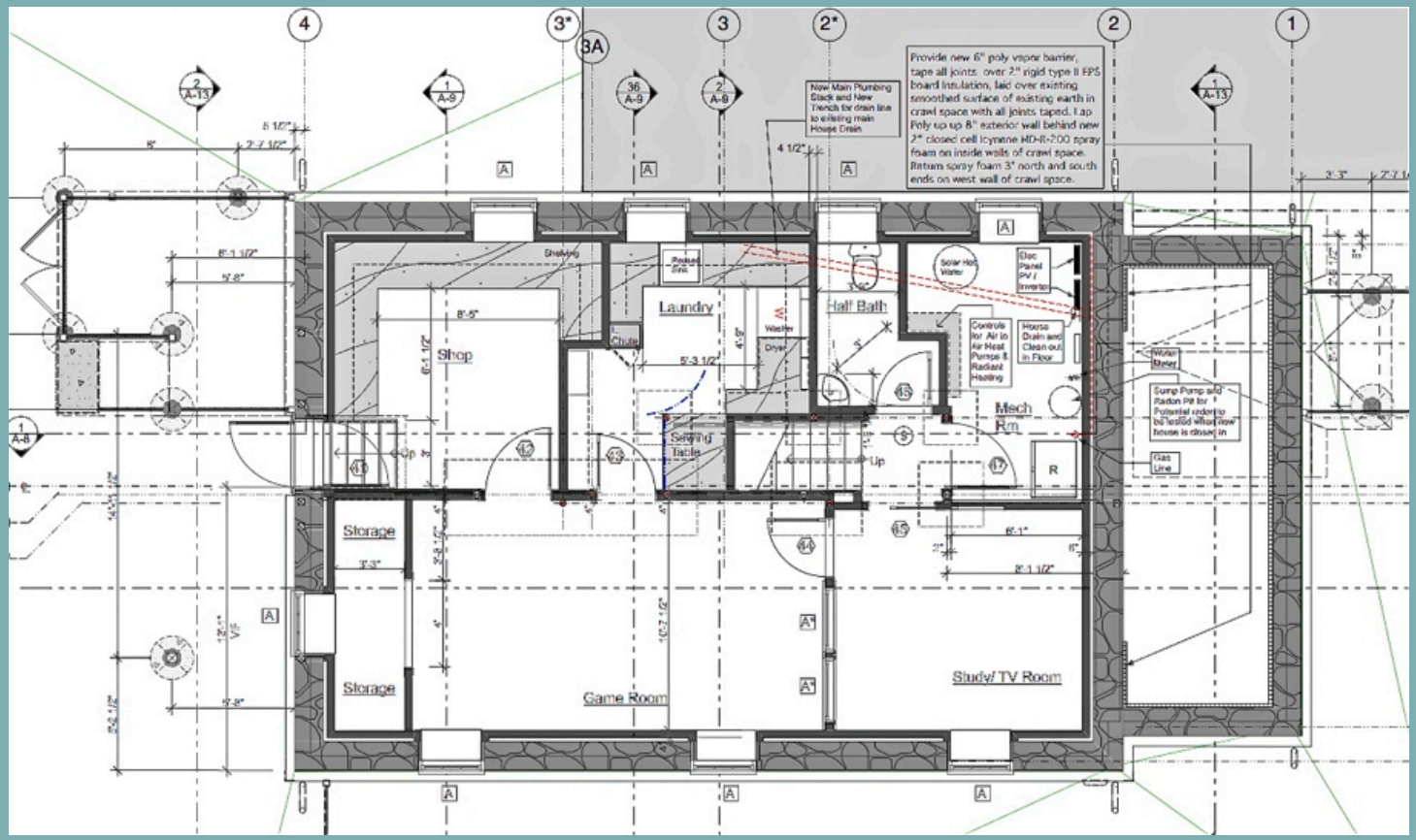


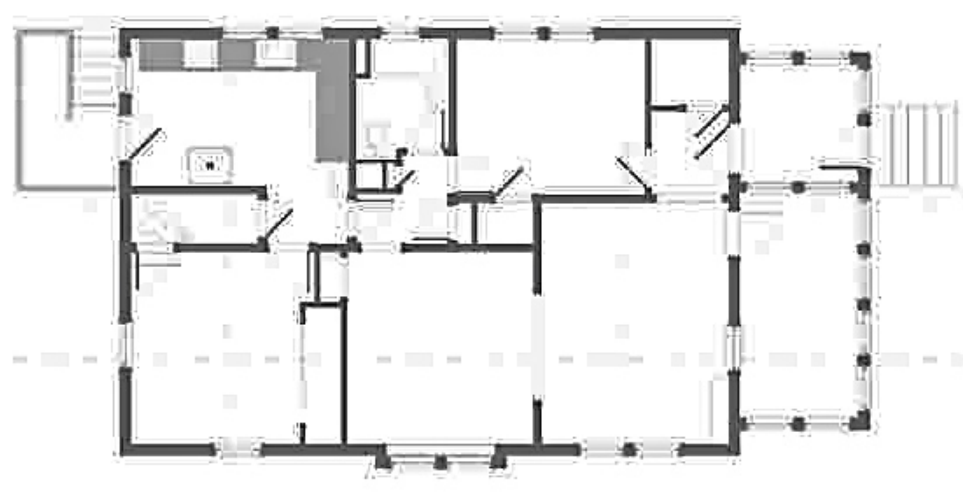
Basement floor done in 2 pours opposite corners in maintain integrity of Stone foundation. By far longest section of project was reworking the existing basement and 2 floors of existing structure/ framing.



