UC Davis

West Village Energy Efficiency Project



PROJECT SPONSORS: University of California, Davis
Office of Resource Management & Planning

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Energy Efficiency Center
Center for Entrepreneurship
University of California, Davis

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Acknowledgments

The following key representatives of the community have been crucial to the development of this project and are able to provide resources for future reference.

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KEY PERSONNEL AND RESPONSIBILITIES

Prof. Andrew Hargadon, Director of the Center for Entrepreneurship and the UC Davis Energy Efficiency Center, oversaw all phases of the project, with a particular emphasis on the generation of innovative marketing and financing models.

Benjamin Finkelor, Program Manager for the UC Davis Energy Efficiency Center, provided project management, as well as market analysis and business case guidance, and assistance for the Emerging Venture Analysts.

Amy Barr & Jonathan Short, Emerging Venture Analysts at the UC Davis Energy Efficiency Center, under the supervision and guidance of the aforementioned faculty and staff, conducted the tasks described in the Scope of Work. This included market analysis and generation of the customized "business cases" for homebuilders and their suppliers to adopt energy efficiency and solar energy technology.

Camille Kirk, Associate Environmental Planner for the Office of Resource Management and Planning, provided the interface between the Office of Resource Management and Planning, the West Village Community Partnership, and the UC Davis Energy Efficiency Center faculty, staff, and students.

Executive Summary

Distributed energy technologies, which include products and services that increase energy efficiency, facilitate demand response and reduction, and produce on-site heat and power offer the promise of many individual and societal benefits. The goal of the West Village Energy Efficiency Project was to create a package of marketing and financing innovations that overcome prohibitive cost barriers, enabling West Village to successfully incorporate the latest distributed energy technologies into the community infrastructure while maintaining the required level of affordability to the first-time buyer and avoiding additional first cost to the University and developer. In terms of distributed energy solutions, the objective was to identify those measures that would result in a zero net electricity bill to West Village residents and tenants.[1]

The EEC developed three business models that integrate appropriate energy technologies and industry partnerships with new and available financing mechanisms to construct homes and buildings with very low energy bills in a way that is largely transparent to the buyer/owner. These models incorporate combinations of solutions from technical, financial, and organizational perspectives in a fashion that is designed specifically to address different scales of the development (single-family homes, multi-family student housing, commercial spaces, and the community as a whole).

The process of developing these business models was just as valuable as the generated solutions. The network created of builders, energy providers, consultants, financial institution representatives, and others, and the additional findings and recommendations formulated, will go a long way towards integrating distributed energy technology solutions into the West Village development and will be essential to the future success of the project.

1 *Originally, the objective was to identify solutions that would achieve a zero net energy bill for residents, but early on in the project, this objective was revised to be a zero net electricity bill. This was due to current technology limits of on-site natural gas and natural gas substitute production capabilities.*

Key findings in this report include:

- Energy Efficiency measures typically provide a net benefit, in terms of affordability
- Distributed generation such as solar power (including both solar-thermal and Photovoltaic) will typically provide a net cost, in terms of affordability
- Performance-based incentive methods will ensure that the energy measures installed are effective and persistent in the long-term
- Preventive maintenance and education programs will be required to upkeep and ensure effectiveness of the energy measures

Key recommendations include:

1. Install into all single- and multi-family units the minimum energy efficient measures (Package 1 seen in Appendix A) identified in the revised Davis Energy Group report that was both commissioned and guided by the project team and advisory committee. These recommended measures increase affordability and energy savings.
2. Create a position whose sole responsibility is to ensure the accurate & successful intergration of the energy efficient measures specified into the final West Village development.
3. Investigate further several of the business models identified in this report and consider merging, where appropriate, two or all three of the models into one business unit.
4. Work towards creating an energy efficiency mortgage program; one which could be designed for all UC institutions but piloted on a small scale here at UC Davis in the West Village development.
5. Form a team consisting of representatives from the University, the developer, and non-University partners to produce an unsolicited proposal for a comprehensive research, education, and outreach program.
6. Investigate further transportation-related solutions that may be both affordable and environmentally preferable for future residents of West Village.

BUSINESS MODELS SUMMARIZED:

Through Project Advisory Committee meetings and smaller sub-committee meetings, a number of conceptual models were identified. The following are those models that showed the most promise and were further explored.

- The SEMO business model would offer a solution at the individual, single-family-home scale. It would purchase the technologies specified in the Davis Energy Group's West Village Report (see Appendix A) and then 'lease' these technologies to the residents of the West Village community for a monthly subscription fee. Additionally, this organization would perform semi-annual preventative maintenance on all installed energy-efficient and distributed generation technologies in order to ensure maximum effectiveness and savings.
- The Micro-U business model would address energy consumption on the community-wide scale for the commercial (community college and leased office and retail space), multi-family (student apartments), and/or entire community (street and recreational lighting). PV panels, and potentially other forms of distributed generation (such as biogas conversion), would be installed on the roofs of the parking structures to offset the electrical consumption of the community, thus creating a zero net electrical bill on those portions of the project associated with the Micro-U. The micro-utility would work as an intermediary between West Village and the energy provider and in doing so would be responsible for distributing solar, and potentially other forms of distributed generation, to all structures in the development. Like SEMO, this organization would also be commissioned to maintain optimal effectiveness of the technologies installed.
- The FACT business model (sometimes referred to as the Silent Second) would offer a solution at the individual, single-family home scale and would work closely with the management organization selected for the West Village community. FACT would work in many ways like SEMO, only from inside the University with a prescriptive-method approach. FACT offers a solution that would have the management organization, not residents, purchase energy efficiency and distributed generation upgrades, but residents would reap the benefit of that installation. Outside lending sources would be repaid in balloon payments as each of the homes are resold; in effect, the second homebuyer would be paying for the installations in the home, while the first homebuyer gets to enjoy the energy savings.

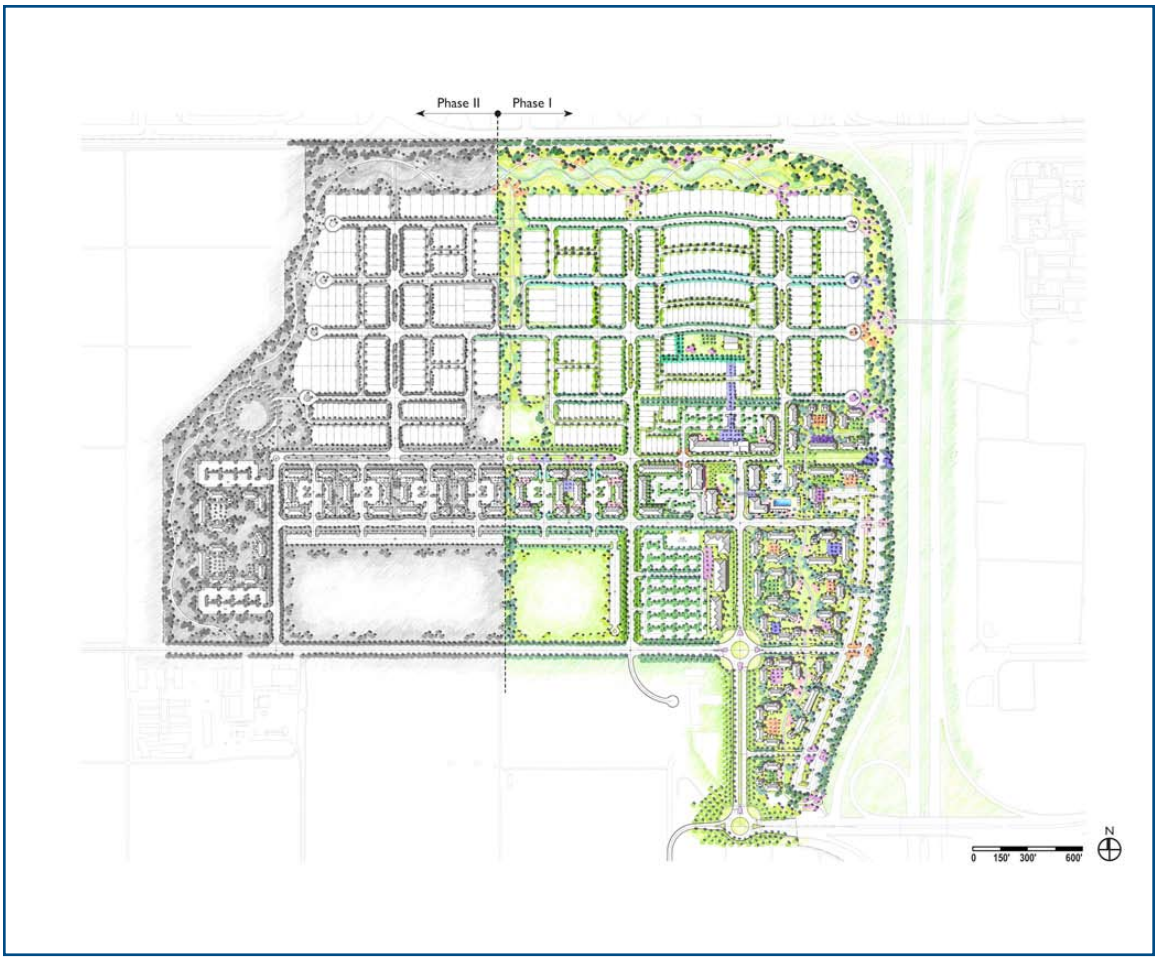

Figure 1: Illustrative Plan *The West Village residences and apartments provide new choices for those who desire to live, work, and recreate in a sustainable residential neighborhood that is seamlessly integrated with UC Davis' core activities. It is based on the three core principles of housing affordability, environmental responsiveness, and quality of place. Phase I establishes the community design and infrastructure to realize the goals and principles identified in the Master Plan and includes rental apartment student housing, for-sale faulty/staff hosing, mixed use space, infrastructure, and educational facilities and recreation fields.*

Background

The West Village Community Development (West Village) is a UC Davis on-campus housing development designed to provide affordable housing to staff and faculty as a recruitment and retainment measure. It is programmed for 500 faculty and staff single-family homes and multi-family housing for 3,000 students as well as community-building elements including parks, education centers, bikeways, and recreation fields.

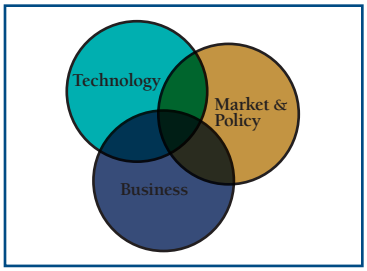

Figure 2 EEC Venn Diagram *The Energy Efficiency Center bridges that gap between researchers and the marketplace by developing business models that translate research results into viable ventures. With the network of technology, University, and strategic partners developed throughout the course of this project, we were able to create viable business ventures centered around promising energy efficient technologies and connect those ventures to the financial and social capital that will be critical to their success.*

West Village meets the test for a strong, sustainable community on many levels. University affiliates will be offered housing at more affordable prices than available in the local marketplace. Auto commute trips to campus will be greatly reduced, replaced by an extensive network for bike and bus trips, which use less energy, cause less air pollution, and avoid regional traffic congestion. New education partnerships are being built with the community college and local school districts to offer multi-level educational opportunities to the entire Davis community. Storm water and landscape systems are integrated to provide on-site drainage, minimizing site runoff, establishing a greenbelt open space network, and creating on-site habitat value. Buildings are oriented along east/west streets to manage sun exposure—protecting spaces from the sun at appropriate times—and to capture the cooling breezes from the Delta in the summer.

In November of 2003, UC Davis commissioned the Davis Energy Group (DEG) to offer an energy-efficient perspective on the West Village site plan and to identify packages of energy saving investments to optimize energy use in West Village buildings. It was the view of the development team that the additional capital costs required to make the identified energy investments could not be incorporated into the homes if the objective of providing affordable entry into the housing market is to be met. Therefore, the energy efficiency and financial strategies implemented must be independent of the already established home prices. Even if it can be demonstrated that payback will occur in a reasonable timeframe, the initial sale price of the home is approaching its upper limit.

Of particular interest is the challenge of developing innovative business models that reduce the high first cost of distributed energy technology infrastructure.

The UC Davis Energy Efficiency Center (EEC) is dedicated to supporting the commercialization of energy efficient technologies through new ventures. This includes support both for businesses intending to bring energy efficient technologies and services to market and also for market-

making activities, such as connecting technology champions to customers, utilities, state agencies, and other third parties. The EEC has a strong interest in addressing some of the challenges the West Village project faces in terms of incorporating energy efficiency technologies into the community. Of particular interest is the challenge of developing innovative business models that reduce the high first cost of distributed energy technology infrastructure. In conducting the analysis for this report, the EEC has commissioned an update to the original 2003 report from the DEG and used these findings as a basis for developing business models, drawing conclusions, and generating recommendations around making the West Village Community Development a model in energy resource management.

Objectives and Outcomes

PROJECT OBJECTIVES

The goal of the West Village Energy Efficiency Project was to create a package of marketing and financing innovations that overcome prohibitive cost barriers, enabling West Village to successfully incorporate the latest distributed energy technologies into the community infrastructure while maintaining the required level of affordability to the first-time buyer and avoiding additional first costs to the University and developer. The West Village Energy Efficiency Project is addressing a consumer-oriented challenge. It is not enough for the developers to identify the energy efficiency opportunities and expect the first cost to be absorbed by the consumer. The developers must be able to offer the end consumer a streamlined product that finances the implementation and adoption of the most appropriate energy efficiency technologies.

The EEC was asked to develop a number of business models that integrate appropriate distributed energy technologies and industry partnerships with new and available financing mechanisms to construct homes and buildings with very low energy bills in a way that is largely transparent to the buyer/owner.

The EEC was asked to develop a number of business models that integrate appropriate distributed energy technologies and industry partnerships with new and available financing mechanisms to construct homes and buildings with very low energy bills in a way that is largely transparent to the buyer/owner.

Originally, the objective of the West Village Energy Efficiency Project was to incorporate technologies that allow for zero net energy bills for tenants and homeowners. Natural gas is expected to be included in the development for both appliances and heating (both water and space conditioning) purposes; due to this gas component, it would not be feasible to reach zero net energy bills until either the developmenvt is planned for all electric or distributed generation of biomass derived natural gas substitutes become a viable and mature technology.

It was agreed early on by the project team and project sponsors that the aim of those distributed energy technologies installed should be changed to generate a zero net electricity bill. While solar thermal technology integration was considered in an effort to reduce the amount of natural gas used for water heating purposes as much as feasible, the prospect of generating a zero net natural gas bill, and thus zero net energy bills was eliminated from the a scope of this study.

Contextual Considerations

Over the course of the project several underlying contextual Considerations were identified as relevant to the project's goals. These issues were common to one or more of the business models as well as the findings and recommendations that were generated. Below is a list of these issues (see Appendix D for expanded explanations).

- **Performance- vs. Prescriptive-Based Savings:** There are two general approaches to implementing energy savings—performance-based and prescriptive-based. In a performance-based method, energy savings are reimbursed based on audited performance. A prescriptive-based method uses a predetermined incentive payment based on projected energy savings and distributed generation amounts derived from estimated averages. Performance-based implementation tends to be accurate, persistent, and dynamic, while generally incurring a higher transactional cost. Prescriptive-based methodology will typically have a much lower transactional cost but is less accurate and has a less dynamic response to changing environmental conditions.
- **Home Affordability:** The purchase price for West Village single-family homes has been designed to be affordable relative to the purchase price of a traditional (land-ownership model) single-family home in the greater UC Davis community. This does not necessarily mean these homes are undervalued on the market since there is a University land-lease and accompanying University requirements (capped appreciation formula, occupancy restrictions, etc). Over time, the market price may outpace the capped appreciation rate of West Village single-family homes—this would make the homes that much more affordable relative to the surrounding community.
- **Infrastructure Costs:** It was hypothesized that if zero net electricity bills were achieved there could be a beneficial impact on the infrastructure costs to the West Village Community Partnership developers and the utility company, Pacific Gas & Electric (PG&E) that provides services to the project. Intermittent sources, however, such as most distributed generation measures, will not necessarily reduce the need for any amount of infrastructure since backup resources will be required should the community load not match the distributed generation output. Energy efficiency measures that cut load may indeed have infrastructure cost ramifications and this should be explored.
- **Preventative Maintenance:** Preventative maintenance is an important part of homeownership and integral to ensuring maximum energy performance throughout the life of the technologies installed in the development. Because of the magnitude of potential savings achievable purely from preventative maintenance, it is suggested that a program in which each homeowner is required to be a member of a West Village preventative maintenance program be incorporated into the West Village development.

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Process Design

The process of developing business models was just as valuable as the generated solutions. The network created of builders, energy providers, consultants, financial institution representatives, and others, and the additional findings and recommendations formulated, will go a long way towards integrating distributed energy technology solutions into the West Village development and will be essential to the future success of the project.

The West Village Energy Efficiency Project assembled an interdisciplinary team to serve as the Project Advisory Committee. This committee was designed to have representation from stakeholders that would have an interest in or be impacted by energy efficiency and distributed generation solutions being incorporated into the overall project.

The process of developing business models was just as valuable as the generated solutions.

The committee was formally brought together three times over the course of the six-month project. Members were asked to brainstorm and explore the world of possible solutions for integrating energy efficiency into the West Village project. Solutions were broadly categorized into three groups: technical, financial, organizational/operational. Subcommittees on each topic were brought together to conduct further brainstorming sessions.

The committee was then asked to provide guidance on integrating combinations of solutions from each group into business models that were designed specifically to address different scales of the development (single-family homes, multi-family student housing, commercial spaces, and the community as a whole). The committee activity and the overall research process resulted in these models as well as relevant information and recommendations for action and further research that may prove even more valuable than the selected business models under development.

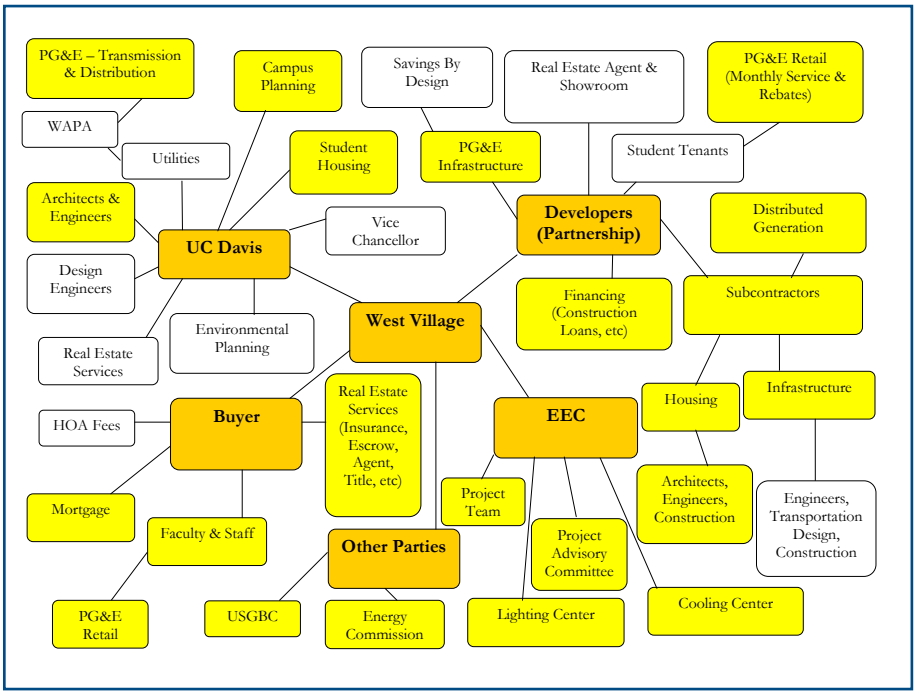

Figure 3: Stakeholder Flow Chart *The PAC was designed to have representation from stakeholders that would have an interest in or be impacted by energy efficiency and distributed generation solutions being incorporated into the overall project. The network created and the findings and recommendations that were formulated will go a long way towards integrating energy efficiency into the West Village development and are essential to the future success of the project.*

Set of Possible Solutions

Select Project Advisory Committee members and additional outside contributors identified three categories of solutions: technical, financial, & organizational. Brainstorming was facilitated within each category, leading to lists of current and potential solutions.

- Technical: Technology-specific solutions relevant to the project were identified and analyzed by Davis Energy Group (working in concert with the Building America program and building on the previous Davis Energy Group report). The state-of-the-art cost-effective energy efficiency and distributed generation technologies were evaluated based on product maturity, builder acceptance, estimated energy benefit, and cost effectiveness.
- Financial: Existing incentive and financing programs that make energy investments more affordable for builders and owners were identified in combination with technical solutions. Additional financing mechanisms, including mortgages and external debt capital sources, were explored as potential funding sources for packages of relevant technologies.
- Organizational: Appropriate structures were explored for organizing the implementation of identified technical and financial solutions. Organizations will ultimately make it possible to operationalize the technical and financial solutions. They will be responsible for:
    - o Purchasing, installing, and maintaining equipment and technologies
    - o Running accounts payable and receivable
    - o Providing auditing and oversight of energy and service performance

TECHNICAL

Working with the Project Team, the Davis Energy Group revised their original analysis of the West Village report and packaged three sets of distributed energy measures that might be incorporated into the project (see Appendix A for complete analysis). Other technologies (such as radiant heating and cooling, LED downlights, and water-based cooling devices) were considered but not included due to the unlikelihood of their adoption by the construction industry. These technologies may gain higher market penetration between now and the time of construction and should be continually monitored for product maturity, reliability, and serviceability.

Other technologies (such as radiant heating and cooling, LED downlights, and water-based cooling devices) were considered but not included due to the unlikelihood of their adoption by the construction industry. These technologies may gain higher market penetration between now and the time of construction and should be continually monitored for product maturity, reliability, and serviceability

Package 1, comprised solely of Energy Efficient Measures, is designed to maximize energy savings while maintaining the net affordability for the homeowner, including both mortgage and utility costs. Package 2, made up of both Energy Efficient Measures and Distributed Generation, in an effort to reasonably increase energy savings, incorporates a modest amount of distributed generation (solar electric and thermal technologies) as well as slightly less cost-effective energy efficiency measures. A final "super energy" package (Package 2+), containing Energy Efficient Measures and a maximum level of Distributed Generation, could be constructed to achieve the project goals by adding additional PV to fully offset the remaining electrical consumption. This should achieve the original goal of zero net electrical energy usage, but it presupposes that sufficient roof area will be available. Centralized community PV solar may be a more cost effective solution and would address any concern over lack of roof area, but the current regulatory environment does not allow for homeowners to share the cost and benefit of a community solar array.

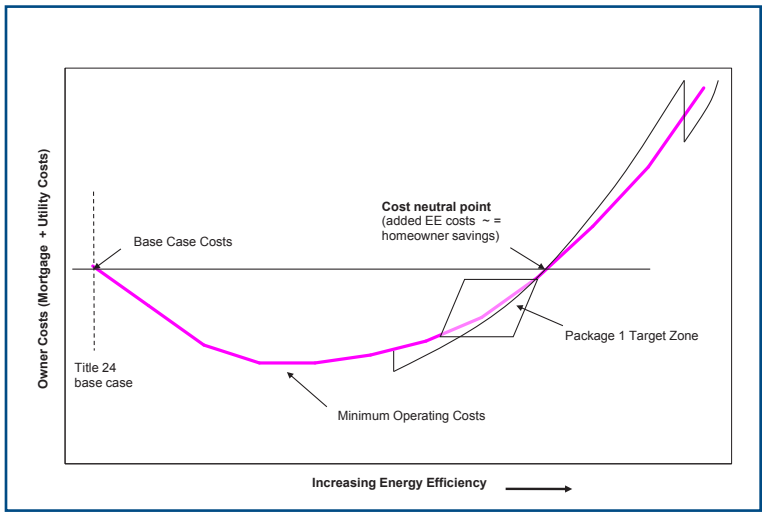

Figure 4: Typical Owner Cost/Energy Efficiency Relationship

As the graph illustrates, the goal of Package 1 is to stop short of the point where owner costs exceed the base case cost point. Packages 2 and 2+, by incorporating greater energy efficiency and (highly visible but more costly) renewable solar technologies, will require an alternate funding approach if the goal is to avoid increasing costs beyond the base case reference point.

