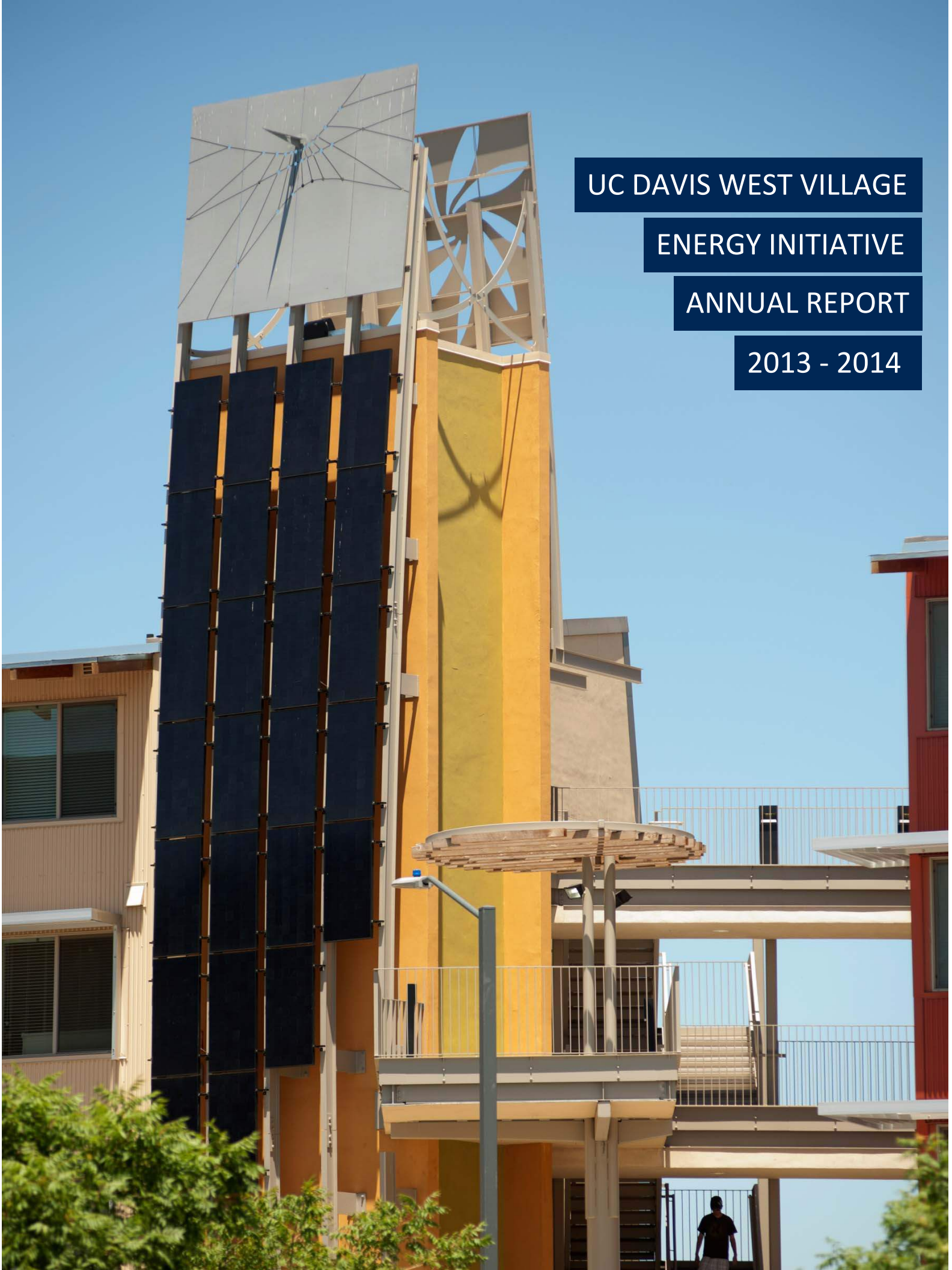


UC DAVIS WEST VILLAGE ENERGY INITIATIVE ANNUAL REPORT 2013 - 2014

UC DAVIS WEST VILLAGE ENERGY INITIATIVE
ANNUAL REPORT 2013-2014

EXECUTIVE SUMMARY

UC Davis West Village (West Village) is a neighborhood on the UC Davis campus that is owned and operated by West Village Community Partnership, LLC (WVCP). The West Village Energy Initiative (WVEI) established a goal to achieve Zero Net Energy (ZNE) from the grid annually by full buildout of West Village. The 2013-2014 WVEI Annual Report is a snapshot of progress towards this goal. The reporting period is September 2013 through August 2014, which is the leasing year for students living in the community. During this period the community housed nearly 2,000 residents, primarily students, in 663 apartments. Approximately 42,500 square feet of commercial/retail was near full occupancy with approximately three-quarters occupied by the UC Davis Energy and Transportation Research Cluster.

During 2013-14, approximately 4.1 megawatts of photovoltaic panels (PV) at West Village generated nearly 5.8 million kilowatt hours (kWh) of electricity. Production from the panels was 102 percent of the expected energy. This better than expected production likely resulted from clearer skies during the ongoing drought, less dust compared to the initial period when construction was underway, and implementation