Original
Basement Plan

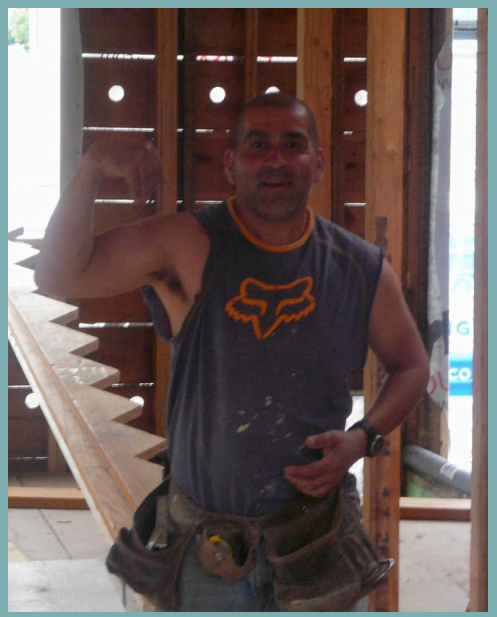
New Basement Plan





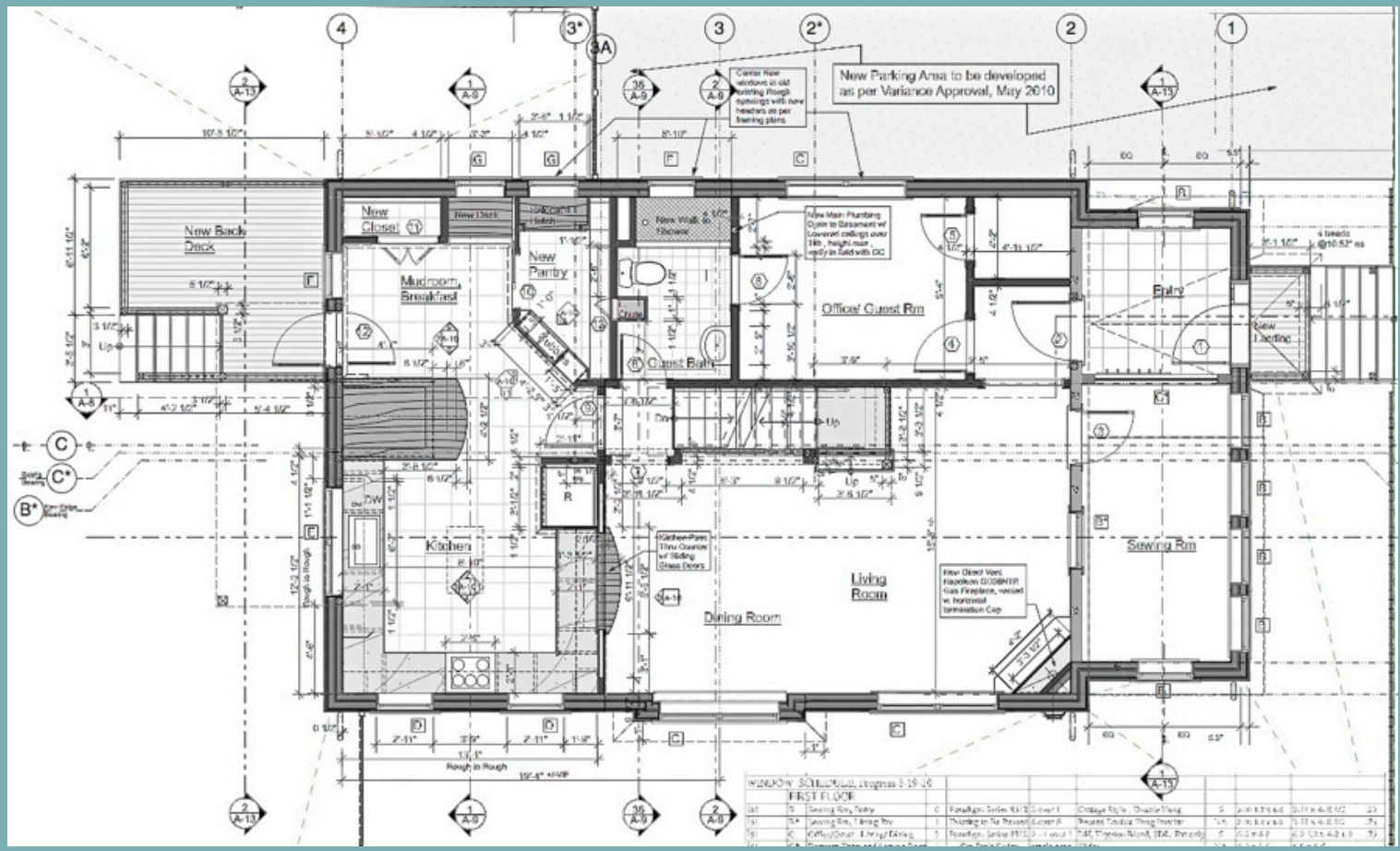
Original First Floor

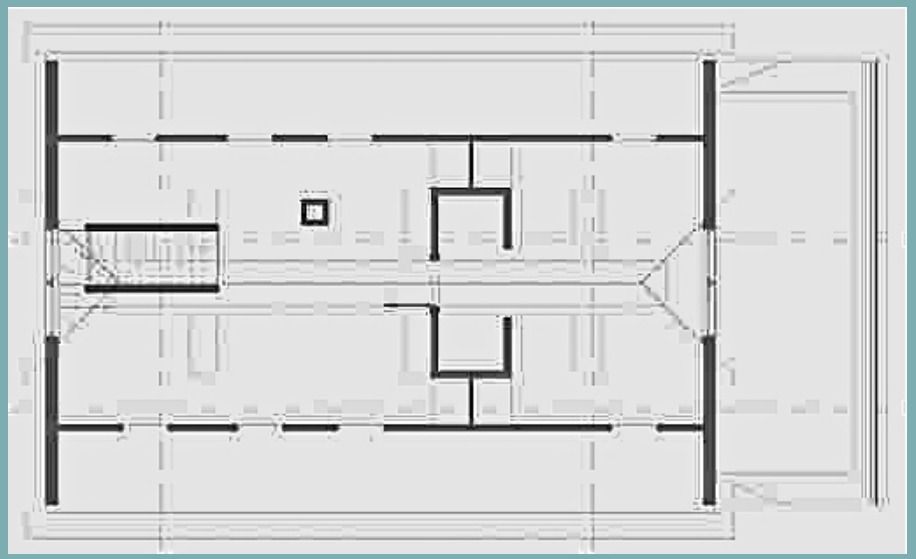
Cables for an IBM'er



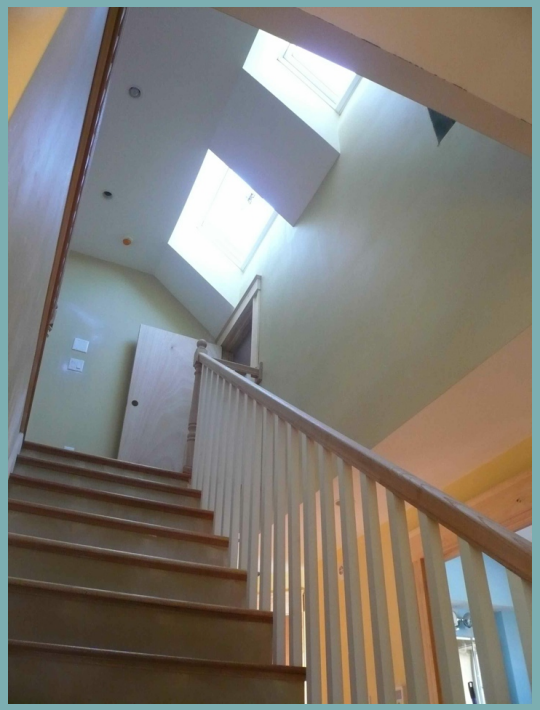
Carlos

New First Floor

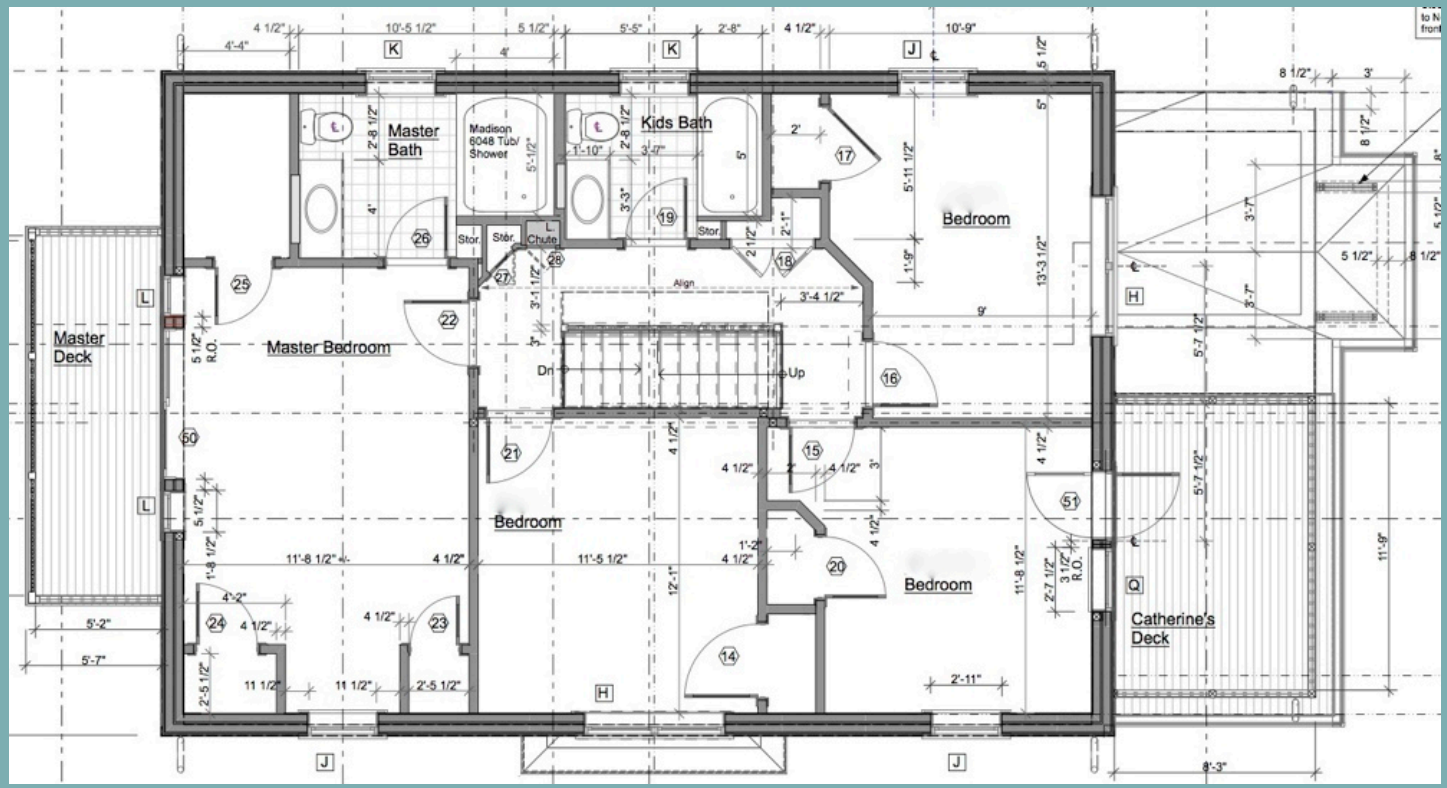


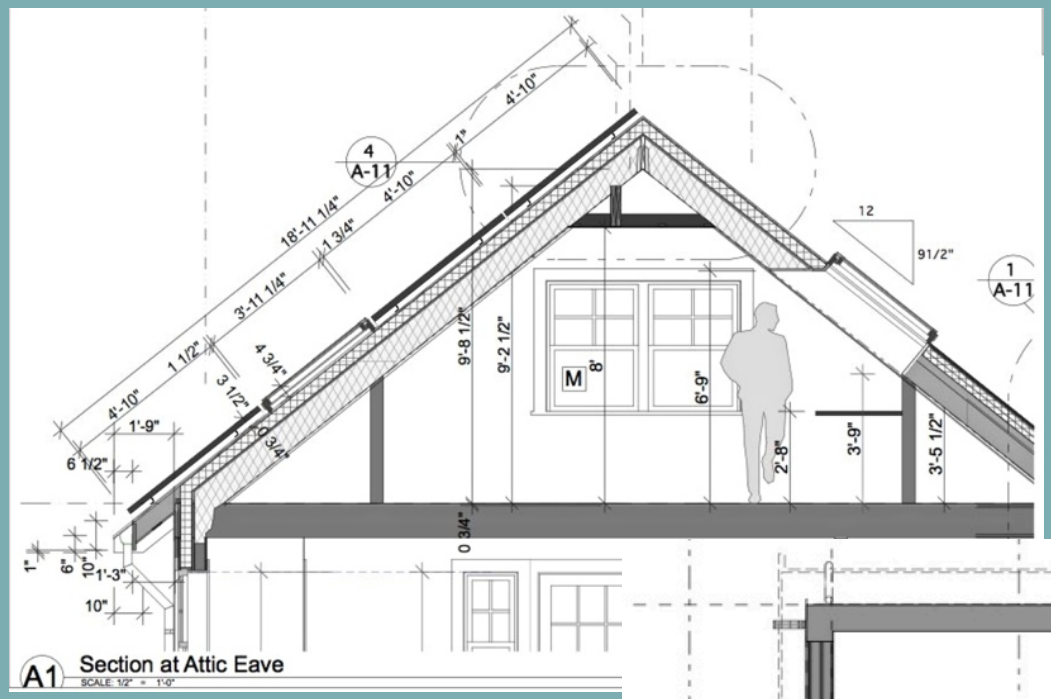


Original Second Floor

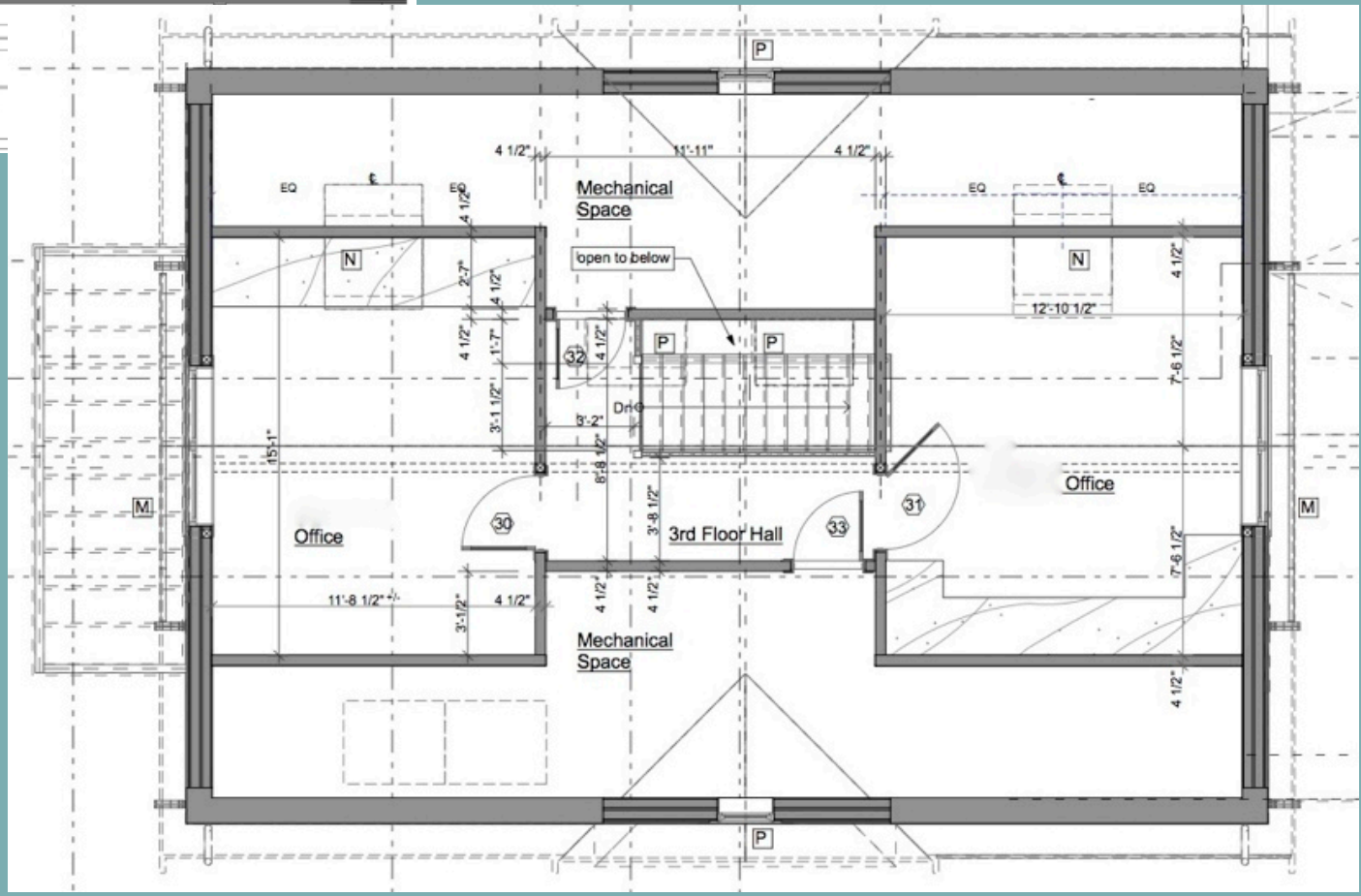


New Second Floor

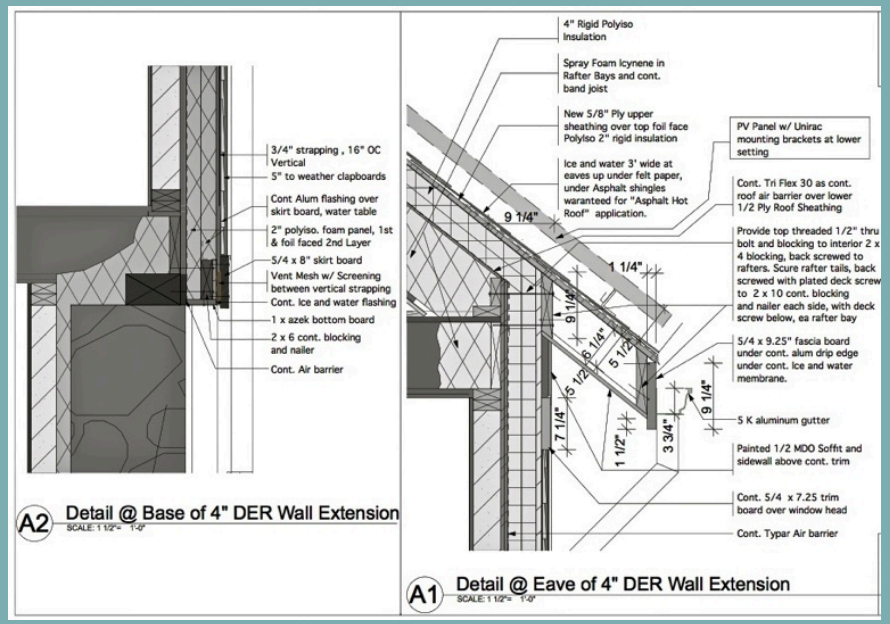


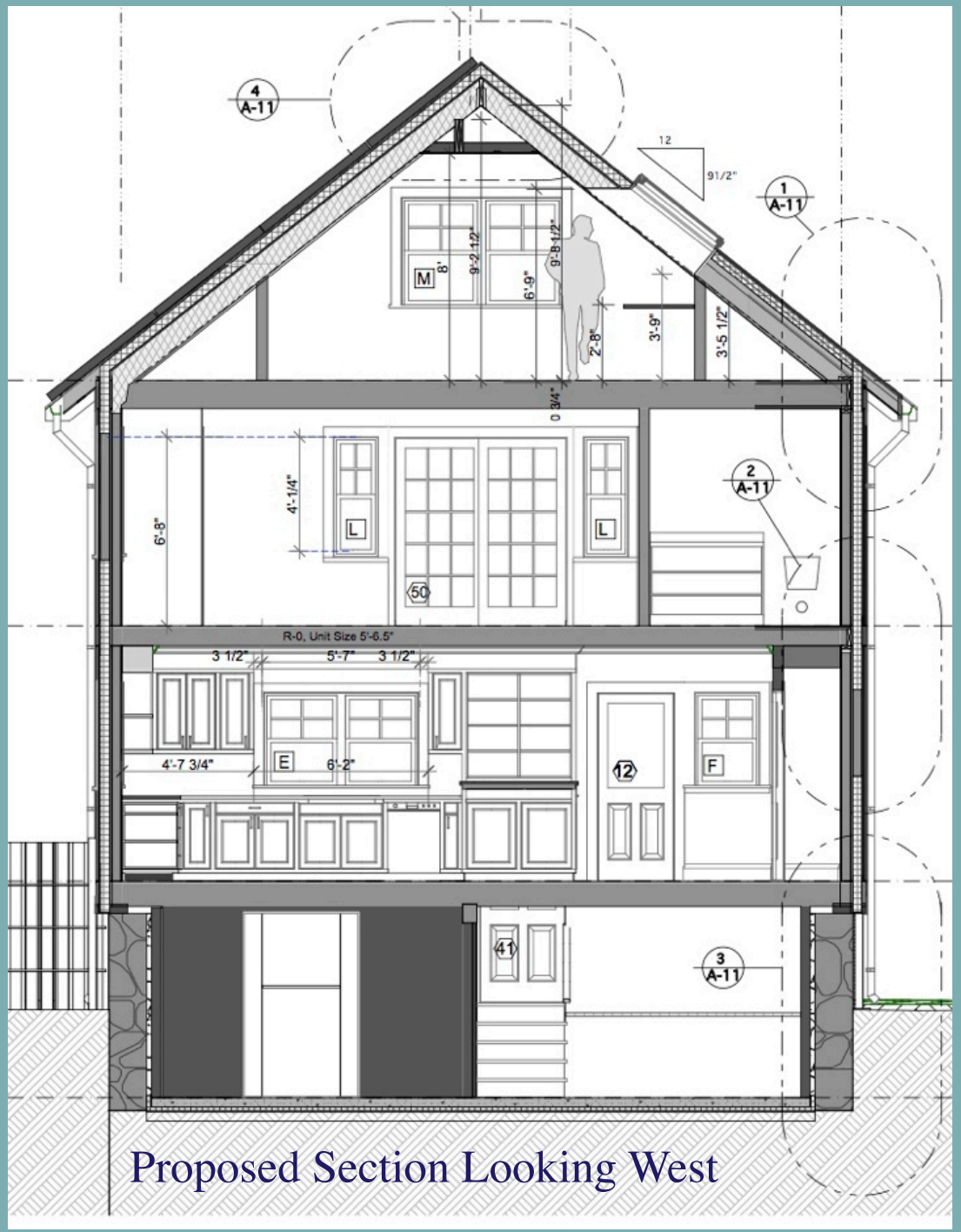


New Third Floor



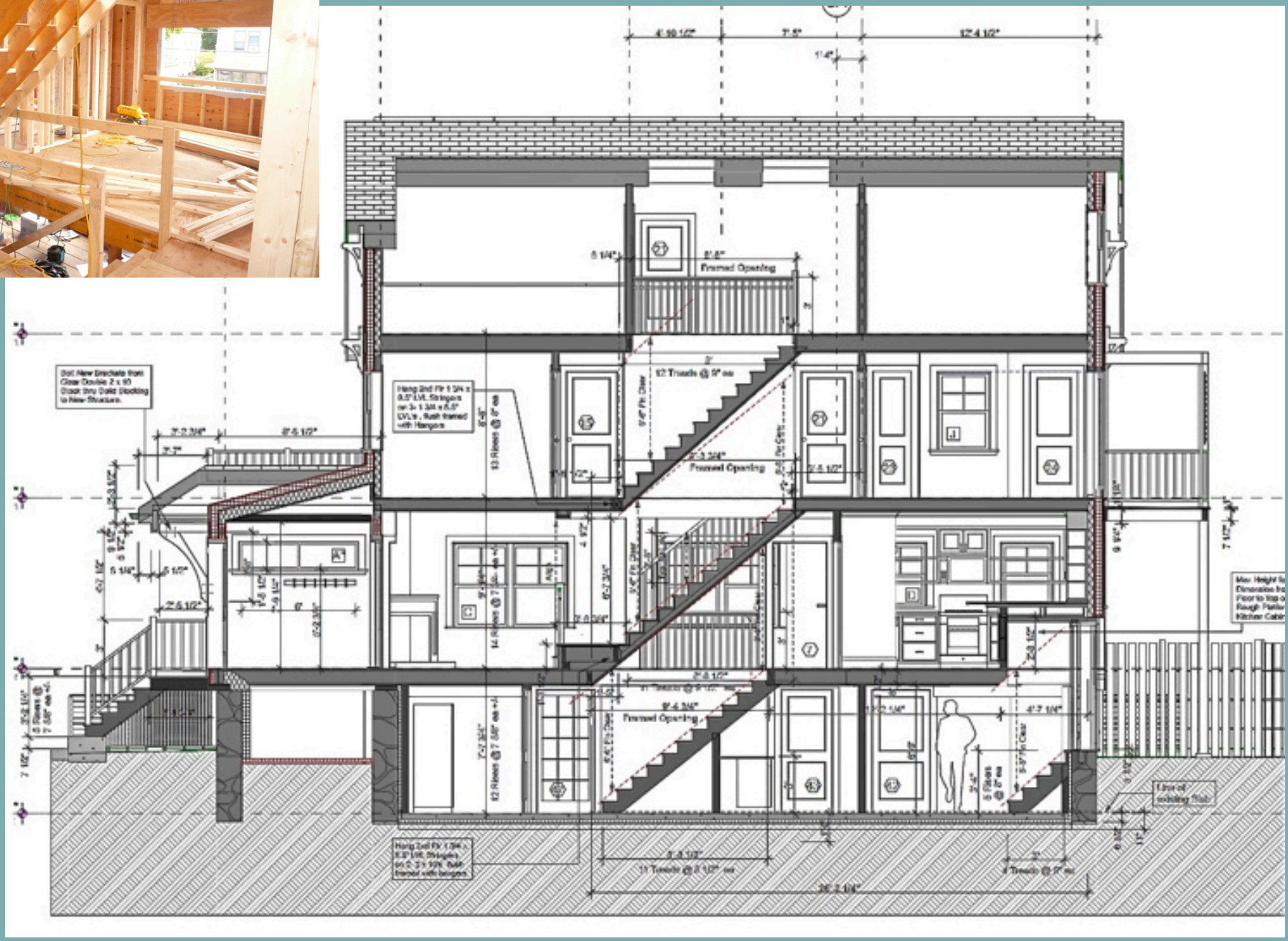
Existing Section Looking West





Proposed Section Looking West

Section Looking South



Project team constructed a wall section mock-up that demonstrated window flashing, air sealing, and attachment of exterior insulation, providing opportunities to resolve unique installation questions and serve as an effective communication tool.