Its net cost is $3,529 (after $2,000 in builder incentives) per home and is projected to save the homeowner $399 (24%) in energy bills every year.

Energy Efficient Measures (Package 1) For the single-family home, Package 1 calls for improved insulation, Energy Star appliance package, tankless water heater and optimized water delivery, efficient

HVAC ducts, equipment, and airflow, and an efficient lighting design. Its net cost is $3,529 (after $2,000 in builder incentives) per home and is projected to save the homeowner $399 (24%) in energy bills every year.

For multi-family student housing, Package 1 calls for improved insulation and envelope, Energy Star appliance package, tankless water heater and optimized water delivery, efficient HVAC ducts, equipment, and airflow, an efficient lighting design, and a bathroom lighting system. Its net cost is $2,636 (after $2,000 in builder incentives) per unit (average of four beds per unit) and is projected to save each individual unit $332 (26%) in energy bills every year.

Energy Efficient Measures & Distributed Generation (Package 2) For the single-family home, Package 2 calls for all of those measures specified in Package 1 along with improved ceiling, slab, and envelope insulation, ducts in the conditioned spaces, a NightBreeze system, solar water heating, and 2.6 kW of PV. Its net cost is $21,575 (after $4,000 in builder incentives, $3,050 in homeowner incentives, and $5,050 in state PV rebates) per home and is projected to save the homeowner $1,017 (62%) in energy bills every year.

For multi-family student housing, Package 2 calls for all of those measures specified in Package 1 along with improved ceiling and slab insulation and 1.8 kW of PV. Its net cost is $14,762 (after $2,000 in builder incentives and $5,050 in state PV rebates) per unit (average of four beds per unit) and is projected to save each individual unit $753 (60%) in energy bills every year.

Energy Efficient Measures & Complete Distributed Generation (Package 2+) For the single-family home, Package 2+ takes Package 2 and increases the PV to 3.3 kW in order to provide enough solar generation to completely offset the use of electricity by the homeowner. Its net cost is $26,075 (after $4,000 in builder incentives, $3,050 in homeowner incentives, and $5,050 in state PV rebates) per home and is projected to save the homeowner $1,640 (100%) in energy bills every year.

For multi-family student housing, Package 2+ takes Package 2 and increases the PV to 2.9 kW in order to provide enough solar generation to completely offset the use of electricity by the tenant. Its net cost is $23,162 (after $2,000 in builder incentives and $5,050 in state PV rebates) per unit (average of four beds per unit) and is projected to save each individual unit $1255 (100%) in energy bills every year.

FINANCIAL

Rebates & Incentives

Rebates and incentives come in a variety of forms. Individual measures consist of the California New Solar Homes Partnership, which starts at $500 and $2.50 per kW of solar power installed and increases from there. There are also federal tax credits to the homebuyer in the form of $2,000 each for PV and solar thermal and to the developer as $2,000 per home for a reduction of 50% in the heating and cooling as compared to the IECC 2004 standard. Packaged incentives have also been created by Energy Star ($500 per home to the builder) and PG&E (up to $1,250 per home) and there are property tax exemptions available in California for certain types of solar energy systems installed before the end of 2009.

Mortgage Options

There are three mortgage solutions identified for this project: the University of California Mortgage Origination Program (MOP), the Energy Efficient Mortgage (EEM), and the Location Efficient Mortgage (LEM).

The MOP is below-market financing currently available only to tenure track University of California faculty. It has had an average rate of 4.66% over the past four quarters. Reworking the MOP qualifications in order to permit staff to also qualify for the MOP would allow for more people to use this advantageous financing if they opt for energy efficiency. While this does not directly finance the energy efficiency, it would increase the pool of buyers who could afford the homes.

The EEM is typically used to finance retrofits and remodels. It is, however, available for new construction and as a 15- or 30-year fixed-rate mortgage or an adjustable rate mortgage. The EEM essentially serves to lower the debt-to-income ratio of the homeowner, allowing the homeowner to borrow more than otherwise would be possible. The LEM is similar to the EEM but is available for homeowners who live in convenient neighborhoods where residents can walk from their homes to stores, schools, recreation, and public transportation. It is available as a 15- to 30-year fixed-rate mortgage set in competition with prevailing rates on the date of the home purchase. It may be worth exploring the potential of combining the EEM & LEM into a joint mortgage that could potentially have a reduced interest rate.

External Capital

Third-party financing in the form of loans from banks, such as New Resource Bank and Bank of America, and new project finance institutions, such as MMA Renewable Ventures, could provide the capital to fund the distributed energy measures. There is also the opportunity for loans and grants from foundations, state and federal regulatory and research agencies, and private individuals and corporations that could help finance the installation of the technologies.

ORGANIZATIONAL

Prescriptive Capability through the 'Master Land Lease Agreement'

The University is still finalizing their contract with the developer and, as such, has the ability to insert certain restrictions into the master land lease. One such option is a construction requirement that would call for energy efficient and distributed generation technologies as an install requirement of the lease. In doing so, however, the University needs to ensure that any requirements it makes does not adversely impact the agreed upon pro-forma financials. The developer is a critical partner in the West Village project and cannot be expected to take on additional burden without compensation. As such, this solution may have a limited application.

The developer is a critical partner in the West Village project and cannot be expected to take on additional burden without compensation.

Management Organization

At minimum, the University will be providing lease-management services to homeowners. It has yet to decide, however, the type of management organization through which it intends to provide these services. Billing for water, sewage, and drainage, municipal services including police, fire, ground maintenance, and street maintenance, and curbside refuse collection are all slated to be included in the duties of the organization. The structure of this organization could take many forms. It could be a department within the University's Real Estate Services or it could be a separate non-profit organization, such as a Homeowners Association (HOA), that has ties back to the campus. There are two readily available examples of such organizations: Aggie Village, which is managed through the University of California, Davis Real Estate Services Department, is a model of a campus department managing the provided services and the Irvine Campus Housing Authority (ICHA), which is an independent 501c3 corporation. Whichever organization is chosen could potentially provide, in addition to the many expected services, energy-related services, billing and oversight.

External Organization (Third-Party Contract Model)

External groups not associated with the University or the developers may have certain expertise or preferable institutional flexibility that will improve the effectiveness of managing the purchase, installation, maintenance, and related services around energy efficiency and distributed generation measures. Such an organization could be contracted to provide these solutions to West Village properties or could be tasked with sub-contracting some or all of these solutions to select contractors.

An external organization may have the ability to respond to unforeseen opportunities and challenges in a timely and relevant manner, more so than a University division or non-profit organization. Timing will be critical in the implementation of any of the identified business models as well as most innovative solutions that might be pursued. Attracting preferable financing (tax exempt, low interest, state or federally subsidized, etc.), however, may not be as easy for an external organization to accomplish.

Research or Educational Institution

The University excels as both a research and educational institution. Likewise, the community college that is expected to inhabit 60,000 square feet of building space within the development is an excellent educational resource. Both of these organizations might be leveraged to provide services, installation, and general outreach regarding energy efficiency and distributed generation measures installed in the West Village community. The University is well suited to conduct the performance of research and analysis on installed equipment and the community college system is equally well-suited to provide training to service technicians in related fields. While this may require approval and participation from tenants and property owners, there may be benefits available to all parties involved.

Business Models under Development

Three business models have been developed that combine the technical, financial, and organizational components identified in the analysis by the Project Advisory Committee and project team. These business models are designed to provide affordable distributed energy solutions on an individual home, multi-family, and community-wide scale to the West Village development. These conceptual business models, should they be pursued, would require additional action steps to develop the model further and begin implementation. Both the business models and the action items are listed below.

The first two business models could be combined under the same operational contract or organization. The third model would most likely need to be a business unit internal to the University.

BUSINESS MODEL #1

UC Davis West Village Strategic Energy Management Organization (SEMO)

SEMO would offer a solution at the individual, single-family-home scale, though it requires that all single-family homeowners participate. It would purchase the technologies specified in the Davis Energy Group's West Village Report (see Appendix A) and then 'lease' these technologies to the residents of the West Village community for a monthly subscription fee. Additionally, this organization would perform semi-annual preventative maintenance on all installed energy-efficient and distributed generation technologies in order to ensure maximum effectiveness and savings. SEMO would finance the up-front marginal costs of equipment and installation through competitive market rate debt financing, servicing the debt through the monthly subscription fees charged to homeowners. The project team has identified some lending institutions, Bank of America and New Resource Bank, which may have an interest in projects of this kind. Additionally, MMA Renewable Ventures, which recently launched a project finance fund for energy efficiency implementation in the commercial and industrial sectors, may be interested.

	Status Quo	EEM Only	EEM & DGM
Capital Required (per home)		$2,967.00	$22,672.00
Monthly P&I (7%, 30yrs)		$19.74	$150.84
Maintenance Contract		$13.00	$18.00
Utility Bill	$135.00	$101.75	$50.25
SEMO Subscription Fee		$36.77	$186.36
Monthly Maintenance Costs	$16.67		
Monthly TOTAL	**$151.67**	**$138.52**	**$236.61**
Monthly SAVINGS/COST		**$13.15**	**($84.94)**

Figure 5: Financial Breakdown of SEMO Business Model – Set Subscription Fee

As shown, Package 1 would provide the most savings for the homeowner (about $13.15 per month) using a revenue model of a set monthly subscription fee. Package 2, while providing significantly more energy efficiency and, thus, smaller utility bill, actually ends up costing the homeowner about $84.94 more every month because the capital required is so much more as a result of the PV incorporated into the package. This scenario allows for SEMO to recoup a small monthly income in exchange for their services so that it can continue to operate and provide the homeowners with energy savings. This is only one of many options of revenue collection available to this organization.

In this model, SEMO would be a third party contractor, separate from the University. As such, the University would need to put out an RFP to select a contractor to engage in this role. The advantage would be that, as a separate organization, SEMO would have the flexibility and timely response of a private sector firm that would allow it to adapt to the changing technical, regulatory, and business environment. It would also have the ability to replicate its services in other developments throughout the country.

The method of measuring energy savings and contract performance would be an integral part in determining the amount of the subscription fee collected from residents. The chosen system, either prescriptive- or performance-based, will affect both the energy performance and the revenue model that fits the recommendation best. A set subscription fee would work best with a pure prescriptive-based model; however, this might not provide the most savings to the user. Additionally, there would be little incentive for SEMO to maintain optimal efficiency of the installed technology since, regardless of the savings to the homeowner, SEMO would receive the same monthly amount.

An alternative option is a subscription fee that is a percentage of the savings that SEMO's combination of energy-efficient and distributed generation measures provides to the user. In this system, a baseline would need to be determined and a performance-based measurement approach would be necessary (most likely with a third party auditor utilizing advanced metering and monitoring) because SEMO would need to know exactly how much the user is saving every month (compared to the baseline) in order to calculate the percentage to be billed as the subscription fee. This method would be beneficial in that it would provide SEMO with an incentive to truly maintain the highest efficiency possible of the installed technologies. The additional transaction costs inherent in using a performance-based model, however, may not justify the savings. Around this issue may be an ideal opportunity in which to include the University and its research departments into the West Village development (and in doing so, could potentially expand the possible grant opportunities available to this organization).

The final revenue option is a combination of the two methods, where there is a set base fee paid monthly by the homeowner plus a percentage-based fee that depends on the monthly energy savings the technologies provided the home, the maintenance record of the energy equipment, and the satisfaction of the homeowner. Again, this option contains the added costs associated with measuring the savings to each home, though reducing the detail and/or frequency of the measurements could reduce these costs.

The form of the model for revenue collection can take many other variations; however, it appears it is in the best interest of all parties involved to choose one that includes some portion of a performance-based system. To this effect, SEMO would be able to provide the most energy efficiency to the homeowner and would, thus, be working to fulfill the University's goal of offering homes with the most energy savings possible to the West Village.

KEY ACTION ITEMS:

- Confirm that incentives, rebates, and tax credits associated with the energy-efficient technologies can be collected by Micro-U (or transferred to Micro-U from the developers/University)
- Contact sources of market-rate financing - Solicit proposals from renewable energy companies, ESCOs and the local utility to provide distributed generation services as well as EEM purchase, installation, and maintenance determine cost-effective and strategic investment strategy
- Decide whether to master meter and whether and to what degree to sub-meter
- Explore revenue models: determine reasonable subscription fee, percent subscription fee, combination of both
- Determine the method of measuring energy savings—performance-or prescriptive-based

BUSINESS MODEL #2

UC Davis West Village Micro-U

The Micro-U business model would address energy consumption on the community-wide scale for the commercial (community college and leased office and retail space), multi-family (student apartments), and/or entire community (street and recreational lighting). Since aggregated distributed generation (solar PV in a central location - most likely on commercial and multi-family building rooftop) is a central piece of this model, this would not be viable for single-family homes due to the current regulatory restrictions.

Micro-U would act in much the same way as SEMO, as a third party contractor, though Micro-U might have the additional responsibilities of installing and managing the sub-metering and billing for tenants of the West Village community's commercial, retail, and apartment spaces. PV panels, and potentially other forms of distributed generation (such as biogas conversion), would be installed on the roofs of the parking structures to offset the electrical consumption of the community, thus creating a zero net electrical bill on those portions of the project associated with the Micro-U. The micro-utility would work as an intermediary between West Village and the traditional Utility provider and, in doing so, would be responsible for distributing solar, and potentially other forms of distributed generation, to all structures in the development. Like SEMO, this organization would also be commissioned to maintain optimal effectiveness of the technologies installed. Initial financial capital would be funded from external sources in the form of market rate financing.

	Status Quo	EEM Only	EEM & DGM
Capital Required (per bed)*		$638.00	$6,572.50
Monthly P&I (7%, 30yrs)		$4.24	$43.73
Maintenance Contract		$3.25	$4.50
Utility Bill	$25.00	$18.08	$2.50
Micro–U Subscription Fee		$8.43	$53.23
Monthly Maintenance Costs	$4.17		
Monthly TOTAL	**$29.17**	**$26.51**	**$55.73**
Monthly SAVINGS/COST		**$2.66**	**($26.56)**

Figure 6: Financial Breakdown of Micro–U Business Model – Set Subscription Fee (per bed) *As shown, Energy Efficiency measures by themselves (EEM only) would provide the most savings for the individual tenant (about $2.66 per month) using a revenue model of a set monthly subscription fee. In the chart above, EEM, combined with Distributed Generation Measures (DGM), while providing significantly more energy savings and, thus, smaller utility bill, would actually end up costing the tenant a projected $26.56 more every month because the capital required is so much more as a result of the PV incorporated into the package.*

** Numbers based on average of 4 beds per unit.*

While SEMO would likely be a separate organization, but one that collaborates closely with the University (and the University selected management organization) for ongoing operations, Micro-U would likely be a separate organization that would need to work closely with the developer, specifically working with the developer-owned facilities that lease-out the property. Micro-U might be well suited as a business unit within the building management organization that the developer establishes or contracts with to provide services to its tenants.

The fact that there is a single owner of a large set of facilities, and therefore a single-payer to the utility, makes distributed generation more advantageous to the Micro-U model. Through net-metering, facility owners can invest in distributed generation that produces as much electricity as is consumed by the property over the course of a given year. Any power that is produced beyond what is consumed would not be credited, so under the net metering arrangement, property owners are incentivized to invest in an optimized amount of distributed generation. For small property owners who have relatively small annual energy consumption, they are not able to invest in distributed generation at a scale that allows them to make a cost effective investment. On the other hand, large property owners, such as commercial and industrial users, do have the capability to make well-scaled investments. While many firms have and are increasingly making these investments, no multi-family projects (other than a few cases of trailer parks) in the US have yet to successfully make an investment on behalf of their entire project and have it be net metered for the benefit of tenants and the building owner.

Since the developer will still own and maintain the property after construction, they will be in a position to serve as a single payer to the servicing utility. This allows the net-metering to occur at a large enough scale to make a community centralized solar PV installation at a large enough scale more compelling.

One of the earliest decisions that the developer and Micro-U would have to make is whether to sub-meter their tenants. Individual unit metering will increase the likelihood of energy savings since Micro-U would then be in a position to monitor and provide feedback to each of their tenants. With metering in place, they would be able to send price signals as opposed to simply having a set fee. Without a price signal, tenants would be less aware of their energy use and have less of an incentive to conserve because they would be billed the same amount regardless of energy use behavior. One revenue model available with sub-metering in place would be to set a monthly kW allowance for each unit. As long as tenants stay under that limit, the residents will not receive a bill. If they exceed the set amount they would be charged a fee per unit overage (similar to the way in which cell phones charge for going over minutes). In doing so, Micro-U would be providing the tenants with an incentive not to over consume while at the same time rewarding them with no energy bill (for electrical use) if they are able to remain conservative on their use of electricity. With proper oversight of the pricing model, Micro-U and the building management organization would also be incentivized to educate and encourage tenants not to go over their monthly energy allotment, as the margin would be a source of income (and if designed properly, a greater revenue source than monthly overage charges).

If the developer were to increase monthly rents by that amount (so that there was no fiscal impact to the tenant), that would translate to an additional $7,980 every month ($2.66 x 3,000 beds) to the developer.

The revenue model for collecting subscription fees could also be broken down into the same three options as SEMO's: set subscription fee (based on a pure prescriptive model), a percentage-based fee (using a performance model), or a combination of the two that sets a minimum base fee plus a percentage-based fee.

It is important to note that in the above financial breakdown it is not assumed that the PV installation is purchased and installed at a larger, more favorable scale. At the time of this report, the cost breakdown on PV installation that would service the commercial and educational facilities, the community infrastructure, and the multi-family dwellings, all under a single-payer, was not available. This cost analysis will need to be determined through a rigorous contract bidding process. It is expected, however, that with a single-payer setup and a central PV array on top of a parking structure would generate much better economics then those shown above. It can be speculated that the energy produced by the PV would end up having no increase to the monthly utility bills, possibly even with a savings.

Also important to note is that the developer-owned and operated buildings will be rented at market rates. Prospective tenants will be comparing their utility bill to existing competitive market rates. If Micro-U can show that they will be saving x amount every month, then the developer can charge an additional x amount per month and still remain competitive with the rest of the market. For instance, using the chart above, residents of the multi-family units will be saving $2.66 every month with only the Energy Efficiency Measures (EEM) installed and maintained. If the developer were to increase monthly rents by that amount (so that there was no fiscal impact to the tenant), that would translate to an additional $7,980 every month ($2.66 x 3,000 beds) to the developer. It therefore makes sense to consider installing Package 1, at the very least, on the multi-family homes, regardless of whether or not centralized distributed generation is included.

KEY ACTION ITEMS:

- Confirm that incentives, rebates, and tax credits associated with the energy-efficient technologies can be collected by Micro-U (or transferred to Micro-U from the developers/University)
- Contact sources of market-rate financing - Solicit proposals from renewable energy companies, ESCOs and the local utility to provide distributed generation services as well as EEM purchase, installation, and maintenance determine cost-effective and strategic investment strategy
- Decide whether to master meter and whether and to what degree to sub-meter
- Explore revenue models: determine reasonable subscription fee, percent subscription fee, combination of both
- Determine the method of measuring energy savings—performance-or prescriptive-based

BUSINESS MODEL #3

UC Davis West Village Financial Advisory & Consulting Team (FACT)

The FACT business model (sometimes referred to as the Silent Second) would offer a solution at the individual, single-family home scale and would work closely with the management organization selected for the West Village community. FACT would solicit from one or more outside lending services the necessary financing for the purchase and installation (and potentially preventative maintenance) of the EEM and DGM that have been identified in the recently updated Davis Energy Group West Village Report. FACT would work in many ways like SEMO, only from inside the University with a prescriptive-method approach.

The FACT business model offers a solution that would have the management organization, not residents, purchase energy efficiency and distributed generation upgrades, but residents would reap the benefit of that installation. The outside lending sources would be repaid in balloon payments as each of the homes are resold; in effect, the second homebuyer would be paying for the installations in the home, while the first homebuyer enjoys the energy savings. Presumably, however, this would still maintain the overall affordability of the homes. While the first homebuyer would enjoy those energy savings, the second homeowner (assuming the real estate market appreciates positively over time, as it has in the past) would still be purchasing a home that is relatively affordable to the market rate for a non-University single-family home.

The FACT business model offers a solution that would have the management organization, not residents, purchase energy efficiency and distributed generation upgrades, but residents would reap the benefit of that installation.

One of the most critical ingredients to this model is the market rate at which outside lending sources would be willing to assign given the terms of the financing requested.

The risk of default, for instance, would be closely considered by any outside lending source. This risk should be minimized by the fact that repayments will coincide with home sales, but there are also concerns around the timing of repayment. Most lenders are not comfortable loaning money for unspecified periods of time. While the average resale will occur every seven years, it is possible that homes in West Village will resell much less frequently. In fact, resale may not happen on a given property for as long as 40 years. While a lender might be willing to take on this additional risk, it will likely require a higher interest rate to do so.

Based on historic data, there is an assumption that the market appreciation rate for residential real estate in Davis will most often be positive or zero. It is possible, in theory, that the real estate market could depreciate in value. However unlikely, this is a possibility that any outside lending source will consider and, to compensate for this risk, may demand yet a higher rate of return. Much of these risks to lenders could be mitigated by having the University act as guarantor on the loan. Alternatively, the University could engage in the process of becoming its own lending source for the required funding.

Additional alterations to the model could also reduce the risk to the lending source and increase the equitable distribution of "affordability" between the first and second homebuyers. If the first homebuyer was required to pay a monthly fee that would be equivalent to the baseline energy bill that the homeowner would have paid had there not been any energy infrastructure installed on their behalf (thus not impacting affordability), the outside lending source would receive some on-going compensation towards interest and potentially a portion of the principal as well. At the point of resale, the second homeowner would still have a balloon payment included in the purchase price, but it would have been bought down considerably.

KEY ACTION ITEMS:

- Determine which management organization will be used and how it will manage and verify the investment of the borrowed funds and the loan repayment
- Determine terms of a loan proposal that are not negotiable from the management organization/University's point of view
    - o Amount of funds needed
    - o Flexible repayment periods
    - o Balloon payments (no interest or principal)
- Request proposals from lenders – focus on those that specialize in energy improvement loans or new institutions that have an interest in energy efficiency (like New Resource Bank and MMA Renewable Ventures)
- Determine the implications of homeowners refinancing on their first mortgage, a quick initial re-sale by the first homeowner, and the fairness/affordability level to the 2nd homeowner or owner at the time the loan is repaid

Additional Findings

During the course of this six-month project, additional findings and compelling opportunities have been identified. Below are the three most promising. Included are notes from preliminary investigations and suggested action steps.