of a trial cleaning program. Meanwhile, the community consumed 7.0 million kWh with 88 percent of demand coming from residential use, 7 percent from commercial/office use, and 5 percent from the student center and maintenance facilities. The balance is of supply meeting demand at this point in the community's development is 82 percent. Achieving 100 percent ZNE for West Village will depend on a combination of increasing PV production and reducing demand.

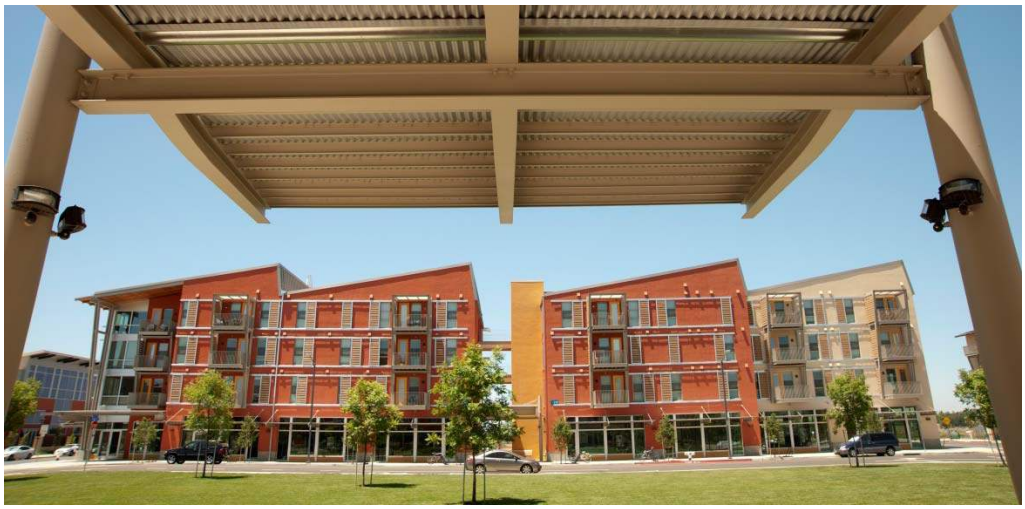
A variety of actions taken at facilities that existed 2012-13 have improved their performance in 2013-14. Total energy consumption in the Ramble and Viridian apartments and common areas decreased nearly 3 percent and energy production was up slightly due to cleaning the PV panels more regularly and more sunny days due to the drought. Several actions taken were only in place for part of the year should yield more improvements in the future. For example, more efficient pumps were installed at the community pools and spa. As a result, electricity consumption was down over 17 percent. Student engagement programs suggest that an additional 5 percent reduction in consumption may be achievable. Issues with High Performance Water Heaters tripping to the highly inefficient flash mode continue at a limited number of sites. Additional PV capacity may need to be installed to achieve the ZNE goal.