April 2010 through February 2011


HomeWrap
HomeWrap
TIMELESS
ARCHITECTURE
NEW DESIGN
&
RENOVATIONS
617-696-6448


DOW
TUFF-R
Commercial Insulation
Protecto Wrap

South Elevation

Proposed View from Southwest


May 2011

Mechanical Systems

• **Heating system:**
96% eff Phoenix Evolution Versa Hydro integrating solar & gas heating, radiant slab & hydro air

• **Cooling:** Carrier Infinity Air to Air Heat Pumps, SEER 16.5 COP 4.08 @ 47*F, 2.80@17*F

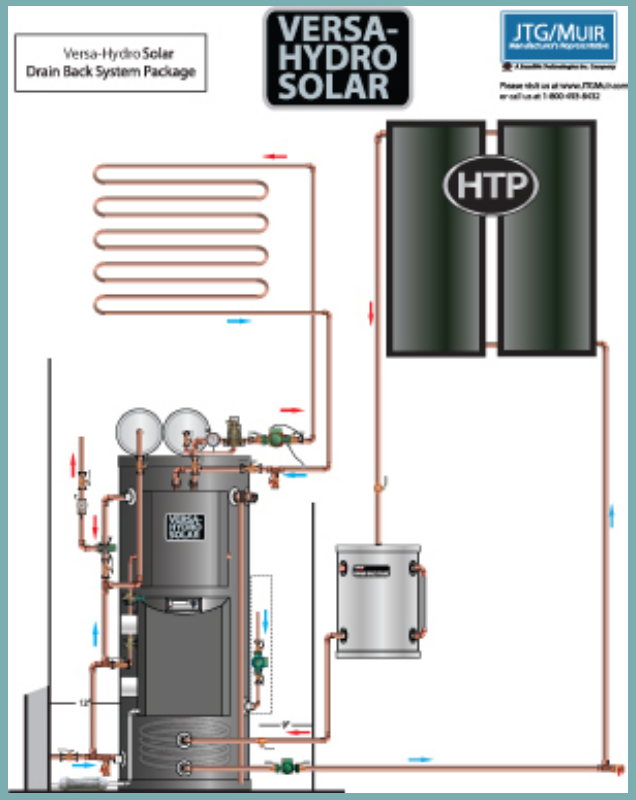
• **Ventilation:**
Lifebreath HRV, 88% efficient ducted to central AHU in Attic

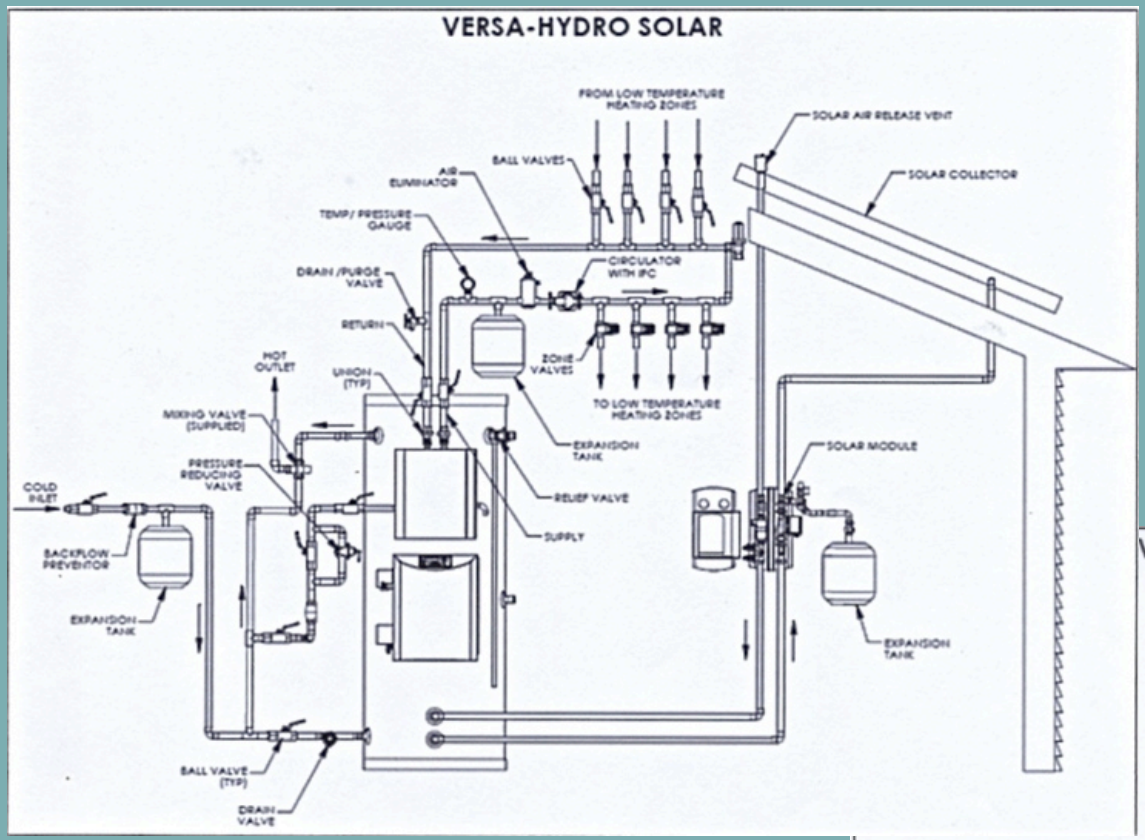
DHW: Phoenix Evolution Versa-Hydro™ direct-fired storage water heater with heat exchanger for input from 6 Velux integrated solar thermal collector panels.

• **Lighting:** Compact flourescent or better throughout
• **Appliances:** ENERGY STAR dishwasher frig. & cloths washer.

• **Site Generated Power**
6.25 KW Solar PV w/ Sun Run Residential PPA w/ Sunrun
(210 W/ panel)

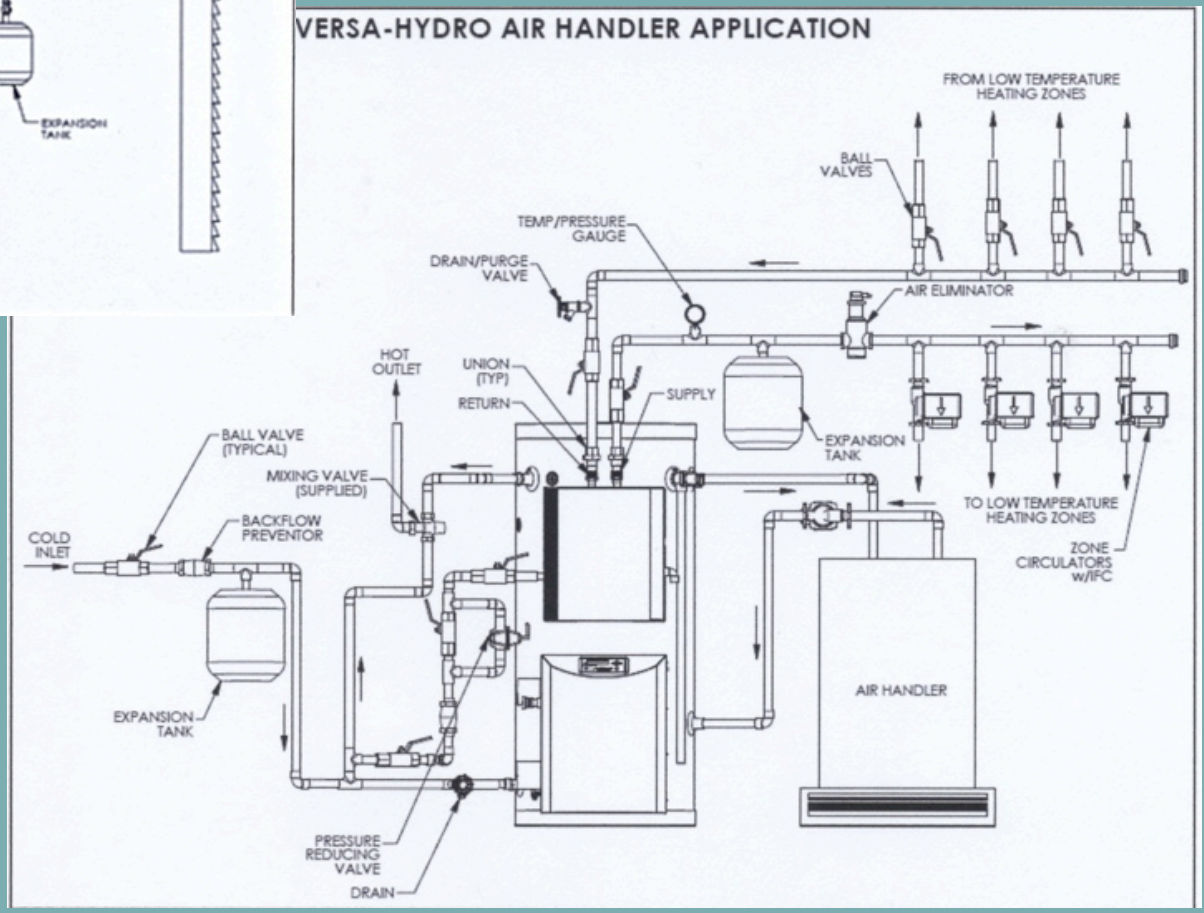
This is a tri-fuel system, solar thermal, air to air heat pump & gas fuel driven by the outside temperature which maxes out the hot water being produced by solar thermal panels before using natural gas.



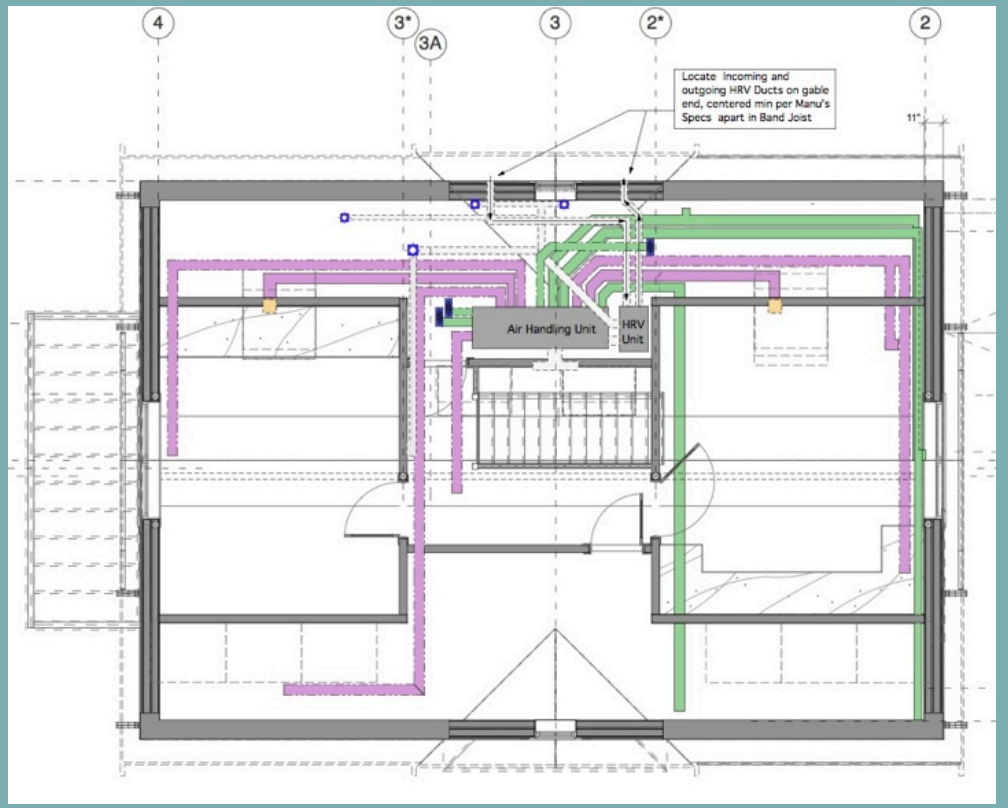


On a call for heat: if the solar sensor up on the panels is hot then all heating should be done with the solar regardless of the outside temperature.

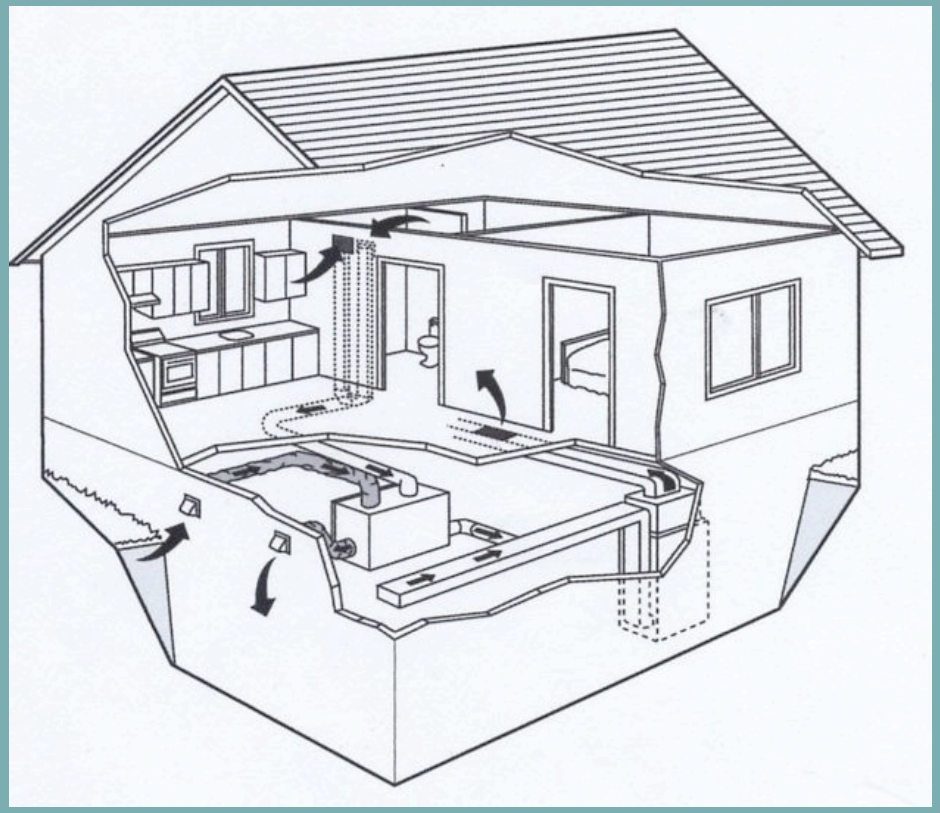
In solar thermal mode, the gas is locked out. If the solar sensor is not hot (no solar heating) then the heat pump should be running with the gas locked out down to 36*.



The max heat output of that Carrier heat pump is 37,800 BTU/Hr. We track outside temperature to know when the house needs more heat than the heat pump can put out. This is what we call the balance point of the Heat Pump, below which point all heating is done by gas.

