

Aug 11th, 3:00 PM - 3:30 PM

Current projects at the UNLV Center for Energy Research

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CURRENT PROJECTS AT THE UNLV

Center for Energy Research

UNIVERSITY OF NEVADA,
LAS VEGAS

UNLV





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Amonix Projects

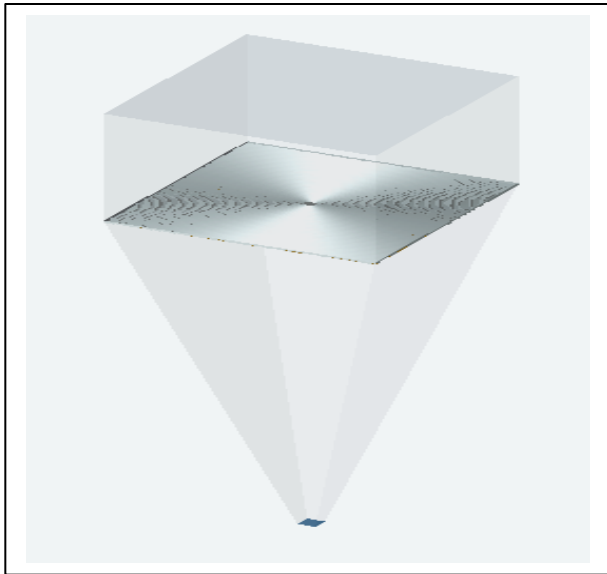
AMONIX



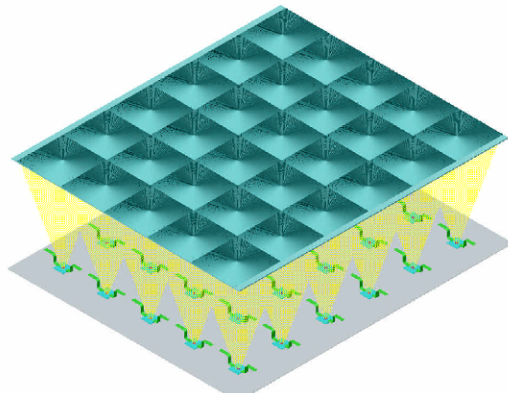
CEP
The Center for Energy Research



Introduction to Amonix HCPV



- System uses Acrylic Fresnel lens to concentrate Direct Normal Irradiance (DNI) on photovoltaic cell,
- Reduces the amount of expensive PV semiconductor materials required,
- System requires two-axis tracking to follow the sun, which also allows for higher energy generation.

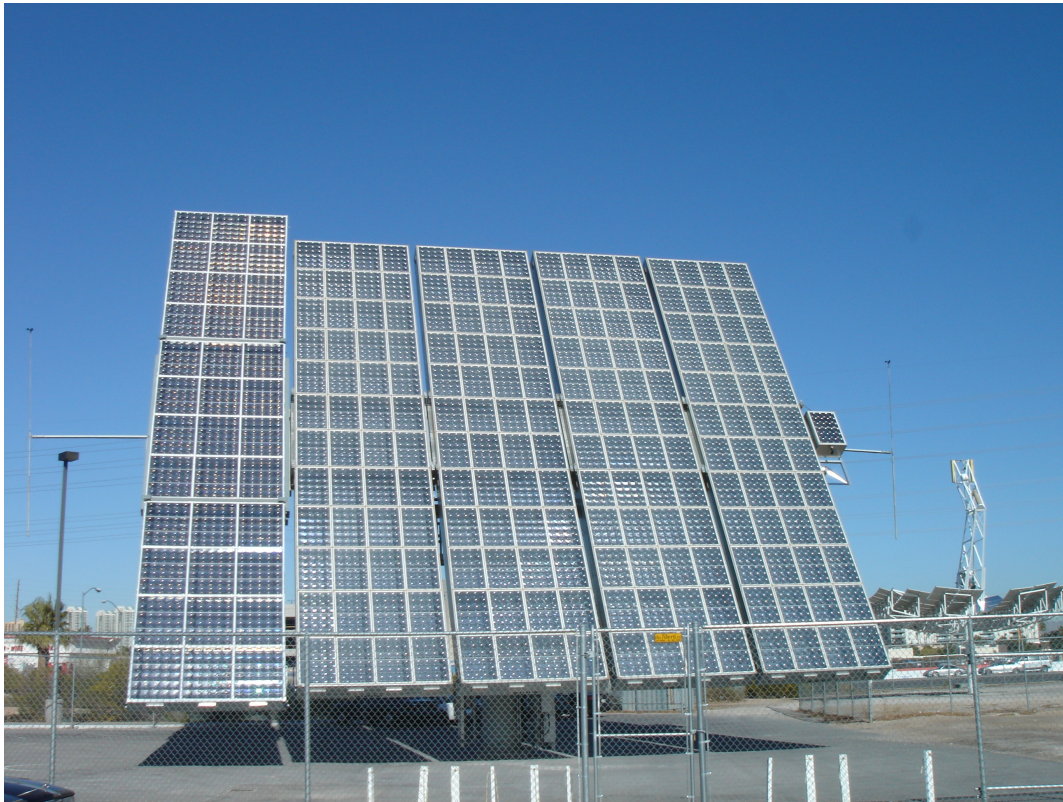


1st system at UNLV

- Project began in 2003 as an NREL funded project,
- 25kW installation on Campus,
- System used Amonix Silicon HCPV cells (~25% cell efficiency),
- Geometric Concentration Ratio 250:1,
- Objectives:
 - Generate a data base for MTBF/ MTBI
 - System characterization
 - Test bed for testing new advanced technologies