ABOUT UC DAVIS WEST VILLAGE

West Village is a campus neighborhood designed to be the home for approximately 3,000 students and 500 staff and faculty families at full buildout. The overarching goals for the community are:

> ***Quality of Place*** – to create a great community and desirable place to live that will help UC Davis recruit the best and brightest students, faculty and staff, to let them live within walking or cycling distance of the campus, and to participate fully in campus life.
>
> ***Affordability*** – to enable faculty and staff to purchase new homes locally at below market prices and to expand the choices for students to live near campus.
>
> ***Environmental Responsiveness*** – to develop the site and buildings according to sound environmental principles so as to reduce reliance on cars, limit energy consumption, enable renewable energy production, and contribute to a healthy environment.

The current phase of West Villages has been developed through a public-private partnership between UC Davis and West Village Community Partnership, LLC (WVCP), a joint venture of Carmel Partners from San Francisco and Urban Villages from Denver.



THE WEST VILLAGE ENERGY INITAITIVE

Through a collaborative design process with WVCP, UC Davis expanded upon its core principle of making UC Davis West Village environmentally responsive. UC Davis and the WVCP development team first looked for ways to make West Village as energy efficient as possible. In 2007, UC Davis commissioned a study with the UC Davis Energy Efficiency Center and a local consulting firm, the Davis Energy Group, to help identify deep energy efficiency measures that could be included in student housing and single family residences. The results of this study demonstrated that by adopting deep energy efficiency measures, WVCP could reduce consumption in West Village by nearly 50 percent compared to the applicable California Energy Efficiency Building Code.

With this result, WVCP and UC Davis realized that a much larger goal was within reach – making West Village a ZNE community. In 2009, WVCP and UC Davis decided to strive for the goal of making UC Davis West Village "zero net energy from the grid measured on an annual basis." Because West Village had to be accessible for UC Davis faculty, students and staff, the ZNE goal had to be balanced against the goal of affordability. In response to these competing principles, WVEI was created and the following principles were adopted by the team:

- West Village would strive to use ZNE from the grid measured on an annual basis.
- ZNE needed to be achieved at no higher cost to the developer.
- ZNE needed to be achieved at no higher cost to the consumer.
- West Village would adopt deep energy efficiency measures to reduce energy demand.
- ZNE would be achieved through multiple renewable resources developed on-site at a community scale.
- West Village would be used as a living laboratory for further energy-related topics.

MAJOR MILESTONES IN THE CONSTRUCTION OF UC DAVIS WEST VILLAGE

In September 2013, the Solstice Apartments opened for occupancy. This complex included 156 units with 504 student beds. The Phase II Ramble Apartments (192 units with 630 student beds) opened in September 2012 and were not included in the first annual WVEI annual report because they were not occupied during the entire evaluation period. These new facilities also brought online an additional 2.0 MW of PV raising the total onsite PV generating capacity to 4.1 MW.

INSTALLED PV CAPACITY (2013-14)

Facility	Installed PV (Rated kW STC_{DC})
Ramble Apartments Phase 1	1,076
Ramble Apartments Phase 2	1,083
Viridian – Apartments and Commercial Areas	872
Leasing Recreation Center	154
Solstice Apartments	797
Solstice Pool Building and Lot W	101
Maintenance Building	4
TOTAL	**4,087**

The Phase I Ramble Apartments (192 units with 654 student beds) were occupied in September 2011. The mixed use buildings around the Village Square including the Viridian Apartments (123 units with 192 beds) on the second through fourth floors were occupied in September 2011. The Viridian apartments are a higher end product consisting of one and two bedroom units and are occupied by faculty and staff as well as students. The Solstice Apartments are the last apartment complex planned for UC Davis West Village Phase 1 and bring the total number of units in the neighborhood during the 2013-14 to 663 with 1,980 beds.

The first floors of the Viridian mixed use buildings include approximately 42,500 square feet of office/retail space. This space was unoccupied until January 2013 when the UC Davis Energy and Transportation Research Cluster was established and moved the associated centers and institutes into approximately three-quarters of the ground floor office space at West Village. However, the solar panels were operating prior to occupancy.