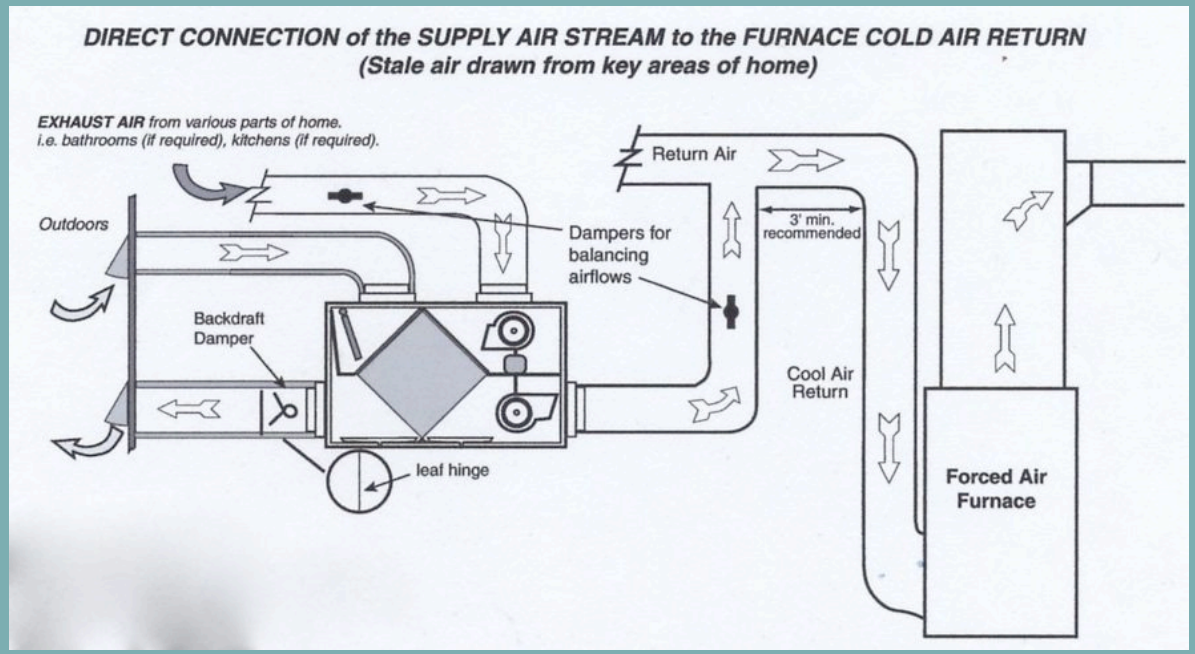


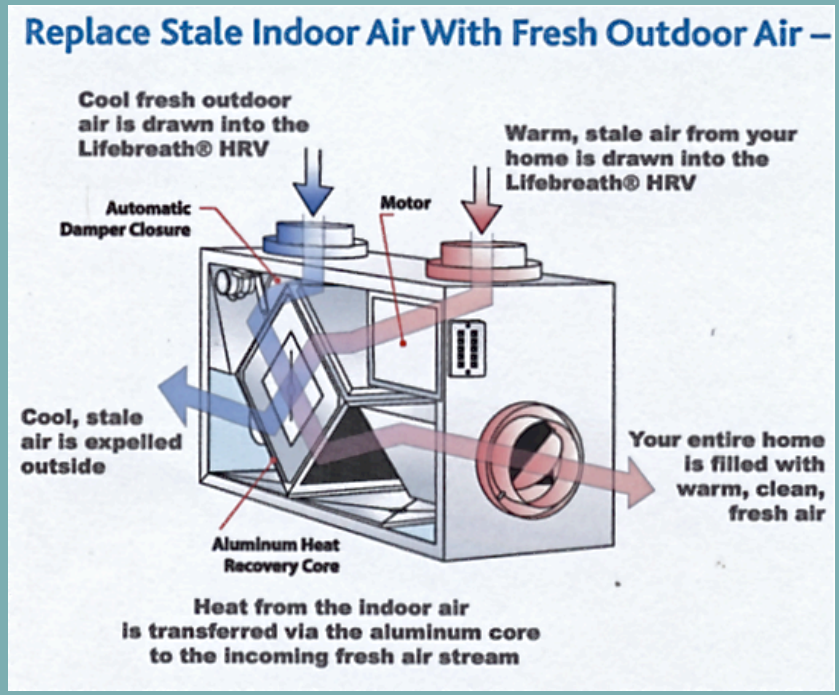
3rd Floor Mech. Plan



During measurement and verification testing, BSC confirmed that the HRV was ducted to the central forced-air system in a way that would allow air to be drawn through the ventilation unit when the ventilation system is not running.

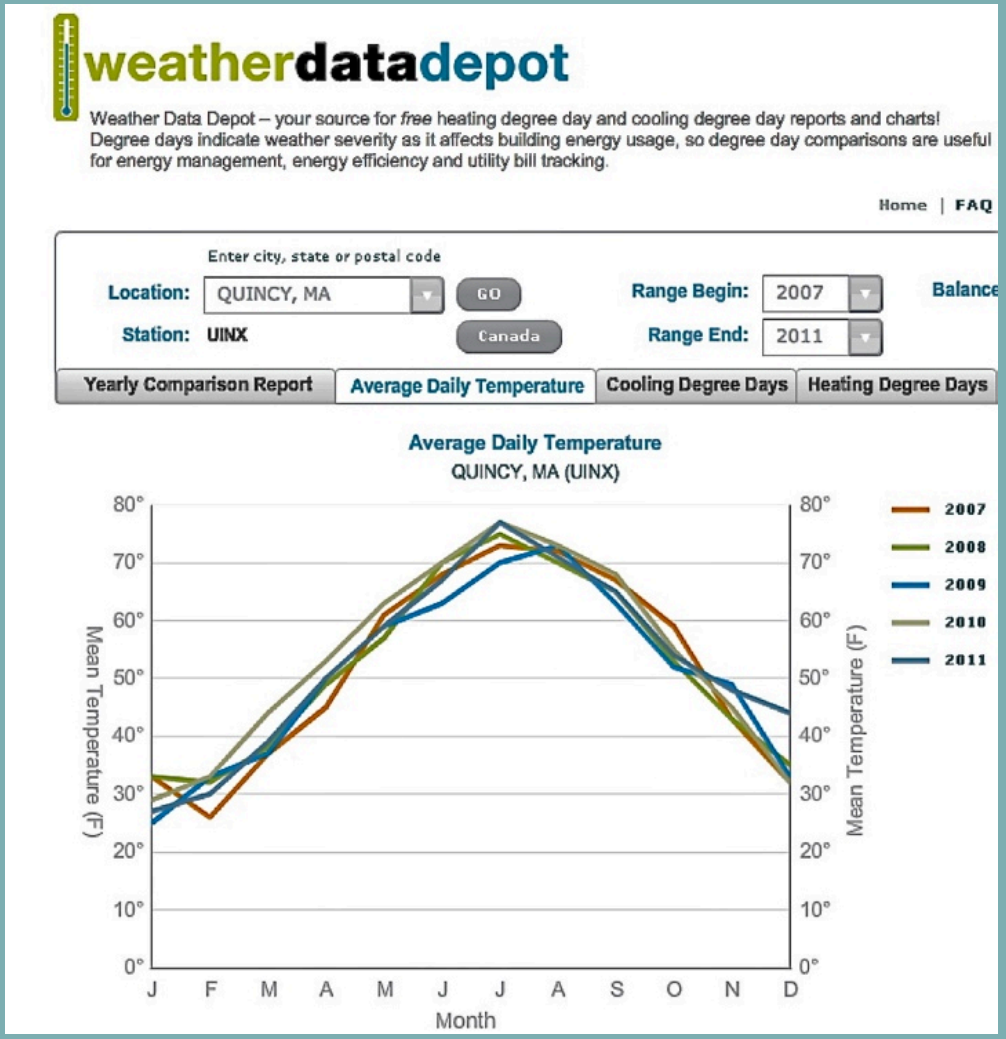
Schematics from Lifebreath HRV





1000 Home Challenge
ACI Affordable Comfort

In order to meet the 1 year monitored threshold set by National Grid, of 11,007 total kWh a year determined by the 1000 Home Challenge Program, we worked with the clients to set a monthly average target cap for energy use.

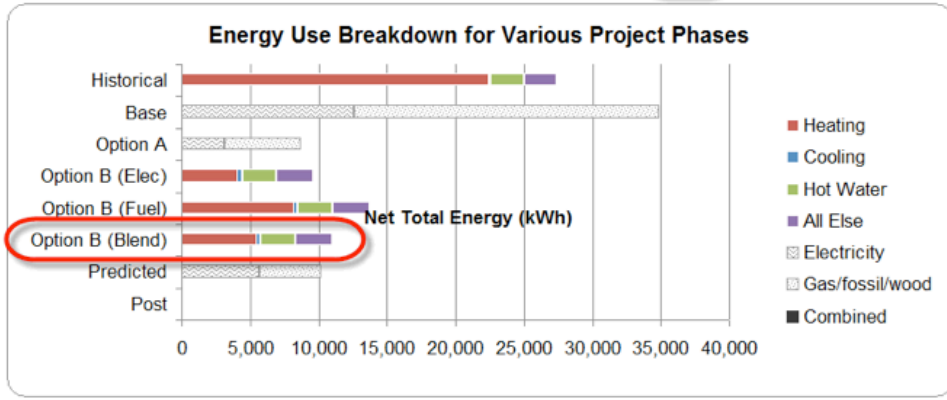


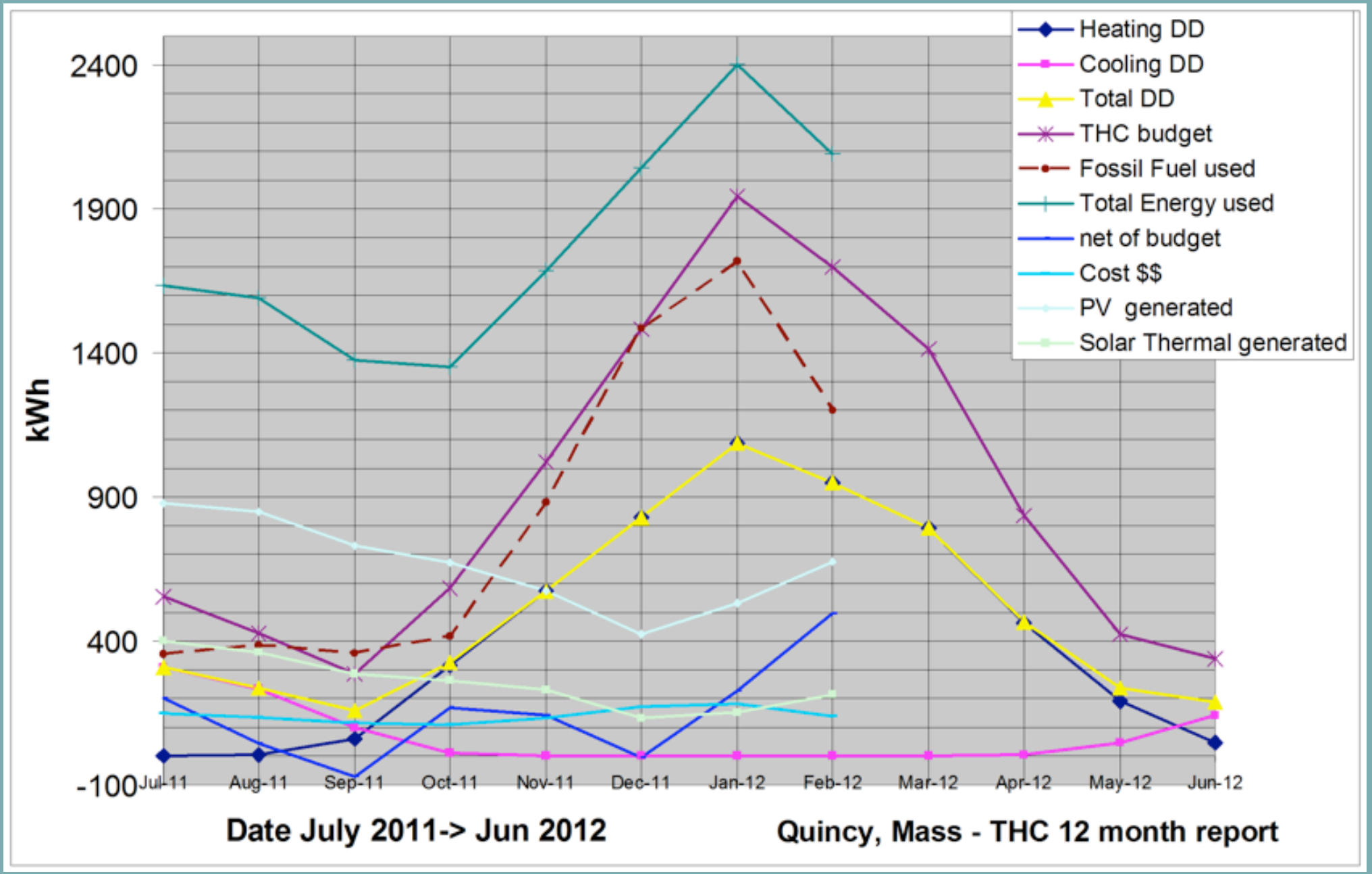
Data taken from last 5 year average degree days from Quincy, MA weather station logged in by weather data depot. http://www.weatherdatadepot.com/#

Energy Breakdown (in kWh/year)

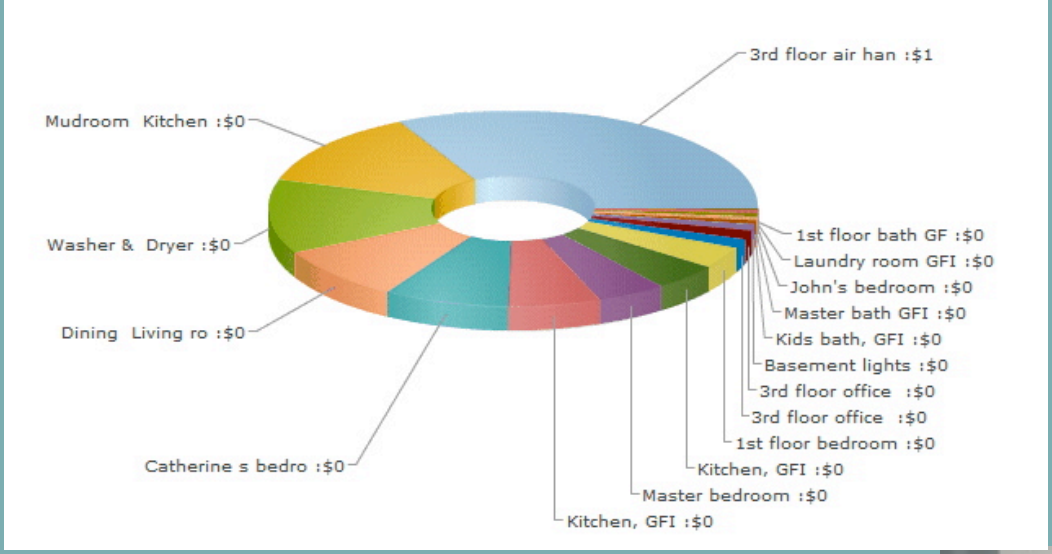
Use the following to enter known data. For each stage, enter information by total, by fuel, or by component.

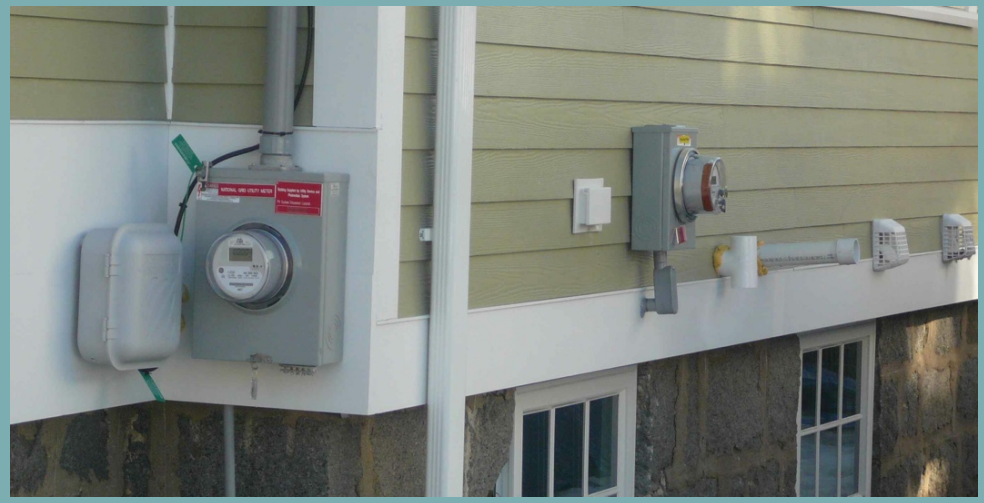
Total	Historical	Base	Option A	Option B (Elec)	Option B (Fuel)	Option B (Blend)	Predicted	Post
Total Energy	0	34,932	8,733	9,649	13,723	11,007	10,213	0
Fuel								
Electricity	0	12,570	3,143	9,649	5,576	8,291	5,700	0
Gas/fossil/wood	0	22,362	5,591	0	8,147	2,716	4,513	0
Component								
Heating	22,358			4,074	8,147	5,432		
Cooling	228			365	365	365		
Hot Water	2,394			2,481	2,481	2,481		
All Else	2,394			2,730	2,730	2,730		