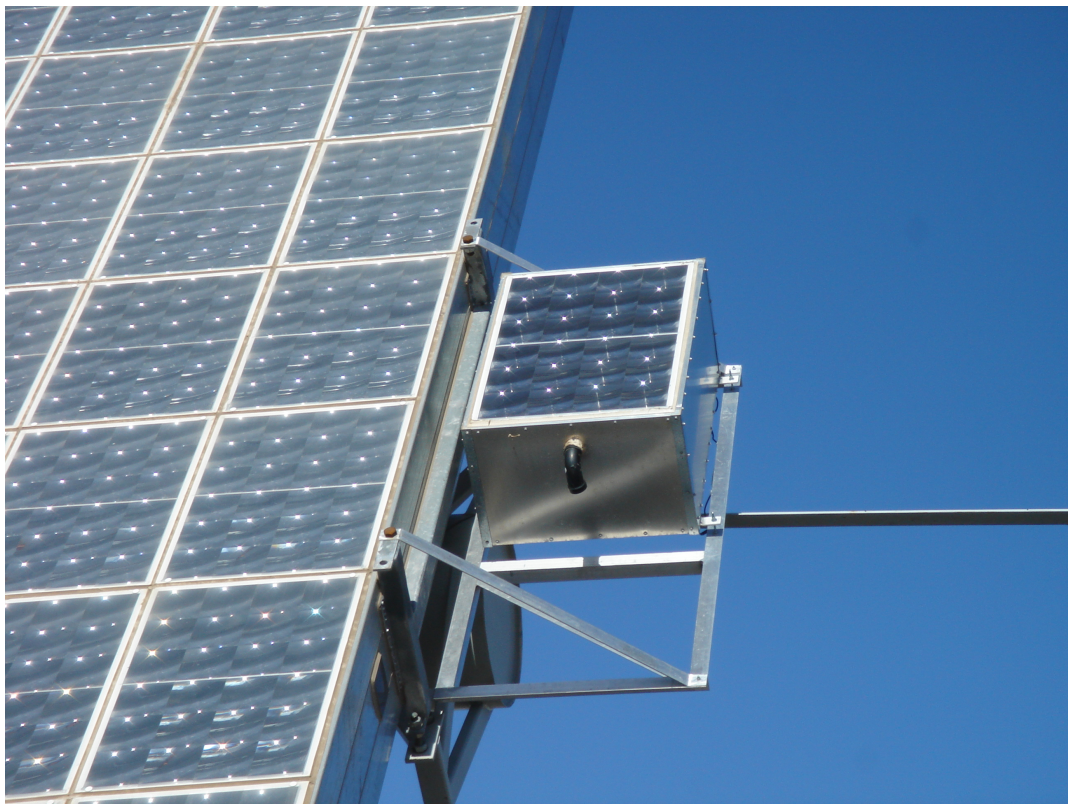


Component Testing



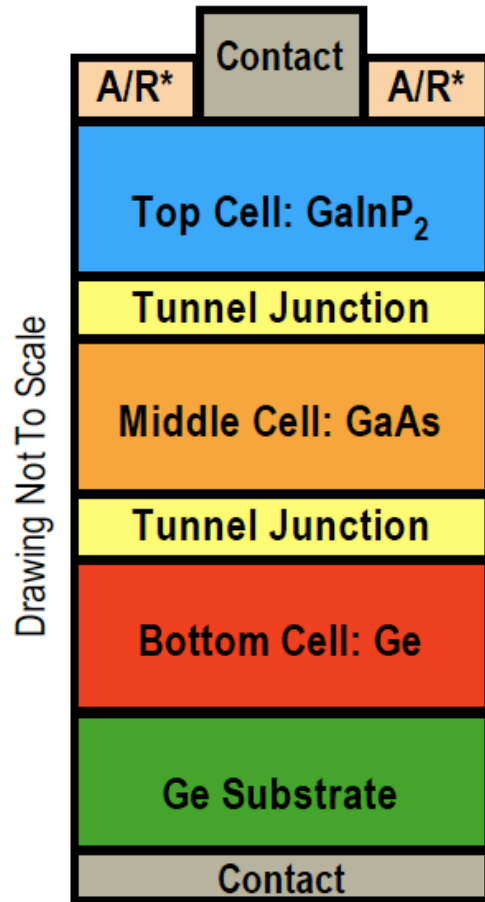
- System was used to prove out new Megamodule designs which allowed reductions in weight with improved concentration ratios,
- Tested new cell plates with high efficient cell packages.

Advanced Multijunction Cell Evaluation

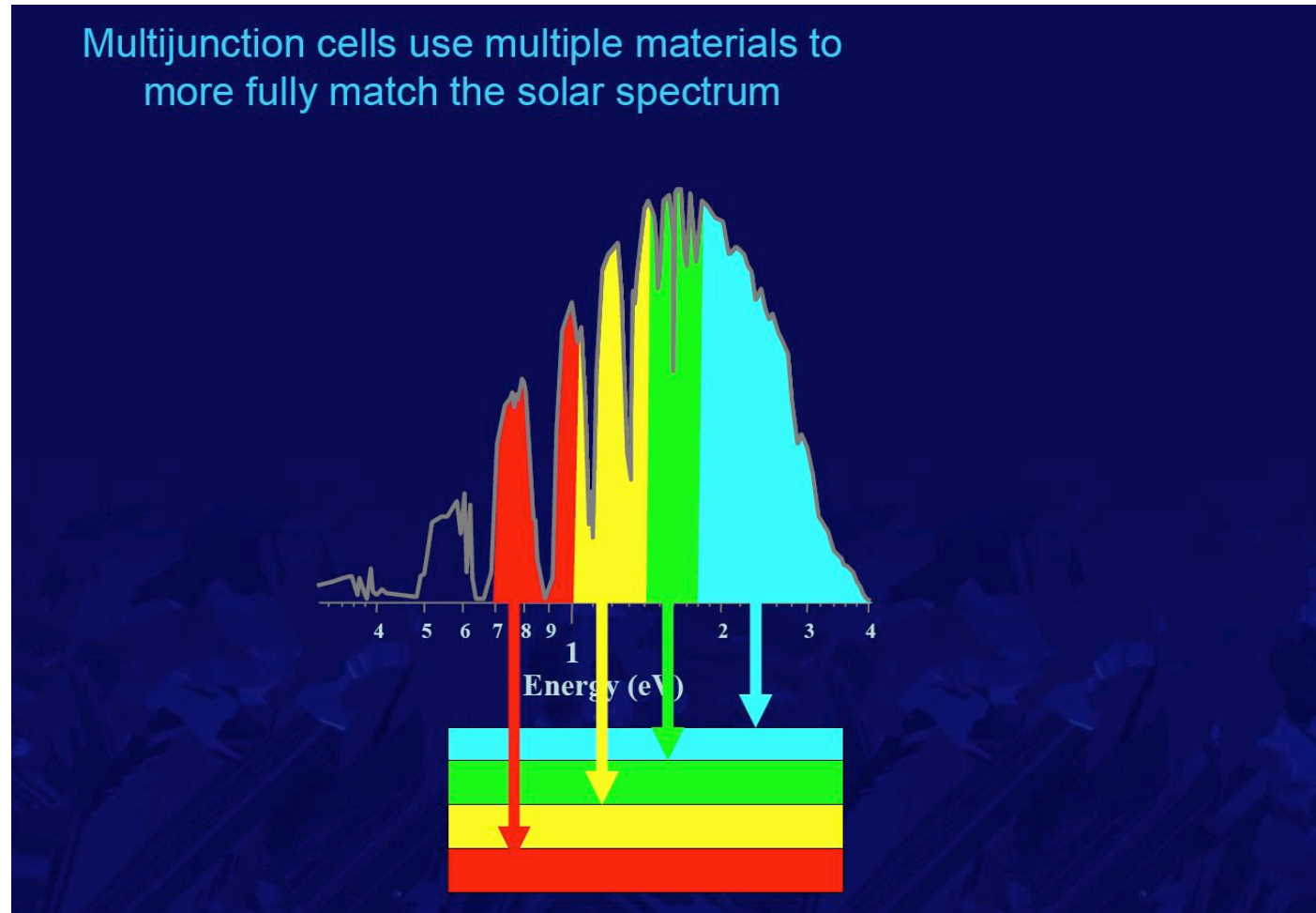


- Spectrolab highly efficient MJ cells (~35% cell efficiency) field tested,
- Potential installed cost reduction,
- More energy generated per area,
- Stable operation under high flux densities,
- Geometric concentration ratio of 450:1

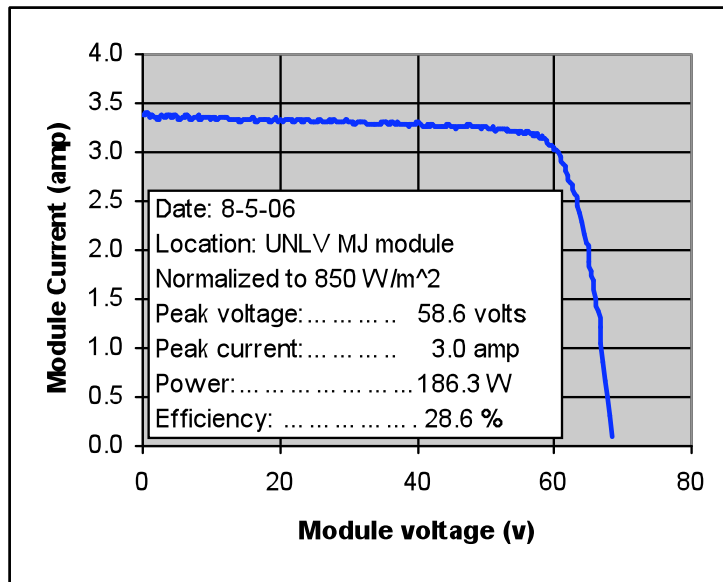
High Concentration–MJ Cells



*A/R: Anti-Reflective Coating



MJ Cell Plate Characterization



Data adjusted to 850 W/m ² and 20°C		
	Average	Average
Date	Power	Efficiency
6/30/2006	174.1	27.0%
8/5/2006	188.3	28.9%
10/11/2006	178.5	27.7%
10/15/2006	177.8	27.6%
1/16/2007	167.1	25.80%
2/10/2007	179.2	27.90%
5/15/2007	168.4	26.10%
5/19/2007	166.3	25.80%

UNLV System Refit to 7500



- Uses MJ cells and new Megamodule designs,
- New inverter tested and optimized,
- Measured AC efficiencies 25 to 29.6%

NV Energy (formerly Nevada Power Company) Systems



- 3 – 25kW systems located at Clark Generating Station,
- Installed in 2006,
- Uses Amonix Silicon Cells, and APS trackers,
- Operation, field support and minor maintenance by UNLV CER staff and students,
- Solar Resource Assessment Site with UNLV, NVE and NREL.