- Mortgage Solutions
- Research, Education, & Outreach Project Integration
- Transportation Related solutions

MORTGAGE SOLUTIONS

The University of California Mortgage Origination Program (MOP) and Supplemental Home Loan Program (SHLP) provide extremely attractive financing. Currently, though, these programs have many restrictions, including primarily limiting availability only to faculty who are buying a first and principal residence in the community. Affordability and energy efficiency could be achieved by making the MOP/SHLP programs available to faculty and staff who buy a home with a certain level of energy efficiency. Such an energy efficiency mortgage program could be created at the UC-wide level and would have a significant impact on both affordable housing developments, such as West Village, and developments in other University of California communities. Approval of such a program would require approval from the Regents and the Office of the President of the UC. The creation of such a loan program, one that could very well be piloted on a small scale here at UC Davis, might be very advantageous to the University in terms of its ability to attract and retain personnel (the purpose of the West Village Community Development). Such a program would also align well with the University's commitments to environmental and energy related research, education, and outreach programs.

Such an energy efficiency mortgage program could be created at the UC-wide level and would have a significant impact on both affordable housing developments, such as West Village, and developments in other University of California communities.

Specific investigation into expanding the SHLP financing to all University affiliates who purchase an energy-efficient home with a zero net electricity bill is also an intriguing mortgage solution option. This would be an interest-only loan with a set payback period and would be assumable by subsequent buyers. Because of the predetermined income stream, the University can issue bonds to fund this program. This would effectively make the FACT business model no longer applicable. The University's ability to borrow and lend at below-market rates and its proven sophistication at administering programs of this nature will allow it to execute the solution at a drastically reduced cost. The University is considering a rate around 5% (compared to a market rate that could be more than twice that), which, in addition to the savings realized from the reduced overhead, is a considerable savings that can be passed on directly to the residents. This proposal would provide both the energy efficiency and the affordability components that are critical to the goal of the West Village Energy Efficiency Project and the entire University of California system's commitment to sustainability.

KEY ACTION ITEM:

- Continue to work with the Regents and the Office of the President to expand and/or create new energy-specific versions of the MOP/SHLP programs.

RESEARCH, EDUCATION, & OUTREACH PROJECT INTEGRATION

Research

Given the variety of property types in the West Village development, the staggered installation of those property types, and the integrated relationship between the University and the tenants and homeowners, West Village represents an ideal location and subject matter on which to conduct energy-efficiency, distributed generation, transportation, and sustainability-related research. Having an affiliation with a renowned research University makes it more likely that residents of the West Village development will be more willing to participate in human behavior and technology demonstration studies. The ability to assign some homes and facilities as research subjects and some as controls in a real-world environment would essentially create a research field laboratory unlike any other master planned development in the country.

UC Davis has four research centers that have a direct interest in the West Village "laboratory" environment, all of which are rapidly growing (especially within the past 5 years) and are seeking space as they expand. These centers are the Energy Efficiency Center, the California Lighting Technology Center, the Western Cooling Efficiency Center, and the Institute of Transportation Studies. The commercial space being built within West Village would be an ideal centralized home for these energy research centers to conduct their operations, especially as they develop and conduct research on and around the premises. A centralized location for these centers will be advantageous for education and outreach purposes as well.

These research centers have received funding or are already seeking funding from various grant programs in conjunction with a number of industry partners and these efforts could quite appropriately be applied to the West Village project. The following is a list of three such funding opportunities which are being investigated:

Building Energy Research Grant (BERG)—up to $200,000

The BERG Program, offered through Public Interest Energy Research (PIER), provides funds to advance science or technology in the area of residential- and commercial-building energy efficiency. Research projects must address a California energy problem and provide a benefit to California consumers. Up to two solicitations per year are planned. There is a special category in the BERG Program to co-fund American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) research projects, up to $50,000 each.

Zero Energy New Homes (ZENH)

The ZENH program (also offered through PIER) aims to include 25% reduction in energy use (through efficiency), 70% reduction in utility bills (using efficiency and PV), and one kW peak demand at an incremental cost of $5,000 per unit. There may be an opening for West Village to petition receiving these funds.

PG&E's Sustainable Communities Program

PG&E is committed to both energy efficiency as well as sustainability. They have recently launched a Sustainable Communities program and are seeking approval from the California Public Utilities Commission to secure funding from Public Good Charges for its activities. The Sustainable Communities program is considering the selection of development projects in which to fund, showcase, and pilot sustainable technology demonstration. West Village may be the perfect test site.

Other research centers and institutions, both internal and external to UC Davis, would also have a significant interest in conducting research at West Village, including efforts in biomass, solar, wind, and human behavior, and would likely be interested in collaboration.

Possible avenues on which to conduct technical and behavioral research include (among others):

- Advanced metering infrastructure, internet over the grid, and energy consumption feedback mechanisms
- Advanced lighting and cooling design, including solar to DC direct applications
- On-site community biogas production and distribution

- Plug-In Hybrid Vehicles, Neighborhood Electric Vehicles and accompanying infrastructure
- Alternatives to standard vehicle ownership (car-sharing)
- Alternative fee structures and business models (subscription fee pricing with overage charges, power purchase agreements for demand reduction, etc.)
- District heating & cooling and alternative utility business models (selling cubic feet of refrigerator and freezer space, space conditioning, lighting, community-wide supply & demand gap financing models)

Education & Outreach

Just as research opportunities will be plentiful in the West Village Community Development, so will education and outreach opportunities. UC Davis students, through campus as well as University Extension, will have an opportunity to study case studies on energy technologies in the built environment and then see those case studies in practice in the "living laboratory" next door. Los Rios Community College students will have an opportunity to learn vocational skills regarding energy efficiency and distributed generation technology installation and preventative maintenance - this is especially critical for new types of cooling, lighting, and electric drive vehicle technologies. This meets a growing need for service technicians to master working with these technologies.

Just as research opportunities will be plentiful in the West Village Community Development, so will education and outreach opportunities.

Utilities and leading energy companies also have education and outreach programs that may be suitable for co-locating or being conducted at a facility within the West Village Community Project since there will be many real world installations to tour.

Outreach can in many ways be incorporated into the educational opportunities by all of the same partner organizations, as many programs can be designed for and made available to the public.

Possible avenues on which to conduct education and outreach through include (among others):

- Interactive education center that highlights sustainability and energy efficiency technologies and conservation measures at the individual, neighborhood and community-wide scales
- Energy company sponsored courses on sustainable design and energy technologies taught within the local community college facility and interactive education center
- Technician education and training and preventative maintenance/owner's manuals for the homeowner

KEY ACTION ITEMS:

- Pursue identified grant opportunities - continue to seek out new grant opportunities
- Form an integrated team consisting of University, developer, and non-University partners to put together an unsolicited proposal for comprehensive research, education, and outreach program
- Consider space allocation of the West Village commercial space to an integrated set of energy efficiency research organizations, including the EEC, the CLTC, the WCEC, and STC - engage leadership from the four centers in building design and lease negotiations

TRANSPORTATION RELATED SOLUTIONS

Transportation has been identified as an attractive method to achieve increased energy efficiency in the West Village development. Recent studies suggest that alternatives to standard vehicle ownership, such as car-sharing and low-speed vehicles (also known as neighborhood electric vehicles, or NEVs), may be applicable, viable options for the West Village demographic as use of these alternatives have been linked closely with high levels of education and low levels of overall driving. The bike- and pedestrian-friendly design of the development, as well as its proximity to campus and downtown Davis, make it the perfect candidate for both of these measures.

Car-sharing

Car-sharing is an increasingly popular alternative to car ownership, with approximately 200,000 users worldwide. It allows conveniently located hourly rentals of a car or truck without the burden of personal insurance, maintenance, or parking. For individuals who don't have a need for an everyday gas vehicle, car-sharing can also be less expensive than car ownership, saving an average household $500-$1,500 per year in vehicle-related expenses. Additionally, studies have shown that, although car-sharing both reduces driving for previous car owners and increases driving for the previously car-less, the overall effect is a net decrease in driving, primarily because the user does not take on the 'sunk cost' of traditional vehicle ownership. The developer can also reap rewards for encouraging car-sharing. Each car-sharing vehicle can offset the equivalent of 10-20 sole-owned cars, meaning that there is a reduced need for parking spaces and the extra land may then be allocated to more profitable uses.

There are multiple ways to start a car-sharing program in the West Village. One could be to start a program from the ground-up and run it as part of the development or as part of the University. A far simpler plan would be to provide an incentive in the form of dedicated premium parking spots for use by a local car-sharing organization, such as Flexcar, Zipcar, or City CarShare. Free or subsidized parking is an excellent incentive and, if it were possible to include a number of spots in the development specifically for car-sharing, it is highly likely that a car-sharing company would jump at the opportunity to run a program there at no cost to the University or the developers.

Neighborhood Electric Vehicles

NEVs are low-speed electric vehicles designed for city use. They have a federally mandated speed limit of 25 mph and typically have a range of 25-50 miles with a rate of energy use from 100 to 150 mpg-equivalent. Davis is one of the few cities with numerous NEVs already on the road - a testament to the utility of an in-town vehicle in this area. Additionally, Davis Electric Vehicles opened its doors in 2007, becoming the first retail electric vehicle store in the country. A typical NEV, such as a DaimlerChrysler GEM, costs four times less per mile to drive than an average 27.5 mpg car, meaning that drivers would pay the equivalent of only $0.80 per gallon of gas at today's prices when they recharge their NEV at home. Given current energy and insurance prices, those savings could pay for the car in as little as five years, although the long-term maintenance and insurance savings will require further investigation.

A typical NEV costs four times less per mile to drive than an average 27.5 mpg car, meaning that drivers would pay the equivalent of only $0.80 per gallon of gas at today's prices when they recharge their NEV at home.

The primary challenge in encouraging the adoption of the NEV in the West Village development is the $9,000-$15,000 price tag (depending on the model). However, by partnering with Davis Electric Vehicles, the West Village development could bring that price down by approximately $1,000 per car by batch-ordering the vehicles, according to Theo Druscell, the company's president. Additionally, it may be possible to combine a home purchase with a NEV purchase, which not only adds an attractive feature to the home, but also places the most energy-efficient car in the hands of its most likely users. One way to achieve this goal without raising the home price would be to downsize the home by replacing a stan-

dard garage with an outdoor charging station and a brand-new NEV waiting beside it. However, the ability of the developer or the University to bundle a vehicle sale with home purchase (for instance, as a part of the mortgage price) is currently unknown - the EEC will be investigating this possibility further.

The greatest overall energy savings would be achieved by combining a car-sharing program with a point-of-construction NEV program, thereby giving NEV drivers the option to car-share when they need a gas vehicle instead of the typical purchase pattern of owning one gas vehicle and one NEV. In this scenario, the University would reserve a number of parking spots specifically for car-sharing and also offer NEV home packages. We believe that the synergy between the two programs would make both of them more successful than either could be on its own, resulting in significant transportation-related energy savings for participating households.

KEY ACTION ITEMS:

- Explore feasibility of car sharing infrastructure installation
- Explore feasibility of NEV program

Conclusions

In attempting to solve the financial challenges of installing technologies to achieve a zero net electricity bill for homeowners and tenants within the West Village development with no additional up-front costs to the developer or University, the Project Team identified a series of parameters that should be considered in comprehensively overcoming the underlying challenge of providing sustainable energy resource management in an affordable manner.

1. Select energy efficiency measures will typically provide a net benefit, in terms of affordability, to the project assuming the right model can be installed to finance the up-front and on-going costs through revenues of collected "savings." The challenge with such measures is that these are often hard to evaluate, verify and measure and, therefore, have a higher transaction cost.
2. Distributed generation, especially when installed on a small (single-unit) scale, will typically provide a net cost, in terms of affordability, to the project and will likely require higher monthly charges (for additional financing costs) than otherwise would be spent on monthly utilities.
3. Though there likely is a higher transaction cost, a performance-based incentive method will ensure that the energy measures installed are effective and persistent in the long-term.
4. Preventive maintenance and education programs will be required to upkeep and ensure effectiveness of the energy measures.

Recommendations

A number of action items are recommended throughout the report. A few high level recommendations are listed below.

1. In keeping with the goal of maintaining affordability, it is strongly recommended that Package 1 (the energy efficient measures identified in Davis Energy Group's revised report seen in Appendix A) be incorporated into all single- and multi-family units. According to the estimates, these investments make the home more affordable (when you include monthly mortgage costs and utility costs) despite a higher initial cost. The total marginal capital required for this package on a single-family basis is roughly $3,500 per home, which is less than 1% of a $400,000 home. If the University has flexibility in price determination and can increase the price by this percentage, it is strongly urged that all measures be taken to incorporate these technologies into the development.[5]
2. The University should take every precaution to ensure that these distributed energy technology measures chosen for the project are accurately and successfully incorporated into the appropriate structures. To that effect, it is strongly suggested that a position be created for an employee whose sole responsibility is to make sure that those technologies specified are installed into the West Village development.
3. Of the business models developed in this project, SEMO and Micro-U would provide West Village with the most energy savings at the lowest cost to the developer, homeowner/tenant, and University. They are not free of obstacles, however, and the ability of these business models to raise the necessary funds and work within the confines of the University and the University-developer relationship could limit implementation. Nonetheless, we recommend follow up on the Key Action Items provided for each of the first two business models presented as these are both innovative options for integrating energy efficiency into the West Village. The organizations that would administer these two business models could potentially be merged into one unit that provides services to two separate groups: the commercial/multi-family units and the individual homeowners. Any business model that is pursued will need to work with (and be overseen by) the management organization that is selected by the University and developer to manage the contract relationship and collect agreed upon fees.
4. The University should work towards creating an energy efficiency mortgage program; one which could be designed for all UC institutions but piloted on a small scale here at UC Davis in the West Village development. Investigation may benefit from using the currently available SHLP financing model as a starting point for designing a second mortgage which will provide additional necessary financing for sustainable energy technologies that make possible zero net electricity bills for new and retrofit homes.

5 *It should be noted, however, that if additional distributed energy measures are later incorporated into the project (such that technologies in Package 2 or 2+ are included), the cost-benefit nature of the entire suite of technologies should be calculated holistically, not just the marginal cost-benefit of the additional distributed generation measures. The technologies listed in Package 1 are the most cost-effective and, if these are installed and effectively separated out of the analysis for the more capital intensive distributed generation measures seen in package 2 or 2+, the benefit-cost ratio for package 2 or 2+ will inappropriately appear lower than otherwise calculated.*

5. Grant opportunities from foundations and local, state, and federal regulatory and research agencies may be available to support creative solutions such as the ones listed in this report. The landscape for these grants is constantly changing and new grants may become available. Continued research on fundraising opportunities is recommended and, in some cases, a professional grant writer or service may be the best way to apply for such grants. A team consisting of representatives from the University, the developer, and non-University partners should be formed to produce an unsolicited proposal for a comprehensive research, education, and outreach program.
6. Further study, as suggested in the report, should be considered regarding the transportation-related solutions that may be both affordable and environmentally preferable for future residents of West Village.

Appendices

DAVIS
ENERGY
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UC DAVIS WEST VILLAGE
ENERGY EFFICIENT HOUSING STUDY
(2007 UPDATE)

Issued: May 17, 2007

Presented To: Benjamin Finkelor
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EXECUTIVE SUMMARY

Analysis was completed on prototype single- and multi-family housing plans to evaluate individual energy efficiency measures, and then assemble preferred packages for the proposed UC Davis West Village project. The West Village project is comprised of single-family faculty housing, multi-family student rental housing, and non-residential construction outside the scope of this study. Analysis was completed using the MICROPAS7 compliance software certified for the 2005 Title 24 Residential Building Standards. Some additional measures not included in the MICROPAS program were evaluated using other analytical tools or data sources.

Prospective energy efficiency measures were screened for cost-effectiveness relative to a Title 24–compliant base case building. The cost-effectiveness threshold was defined as the estimated annual utility operating cost savings exceeding the added incremental costs amortized at 6% over a 30-year term. Measures were

then combined into two packages: Package 1 incorporates cost-effective measures that result in total costs (mortgage + utilities) less than the base case costs, and Package 2 incorporates additional, less cost-effective measures, as well as solar thermal and solar electric systems.

Based on the assumptions of this study, we project Package 1 will deliver annual natural gas and electric savings in the 24-28% range for both single- and multi-family building types, with operating cost savings of approximately 25%. Package 2, by incorporating additional efficiency measures and renewable solar technologies, is expected to deliver gas savings in the 35-40% range, electric savings of 73-87%, and operating cost reductions of about 60%. Projected single-family incremental costs are estimated at $3,000 and $22,700 (after incentives and tax credits) for Packages 1 and 2, respectively. Multi-family "per unit" Package 1 and 2 costs are 79-86% of the single-family costs.

The Package 2 option creates an opportunity to develop an advanced business model that captures the full array of environmental benefits renewable technologies offer in terms of reduced carbon footprint and reduced peak electrical-load impacts. Pursuing such a path would also give UC Davis a high visibility leadership role in the development of advanced residential communities. We strongly recommend that Package 2 be explored in more detail.

Other key recommendations include:

1. Several of the single-family preliminary home designs feature a long and narrow footprint with above-average perimeter length per unit floor area. A design with a reduced aspect ratio would result in less exterior wall area (i.e. energy savings), but more importantly, construction cost savings. We estimate construction cost savings of ~$100 per foot of perimeter reduction. Our strong recommendation is that perimeter reduction be actively pursued, with the resulting construction-cost savings applied to energy efficiency and/or renewable energy technologies.
2. Locate outside sources of funding (e.g. the Energy Commission's Public Interest Energy Research (PIER) program) to support ongoing energy efficiency evaluations. In a few months, a beta version of the 2008 Title 24 compliance software will be available for testing. A review of this analysis should be completed with the updated software, reflecting the Title 24 stipulations that will be in effect when the West Village project goes to permit. Ongoing analysis of the evolving designs will increase the precision of the savings estimates and verify compliance with the performance goals that enable state and Federal tax credits/incentives.
3. Update the solar electric economics as multi-family New Solar Homes Partnership rules become better defined.
4. Track amendments and timeline extensions on state and federal tax credit programs.
5. Research infrastructure cost issues with PG&E. If a significant commitment to both energy efficiency and photovoltaics (PV) is pursued with this project, there may be cost savings in PG&E electrical infrastructure costs that could be passed on to the developer.
6. Reevaluate multi-family solar water-heating economics and the overall water- heating design after a preliminary water-heating design has been developed.

BACKGROUND

In January 2004, Davis Energy Group (DEG) completed an energy efficiency study for the proposed UC Davis West Village project. The 2004 DEG study relied on a prior consultant report and energy-use estimates contained in a Pacific Gas and Electric statistical survey report from the late 1990's. The 2004 report developed energy efficiency package options that were projected to result in operating cost savings ranging from 48 to 84%, depending upon building type.

As the West Village project moves closer to reality, UC Davis commissioned DEG in early 2007 to update the original study. The following developments will impact the 2004 project conclusions:

1. The 2005 Title 24 Building Standards have been implemented with a significant impact on lighting energy use, as well as improvements in "base case" heating, cooling, and water heating energy consumption.
2. The California Statewide Residential Appliance Saturation Study (RASS) was updated in 2004. The RASS study provides a statistical breakdown on statewide residential energy end uses. The 2004 update provided a better characterization of typical new single- and multi-family energy usage.
3. Federal equipment efficiency regulations have increased air conditioner minimum efficiencies from 10 SEER[1] to 13 SEER, and also increased typical gas storage water heater efficiencies by ~ 6%.
4. Several emerging technologies have gained a toehold in the market, providing better information on cost, performance, and market acceptance. Examples include tankless gas water heaters, fluorescent lighting technologies, attic radiant barriers, and cool roofing materials. In addition, third-party construction inspections for duct systems, HVAC airflow, and insulation quality have become more common, contributing to improved thermal envelopes.

OBJECTIVES

The key project objective is to evaluate and develop energy efficiency measure packages for West Village single- and multi-family building types. A two-tiered approach was taken in developing these packages. Package 1 is designed to include cost-effective measures that will offer favorable economics to the homeowner/building owner. Package 2, in an effort to approach zero annual utility cost, incorporates solar electric and thermal technologies, as well as less cost-effective measures. For each package, operating cost savings, added construction costs, and potential incentives/tax credits were included in the overall evaluation.

Figure 1 schematically represents the relationship between added energy efficiency and owner costs (combined mortgage plus utilities). The initial addition of the most cost-effective measures results in a steady reduction in costs. At some point costs reach a minimum. Beyond this point, increased energy efficiency can be achieved, but owner costs start to rise as the cost-effectiveness of subsequent measures diminishes. Federal and state tax credits are triggered based on achieving "X% beyond a standard," resulting in the discrete jogs shown in Figure 1 (black line), as opposed to the smooth magenta curve.

The goal of Package 1 is to stop short of the point where owner costs exceed the base case cost point. Package 2, by incorporating greater energy efficiency (and attractive, but costly renewable solar technologies), will require an alternate funding approach if the goal is to avoid increasing costs beyond the base case reference point.

1 *Seasonal Energy Efficiency Ratio is the federally mandated efficiency descriptor for split system air conditioners. The current Federal minimum SEER is 13.0.*

METHODOLOGY

The primary analysis tool used to assess performance was the MICROPAS7 hourly building energy simulation model. MICROPAS7 is one of a handful of computer programs used to demonstrate compliance with the California Title 24 Residential Building Standards. A few measures not currently handled by MICROPAS7 were evaluated externally. These measures include the NightBreeze ventilation cooling system, photovoltaic electric systems, and slab edge insulating systems[2].

Current West Village project design documents are in the schematic design phase. Since detailed floor plans and elevations are not available, we relied on a prototypical 1,882 ft² two-story house to both evaluate individual measures and construct the final packages. Although actual West Village house types will vary slightly, the analysis presented here will provide similar savings impacts for the thermostat and occupancy assumptions.

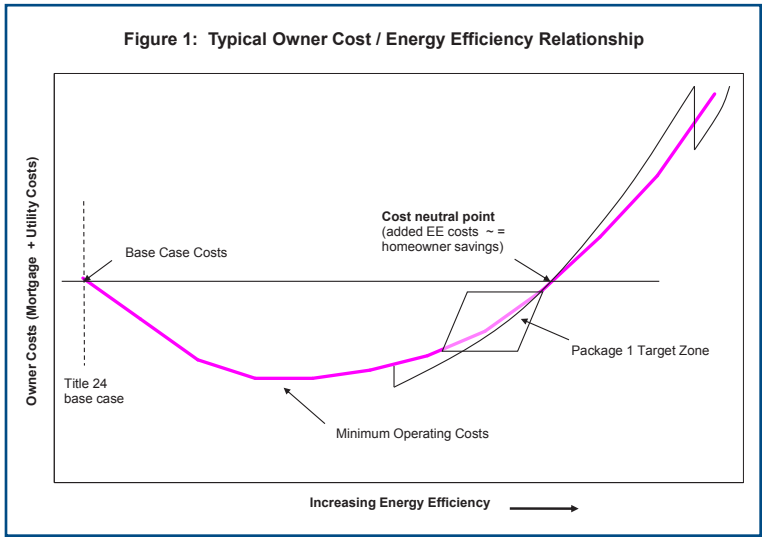


Figure 1: Typical Owner Cost/Energy Efficiency Relationship

Multi-family evaluations were completed based on schematic designs based on "building type 1" provided by UC Davis Office of Resource Management and Planning (ORMP) staff. A three-story building comprised of six 1,400 ft², four bedroom/four bath units was modeled.

Individual energy efficiency measures were evaluated to determine annual gas and electric performance impacts relative to the Title 24 base case. Incremental costs to the developer, after available incentives or tax credits, were calculated with projected operating cost savings. Cost effectiveness was calculated in the form of a benefit cost ratio (BCR), where *benefit* is defined as the value of the annual energy savings and *cost* is calculated based on how far the savings could justify incremental mortgage cost to the homeowner[3]. A BCR equal to 1.0 would indicate energy savings are accrued at the rate of $72 per year for each $1000 of incremental cost.