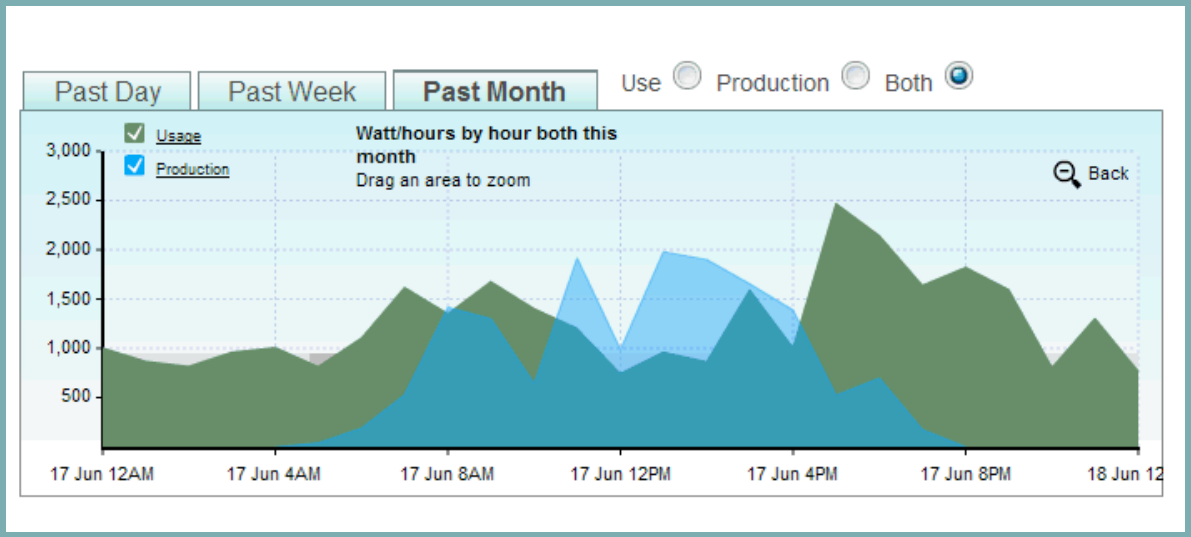


Graph: Thomas Hall & Matthew Shrago



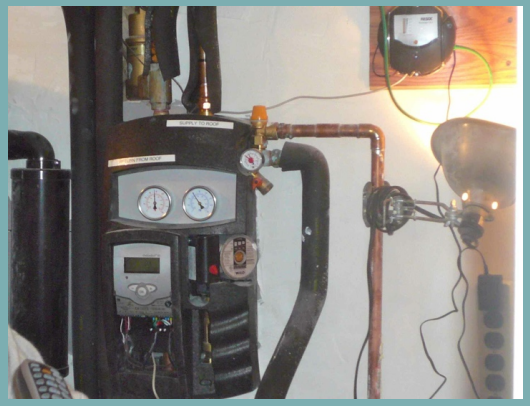


Powerhouse Dynamics Solar PV Monitoring is doing ongoing monitoring on the project , which the Owners have set up circuit by circuit. The Owners are also working w/ the SunRun Home Solar program which has them locked in at $11.a kWh for 20 years, w/ $1K, paid back in 1st 48 months.

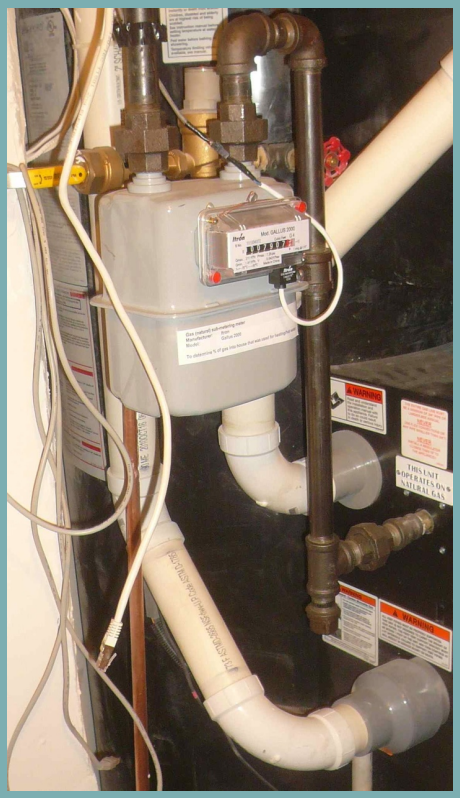


Thomas Hall Owner & Henry Vandermark, Solar Wave Inc

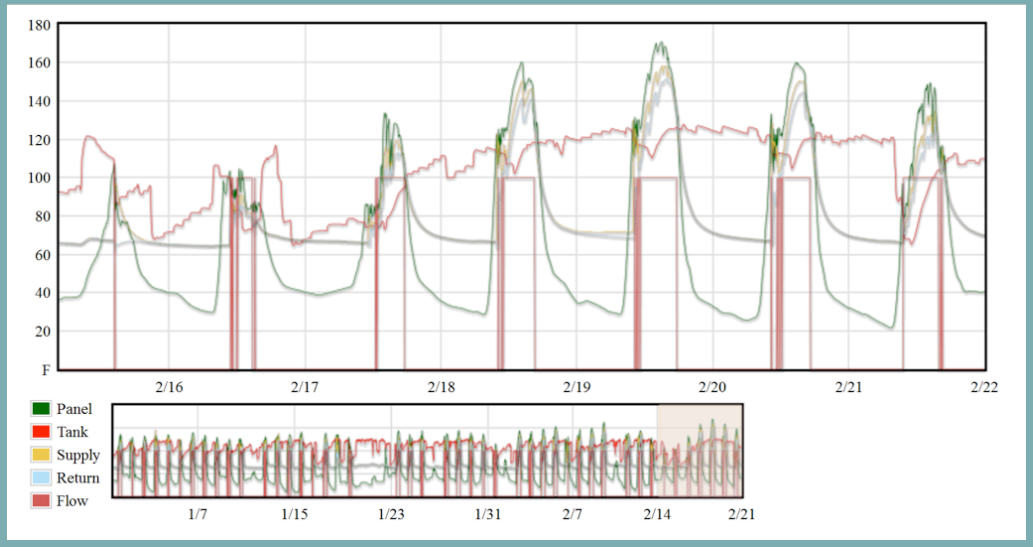
Velux & resol monitors for solar thermal

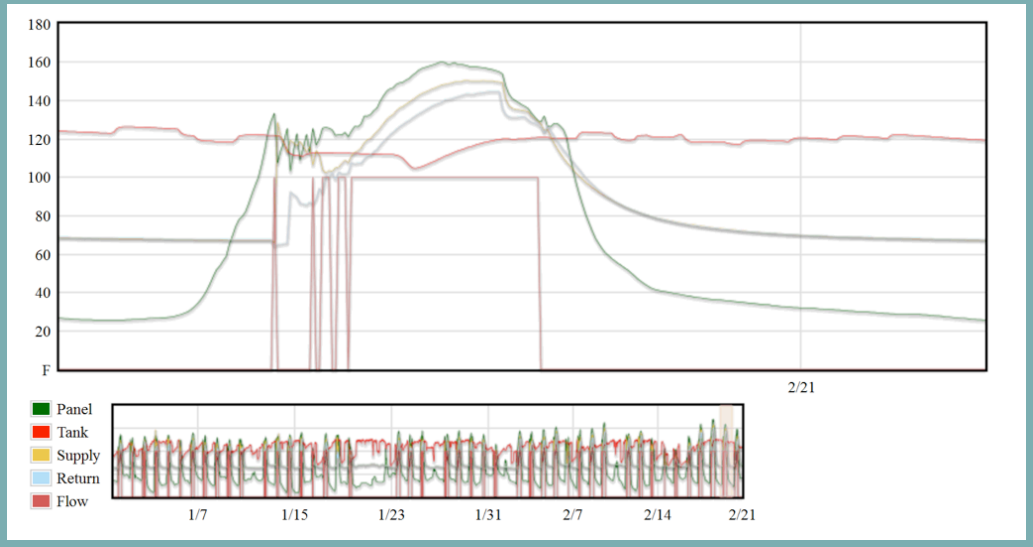


Small natural gas meter on Versa Hydro for breaking out gas from solar therms



Solar Wave Inc Data on Project for more info http://sol.lan.solarwave.net/quincyHouseDev/quincyEconomics.php





Energy Modeling and Performance 2011-12

The Quincy home total operating energy load as estimated and modeled by Conservation Services Group (based on the building shell & mechanical systems specified) was 23,351 kWh a year, or 79.7 MMBTU, which for this 3,560 SF home is 22,380 BTU/ SF/ YR.

The house received a HERS (Home Energy Rating) of 25 from CSG as well as a leakage rate of 762 CFM50 or 1.26 ACH50 by Building Science Corp, w/ 85% infiltration air leakage reduction from 5050 50CFM and 18.5 ACH50.

For the true up process required to meet the THC, we determined a 37% electric to 63% gas split for space heating (1,119 kWh elec. & 3,044 kWh gas). Fossil fuel energy use for 2011-12 is at 8,564 BTU/ SF/YR, or 1.39 KBTU/ SF/DD/ YR.

THC Annual True-Up Process

As part of true-up process for the 1000 Home Challenge, the team was required to verify the electric vs. gas with respect to space heating, set at 50% each as a default. The read out of 1,925 kWh for the gas was provided as part of the Solar Wave online thermal read out. To determine the electrical space heating, we created the chart below in which we listed all the electricity for the year to run the condenser unit, air handler and phoenix boiler from the e-monitor site. We then interpolated for heating vs cooling degree days and isolated out the cooling by pro rating the loads by the heating and cooling degree day split. This gave us 1,118 kWh / YR for the electrical space heating & a total of 3,044 kWh for both, with a new 37-63% electrical to gas heating split. Plugging this number into option B, our annual THC threshold was increased from 11,007 to 11,522 kWh.

	HVAC Equipment				Environmental predicted usage (heating vs. cooling as %)				Total HVAC equipment electricity usage		
	Condenser kWh used per month	Phoenix kWh used per month	Air Handler kWh used per month	Total of all HVAC equipment kWh used per month	HDD Average of previous 5 years	CDD Average of previous 5 years	Total Degree Days (heat + cool)	% of DD used for heating HDD/Total DD	*used for space heating kWh*	*used for cooling kWh*	
Jan-11		*4*									
Feb-11	*9*	*37*									
Mar-11	*21*	*36*									
Apr-11	*61*	*19*									
May-11	*152*	*14*	*77*								
Jun-11	*284*	*9*	*64*								
THC Start	**Condenser**	**Phoenix**	**Airhandler**	**Total**	**HDD**	**CDD**	**Total DD**				
Jul-11	496	8	80	584	3	307	310	1%	5	579	Jul
Aug-11	387	8	48	444	5	233	238	2%	9	435	Aug
Sep-11	252	8	34	294	60	100	160	38%	110	184	Sep
Oct-11	85	10	45	140	316	11	327	97%	136	5	Oct
Nov-11	32	12	12	56	572	-	572	100%	56	0	Nov
Dec-11	82	13	6	100	830	-	830	100%	100	0	Dec
Jan-12	168	17	10	195	1,089	-	1,089	100%	195	0	Jan
Feb-12	104	15	6	125	950	-	950	100%	125	0	Feb
Mar-12	63	11	8	82	792	-	792	100%	82	0	Mar
Apr-12	49	8	5	62	461	6	467	99%	62	1	Apr
May-12	149	9	18	176	191	47	238	80%	141	35	May
Jun-12	339	8	45	392	47	142	189	25%	98	294	Jun
THC End											
Sum for THC	2,205	128	318	2,650	5,317	845	6,162		1,118	1,532	2,650
									42%	58%	

Energy Modeling and Performance 2011-12

The house produced & consumed (58.9% solar)

8,531 kWh /from PV
4,296 kWh from ST/YR.
12,827 kWh Total Solar Production

The house bought & consumed

7,764 kWh (natural gas)
1,172 kWh (elec. from grid)
8,936 kWh/YR,

Fossil fuel energy use for 2011-12 22.4% under the 11,522 threshold.
8,564 BTU/ SF/YR

This is 87.78 % below typ. 70 KBTU/SF/YR home in Boston!!
(8,564/ 70,000 = 12.23%)

Total load of 21,763 kWh and 93.2% of the 23,351 kWh (79.7 MMBTU) CSG model. Comparing Degree Days for the monitoring period, we were at 81.5% of the average last 5 years, indicating that even with a warm winter, and the proportional 77.6% of the threshold set, the DER in Wollaston still beat the challenge.

Energy Modeling and Performance 2012-13

The house produced & consumed (46.7% solar)

8,306 kWh /from PV (down 2.5%)
4,146 kWh from ST/YR. (dn. 3.6%)
12,452 kWh Total Solar Production

The house bought & consumed

10,228 kWh (natural gas)
3,982 kWh (elec. from grid)
14,210 kWh/YR,

Fossil fuel energy use for 2012-13 was 23.4% over the 11,522 THC
(14,210 x 3412) / = 13,619 BTU/ SF/YR

This is still 80.6% below typ. 70 KBTU/SF/YR home in Boston!!
(13,619/ 70,000 = 19.4%)

Total load of 26,662 kWh is 14.8% over the 23,351 kWh (79.7 MMBTU) CSG model. Comparing DD for the monitoring period, we were at 94% of the average last 5 years, indicating that even with the slightly warmer winter, the 23.5% increase over the challenge would be a bit further.

2011-12	PV Solar	Solar Thermal	A. Solar Total	Elec. from Nat. Grid	Gas from Nat. Grid	B. Fossil Fuel Total	A-B	Running Tally For THC	Average Fossil Fuel Use / Mo	Total DD in 2011-2012 bal 65*
July	879	491	1,370	90	264	354	1,016	1,016	744.66	389
August	849	434	1,283	148	234	382	901	1,917	744.66	186
Sept	730	359	1,089	93	264	357	732	2,649	744.66	139
October	671	318	989	65	352	417	572	3,221	744.66	333
Nov	574	290	864	178	703	881	-17	3,204	744.66	492
Dec	422	164	586	491	996	1,487	-901	2,303	744.66	804
Jan	532	191	723	340	1,377	1,717	-994	1,309	744.66	965
Feb	674	268	942	1	1,201	1,202	-260	1,049	744.66	838
Mar	744	395	1,139	-68	1,143	1,075	64	1,113	744.66	617
April	920	517	1,437	-239	557	318	1,119	2,232	744.66	419
May	714	399	1,113	-28	439	411	702	2,934	744.66	193
June	804	470	1,274	101	234	335	937	3,873	744.66	185
Totals to date	8,513	4,296	12,809	1,172	7,764	8,936	3,873			5,560

Reference http://www.weatherdatadepot.com/#

2012-13	PV Solar	Solar Thermal	A. Solar Total	Elec. from Nat. Grid	Gas from Nat. Grid	B. Fossil Fuel Total	A-B	Running Tally For THC	Average Fossil Fuel Use / Mo	Total DD in 2012-2013 bal 62*
July	872	528	1,400	556	176	732	668	668	1,184.17	305
August	928	556	1,484	576	176	752	732	1,400	1,184.17	301
Sept	762	410	1,172	377	234	611	561	1,961	1,184.17	144
October	587	267	854	253	586	839	15	1,976	1,184.17	270
Nov	548	223	771	347	879	1,226	-455	1,521	1,184.17	677
Dec	300	99	399	979	879	1,858	-1,459	62	1,184.17	817
Jan	518	152	670	766	2,256	3,022	-2,352	-2,290	1,184.17	1030
Feb	490	169	659	316	2,022	2,338	-1,679	-3,969	1,184.17	942
Mar	687	249	936	106	1,729	1,835	-899	-4,868	1,184.17	839
April	930	527	1,457	-275	762	487	970	-3,898	1,184.17	475
May	874	527	1,401	-139	294	155	1246	-2,652	1,184.17	259
June	810	439	1,249	120	235	355	894	-1,758	1,184.17	196
Totals to date	8,306	4,146	12,452	3,982	10,228	14,210	-1,758		14,210	6,255

Reference http://www.weatherdatadepot.com/# 12.5% Increase on 2012-13 over 2011-12

The existing 6.25 KW SunTech system on the house now is producing 8,500 kWh a year for the 30 panels, which is 283.3 KW/ per panel per year, each showing a max power of 210 Watt.

To make this a NZE we would need to jump up the system 2,878 kWh, or (2,878 / 30) 96 kWh/ year for each panel, or a replacement system for this PPA when ready to increase each panel up 34% to 478/kWh a year.

An alternate plan would be to add more PV elsewhere on the site, possibly on the garage, or further reduce the load.

