TEAM LAS VEGAS

PRESENTS

Sinatra LIVING

JURY NARRATIVES

08.10.17

UNIVERSITY OF NEVADA LAS VEGAS

U.S. Department of Energy Solar Decathlon 2017

Jury Deliverables

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FOREWARD

Life begins when you start living passionately.

We designed a home that helps you live passionately by embracing every moment, simplifying your life, and giving you freedom.Sinatra Living is an energy-efficient and health-conscious home for active aging citizens of Las Vegas and beyond.

U.S. Department of Energy Solar Decathlon 2017—Team Las Vegas
Howard R. Hughes College of Engineering

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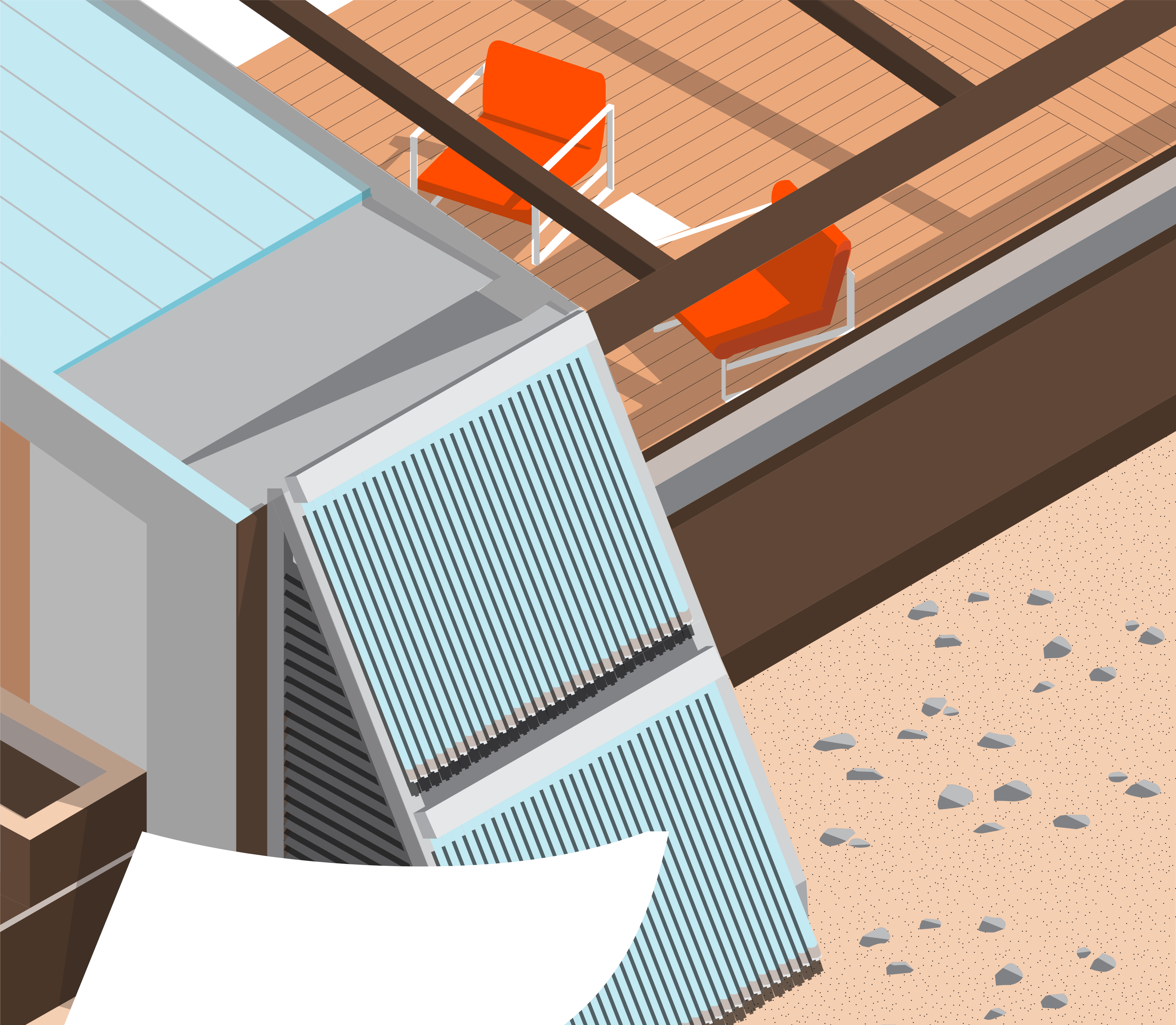


INNOVATION

From home automation, to virtual reality, Sintra Living takes steps towards innovation by using cutting edge design-tools and energy systems.

The home features several key innovations such as home automation, and integrated mechanical pod, air-quality makeup system, electrical systems back-up, and an integrated architectural shade partition.

HOME AUTOMATION

Overview

A unique feature to Sinatra Living is home automation. Our home automation hub keeps our users safe and simplifies everyday tasks. This system can trigger lights and unlock doors to assist an emergency response. It can also detect and differences between falls and false alarms in the home. We make a seamless integration with these features. Through this system, a homeowner can alert their caregivers if an accident may occur.

Control

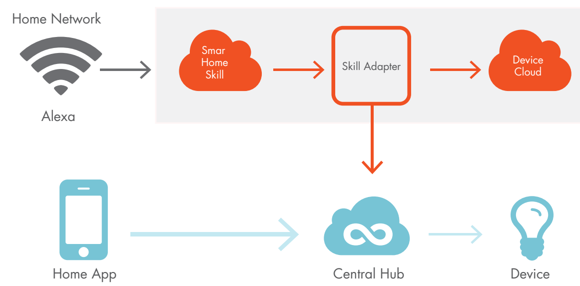
Automated key features of the home use reliable dual-band RF/Power Line communication. A central hub handles communication between the user and key items in the home. You can control the hub while at home or away. Voice activated commands are for hands free control, when you're cooking or entertaining. Adjustable items include HVAC, lights, media, and adjustable shades. If you need to request a ride or get food delivered, the home automation hub can help.

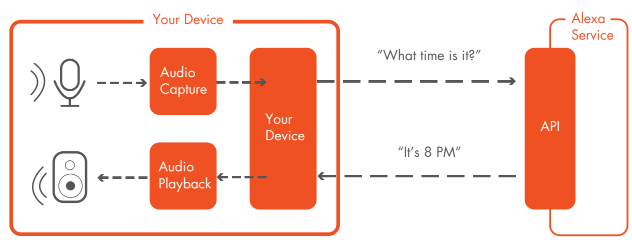
Monitor

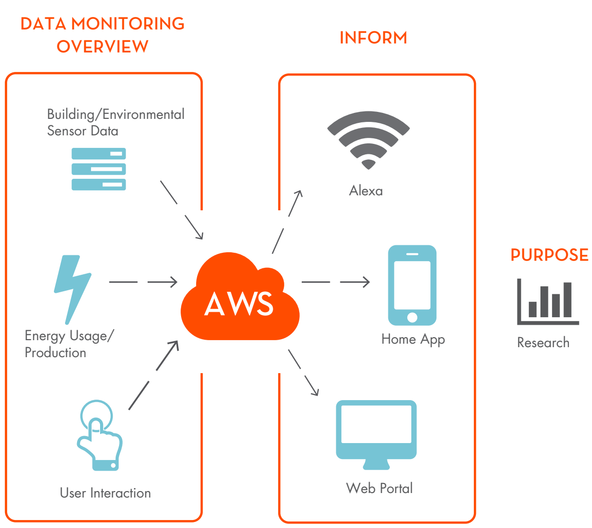
The automation hub stores sensors energy consumption data every half hour. Other measurements include water usage of the house, temperature, humidity, and air humidity. All measurements go to AWS Relational Database Service (RDS) every minute. The compiled data can help various commercial industries in improving home design. The ideal benefactors of this data are home builders, engineers, and healthcare providers.

Inform

A voice activated system with push buttons can breakdown key features of the home. This can work for exhibition tours or for a homeowner. A homeowner can use voice commands to learn more about any feature. This includes using data stored from within the home to AWS. A homeowner can track data of energy usage and production from any mobile device. Our home automation app shows monthly water usage, and lets you know what to conserve. We will be using this concept during live tours of the competition. Post-competition, the home will use this method of ambient learning for visitors.







MECHANICAL POD

Mechanical Pod

Sinatra Living features a mechanical pod designed to meet the home's hot water demand, while complementing its architectural form. Solar thermal is at the core of the mechanical pod, it features a combined 3.8kW (13 MBTU) pair of solar thermal evacuated tube collectors. Evacuated tube collectors were chosen over flat plate due to their increased performance throughout the year and reduced chance of dissipating heat and freezing over during winter nights. It's designed to provide domestic hot water and radiant heating. An optimized collector slope allows for year long solar exposure. Furthermore, a plug & play design makes it an integratable feature for any home. The modular design allows for separation between living space, mechanical systems and maintenance.

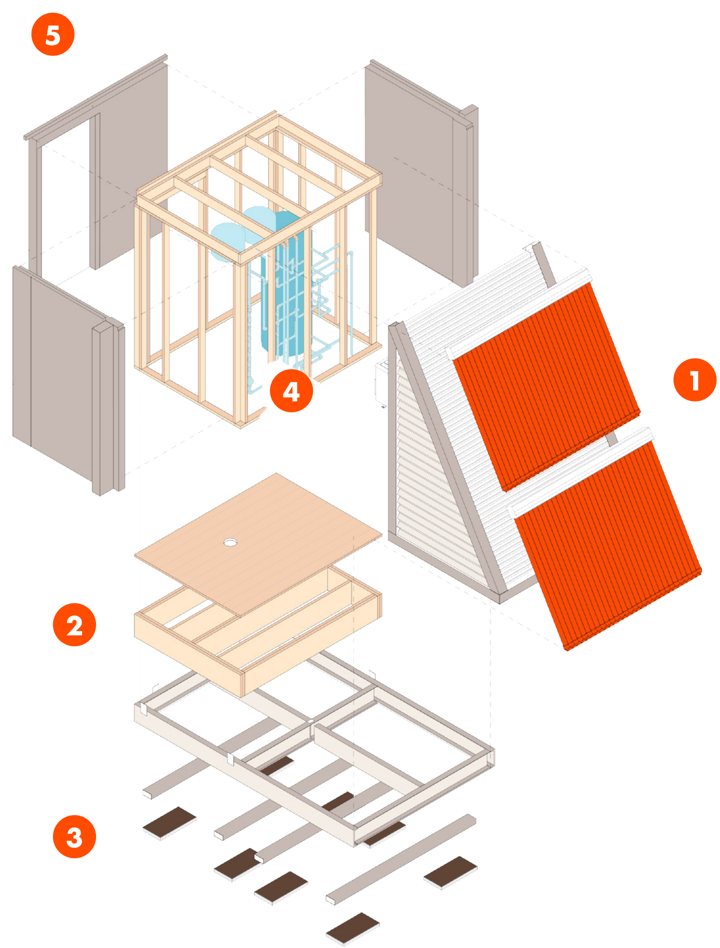
All-in-One Solution

The Mechanical Pod provides simplified integration. All the components within the pod will be pre-assembled and plumbed in the structure. As a result, the pod will have hassle free shipping and commissioning. The exterior of the building supports the required solar thermal collectors. The interior will house the solar thermal tank, pumps, and necessary plumbing components. The unit will also have a self contained electrical panel and controls. These electrical components can plug into the home for power and control.

Optimized Yearlong Performance

The Mechanical Pod provides simplified integration. All the components within the pod will be pre-assembled and plumbed in the structure. As a result, the pod will have hassle free shipping and commissioning. The exterior of the building supports the required solar thermal collectors. The interior will house the solar thermal tank, pumps, and necessary plumbing components. The unit will also have a self contained electrical panel and controls. These electrical components can plug into the home for power and control.

1 Solar Thermal Evacuated Tubes
2 Mech Pod Subfloor
3 Steel Framing
4 Hot Water Tanks
5 Exterior Walls



PCM & HEPA FILTRATION UNIT

Fresh Air Intake

Sinatra's Living's tight building envelope minimizes air exchanges through the home. Although this has a thermal benefit, maximizing the quality of air in the home is key for any resident. Sinatra Living utilizes ASHRAE 62.2 guidelines, to provide occupants with good indoor air quality. Operable windows are available in all living spaces to provide clean air to occupants. A mechanical system is utilized to reduce the introduction of allergens and/or pollutants as well as mitigate heating and cooling loads. This makeup air and filtration system to supplement the home's heating and cooling system. This system uses a phase change material for year-round heating and cooling load reduction. The system is combined with a HEPA and carbon filter unit, to treat both fresh and return air supplied to the home.

Phase Change Material

Phase Change Material (PCM) is a substance with a high heat of fusion. By melting and solidifying at certain temperatures, it is capable of storing and releasing large amounts of energy. PCM is used in the home's active fresh-air plenum. Thus, reducing air conditioning required to heat or cool incoming fresh air. The system which has been in testing for two years at UNLV uses a commercially available PCM. The PCM is made from an encapsulated eutectic salt, which is contained in foil packets that are approved for installation in the air plenum. The packets are designed to be maintenance free and can continue operating with building for the duration of it's life. This PCM is designed to "freeze" below "thaw" above 78 ° F . When installed in the fresh air plenum, PCM will melt in the higher ambient temperatures and absorb heat from the incoming air. During cooler evening hours, the absorbed heat is rejected to the ambient, or used to heat the inside spaces. When the home is operating in the heating mode the PCM will absorb rejected heat. This can be used during cooler hours to also heat the home. The PCM enclosure separates supply and exhaust air streams to provide clean air while conditioning the PCM for further use. The PCM quantity is calculated using ASHRAE 62.2 standards, desired change in temperature, sensible heat constant, and desired time of operation. This can then be adjusted to the heat capacity of an individual PCM packet to identify required quantities. See Appendix Energy Modeling: Phase Change Material

The University of Nevada, Las Vegas has conducted studies on PCM in the active fresh air plenum. These studies have shown that PCM in the active fresh air plenum, can reduce heating and cooling loads by up to 50%.

Indoor Air Filtration

The home's air filtration system treats return air and conditioned fresh air through the PCM plenum. The filtration system includes a pre-filter, carbon filter and 99.99% at 0.3 micron HEPA filter. The combination of filters will help reduce odors, allergens and small particles.

Building Exhaust

Exhaust systems will remove sensible and latent loads at their origin and improve air quality. This will include an efficient bathroom exhaust to remove humidity from showering. An exhaust system in the laundry room and a kitchen exhaust hood will remove heat and odor from cooking. The bathroom and laundry exhaust will "freeze" or "thaw" the PCM, depending on the heating/cooling mode. The exhaust stream will be separated from the supply. Providing only heat transfer to the PCM through convection.

ELECTRICAL SYSTEMS BACK-UP

Battery Systems

Sinatra Living utilizes a 13.2 kWH battery that is AC coupled. The battery system is designed to store power from the home's PV system or utility grid, depending on the operation. The battery will be used to provide peak shaving by storing excess power from the PV system or grid during off peak (low cost) hours. The battery can then discharge during peak (expensive) utility hours. This will allow the home to gain the full value of its PV system while mitigating high utility costs. For further information, modeling and calculations See Appendix Energy Modeling : Battery Analysis.

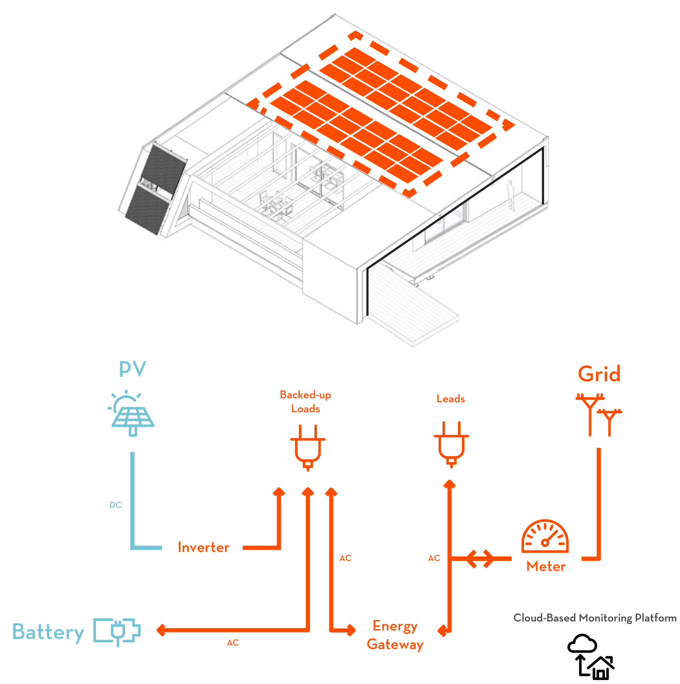
Back-Up Gateway

Sinatra Living utilizes an energy gateway to control the flow of power from the grid and/or PV system to the home's battery. This unit is set to monitor current from both solar and grid and select the optimal source based on the home's operation. The energy gateway also serves as a backup system. The unit can detect grid outages and respond accordingly. Most traditional PV systems will stop generating power when there is a loss in grid power as per UL 1741. The energy gateway allows the home to disconnect from the grid power and maintain the home's operations. This is sustained by powering only critical loads through solar and stored battery energy. These critical loads reside on an isolated sub-panel and include circuits for the refrigerator, HVAC, partial lighting and electrical outlet that would be used for medical and/or communications purposes. Reducing electrical loads on the home during outages will increase the battery's ability to sustain power to the home when solar is not available.

Load Prediction and Control

Sinatra Living features an instrumentation suite that allows for monitoring of the interior and exterior environment. Using these sensors, the home is able to predict cooling and heating spikes before they occur. This allows the home to control and ramp mechanical systems to maintain thermal comfort. To avoid the cost of inrush current during peak hours, the home can begin discharging the battery to meet the load.

ENERGY PRODUCTION



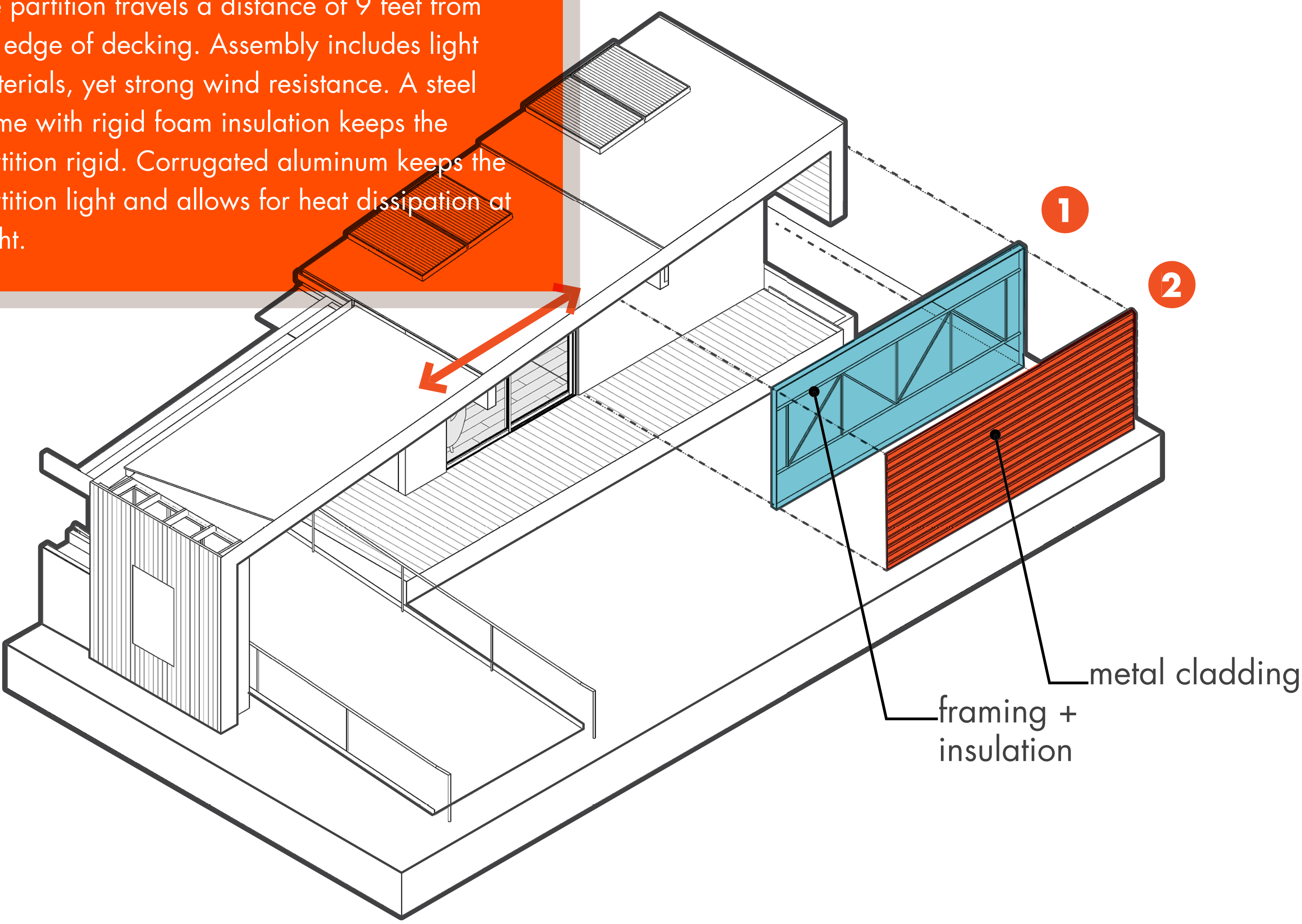
INTEGRATED MOTORIZED ARCHITECTURAL PARTITION

Overview

This innovation will shelter the home from excessive heat gains on the east facade. We designed this feature with the target client in mind. Exposure to the outdoors serve as a natural health supporter for aging.