Upon completion of individual measure analysis, measures were packaged to satisfy Package 1 and 2 criteria. Package 1 was designed to include measures that would not result in increased owner mortgage + utility costs. Direction provided to the consultant at a team review meeting suggested stopping short of the point at which combined costs exceeded the base case reference costs. Package 2 performance criteria suggested a target of zero net energy cost for the homeowner. This is an ambitious target that unfortunately would result in very high incremental costs and an architectural design that may not be acceptable to a mainstream developer.

2 *Although MICROPAS7 does model slab edge heat transfer (and the benefits of adding slab edge insulation), the most recent modeling rules incorporated into the program do not accurately model slab heat transfer. This shortcoming will be corrected for the 2008 Standards.*

3 *A 6%, thirty year mortgage requires $72 in annual operating cost savings to offset an additional $1000 in principal, ignoring any tax benefits.*

ASSUMPTIONS

This section summarizes key assumptions used in the analysis.

PG&E Electric and Gas Rate Assumptions

PG&E's E-6 time of use electric rate was used for all cases analyzed. Time of use metering will be implemented during the course of the West Village build out. The Davis area is included in PG&E Baseline Territory S, with winter and summer[4] baseline usage quantities of 12.5 and 15.9 kWh/day, respectively. The five-tiered E-6 rate structure shown in Table 1 provides for increasing "per kWh" rates as usage increases and during the more costly part-peak and peak periods. With any energy analysis study, it is difficult to know what the energy use characteristics of a particular household will look like. To simplify the analysis, we based non-space-conditioning electrical consumption on "typical" RASS usage estimates and selected the second tier (100-130%) as the marginal rate for our calculations. The exception to the average second-tier rate assumption was cooling energy use, which is biased towards the more costly peak periods of the day.

Table 1: PG&E E-6 Electric Rate Summary (cost per kWh)

	Peak	Part-Peak	Off-Peak
Winter			
Baseline	----------	$0.12417	$0.10046
100-130% of base	----------	*$0.13972*	*$0.11601*
131-200% of base	----------	$0.23705	$0.21334
201-300% of base	----------	$0.32702	$0.30331
>300% of base	----------	$0.37417	$0.35046
Summer			
Baseline	$0.20861	$0.11178	$0.09422
100-130% of base	$0.22424	$0.12733	$0.10977
131-200% of base	$0.32157	$0.22466	$0.20710
201-300% of base	$0.41154	$0.31463V	$0.29707
>300% of base	$0.45869	$0.36178	$0.34422

Notes: *Winter Part-Peak = 5-8 PM weekdays; all other times (and Holidays) are off-peak Summer Peak = 1-7 PM weekdays, Part-Peak = 10 AM – 1 PM & 5 – 8 PM weekdays; all other times (and Holidays) are off-peak*

Natural gas rates, which have fluctuated widely over the past few years, were based on average gas costs over the preceding twelve months. For individual measure analysis, savings were based on the average marginal monthly gas rate of $1.33 per therm. Package evaluations, which incorporate multiple savings measures together, assumed an average rate of 90% of the marginal rate to reflect the impact of multiple savings measures reducing the marginal cost. It should be noted that natural gas rates, in particular, are difficult to forecast since short-term winter price fluctuations, due to weather severity, have resulted in large month-to-month variations over the past few years.

Modeling

The first evaluation step was to verify that the proposed base case building meets the Title 24 energy requirements. For each of the sixteen California climate zones (Davis is in climate zone 12), the Title 24 Standards specify a package of energy measures that define a "standard" budget. The standard budget sets the efficiency level the proposed house needs to meet, although the final mix of energy measures can deviate based on design issues and builder preferences. Production builders work intently to develop an optimized package of cost-effective energy efficiency measures for each plan they build. Based on input from the provider of the MICROPAS7 program, we assembled a builder-optimized package of measures that local builders are currently using to satisfy the 2005 Title 24 Standards. Table 2 summarizes both the prescriptive measures and the assumed measures that builders are currently implementing. (The "√" denotes whether the prescriptive requirement or the assumed performance level is more stringent.) The set of "assumed" measures define the base case home performance level. To better reflect reality, the nominal Title 24 cooling setpoints were modified to a 76ºF summer setting, with a nighttime 75ºF ventilation target[5].

4 *Winter period runs from November through April; summer from May through October*

Measure Costing

Davis Energy Group has been working with several California homebuilders as part of t Building America and the LEED Residential pilot programs. In the process of this work, we have started to develop information on current costs for various energy efficiency measures. These data were used in the cost analysis for the West Village project. In addition, we used other sources or industry experts to estimate costs. For emerging technologies that are just entering the marketplace, measure costing is at best an educated guess given uncertainty in how product marketing and sales volumes will develop in the next few years.

New Construction Incentives

A wide range of incentives are currently available from PG&E, the California PUC, and the federal government. The assumption was made that these incentives will be applicable during the West Village construction timeline, although some are slated to end before the project completion date, or may diminish as time goes on[8]. More detail on incentives can be found in Addendum.

Table 2: Climate Zone 12 Prescriptive Requirements

Parameter	Prescriptive	Assumed
Wall Cavity R-value	19 √	13
Ceiling Insulation R-value	38 √	30
Attic Radiant Barrier	Yes √	No
Glazing U-value[6]	0.57	0.40 √
Glazing SHGC[7]	0.40	0.35 √
Low Leakage Ducts	Yes	Yes
Duct R-value	6.0 √	4.2
Furnace Efficiency (AFUE)	0.78	0.80 √
Water Heater Energy Factor	0.58	0.62 √
201-300% of base	$0.41154	$0.31463V
>300% of base	$0.45869	$0.36178

– *Pacific Gas and Electric Company* Incentives for both qualifying single and multi-family projects.
http://pge.com/res/energy_tools_resources/efficient_new_homes/info_for_builders/

– *California New Solar Homes Partnership* (Tier 2 Incentives)
http://www.gosolarcalifornia.ca.gov/nshp/index.html

– Federal tax credits for homeowners (solar thermal and PV; $2000 each)
These credits apply for solar thermal and PV installations for individuals. A maximum tax credit of $2000 each can be received for qualifying installations.
http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=US37F&State=federal&currentpageid=1&ee=1&re=1

– Federal tax credits for single-family-home builders who surpass the 2004 International Energy Conservation Code (IECC) reference level by 50%. (According to the Heschong Mahone Group, tax credits for multi-family rental units were overlooked in the original legislation. An amendment to the original legislation that will include rental units is slated for a vote this summer. The prognosis is optimistic, but uncertain.)
http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=US41F&State=federal&currentpageid=1&ee=1z&re=1

5 *The ventilation target temperature defines the indoor temperature when the simulation program assumes windows are closed. The 75ºF target was used to recognize the reality that most people do not ventilate their homes at night by opening windows, largely due to security concerns.*

6 *The "U-Value" characterizes a glazing units performance in terms of heat conduction.*

7 *Solar Heat Gain Coefficient represents how well a window blocks solar heat gain. The SHGC ranges from 0 to 1, with lower values indicating better solar reduction capabilities.*

8 *The New Solar Homes Partnership program has diminishing incentive levels over time. Initial incentives of $2.50 - $2.60 per Watt, reduce by $.25/Watt after 15 MW of reservations have been received.*

Excluded Technologies

Some emerging technologies were excluded from this analysis to make the final packages more palatable to the developers. Technologies such as advanced evaporative cooling (comfort concerns, long-term reliability) and evaporative condensing units (long-term reliability) fall into this category.

RESULTS

Table 3 summarizes projected annual *base case* energy usage for the 1,882 ft^2 single-family-home prototype and a single 1,400 ft^2 apartment unit (as part of a 8,400 ft^2 three-story building). Projected annual PG&E utility costs total $1,645 and $1,262 for the single- and multi-family buildings modeled.

Single-Family Evaluation

Figure 2 provides a graphical breakdown of expected typical single-family household energy consumption for the 1,882 ft^2 West Village base case house.

The individual measure analysis was completed on candidate energy efficiency measures. The following measures were evaluated external to the MICROPAS7 program:

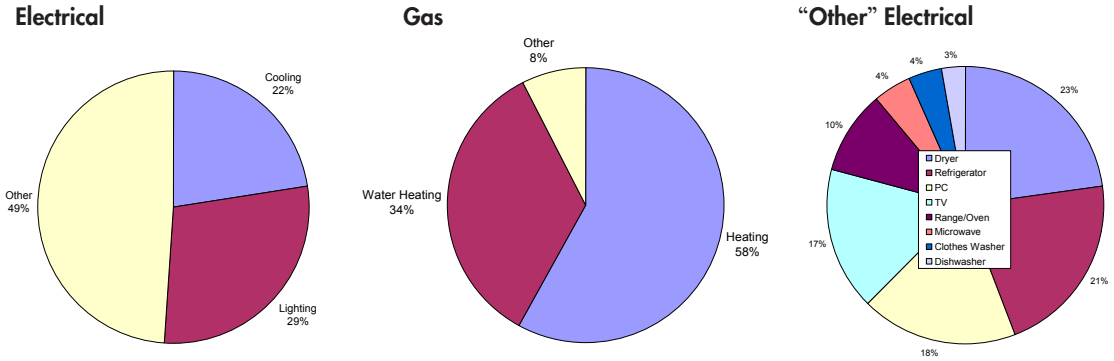
Table 3: Project Base Case Energy Usage

End Use	Single Family[1]	Multi-Family[2]
Heating therms	314	187
Water Heating therms	185	*168*
Other (cooking, etc.)	41	35
Total Gas Use (therms)	**540**	**390**
Cooling kWh	1,473	1,419
Lighting kWh	1,872	1,560
Other kWh	3,202	2,240
Total Electric Use (kWh)	**6,547**	**5,219**

Notes: **1**= *1,882 ft2 home,* **2**= *1,400 ft2, 4 bed/4 bath unit*

Lighting design and kitchen lighting: Title 24 handles lighting measures prescriptively. In discussions with the California Lighting Technology Center staff, several lighting improvement opportunities over the current 2005 Title 24 Standards were identified. One area relates to a lighting design process to that would optimize kitchen fluorescent lighting plans and specify appropriate fluorescent fixtures for other key installed lighting fixtures. Product availability, light quality, and pricing is changing rapidly and it is therefore difficult to pinpoint costs for a 2008-2009 project at this point; however, there is a significant savings potential for converting numerous hard-wired fixtures from incandescent to fluorescent.

Figure 2: Breakdown of Electrical Use, Gas Use, and "Other" Electrical



Slab edge insulation: The 2005 Title 24 slab edge heat-transfer modeling rules were updated. Unfortunately the changes to the model are not accurate. It will be corrected for 2008 Title 24. An external calculation using proposed 2008 modeling results was used to estimate slab edge insulation savings. Typical heating savings for a two-story home in Sacramento are approximately 6-7% of base case heating energy usage.

NightBreeze ventilation cooling: The NightBreeze system utilizes advanced controls, a damper system, and an outdoor air duct to allow a furnace air handler[9] to perform summer-night ventilation cooling, and also fresh-air ventilation during the winter. The system operates automatically, without the need of opening and closing windows, and sets nightly vent target temperatures based on weather severity and homeowner comfort preferences. Although PG&E offers new construction incentives for ventilation cooling based on projected energy savings and load shifting, Title 24 does not currently address the technology. Based on prior detailed modeling studies, DEG is estimating cooling energy savings of 50-60% for typical new-construction installations in the Sacramento area.

The remaining measures were evaluated primarily using the MICROPAS7 program. Three measures that aren't formally reported on are discussed here. The first, ***attached housing***, was evaluated to assess the energy implications of moving from single-family detached housing to a duplex common-wall design. The common-wall concept has energy benefits, but would also have a significant impact on aesthetics, marketability, and developer insurance costs. In addition, a common-wall design involves glazing relocation, addition of skylights, and likely increased lighting energy use that are difficult to properly evaluate within the existing project scope. Preliminary MICROPAS7 savings estimates for a common-wall approach suggests savings on the order of 5% cooling (80 kWh/year) and 16% heating (49 therms/year). The second, ***reduced building perimeter***, reflects the opportunity of modifying the current house plan schematic design from an overly linear design (larger than normal perimeter length per ft^2 of floor area) toward a more surface-area-optimal square design. A number of site issues are involved in this suggestion, but a preliminary analysis suggests modest energy savings (3-4% heating) can be realized by a 10' perimeter reduction and associated exterior-wall reduction. More importantly, perimeter reduction translates into reduced construction costs, estimated at $100 per foot. Future design development should strongly consider perimeter reduction for the more-linear house design, not only from an energy efficiency perspective, but also from a construction cost-reduction perspective. The cost savings could be directed towards additional efficiency measures. The final measure, ***optimized hot water distribution system layout***, represents a focused design and installation approach to the hot water distribution system. PEX piping systems with a manifold in close proximity to the water heater have a large market share in Northern California. The manifold runs dedicated small-diameter (3/8 or ½") PEX lines to individual fixtures, reducing the hot-water waiting time and energy loss in transporting hot water to the use points. The industry still needs guidance on the design and installation of these systems, and architects need to keep hot water fixtures clustered, where possible, to maximize distribution-system performance. Since this measure represents a "no-cost" training and education initiative, zero incremental cost was assigned to the measure. The measure was included in all packages, with estimated annual savings of 7 therms. Other training and education measures, such as homeowner/renter "operation and maintenance manuals," should be pursued as part of this project.

9 *Furnace must have a variable speed electronically commutated motor (ECM)*

Table 4 summarizes analysis results relative to the base case house for the evaluated measures. Tabulations include energy savings, estimated cost to the builder, available incentives, net cost to the owner (with 10% builder/developer markup[10]), projected annual cost savings, and the calculated BCR. A BCR greater than one indicates that the projected annual utility cost savings exceed the added mortgage cost. Measures in Table 4 are ranked in BCR order, from most cost-effective to least cost-effective. Some measures, such as Quality Insulation Installation, or QII, require Home Energy Raters (HERS) to perform third-party inspections of insulation and framing details, duct leakage measurements, and air-conditioner-supply airflow measurements. HERS inspections are a valuable tool in insuring expected performance is achieved in the field

Table 4: Performance, Cost, and BCR for Single Family Measures

	ANNUAL SAVINGS								
	Cooling (kWh)	Other (kWh)	DHW (thms)	Heating (thms)	Cost to Builder	Incentive	Net Cost to Owner	Annual Savings	BCR
Lighting design (10 fixtures)		374			$ 393	$ 100	$ 322	$ 57	2.46
EnergyStar dishwasher (builder installed)		33	3		$ 75	$ 30	$ 50	$ 9	2.42
Appliance pkg (Refr, washer, gas dryer)		731	-31		$ 450	$ 115	$ 335	$ 57	2.38
Kitchen lighting (LED undercabinet)		99			$ 130		$ 143	$ 15	1.46
High Eff HVAC (94% AFUE & 14/12 AC)	190		0	47	$ 1,300	$ 450	$ 935	$ 95	1.41
Quality Insl Installation (HERS)	75		0	23	$ 550	$ 150	$ 440	$ 44	1.40
Buried ducts, HVAC airflow, QII (HERS)	153		0	42	$ 955	$ 190	$ 841	$ 84	1.39
R6 ducts, HVAC airflow (HERS)	68		0	8	$ 185		$ 264	$ 23	1.20
0.8+ EF tankless water heater	0		51	0	$ 900	$ 200	$ 770	$ 59	1.07
"Tight" building envelope	38		0	55	$ 1,000		$ 1,100	$ 82	1.04
Attic radiant barrier	120		0	3	$ 300	$ -	$ 330	$ 25	1.03
R19 equivalent wall insulation	114		0	37	$ 944		$ 1,039	$ 71	0.94
NightBreeze, condensing furnace	737		0	47	$ 3,600	$ 750	$ 3,135	$ 208	0.92
R38 ceiling insulation	49		0	4	$ 220		$ 242	$ 14	0.79
Ducts in conditioned space	92		0	22	$ 500		$ 550	$ 29	0.74
Slab edge insulation	-9		0	20	$ 452		$ 497	$ 26	0.73
2.6 kW (DC) PV system		3469			$ 18,000	$ 7,400	$ 11,660	$ 461	0.55
Solar water heating (Suncache)			56		$ 3,500	$ 1,050	$ 2,800	$ 74	0.37

Two efficiency packages were developed based on the measure ranking in Table 4. Package 1 is geared towards incorporating measures with BCR's ~ = 1.0, resulting in an overall package BCR >1. Package 2 was developed to further push the envelope in terms of energy efficiency, as well as lower BCR renewable technologies.

Table 5 presents the measures included in Package 1. An additional 10% "coordination cost" was added to the individual measure incremental costs to reflect the added overhead associated with coordinating package implementation. The overall Package 1 BCR was calculated at 0.92 without the builder Federal tax credit ($2,000) and PG&E rebates ($1,065), and at 1.87 with the various financial incentives included. Incremental builder costs are estimated at $6,032 before the tax credit/incentives, with annual homeowner utility savings of $399 per year (or 24%). The post-construction appliance package (horizontal-axis clothes washer, gas dryer, and Energy Star refrigerator) was included in Package 1 due to its high cost-effectiveness.

Package 2 includes all measures shown in Table 5, plus those summarized in Table 6. Incorporating solar thermal and solar electric technologies allows for additional incentive options to be tapped. Federal renewable technology tax credits provide for personal tax credits of 30% of installed cost for both solar thermal (>30% solar fraction) and photovoltaic systems. The maximum credit for each is $2,000. The high cost of the PV system results in the maximum $2,000 credit, however the estimated $3,500 solar thermal cost results in only a $1,050 tax credit. An additional $2,000 developer incentive on top of the $5,400 PV incentive can be received from the California New Solar Homes Partnership for Tier 2 homes that surpass Title 24 by 35% and demonstrate a cooling budget reduction of 40% or more. The proposed Package 2 home qualifies for Tier 2 and would therefore generate developer incentives of $11,050 per unit and homeowner tax credits of $3,050.

10 *The one exception is the "appliance package", developed as an independent homeowner purchase of an Energy Star refrigerator, horizontal axis clothes washer, and gas dryer with moisture sensor control.*

Table 5: Single-Family Package 1 Summary

Measure	Description
ENV- Attic radiant barrier	Foil laminated to underside of roof sheathing to largely eliminate radiant heat transfer to attic
ENV- Quality Insulation Installation	Require insulation-contractor training and added installation time to properly install wall and ceiling insulation. HERS inspection required.
ENV- R-19 equivalent wall	Add R-4 or R-5 rigid insulation to wall exterior. Increases wall effective R-value.
DHW- 0.80+ tankless water heater	Tankless water heater eliminates storage water heater tank standby losses
DHW- Optimal distribution system	Contractor training to optimally locate water heater and install distribution system. If possible, architectural design should influence clustering of hot water use points.
HVAC- High efficiency equipment	94% AFUE condensing furnace and 14 SEER/ 12 EER air conditioner. Manual J and D used for system and duct sizing.
HVAC- R6 ducts, HVAC airflow	Upgrade duct R-value and HERS testing of system airflow to verify nominal system supply airflow is being delivered.
LTG- Lighting design	Presumes an overall project lighting design can develop recommendations for advanced lighting options to eliminate incandescent fixtures.
LTG- LED undercabinet lighting	LED undercabinet fixtures for the kitchen are emerging with expected 50% energy savings.
MISC- Energy Star dishwasher	Installation of Energy Star–rated appliance
MISC- Appliance Package	Post-construction purchase of horizontal axis clothes washer, gas dryer, and Energy Star refrigerator

The overall Package 2 BCR was calculated at 0.38 without the $14,100 combined incentives/rebates/tax credits, and at 0.62 with the incentives. Incremental builder costs are estimated at $36,700 before incentives, with annual homeowner utility savings of $1,017 per year (or 62%).

Multi-Family Evaluation

The multi-family evaluation proceeded in a similar manner to the single-family analysis. Again, two packages were developed: Package 1 included the more cost-effective measures, while Package 2 added some additional measures and solar electric, while factoring in the assumed $2,000 Federal tax credit[11].

Table 6: Single-Family Package 2 Summary

Measure	Description
ENV- R-38 ceiling insulation	Added insulation
ENV- Slab-edge insulation	An insulated concrete form system that provides R-10 insulation at the slab edge.
ENV- Tight envelope	Requires training and added labor for framing contractors (or use of specialty contractors) to properly caulk and seal, as well as draftstopping of interior columns, soffits, drop ceilings, arches, floor systems, etc. Ideally, eliminate inefficient wood-burning fireplace (common infiltration source) and replace with a buyer option for a direct-vent gas fireplace with a minimum efficiency of 60%.
DHW- Solar water heating	A new generation of lower-cost polymer-based solar water heaters are entering the market. Minimum solar fraction of 30% required.
HVAC- Ducts in conditioned space	Requires architectural design modifications to integrate ducting system within conditioned space. Generally results in a more compact duct layout with essentially zero thermal losses to unconditioned space. (Eliminates Package 1 duct measure.)
HVAC- NightBreeze condensing furnace with ECM motor	Requires upgrade of Package 1 condensing furnace to a unit with an ECM motor. Integration of NightBreeze system with existing HVAC system.
MISC- 2.6 kW (DC) PV System	Installation & commissioning of a 2.6 kW PV system with estimated generation of 3,469 kWh/year.

11 *The credit for multi-family rental units is anticipated, but not certain at this point in time.*

A key factor affecting package development was the assumption of individual water heaters as opposed to a central building or building cluster water-heating design. This assumption affects the package design and should certainly be revisited once preliminary mechanical and plumbing designs are developed. A central water-heating design optimization can only be done when a base design has been conceptualized.

A second complication relates to rebates for photovoltaic systems for "for rent" multi-family units. At this point in time, the rules for how incentives will be applied under the New Solar Homes Partnership have not been finalized. Any final decisions on PV should be revisited once the rules are adopted. Table 7 summarizes the individual measure analysis results.

Table 7: Performance, Cost, and BCR for Multi-Family Measures

	ANNUAL SAVINGS								
	Cooling (kWh)	Other (kWh)	DHW (thms)	Heating (thms)	Cost to Builder	Incentive	Net Cost to Owner	Annual Savings	BCR
Appliance Pkg (washer, gas dryer, refr)	0	585	-25		$ 450	$ 115	$ 380	$ 59	2.16
EnergyStar dishwasher	0	26	2		$ 75	$ 30	$ 50	$ 7	1.93
Lighting design (6 fixtures)	0	199			$ 276	$ 60	$ 237	$ 30	1.77
Kitchen Lighting (undercabinet)	0	50			$ 65		$ 72	$ 8	1.46
Attic Radiant Barrier	71		0	1	$ 150	$ -	$ 165	$ 13	1.13
Quality Insulation Installation (HERS)	63		0	15	$ 440	$ 60	$ 424	$ 30	0.99
R19 equivalent wall insulation	115		0	27	$ 710		$ 781	$ 55	0.99
0.80 EF Tankless water heater	0		51	0	$ 900	$ -	$ 990	$ 68	0.96
"Tight" Envelope (HERS)	-23		0	47	$ 800		$ 880	$ 59	0.93
R6 ducts, HVAC airflow (HERS)	64		0	5	$ 185		$ 264	$ 17	0.91
Bathroom Lighting System		144	0	0	$ 364	$ 40	$ 356	$ 22	0.85
R38 ceiling insulation	23		0	2	$ 97		$ 106	$ 6	0.81
High Eff HVAC (94% AFUE & 14/12 AC)	173		0	28	$ 1,105	$ -	$ 1,216	$ 66	0.76
Ducts in conditioned space	97		0	18	$ 400		$ 440	$ 24	0.76
Slab edge insulation	-9		0	17	$ 413		$ 454	$ 21	0.64
0.92 EF TWH, combined hydronic htg	0		65	24	$ 3,380	$ -	$ 3,718	$ 119	0.44
1.8 kW (DC) PV system		2402			$ 14,000	$ 4,600	$ 11,440	$ 319	0.39
Solar water heating (Suncache)			50		$ 3,500	$ -	$ 2,800	$ 74	0.24

Table 8 presents the measures included in multi-family Package 1 with "descriptions" added only for measures not previously presented in the single family analysis. The overall Package 1 BCR was calculated at 0.91 without including the presumed $2,000 builder Federal tax credit and $505 PG&E rebates, and at 1.81 with the incentives included. Incremental builder costs for the 4 bedroom/4 bath unit type evaluated are estimated at $5,060 before the incentives, with annual utility savings of $332 per year (or 26%). The post-construction appliance package (horizontal-axis clothes washer, gas dryer, and Energy Star refrigerator) was included in Package 1 due to its high cost-effectiveness.