Lessons Learned from Mechanical Engineer Drew Gillett
Overall Energy Performance

Positive, To Repeat

1. Replicate r 60 40 20 5 0.1 ACH/50 works just do it
2. Dedicated smart involved homeowners are priceless, strive to find and work with them.
3. Incentive programs work but the major benefit especially of those based on performance is the continuing feedback and commissioning over time with the project team.
4. Having a good DER coordinator (the Architect in this case) is a critical part of what becomes a complex project team and coordinated effort.

Negative, Changes to make

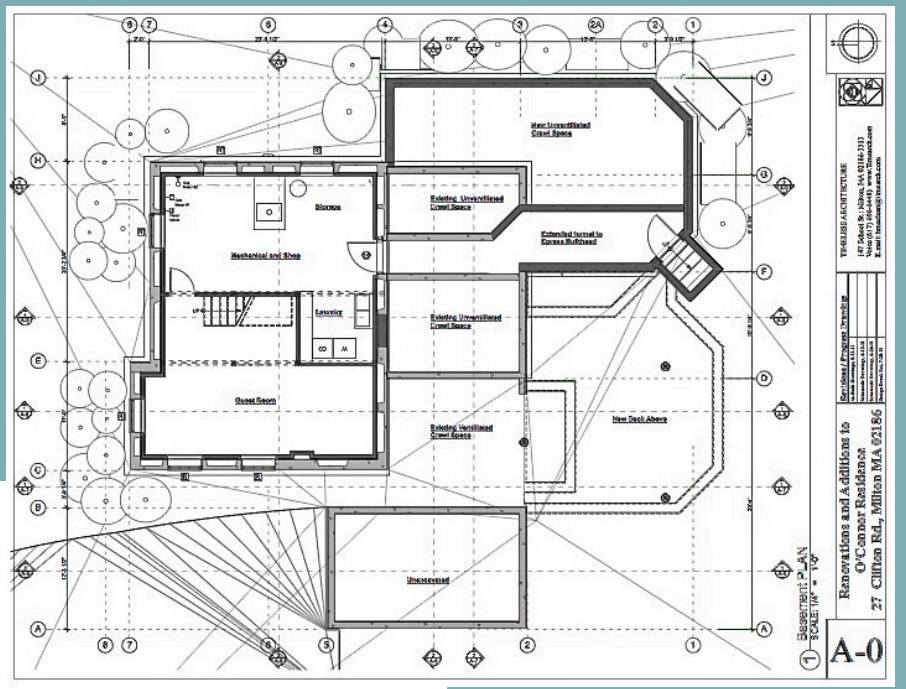
1. Consider avoiding Gas as it is a fossil fuel and harder to integrate in a DER.
2. Stratify collector to coldest load and use collector glycol return directly to load.
3. Strive to increase occupancy over 5 people per 3,500 SF, work with 2 family units as this is more efficient.
4. Consider dedicated heating distribution that is not a part of the HRV system. While these systems will lower costs and eliminate heating and cooling ductwork with mini-splits, better flow requires sacrifice of privacy.
5. Make solar bigger particularly thermal. Don't let PV dominate, consider Hybrid systems like Sundrum.
6. Big incentives ultimately tend to distort process as they tend not to focus on long term goals and may not exist thru construction never mind life of project.

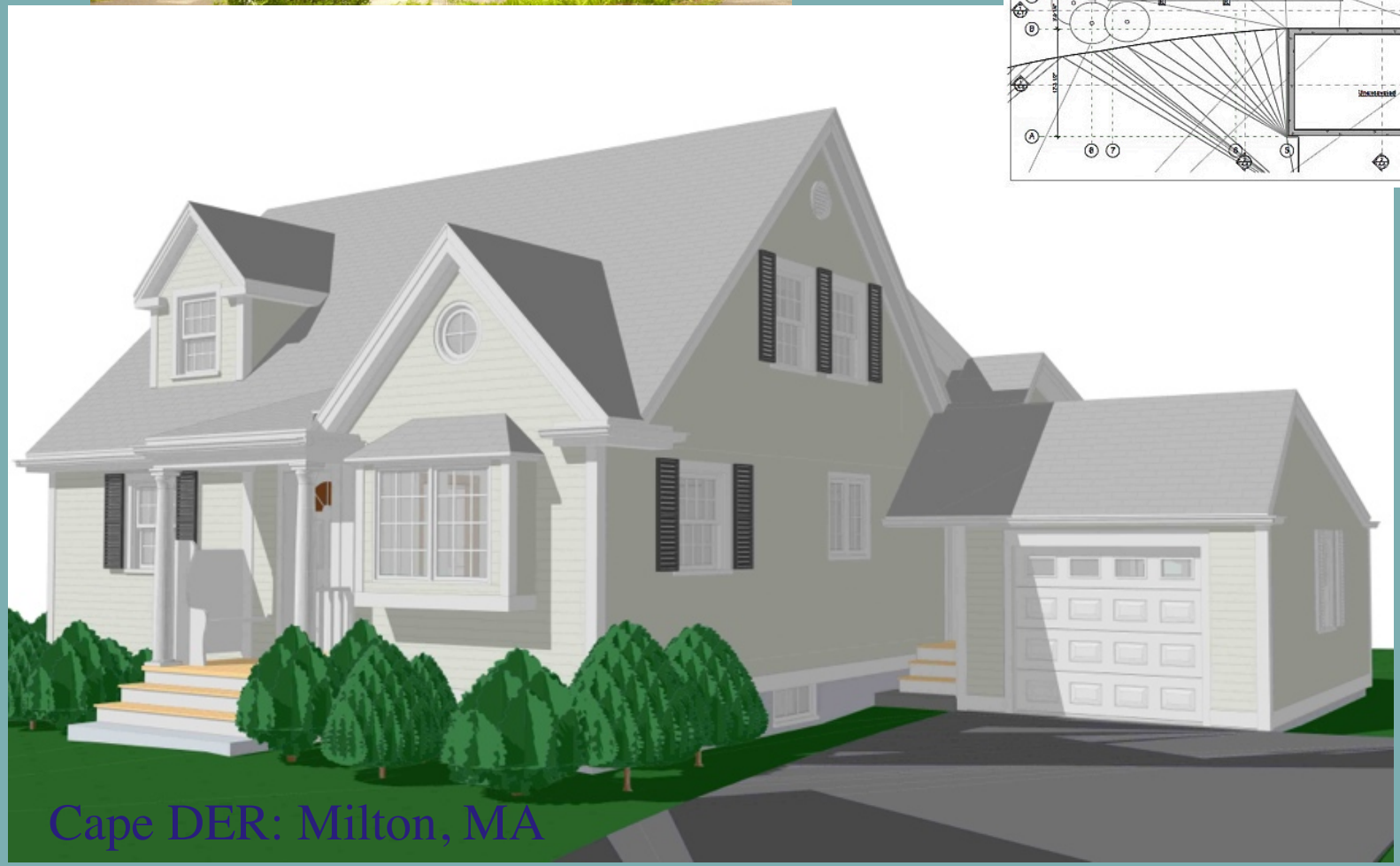
The kitchen is the hub of this home, with pass thru to open living / dining and music room beyond.

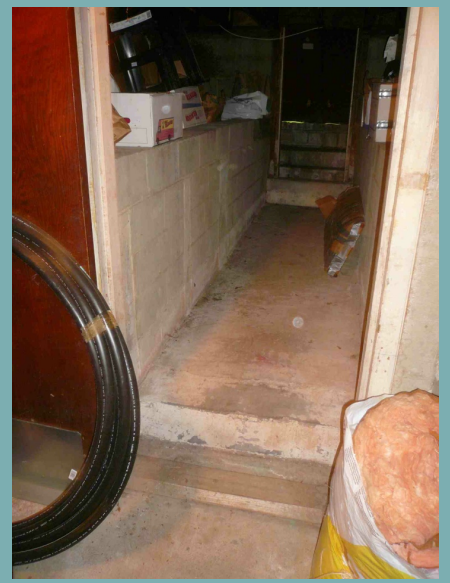
The owners, a young family of five, are thrilled with the building and doing their part to make a greener world, while creating a beautiful home and investment strategy that is "consistently comfortable."

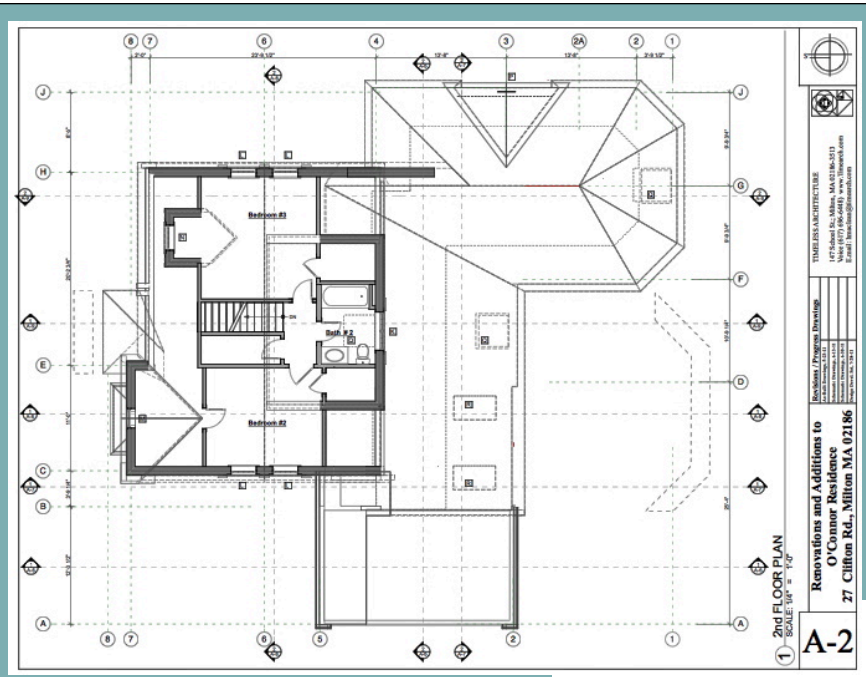
Open Living Dining and Stair to 2nd Fl.

Music Rm at Front and east street entry

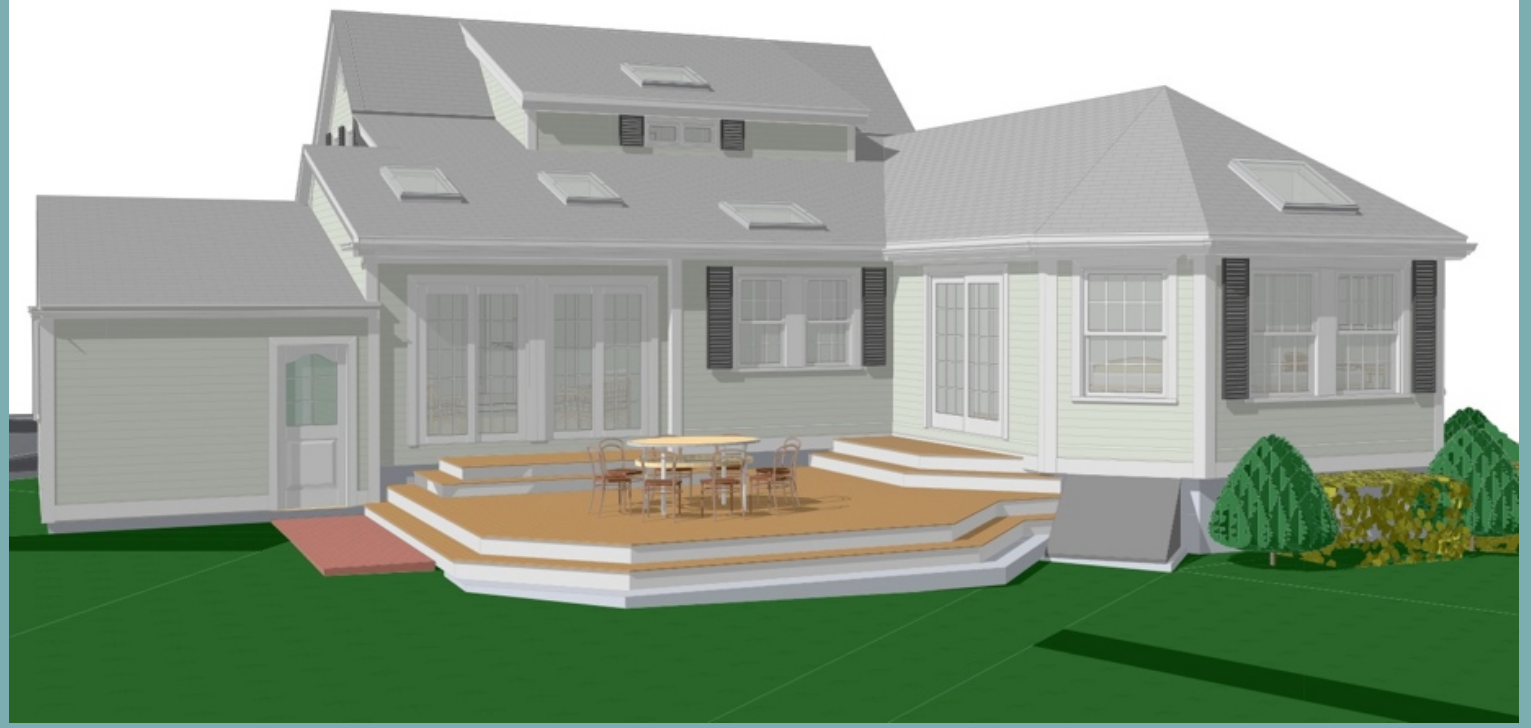

Renovations and Additions to
O'Connor Residence
27 Clinton Rd., Milton MA 02186
A-0