Construction of single family homes is expected to start in late 2016. The first building of the Sacramento City College West Village Center opened in January 2012 with the second building slated to open in November 2017. The community college currently is not a participant in the ZNE goal.

PROGRESS TOWARDS THE ZERO NET ENERGY GOAL

The WVEI defines ZNE to mean "zero net energy from the grid measured on an annual basis." More specifically, this means the community would produce enough energy on site to offset its annual consumption. It is connected to the regional electrical grid and during peak hours will feed electricity into the grid while at night and other times it will draw electricity from the grid.

In late 2014, WVCP engaged the Davis Energy Group to perform a comprehensive evaluation of the West Village energy consumption and production for September 2013 through August 2014 in order to assess progress towards the ZNE goal. The beginning and ending of this period correspond to the leasing year for students living at West Village.

The first WVEI annual report covering March 2012 through February 2013 found, West Village had achieved a remarkable 87 percent of the initial ZNE goal. In addition, several lessons were learned about facility commissioning, modeling and design, and occupant behavior variability. In response to these results, WVCP initiated a number of actions during 2013-14 to reduce energy consumption through either additional energy efficiency or user modification and education program. Many of these actions began during the 2013-14 reporting period and their benefits will not be fully realized until subsequent reporting periods. The actions implemented included:

Leasing & Recreation Building

- Fall 2013-February 2014 – WVCP hired a consultant to evaluate energy use at the Leasing & Recreation Building and to recommend actions that could reduce overall energy use.
- January 2014 – Three continuous speed pumps for the community pools and spa were replaced with variable speed pumps to reduce pumping energy use.
- Early 2014 – All HVAC and lighting settings were reviewed within the building and adjustments were made to reduce use during unoccupied periods.

The Ramble Water Heating Systems

- May 2014 – Alarm lights were placed on the outside of heat pump water heaters (HPWHs) to alert maintenance staff when the units were not functioning properly.
- All HPWHs were checked daily by maintenance staff to verify that units did not trip into the extremely energy consumptive electric resistance mode.

Resident Engagement

- October 2014 – WVCP created and launched an internal program called EMPOWER to promote sustainability onsite and educate residents.
- Summer 2014 – WVCP hired a consultant to run a one-year residential engagement program onsite (9/1 /14 - 8/31/15) that includes monitoring usage and sending messages to tenants regarding their usage via text, email or door-to-door. The

program targets high users and initiates programs and competitions for residents to reduce consumption.

Performance Data Quality Improvement

- Summer 2014 – WVCP hired a consultant to begin resolving data issues with the SunPower equipment to improve reliability of SunPower consumption meters and provide an easier process for data tracking and identifying high energy meters and users.

Other Actions

- January-December 2014 – PG&E funded a study to examine consumption trends over 12 months on 120 apartments at The Ramble and Viridian. Disaggregated electricity use at each unit was monitored over the 12 month period. The goal was to determine the effectiveness of using technical interventions and resident engagement to change behavior and apply corrections to move West Village closer to ZNE.

- January-December 2014 – PG&E monitored 13 common use meters at Viridian and The Ramble to evaluate HPWH performance in more detail.

- June-September 2014 – WVCP maintenance staff rewired all apartment thermostats to limit indoor fan settings to "Auto" and "Off" eliminating the "Fan On" function. Some thermostats were reprogrammed to limit heating set point maximum at 72°F and cooling set point minimum at 68°F. Residents still have the ability to override the temperature.

While overall ZNE performance dropped from the first reporting period much of the community saw an improvement in overall performance. Key findings from the evaluation include the following:

- PV production for the September 2013 - August 2014 evaluation period was 82 percent of annual electricity consumption compared to 87 percent for 2012-13.