Strategic use of natural light can also help mitigate symptoms of depression. At the same time, this reinforces natural circadian rhythms.

The partition travels a distance of 9 feet from the edge of decking. Assembly includes light materials, yet strong wind resistance. A steel frame with rigid foam insulation keeps the partition rigid. Corrugated aluminum keeps the partition light and allows for heat dissipation at night.



Sinatra

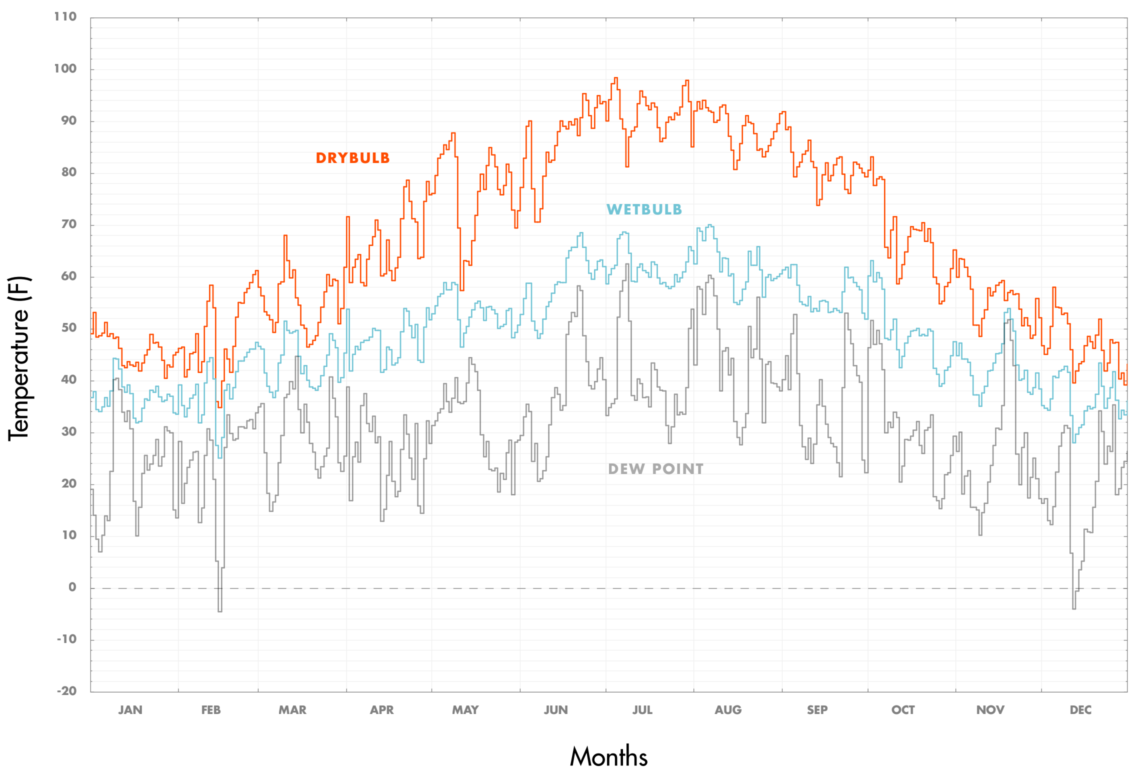
LIVING

ENGINEERING APPENDIX

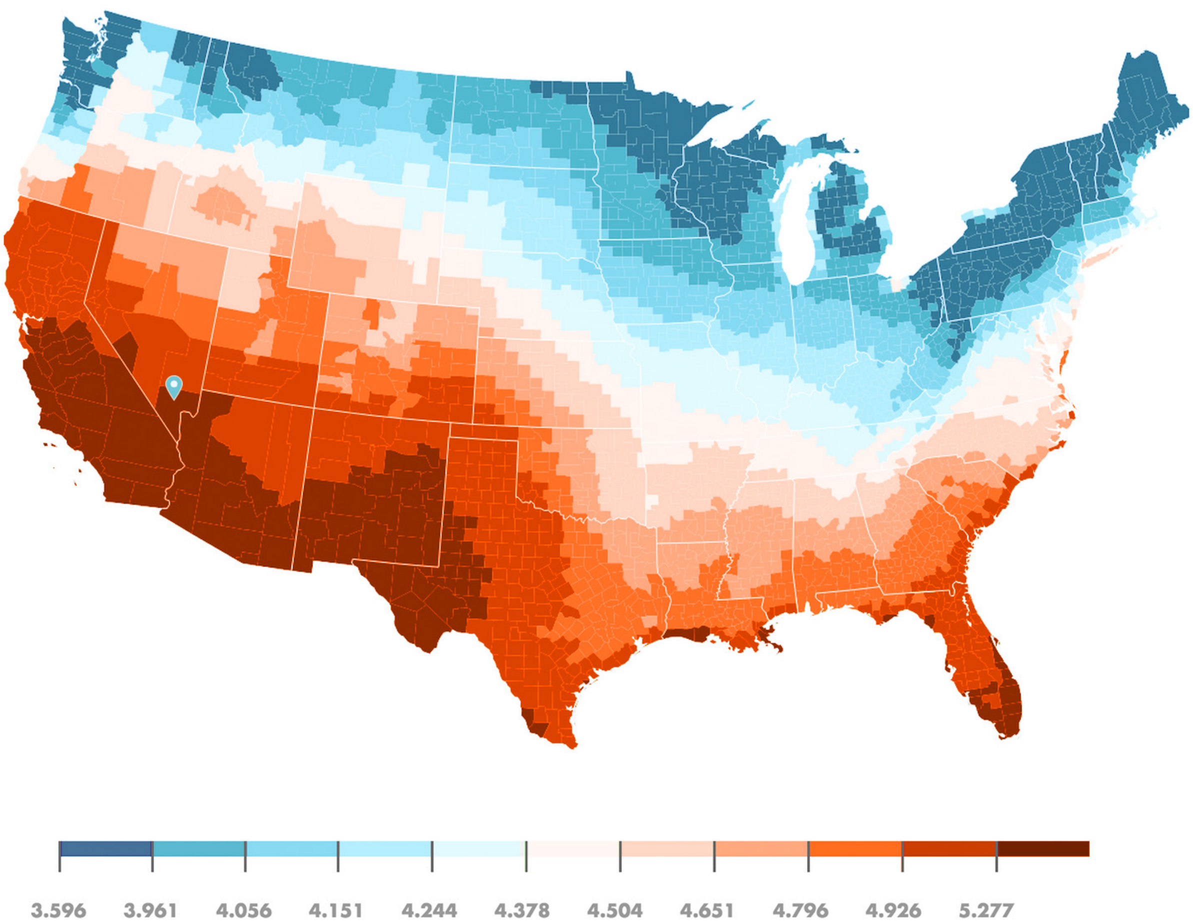
INTRODUCTION - Location and Considerations

Nevada and Las Vegas in particular have a unique set of environmental conditions. Temperature, precipitation, and irradiance need special consideration during energy analysis and building design. The average annual temperature in Las Vegas is 69.3 ˚F. Temperatures range from an average low of 56.6 ˚F to an average high of 80 ˚F . At an average of 4.17 inches of rain/year, Las Vegas receives most of it's precipitation over an average 21 days. The rest of the year, Las Vegas experiences plenty of irradiance, approx. 3,817hr of sunshine. Las Vegas is within zone 1, of the solar insolation map for the United States. The city receives 5.3 kWh/m2 in solar irradiance/day, leading the nation in solar energy potential. These environmental conditions guide Sinatra Living's design towards net energy balance.

Outdoor Temperature per Month

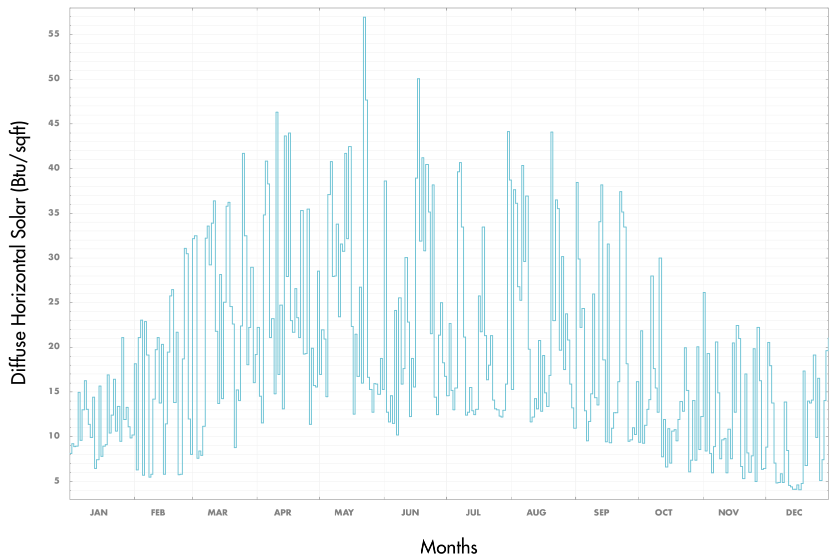


INSOLATION MAP - United States

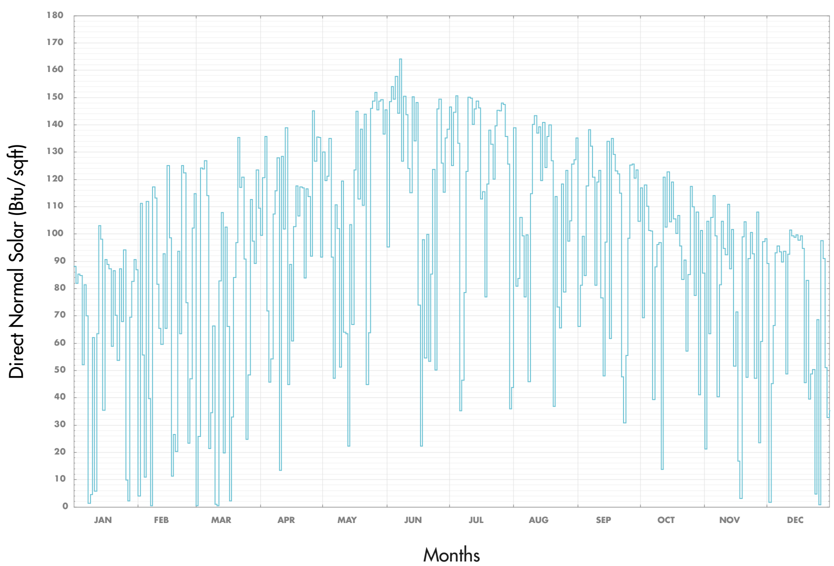


Avg. daily sunlight, 1979-2011 (measured in kilowatt hours of solar radiation per square meter) *SOURCE: North America Land Data Assimilation System (NLDAS) Daily Sunlight (Insolation) years 1979-2011 on CDC WONDER Online Database, released 2012. Published July 13, 2015*

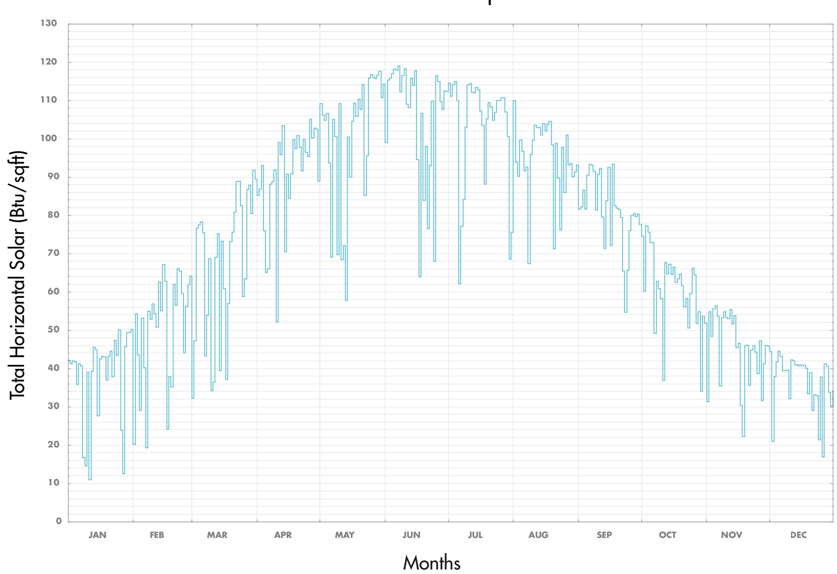
Diffuse Horizontal Solar per Month



Direct Normal Solar per Month



Total Horizontal Solar per Month

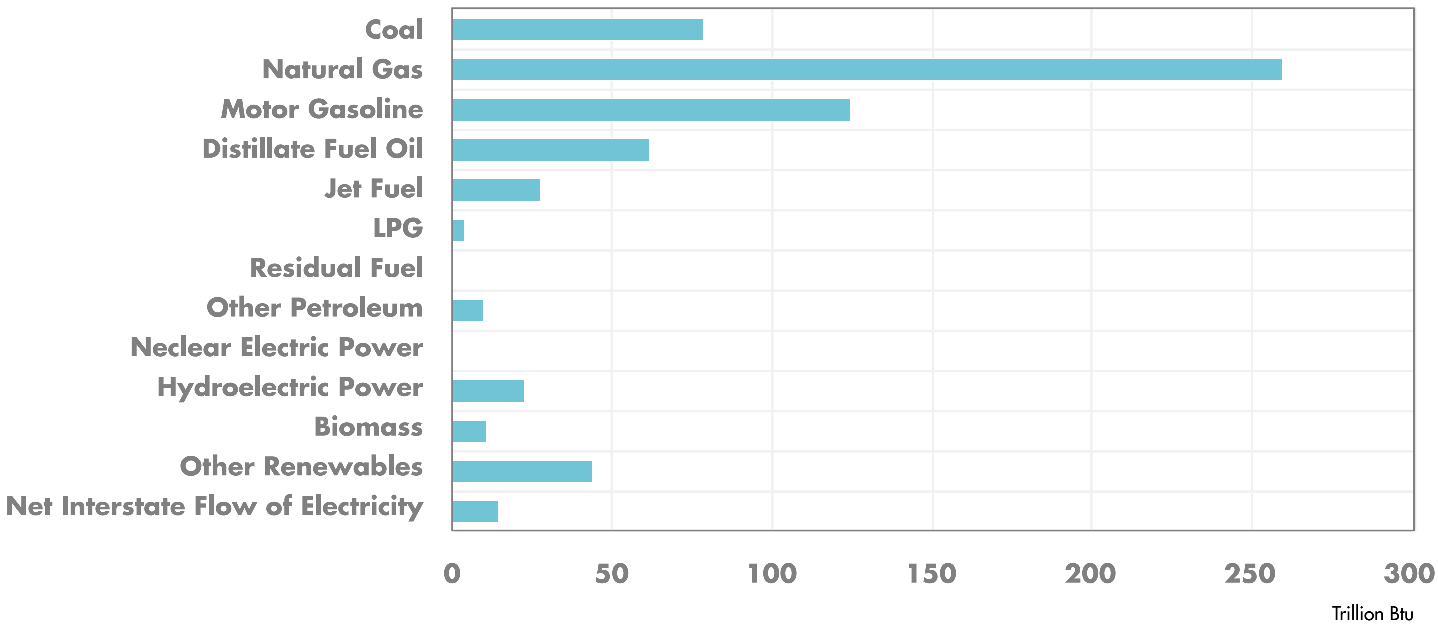


ENERGY CONSUMPTION - Nevada

Las Vegas is the largest city in Nevada attributing to a sizeable amount Nevada's overall energy consumption. Nevada's total energy consumption in 2013 was 667 trillion Btu (ranked 38th in the US), with total energy expenditures for that year residing in the scope of $10 Billion ($10,178,000,000, ranked 36th in the US).

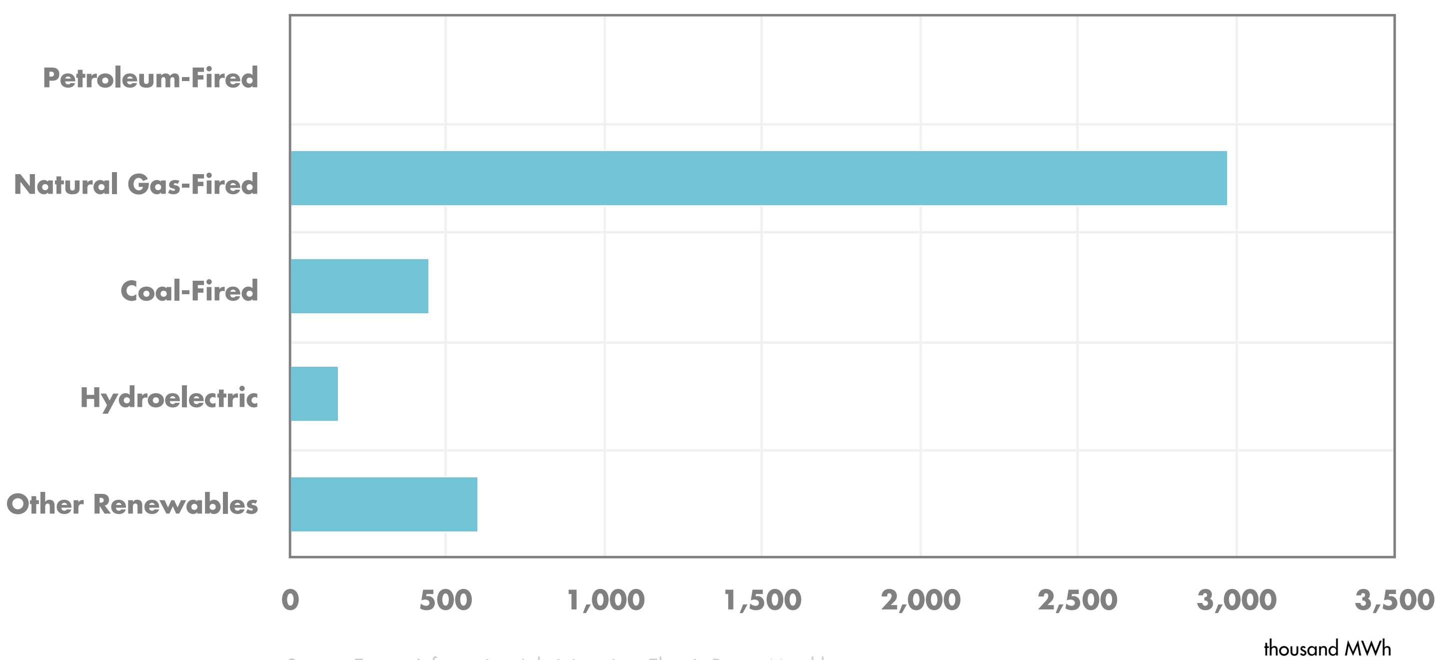
The state's total energy is divided into residential (162 trillion Btu), Commercial (121 trillion Btu), Industrial (166 trillion Btu), and Transportation (208 trillion Btu). As of 2013 Nevada was ranked 41st in energy consumption per capita, with the total consumed per capita at 235 million Btu. Nevada is also ranked 18th in the country in electricity prices across all sectors, and 29th in the country for natural gas prices across all sectors. Currently, more than 90% of the energy Nevada consumes comes from outside the state, with a large portion of that energy coming from natural gas. In 2015 alone, Nevada generated >68% of its electricity from natural gas. Nevada's higher utility costs can be attributed to its lack of onsite energy production geared towards directly fulfilling the state's energy needs as well as purchasing energy from bordering states. Furthermore, the state and specifically Las Vegas (it's largest city) are located in a hot/dry zone that require large HVAC solutions that can satisfy the peak cooling loads of buildings in the summer, attributing to the largest energy load for the city.