Cape DER: Milton, MA

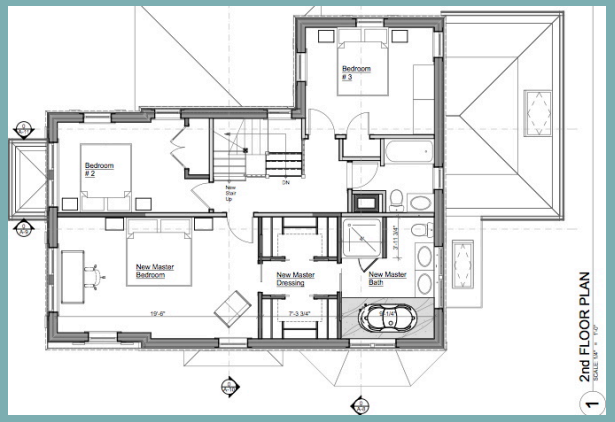


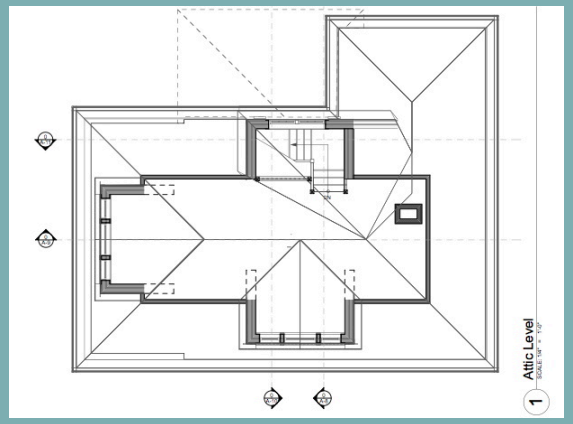


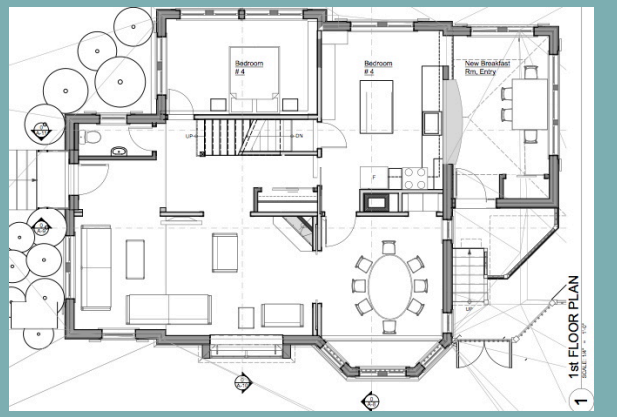
Cape DER: Milton, MA

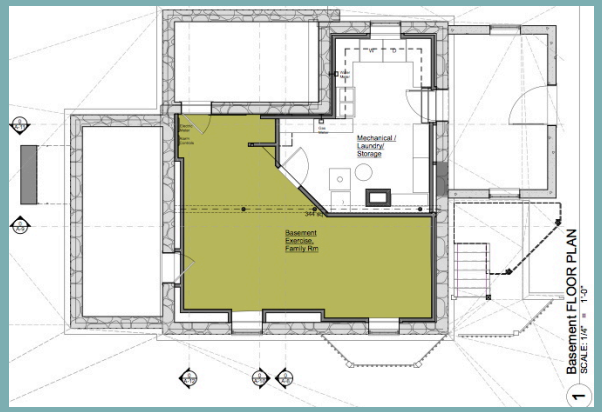


Colonial DER: Milton, MA

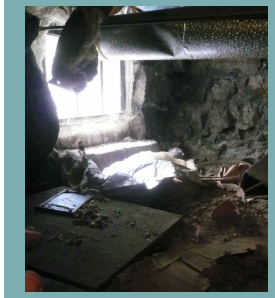


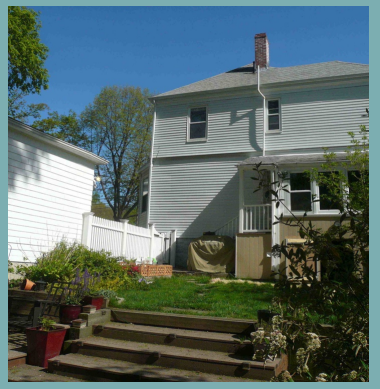


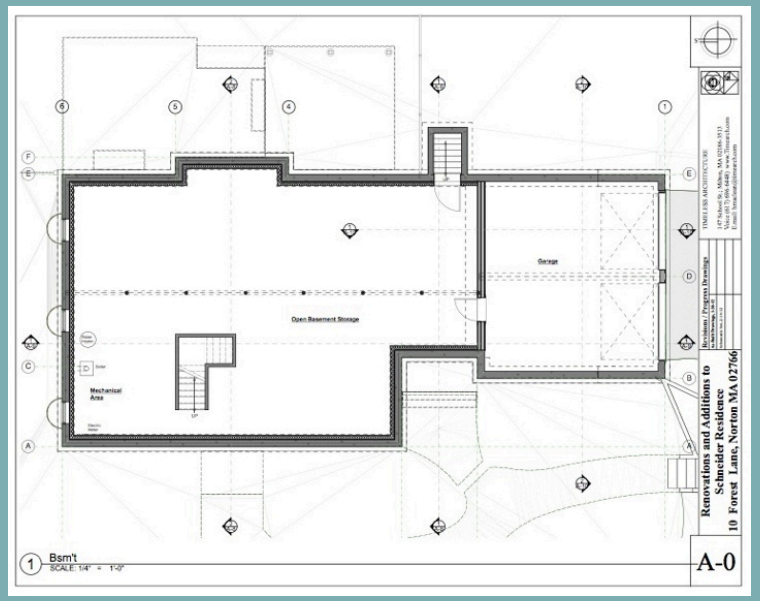


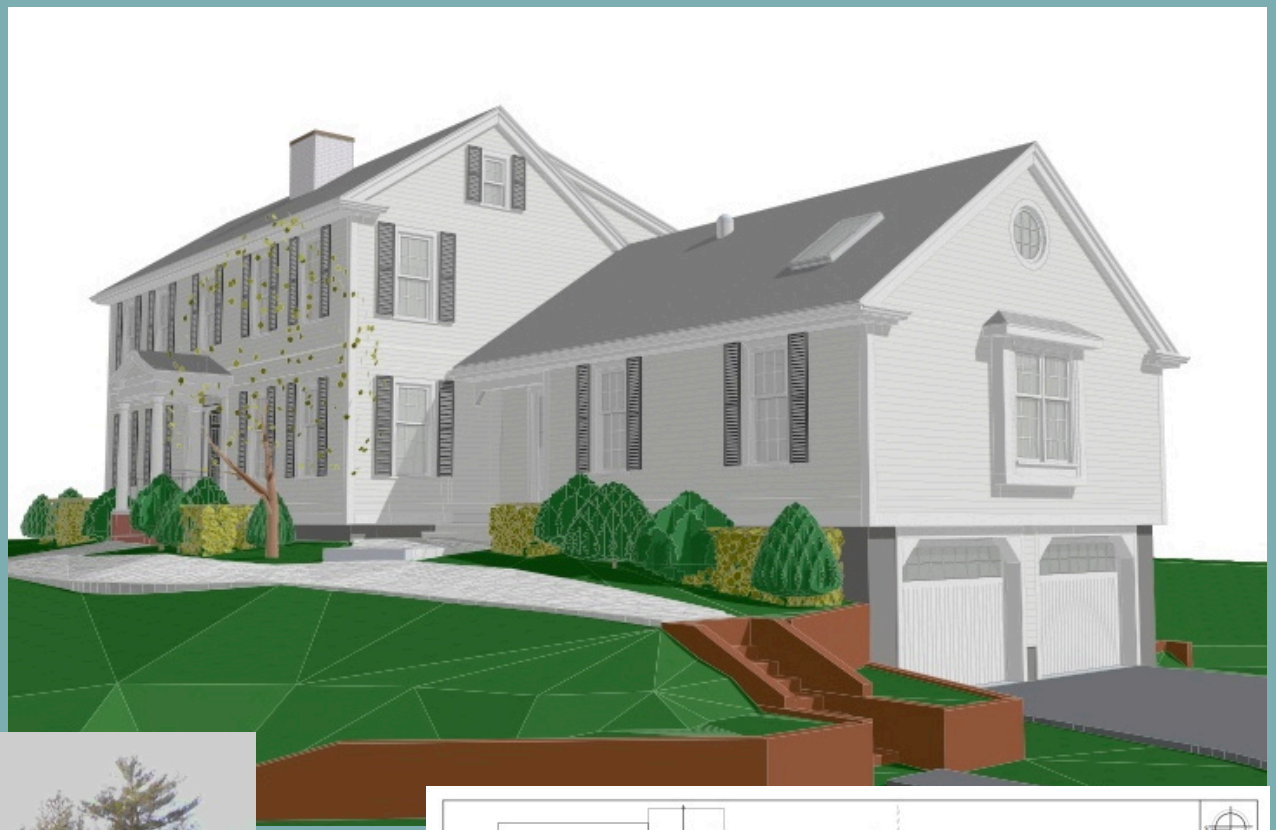


Colonial DER: Milton, MA

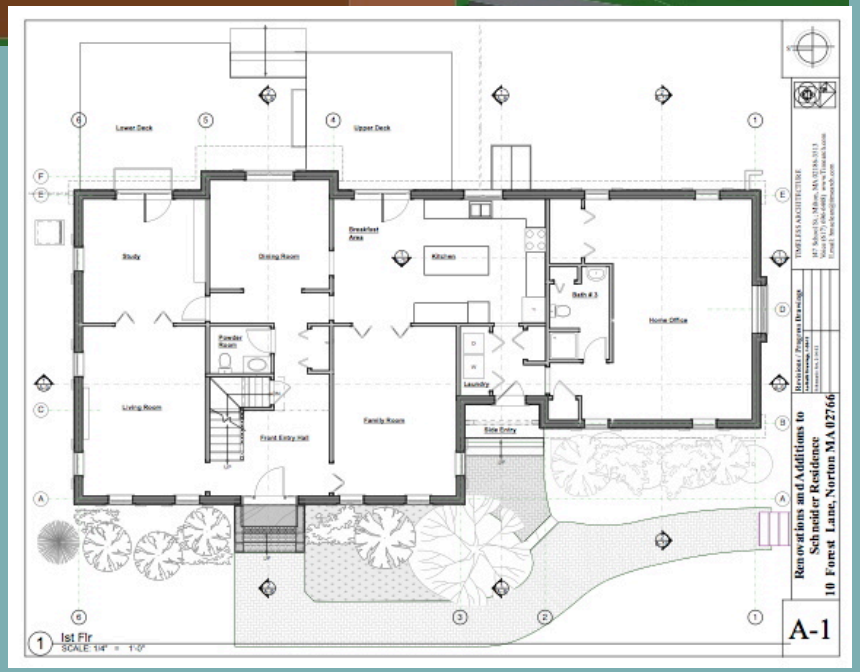




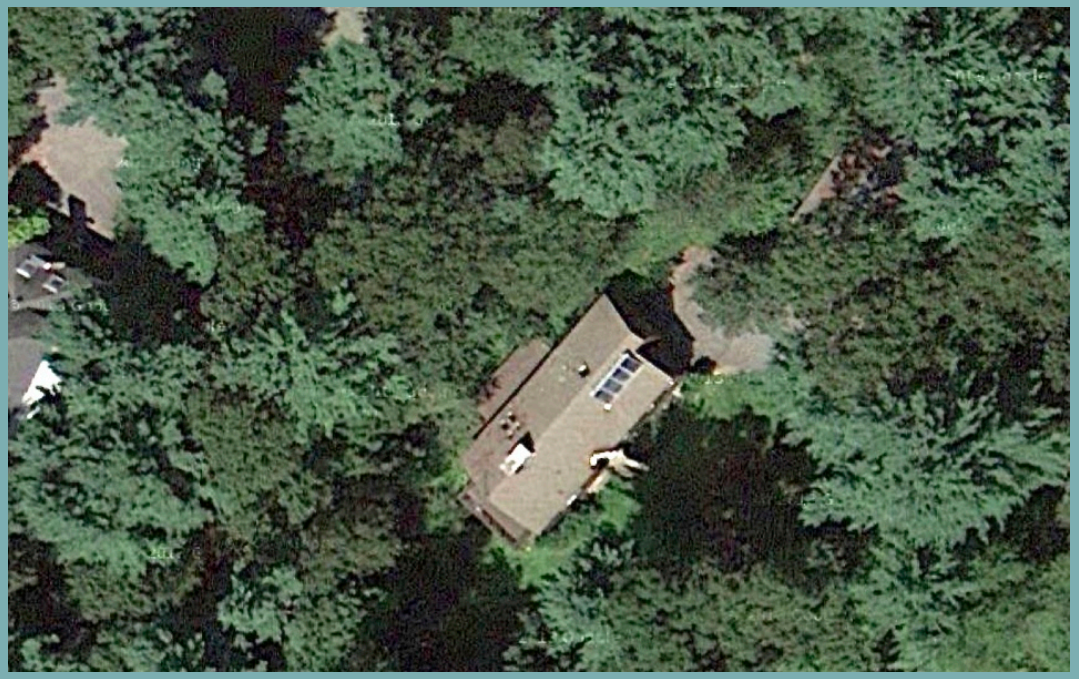




Colonial DER: Norton , MA



Colonial DER: Norton , MA



TRANSFORMATIONS™
Zero Energy Homes

Ted Sawyer
PV Project Manager
Mobile: 913-231-7579
PV Office: 781-933-2731

Solar Array			
Total Gross Project Investment	$ 39,510.00		
Total System Size (Watts): 36 Canadian Solar 250 Watt panels	9,000	w/ SREC's @ Minimum $[2]	SREC's Spot Market ($200.00)[3]
Total Investment ($/Watt DC)	$ 4.39		
Total Rebates, Tax Credits, and Incentives	$ 39,335.89	$ 33,337.39	$ 31,948.03
10 Year Energy Production Value	$ 12,948.65	$ 12,948.65	$ 12,948.65
25 Year Energy Production Value	$ 34,934.86	$ 34,934.86	$ 34,934.86
Total NET Cost (Savings) after 10 years	$ (12,774.54)	$ (6,776.04)	$ (5,386.68)
Total NET Cost (Savings) after 25 years	$ (34,760.74)	$ (28,762.25)	$ (27,372.89)

Concord Light Rebates	
Concord Light Rebates ($625 / Watt AC. Max. $3,125.00)	$ 3,125.00

Commonwealth of Massachusetts Personal Tax Credit	
15% - Can not exceed $1,000.00	$ 1,000.00

Federal Tax Credit	
30% - No Limit	$ 10,915.50

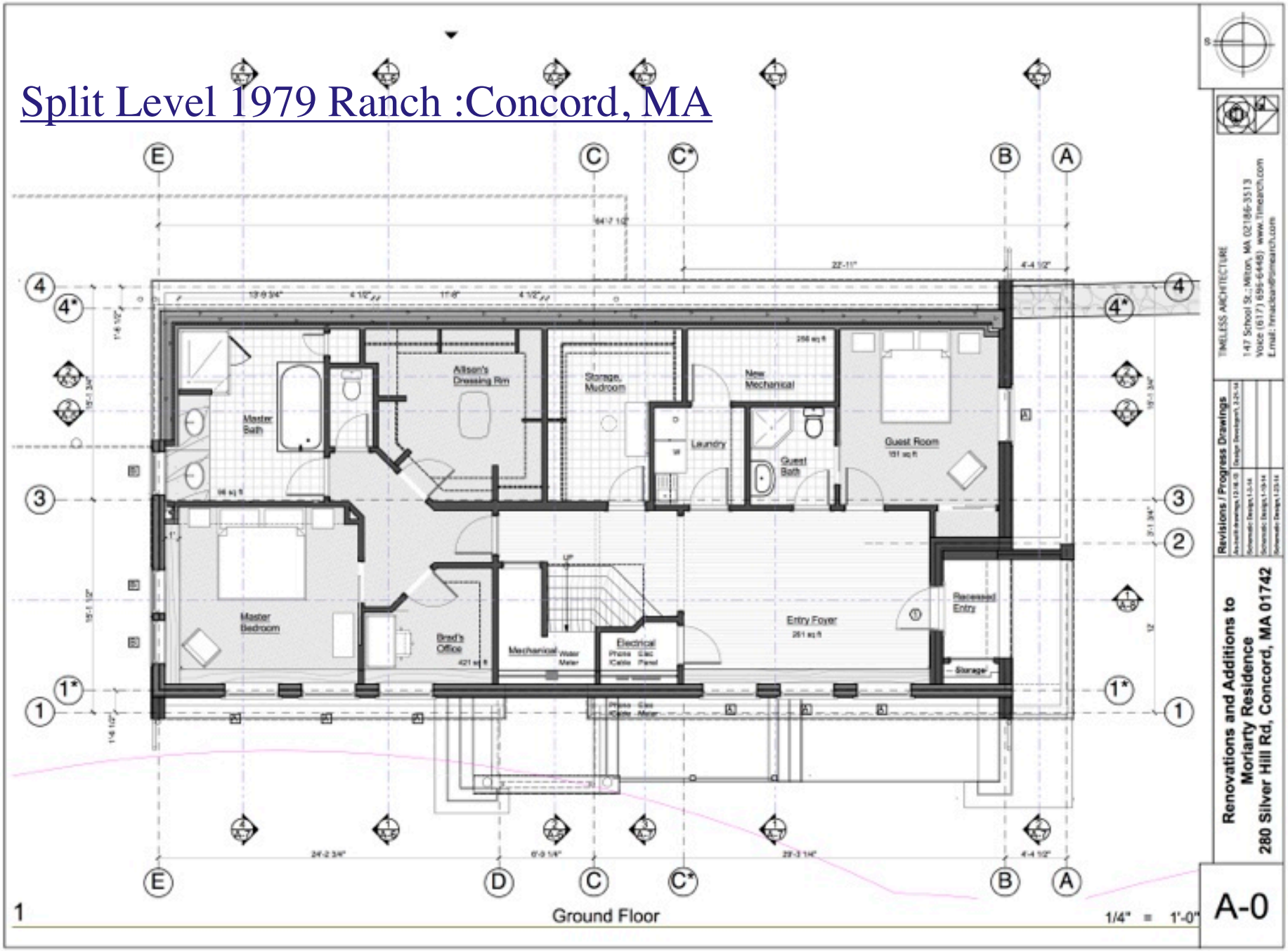
Split Level 1979 Ranch :Concord, MA

MA Solar Renewable Energy Credits (SREC)		w/ SREC's @ Minimum $[2]	SREC's Spot Market ($230.00)[3]
SREC's Generated Per Year:	7.738		
Rebate: 2014 (@ $375.00 per SREC)[1]	$ 2,756.66	$ 2,095.06	$ 1,690.75
Rebate: 2015 (@ $375.00 per SREC)[1]	$ 2,756.66	$ 2,095.06	$ 1,690.75
Rebate: 2016 (@ $350.00 per SREC)[1]	$ 2,572.89	$ 2,095.06	$ 1,690.75
Rebate: 2017 (@ $350.00 per SREC)[1]	$ 2,572.89	$ 1,992.15	$ 1,690.75
Rebate: 2018 (@ $350.00 per SREC)[1]	$ 2,572.89	$ 1,889.23	$ 1,690.75
Rebate: 2019 (@ $333.00 per SREC)[1]	$ 2,447.92	$ 1,793.67	$ 1,690.75
Rebate: 2020 (@ $316.00 per SREC)[1]	$ 2,322.95	$ 1,705.46	$ 1,690.75
Rebate: 2021 (@ $300.00 per SREC)[1]	$ 2,205.33	$ 1,624.59	$ 1,690.75
Rebate: 2022 (@ $285.00 per SREC)[1]	$ 2,095.06	$ 1,543.73	$ 1,690.75
Rebate: 2023 (@ $271.00 per SREC)[1]	$ 1,992.15	$ 1,462.87	$ 1,690.75
Total Production Incentive	$ 24,295.39	$ 18,296.89	$ 16,907.53