- The primary cause for the 5 percent change from 2012-2013 to 2013-14 was that the Viridian commercial spaces were partially unoccupied during the first evaluation period. Annual electrical consumption for the six Viridian mixed-use commercial spaces during the current evaluation period amounted to a production shortfall of 13 percent. Consumption during the prior evaluation was minimal because the commercial spaces were not fully occupied until early 2013. However, the PV systems were operational. This increase in consumption was expected and was identified in the first annual report.

- Not including Viridian commercial spaces or the Solstice apartments, which did not come on line until fall 2013, community energy consumption dropped by 116 MWh or 2 percent from the previous evaluation period.

ENERGY PRODUCTION AND CONSUMPTION (September 2013 through August 2014[1])

Facility[2]	Production (MWh)			Consumption (MWh)			Percent (AP/AC)
	Modeled (MP)	Actual (AP)	Percent (AP/MP)	Modeled (MC)	Actual (AC)	Percent (AC/MC)	
Ramble Apartments Phase 1							
Apartments	1,024	1,120	109%	1,127	1,303	116%	86%
Common Areas[3]	444	444	100%	368	561	152%	79%
TOTAL	1,468	1,564	107%	1,495	1,864	125%	84%
Ramble Apartments Phase 2							
Apartments	1,003	1,124	112%	1,118	1,362	122%	83%
Common Areas	506	486	96%	434	539	124%	90%
TOTAL	1,509	1,610	107%	1,552	1,901	122%	85%
Solstice Apartments							
Apartments	915	838	92%	929	1,021	110%	82%
Common Areas	264	248	94%	270	408	151%	61%
TOTAL	1,179	1,086	92%	1,199	1,429	119%	76%
Viridian Apartments							
Apartments	520	563	108%	530	539	102%	104%
Common Areas	302	318	105%	196	447	228%	71%
TOTAL	822	881	107%	726	986	136%	89%
Viridian Commercial Areas							
TOTAL	415	397	96%	551	477	87%	83%
Leasing and Recreation Center							
TOTAL	226	206	91%	225	332	148%	62%
Maintenance Building							
TOTAL	6	6	100%	0	19	--	32%
TOTAL	**5,625**	**5,750**	**102%**	**5,748**	**7,008**	**122%**	**82%**

[1] Source: Evaluation of UC Davis West Village Energy Use and PV Production. Final Report. Davis Energy Group, Inc. September 23, 2015.

[2] Facilities Include buildings/meters with a full year of occupancy and production. Los Rios Community College is not part of the ZNE goal and so not included in this analysis.

[3] Common areas include central heat pump water heaters, common area lighting and elevators, and common area meters also have parking lot and path lighting loads attached.

- Actual annual electrical consumption for The Ramble and Viridian apartments and common meters amounted to a ZNE shortfall of 15 percent. This is an improvement from the previous year.
- Actual annual consumption of the apartments exceeded PV production by 14 percent, Usage among individual apartments still varies widely, highlighting occupant behavior as a critical piece in reaching ZNE.
- Common meter PV production consumption is approximately 76 percent of annual consumption for all buildings. HPWH performance appears to be a primary factor in the higher consumption for these meters.
- A number of building common area meters saw an increase in energy use in the last year. While some of this increase in energy use might be explained by behavioral differences with the occupants during these two periods, HPWH operation and increased reliance on electric resistance water heating is most likely also a contributor.
- Actual annual electrical consumption for the Leasing and Recreation Center was 70 MWh, or 21 percent, below consumption in the previous annual report. There was still a 126 MWh shortfall, but this is significantly down from 184 MWh in the prior study. Original projections and PV sizing did not account for pool pumping and outdoor area lighting.
- This analysis reports on the first year of Solstice performance. Consumption on a per bedroom basis is similar to both Ramble phases, but PV production is lower per building than The Ramble buildings. Projected PV production for Solstice is needed to better understand why PV production is lower.