Table 8: Multi-Family Package 1 Summary

Measure	Description
ENV-Attic radiant barrier	
ENV-Quality Insulation Installation	
ENV-R-19 equivalent wall	
ENV- Tight envelope	
DHW-0.80+ tankless water heater	
HVAC-R6 ducts, HVAC airflow	
LTG-Lighting design	
LTG-LED undercabinet lighting	
LTG-Bathroom Lighting System	Advanced linear bath fixture w/ occupancy sensor
MISC- EnergyStar dishwasher	
MISC- Appliance Package	

Table 9 summarizes Package 2 measures in addition to those shown in Table 5. Without solar thermal incentives available, the incorporation of dedicated solar water heating for each unit is not favorable enough to warrant consideration. (If central water heating becomes the preferred design approach, solar water heating should be revisited.) Package 2 presumes that PV rebates would apply under the New Solar Homes Partnership. The overall Package 2 BCR was calculated at 0.42 without the $7,100 combined incentives, and at 0.58 with the incentives. Incremental builder costs are estimated at $25,000 before incentives, with annual homeowner utility savings of $753 per year (or 60%).

Table 9: Multi-Family Package 2 Summary

Measure	Description
ENV- R-38 ceiling insulation	
ENV- Slab edge insulation	
HVAC- High efficiency equipment	
MISC- 1.8 kW (DC) PV System	Installation & commissioning of a 1.8 kW PV system with estimated generation of 2,402 kWh/year.

CONCLUSIONS

Packages of energy efficiency measures (EEMs) were developed for both single- and multi-family prototype housing units for the UC Davis West Village project. Where possible, measures were evaluated using the current MICROPAS7 simulation program, the most widely used compliance package in California. Package 1 was based on combining EEMs familiar to the construction industry in a package that generates favorable paybacks based on a 6% fixed rate, 30-year mortgage. Package 2 achieves much higher savings and costs by adding less cost-effective measures (solar thermal and PV) and measures that are just now entering the marketplace. The specific measures are listed in Table 5 and 6 (single family) and Table 8 and 9 (multi-family). Tables 10-13 summarize energy usage, savings, and costs for the two packages.

Table 10: Projected Annual Energy Consumption (Single-Family Home)

	Base Case	Package 1	Package 2
Gas Use			
Heating	314	212 (-32%)	169 (-46%)
Water Heating	185	123 (-34%)	83 (-55%)
Other	41	72 (+76%)	72 (+76%)
Total	**540**	**407 (-25%)**	**324 (-40%)**
Electric Use			
Cooling	1473	994 (-33%)	598 (-59%)
Lighting	1872	1399 (-25%)	1399 (-25%)
Other	3202	2339 (-27%)	2339 (-27%)
PV	0	0	-3469
Total	**6547**	**4732 (-28%)**	**867 (-87%)**

Table 11: Projected Annual Energy Consumption (Multi-Family Unit)

	Base Case	Package 1	Package 2
Gas Use			
Heating	187	98 (-48%)	69 (-63%)
Water Heating	168	117 (-30%)	117 (-30%)
Other	35	66 (+76%)	66 (+76%)
Total	**390**	**281 (-28%)**	**252 (-35%)**
Electric Use			
Cooling	1419	1172 (-17%)	1026 (-28%)
Lighting	1560	1167 (-25%)	1167 (-25%)
Other	2240	1629 (-27%)	1629 (-27%)
PV	0	0	-2402
Total	**5219**	**3968 (-24%)**	**1420 (-73%)**

Table 12: Projected Single-Family Package Economics

	Package 1	Package 2
Annual Utility Savings	$399 (-24%)	$1,017 (-62%)
Incremental Costs	$6,032	$36,737
Builder Incentives	$3,065	$11,015
Homeowner Incentives	**$0**	**$3,050**
Net Cost	$2,967	$22,672

Table 13: Projected Multi-Family Package Economics

	Package 1	Package 2
Annual Utility Savings	$332 (-26%)	$753 (-60%)
Incremental Costs	$5,057	$24,995
Builder Incentives	$2,505	$7,105
Homeowner Incentives	**$0**	**$0**
Net Cost	$2,552	$17,890

A final "super energy" package could be constructed by adding additional PV to fully offset the remaining Package-2 electrical consumption. Given the prior energy efficiency efforts included in Package 2, PV is likely to be one of the most cost-effective options to fully eliminate the remaining 867 kWh (single family) and 1402 kWh (multi-family) energy usage, provided that sufficient roof area is available. To achieve a zero electrical energy level, the single-family PV system would need to be increased to 3.3 kW and the multi-family to 2.9 kW, with estimated per-unit cost increases (after PV incentives) of $4,500 and $8,400, respectively. If true zero energy status was the goal, water heating, space heating, cooking, and clothes drying would need to be converted from gas to electric. Of the four, electric water heating would be the most challenging conversion since the best option, heat-pump water heaters, has a questionable track record in terms of reliability.

Aggregate project-wide savings for efficient single- and multi-family housing were developed based on the two packages, the estimated of the number of units, and the expected square footage relative to the prototypes modeled in this study. West Village preliminary planning suggests the following breakdown:

Single-Family townhomes: 216 @ average 1350 ft^2
Single-Family homes: 219 @ average 1500 ft^2
Single-Family market-rate homes: 40 @ average 3000 ft^2
Multi-Family 4 bed/4 bath[12]: 600 @ average 1500 ft^2
Multi-Family 2 bed/2 bath: 350 @ average 785 ft^2

Table 14 provides aggregate energy efficiency savings estimates based on the above total project ft^2, and the modeling results for the 1,882 and 1,400 ft2 prototypes. PV savings are estimated based on a total of 475 2.6 kW single-family installations and 950 1.8 kW multi-family installations. Project-wide energy efficiency savings are estimated to range from 143,800 to 200,700 therms/year, and from 1,764 to 2,041 MWh/year. Projected PV generation is estimated at 3,930 MWh/year.

Table 14: Projected Project-wide Savings Estimates

Measure	Value
Single-Family Energy Efficiency Savings	
Package 1 therms/year	52,300
Package 2 therms/year	84,900
Package 1 MWh/year	714
Package 2 MWh/year	869
Multi-Family Energy Efficiency Savings	
Package 1 therms/year	91,500
Package 2 therms/year	115,800
Package 1 MWh/year	1,050
Package 2 MWh/year	1,172
Estimated PV Generation	
Single Family MWh/year	1,650
Multi-Family MWh/year	2,280

12 *Davis Energy Group estimated the breakdown of 4bed/4bath & 2bed/2bath units to arrive at a total of 3100 beds.*

RECOMMENDATIONS

The following recommendations were developed during the course of the UC Davis West Village project evaluation:

1. Several of the single-family preliminary home designs feature a long and narrow footprint with above-average perimeter length per unit floor area. A design with a reduced aspect ratio would result in less exterior-wall area (energy savings), but more importantly, construction-cost savings. We estimate construction-cost savings of ~$100 per foot of perimeter reduction. Our strong recommendation is that perimeter reduction be actively pursued with the construction-cost savings applied to energy efficiency and/or renewable energy technologies.
2. Package 1 represents a cost-favorable collection of energy efficiency measures and represents, in our mind, the minimum level of efficiency to be incorporated into the project. Package 2 offers the potential for a cutting-edge, high-visibility effort by UC Davis and should be pursued if funding alternatives can be developed.
3. Locate outside sources of funding (e.g. the Energy Commission's PIER program) to support ongoing energy efficiency evaluations. In a few months, a beta version of the 2008 Title 24 compliance software will be available for testing. A review of this analysis should be completed with the updated software, reflecting the Title 24 stipulations that will be in effect when the West Village project goes to permit. Ongoing analysis of the evolving designs will increase the precision of the savings estimates and verify compliance with the performance goals that enable state, utility, and federal tax credits/incentives.
4. Update the PV economics as multi-family New Solar Homes Partnership rules become better defined. Track amendments and timeline extensions on state and federal tax credit programs.
5. Research infrastructure-cost issues with PG&E. If a significant commitment to both energy efficiency and PV is pursued with this project, there may be cost savings in PG&E electrical-infrastructure costs that could be passed on to the developer.
6. Reevaluate multi-family solar water-heating economics and the overall water-heating design after a preliminary design has been developed.

ADDENDUM: SUMMARY OF INCENTIVES FOR PRODUCTION HOMES

PG&E, State, and Federal

1. PG&E Service Territory

   a. Energy Star Program: Builders of homes that meet Energy Star (15% better than Title 24) are eligible for a $500 incentive per house in the inland areas of California. The homes must also meet the Quality Insulation Installation (QII) Thermal Bypass Checklist inspections.

   b. Prescriptive Program: Builders can earn incentives for the following efficiency measures as long as they are not used to meet Title 24:
   In addition, builders are eligible for prescriptive rebates on the following appliances:

• 90+ AFUE Furnace	$200
• 90+ AFUE Furnace w/ variable speed fan	$250
• Gas Tankless Water Heater	$200
• Quality Insulation Installation (QII) inspection	$150
• Tight Ducts (verified testing)	$175
• SEER 14 / 12 EER Air Conditioner	$250
• Night Ventilation Cooling w/ variable-speed fan (NightBreeze) fixed-speed fan (SmartVent)	 $500 $250
• Refrigerant charge verification	$40

   - o High-Efficiency Dishwashers $30-$50
   - o High-Efficiency Refrigerators $50
   - o High-Efficiency Clothes Washers $35-$75
   - o Natural Gas Clothes Dryers $50
   - o Hard-wired fluorescent lighting w/ controls $10/fixture
   - o Prescriptive incentives for gas appliances are available to PG&E gas customers located in municipal utility districts (i.e. SMUD). More information is available from:

http://www.pge.com/docs/pdfs/res/energy_tools_resources/efficient_new_homes/info_for_builders/06RNC-ESAppPkg.pdf

   c. California New Solar Homes Partnership: Builders who install PV on homes are eligible for incentives under this two-tiered program. The first tier provides a $500 incentive plus $2.50 per kW (AC). This program requires that homes use15% less energy than the Title 24 standard. An additional $2,000 rebate can be earned if the homes are 35% better than Title 24 overall, and 40% better for cooling only. The per kW rebate increases to $2.60 per Watt if 50% or more of the homes in a builder's community have PV. This program preempts other utility incentive programs such as PG&E's performance and prescriptive programs.
   Most PV providers/manufacturers can provide the details on this program, will complete the necessary paperwork, and will claim the rebate, selling the equipment at the market cost less the rebate amount.
   See the following link for more information:

   http://www.gosolarcalifornia.ca.gov/nshp/index.html

2. **Federal Incentives**

   a. Production builders are eligible for a $2,000 federal energy tax credit for each home sold that uses 50% less heating and cooling energy than the 2004 IECC standard home. A home that meets Title 24 is approximately 25%-30% better than the 2004 IECC. All homes must meet the QII/Thermal Bypass Checklist requirements, which require inspections and coordination to insure that insulation contractors are doing quality work and that the homes are properly sealed.
   Builders must build 85 or more homes per year to qualify as a production builder. This incentive is available by application, using IRS Form 8908, and is currently available through 2008.

   Costs for completing the Thermal Bypass Checklist vary, but may be around $600 depending on the specific rater used and house location. More information on the Thermal Bypass Checklist requirements is available from:

   http://energystar.gov/ia/partners/bldrs_lenders_raters/downloads/TBC_Guide_112106.pdf

   b. Homebuyers are eligible for a one-time 30% tax credit up to a maximum of $2000 for both photovoltaic systems and solar thermal systems. Both credits may be taken. For example, if the net cost of the system (after local rebates) exceeds $6,667, the buyer is eligible to claim the full $2,000 credit. If both solar thermal and electric systems are installed, the buyer may claim a $4,000 credit. The builder must supply the buyer with evidence of the cost. This incentive is available by application, using IRS Form 5695, and is also currently available through 2008.

3. ***State Incentives***

   a. PV Incentives
   Offered until this year, state rebates for PV systems on new homes are now channeled through the utilities.

   b. Property Tax Exemption

   Section 73 of the California Revenue and Taxation Code allows a property tax exemption for certain types of solar energy systems installed on or before December 31, 2009. Qualifying active solar energy systems include solar space-conditioning systems, solar water-heating systems, and photovoltaic (PV) systems. Solar pool-heating systems and solar hot-tub-heating systems are not eligible.

Scope of Work

The specific tasks to be conducted by the UC Davis Energy Efficiency Center (EEC) within the context of the UC Davis West Village Energy Efficiency Project are as follows:

TASK 1: ***Administrative***

The EEC began by forming a Project Advisory Committee (PAC) and a project team. The PAC consists of representatives from all key stakeholders relevant to the West Village development, including, but not limited to, the UC Davis Office of Resource Management & Planning (ORMP), select developers, Davis Energy Group staff (associated through the Building America program), and EEC leadership.

The project team consists of EEC leadership, EEC technical expertise, an EEC project manager, and two select MBA graduate students with relevant experience.

Task 1.1 The PAC was formed to guide the project team throughout the life of the project.

Task 1.2 The project team was selected. Two MBA graduate students were hired for the duration of the two-quarter project.

Task 1.3 The Program Manager for the EEC provided monthly progress reports to the project sponsor and PAC. The reports were used to track total project process and to guide discussions at the PAC meetings.

Task 1.4 The Program Manager submitted a draft report of the findings from Tasks 2, 3, and 4 for review by the Project Advisory Committee. The draft report included brief descriptions of the proposed solutions and a synopsis of the recommended next steps for moving the energy efficiency efforts forward.

Task 1.5 The Program Manager submitted to the project sponsors a final report of the findings from Tasks 2, 3, and 4 that responds to comments in reaction to the draft report.

TASK 2: ***Assessment of the Potential Energy-Efficiency-Infrastructure and -Technology Improvements to the West Village Development Plans***

The project team began by becoming intimately familiar with the West Village project. A current draft of the West Village Implementation Plan, with site plans and floor plans, is available from the Office of Resource Management and Planning (www.westvillage.ucdavis.edu). This document was used as a starting point for understanding the greater context of future work.

The project team collaborated with the Davis Energy Group (working through the Building America program) to identify state-of-the-art cost-effective energy efficiency technologies appropriate for the West Village project.

Task 2.1 Reviewed the current draft of the West Village Implementation Plan. Interacted with the development team to understand the plan in detail.

Task 2.2 Reviewed the report written in 2003 by Davis Energy Group that describes the available technological solutions regarding distributed energy and energy efficiency technologies.

Task 2.3 Considered updates and additions to the report's original recommendations, drawing on expertise from university staff at the California Lighting Technology Center and the Western Cooling Efficiency Center.

Task 2.4 Collaborated with Davis Energy Group, through the Building America program, to finalize a list of technical recommendations. These recommendations include consideration of demand response and wireless monitors & controls. Recommendations also include the bundling of non-energy-related products and services.

TASK 3: ***Review of Existing Programs and Incentives for Energy-Efficiency-Infrastructure Affordability***

There are existing programs available to builders and owners that make energy investments more affordable. These incentives and financing programs, however, are not well known. To overcome this market barrier, the project team sought to bundle available financial incentives for the West Village developers and consumers. Both State of California and federal subsidies and energy-efficient mortgages were explored and appropriately packaged with relevant technologies. Programs available through utility company programs were also assembled. With the available incentives packaged for them, developers and consumers can be assured that they haven't missed any currently available opportunities.

Task 3.1 Reviewed marketing and financing industry best practices for technology vendors selling to residential developers, and for residential developers currently selling distributed generation and energy efficiency technology to end-consumers.

Task 3.2 Reviewed available and emerging local, state, and federal financing and incentive programs for reducing the initial cost of energy efficiency infrastructure.

Task 3.3 Bundled the most relevant findings into a package of information useful for West Village developers and end-consumers.

TASK 4: ***Create Innovative Complementary Marketing and Financing Solutions for Energy-Efficiency-Infrastructure Affordability***

While research shows that up-front energy investments will pay for themselves in reduced energy bills over a reasonable period of time, the available subsidies and incentive programs will likely not be adequate to finance all of the up-front improvements. Additional financing mechanisms will probably be needed to reduce up-front costs in order to create a viable energy package for the consumer. The project team attempted to resolve this challenge by answering questions such as:

- Can these up-front energy investments be valued in a new way in the university's value assessment of the home and property?
- Can energy investments add value to the home and property in a measurable way up-front?
- Can a novel financing mechanism be established to carry homeowners and/or developers through the payback period until energy investments begin to pay off?
- Can we engage the photovoltaic (PV) industry to develop volume discount programs, or work with them to further their goals of advancing the industry through new applications and heightened visibility?
- Can we engage the energy industry as owners of a site-based rooftop PV system on a neighborhood scale?

The project team modeled three potential solutions that address multiple levels: the developer level, which has community-wide impact upstream in the project development process and the individual consumer level, which has unit-based impact downstream in the project development (buying) process. Solutions were mapped specifically to the technical recommendations made in Task 2.

Task 4.1 Reviewed novel and state-of-the-art financing mechanisms for benchmarking and inspiring creation of an innovative improvement.

Task 4.2 Researched and mapped key relevant private-sector partners, including financial institutions, and energy efficiency technology manufacturers and distributors.

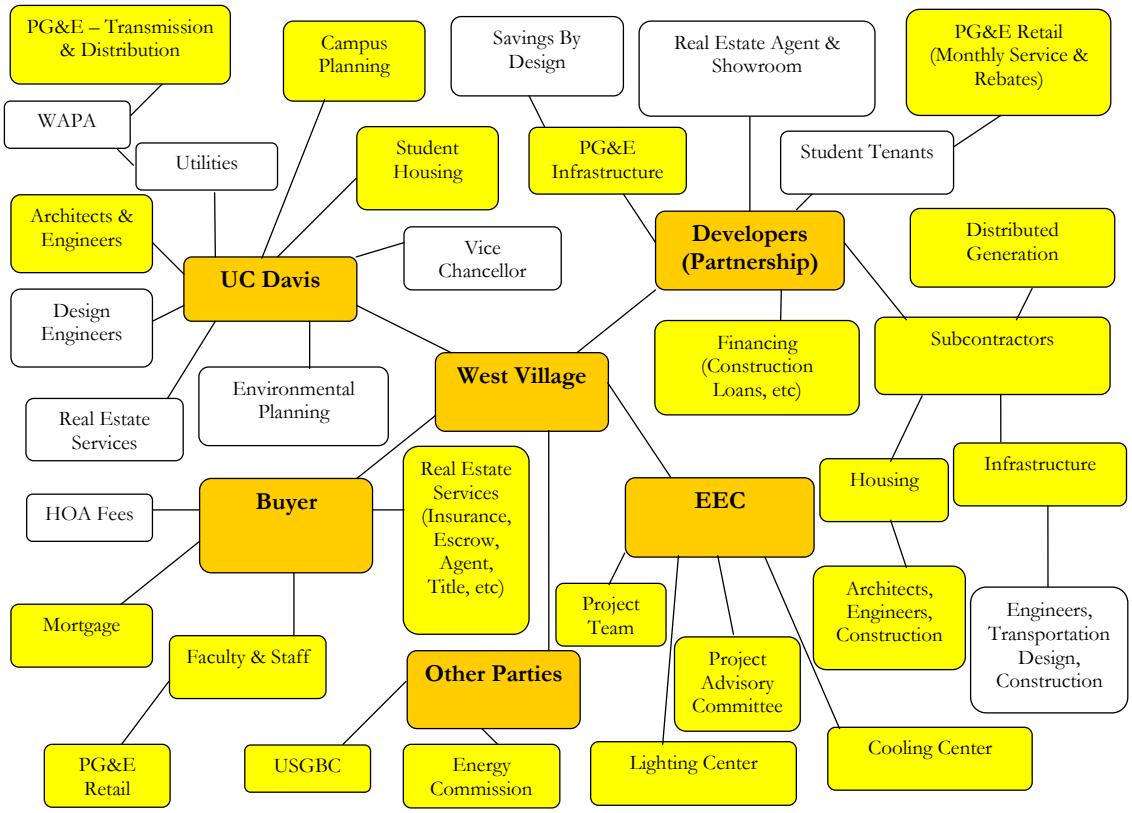
Task 4.3 Conducted outreach to relevant private-sector partners, with particular emphasis on those companies that will benefit the most from the successful development of a new financing model.

Task 4.4 Generated three unique scenarios, or business models, that create an opportunity to further reduce the cost and/or finance the infrastructure of energy efficiency, demand response, and distributed generation - reducing net energy costs to residents (see Appendix L).

Task 4.5 For each of the scenarios, or business models, created a business case (with supporting PowerPoint presentation) that includes:

– The central value proposition(s) customized to central stakeholders,
– Analysis of the energy and non-energy-related benefits to the end-consumer, and
– Cost/Benefit analyses summarized for each set of decision-makers.

Stakeholder Flow Chart



PERFORMANCE- VS. PRESCRIPTIVE-BASED SAVINGS

There are two primary methods of classifying energy savings incentive programs — performance-based and prescriptive-based. In a performance-based method, energy savings are reimbursed based on audited performance. This auditing is conducted on a regular basis by professionals and/or advanced meters which measure the energy savings and performance of the installed systems and/or programs. This ultimately ensures that the energy savings and distributed energy generation (and any correlated GHG emission reductions) are real, ongoing, and significant per expectations. A prescriptive-based method uses a predetermined incentive payment based on projected energy savings and distributed generation amounts derived from estimated averages. There is typically no auditing mechanism, making it a less accurate and less dynamic relative to changing environmental conditions; the savings are assumed based on what has previously been observed from the use of those technologies.

While the performance-based method generally ensures that energy savings occur and also encourages that on-going preventative maintenance occurs, there is typically a higher transaction cost for monitoring, auditing, and on-going technology support, and the need to continuously refresh and replace the technology investments in order to maintain the optimal level of performance. In theory, a performance-based method will allow the user to claim energy savings, distributed generation, and GHG emission reductions from technology performance in a more robust manner.

Prescriptive-based is usually a less expensive method, but it does not provide as accurate a measure of the actual savings to the user because it uses an expected average savings estimated from savings observations in other situations. For example, the energy savings provided by the Davis Energy Group in their revised report (see Appendix A) is a list of prescriptive measures – cost savings and payback analysis are estimates for what a typical home would save using the recommended group of technologies. For the prescriptive method, if you choose to maintain a certain energy savings level over time, it is necessary to refresh those prescriptive-based investments, even though you are not continuously auditing the technologies, because the measures will likely lose effectiveness over time.