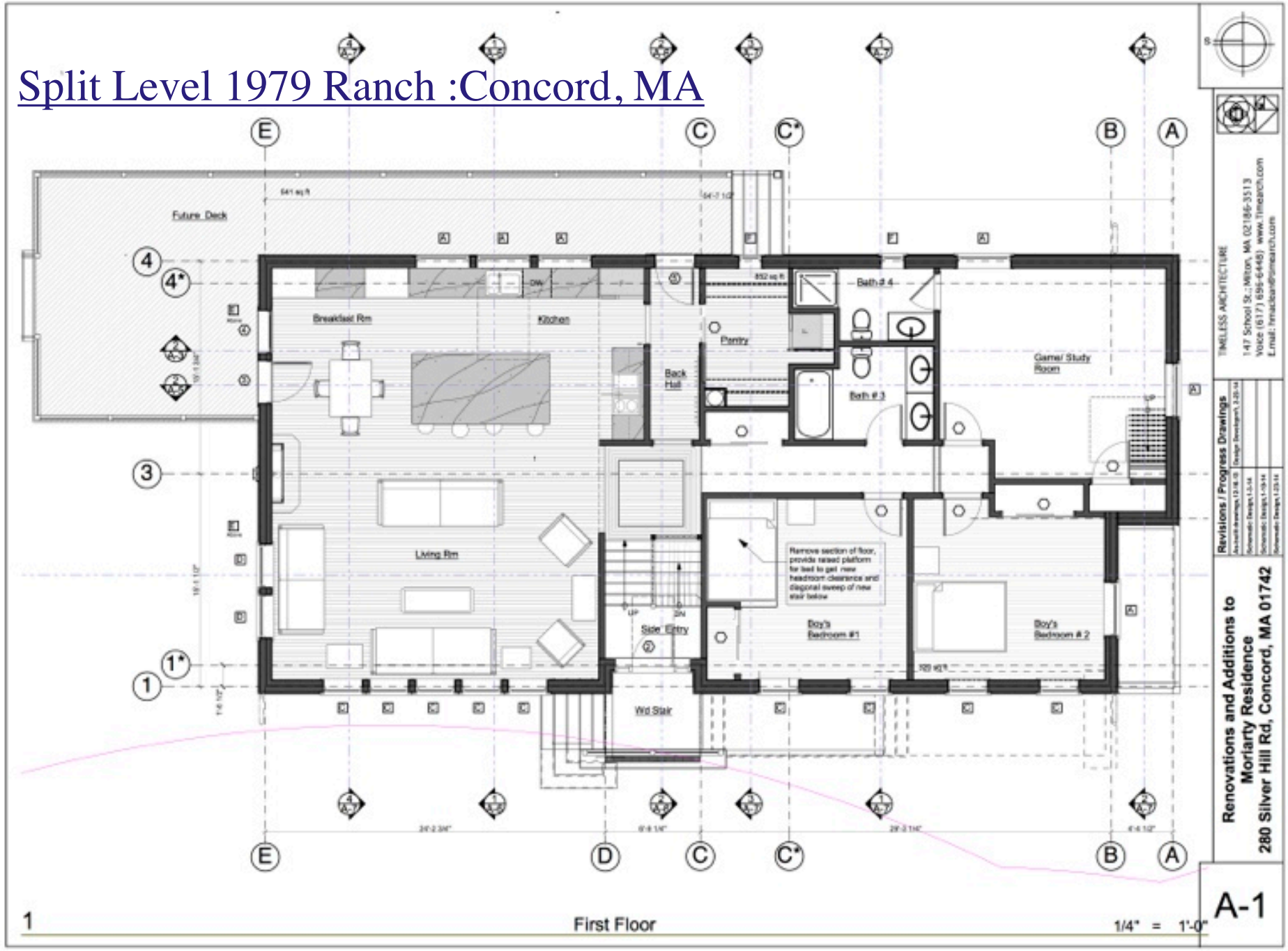
[1]ACP Rate Schedule from MA DOER 10-Year Forward Schedule, minus 5% Aggregation Fee.
[2]Minimum Standand, minus 5% Auction Fee and 5% Aggregation Fee.
[3]Spot Market SREC projections are based on current market value, minus 5% Aggregation Fee.

Split Level 1979 Ranch :Concord, MA

Split Level 1979 Ranch :Concord, MA



Split Level 1979 Ranch :Concord, MA



Split Level 1979 Ranch :Concord, MA

Moriarty ANNUAL NET HEATING LOAD, 2-12-14, R-5 Windows

Monthly interior electrical usage, kWh: 550

Heating Degree Days Base 62 F set point from weather data depot

Month	HDD70	Gross heat loss, BTU/month	Electric Gains, BTU/	Solar Gains, BTU/month	Utilization factor	Net heat loss, BTU/month
Jan	1040	9,607,952	1,876,600	524,720	1.00	7,208,389
Feb	936	8,647,157	1,876,600	694,028	1.00	6,080,726
Mar	827	7,640,169	1,876,600	1,216,684	0.99	4,567,001
Apr	445	4,111,095	1,876,600	1,163,738	0.93	1,280,199
May	189	1,746,061	1,876,600	1,785,587	0.47	22,776
Jun	21	194,007	1,876,600	1,801,407	0.05	0
Jul	2	18,477	1,876,600	1,924,529	0.00	0
Aug	2	18,477	1,876,600	1,899,604	0.00	0
Sep	113	1,043,941	1,876,600	1,192,269	0.34	3,142
Oct	361	3,335,068	1,876,600	956,332	0.89	804,260
Nov	700	6,466,891	1,876,600	485,804	1.00	4,114,265
Dec	1022	9,441,660	1,876,600	585,058	1.00	6,982,196
				Annual Net Heating Load, BTU/year		***31,062,954***
				Annual Net Heating Load, kWh/year		***9,104***

DER Incentives					
Area of Incentive	SF Area	$ / psf Incentive	incentive	Door sf	window sf
Total SF , 3,779					
1,988 2nd ,1629 1st, 162 loft					
Basement Slab	1437	$2.00	2874		
Basement Foundation Walls.					
140 S, 471 N, 99 E, 8 N	718	$2.00	1436		
Above Grade Walls					
North Elevation	555	$3.50			
W & D (3 x14) + 22				42	22
West Elevation	537	$3.50			
W & D (4 x 14) + 8 +18				64	18
South Elevation	363	$3.50			
W & D (2 x 10) + (2 x 18) + (3 x 9) + 47				83	47
East Elevation	751	$3.50			
W &D (9 x 15) + (6 x 14) + 35 + 6 =				225	35
Sum above Grade Walls, (2,206 SF)		$3.50	8012		
Skylights 18 + 12 + 12				414	122
Sum windows and doors	578				
Overhangs, cantilevered 2nd Floor					
37 + 45 + 209	291	$1.50	437		
Roof	2117	$3.00	6352		
Total Shell	7,183				
CFM 50 reduced = 4288 ???	4288	$1.75	7504		
Total Incentive			26,615		

	Quincy Project (1907)	Milton Project (1939)	Norton Project (1995)
# of Occupants	5 people	2 people	5 people
Existing Conditioned Area	1,808 sf	2,305 sf	3,111 sf
Added Non Basement Space	1,752 sf	559 sf	0 sf
Renovated Basement	838 sf	688 sf	1,386 sf
New Proposed Total	3,560 sf	2,864 sf	4,497 sf
Innitial 6 sided envelope	5,388 sf	5,177 sf	7,533 sf
New Proposed 6 sided envelope	6,773 sf	6,743 sf	9,281 sf
Total DER Project Costs	$550,000	$370,000	$237,000
	w/ Solar	no Solar	w/ Solar
	& new mechanicals	existing recent mechanicals	& new mechanicals
Total Non DER Project Costs	$450,000	$326,000	$162,000
	& new mechanicals	existing recent mechanicals	& new mechanicals
Added DER Investment	$80,000	$44,000	$75,000
DER and Additional Incentives	$52,000	$42,000	$42,000
Added DER Costs - Incentives	$33,000	$2,000	$33,000
Annual Energy Use as a Code House or Existing	$5,700	$3,800	$6,200
	assume 54 KBTU/sf/yr	assume 45 KBTU/sf/yr	assume 76 KBTU/sf/yr
Annual Energy w/ DER, 10 KBU w.o Sol, or 20 KBU w Sol	$1,750	$2,500	$1,950
Annual Energy Savings	$3,950	$1,760	$4,250
	$ 33,000 / $3,950 = 8.4	$2,000 / $1,760= 1.14	$ 33,000 / $4,250 = 7.76
Payback Simple ROI, w/ out interest	8.4 years	1.14 Years	7.76 years
	11.6 x $3,950	18.86 x 1,760	12.24 x $4,250
20 YR Investment w/ no Interest or Energy Costs Increase	$45,820	$33,193	$52,020
Add increase in Property Value w out appreciation	$400,000	$300,000	$200,000

	Quincy Project (1907)	Concord Project (1979)	Milton Project (1939)	Norton Project (1995)
# Of Occupants	5 People	4 People	2 People	5 People
Existing Conditioned Area	1,808 sf	3,779 sf	2,305 sf	3,111 sf
Addition, Non Basement Space	1,752 sf	0 sf	559 sf	0 sf
Renovated Basement	838 sf	1,752 sf	688 sf	1,386 sf
New Proposed Total	3,560 sf	3,779 sf	2,864 sf	4,497 sf
Shell Area Existing	5,388 sf	7,000 sf	5,177 sf	7,533 sf
CFM-50/ SF Shell area, existing				
Shell Area Proposed	6,376 sf	7,186 sf	6,743 sf	9,281 sf
CFM-50/ SF Shell area, proposed	0.1194	0.1194		
Total DER Project Costs	$550,000	??????	$370,000	$240,000
	w/solar			
Total Non - DER Costs				
Added DER Investment	$80,000	??????	$44,000	$75,000
DER and added Incentives	$52,000		$42,000	$42,000
Annual Energy Costs as Code / Existing	$5,700	$5,800		
Added Energy Costs as DER				
Annual Energy Savings	$3,950	$3,720	$1,760	$4,250
Payback, Simple ROI w/ out Interest				
20 Yr. Invest. w/ no Interest or Energy Increase		20 x 3,720 = $74,400		
Additional Property Value with out Appreciation		$200,000		

Boston Deep Energy Retrofits @3 Scales (w/goal of 80% reduction by 2050)

http://timearch.com/assets/NE-Sun-GBOH-2011.pdf

Quincy DER, 85% savings over typical home and 34 MM BTU/ YR with EUR @1.7 BTU/SF /DD/ YR.

www.castledeepenergy.com/

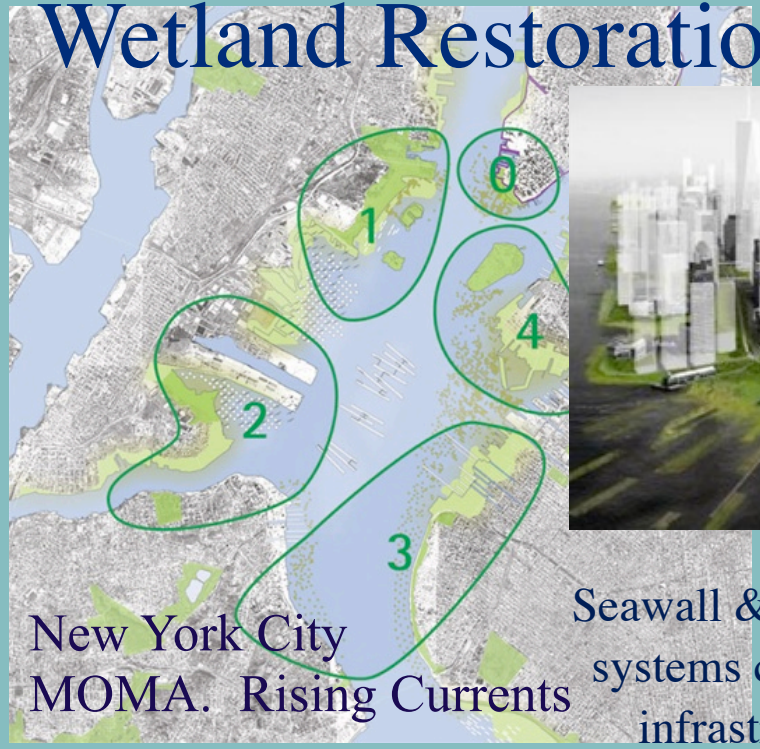
Boston South End, 192 unit apartment building with energy savings of 72% and 10,791 MM BTU/ YR with new EUR of 3.45 BTU/SF /DD/ YR.

www.basea.org/
GreenBCH.php

Greening of Boston City Hall, modeled for energy savings of 75% & 64,640 MM BTU/ YR , EUR dropping from 23.5 to 5.6 BTU/SF /DD/ YR .

How do we achieve DER's for the vast majority of existing buildings w/ limits to green opportunities?

Wetland Restoration



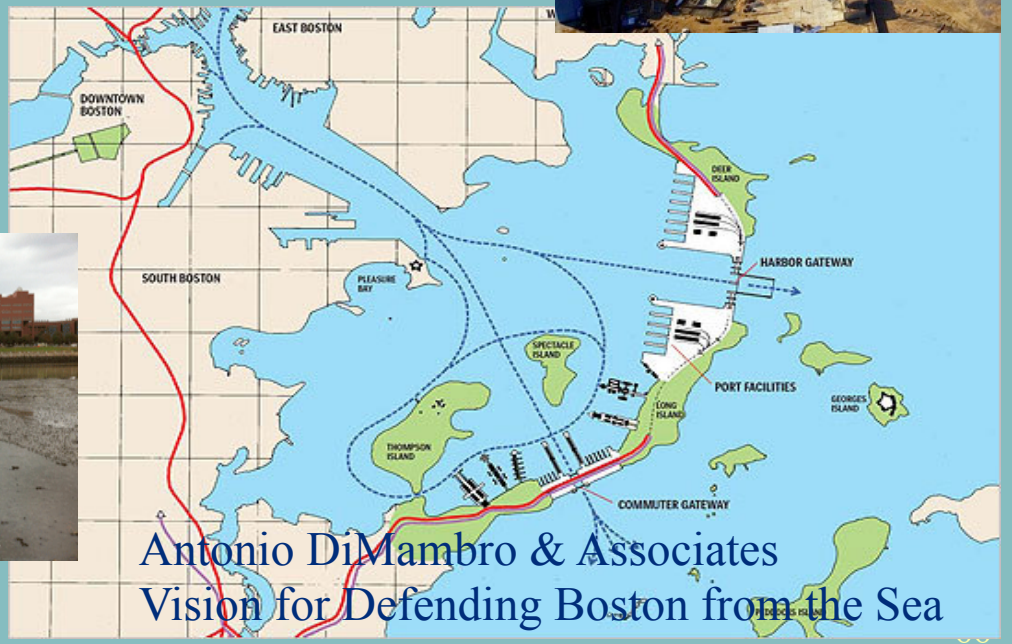
New York City
MOMA. Rising Currents

and / or Seawalls ??

Seawall & wetland restoration projects show that systems can protect dense urban populations & infrastructure from storm surges & floods.

St. Petersburg defense barrier.

Dr. Anamarija Frankic
Biomimicry and Oysters
Green Harbors Project, U MASS Boston



Antonio DiMambro & Associates
Vision for Defending Boston from the Sea

Thank-you .
Questions ??

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Milton, MA

Timearch.com