Amonix 7700 System at UNLV



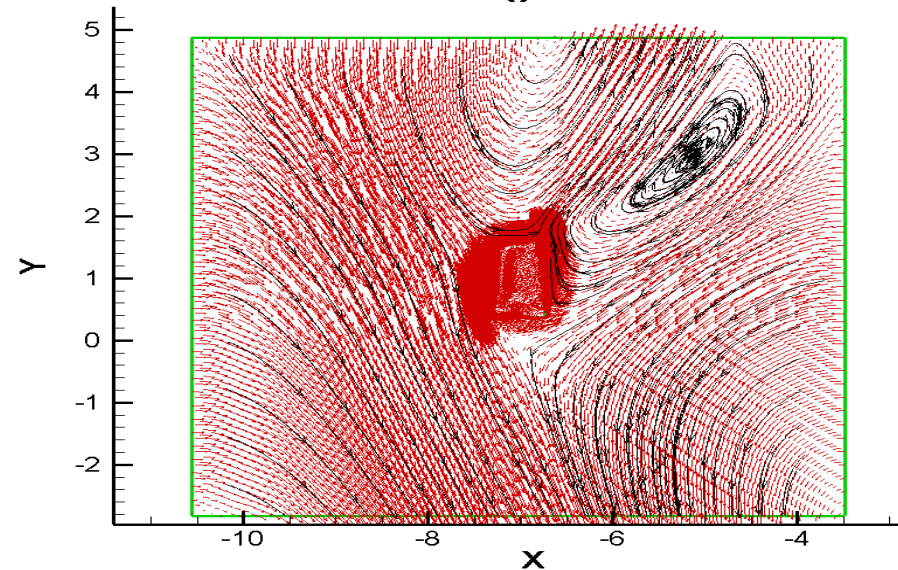
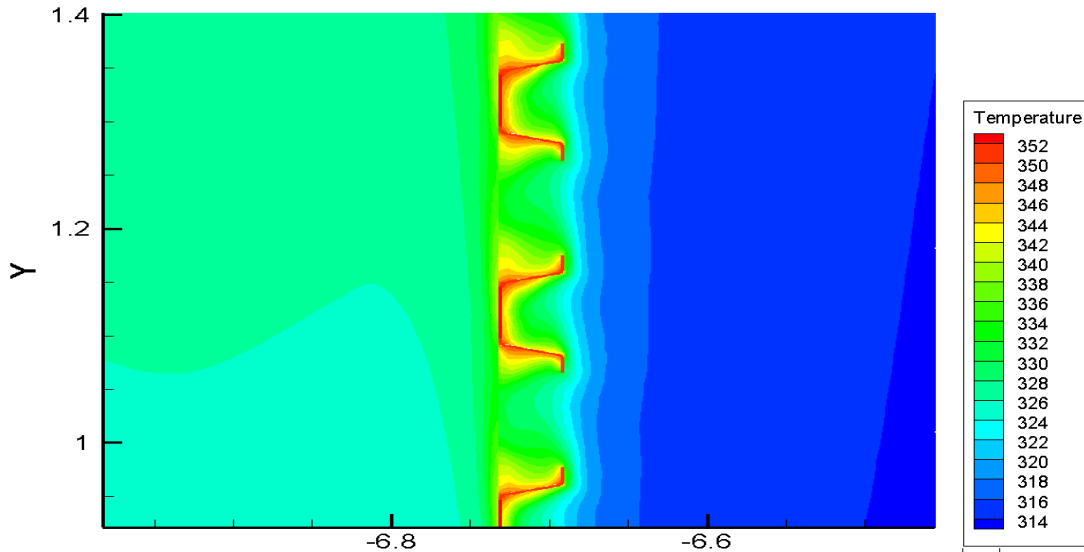
- 53kW system,
- Installed in early 2009,
- New tracker structure, drives, hydraulics, and controller,
- Uses Multijunction cells,
- AC efficiencies above 25%.

SNWA River Mountain Pumping Station



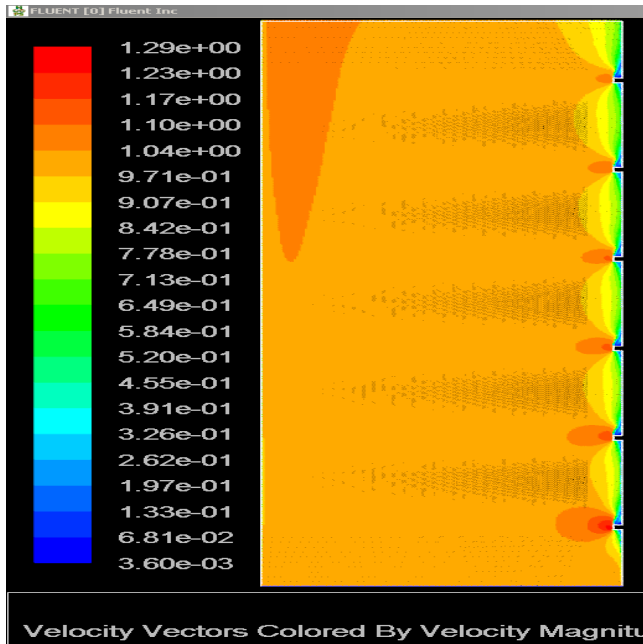
- 6 - Amonix 7500 systems installed in 2009,
- Located in Southeast Henderson,
- Installation recently completed, on-sun testing currently underway by Amonix and UNLV research staff,
- Uses MJ cells.

Amonix Related Research



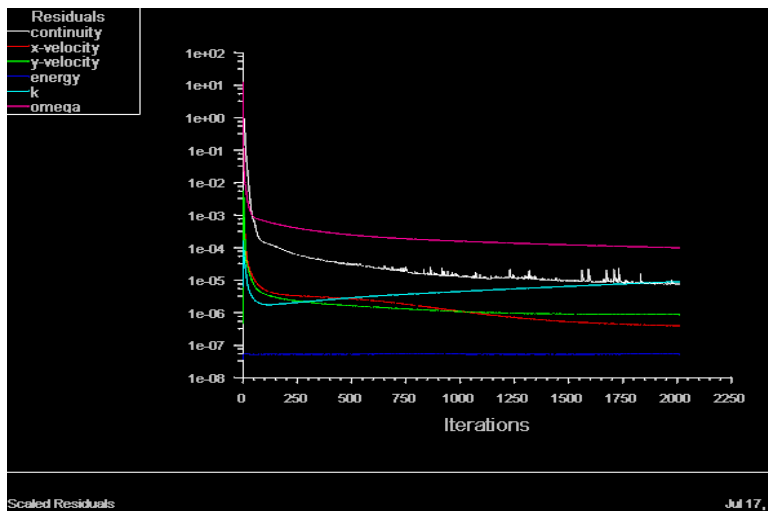
- Numerical modeling of cells, modules, and fins to optimize system performance,
- Temperatures and velocity flow fields analyzed.

Amonix Related Research



Numerical modeling continues to improve models:

- Study temperature and air currents inside chambers and Megamodule to optimize designs.



Amonix Related Research



Lens soiling and cleaning studies:

- Determine soiling performance losses, system stow positions, cleaning requirements, possible lens degradation from cleaning methods.

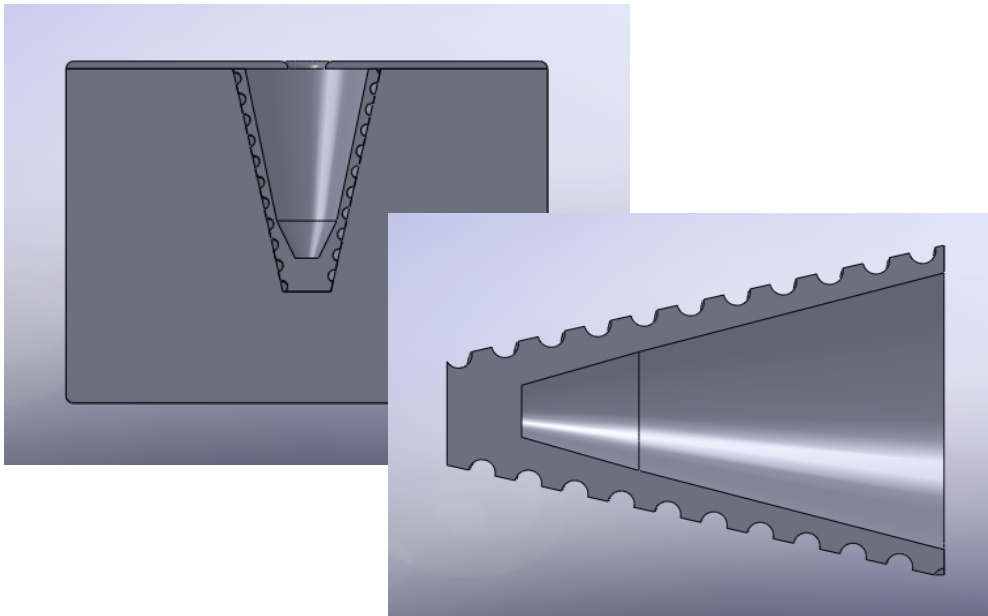


Amonix Related Research



Calorimetry testing:

- Measures energy and temperatures in cell package,
- Used to improve heat removal and improve cell performance,
- Advanced calorimeters currently in development that will allow measurements using high flux concentrations.