Real-time energy consumption feedback mechanisms and Building operation education programs are often heralded as providing a source of valuable energy savings and long-term preventative maintenance. It is difficult, however, to quantify their energy impact on a prescriptive basis, so performance-based methods may be preferable means of encouraging the inclusion of education and outreach activities.

HOME AFFORDABILITY

There is concern as to whether these homes will truly be below market or just relatively affordable. The price of the homes was arbitrarily selected to be set at 75% of the fair market value of the average home in Davis, which is a fee simple ownership, and the University opted to maintain ownership of the land and

lease the right to occupy to residents. Thus, the total cost to residents for occupying a long-term ground lease may actually be more than the market is willing to bear. The university will effectively make these homes more affordable than other homes in Davis, but there may still not be demand to have less-than-fee interest at this price level. This is especially important to consider as we project future home price increases as a way to determine future affordability and market value.

INFRASTRUCTURE COSTS

Because peak energy loads throughout the West Village development would be reduced through the energy efficiency measures installed in the project, it was thought that there could be a beneficial impact on the infrastructure costs to the West Village Community Partnership developers and the utility company that provides services to the project. Since there could be stepwise reductions of the load targeted, it was initially believed that there could be less infrastructure needed to carry the energy loads throughout the property, translating to infrastructure savings. PG&E, the utility serving the West Village project, has advised us that the need for supplementary transformers, due to the likely inclusion of solar PV, would actually increase infrastructure costs. While there would probably be additional costs in the form of supplementary transformers, these charges would not affect the developer's pro-forma. PG&E has stated that they will cover any additional infrastructure costs associated with the inclusion of solar PV into the West Village development.

PREVENTATIVE MAINTENANCE

Preventative maintenance is an important part of homeownership and integral to ensuring maximum energy efficiency throughout the life of the technologies installed into homes. According to the Beutler Corporation one of the largest HVAC companies in Northern California, "the build-up of just one-twentieth of an inch of dirt on a heating or cooling coil can result in a 21% decrease in efficiency … [which] translates into energy bills up to 20% higher."[13] According to the Davis Energy Group's revised report for the West Village development, the average energy bill for Davis single-family homes is about $100 a month. At this rate, residents could be paying $20 a month (or $240 a year) more than they should simply by failing to complete regular preventative maintenance.

There are many organizations that might be capable of providing preventative maintenance. We have contacted two such companies to verify price ranges. Beutler Corporation and Blake's Heating and Air Conditioning, a local company that serves Yolo and Solano counties. Both have similar pricing: Beutler charges $899 for a five-year service plan and Blake's charges $88 semi-annually (which translates to $880 over five years).

Beutler's *Comfort Club* provides a progressive pricing and performance model. It is an affordable preventative maintenance and warranty program that facilitates the greatest amount of energy savings for the homeowner. Because of the magnitude of potential savings achievable purely from preventative maintenance, we strongly suggest that a similar program, in which each homeowner is required to be a member of a West Village preventative maintenance club, be incorporated into the West Village development.

13 *Beutler Corporation, http://www.beutler.com/?id=19.*

WEST VILLAGE SINGLE FAMILY RESIDENCES: "ENERGY SECOND" PARAMETERS

Concept: Bridge cost gap between affordability goal on sale price and energy efficiency goal on additional technical measures. [For the financial parameters of West Village, see the attached document.]

- Investors would provide first cost financing for identified measures, as specified from the updated Davis Energy Group technical report:
  - The technical measures would be installed in every home.
  - The first buyers would not pay more for the home, though they would have use of the energy efficiency measures.
  - The silent second would be allowed a rate of return necessary to induce private investment that would likely be higher than the faculty salary index.
  - The investors would be repaid upon resale of the home.
  - The second buyer would essentially pay back the investor: is this fair? This is a policy issue.
  - Investors would take a risk on housing turnover rates. Alternatively, there could be a guarantee on return at a fixed point in time.
  - To explore: First home purchasers could have an option to buy the silent second, essentially investing in the larger rate of return than their equity rate, if they can afford it, but they wouldn't have to invest.
  - To explore: How would efficiency measures be maintained and updated? Perhaps a portion of the payback is plowed back into maintenance and renewal funds.
  - To explore: Ways to share some of the burden with the first owner? Energy efficiency fee? What would the energy second look like: Would this be fully amortizing or a balloon payment?
  - To explore: Third-party ownership model, no silent second, where a for-profit company owns the energy efficiency measures as depreciable assets; owners pay a maintenance and renewal fee; company provides regular maintenance, and renewal of assets. (Compare this "maintenance model" to something like Web laundry services.)

Example of an "energy second:"

YEAR	Equity growth 3% Initial House Price	Rate of return 7% Energy 2nd	Total
0	$425,000.00	$20,000.00	$445,000.00
1	$437,750.00	$21,400.00	$459,150.00
2	$450,882.50	$22,898.00	$473,780.50
3	$464,408.98	$24,500.86	$488,909.84
4	$478,341.24	$26,215.92	$504,557.16
5	$492,691.48	$28,051.03	$520,742.52
6	$507,472.23	$30,014.61	$537,486.83
7	$522,696.39	$32,115.63	$554,812.02
8	$538,377.28	$34,363.72	$572,741.01
9	$554,528.60	$36,769.18	$591,297.79
10	$571,164.46	$39,343.03	$610,507.49

WEST VILLAGE – KEY PARAMETERS

- Overall deal parameters for the West Village Master Lease and Sub-phase Leases:
  - The West Village transaction is structured as a master ground lease with sub-phase leases for the faculty staff housing and the student housing/commercial uses.
  - The developer is responsible for putting in the entire on-site infrastructure under the master ground lease. Once the infrastructure for a sub-phase of faculty/staff or student housing is completed, a portion of the overall land will be dropped into a sub-phase lease for the vertical construction of that portion of the project.
  - The overall economics of the deal are based upon fixed prices for the faculty/staff homes assuming a risk-adjusted rate of return for the developer.

- Who can buy or rent in West Village?
  - Eligible faculty and staff can buy capped housing or market rate housing; students can rent student housing
  - Lottery description: See attached draft housing policy.

- Home types, quantities:

			Quantity	
Type	**Pricing at first sale:**	**Square Footage**	**Phase I**	**Phase II**
"Townhome" style single family units (detached)	Range from $379,000 to $419,000, with an average price not to exceed $399,000, and at least 25% of the townhomes sold at $379,000 in May 2006 dollars.	1,350 plus or minus 20%	133	83 [(1)]
Single family units	Range from $411,000 to $454,000, with an average price not to exceed $432,000, and at least 25% of the homes sold at $411,000 in May 2006 dollars.	1,500 plus or minus 20%	139	80 [(1)]
Market Rate	market	Approximately 3,000 but not to exceed 50% home size to lot-size ratio	40	0
Student Housing: 4BD/4BA ap'ts 2BD/2BA ap'ts	Prevailing market rental rates	Approximately 1,500 Approximately 785	1,980 beds total	1,020 beds total

(1) Phase 2 quantities are estimates and not approved at this time.

- The two "Flex" blocks (p. 18, *West Village Implementation Plan*) offer potential for "townhome" style student rental housing or for-purchase housing, not to exceed 343 units (312 units +10%) of faculty/staff housing or 1980 beds (1,800 beds +10%) of student housing in Phase I.

- Equity growth cap is tied to the faculty salary index or CPI, which is assumed to be about 3.0% per year Student rental rate will be market rate with a percentage of gross rental proceeds paid to the university for financial aid.

- Details on the UC Office of the President Mortgage Origination Program can be found at: www.ucop.edu/facil/olp, and in the attached brochure.

TECHNICAL SOLUTIONS

Package #	Single-Family Home	Multi-Family Home	Community (in progress)
1	**Energy Measures** · Improved insulation · Energy Star Appliance package · Tankless water heater and optimized water · Efficient HVAC ducts, equipment and airflow · Efficient Lighting design **Installation Costs** · Incremental Costs = $5,529 · Builder Incentives = $2,000 · Net Cost = $3,529 **Homeowner Benefits** · Annual Utility Savings = $399 (-24%) BCR = 1.57	**Energy Measures** · Improved insulation and envelope · Energy Star Appliance package · Tankless water heater and optimized water · Efficient HVAC ducts, equipment and airflow · Efficient Lighting design · Bathroom Lighting System **Installation Costs** · Incremental Costs = $4636 · Builder Incentives = $2,000 · Net Cost = $2,636 **Occupant Benefits** · Annual Utility Savings = $332 (-26%) BCR = 1.75	**Energy Measures** · Bi-Level HID Pole Lights for Commercial Park Lot · Bi-Level HID Wall Pack for Commercial Park Lot · LED Bollard for Commercial, Park, and Pathway Applications **Installation Costs** · $400 per unit **Community Benefits** · Annual Utility Savings = $103 per unit (+maintenance benefits of about $35/
2	**Energy Measures** · Includes above measures · Improved ceiling, slab, envelop insulation · Ducts in conditioned space · NightBreeze **Distributed Generation** · Solar water heating · 2.6 kW (DC) PV System **Installation Costs** · Incremental Costs = $33,675 · Builder Incentives = $4,000 · State PV Rebate = $5,050 · Net Cost = $21,575 **Homeowner Benefits** · Annual Utility Savings = $1,017 (-62%) · Homeowner Incentives = $3,050 BCR = 0.53	**Energy Measures** · Includes above measures · Improved ceiling and slab insulation **Distributed Generation** · 1.8 kW (DC) PV System **Installation Costs** · Incremental Costs = $21,812 · Builder Incentives = $2,000 · State PV Rebate = $5,050 · Net Cost = $14,762 **Occupant Benefits** · Annual Utility Savings = $753 (-60%) BCR = 0.53	**Distributed Generation** · Small amount of centralized PV System
2+	**Energy Measures** · Includes above measures **Distributed Generation** · 3.3 kW (DC) PV System **Installation Costs** · Per unit cost increases = $4,500 **Homeowner Benefits** · Annual Electric Utility Savings = 100% · NOTE: For true Zero Energy status, water heating, space heating, cooking, and clothes drying converted from gas to electric	**Energy Measures** · Includes above measures **Distributed Generation** · 2.9 kW (DC) PV System **Installation Costs** · Per unit cost increases = $8,400 **Occupant Benefits** · Annual Electric Utility Savings = 100% · NOTE: For true Zero Energy status, water heating, space heating, cooking, and clothes drying converted from gas to electric	**Distributed Generation** · Full centralized PV System
Research & Education Value	· Complete redesign of envelop, layout and density with zero energy goal in mind · Homeowner/renter "operation and maintenance manuals"	· Complete redesign of envelop, layout and density with zero energy goal in mind · Occupant "operation and maintenance manuals"	· Community education in form of museum style plaques

FINANCIAL SOLUTIONS

Type	Example
Rebates & Incentives	**Individual Measures** • Appliances/lighting ≤ $500 • CA New Solar Homes: Tier 1 - $500 + $2.50/kW, increasing • Homebuyer - $2000 each for PV & Solar Thermal • Developer - $2,000 per home tax credit for 50% less heating & cooling than IECC 2004 standard **Packages of Measures** • Energy Star (builder) - $500/home • PG & E Incentives ≤ $1250/home • Potential property tax exemption
Mortgage Solutions	**Existing** • MOP – below-market financing for faculty only • EEM – Lower Debt-to-Income ratio • LEM – Similar to EEM for people who live near public transportation, amenities, schools, etc. **Potential** • Reworking the MOP qualifications – This idea would allow more people to use MOP financing if they opt for energy efficiency instead of other upgrades (increases pool of buyers, does not finance EE directly)
External Capital	• 'Silent Second' debt financing • Micro-grid investment in distributed generation and metering • 3rd party ownership of depreciable Energy Efficiency Measures that are financed through required maintenance and renewal fees
Angel Investment	• Research Grant proposals to state and federal agencies, including: • CA Energy Commission • Public Utilities Commission, and • Department of Energy • 'Friend of the University' • Special EE construction financing for developer, if available

Mortgage Options

Program	Description
University of California MOP Available only to faculty (+ additional restrictions) Average rate of 4.66% over the past 4 quarters	The Mortgage Origination Program (MOP) was created by the University of California to support the recruitment and retention of faculty and Senior Managers by assisting them with the purchase of a principal residence near their campus. MOP Loans have a one-year adjustable rate based on an internal university index [STIP + 0.25]. The standard repayment term is 30 years; however, borrowers may request a shorter term, or a longer term of up to 40 years. MOP is administered by the university's Office of Loan Programs, located in Oakland, California.
Energy Efficient Mortgage Available as a 15- or 30- year fixed-rate mortgage or as an Adjustable Rate Mortgage	Energy Efficient Mortgages (EnEMs) make it easier for borrowers to qualify for loans to purchase homes with specific energy efficiency improvements. Lenders can offer conventional, FHA, or VA EnEMs. Conventional EnEMs can be offered by lenders who sell their loans to Fannie Mae and Freddie Mac. Conventional EnEMs increase the purchasing power of buying an energy-efficient home by allowing the lender to increase the borrower's income by a dollar amount equal to the estimated energy savings. The Fannie Mae loan also adjusts the value of the home to reflect the value of the energy-efficiency measures.
Location Efficient Mortgage Available as 15- to 30-year fixed-rate mortgage set in competition with prevailing rates on date of home purchase	The Location Efficient Mortgage® (LEM) is a mortgage that helps people become homeowners in location-efficient communities. These are convenient neighborhoods in which residents can walk from their homes to stores, schools, recreation, and public transportation. People who live in location-efficient communities have less need to drive, which allows them to save money and improves the environment for everyone.

Rebates & Incentives

Program	Description
PG&E Energy Star	Builders of homes that meet Energy Star (15% better than Title 24) are eligible for a $500 incentive per house in the inland areas of California. The homes must also meet the Quality Insulation Installation (QII) Thermal Bypass Checklist inspections.
PG&E prescriptive measures (not used to meet Title 24)	Builders can earn incentives for the following efficiency measures as long as they are not used to meet Title 24: a. 90+ AFUE Furnace: $200 b. 90+ AFUE Furnace w/ variable speed fan: $250 c. Gas Tankless Water Heater: $200 d. Quality Insulation Installation (QII) inspected: $150 e. Tight Ducts (verified testing): $175 f. SEER 14 / 12 EER Air Conditioner: $250 g. Night Ventilation Cooling 1. w/ variable-speed fan (NightBreeze): $500 2. fixed-speed fan (SmartVent): $250 h. Refrigerant charge verification: $40
PG&E appliance rebates	Builders are eligible for prescriptive rebates on the following appliances: a. High-Efficiency Dishwashers: $30-$50 b. High-Efficiency Refrigerators: $50 c. High-Efficiency Clothes Washers: $35-$75 d. Natural Gas Clothes Dryer: $50 e. Hard-wired fluorescent lighting w/controls (per fixture): $10
California New Solar Homes Partnership	Builders who install PV on homes are eligible for incentives under this two-tiered program. The first tier provides a $500 incentive plus $2.50 per kW (AC). This program requires that homes use 15% less energy than the Title 24 standard. An additional $2,000 rebate can be earned if the homes are 35% better than Title 24 overall, and 40% better for cooling only. The per kW rebate increases to $2.60 per Watt if 50% or more of the homes in a builder's community have PV. This program preempts other utility incentive programs, such as PG&E's performance and prescriptive programs. Most PV providers/manufacturers can provide more details on this program.
Federal to Builder tax credit	Production builders are eligible for a $2,000 federal energy tax credit for each home sold that uses 50% less heating and cooling energy than the 2004 International Energy Conservation Code (IECC) standard home. A home that meets Title 24 is approximately 25%-30% better than the 2004 IECC. All homes must meet the QII/Thermal Bypass Checklist requirements, which require inspections and coordination to insure that insulation contractors are doing quality work and that the homes are properly sealed. Builders must build 85 or more homes per year to qualify as a production builder. This incentive is available by application, using IRS Form 8908, through 2008. Costs for completing the Thermal Bypass Checklist vary, but may be around $600 depending on the specific rater used and house location.
Federal to Homebuyer tax credit	Homebuyers are eligible for a one-time 30% tax credit, up to a maximum of $2000, for both photovoltaic systems and solar thermal systems. Both credits may be taken. For example, if the net cost of the system (after local rebates) exceeds $6,667, the buyer is eligible to claim the full $2,000 credit. If both solar thermal and electric systems are installed, the buyer may claim a $4,000 credit. The builder must supply the buyer with evidence of the cost. This incentive is also available by application, using IRS Form 5695, through 2008.
Property Tax exemption	Section 73 of the California Revenue and Taxation Code allows a property tax exemption for certain types of solar energy systems installed on or before December 31, 2009. Qualifying active solar energy systems include solar space-conditioning systems, solar water-heating systems and photovoltaic (PV) systems. Solar pool-heating systems and solar hot-tub-heating systems are not eligible.

OPERATIONAL SOLUTIONS

Type	Example
Prescriptive 'Lease'	· Construction requirement built into the lease (2% increase associated with fire sprinklers)
Management Organization	University provides minimum services · Lease management · Water, sewage, drainage · Municipal services (police, fire, ground maintenance, street maintenance) · Curbside refuse collection Incorporate energy measures into · University Management Organization (Aggie Village) · HOA (UC Irvine)
External Organization	Micro-Utility model · Energy efficiency and distributed generation delivered to single user (UK district heating and cooling communities) · Centralized distributed generation (commercial with large rooftop PV installations) Third-Party contract model · Contracted maintenance organization (Blake's HVAC...)
Research or Educational Institution	· Utility, Extension, and/or Community College Training & Education Program · CEC or PUC funded Outreach

EXAMPLES OF SOLAR AND ENERGY EFFICIENT COMMUNITIES

- Lennar – West Roseville
  - o Ironcrest at Fiddyment Farm
  - o Laureate at WestPark
  - o Wayfarer at WestPark
- Lyons Valley Village – Lyons, Colorado
  - o 18-home sustainable community
- Premier Homes – Roseville
  - o Premier Oaks
- Treasure Homes – Sacramento
  - o Fallen Leaf at Riverbend

  Contacted Jim Bayless, but he was unresponsive
- Christopherson Homes – West Roseville

  First homebuilders to satisfy Roseville's BEST Homes standard
- Pulte Homes Corporation – Brentwood
  - o Summerset IV at Brentwood
- Meritage Homes

  Have rep on PAC
- John Laing Homes – Brighton, Colorado
  - o Albuquerque, New Mexico
    - ▪ Arbolera de Vida Sawmill Redevelopment
    - ▪ La Cuentista
  - o Contra Costa
    - ▪ Cowell Ranch
  - o Tucson, Arizona
    - ▪ Civano Solar Village
  - o Santa Fe, NM
  - o Emeryville
    - ▪ Del Monte Urban Village
  - o Sacramento
    - ▪ Somerset Parkside
  - o Novato
    - ▪ Marin Solar Village
  - o Danville
    - ▪ Hansen Lane Village
  - o Berea, Kentucky
    - ▪ Berea College Ecovillage
  - o Mill Valley
    - ▪ Citizens' Housing Fireside Project
  - o Outlook

    Have rep on PAC
- Van der Ryn Architects

  Emailed Owner/Founder but have not heard anything back yet

  *Van der Ryn Architects in general looks like it's had a lot of experience in affordable energy efficient communities
- Morrisson Homes – Elk Grove
  - o Morrison Homes at Lakeside
- Premier Homes
  - o Premier Gardens – Sacramento
  - o Premier ProEnergy Community – Roseville
- Clarum Homes – Watsonville
  - o Vista Montaña
- Pardee Homes – San Diego
  - o Soleil at Bordeaux
- The Grupe Company (GrupeGreen homes)
  - o Carsten Crossings – Rocklin

PAC Meeting #1

PAC MEETING #1—AGENDA

West Village Energy Efficiency Project
Project Advisory Committee
Meeting #1
March 9, 2007
Sudwerks
3:15-5:15 pm

1. Introductions
2. West Village Video
3. West Village Overview
4. West Village Energy Efficiency Project
5. Energy Efficiency Center
6. Purpose of Advisory Committee
7. Brainstorming Discussion

PAC MEETING—#1 NOTES

West Village Energy Efficiency Project
Project Advisory Committee Meeting
March 9, 2007, Sudwerk's – Davis, CA, 3:15-5:15

In Attendance: Amy Barr, Andrew Hargadon, Ben Finkelor, Bill Starr, Bob Segar, Bruce Dickinson, Cheri Davis, Curt Houston, Dave Springer, Geetika Misra, Jon Short, Karl Mohr, Ken Topper, Lance Lowe, Margaret Teichert, Martin Lewis, Mary Hayakawa, Matt Brost, Matt Paoni, Shawn Smith, Sid England, Tani Elliott, Tony Macias

1. Introductions
2. West Village Overview – by Karl Mohr
3. West Village Video
4. West Village Energy Efficiency Project – by Karl Mohr
5. Energy Efficiency Center Overview – by Andy Hargadon
6. Purpose of Advisory Committee – by Andy Hargadon
7. Brainstorming Discussion
    a. Levels at which we can act – home, neighborhood, university
    b. Kinds of solutions – technological, financial, organizational
    c. Task for WVEEP:
        i. Update DEG report
        ii. Gather incentive programs
        iii. Combination of technological, financial, and organizational solutions
        iv. Want to be able to use as a model for future developers/start-up companies that can be formed
    d. IRR or break-even point?
        i. Amortized improvement cost offset by energy savings = goal — costs equal or less than energy savings
    e. Energy efficient mortgage
        i. Cheri Davis: challenges they've faces
            1. Zero energy new homes
                a. 3 contracts: goal = develop sustainable business models and demonstration neighborhoods
                b. Challenges : Builders are pulling out (2 of 4)
    f. Pacific Coast Building Products – Jon has connection
        i. Any solution needs to have safe partner and/or mature technologies because of liabilities
    g. Bruce: how to define energy efficiency? How far along is the design?
        i. Plans/infrastructure established — now at building part
    h. Has there already been a commitment to incorporate all the options that have no incremental costs (from the Energy Efficiency Studies Summary Report put together by the Davis Energy Group)?
        i. Energy Star appliances – build into purchase price?
            1. Currently don't have refrigerator and washer/dryer included
                a. Retail partners?
                b. GE package plan – Shawn Smith can get info
        ii. High density boilers (for apartments, etc) that is shared amongst multiple units

iii. Micro-utility: a lot going on with sub-metering right now

i. Need to decide which of the two variables to make constant (affordability or energy efficiency) → from there, can make the other variable the one you work with and are more creative with
   i. Bob: set energy goal and make it a challenge of technology and financing

j. If can have energy efficient mortgage, can purchase price increase?
   i. University's ability to get tax exempt financing = possible financial solution
      1. Lower cost of capital
   ii. Re-think formula for appreciation of home prices

k. Control group/long-term research project
   i. Portion of homes have lower costs if agree to allow home to be viewed/researched
   ii. Energy efficiency grant through PG&E to increase rebate
   iii. Market as research/educational project
   iv. Have grant go to organization/company to fund energy efficiency measures — won't affect home costs

l. Ways to find list of solutions?
   i. Federal tax credits
   ii. PG&E
   iii. New Solar Homes Partnership

m. Utilities looking for Tier II (35% more efficient that Title 24)
   i. Provide more incentives ($2,000)
   ii. Title 24 getting tighter

n. Goals should be either:
   i. Prescriptive (cleaner & simpler)
   ii. Performance (could have better results)

o. Costs for retail and commercial EE upgrades are easier to pass onto tenant

p. Student housing does not have lease cap rates

q. Advanced metering
   i. PG&E Smart Metering
   ii. Demand-response (from Shawn)
   iii. Energy displays
      1. Change human behavior/attitudes (where put light switches — more convenient, etc)
      2. Want to be sure people don't see that spending less on energy so end up using more energy
   iv. Energy management controls — turn off certain electrical nodes, etc

r. Video from Shawn to show homeowners how can save

s. Educational research
   i. Half of homes with certain solutions and compare energy use amongst rest, etc

t. PG&E energy base — change so now in line with percentage of energy that should be saved based on efficiency technology/measures

u. Community utility that did net metering
   i. Bruce looking at communities in London
      1. DC generated – can distribute DC power or heat or energy
         a. Power only goes to DC currents, so energy savings only apply to those portions of energy use

b. Pull power into newer homes

2. More efficient to generate centrally
3. Tri-generation (cooling, heating, electricity)
4. Have community college be solar generating power plant?
    a. Transfer power to homeowners
    b. Overage can go towards offsetting initial costs

ii. Micro version carbon credits?