Nevada Energy Consumption Estimates, 2014



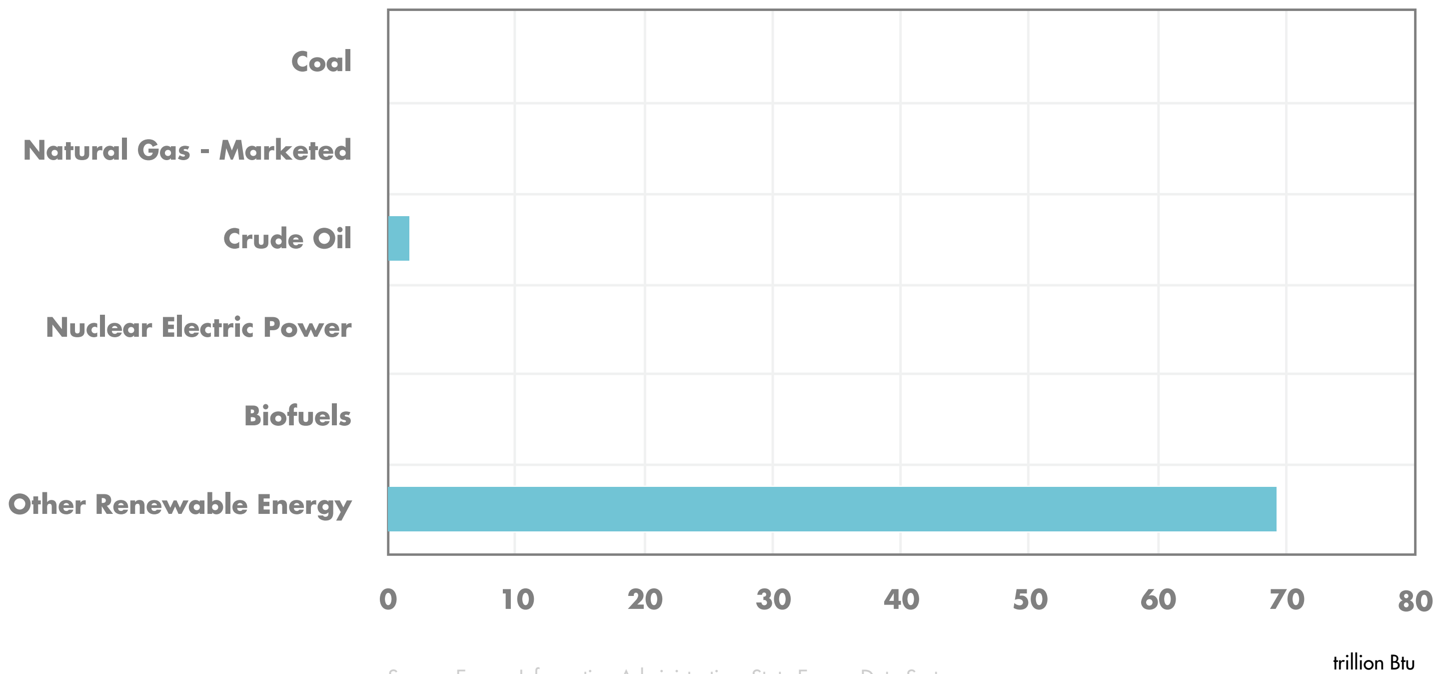
Source: Energy Information Administration, State Energy Data System

Nevada Net Electricity Generation by Source, Jul. 2016



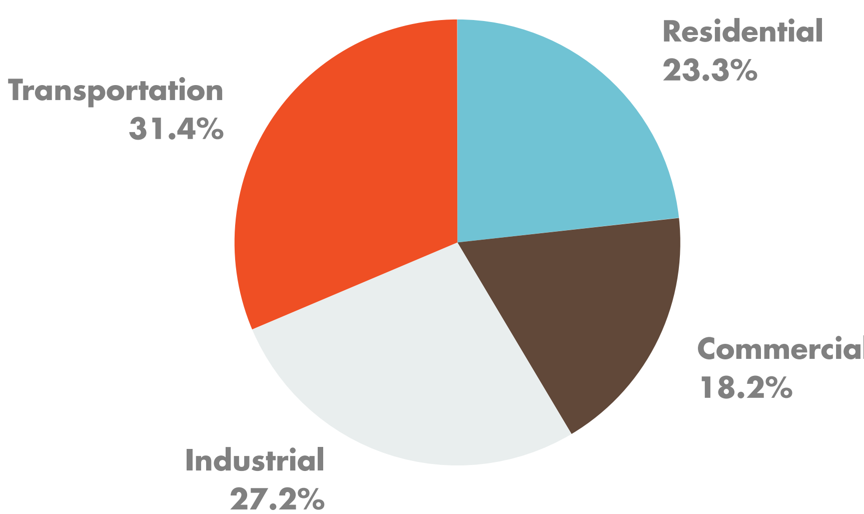
Source: Energy Information Administration, Electric Power Monthly

Nevada Energy Production Estimates, 2014



Source: Energy Information Administration, State Energy Data System

Nevada Energy Production by End-Use Sector, 2014



Source: Energy Information Administration, State Energy Data System

IECC REQUIREMENTS

Fenestration (IECC Sections R303.1.3, R402.3, R402.5)

Required (U-Factor)	Team Las Vegas (U-Factor)
0.32	0.29

Insulation (IECC Section R303.1.4 and R402.2)

Required (R-Value)	Team Las Vegas (R-Factor)
Roof + Ceiling	Roof + Ceiling
38	50.56
Wood Frame Wall	Wood Frame Wall
20	29.75
Floor	Floor
30	38.91
Slab R-Value & Depth	Slab R-Value & Depth
10, 2FT	N/A

Ducts (IECC Section R403.2)

Measured	Measured
Total Leakage: >4cfm/100sqft	TBD
Supply Ducts @ R-8	To comply with 2015 IECC Nevada Requirements
All Other Ducts @ R-6	To comply with 2015 IECC Nevada Requirements

Air Sealing (IECC Section R402.4)

Air Leakage Rate (ACH)	Air Leakage Rate (ACH)
3 ACH	TBD

System (IECC Sections R403)

HVAC System Sizing: See Attached Documents For Manual J

Temperature Controls: To comply with 2015 IECC Nevada Requirements

Mechanical System Piping Insulation: To comply with 2015 IECC Nevada Requirements

Hot Water Piping Insulation: To comply with 2015 IECC Nevada Requirements

Lighting (IECC Sections R202 and R404.1)

Required 75%	Team Las Vegas 75%
50 lm/W if <40W & <15W	TBD

7.3 ENERGY ANALYSIS AND RESULTS DISCUSSION

Building Envelope

Floor: 38.91

THICKNESS (IN) x [QUANTITY]	MATERIAL	THERMAL RESISTANCE (R VALUE)
1 1/8"	Subfloor	1.41
1"	Closed Cell Spray Foam	6
9"	Open Cell Spray Foam	3.5 x 9 = 31.5

Wall: 29.25

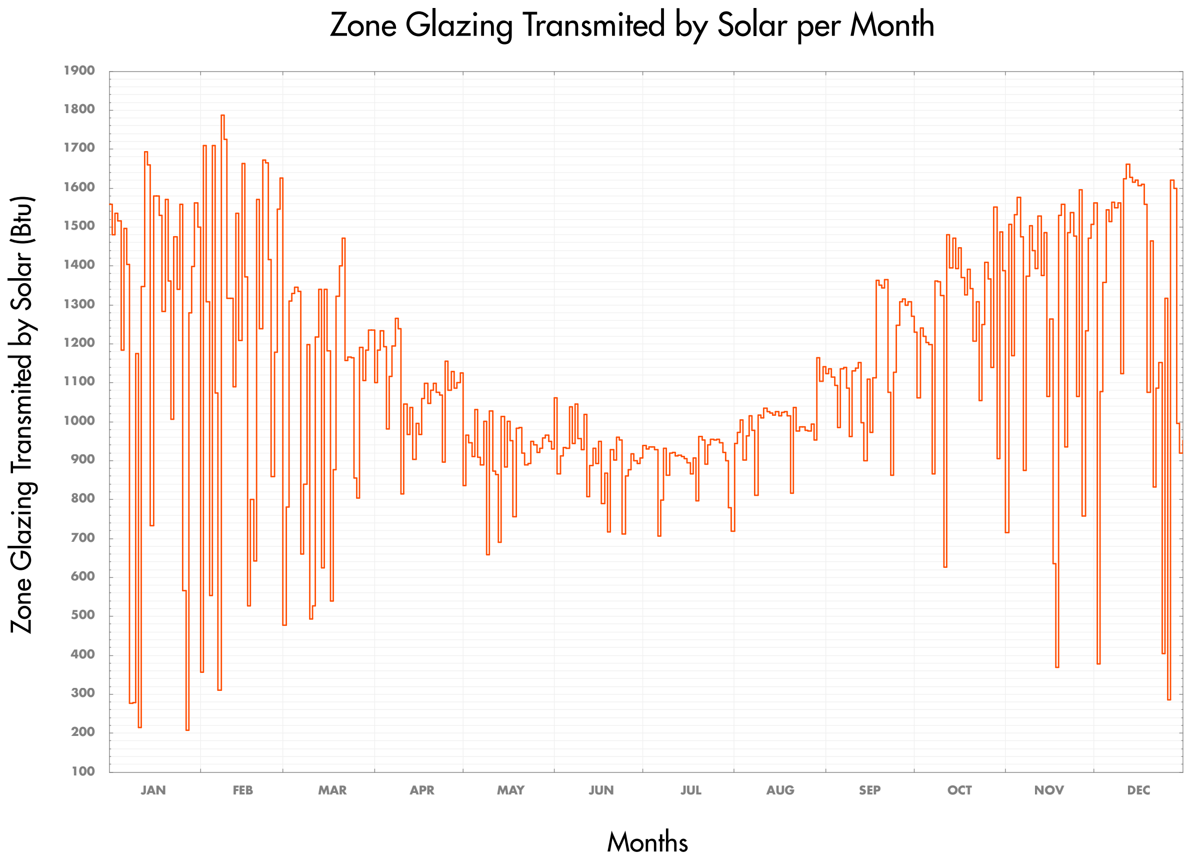
THICKNESS (IN) x [QUANTITY]	MATERIAL	THERMAL RESISTANCE (R VALUE)
1/4"	Fiber Cement (Equitone)	.5
1"	Air Space	1
1 1/2"	Zip R-Sheathing	6
1"	Closed Cell Foam	6
4.5"	Open Cell Spray Foam	15.75
5/8"	Gypsum Board	.5

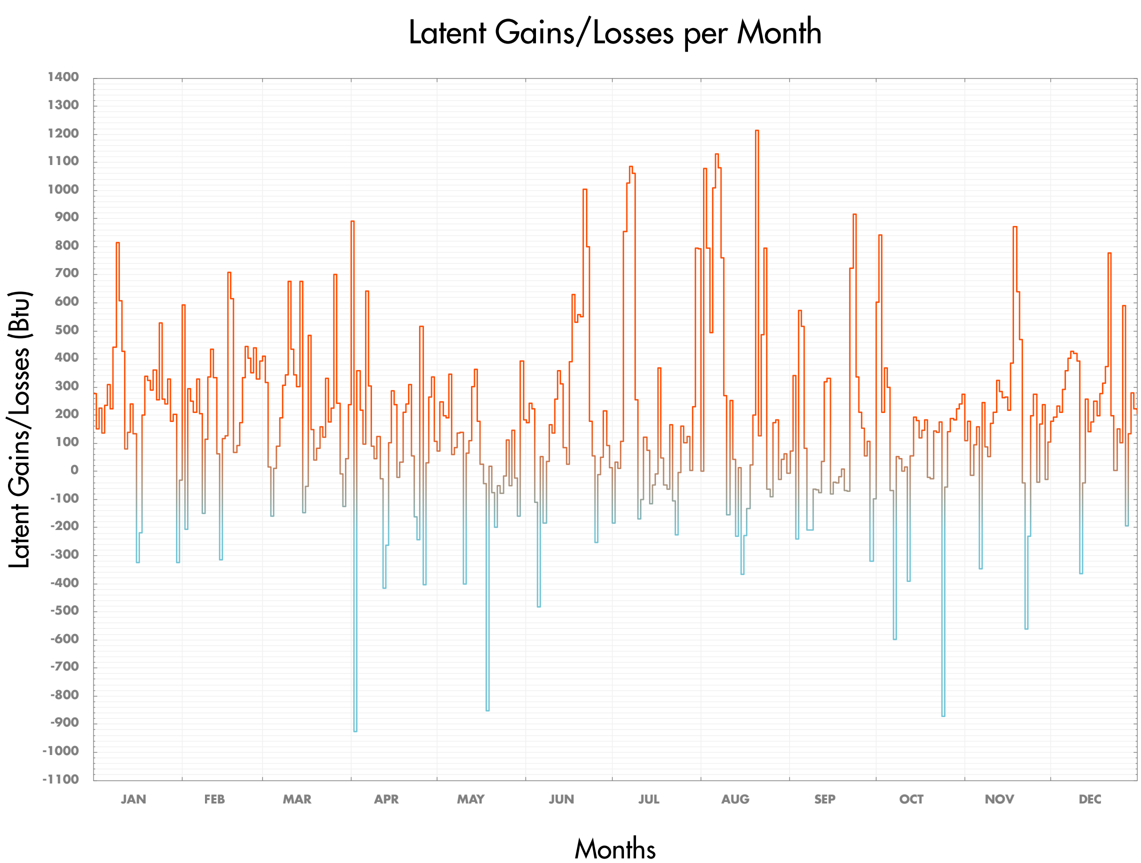
Roof: 50.56

THICKNESS (IN) x [QUANTITY]	MATERIAL	THERMAL RESISTANCE (R VALUE)
1"	Closed Cell	6
10 7/8"	Cellulose	38.06

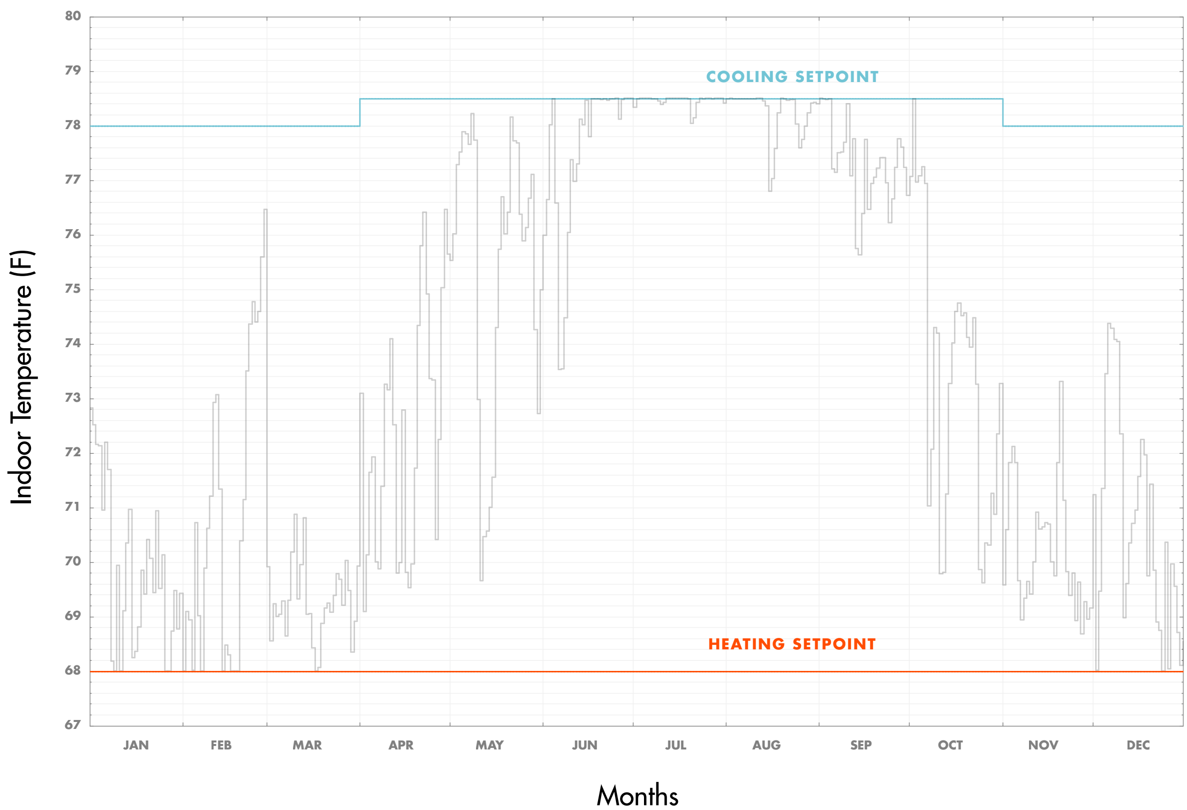
Window

WINDOW TYPE	FRAME	THERMAL RESISTANCE (R VALUE, FRAME + GLASS)
Double Pane	Aluminum w/ thermal break	4