BACKGROUND OF UNLV ZEH PROJECT

- Applied to the National Renewable Energy Laboratory (NREL) for Funding.
- Involved Pinnacle Homes, a local builder (1200 homes since 1992) that has an interest in innovation.
- Took a design for a conventional house and modified it many in ways not apparent to the eye. It has the look of a conventional tract house.
- It and a companion conventional house (“base case”) were completed in fall 2005, and monitoring began.

NREL

Pinnacle
HOMES



THE TWO HOUSES



Base case on left and ZEH on Right.

Served as model homes at The Vinings.



SOUTH ROOF OF ZEH



CLOSE UP OF PV "TILES"



The Zero Energy Home is designed to minimize energy consumption and generate electricity through the use of the following features/design elements:

-A “T-Mass” insulated concrete exterior wall system developed by the Dow Corporation.

-A CopperSun solar water heating system looped into the heating system minimizing natural gas consumption for hot water heating.

-A Noritz “tankless” hot water heater.

-Approximately 400 square feet of roof-mounted photovoltaic panels rated at 5.28KW manufactured by GE Energy to generate electricity. Net metering applicable.



Features, Continued.

-A 19 EER water-cooled air conditioning condensing unit manufactured by Freus.

-Energy efficient vinyl framed windows with low “E” glass.

-PolarPly reflective roof sheeting.

-Energy Star rated light fixtures with highly efficient fluorescent bulbs.

-Energy Star rated GE appliances.

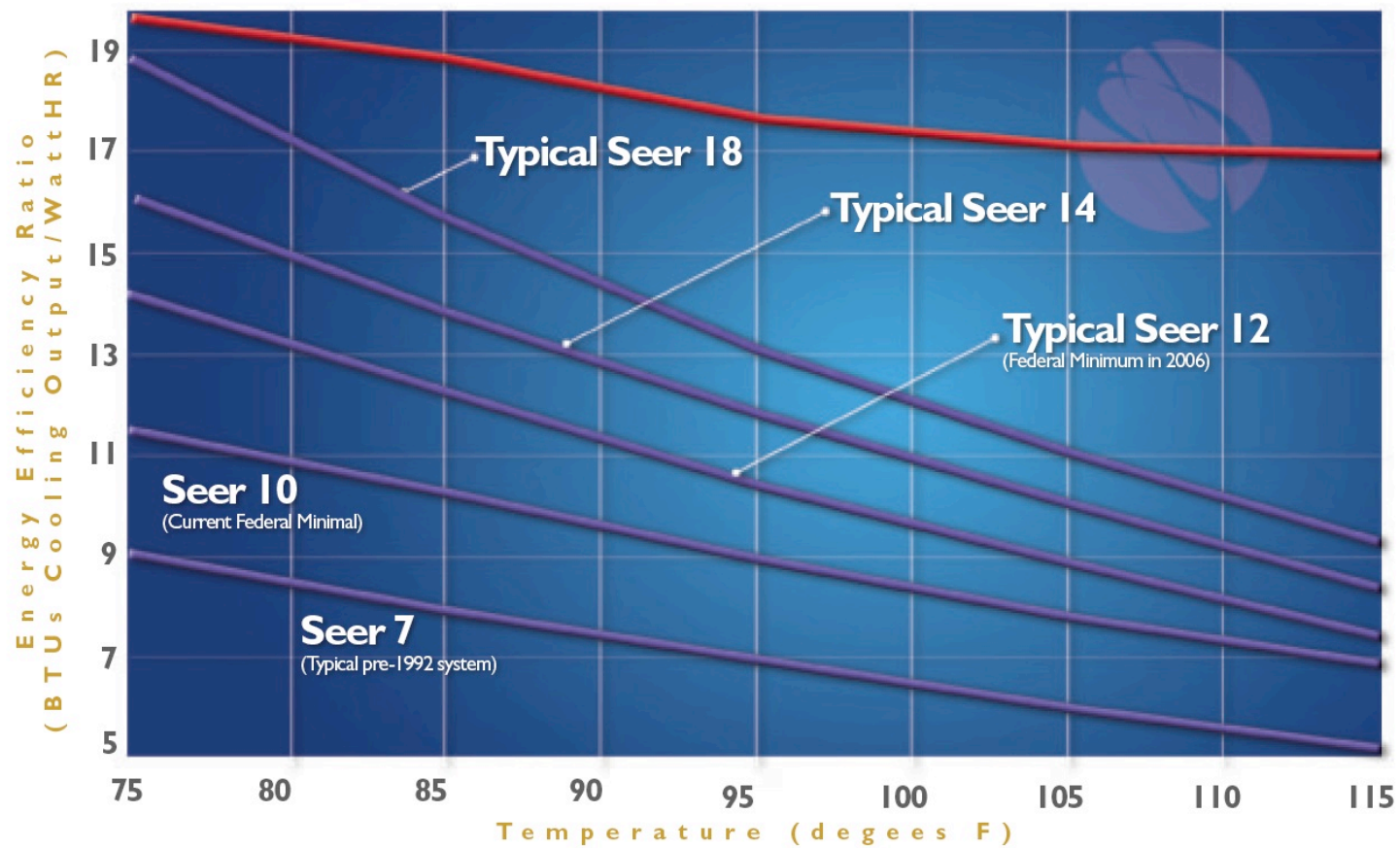


Mass Wall Construction Concrete/Styrofoam/Concrete (3"/2"/3", R9 SS, ~R36 Transient)