PAC Meeting #2

PAC MEETING #2 — AGENDA

West Village Energy Efficiency Project
Project Advisory Committee Meeting
May 11, 2007
174 AOB IV
3:00-5:00 pm

Problem Statement: The overall objective for the West Village Energy Efficiency Project is to develop solutions for the project stakeholders (notably the future residents, the university, and the developers) to achieve for the project high levels of energy efficiency and distributed generation of renewable energy that will maintain the affordable nature of the units and not increase the additional first cost of the overall development.

We've structured the project to research the world of possible technical, financial, and operational energy solutions that might be applicable for the West Village development; from there, we will be able to package solutions to include those that are most applicable to the West Village itself and then go one step farther to understand the cost-benefit analysis of a package of the most appropriate measures.

The focus of this particular meeting is to generate possible combinations of technical, financial, and operational solutions that can be applied to the West Village project.

1. Review relevant technical, financial, and operational approaches to implementing energy efficiency and distributed generation of renewable energy
2. Drawing upon the aforementioned approaches, consider and provide guidance on potential solutions appropriate to the different scales of the project
    a. Scale 1 – Individual Home
    b. Scale 2 – Neighborhood (multi family and commercial)
    c. Scale 3 – Community-wide
    d. Scale 4 – External
3. Next steps
    a. Explore additional possible solutions
    b. Provide guidance on combinations
    c. Review and comment on DEG draft report

PAC MEETING #2 — NOTES

In Attendance: Amy Barr, Andrew Hargadon, Ben Finkelor, Bob Segar, Camille Kirk, Cheri Davis, Curt Houston, Jon Short, Karl Mohr, Ken Topper, Marc Hoeschele, Margaret Teichert, Mary Hayakawa, Matt Paoni, Nolan Zail, Shawn Smith, Sid England, Tani Elliott, Wes Morgan, James Moranti, Clay Schmidt, and Marshall Hunt

Meeting began with introductions and Ben giving an overview of the entire project and a brief overview of what we've done since the last PAC meeting (technical, financial, operational subcommittee meetings).

1. Review relevant technical, financial, and operational approaches to implementing energy efficiency and distributed generation of renewable energy

Review 3 posters in detail

Technical Poster

- Based savings on real parameters through PG&E
- Looked at bigger incentive pools out there through federal tax credit, CA solar homes partnership whose timeline is slated to end at end of 2008 (but likely they'll be extended)
- Developed base case model then modified with various technologies, ranked, and analyzed
- Goal = package that more than pays for self so if homeowner's paying for all EE costs, will still come out ahead.
- In general, every $1,000 of energy upgrades translates to a cost of $72 (amortized for 30 years at 6%). This was used to calculate Benefit Cost Ratios (BCR) for each package analyzed.
- Explanation of package 1 (in detail) – goal is to make energy efficient measures cost effective
    - Allowed project to qualify for federal tax credit of $2,000 – if back off, lose that, but there are opportunities to go either way
    - Benefit Cost Ratio (BCR) > 1, which means the package more than pays for itself in reduced costs.
- Explanation of package 2 (in detail) – goal is to really improve EE
    - addition of solar immediately opens it up to additional credits
    - Considerably more expensive but the incentives for this package are much greater [?].
    - BCR <1 because PV is not very cost effective
- peak load difference between 1 & 2
    - 3 ton (base)
    - 5 kw (peak for Package 1)
    - 1.5 kw (peak with solar)
- Explanation of package 2+ (in detail) – goal is to get as close to zero energy as possible
    - Add a few thousand more on top of $4,500 increase to convert everything to electrical, etc.
- how much variation is there in energy consumption amongst various homeowners (adults & kids vs. just adults vs. elderly, etc)
    - there is some variation, but tried to take the average and keep all that in mind in projections
    - Curt asked if would it be better to amend energy use so is really specific to expected customer for WV?
- DEG stressed that we are shooting at a moving target. Regulations and incentives continually change as do cost/effectiveness of technologies. It was suggested that we be forward-thinking. Specifically it would be wise to wire for Smart Meters, which will be coming on line through PG&E in the next year or two. Wiring for plug-in hybrids was also suggested, though this is more likely to be an optional upgrade.
- Wes made a similar point about lighting, in that what is available/cost-effective today will be very different in the next 12-18 months.

– Nolan asked about LEED (or similar) certification as a way to increase the marketing options for his team. Margaret mentioned that she could forward some information about a nearby county that developed its own green rating system.
– Evaporative condenser is too much of an emerging technology so DEG didn't look at it because are some reliability issues
    o That and other emerging technologies would be good options for research project
– Wind generation – could explore, but we've been looking more at distributed generation
    o In general, not enough wind in this area

Financial Poster

– Can we get non-faculty people to qualify for MOP?
    o Might be able to by external organization, but doubtful that university would
    o Extending it to energy efficient homes might be able to work because works with goals of Regents – would take a while, though
– External capital
    o Concept of silent 2nd
        ▪ Index appreciated according to index and that's the most a home can be re-sold for
            • Using Aggie Village as example, re-sale price is currently less than 50% market
            • Might be able to entice private equity investor to invest in energy efficiency package so that that portion increases at certain rate of return (7 or 8%, for example)
                o Over time, when home resells, investor would be able to get their capital out
            • Issues:
                o Betting on average turnover of home for when can recoup investment
                o Policy/equity issue that 2nd buyer is essentially paying for all energy efficiency measures that 1st buyer is getting benefit of.
                    ▪ Still will be lower than market (so will still seem like bargain) but fundamentally, they'll still be paying for measures
                    ▪ Those measures are somewhat depreciated – every time resell, can we upgrade energy efficiency package to make sure staying with current and so that 2nd buyer's not footing whole bill for 1st owner's benefit?
                    ▪ Way to give initial investor portion of energy savings over time so secondary cost (to 2nd buyer) isn't as great?
                    ▪ EverGreen approach = continual reinvestment in energy investment
                    ▪ Partially amortize over 20 year term 2nd buyer's portion is smaller
                        • Would function more like traditional loan
                    ▪ Cost of utilities will increase faster than salaries, so 2nd buyer's savings will really be significantly more than 1st
        ▪ Investor owning infrastructure = 1 model
            • Leasing and receiving service fee or only investing and expect return upon resale?
            • Conventional financing might be more attractive to investor
            • Other thing for investor = what is exit strategy?
            • Need to get rate of return big enough
        ▪ University sponsored energy 2nd

        - Probably difficult to find institutions that are willing to finance silent 2nd
            - Better to set up as lease
        - New Resource Bank has 'Solar 2nd'
            - 25 year amortizing loan
            - Fixed rate for 7 years then adjustable after that
            - For post-construction retrofitting
            - 24 hour turn around time for application
            - Once approved, SunPower comes in and takes care of everything
            - Credit driven
            - What's the rate?
            - Collateralize only PV system – don't put lien on whole house
- From marketability standpoint, people won't know what they're saving because they've never done this before
- Are Regents in position to act as guarantor?
- Energy efficiency costs buried in service fee because people, if given the choice, aren't going to choose to pay for upgrades
    - Need to structure it so that EE measures are not an option

Operational Poster

- Options project and university has as far as implementing:
- WV could be good place for upcoming innovators and entrepreneurs to research and test
    - How much risk do the university and project want to take on?
    - Risk will go down over time
    - Project does have subsequent phases, so might be good to do different emerging technologies at different times
        - Makes great test-site
- Demo case = get grant to show that product works via prototype now
- Keep in mind that customer has slightly different mindset – are interested in helping with research and being forefront of this technology (Prius/early adopter mentality)

2. Drawing upon the aforementioned approaches, consider and provide guidance on potential solutions appropriate to the different scales of the project
    a. Scale 1 – Individual Home
    b. Scale 2 – Neighborhood (multi family and commercial)
    c. Scale 3 – Community-wide
    d. Scale 4 – External

Idea Templates

- Try to answer questions from venture perspective
- Key uncertainties = key questions that should be answered before invest too much time and energy in it

Mix-and-Match Solutions

3. Next steps
    a. Explore additional possible solutions
    b. Provide guidance on combinations
    c. Review and comment on DEG draft report

Post-It Votes:

- Technology
    - DEG 1 — 1
    - DEG 2 — 29
    - DEG 2+ — 18
    - Research & Education — 7
        - Existing floor plans could be optimized for energy and construction cost savings
- Financial
    - Mortgage — 11
    - External — 23
        - Could the energy seconds be sold as carbon credits?
    - Angel — 16
- Operational
    - Lease — 2
        - Can money be put aside for ongoing high efficiency equipment replacement?
    - Management Organization — 6
    - External Org — 22
    - Research or Educational — 24

PAC Meeting #3

PAC MEETING #3 – AGENDA

West Village Energy Efficiency Project
Project Advisory Committee Meeting
June 8, 2007
Sudwerk's
3:00-5:00 pm

Problem Statement: The overall objective for the West Village Energy Efficiency Project is to develop solutions for the project stakeholders (notably the future residents, the university, and the developers) to achieve for the project high levels of energy efficiency and distributed generation of renewable energy that will maintain the affordable nature of the units and not increase the additional first cost of the overall development.

We've structured the project to research the world of possible technical, financial, and operational energy solutions that might be applicable for the West Village development; from there, we will be able to package solutions to include those that are most applicable to the West Village itself and then go one step farther to understand the cost-benefit analysis of a package of the most appropriate measures.

The focus of this particular meeting is to provide final feedback to the team on the three recommendations presented and additional recommendations to the Draft Final Report.

1. Introductions (3:00-3:15pm)
2. Presentations of three recommendations (3:15-4:15pm)
    a. External Organization – Micro-Utility Model
    b. Management/External Organization – Third-Party Contract Model
    c. Prescriptive Lease – Silent Second
3. Review of Additional Recommendations from draft report (4:15-4:45pm)
    a. Comments
    b. Questions
    c. Suggestions
4. Recap (4:45-5:00pm)

PAC MEETING #3 – NOTES

In attendance: Amy Barr, Ben Finkelor, Jon Short, Wes Morgan, Tani Elliott, Marc Hoeschele, Shawn Smith, Camille Kirk, Sid England, Mary Hayakawa, Lance Lowe, Matt Brost, Curt Houston, Bob Segar, Bill Star, Matt Paoni, and Ken Topper

1. Overview

   Based on feedback from previous meetings we have developed three solutions and a list of additional opportunities. The solutions are less aggressive than the group has indicated it would prefer, but we feel that they are more practical and replicable. In the additional opportunities section of the report we have tried to address the concerns of this committee and identify solutions that are more aggressive and/or less replicable (i.e. one-time grant opportunities).

2. Presentations of three recommendations (see attached power point files)
   a. Overview/Background slides – to be used in presenting all three solutions
   b. Management/External Organization – Third-Party Contract Model
      PAC comments/suggestions on the presentation are recorded as follows:
      i. Add utility escalation to 'Economics' slide
      ii. Run financial numbers with 4% (instead of 7%)
      iii. Include inverter replacement between years 12 and 18 in financial analysis
      iv. Cleaning PV panels is not cost-effective
      v. Model tiered subscription fees that increase with usage
      vi. The development team is considering taking a reduced profit margin on energy efficiency options upgrades
      vii. Consider the fee structure for homes that don't install Package 2
      viii. The additional solar may require more transformers and thereby actually increase the infrastructure costs. Shawn will know more about this in July. In the communities where Matt Brost has worked this has not been the case.
      ix. Does the model work any better as a non profit organization
   c. External Organization – Micro-Utility Model
      PAC comments/suggestions on the presentation are recorded as follows:
      i. Bring 'Economics' to per bed (instead of per unit) — 4 beds per unit
      ii. Utility bill added to rent?
      iii. Master meter on multi-family
      iv. Power Purchase Agreement with commercial spaces and community college
      v. No bill for student housing unless exceed kW allowance for month
      vi. Need to include profile and costs of community lighting
      vii. Metering each unit has not been determined but is likely.
      viii. Be cautious about making sure the structure of this solution can't get tangled up
   d. Prescriptive Lease – Silent Second
      PAC comments/suggestions on the presentation are recorded as follows:
      i. Turnover rate = key
      ii. Affordable (but not as much) for 2nd homeowner
      iii. Very drastic market adjustment for depreciation to take place (because written into CCRs)

iv. Assumption that gap will widen between Davis and WV home prices
v. Make formulaic to account for outliers (i.e. sell after 2 years or 30)
vi. Ownership issue — management organization purchases improvements
    1. 2nd homebuyer buys out management organization — lien on unit
    2. Individual homeowners need to own measures being collateralized
vii. Balloon payment = difficult because gets big real fast
viii. Can de-couple EEMs from appreciation of home?
ix. This solution is fairly similar to the first solution presented, except perhaps more prescriptive than performance driven

3. Review of Additional Recommendations from draft report
    a. Suggestions provided by the PAC include:
        i. Package 1 = wouldn't bother setting up organization for — if decide on it, just go with it (University and developer) and do it (don't need some big organization to make it happen)
        ii. 'University Preferred Financing' — from marketing perspective is more attractive the more aggressive it is
            1. Would be good for zero net electricity bill
        iii. Electric vehicle car-sharing
            1. Won't be paying for parking pass (not allowed) — $400 savings
            2. Can savings from electric car help to offset some of costs of DEG packages and solutions?
        iv. If bringing this in front of the Regents, having comprehensive plan with energy, transportation, and sustainability would be ideal, though no complete redesign is necessary.

Technology Subcommittee Meeting

TECHNOLOGY SUBCOMMITTEE MEETING – AGENDA

West Village Energy Efficiency Project
Technology Subcommittee Meeting
April 3, 2007
224 AOB IV
1:00-3:00 pm

Problem Statement: The overall objective for the West Village Energy Efficiency Project is to develop an understanding of the world of possible solutions for the West Village development. From there, we must narrow the list to include those that are most applicable to the West Village itself and then go one step farther to understand the cost-benefit analysis of a package of the most appropriate measures.

The focus of this particular Subcommittee meeting is to add to the list of technologies that have already been identified and to provide guidance to the DEG as they update their report on potential energy efficiency measures. Further still, the group is tasked with exploring the technical

1. Review Objectives—fill gaps & provide guidance to DEG
    a. Scope
    b. The world of technical solutions
        i. What should be added to the DEG list?
        ii. What haven't we considered?
        iii. What is now obsolete?
    c. Identify those solutions applicable to West Village
    d. Cost-Benefit analysis on applicable solutions

2. Review DEG Report
    a. Refined base case (define a "typical" new home's energy features?)
    b. Finalize assumptions and approach for DEG evaluation

3. Research Opportunities
    a. What could we do if money was not an issue?

TECHNOLOGY SUBCOMMITTEE MEETING – NOTES

Introductions: Ben Finkelor, Bruce Dickenson, Bill Star, Camille Kirk, Matt Brost, Marc Hoeschele, Wes Morgan, Dick Bourne, Dave Springer, Andy Hargadon, Shawn Smith, and Cheri Davis.

Overview of Agenda

1. Comfort/Acceptability is a major concern - Definitions for DEG; particularly for evaporative cooling. Some cultures (Japan) set thermostats at 84º.
2. We could approach the entire project as a portfolio instead of individual units. This means getting the largest gains (savings) on the houses that are best-suited to energy efficiency and accepting lower gains on the others, so that the overall project meets a certain level of efficiency.
3. We could use different designs for different parts of the community, like north-facing vs. south-facing residences. Changes to the existing planned design were brought up several times with a consistent message from Camille on behalf of ORMP:
4. The basic designs and specifications should be used as listed in the Implementation Plan. That being said, if there is a compelling story for deviating from the Plan (e.g. changing floor plans to minimize wasted interior space and exterior walls can save 40%) it should be presented to ORMP who can go back to the Regents. This is a costly alternative (in terms of time and money), so the case must be compelling.
5. Another interesting idea is to develop an 'Owner's Manual' of sorts for the homes that help residents achieve peak performance from all the home's systems. This starts to overlap with an Organizational solution where maintenance of home equipment is overseen by a body other than the home-owner.
6. Concerns were raised again as to who will enforce the solutions that we develop. Whether the responsibility falls to a micro utility (Organizational Solution) or the University, there must be monitoring to ensure that the 20% more efficient widget delivers as promised. This endeavor will benefit from establishing a target and a periodic review process.
7. While there is a point of efficiency that can be achieved with no additional cost, it was suggested that we need to shoot for a lower cost than the starting point. This is in line with our goal of affordability. Certain measures drive costs down from the base case (doing nothing) to a low point after which additional savings drives price back up. We need to find that delicate balance between the maximum achievable efficiency and affordability. Increasing efficiency beyond this point is a lofty goal and one that should be pursued but not at the expense of the homeowner (Financial Solutions group can work on how to pay for this).
8. PG&E will ultimately have real-time metering on all homes in this community (though not necessarily from day one).

Review of Assumptions

1. Use the design elements in the Implementation Plan
2. The homes will be built under a stricter standard than can currently be modeled (2005 Title 24).
3. Time of use (E6) rates should be used where appropriate.
4. MICROPAS has flaws, but it will still be used for this analysis. Energy Star tracked homes built on a MICROPAS model for a year and found significant differences between compliance and performance.
5. For solar the PPA model should be used. MB knows of a tool that will calculate savings on utility bill from simple inputs which he will share with DEG. It would be worthwhile to investigate a solar-powered attic fan.
6. The multi family should all be either two-bed/two-bath or four-bed-four-bath.
7. Evaluate District Heating & Cooling

8. DEG will use the federal tax credit and 2nd-tier PV incentives. MB will provide better information on multi-family PV.

Research/Other Opportunities

1. Building Energy Research Grant will pay up to $200,000 for research
2. Can we use IFC foam blocks or SIP Panels
3. Providing a package of energy efficient appliances or at least information on where to get them
4. LED pathway and home lighting
5. Innovative grant proposal to PG&E who is actively looking for EE/sustainable community-wide research opportunities.

Finance Subcommittee Meeting

FINANCE SUBCOMMITTEE MEETING – AGENDA

West Village Energy Efficiency Project
Financial Solutions Meeting
April 20th, 2007
3:00-5:00
Sudwerk Restaurant & Brewery Pilsner Room
2001 Second Street
Davis, CA 95616
(530) 758-8700, restaurant
(916) 834-6151, Jon Short's cell

Problem Statement: The overall objective for the West Village Energy Efficiency Project is to develop an understanding of the world of possible solutions for the West Village development. From there, we must narrow the list to include those that are most applicable to West Village itself and then go one step farther to understand the cost-benefit analysis of each item.

The focus of this particular group is to add to the list of solutions that have already been identified and then provide guidance as to which to pursue.

1. Current Mortgage options

	MOP	EEM	LEM	Traditional
Loan Types	1st only	1st & 2nd	1st only	1st & 2nd
Amortization	30[1]	30[1]	30	30[1]
Loan To Value	0.9	0.9	0.97	.9[2]
Fixed Rate	No[3]	Available	Yes	Available
Points/Fees	No	Yes	Probably	Possibly
PMI required	No	No	Yes	Yes
Impounds	No	No	??	Yes
Max payment/income	0.4	0.3*	??	0.28*

1 - 40 available

2 - Up to 125% is available through some lenders

3 - Adjusts based on internal formula tied to salary (currently 4.75%)

* - Debt to income ratios

2. Financing a Management Organization (overlaps with organizational solutions)
3. Current Rebates & incentives (Overlaps with Technical solutions)
4. Research Grants (Overlaps with Technical solutions)

FINANCE SUBCOMMITTEE MEETING – NOTES

In attendance: Jon Short, Amy Barr, Marc Hoeschele, Ben Finkelor, Curt Houston, Camille Kirk, Mary Hayakawa, Matt Paoni, Karl Mohr, Nolan Zail (via phone), Tani Elliott (via phone)

The meeting began with quick introductions led by B. Finkelor. Quick overview of what's happened since last PAC meeting – technology subcommittee meeting, spoken with California Lighting Technology Center, Western Cooling Efficiency, and have received a draft of the DEG's updated report.

Here are the variables – let's try to focus on one variable that we can work with. Here are the technological solutions that we've come up with. Given what we have, let's start working on the finance portion of it.

Can look at it 3 different ways: individual homebuyer, neighborhood (first rollout of a block of homes – 40 or 50), community-wide scale (the entire project, which is outside of the DEG report).

Brief overview of the DEG report and how it relates to the finance subcommittee.

- Certain incentives will expire at the end of 2008
- They ranked the various measures by cost-effectiveness
- Energy cost-savings would basically pay for the mortgage cost
- Hard costs to the builder with 10% mark-up – majority of the measures are hard costs
- Soft costs (design, permitting, financing costs and all those others associated with home costs) – are some design costs associated with some of the measures
- Package #1 – series of measures where better than cost neutral with homeowner savings of about $356/year. measures that are more within conventional construction practices that are out there now
- Package #2 – goes into solar and renewable technologies and additional EE technologies and some emerging technologies that allow for a lot more energy efficiencies. About $26,500 hard costs (a lot of which is tied up with the PVs).
- Table 4 – factoring 10% builder mark-up (profit) to every measure
    - BCR – benefit-cost ratio. Benefits of costs taking into account 30 year mortgage at 6%
    - Line of demarcation between Package 1 and 2 is basically a BCR of 1 (above 1 = Package 1, all = Package 2)
    - Incentive levels start to change once you put the measures together
    - How many of below 1 BCR measures are available post-construction (after home's already built)? Both solars, ceiling insulation
    - No maintenance analysis on these – most are not maintenance issues
- Any economies of scale factored into EE measure analysis?
    - Not necessarily because don't usually install them as a group and a lot of them are emerging
- Can we just say some will have Package 1 and some will have Package 2 and when you average out the range of home prices would probably even out
    - Is some flexibility in here where can look at them as option packages
    - Take a portfolio approach to packages to increase cost-benefit ratio
    - Build choice into development and let homeowner's own financial situation decide which package/home they choose
    - Come in at least having Package 1, and then provide premium package (that's an option) to some of the homes
        - Need to plan ahead of time or can homeowner come in and say that they want it added to their home?

- Will be buyer driven
- Only downside could be economies of scale
- What if commodity changes and price of electricity, etc increases??

Solar/PV

- How would costs be recouped if PV was used?
  - EE mortgage?
  - Depends on where the solar is implemented – individual house level, community, etc
- PG&E Sustainable Communities might play into this, but we probably won't hear back from them until the earliest of the fall.
  - Would probably have to be more of a research deal as opposed to just having the money to install the EE measures
  - Could be more difficult to do a micro-utility model
  - Can you transfer the typical MU model (usually commercial) into a residential model?
- Infrastructure costs – if we reduce the load on the community or the neighborhood, there are implications that the developer would see because peak demand is lower (and same with PG&E – cheaper for them too). If we could recover some of those costs that the developer and PG&E are saving, we could put that back into the project in the form of energy efficiency measures.