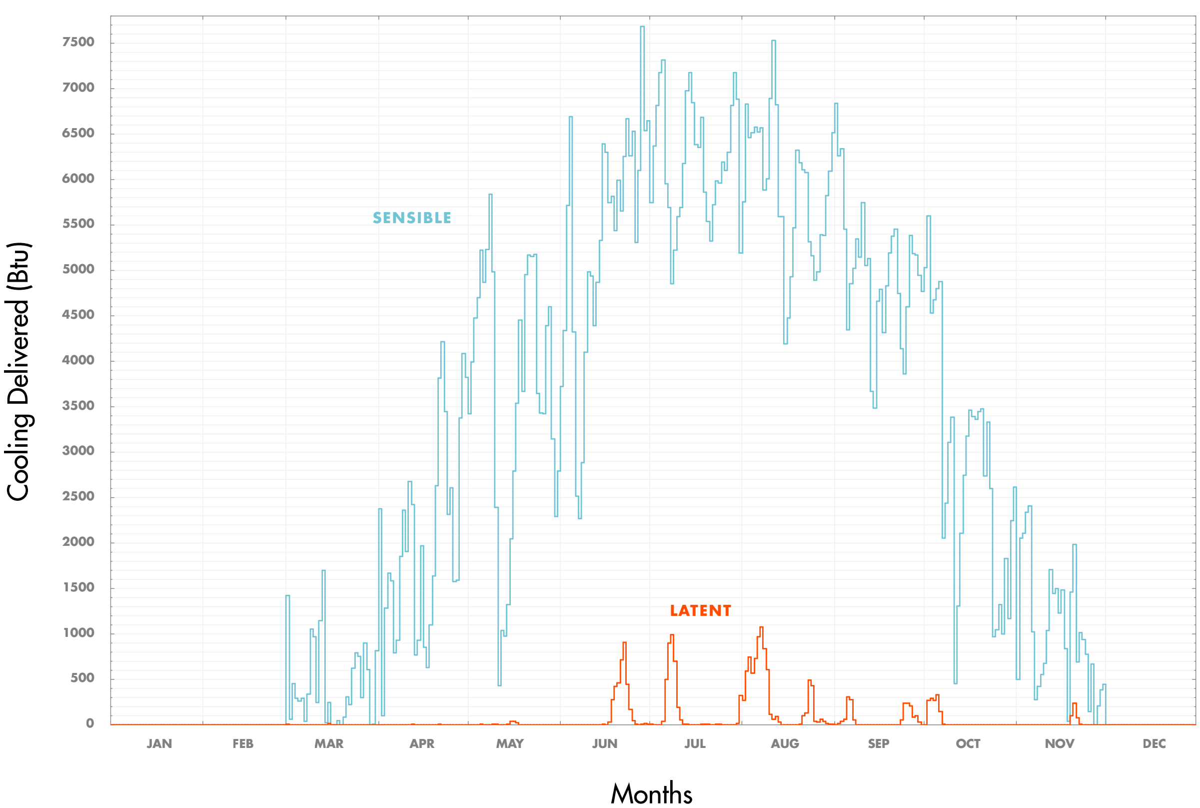

Zone Glazing Transmited by Solar per Month
Zone Glazing Transmited by Solar (Btu)
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Months

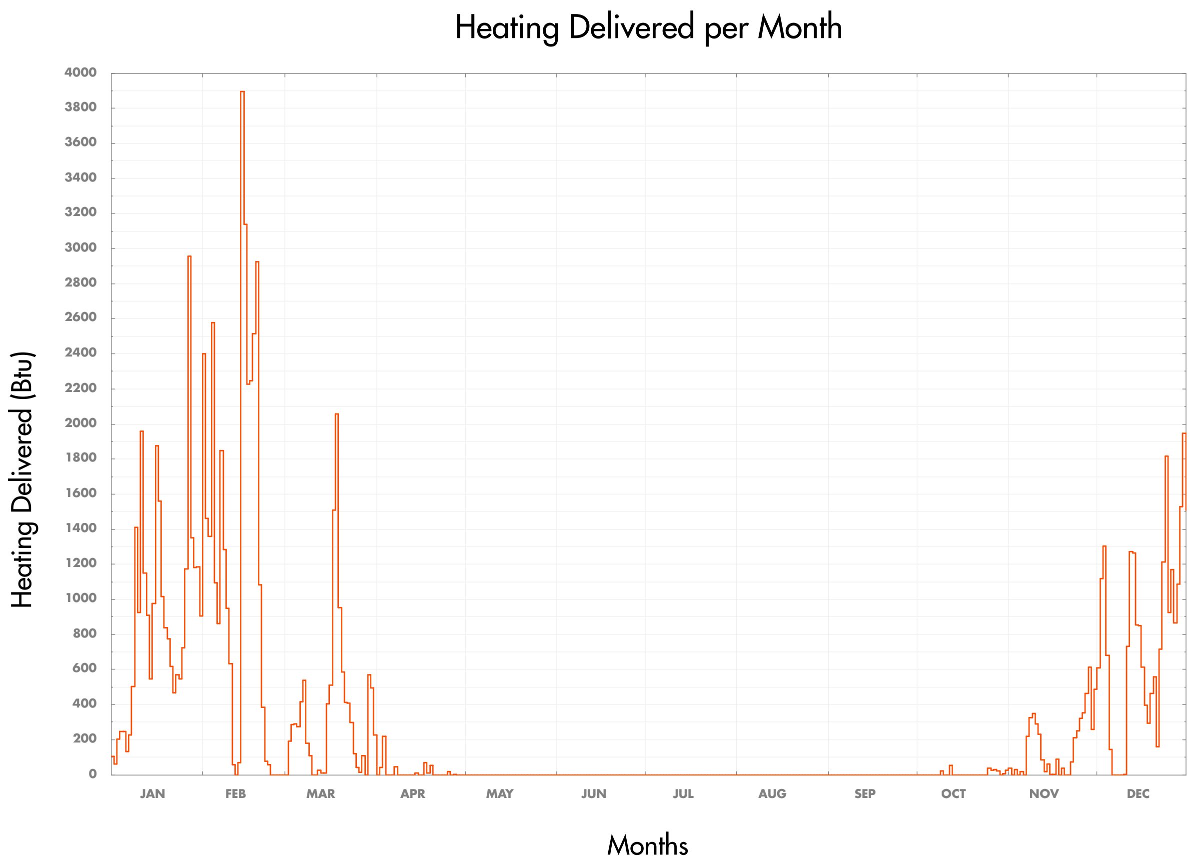

Latent Gains/Losses per Month
Latent Gains/Losses (Btu)
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1000
-1100
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Months

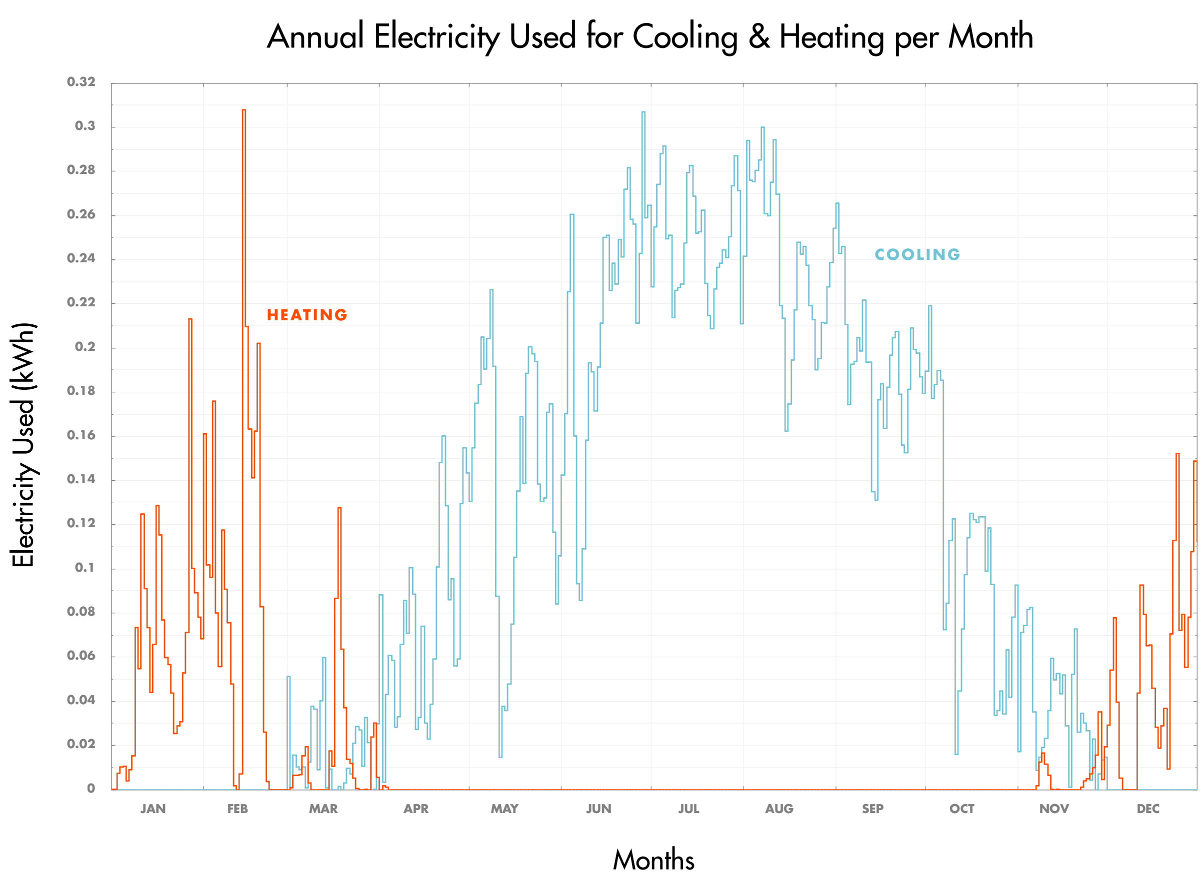
Indoor Temperature with Heating & Cooling Setpoints per Month



Cooling Delivered to Sensible and Latent Loads per Month




Heating Delivered per Month
Heating Delivered (Btu)
4000
3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Months


Annual Electricity Used for Cooling & Heating per Month
Electricity Used (kWh)
0.32
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
HEATING
COOLING
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Months

Heating + Cooling Loads

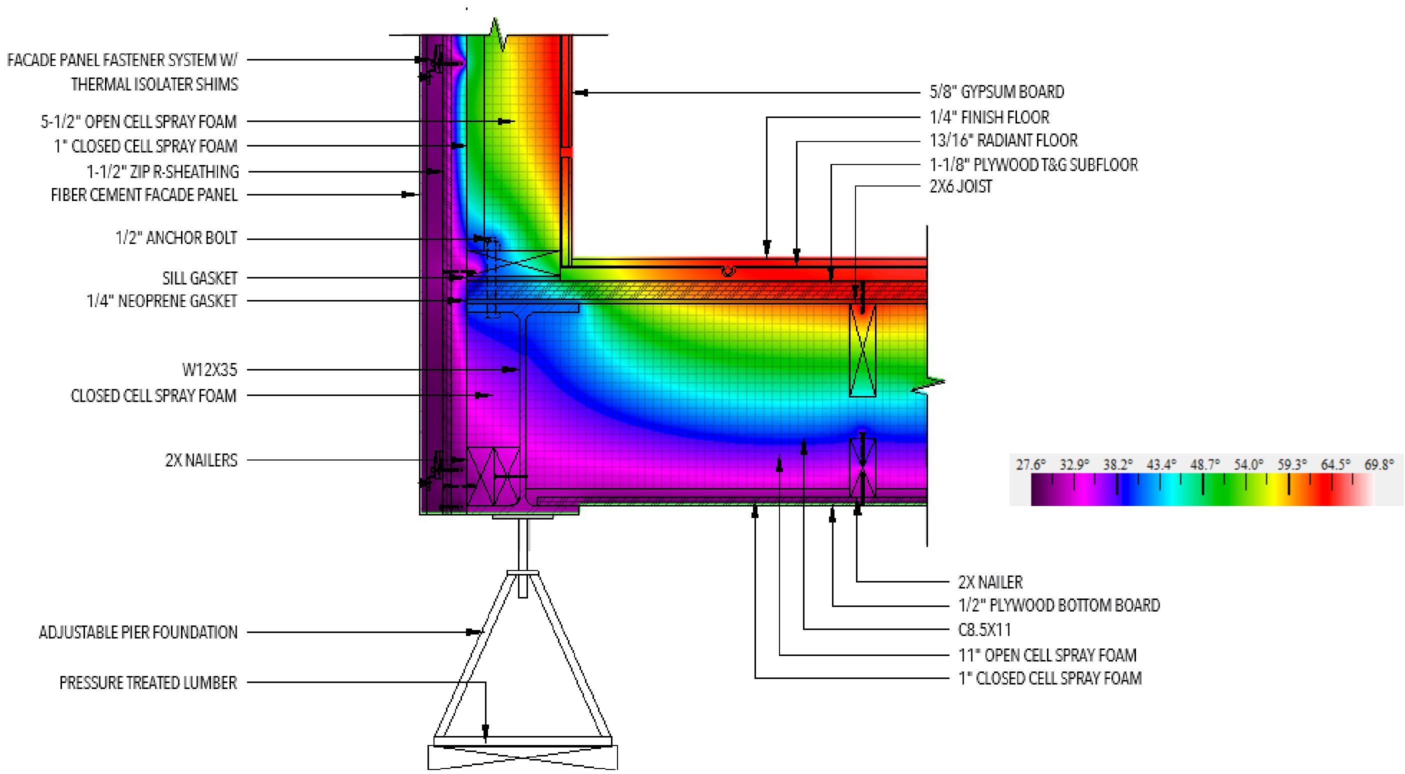
		Design State & City	NV		
Indoor Design Heating db	70	@outdoor (winter) 99% db	30	HTD	40
Indoor Design Cooling db	75	@outdoor (summer) 1%db	106	CTD	31
Indoor Design Cooling RH	50%	Grains Difference	-32	Daily Range	high
Latitude	36	Elevation	2162	ACF	0.93

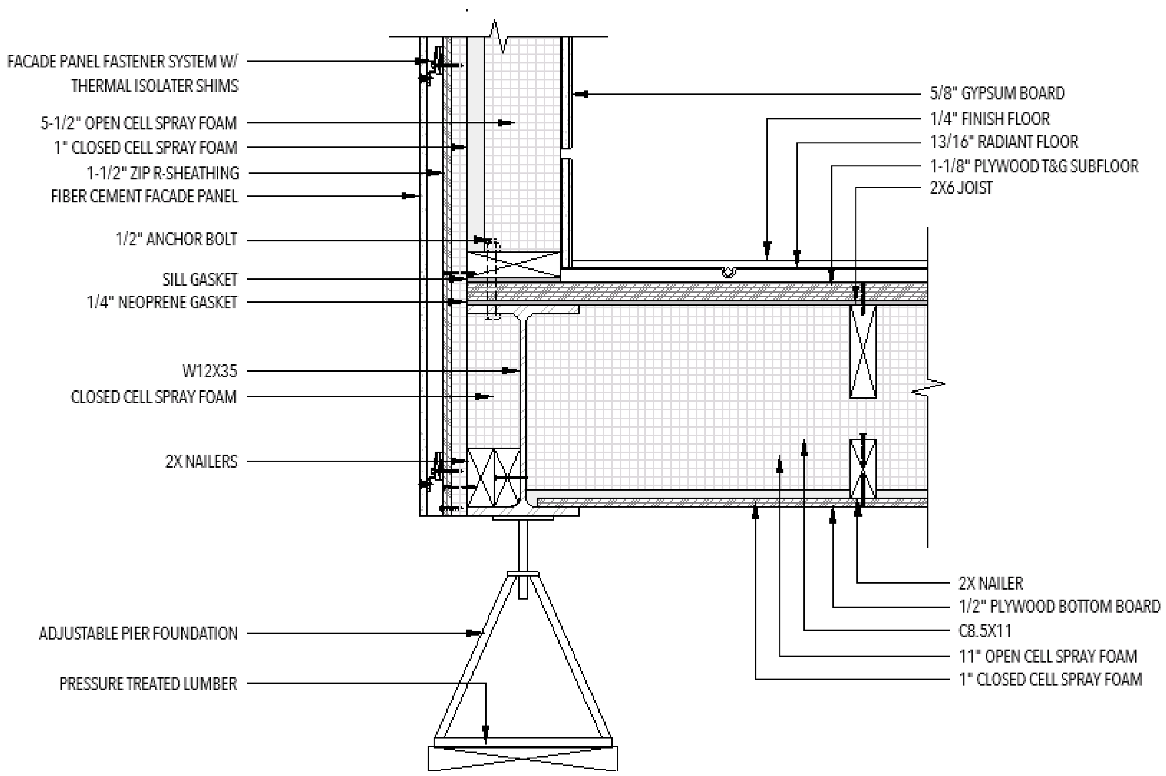
Manual J8AE - Summary Report

		Mfg. Equipment Sensible Heat Ratio Manual Overide Entry for Design CFM		0.75	
Room Name	Heat Loss	HTG CFM	Heat Gain	CLG CFM	ACCA Manual D CFM
BEDROOM	3233	228	4773	234	234
BATHROOM	1487	105	2407	118	118
OFFICE	1761	124	2139	105	124
KITCHEN/DINING	4451	314	6802	334	334
LIVING ROOM	3235	228	4259	209	228
Room Envelope Totals	**14166**	**1000**	**20381**	**1000**	

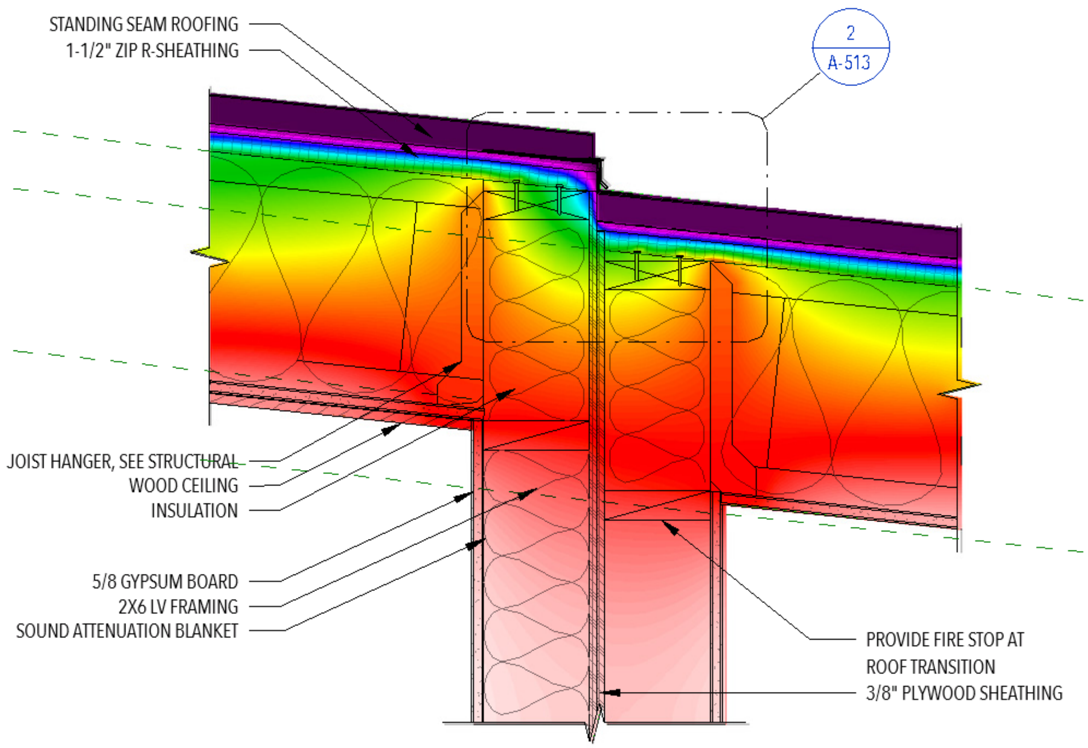
Total Area	Construction Components	Heat Loss		Heat Gain	
267	Windows & Glass Doors	5989 BTU	42.28%	5579 BTU	25.26%
	Skylights				
23	Wood & Metal Doors	351 BTU	2.48%	316 BTU	1.43%
2192	Above Grade Walls	2893 BTU	20.42&	1563 BTU	7.08%
210	Partition Walls	396 BTU	2.80%	1624 BTU	7.35%
	Below Grade Walls				
826	Ceilings	628 BTU	4.43%	1256 BTU	5.68%
	Partition Ceilings				
826	Passive Floors	637 BTU	4.50%	2611 BTU	11.82%
	Exposed Floors				
	Slab Floors				
	Basement Floors				
	Partition Floors				
	Infiltration	1396 BTU	9.86%	581 BTU	2.63%
	Internal Gains			2860 BTU	12.95%
	Duct Loss & Gain	1877 BTU	13.25%	3991 BTU	18.07%
	Ventilation				
	Blower Heat Gain			1707 BTU	7.73%
	Total Sensible	14166 BTU	100.00%	22088 BTU	100.00%
	Total Latent			29 BTU	
	Total Cooling Load			22117 BTU	