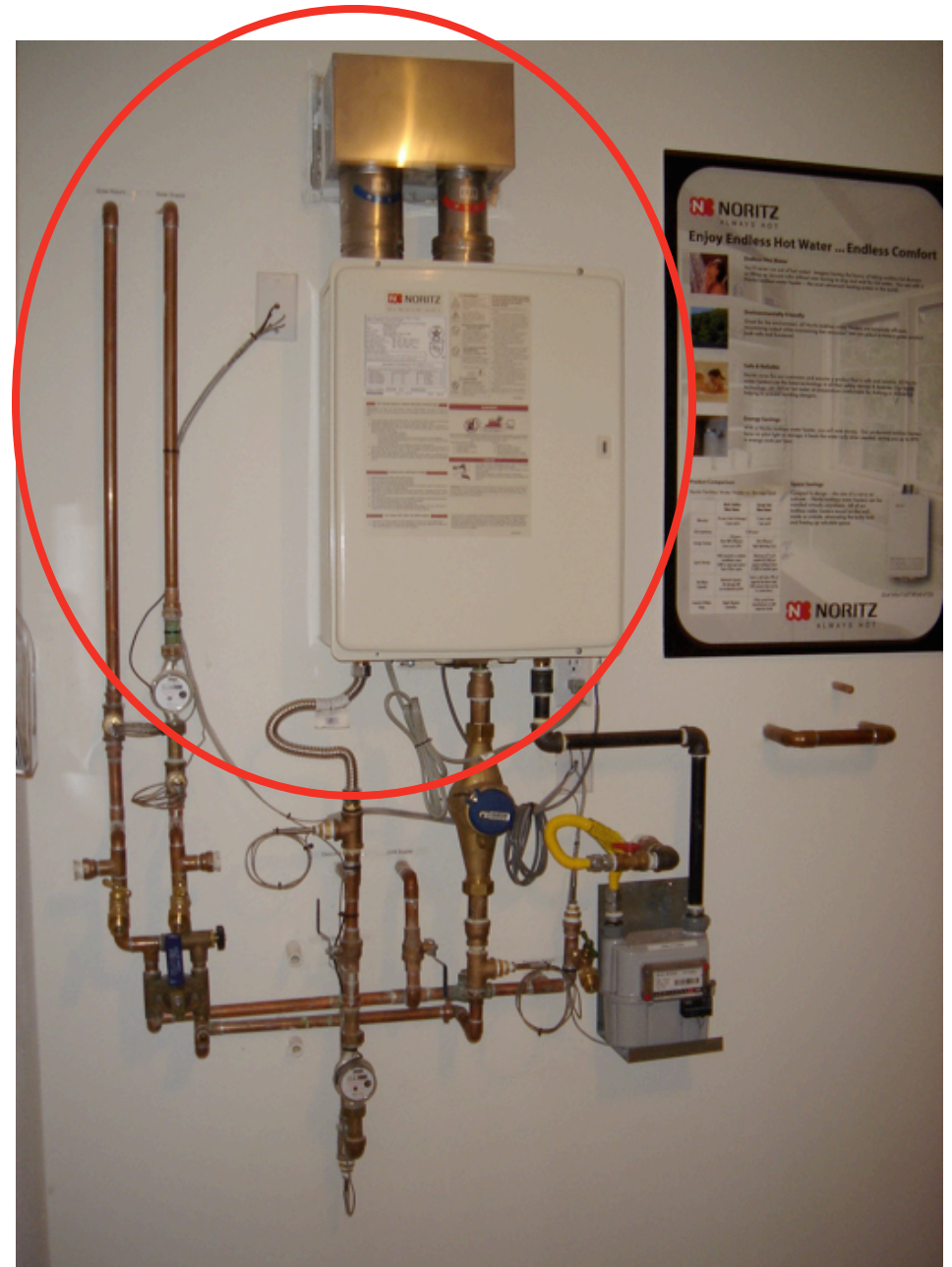


ZEH AIR CONDITIONER--FREUS BRAND

AIR CONDITIONING ENERGY EFFICIENCY RATIO FREUS WATER COOLED VS. AIR COOLED



**NORITZ
GAS-FIRED
TANKLESS
WATER
HEATER**



**FULL CLIMATE
MONITORING,
PYRANOMETER
(NOT SHOWN) IN
PLANE OF PV**





Southwest Energy Partnership

Creating Renewable Energy Centers in the American Southwest

· About the Project

· About the House

· HVAC

· Solar electric

· Solar thermal

· Structure

· Energy Saving Features

· Real Time Data

· Related Links

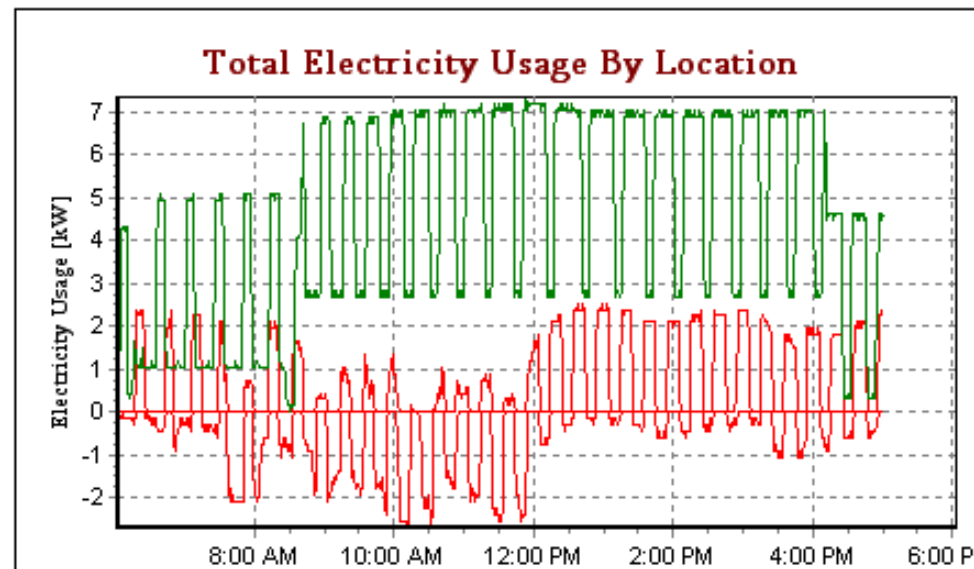
· Contacts

· Sponsors

University of Nevada – Las Vegas Zero Energy Home

Real Time Data

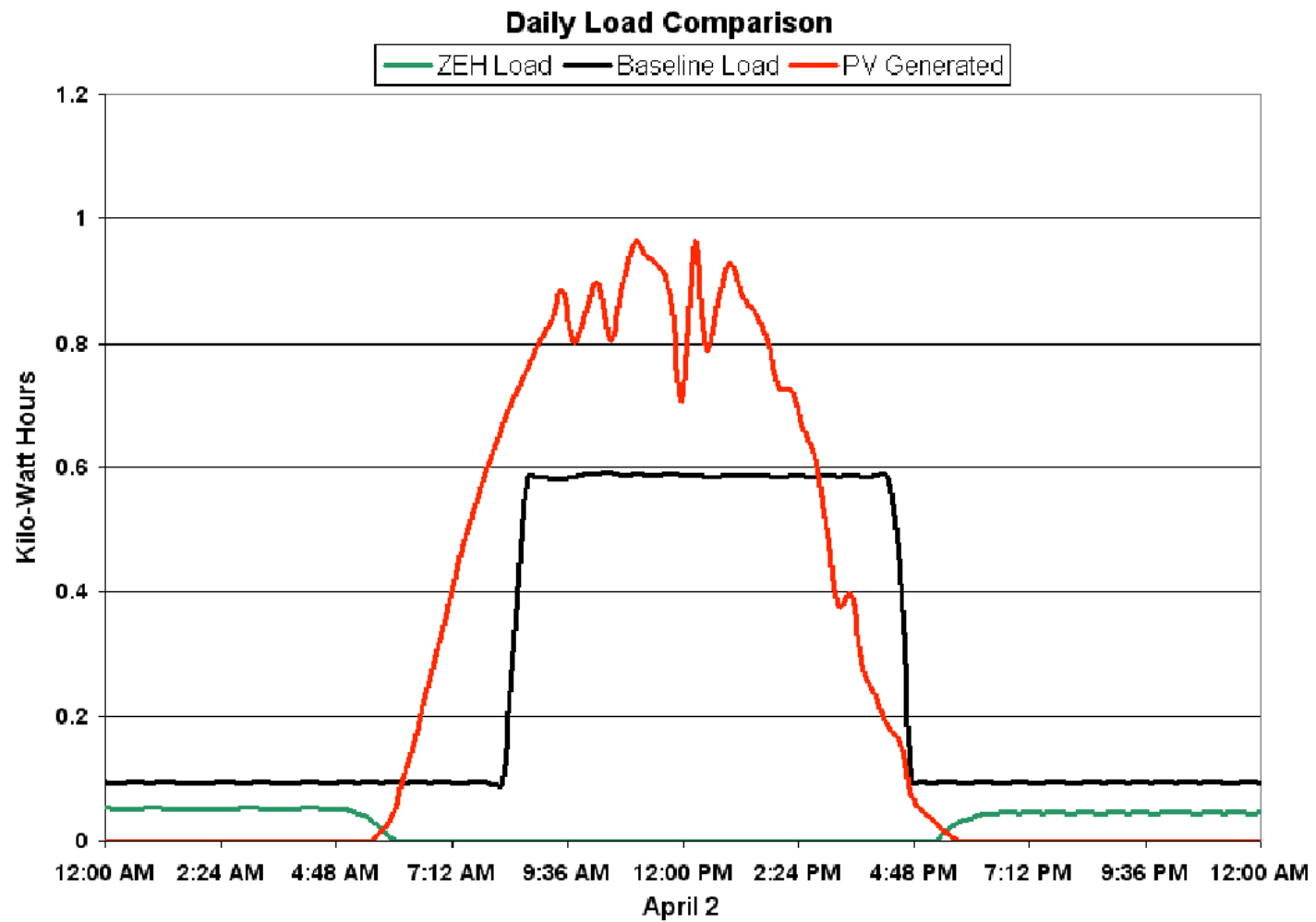
- Site Conditions
- Energy Use
- Gas Use
- Temperatures
- Heat Fluxes
- Water Systems