ENERGY PRODUCTION AND CONSUMPTION COMPARISON (2012-13 to 2013-14)[4]

Facility[5]	Production (MWh)		Consumption (MWh)		Production/Consumption (%)	
	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14
Ramble Apartments Phase 1						
Apartments	1,110	1,120	1,377	1,303	81%	86%
Common Areas	451	444	602	561	75%	79%
TOTAL	1,561	1,564	1,979	1,864	79%	84%
Viridian Apartments						
Apartments	530	563	515	539	103%	104%
Common Areas	314	318	432	447	73%	71%
TOTAL	844	881	947	986	89%	89%
Viridian Commercial Areas						
TOTAL	358	397	84	477	426%	83%
Leasing and Recreation Center						
TOTAL	218	206	402	332	54%	62%
TOTAL	**2,981**	**3,048**	**3,412**	**3,659**	87%	83%

OBSTACLES IDENTIFIED AND LESSONS LEARNED

Student Apartments

Actual consumption data from the student apartments is greater than modeled assumptions. The original energy use projections based on typical multifamily housing in California underestimate plug loads in student housing apartments where a "multiple household" effect exists. This is more evident in the three and four bedroom apartments, where the number of occupant-supplied electronic devices, such as computers, TVs and gaming systems is higher.

There is still a large amount of variability in apartment consumption among the individual apartments, suggesting the effect of occupant behavior as a significant factor in ZNE performance.

Based on monitoring results from PG&E and their collaborators, energy for heating, ventilation and air conditioning on average is higher than modeled assumptions. Based on this result, it was identified that many of the apartment occupants operated the heat pump fans continuously, assuming that these fans provided fresh air ventilation. In fall 2014, when there was tenant turnover, WVCP systematically went through and disabled the fan-only operation

[4] 2012-13 data refers to March 2012 through February 2013 and 2014 data refers to September 2013 through August 2013.
[5] Includes facilities operational during both reporting periods.

within the wiring in all the thermostats, to prohibit occupants from running the heat pump fans continuously. These fans will now only operate while heating or cooling.

Unlike many student apartments, where renters pay for their utilities, students at West Village are not charged separately for the energy they use and currently do not have easy access to energy consumption data. As a result, there is little awareness of the effects of their energy consumption on community ZNE goals.

Consumption comparison from year-to-year is more challenging with student housing because of high tenant turnover each year. In most cases, the tenants in each apartment and within each building are different between evaluation periods. This also presents challenges tenant engagement programs. Educational programs have to be repeated each year with the new tenants.

Heat Pump Water Heaters

The primary cause for high consumption in common areas appears to be due to HPWH operation. Operational issues have led to higher than anticipated energy use for heating water with the backup electric elements, lower overall water heating efficiencies, and higher energy use.

This issue seems to be mostly the result of problematic systems on certain buildings. In buildings where there were few HPWH operational issues, annual consumption was much closer to projections and PV production. High consumption is not seen in all buildings but limited to a number of buildings within each phase. Occupant behavior and differences in hot water use between years may also contribute to performance. Increase in tenant hot water use from year to year will result in higher water heating energy use.

Phase I Ramble common meters had significant operational issues in the first year of operation and experienced many problems resulting in excessive electric resistance operation for water heating. Performance improved from 75 percent of ZNE in the first study to 79 percent of ZNE in this last evaluation.

Viridian HPWHs are particularly problematic, as a result of the system design and location. These units are located in interior closets and frequently cut out at low ambient temperatures in the closet resulting in excessive electric resistance operation.

- Leasing and Recreation Center – A primary cause for production shortfall on the Leasing and Recreation Center is that both original consumption projections and PV sizing were based on building energy use only. Actual energy use includes pumping energy for two pools and the spa, as well as outdoor lighting. Also the modeling estimates assumed that natural ventilation strategies would contribute to cooling the building and this strategy was not implemented fully. Higher than projected building energy use was a factor as well. As discussed above, several measures were taken to reduce total energy use at the Leasing and Recreation Center where consumption dropped by 21 percent.

- PV Production - PV system annual production increased in the last year, primarily as the systems at Solstice came on line in September 2013. There was a slight increase in PV

production on most of the systems. One possible cause could be the dry, clear weather in the winter of 2014 along with reduced dust as a result of reduced construction activities in the last year. There were some operational issues in the first year that could explain the increases as well. Some of the PV systems on the carports experienced electrical issues related to underground wiring connections during the June through August 2012 period.