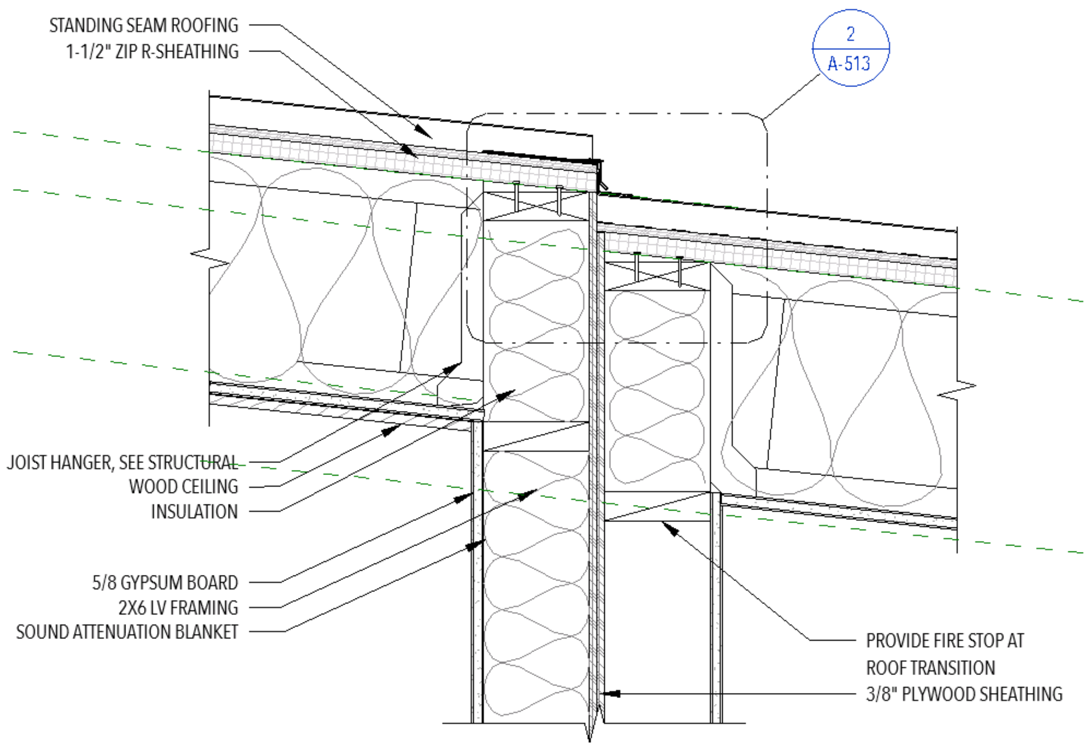
THERM — HEAT TRANSFER MODEL — FLOOR & WALL



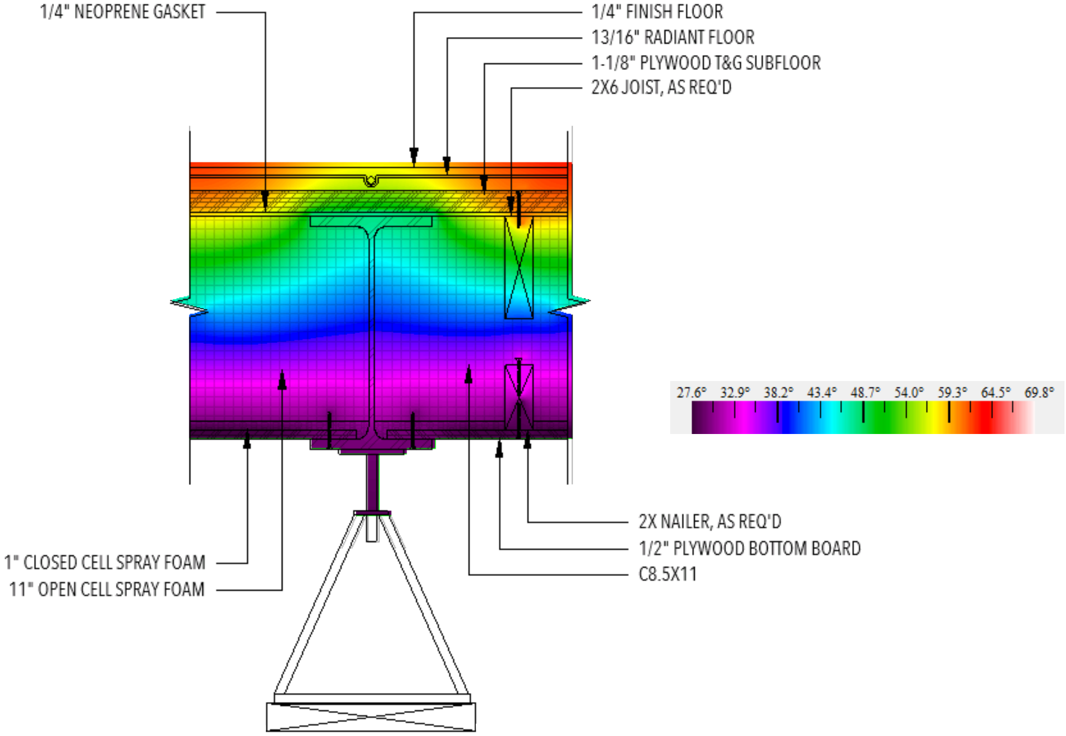


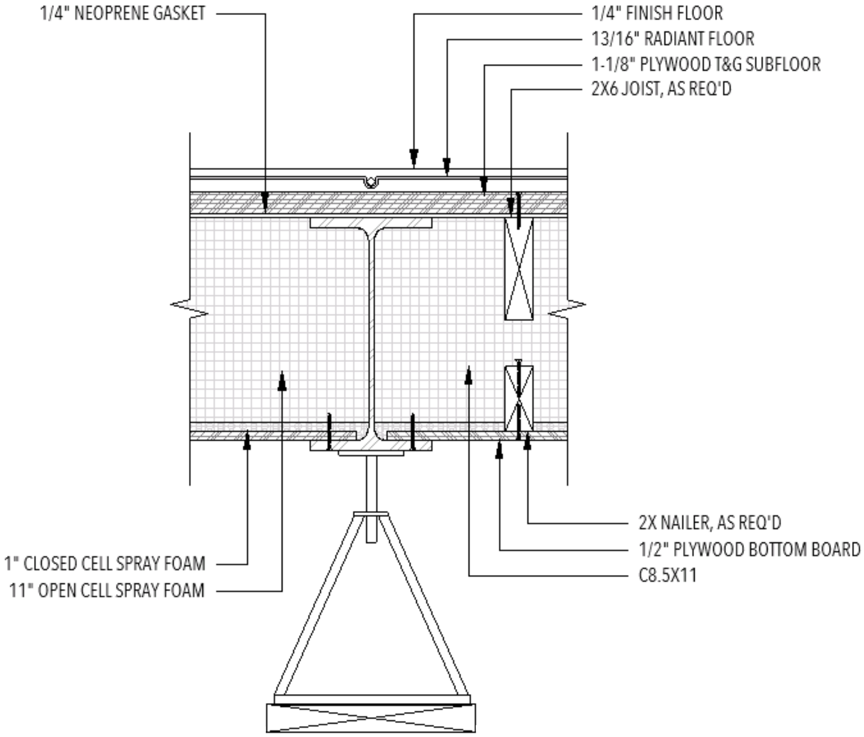
THERM — HEAT TRANSFER MODEL — SPLIT ROOF LINE



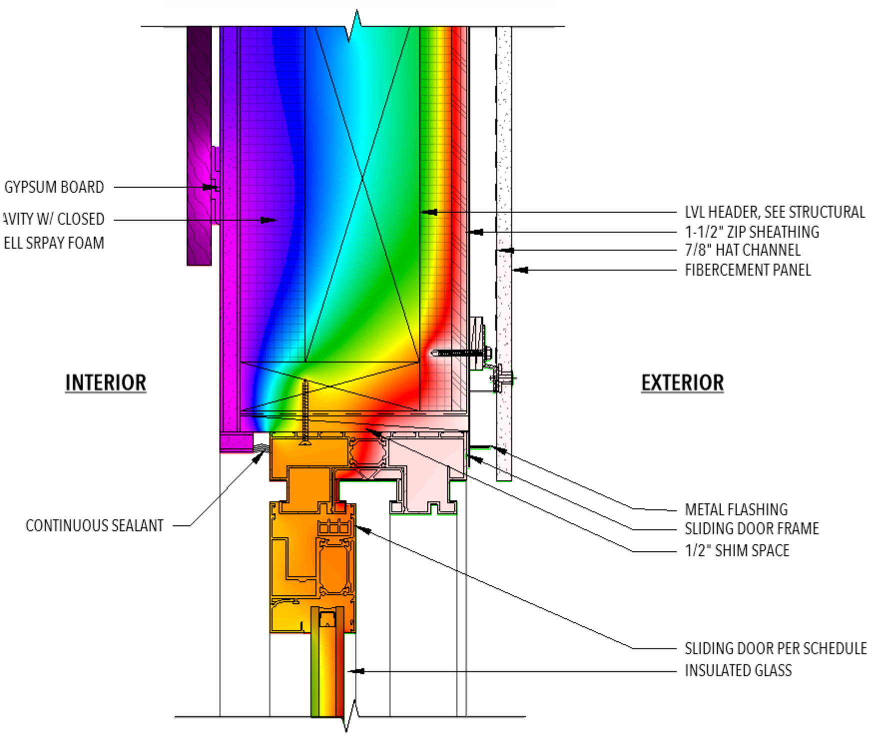


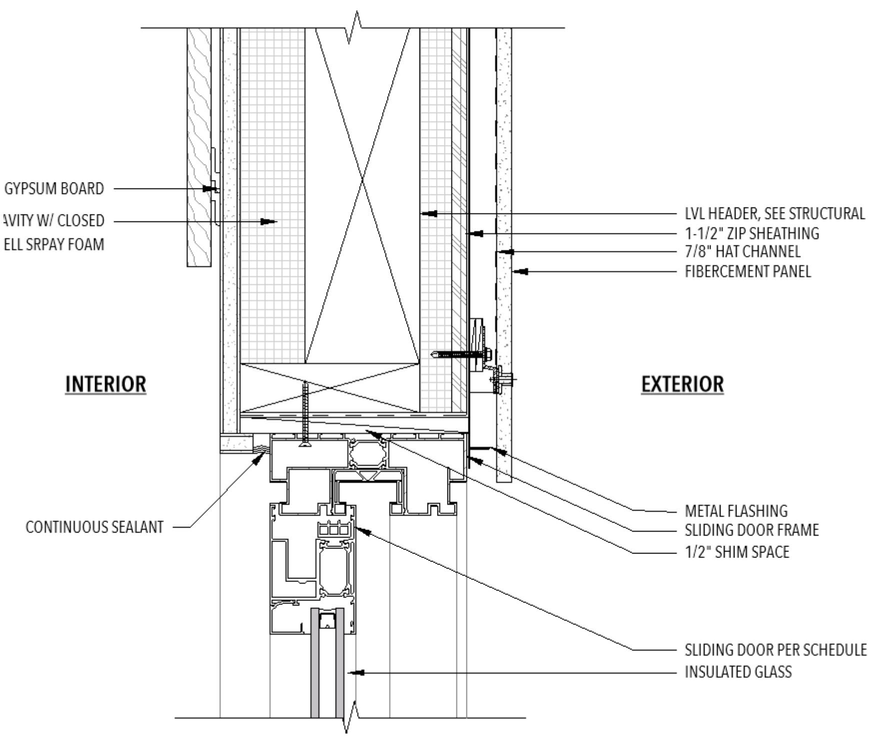
THERM — HEAT TRANSFER MODEL — FLOOR



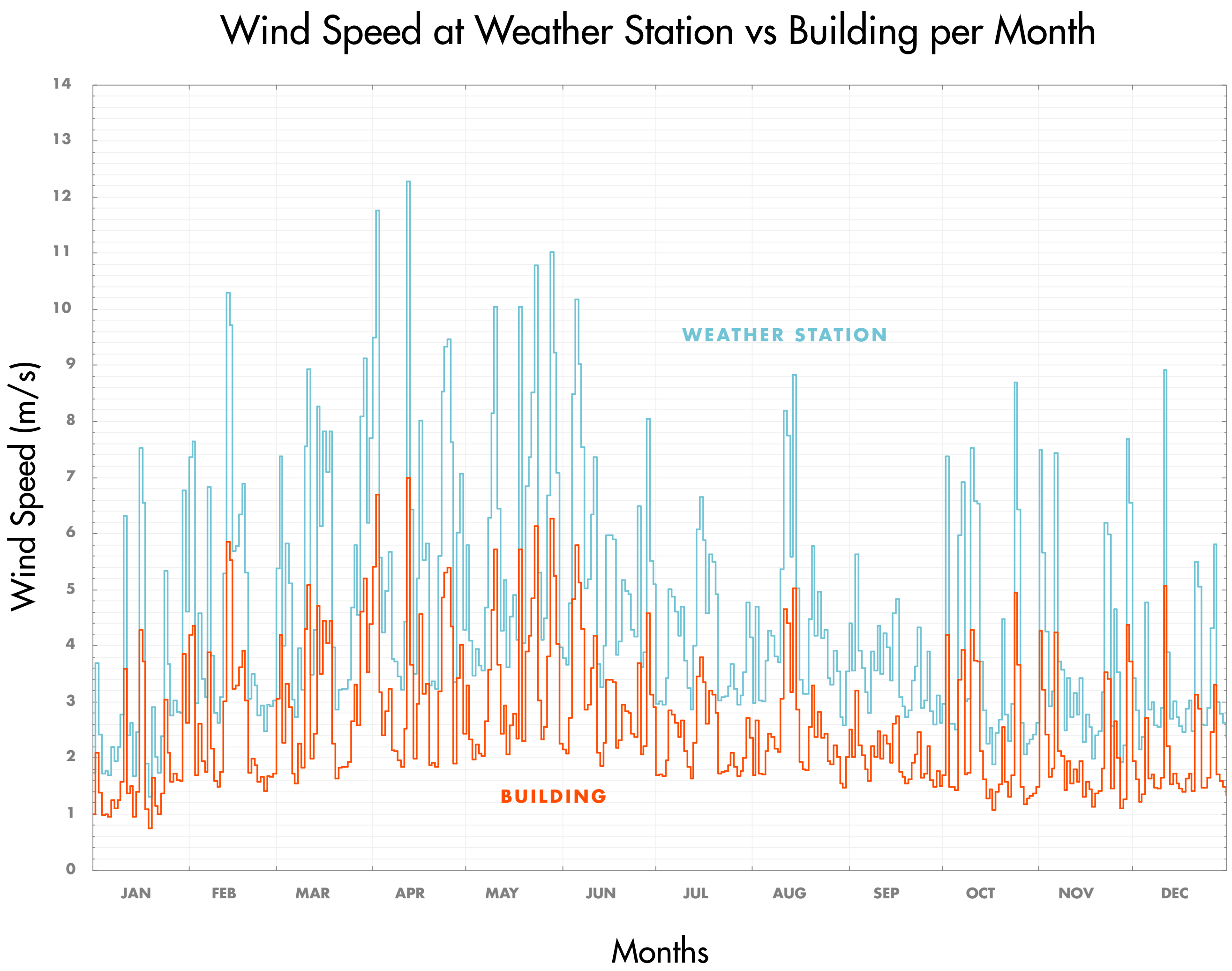


THERM — HEAT TRANSFER MODEL — WINDOW

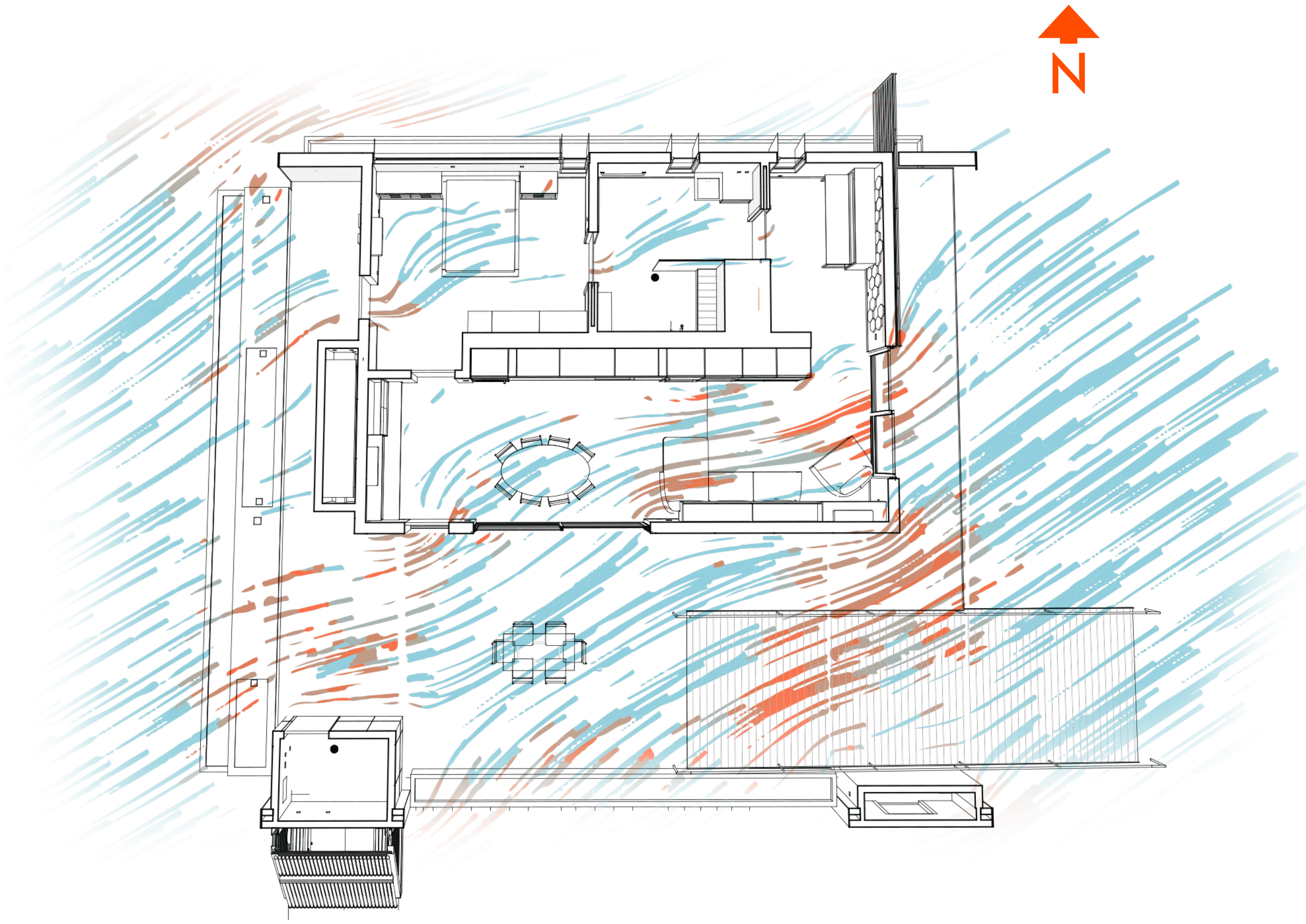




WIND SPEED


Wind Speed at Weather Station vs Building per Month
Wind Speed (m/s)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
WEATHER STATION
BUILDING
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Months

CROSS VENTILATION SIMULATION



RADIANT DESIGN

RADIANT DESIGN - SUMMARY

DESIGN DATA LOCATION	Las Vegas, NV	
Outdoor Temp: Wind Speed:	30 Degrees F	
Total Area: Construction Quality	19 mph 826 FT2 best	
Water Channel 1:	.3 USGPM @ 1.1 FT (H2O) Head (includes S&R and temp. control device head loss	
Total Loops:	6	
Total Manifolds:	1	
Total Zones:	2	
Min. Tubing Required	908 FT	
Total Load:	12,898 Btu/hr	
Total Radiant Load:	11,743 Btu/hr	
Total Supplemental Load:	0 Btu/hr	
RFH Glycol Level:	100% Water	
Design Temp. Drop:	20 Degrees F	(20 Degrees F for all QuickTrak)
Radiant Tubing Volume:	8 gallons (US)	
Volume Water:	8 gallons (US)	
Volume Glycol:	0 gallons (US)	

PHASE CHANGE MATERIAL CALCULATIONS

Sensible:

Airflow x Change in temperature x 1.08 (sensible heat constant) = Sensible Heat BTU of ventilation

Airflow - ASHREA 62.2

- 7.5 x 3 (# of occupants) + 3 * 10 (every 100 sq ft) = 52.5 CFM

The loads are calculated as follows:

- 52.5 CFM x (110 degrees – 85 degrees) x 1.08 = 1,417.5 BTU
- 1,417.5 BTU x 12 hours = 17,010 BTU
- 17,010 BTU divided by 84 BTU/lbs. (NEAL ENERGY CAP) = 202.5 lbs

0.5 lbs per packet of NPCM * 202.5 lbs = 101.25 packets.