www.zeh.unlv.edu

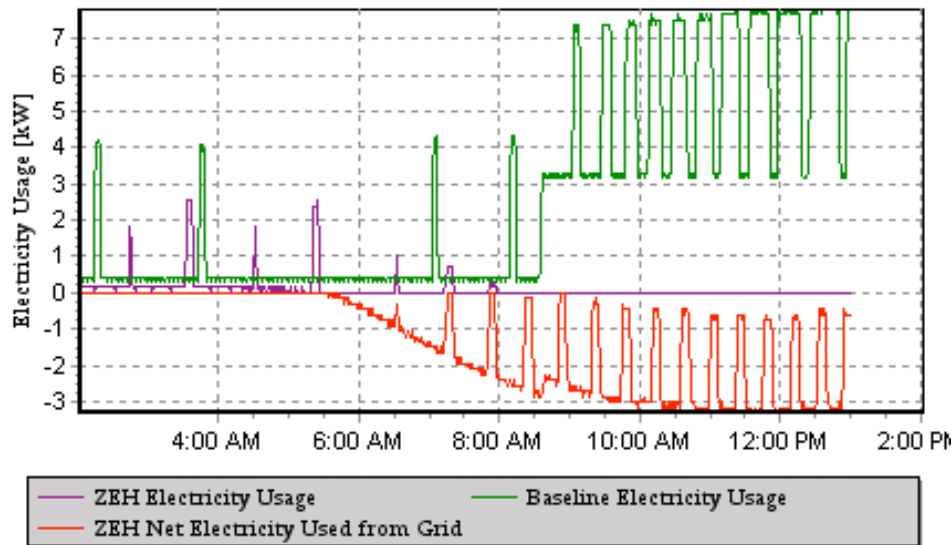


ELECTRICAL COMPARISONS

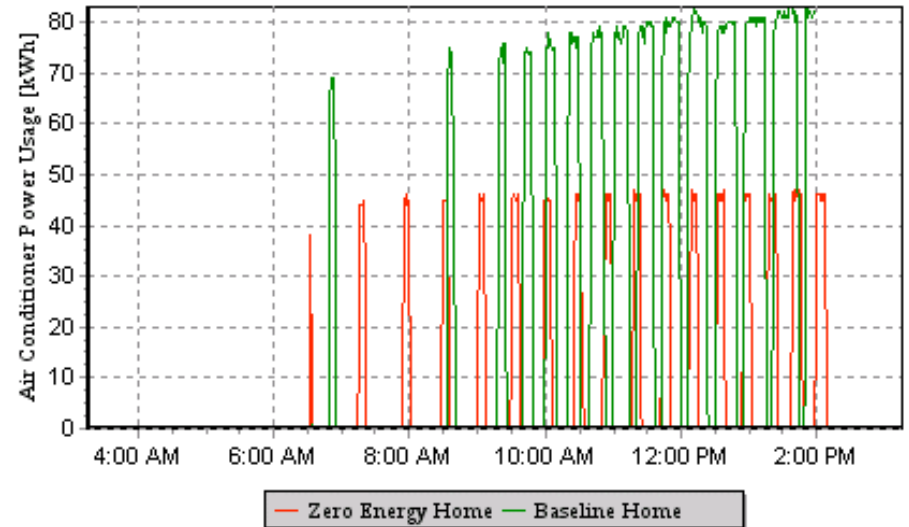


EXAMPLES OF DATA

Total Electricity Usage By Location

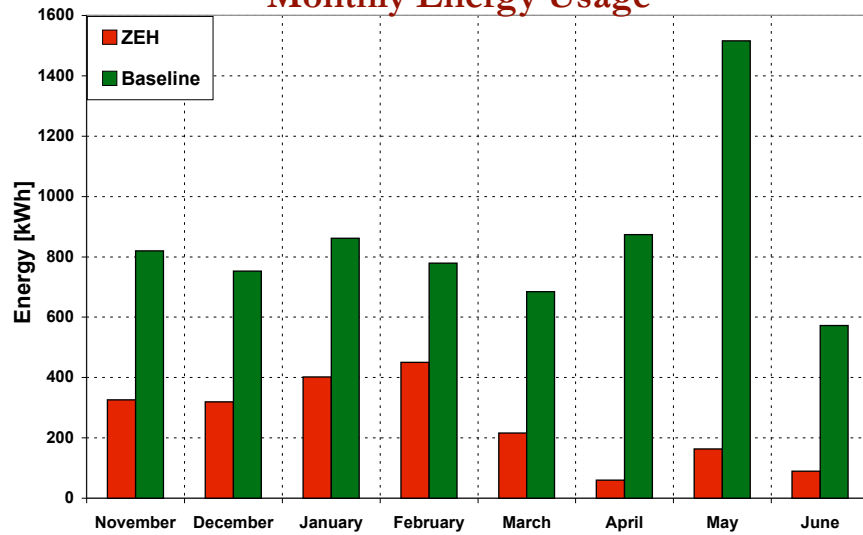


Air Conditioner Power Usage By Location

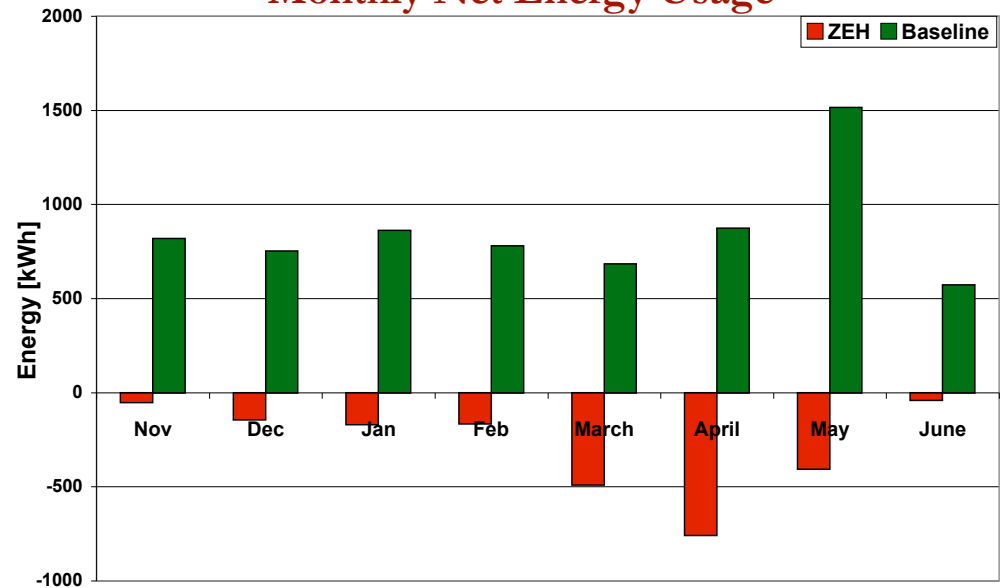


EXAMPLES OF ELECTRICAL DATA

Monthly Energy Usage



Monthly Net Energy Usage



PEAK ELECTRICAL ENERGY USAGE

- Nevada Power Peak Season
June 1st – September 30th
- Peak Hours
1:00 pm – 7:00 pm
- To Date
June: ZEH used 88% less peak energy
July*: ZEH used 78% less peak energy
*partial month



CALCULATED AVERAGE PV EFFICIENCIES

	[%]
November *	10.00
December	9.89
January	10.23
February	9.89
March	9.92
April	9.76
May	8.94
June	8.66
July*	8.75

*partial month



TENTATIVE CONCLUSIONS

- The project allowed the comparisons of the values of various components. Results not given here because of time limitations.
- We wished to investigate what happens when there is a trade off between costs for energy conservation and PV in buildings that are already quite energy conserving. This is addressed in the next project described.



SMART HOUSE, SMART MICROGRID

The Smart House

The potential benefits:

- Lower cost of power
- Cleaner power
- A more efficient and resilient grid
- Improved system reliability
- Increased conservation and energy efficiency

Plug-in Hybrid Electric Car

Xcel Energy is studying how plug-in electric vehicles can store energy, act as backup generators for homes and supplement the grid during peak hours.