- PV production of the Solstice systems averaged 13 percent lower than the Ramble Phase I and 2. Some of this could be the result of lower production at start up in the first few months of operation but it was consistently lower throughout the year.
- The Leasing and Recreation Center saw a 6 percent reduction in PV production primarily between February and May of 2014. This change was not observed elsewhere and it is recommended that this be investigated further.
- It is also important to keep in mind that annual production is expected to decrease in future years. Based on studies by others, an estimated 0.5 percent/year due to PV panel degradation should be expected.

Data Collection and Analysis

Data collection from monthly utility bills and daily SunPower production data for each meter is a very time intensive process that requires significant effort to align the two sources and enable calculating consumption for each meter and the community as a whole. Since WVCP has engaged a consultant to assist in the data collection process this effort should be significantly reduced in the future.

A process for quickly identifying high energy users and other consumption issues is also being developed. While none of these efforts were able to be leveraged for this analysis, it is expected that it will make future reporting and analysis much easier and timelier.

UC DAVIS WEST VILLAGE LIVING LAB

West Village is the home for the UC Davis Energy and Transportation Research Cluster which is aimed at better fostering collaboration among related research units, enhancing interaction with the private sector and accelerating the transfer of university inventions from the lab to the marketplace. West Village is the physical home for these UC Davis research centers:

- Energy Efficiency Center, which includes:
    - Center for Water-Energy Efficiency
    - Program for International Energy Technologies
    - Western Cooling Efficiency Center

- Institute of Transportation Studies, which includes:
  - China Center for Energy and Transportation
  - Plug-In Hybrid & Electric Vehicle Research Center
  - Sustainable Transportation Energy Pathways Program
  - Urban Land Use and Transportation Center
- Policy Institute for Energy, Environment and the Economy
- Energy Institute
- Center for Design in the Public Interest

Locating these research units at West Village enhances the opportunity to use West Village as a "living lab" to evaluate and develop energy and transportation technologies and solutions at the building and community scales. In addition to monitoring activities relating to ZNE for West Village, other research investigations underway or were completed during 2013-14 included:

Honda Smart Home Demonstration Project – In March 2014, Honda in collaboration with UC Davis unveiled one of the most advanced, ZNE smart homes at West Village. Working with the Western Cooling Efficiency Center, the Energy Efficiency Center, and the California Lighting Technology Center, Honda partnered with UC Davis research to showcase energy efficient technology in this home. The Honda Smart Home will generate enough energy for daily living, electric vehicle charging, and, in collaboration with PG&E, provide power back to the grid on demand. Built with energy efficient design in mind, the Honda Smart Home will use less than half the energy of a similarly-sized home in the Davis region.

Multifamily Hybrid Solar Demonstration – A 24-panel photovoltaic plus thermal hybrid solar system was installed at Solstice student housing. The system provided PV electricity to one apartment and supplied thermal energy to the building's central hot water system. The PV+T system was integrated with the central hot water system to interact with the high efficiency air-to-water heat pump to investigate how to optimize both water heating systems for multifamily applications.

Battery Buffered Electric Vehicle Charging Station – On site solar energy, a high voltage lithium-ion battery pack and electric vehicle charging stations were integrated to store PV energy and charge vehicles, day-or-night, without adding loads to the grid.

Single Family Hybrid Solar and Demand Side Management Retrofits – In anticipation of constructing single family homes at West Village, these technologies were tested at an existing home at Aggie Village, a university faculty and staff community located in downtown Davis. The technologies in the test home included a photovoltaic plus thermal hybrid solar system, a lithium ion 2nd life battery, and a home energy management system. The energy management system monitored and controlled plug loads, appliances, battery storage charging and discharging, and electric vehicle charging. The goal of the project was to achieve ZNE in a retrofit environment and transfer learned lessons to future single family homes in West Village and California.