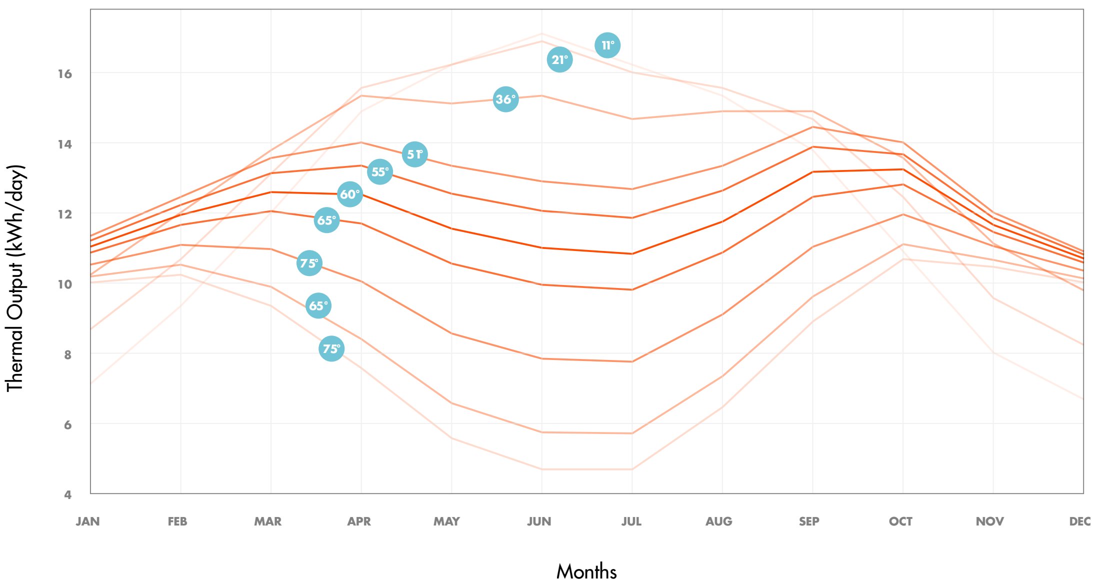
SOLAR THERMAL SIMULATION

EVACUATED TUBE COLLECTOR

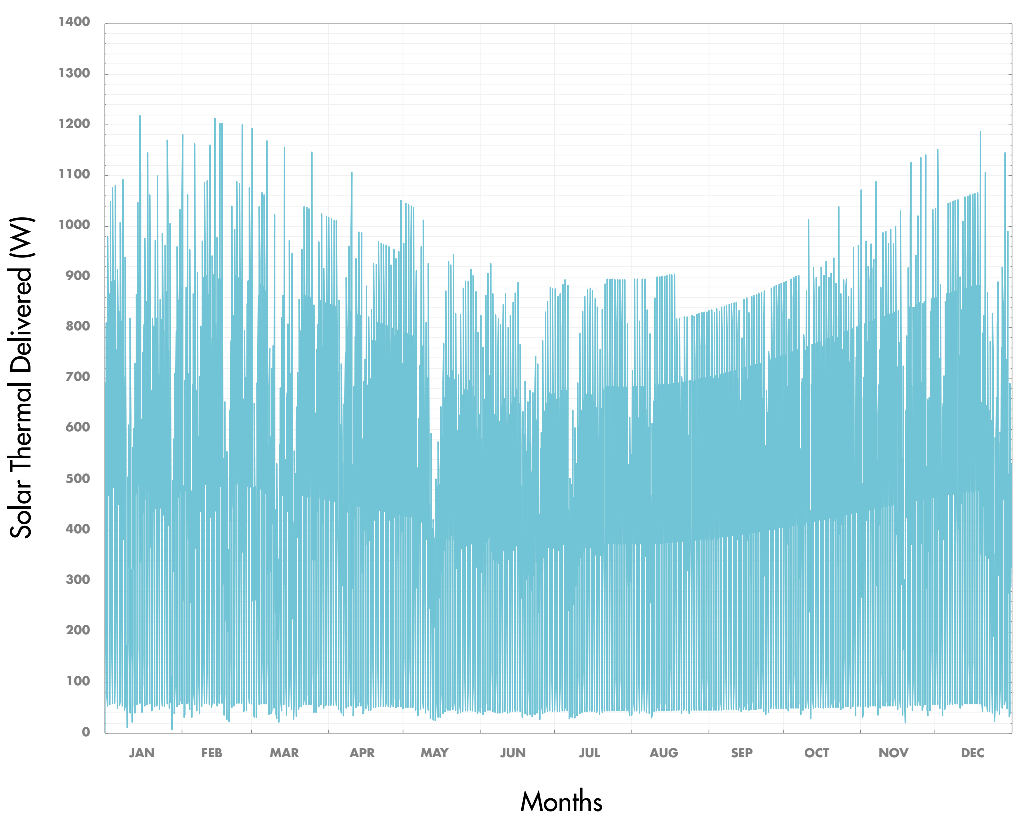
Collector Area	2.436x2
FRla	0.689
FRUL	3.85 w/m2.c
Incidence Angle Modifier	0.2
Working Fluid	Water
Azimuth	180 deg
Tilt	60 deg
Rate System Size	3.8 kW

Solar Thermal Tank	
Solar Tank Volume	.45 m^3
Solar Tank Height to diameter ratio	2.7
Solar Tank U Value	1 W/m2.c
Solar Tank Max Water Temperature	180 F (82.22 C)
Pump Power	45 W

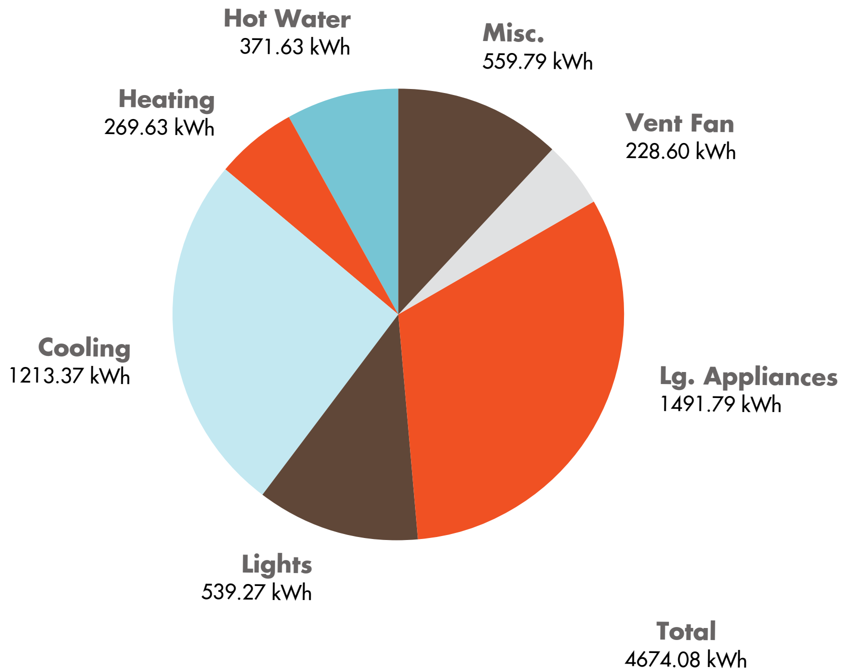
Solar Thermal Performance at Various Tilt Degrees per Month



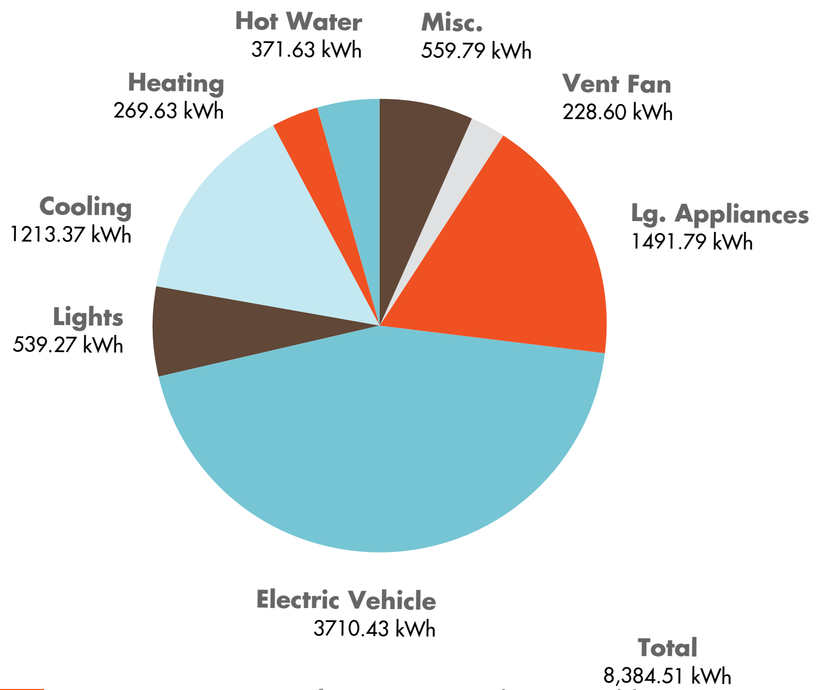
Solar Thermal Delivered per Month



Site Electricty Usage

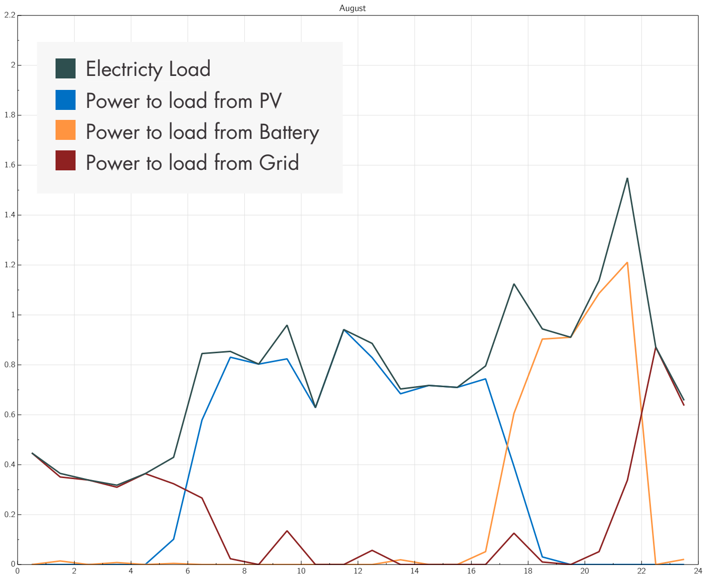


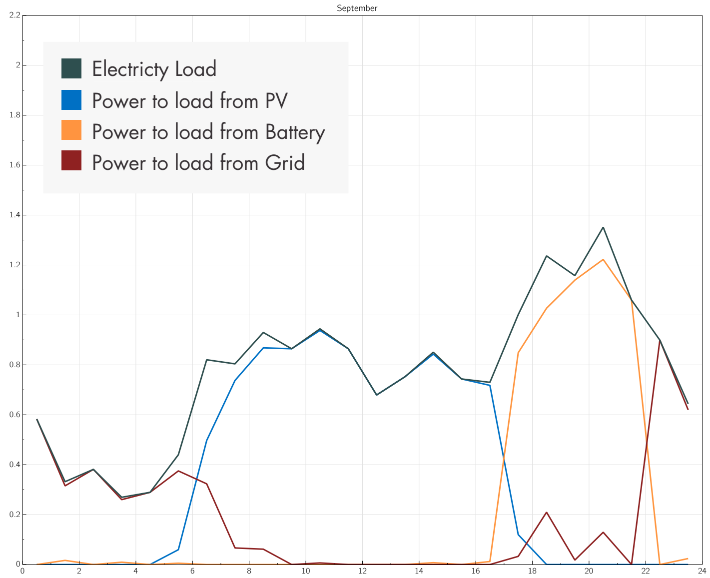
Site Electricty Usage + EV

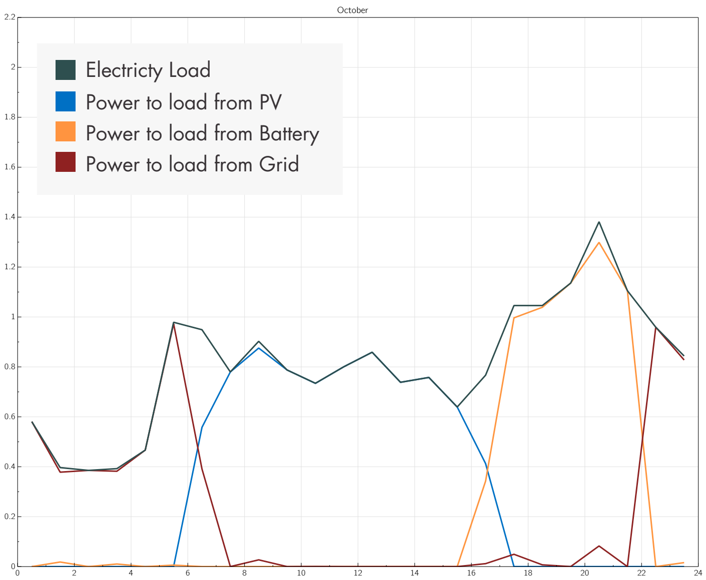


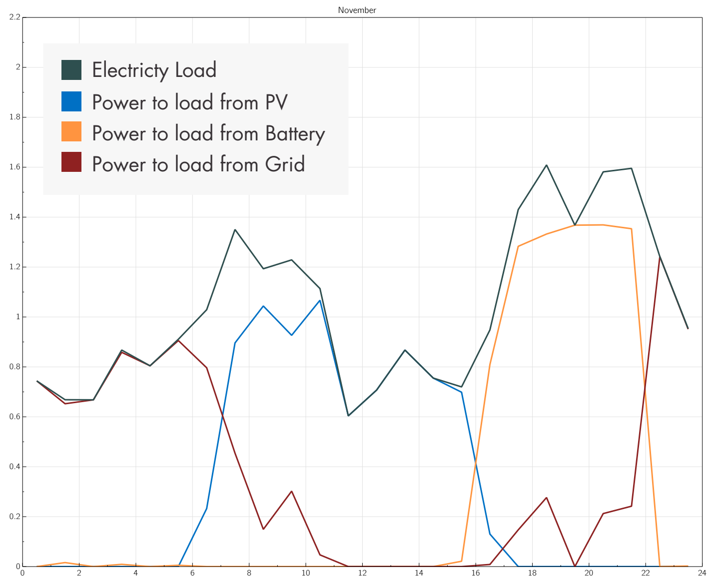
Total Building Electricity Usage vs PV Generation per Month