Smart Meter

Real-time pricing signals create increased options for consumers.

Smart Appliances

Smart appliances contain on-board intelligence that "talks" to the grid, senses grid conditions and automatically turns devices on and off as needed.

Smart Thermostat

Customers can opt to use a smart thermostat, which can communicate with the grid and adjust device settings to help optimize load management. Other "smart devices" could control your air conditioner or pool pump.

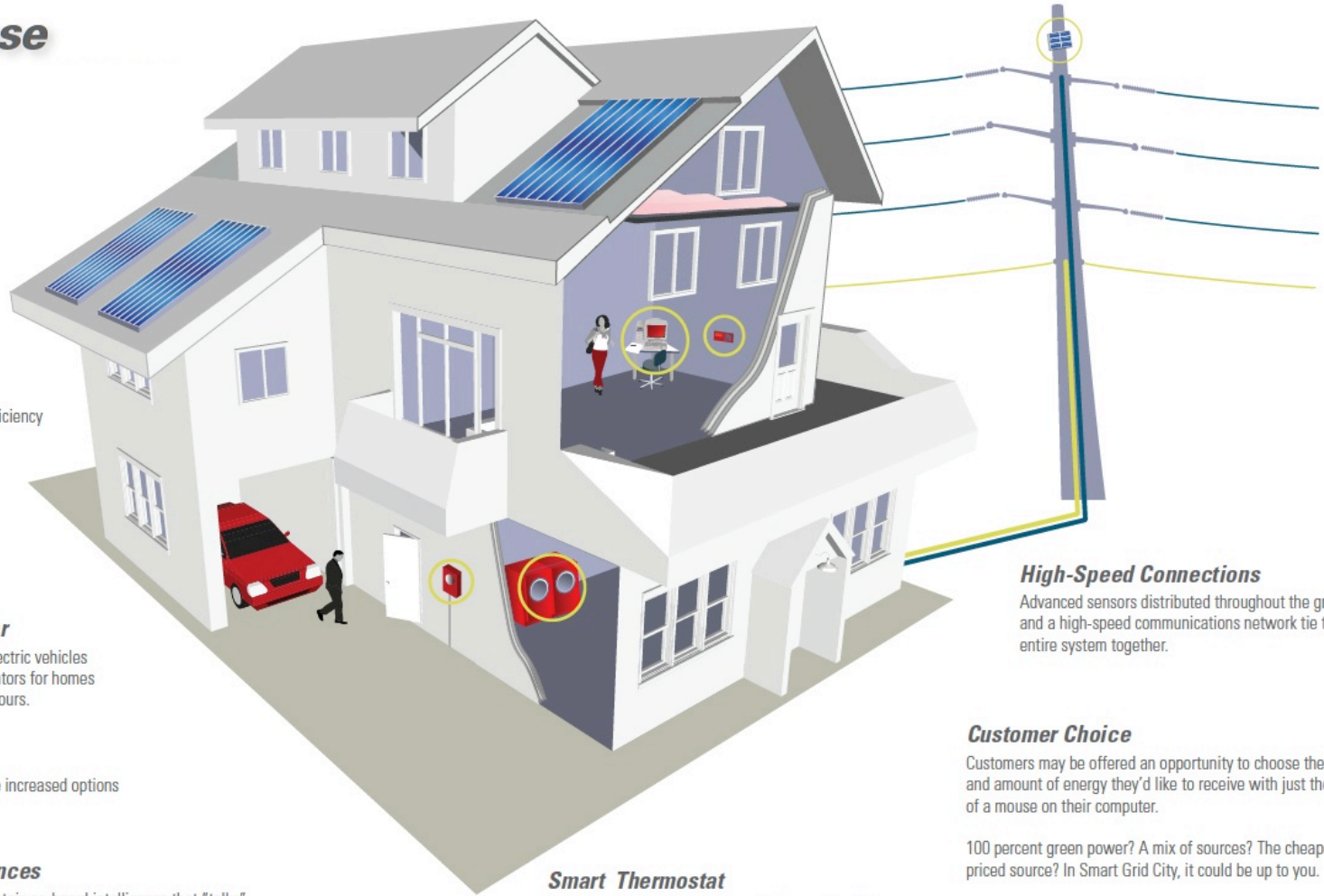
High-Speed Connections

Advanced sensors distributed throughout the grid and a high-speed communications network tie the entire system together.

Customer Choice

Customers may be offered an opportunity to choose the type and amount of energy they'd like to receive with just the click of a mouse on their computer.

100 percent green power? A mix of sources? The cheapest priced source? In Smart Grid City, it could be up to you.



VILLA TRIESTE



- New development of Pulte Homes across freeway from Red Rock Station
- All LEED Platinum certified homes
- Two studies being performed
 - Study of costs to move to Zero Energy (NVE), so far a “paper” study, leading to an actual design later
 - Greatly decrease peak electrical energy demand (DOE) , major effort underway for all houses



VILLA TRIESTE



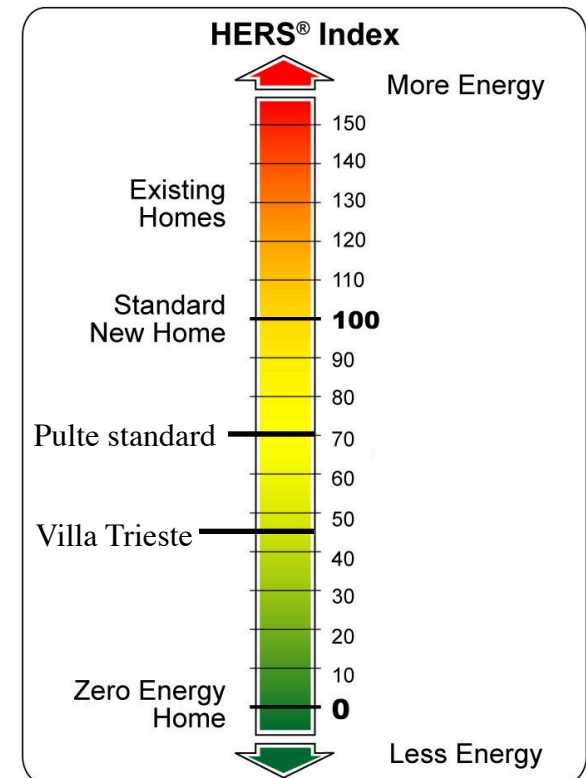
VILLA TRIESTE

- Four home models
 - Floor plans: 1,487 to 1,777 square feet
 - Building America
 - LEED for Homes platinum certified
 - Environments for Living



Heating and Cooling Energy Usage Guarantee					
Model	Square Footage	Annual KWH Usage*	Estimated Cost Monthly/Annually*		HERS
Roma	1,487	4,763	\$76	\$913	44
Torino	1,612	4,707	\$78	\$941	44
Venezia	1,777	4,979	\$81	\$969	46
Milano	1,758	5,541	\$89	\$1,068	44
Firenze	1,960	5,668	\$91	\$1,088	46

*Based on NV Energy and Southwest Gas rates as of July 1, 2007. Guarantee is for energy usage not cost since local utility rates vary. Please see Environments for Living' limited guarantee for details.



MAIN ELEMENTS OF DOE PROJECT

- **Energy conserving design** of buildings, HERS scores range 44-46, 100 is code design
- **PV array** on the roof: 1.764 kW each house, SunPower tiles
- **Active communication system** between customer and utility to allow the former to have pricing information
- **Storage battery** at substation level: charged at night, used during peak, if needed.