NEXT STEPS

Student Apartments

WVCP will continue to develop and implement community engagement strategies to encourage energy conservation. WVCP intends to:

- Continue EMPOWER program to educate residents on sustainability and energy efficiency practices.
- Work with consultants to evaluate effectiveness of tenant engagement activities, including:
    - Identifying and engaging high energy users to encourage reducing energy use.
    - Creating competitions to encourage residents to reduce energy use.
    - Monitoring apartment usage to determine effectiveness of interventions.

- Additional potential strategies include:
    - Providing incentives for apartments that reduce energy use below the monthly utility usage targets.
    - Developing a strategy to discourage excessive (larger than estimated) energy consumption in high use apartment early in the school year.
    - Providing an easy means for occupant feedback and control of consumption.

Common Meters

HPWHs continue to be a significant source of overconsumption, but the issue is restricted to the Viridian and a handful of units at The Ramble. If a water heating system is found to rely increasingly on electric resistance, this should be addressed as soon as an issue is identified, so it does not continue to be an issue for many months. Recommended strategies to address these issues include:

- Further evaluate the common meters and high-consumers. Utilize both the utility meter data and the monitoring results from the PG&E study to identify underperforming HPWHs and address HPWH operational issues or replace equipment if necessary.
- Ramble HPWHs - WVCP is considering replacing three units that continue to have operational and reliability issues.
- Viridian HPWHs – WVCP is investigating replacement of all the units serving Viridian with high efficiency gas water heating systems. Operational costs (both maintenance and utility) of these units are extremely high. Because of the design and location of the equipment, there is no easy HPWH solution. Switching to high efficiency gas water heating will significantly reduce utility costs, but the installed PV systems can't be used to offset gas use.
- Review site lighting and building exterior lighting to evaluate potential savings with integrated controls.

Leasing and Recreation Building

Since the Leasing and Recreation Center meter has several additional loads not included in the original evaluation or PV sizing, PV production will continue to be less than consumption. The work done last year reduced energy use by 21 percent. Additional efficiency retrofit measures could further reduce energy use but at higher cost and diminishing returns. Recommendations include:

- WVCP staff continues to track control and operation of building to ensure that energy use doesn't increase over time.
- LED lighting conversion for outdoor and pool lights Outdoor lighting is predominantly fluorescent, but additional savings may be possible by switching to LED fixtures.
- In order to achieve ZNE performance at the Leasing and Recreation Center, some additional PV will be necessary.

Other Considerations

Since residents due not pay more for energy if they consume more and there is a significant turnover of tenants in September every year, it will continue to be a challenge engaging residents to use energy wisely. Additional electricity loads on site that were not accounted for in the original evaluation will continue to contribute to the shortfall. WVCP began a PV cleaning trial last year on the carport systems. The effect of this practice on seasonal PV performance should be further evaluated to assess whether a broader cleaning program should be implemented. Getting more production out of the existing PV systems would be helpful in closing the ZNE gap, and may be more cost effective than the cost of the additional production through more PV panels, but will not be enough alone to close the gap.

ACKNOWLEDGEMENTS

The WVEI truly has been and will continue to be a coordinated effort of the University of California and its development partners who are committed to making West Village more sustainable and extending results of the project to the broader community. This project would not have been possible without the commitment and efforts of:

- West Village Community Partnership, LLC (Carmel Partners & Urban Villages)
- Nolan Zail Consulting
- U.S. Department of Energy
- California Energy Commission
- California Public Utilities Commission
- Pacific Gas & Electric Company
- Chevron Energy Solutions
- Davis Energy Group
- Energy+Environmental Economics
- ITRON
- UC Davis California Lighting Technology Center
- UC Davis Center for Water-Energy Efficiency
- UC Davis Energy Efficiency Center
- UC Davis Energy Institute
- UC Davis Institute for Transportation Studies
- UC Davis Western Cooling Efficiency Center

1580 Jade Street
Davis, CA 95616
www.ucdaviswestvillage.com

436 Mrak Hall
University of California, Davis
One Shields Avenue
Davis, CA 95616
www.sustainability.ucdavis.edu