LAS VEGAS PV BATTERY & GRID ANALYSIS

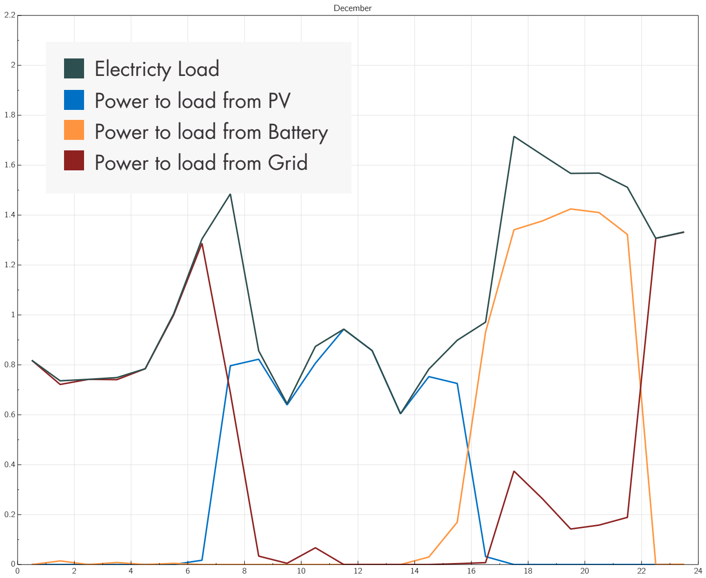


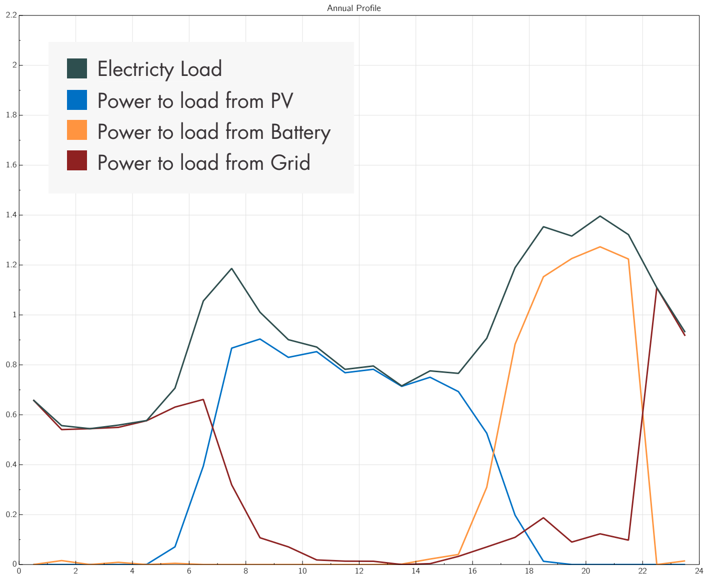


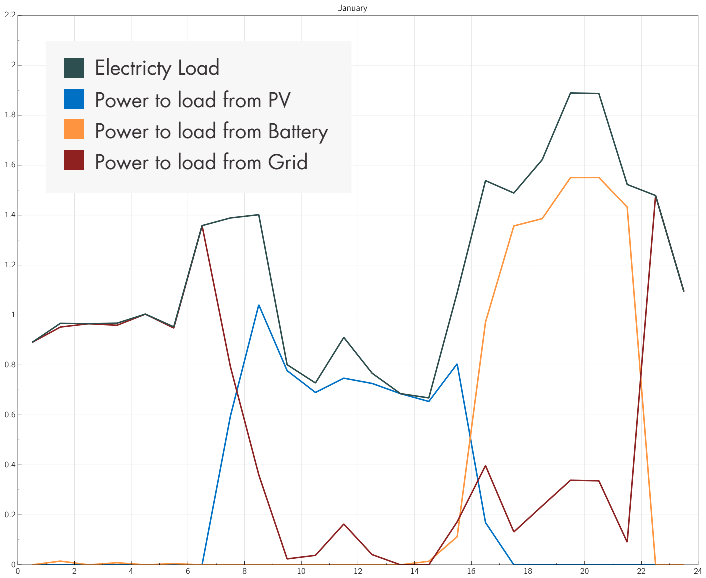


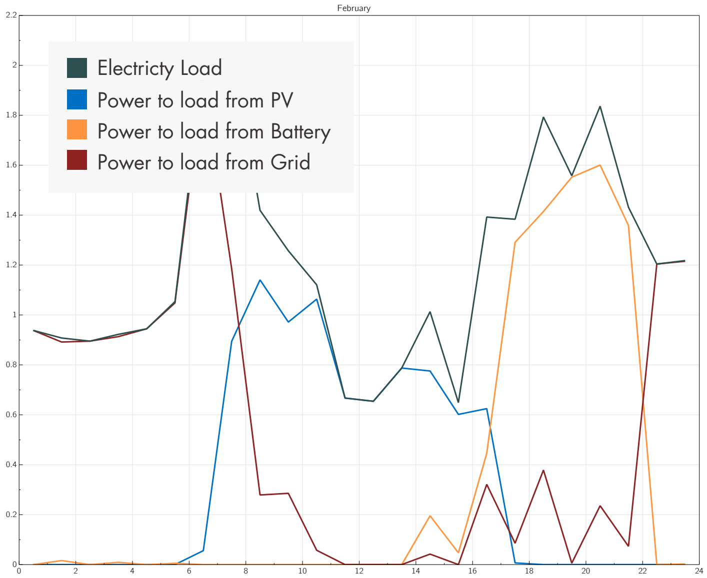


LAS VEGAS PV BATTERY & GRID ANALYSIS

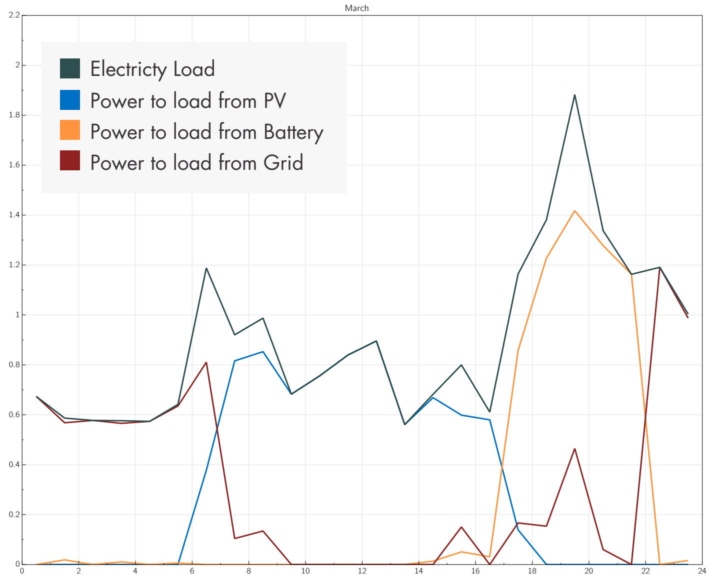


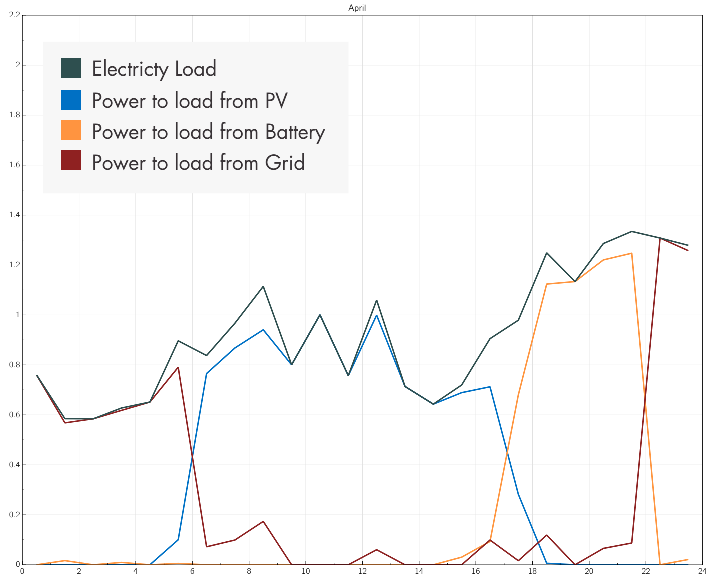


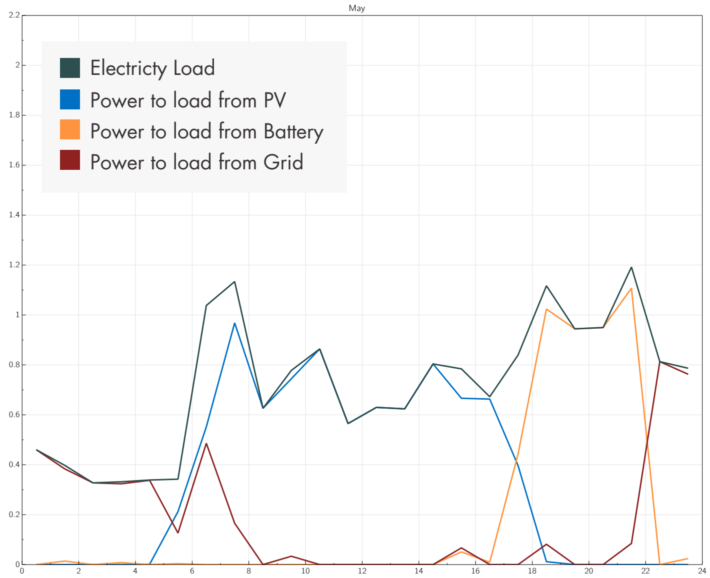


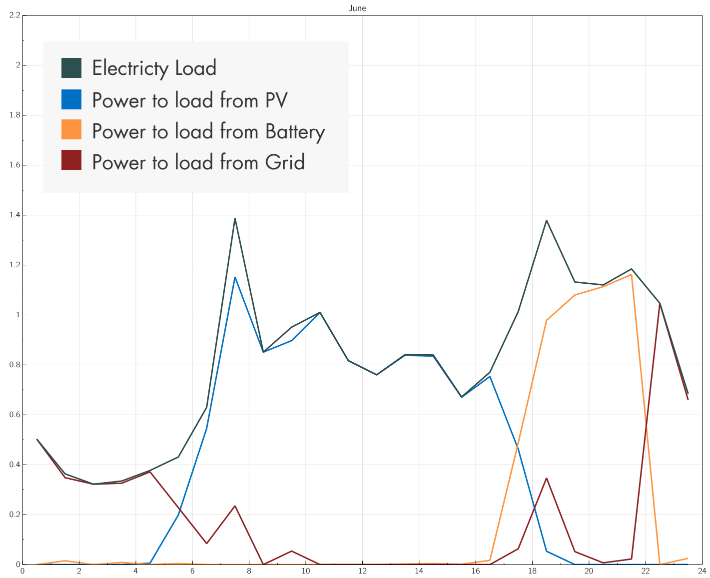


LAS VEGAS PV BATTERY & GRID ANALYSIS

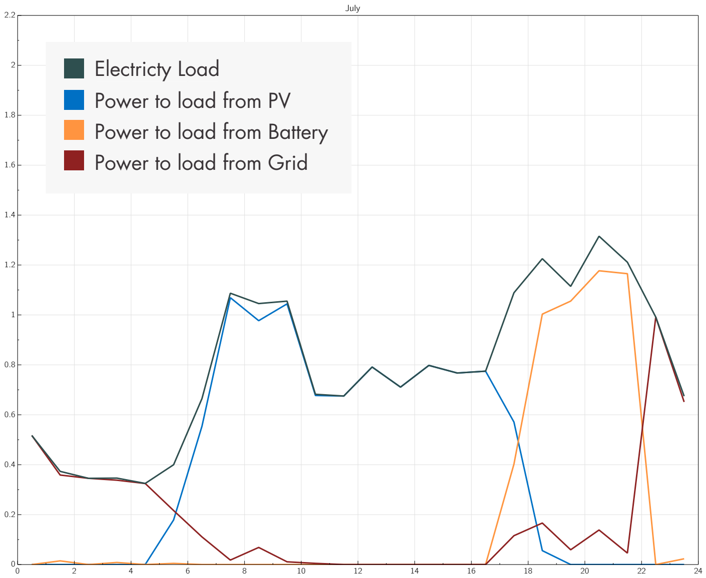




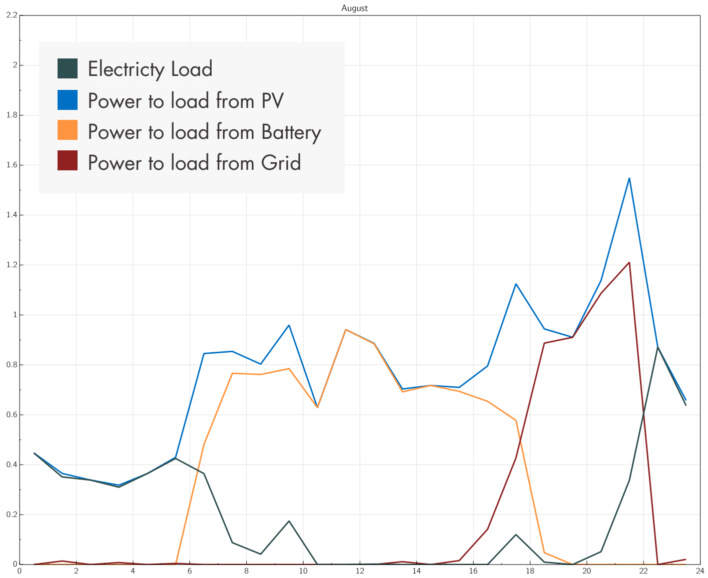


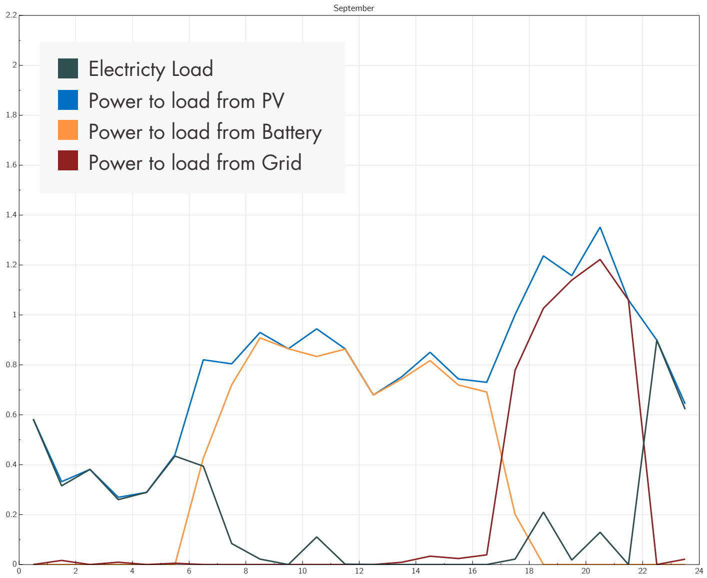


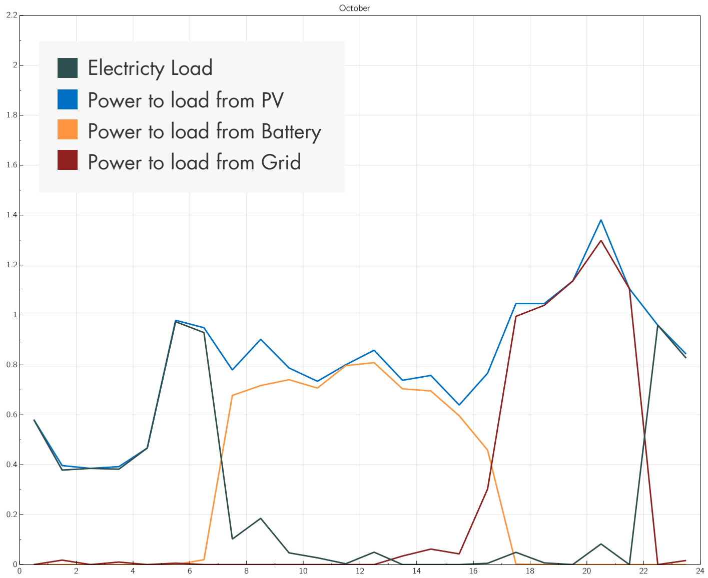
LAS VEGAS PV BATTERY & GRID ANALYSIS

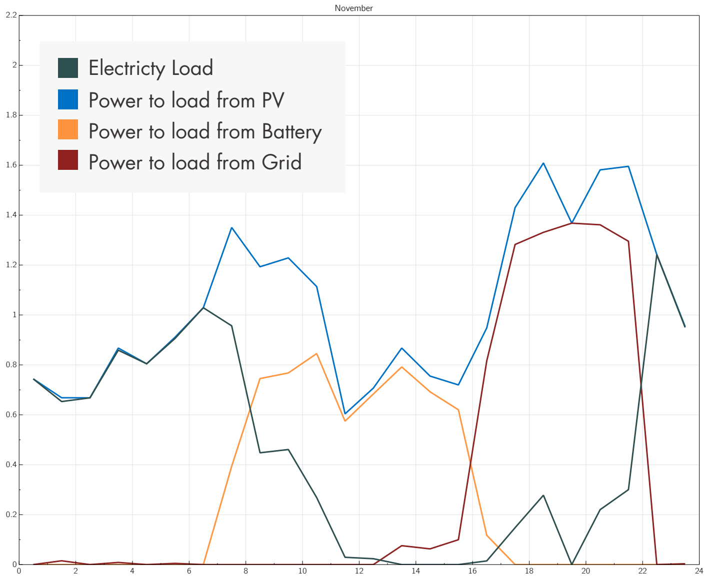


DENVER PV BATTERY & GRID ANALYSIS

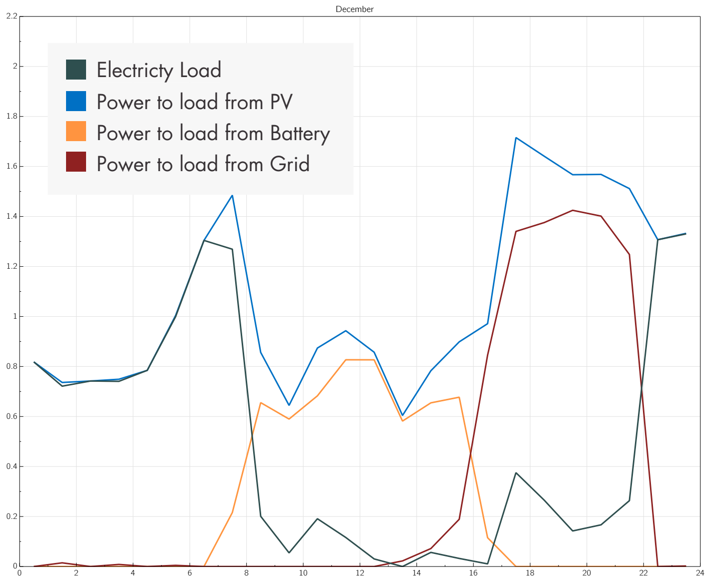


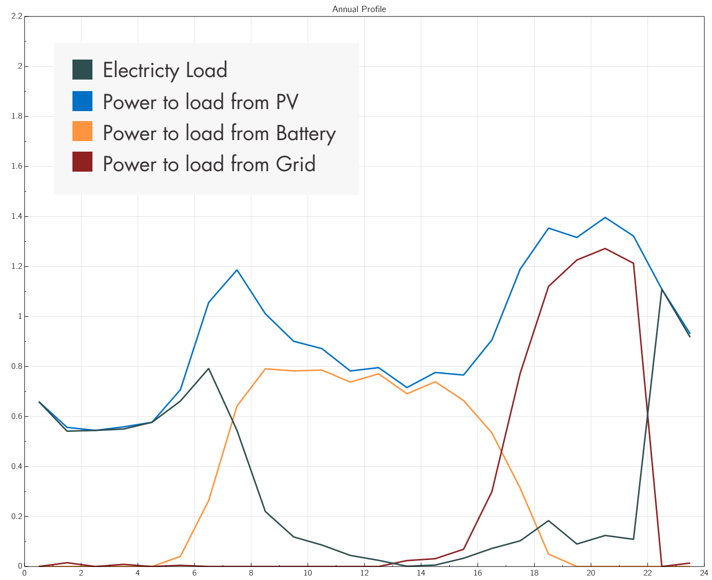


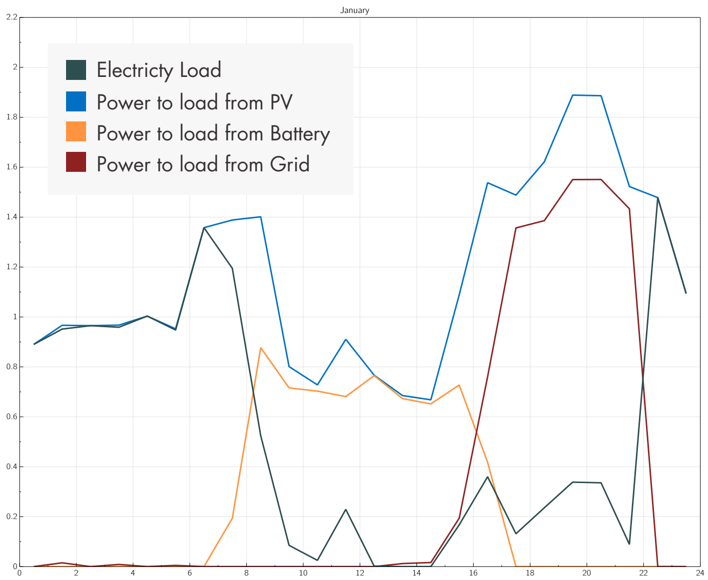


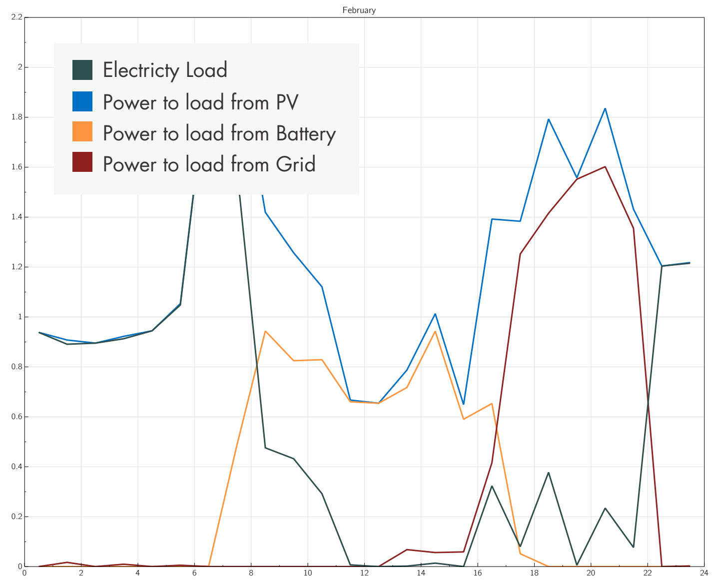


DENVER PV BATTERY & GRID ANALYSIS

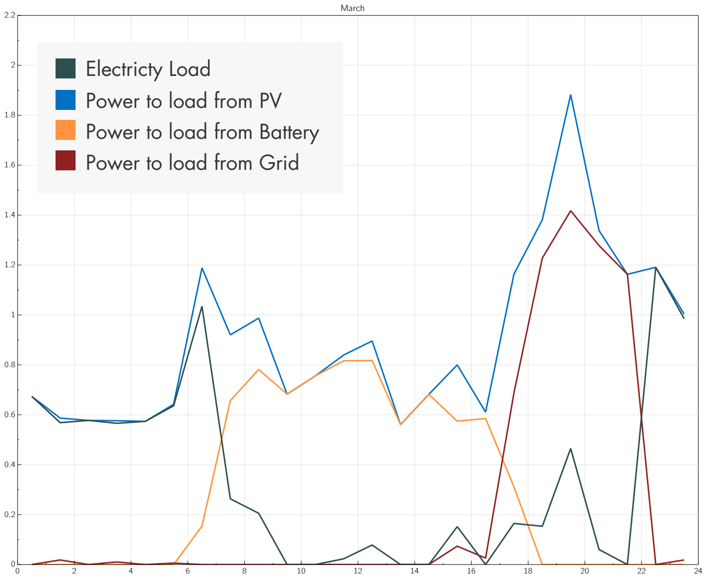


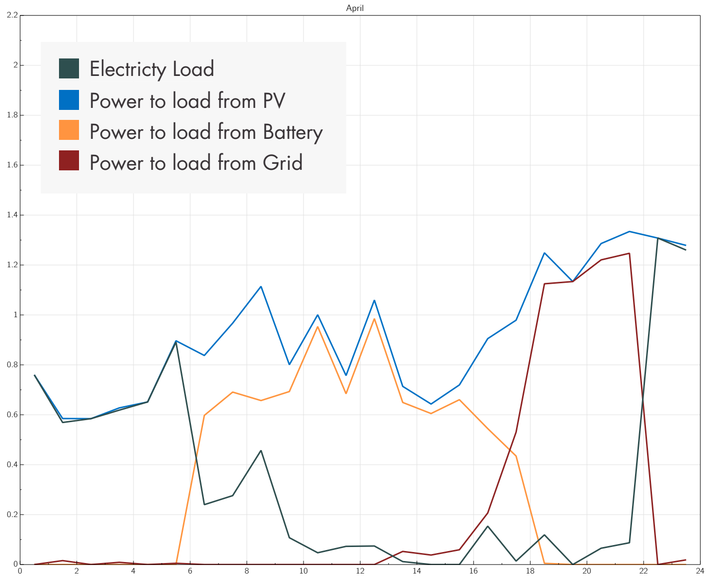


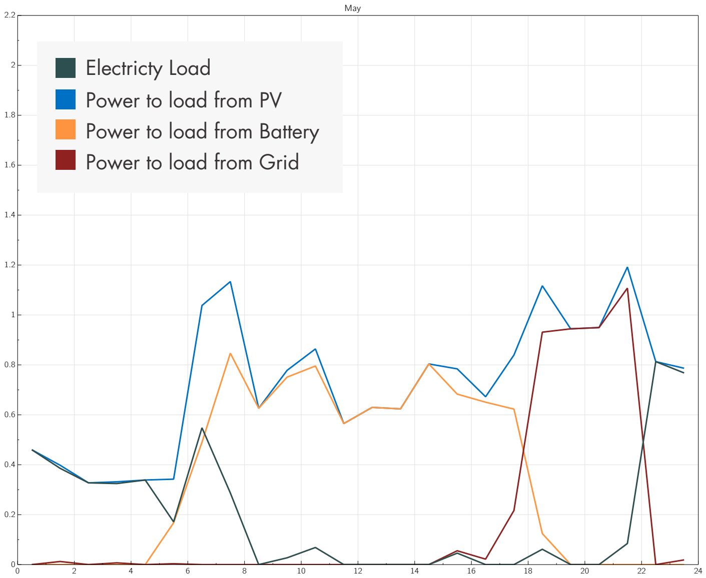


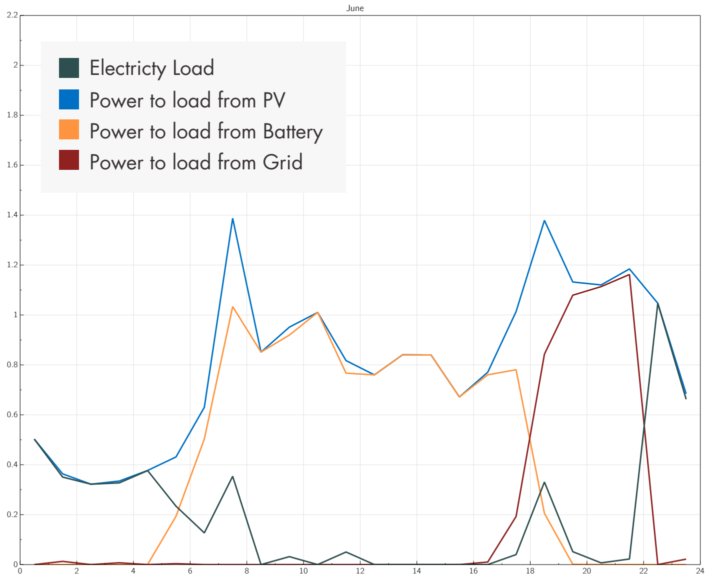


DENVER PV BATTERY & GRID ANALYSIS

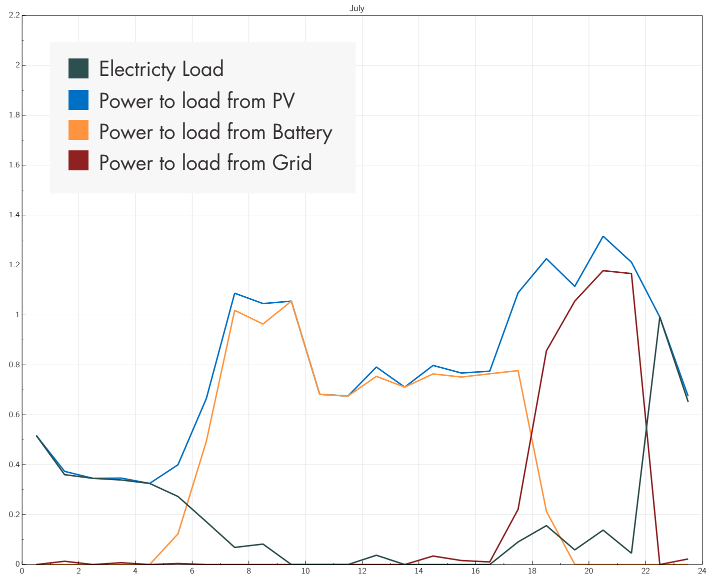








DENVER PV BATTERY & GRID ANALYSIS



OCTOBER 2017 SOLAR DECATHLON HOUSE LOADS, DENVER, CO

Hour\Date	10/5/2017	10/6/2017	10/7/2017	10/8/2017	10/9/2017	10/10/2017	10/11/2017	10/12/2017	10/13/2017
12:00:00 AM	0.36	0.65	0.69	0.66	0.60	0.38	0.35	1.32	0.41
1:00:00 AM	0.31	0.61	0.63	0.61	0.57	0.34	0.40	0.31	0.29
2:00:00 AM	0.32	0.60	0.60	0.58	0.55	0.40	0.26	0.26	0.34
3:00:00 AM	0.33	0.60	0.58	0.58	0.53	0.45	0.27	0.25	0.50
4:00:00 AM	0.35	0.59	0.57	0.59	0.54	0.48	0.28	0.25	0.37
5:00:00 AM	0.40	0.62	0.59	0.61	4.58	0.47	0.32	1.10	0.56
6:00:00 AM	3.16	0.95	0.87	0.75	0.74	0.61	0.49	0.73	0.76
7:00:00 AM	0.67	0.88	0.88	0.89	0.80	0.66	0.57	0.66	0.88
8:00:00 AM	4.38	0.83	0.91	0.70	0.53	2.47	0.48	0.55	0.68
9:00:00 AM	0.60	2.10	0.79	0.43	0.40	0.42	1.11	0.61	1.20
10:00:00 AM	0.91	0.89	0.73	0.95	0.57	0.45	0.55	0.54	0.52
11:00:00 AM	0.64	0.73	0.87	0.74	0.51	0.56	0.59	0.62	0.50
12:00:00 PM	1.35	0.75	0.71	0.48	0.51	0.59	0.63	0.64	0.54
1:00:00 PM	0.63	1.79	0.57	0.46	0.54	0.78	0.65	0.66	0.55
2:00:00 PM	0.66	1.65	0.57	0.47	0.71	0.77	0.67	1.05	0.58
3:00:00 PM	0.67	0.72	0.74	0.44	0.66	0.66	0.70	0.71	0.68
4:00:00 PM	0.76	0.82	1.01	0.51	1.55	0.66	0.77	0.72	0.63
5:00:00 PM	1.07	1.18	0.97	0.70	0.76	0.84	1.88	1.34	0.77
6:00:00 PM	1.08	1.22	1.22	0.99	0.93	0.91	1.77	0.93	0.88
7:00:00 PM	1.41	1.35	1.12	0.99	1.06	0.98	1.05	1.05	1.02
8:00:00 PM	1.19	1.24	3.71	3.45	1.40	0.97	1.12	1.03	1.90
9:00:00 PM	1.11	1.54	1.05	1.15	0.95	0.86	1.05	0.95	1.07
10:00:00 PM	1.53	1.97	0.95	0.86	0.69	1.09	1.56	1.53	0.73
11:00:00 PM	0.82	0.85	1.10	0.75	0.52	0.52	0.62	0.55	0.55
Daily Totals	24.71	25.14	22.41	19.33	21.18	17.32	18.11	18.36	16.89
Competition Totals	183.46								

OCTOBER 2017 PV PRODUCTION. DENVER, CO.

Hour\Date	10/5/2017	10/6/2017	10/7/2017	10/8/2017	10/9/2017	10/10/2017	10/11/2017	10/12/2017	10/13/2017
12:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:00:00 AM	0.71	0.69	0.69	0.64	0.75	0.72	0.44	0.75	0.62
7:00:00 AM	2.25	2.22	1.86	2.23	2.43	2.35	0.64	2.51	2.28
8:00:00 AM	3.54	3.54	2.48	3.77	3.53	4.01	2.03	4.16	3.82
9:00:00 AM	4.62	4.85	4.03	4.86	4.50	4.75	2.38	5.27	4.93
10:00:00 AM	5.26	5.46	4.18	5.41	5.10	2.80	1.82	5.86	5.43
11:00:00 AM	5.49	5.22	4.46	5.57	5.41	5.25	2.83	6.03	5.56
12:00:00 PM	5.34	5.05	1.93	5.03	5.13	4.86	2.66	5.68	5.39
1:00:00 PM	4.15	4.25	1.64	3.76	2.74	4.31	3.42	5.06	4.74
2:00:00 PM	3.31	3.68	1.64	3.00	3.49	3.39	1.52	3.86	3.58
3:00:00 PM	1.58	2.18	1.88	2.12	2.18	2.19	0.98	2.27	2.02
4:00:00 PM	0.58	0.59	0.34	0.50	0.60	0.58	0.17	0.57	0.44
5:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Daily Totals	36.82	37.72	25.12	36.88	35.86	35.20	18.89	42.01	38.81
Competition Totals	307.33								

OCTOBER 2017 BATTERY ENERGY BALANCE. DENVER, CO.