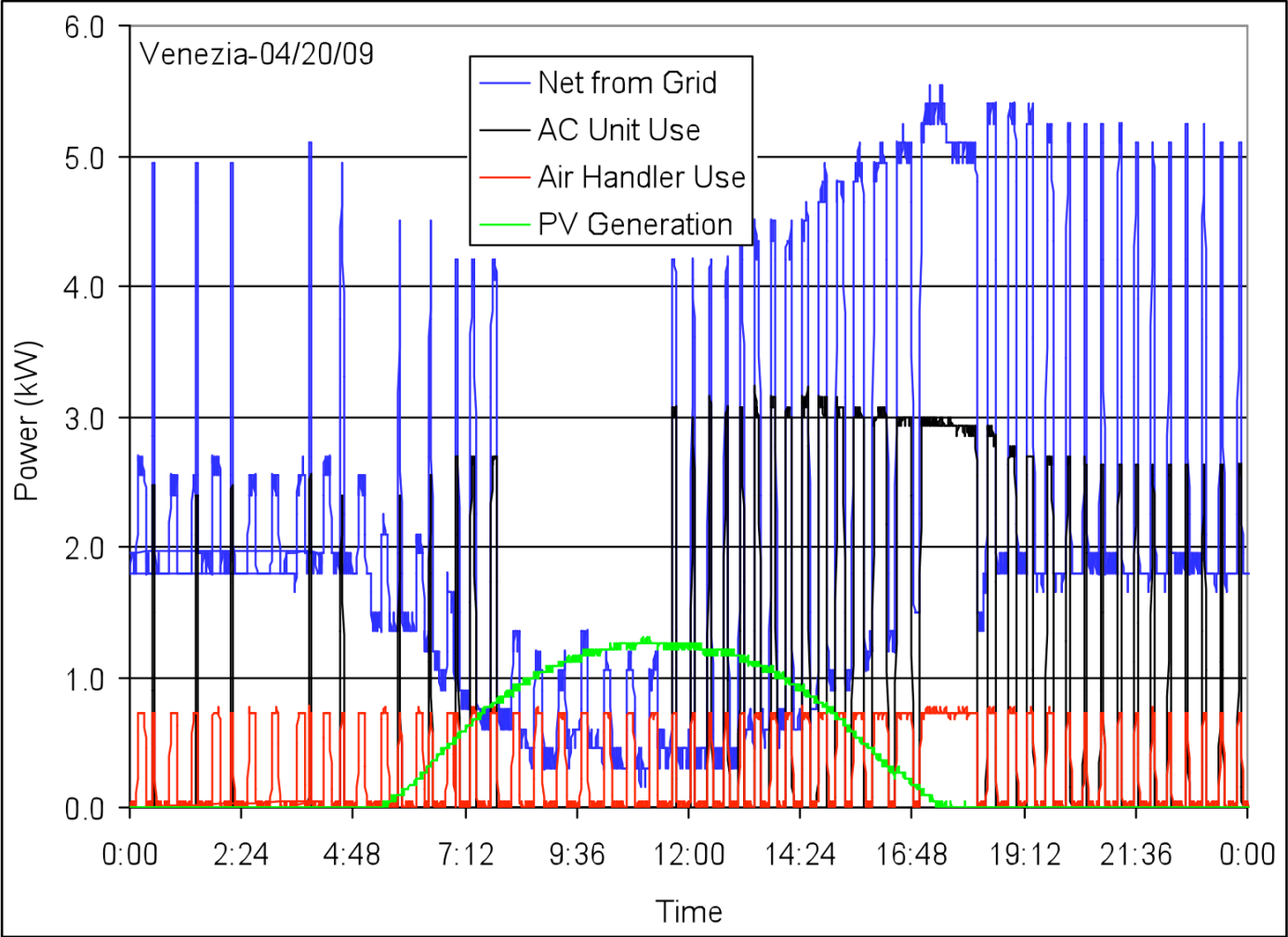


ENERGY SIMULATION AND MONITORING

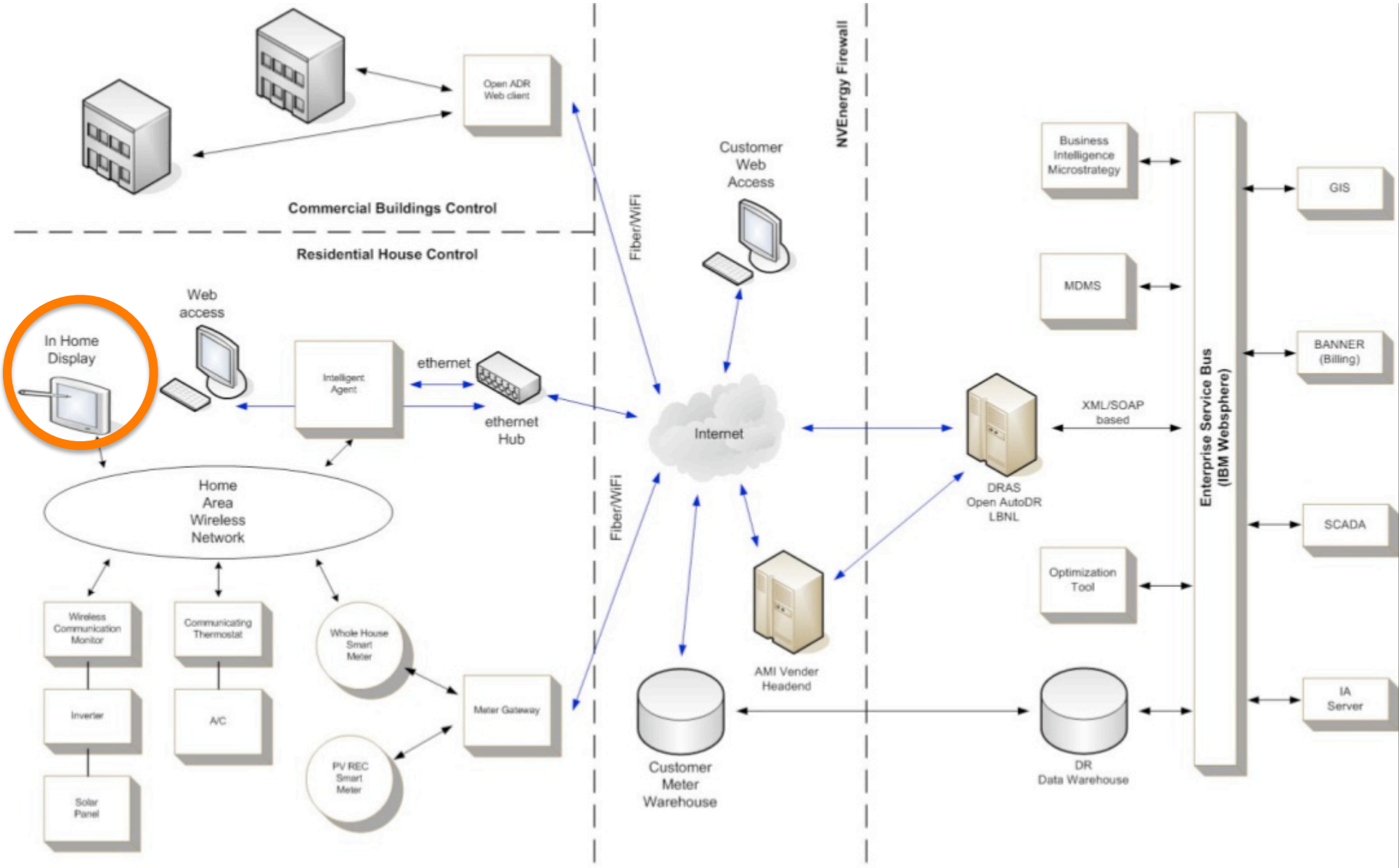
- Key part of the study is the determination of how much energy each house uses, particularly in terms of its time of day use.
- Measurements are being made on each of the houses.
- Actual data compared to results of computer code estimation.
- Good comparisons are being found






ENERGY SIMULATION AND MONITORING



ACTIVE COMMUNICATION SYSTEM



DASHBOARD IN THE HOME

ecoConcierge	ENERGY CONSUMPTION		
	DAY	WEEK	MONTH
YOUR HOME	\$ 6 ⁵⁵	\$ 42	\$ 147
CARBON FOOTPRINT REDUCTION	 40 lbs.	 297 lbs.	 875 lbs.
AVERAGE HOME IN COMMUNITY	\$ 7 ²⁰	\$ 47	\$ 159
AVERAGE AUSTIN HOME	\$ 9 ⁰⁰	\$ 60	\$ 200

- Serves to inform owner of energy use and to receive signals from utility on power cost



BATTERY STORAGE

(Candidate selection ongoing, but it will be big.)



Illustration for graphic purposes only, not actual unit



MOVING TO ZERO ENERGY

- Study has been completed.
- Found that the following items could have the quickest payback, compared to existing Villa Trieste design
 - Higher quality windows
 - Heat recovery ventilator, depending upon cost
 - Increased insulation using Icynene
 - Larger PV array
- Plan to develop a few houses of this type



Thanks from all of us at CER