Hour\Date	10/5/2017	10/6/2017	10/7/2017	10/8/2017	10/9/2017	10/10/2017	10/11/2017	10/12/2017	10/13/2017
12:00:00 AM	12.84	4.16	2.93	1.76	3.71	5.56	6.60	2.24	5.26
1:00:00 AM	12.53	3.55	2.30	1.15	3.14	5.22	6.20	1.93	4.97
2:00:00 AM	12.21	2.95	1.71	0.57	2.59	4.82	5.94	1.67	4.63
3:00:00 AM	11.87	2.35	1.12	0.00	2.06	4.37	5.67	1.41	4.12
4:00:00 AM	11.52	1.76	0.55	0.00	1.52	3.89	5.39	1.17	3.75
5:00:00 AM	11.12	1.14	0.00	0.00	0.00	3.42	5.07	0.07	3.19
6:00:00 AM	8.67	0.87	0.00	0.00	0.01	3.52	5.02	0.09	3.05
7:00:00 AM	10.07	2.07	0.88	1.19	1.46	5.02	5.09	1.73	4.30
8:00:00 AM	9.23	4.48	2.28	3.92	4.14	6.38	6.46	4.94	7.09
9:00:00 AM	12.81	6.92	5.16	7.87	7.79	10.24	7.59	9.08	10.41
10:00:00 AM	13.20	10.99	8.24	11.83	11.82	12.33	8.72	13.20	13.20
11:00:00 AM	13.20	13.20	11.43	13.20	13.20	13.20	10.72	13.20	13.20
12:00:00 PM	13.20	13.20	12.51	13.20	13.20	13.20	12.53	13.20	13.20
1:00:00 PM	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20
2:00:00 PM	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20
3:00:00 PM	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20	13.20
4:00:00 PM	13.01	12.98	12.54	13.19	12.25	13.12	12.60	13.05	13.02
5:00:00 PM	11.95	11.80	11.56	12.49	11.49	12.28	10.72	11.71	12.25
6:00:00 PM	10.87	10.58	10.34	11.50	10.56	11.38	8.95	10.78	11.37
7:00:00 PM	9.46	9.22	9.23	10.51	9.50	10.40	7.91	9.72	10.35
8:00:00 PM	8.27	7.98	5.51	7.06	8.10	9.43	6.78	8.70	8.45
9:00:00 PM	7.16	6.44	4.46	5.91	7.15	8.56	5.73	7.74	7.39
10:00:00 PM	5.64	4.47	3.51	5.06	6.46	7.47	4.18	6.22	6.66
11:00:00 PM	4.81	3.63	2.42	4.31	5.94	6.95	3.56	5.67	6.10
Daily Battery Balance	4.81	3.63	2.42	4.31	5.94	6.95	3.56	5.67	6.10

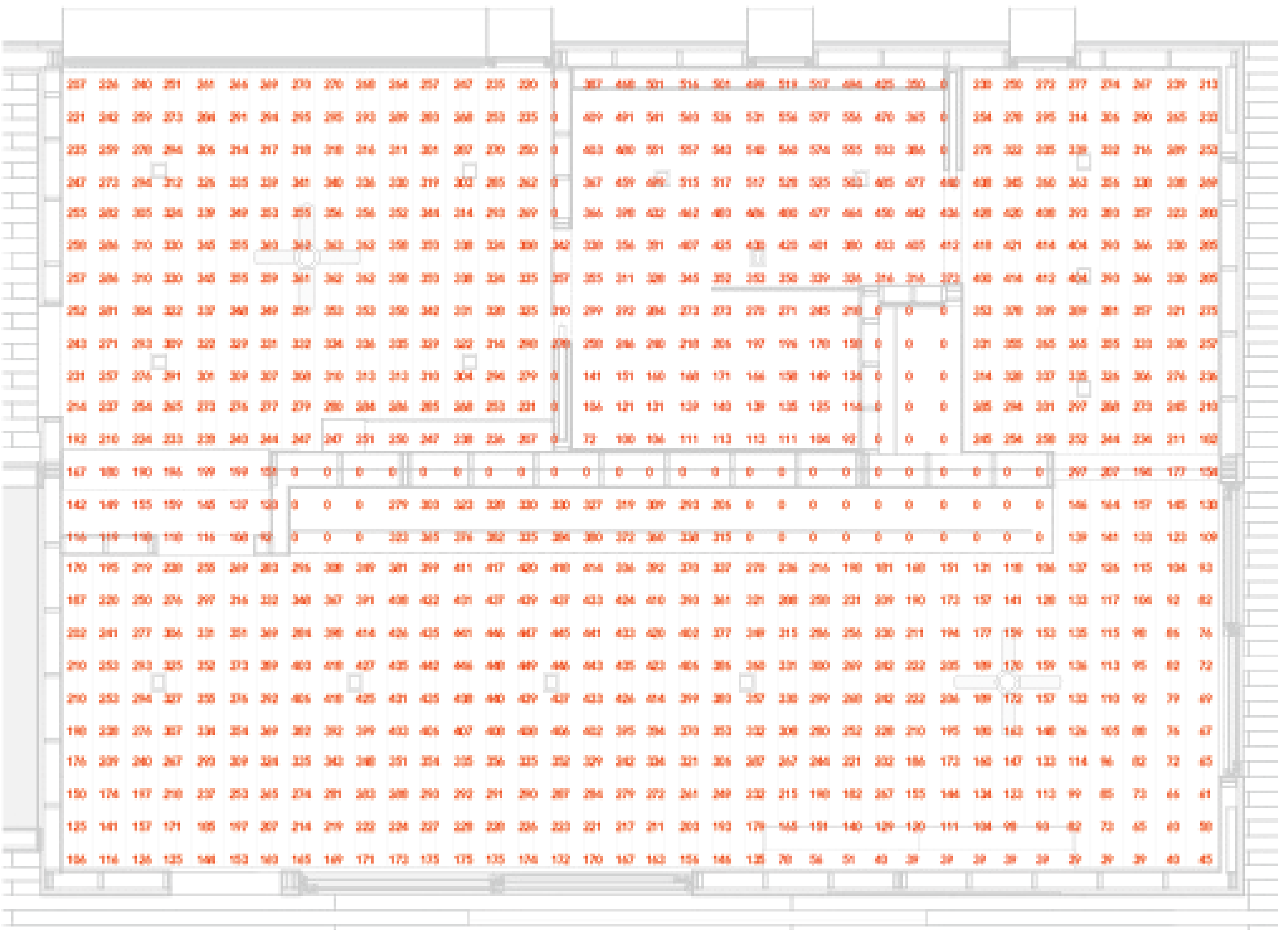
OCTOBER 2017 GRID USE/EXPORT. DENVER, CO.

Hour\Date	10/5/2017	10/6/2017	10/7/2017	10/8/2017	10/9/2017	10/10/2017	10/11/2017	10/12/2017	10/13/2017
12:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:00:00 AM	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00
4:00:00 AM	0.00	0.00	0.00	-0.59	0.00	0.00	0.00	0.00	0.00
5:00:00 AM	0.00	0.00	-0.04	-0.61	-3.06	0.00	0.00	0.00	0.00
6:00:00 AM	0.00	0.00	-0.18	-0.11	0.00	0.00	0.00	0.00	0.00
7:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10:00:00 AM	3.96	0.00	0.00	0.00	0.00	0.00	0.00	1.21	0.00
11:00:00 AM	4.85	2.27	0.00	3.46	3.52	3.82	0.00	5.41	0.00
12:00:00 PM	3.99	4.30	0.00	4.54	4.62	4.27	0.00	5.04	0.00
1:00:00 PM	3.52	2.46	0.38	3.30	2.20	3.54	2.10	4.40	0.00
2:00:00 PM	2.65	2.03	1.07	2.54	2.78	2.62	0.86	2.81	0.00
3:00:00 PM	0.91	1.47	1.14	1.67	1.53	1.53	0.29	1.57	0.00
4:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Daily Battery Balance	19.88	12.52	2.37	14.20	11.59	15.77	3.24	20.43	0.00
Competition Totals					100.01				

OCTOBER 2017 ACCOUNT BALANCE ($). DENVER, CO.

Hour\Date	10/5/2017	10/6/2017	10/7/2017	10/8/2017	10/9/2017	10/10/2017	10/11/2017	10/12/2017	10/13/2017
12:00:00 AM	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:00:00 AM	0.00	0.00	0.00	-0.03	0.00	0.00	0.00	0.00	0.00
5:00:00 AM	0.00	0.00	0.00	-0.03	-0.15	0.00	0.00	0.00	0.00
6:00:00 AM	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00
7:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9:00:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10:00:00 AM	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00
11:00:00 AM	0.24	0.11	0.00	0.17	0.18	0.19	0.00	0.27	0.00
12:00:00 PM	0.20	0.21	0.00	0.23	0.23	0.21	0.00	0.25	0.00
1:00:00 PM	0.70	0.49	0.08	0.66	0.44	0.71	0.42	0.88	0.00
2:00:00 PM	0.53	0.41	0.21	0.51	0.56	0.52	0.17	0.56	0.00
3:00:00 PM	0.18	0.29	0.23	0.33	0.31	0.31	0.06	0.31	0.00
4:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11:00:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Daily Ending Balance	7.06	8.58	9.08	10.92	12.48	14.42	15.07	17.41	17.41
Competition Totals					17.41				

POINT LOCATION LUX VALUES



AVG. 300 LUX

MAKING COMPARISONS - Homes in Las Vegas

TYPICAL HOME IN LAS VEGAS

12031 kWh/year

VS

TEAM LAS VEGAS

4674 kWh/year