Current mortgage options

- Curt has looked into some of the energy efficiency mortgages (EEMs)
  - Fannie Mae has revised their program
  - In the past was designed more to go over and above the sales price and finance energy efficient measures
  - Not sure how you can tweak the process to see how someone can qualify
  - At it's heart, it doesn't offer a better rate – just allows you to borrow more in terms of loan to value because allowing you to put in incremental cost or allowing you to qualify for more because of the energy savings
    - No rate break
- Location efficient mortgage – pretty much does the same thing as EEMs
  - Can't beat MOP offered by university offered by university
- Mortgage origination program
  - Only available to faculty (not staff)
  - One-shot deal – can only be used once, so if faculty who've already used it move into these homes, they are not eligible
  - What percentage of people moving in are not expected to qualify?
  - SHLP used in some circumstance to close gap – would they help to fund some of these energy efficient mortgages?
    - Steve Matthews is head of loan programs at office of president – with visibility of WV, it might be something that they want to explore
    - If MOP program doesn't want to, could we have a preferred lender do 2nds?
    - Way to fund pot of money at campus level at rate of return where campus does this to fund 2nds? Do we buy down some of the EE to help fund some of the technology?
  - MOP has performed pretty well historically.
  - To the extent that there's no flexibility within the system, is there an outside lender that would be

willing to help?
  - o Might be an opportunity to partner with Cal State – they've been involved in a number of projects like this
  - o Should speak with MOP to see if they're interested
  - o If houses met specific performance level/target, that would qualify that person that buys that home for preferred lender or for 2nd for retrofit – finance EE separately.
  - o Collateralizing just upgrades/retrofits of 30 years
    - ▪ Lump in appliance package for things that aren't typically included in a house
    - ▪ Is there a model for that on the rental market?

Financing a management organization – community-wide

- In terms of mortgages, are we limited to these listed or are there others that we can be looking at? Are there options for someone to purchase and own all the appliances and that entity gets financing and the residents pay the entity some amount?
  - o Overlaps a lot with the organizational committee – a way to get some of the costs outside of the costs of the home
  - o Pretty much like a co-op – technically owns it, but they're paying themselves back
  - o PV panel farm located somewhere so solar panels not on someone's roof – distributing/selling back to utility at lower cost
  - o Can we go above and beyond PV and get into the houses in terms of the EE measures?
  - o If it's a 501c3 so that it can get really low rate for financing (4% cost of capital), does that change the PV system up to higher level of BCR? Would probably only bump it up to about a .5, but might not qualify for as many incentives
  - o Could we find sources of fund internally within system?
  - o Any mandatory fees factor into affordability - will get around financing parameters but doesn't necessarily help affordability
    - ▪ Some of these EE measures above the line of BCR will actually be saving the user – should increase affordability
    - ▪ Would have to have economy of scale that would outweigh the amount paid to the entity (which would include a certain amount to pay for keeping the business running in addition to helping to pay off the debt)

Resale restrictions

- Based on a faculty-salary index formula
- If include in with purchase price, then they'll increase with home price
- Would be appreciating with house as opposed to depreciating (like it would if you added on the measures later) – motivation to capture these measures in the price of the home.
  - o Really want to have these measures in before the home is bought so that when that homeowner goes to sell their home, they'll be able to recoup those costs because they've been appreciating with the home instead of something that's been depreciating
- Maintenance issues could be an issue because homeowners have less of an incentive for upkeep
  - o If these measures are financed by the outside organization, they'll have an incentive to maintain the technology and
- Really going to be a feel-good effect for them because all of their savings are going back into upkeep and into other energy efficient measures or the HOA entity, etc – essentially they aren't going to have money left in their pocket by living here

  - Maybe we have a certain level – homeowner has to receive a 10% benefit
  - Focus groups showed that this group that will be buying are interested in the 'green' homes
  - Already have that affordability factor incorporated by being 70% below market value

On Figure 1 of DEG report – where on that curve do we want to be?

- Package 1 should have enough incentives for it to happen because your costs are below base case costs
- If it's pure affordability we're looking for, why don't we just focus on measures above 1.5 BCR?
- Want to get as much energy efficiency in as possible without degrading affordability (and marketability) – it's an affordability project that we want to also be energy efficient

If there wasn't a price restriction, what packages would you offer?

- There are 40 market rate homes – what's their sense of packages offered?
  - They haven't thought of that yet

Sustainable Communities

- If we want to get above this curve and really make this be energy efficient, we need this to be a research project
- We're in such a good position to say we're a pilot project because being a research university
- The number shouldn't be that big to finance that for a big company - $10 or 15 million
- New Resource Bank – provides better rates for projects that qualify for their sustainability criteria

To make as affordable as possible:

- Should look at development budget to see where can squeeze out any resources
- Already structured deal with certain risk rate of return
- Knock off basis points from project loan
- Interesting to see what sort of parameters they have for their loan
- if package as energy efficient project, construction loan could improve – might be better to look at changing it on the front end in the form of the developer's loans

Action items

- Follow up with New Resource Bank (through Matt)
- Package '0' option (through Marc)
- MOP & SHLP info from Steve Matthews (through Mary)

Operational Subcommittee Meeting

OPERATIONAL SUBCOMMITTEE MEETING – AGENDA

West Village Energy Efficiency Project
Organizational Subcommittee Meeting
May 3, 2007
224 AOB IV
12:30-2:30 pm

Problem Statement: The overall objective for the West Village Energy Efficiency Project is to develop an understanding of the world of possible solutions for the West Village development. From there, we must narrow the list to include those that are most applicable to the West Village itself and then go one step farther to understand the cost-benefit analysis of a package of the most appropriate measures.

The focus of this particular Subcommittee meeting is to generate a list of organizational opportunities that can be applied to the West Village project, paying particular attention to those that have already been in use somewhere and their ability to be replicated in future developments.

1. Introduction & Overview
    a. Update of technology and finance subcommittee meeting
        i. Technology Solutions
        ii. Finance Solutions
    b. Why we're looking at organizational solutions

2. Explore organizational opportunities – anything operational and ongoing
    a. Aggie Village (Mary Hayakawa)
    b. UC Irvine (Karl Mohr)
    c. Co-Housing (Ben Finkelor)
    d. European Union (Bruce Dickinson)
    e. HOA (Lance Lowe)
    f. Roseville (Tom Habashi)

3. Generate list/identify cases, examples, and models that are in use somewhere
    a. What have you seen?
    b. What solutions work?

OPERATIONAL SUBCOMMITTEE MEETING – NOTES

Attending: Amy Barr, Lance Lowe, Mary Hayakawa, Karl Mohr, Jon Short, Nolan Zail, Tani Elliott, Tom Habashi (Roseville Electric), Camille Kirk, Andy Hargadon, Chris Soderquist, Ben Finkelor, Will Fleissig, Ken Topper, Bob Segar, Bruce Dickenson

1. Introduction & Overview
    a. Update of technology and finance subcommittee meeting (Ben)
        i. Technology Solutions
        ii. Finance Solutions
    b. Why we're looking at organizational solutions
2. Explore organizational opportunities – anything operational and ongoing (Karl)
   There are some operational things that the University will have to perform as part of the ground lease – Lease management; water, sewer & drainage; contract with city of Davis for curbside refuse collection. There are fees built into the ground lease to cover these services.
   Management of municipal services (police, fire, ground maintenance, street maintenance) is up in the air. We should assume that the City of Davis will not handle these services.
    a. UC Irvine (Karl Mohr) – Irvine Campus Housing Authority; separate 501c3; controlled by UCI; tax exempt financing; balance sheet rolls up to University (not practical for WV); no HOA (the roll of residents will be key for WV); UCI has 10% equity interest in homes
    b. Aggie Village (Mary Hayakawa) – Small (few units), not as many issues, annexed to City of Davis; ground-leased, but city gets property tax revenue to compensate for services
    c. Co-Housing (Ben Finkelor) – not addressed
    d. European Union (Bruce Dickinson)
    e. Private Micro Utility – regulatory issues; works best with master meters, but this is contrary to energy conservation that works best with individual meters
    f. DC heat & power in EU works on de-regulated market
    g. Distributed generation, bio mass, solar, wind are all options for WV if someone manages them
    h. Larger commercial loads could be put all into one system
    i. If we can be a "municipality", we can get tax-free financing
    j. HOA (Lance Lowe) – not addressed
    k. Roseville (Tom Habashi) – BEST Homes; 10% minimum of new homes in Roseville are to be BEST (realizing 30%); $20,000 per home (includes supplier discounts for economies of scale); Roseville contributes $8500 of incentives; Cost Benefit Analysis worked from day 1 increasing home price by difference ($11,500); A/C more efficient than Title 24. It is difficult for WV to simply increase the home price to pay for EE improvements although this may be within our 8% of 'wiggle room'.

3. Generate list/identify cases, examples, and models that are in use somewhere
    a. What have you seen?
    b. What solutions work?

Nolan – ULI conference

Green is way down on the list of improvements that buyers are willing to purchase

Great in commercial world – 'Landlord' model; landlords understand the payback and can manage it on a commercial building

Carnegie-Melon – Green person on campus supported by student groups

Bob – University-Developer (WV) relationship not the same as City-Developer (other models)

Group Discussion – Likely solutions should be customized based on scale. Below is a list of potential solutions to explore:

1. 1. Individual Home Scale – Up front financing of $20,000 (Energy or "Silent" Second)
2. 2. Multi-family or Neighborhood Scale – Private Micro Utility (MUD)
3. 3. Community wide – Net zero purchased power agreement

~ One entity could do 2 & 3 ~

4. 4. Maintenance service contracted out – University, however, will always be put in the middle (Mary)

INDIVIDUAL SCALE

Individual Scale — Phase 1

UC DAVIS CENTER FOR ENTREPRENEURSHIP

Elevator Pitch
Energy efficiency will be included in all single family homes and it's added cost will be offset through a "silent 2nd" mortgage.

Problem and Solution
To incorporate energy efficiency into housing developments without adding first costs to the developer, university, or homeowner. This financing vehicle will allow energy efficiency to be included in every home by offseting it's price through a "silent 2nd" mortgage.

Customers
UC Davis Office of Resource Management & Planning
West Village Partnership
UC Davis Faculty & Staff

Revenue Model	Alt Revenue Model	Alt Revenue Model

Image

Competitors
Energy Efficient Mortgage

Core Technology
All energy efficiency measures specifically chosen for Package 2 by the Davis Energy Group.

Key Uncertainties

Technology
How will technology performance be measured and verified?

Market
Will building occupants use EEMs to highest efficiency in order to get the most from them?

Business
Will a financing organization require a guarantee?

Recommendations
Contact potential financing organization.

phase	go/no go
1	go

Team
West Village

Project Leader
Barr, Amy

Team Members
Amy Barr
Jonathan Short

Appendix K

MULTI-FAMILY/COMMERCIAL SCALE

Multi-Family/Commercial Scale — Phase 1

UC DAVIS CENTER FOR ENTREPRENEURSHIP

Elevator Pitch
The management organization, financed through rebates & incentives, will act as governing body to community to ensure proper use & care of installed technologies.

Problem and Solution
To incorporate energy efficiency into rental units without adding first costs to the developer, university, or occupant. This management organization will purchase and maintain EEMs and DG & collect maintenance & renewal fees.

Customers
West Village Partnership
UC Davis Office of Resource Management & Planning
UC Davis Students and Leaseholders

Revenue Model	Alt Revenue Model	Alt Revenue Model
Subscription Fees		

Image

Competitors
Traditional Maintanence and Service cos.
Existing Property Management Co.

Core Technology
Energy efficient measures specifically chosen from Package 2+ by the Davis Energy Group. May include "building operations manual"

Key Uncertainties

Technology
How fast is technology improving (will we need to replace it often)?

Market
Will building occupants manage EE equipment effectively? care enough about energy efficiency to make this work? How will changing energy rates affect us?

Business
Will a service organization/management organization be willing to take on the long term financing and

Recommendations
- Create education program to make sure energy savings are paximized - Run financial estimates using different energy rate scenarios - Run financials for ave. energy use, amt saved with Package 2, and amt willing to pay

phase	go/no go
1	go

Team
West Village

Project Leader
Barr, Amy

Team Members
Amy Barr
Jonathan Short

COMMUNITY-WIDE SCALE

Community-Wide Scale — Phase 1

UC DAVIS CENTER FOR ENTREPRENEURSHIP

Elevator Pitch
This organization will install centralized PV, EEMs +/or community infrastructure (primarily lighting) to provide and receive monthly fees from occupants in return for offsetting energy costs.

Problem and Solution
To incorporate energy efficiency into common-area developments without adding first costs to the developer, university, or homeowner. This organization will install & maintain centralized PV + EEMs for community infrastructure.

Customers
UC Davis Office of Resource Management & Planning
West Village Partnership
UC Davis Faculty & Staff

Revenue Model	Alt Revenue Model	Alt Revenue Model
Utility Fees	Unit Sales	Subscription Fees

Image

Competitors
Traditional HOA
UC Davis Real Estate Services
Traditional property management

Core Technology
Photovoltaics & Lighting Energy Efficiency Measures (EEMs)

Recommendations
Contact regulatory agencies/potential investors and research load profiles.

phase	go/no go
1	go

Key Uncertainties

Technology
What are the key regulatory hurdles?

Market
What is the projected load profile for the community infrastructure?

Business

Team
West Village

Project Leader
Short, Jonathan

Team Members
Amy Barr
Jonathan Short

EXTERNAL SCALE

External Scale — Phase 1

UC DAVIS CENTER FOR ENTREPRENEURSHIP

Elevator Pitch
Federal, state and/or angel financing will fund a 'living' research & education project at the UC Davis West Village, showcasing advanced energy savings implementation of EEMs and DG.

Problem and Solution
Legislators, Research & Regulatory Agencies seek to showcase hosuing developments with more responsible housing profiles. The WV project educates builders, universities, and the public that this is possible.

Customers
CA Energy Commission (PIER program)
CA Public Utilities Commission
Department of Energy (EERE program)

Revenue Model	Alt Revenue Model	Alt Revenue Model
Professional Fees		

Image

Competitors
Development projects (currently earlier in design)
Roseville BEST program (MUDs)
Lennar Homes Solar Developments

Core Technology
DEG Package 2+. Redesign community with density and layout achieving highest possible energy performance. Goals, including potential transportation, may include building operations manual and interactive education center.

Key Uncertainties

Technology
Can we achieve and maintain the savings estimated by DEG? Is a redesign required?

Market
Is there grant money available for a project of this size?

Business
Is the university capable of managing research grant of this scope and scale?

Recommendations
- Explore funding opportunities at US DOE, CA Energy Commission, Public Utilities Commission

phase	go/no go
1	go

Team
West Village

Project Leader
Short, Jonathan

Team Members
Amy Barr
Jonathan Short

OVERVIEW

West Village Energy Efficiency Project

University of California at Davis

Energy Efficiency Center

UCDAVIS ENERGY EFFICIENCY CENTER

The Team

- Jonathan Short – Emerging Venture Analyst
- Amy Barr – Emerging Venture Analyst
- Ben Finkelor – Program Manager

UCDAVIS ENERGY EFFICIENCY CENTER

West Village Development Overview

- UC Davis on-campus housing development
- 500 faculty and staff homes
- Housing for 3,000 students
- Community-building elements: parks, education centers, bikeways, recreation fields, commercial and light retail
- Criteria: Affordability, Environmental Responsibility, Quality of Place

UCDAVIS ENERGY EFFICIENCY CENTER

The Problem

- Additional 'first costs' cannot be incorporated into the homes and still meet the objective of providing affordable entry into the housing market
- Energy efficiency strategies face the typical barrier of first cost vs. long term cost

UCDAVIS ENERGY EFFICIENCY CENTER

Our Goal

- Create a portfolio of products, services, and practices that enable a more responsible and sustainable West Village project
- Create a breakthrough set of solutions that can significantly influence new privately-developed housing projects

UCDAVIS ENERGY EFFICIENCY CENTER

Already in the Works

- University affiliates will be offered housing at more affordable prices than available in the local marketplace
- Auto commute trips to campus will be greatly reduced and replaced by an extensive network for bike and bus trips
- Storm water and landscape systems are integrated
- Buildings are oriented along east/west streets to manage sun exposure

UCDAVIS ENERGY EFFICIENCY CENTER

World of Solutions

- Technology Solutions
  - DEG Package 1
  - DEG Package 2
- Financial Solutions
  - Rebates & Incentives
  - Mortgage Programs
- Organizational Solutions
  - Micro Utility
  - Management Organization

UCDAVIS ENERGY EFFICIENCY CENTER

Three Solutions

- Management Organization (Amy)
- Micro Utility Model (Amy)
- Silent Second (Jon)
- Additional Opportunities (Jon & Ben)

UCDAVIS ENERGY EFFICIENCY CENTER

MANAGEMENT ORGANIZATION

West Village Project

Strategic Energy Management Organization (SEMO)

UCDAVIS ENERGY EFFICIENCY CENTER

Overview

- External organization
- Purchase, install, and maintain energy efficiency measures
- Subscription fee from residents
- Oversight organization to ensure efficiency performance

UCDAVIS ENERGY EFFICIENCY CENTER

Value Proposition

- Homeowners
  - Improved comfort and environmental consciousness
  - Option for level of efficiency
- University
  - Affordable & sustainable
- Developer
  - No additional upfront costs
- State
  - Replicable model for other developments

UCDAVIS ENERGY EFFICIENCY CENTER

Market

- Single-family homes
  - Phase 1 – 312
  - Phase 2 – 163

Technology

- DEG Package 2 (including PV)
  - Improved insulation
  - Energy Star Appliance package
  - Tankless water heater and optimized water
  - Efficient HVAC ducts, equipment and airflow
  - Efficient Lighting design
  - Improved ceiling, slab, envelop insulation
  - Ducts in conditioned space
  - NightBreeze
  - Solar water heating
  - 2.6 kW (DC) PV System

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How It Works

- Capital acquired to pay for upfront installation costs
- Secure contract with maintenance provider
- Homeowner pays subscription fee to organization and remaining (lower) utility bill to PG&E
- Oversight organization ensures satisfactory energy and maintenance performance

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Economics

	Status Quo	Package 1	Package 2
Capital Required (per home)		$2,967.00	$22,672.00
Monthly P&I (7%, 30yrs)		$19.74	$150.84
Maintenance Contract		$13.00	$18.00
Utility Bill	$135.00	$101.75	$50.25
SEMO Subscription Fee		$36.77	$186.36
Monthly Maintenance Costs	$16.67		
Monthly TOTAL	**$151.67**	**$138.52**	**$236.61**
Monthly SAVINGS/COST		**$13.15**	**($84.94)**

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Subscription Fee

- Pure subscription fee
  - Prescriptive-based
- Percent savings fee
  - Performance-based
- Combination

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Key Uncertainties

- Funding
- Method of measuring energy savings
  - Prescriptive or performance-based savings measurement system
- Formula for subscription fee amount
- Incentives and rebates need to go to organization – can that happen?

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MICRO-UTILITY

West Village Project

Micro U

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Overview

- External organization
- Purchase, install, and maintain energy efficient technologies for multi-family, commercial areas, and/or community lighting
- PV on parking structures
- Subscription fee from residents and tenants
- Oversight organization to ensure efficiency performance

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Value Proposition

- Residents & Tenants
  - Improved comfort and environmental consciousness
- University
  - Affordability
  - Energy efficiency
- Developer
  - No additional upfront costs
- State
  - Replicable model for other mixed use developments

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Market

- Student Housing
  - Phase 1 – 1,842 beds
  - Phase 2 – 1,020
- Mixed Use
  - Phase 1 Retail/Office Space – 45,000 s.f.
  - Phase 1 Mixed Use Housing – 138 beds
- Educational
  - Phase 1 – 80,000 s.f.

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Technology

- DEG Package 2+ (including PV)
  - Improved insulation and envelope
  - Energy Star Appliance package
  - Tankless water heater and optimized water
  - Efficient HVAC ducts, equipment and airflow
  - Efficient Lighting design
  - Bathroom Lighting System
  - Improved ceiling and slab insulation
  - 2.9 kW (DC) PV System

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Economics

	Status Quo	Package 1	Package 2
Capital Required (per unit)		$2,552.00	$26,290.00
Monthly P&I (7%, 30yrs)		$17.14	$176.55
Maintenance Contract		$13.00	$18.00
Utility Bill	$100.00	$72.33	$10.00
SEMO Subscription Fee		$33.89	$214.61
Monthly Maintenance Costs	$16.67		
Monthly TOTAL	**$116.67**	**$106.22**	**$224.61**
Monthly SAVINGS/COST		**$10.45**	**($107.94)**

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Key Uncertainties

- Single-payer issue
- Funding
- Method of measuring energy savings
  - Prescriptive or performance-based savings measurement system
- Formula for subscription fee amount
- Incentives and rebates need to go to organization – can that happen?

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SILENT SECOND

West Village Project

Proposed Solution 3:

The Silent Second

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Overview

A management organization will borrow money from an outside source to fund the purchase of energy efficiency measures on all single family homes in West Village. It will repay the loan in installments upon the first resale of each home. The second homebuyer will pay off the loan on the EEMs

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Market

- Single family homes
  - Phase 1 – 312
  - Phase 2 – 163

Technology

- DEG Package 2 (including PV)

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Value Proposition

- First Homeowner
  - No cost / convenient
  - Enjoy energy savings
- Second Homeowner
  - Pays off the financing on EEMs
- University
  - Affordability
  - Energy efficiency
- Developer
  - Increased marketability
- State
  - Replicable to other projects

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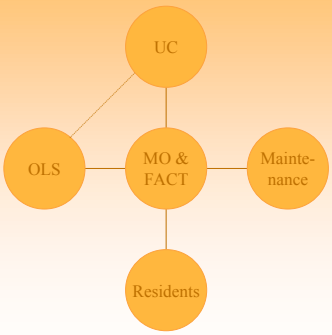
Flow Chart



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Economics

- Capital needed - $36,737 x 312 = $11.5M
- Interest Rate – assume 7%
- Total incentives - $14,065 x 312 = $4.4M
- Energy Savings - $1,017 x 312 = $317K/year
- Maintenance – bill to homeowner

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Key Uncertainties

- Maintenance
- Legality of 3rd party taking incentives
- Turnover → Repayment timing
- Sale motivation
- Market appreciation

- Potential University guarantee

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Next Steps

- Choose MO structure & identify leadership
- Determine necessary loan terms
- Qualify University's interest in guarantor
- Approach lenders

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ADDITIONAL RECOMMENDATIONS

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Additional Opportunities

to Consider

Disclaimer:

- These opportunities are continually changing
- Marketability of the units may be affected

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Prescription Model

- Use remaining 8% price ceiling for financing EEM packages
- Negative impacts on marketability
  - Higher up-front cost
    - Package 1: Increased affordability
    - Package 2: Decreased affordability
  - "Big Brother"
  - Leaves little $ for other upgrades, if necessary

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University Preferred Financing

- Provide preferred mortgage solutions for staff and faculty that buy or retrofit homes with EEMs that meet certain performance measures
- Requires UC Regent approval
- Dramatically increases affordability to potential markets
- Lowers overhead
- Makes Silent Second obsolete

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Research & Grant Awards

- Conducted phased research as single family homes are built out
- Research includes technology verification, human behavior studies
- "Living Laboratory" Concept
- Sources include
  - State funds (CEC, PUC, other)
  - Federal funds (DOE, HUD)
  - Foundations (Energy Foundations, Google.org, other)

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Redesign with aggressive energy/sustainability goal

- Requires complete redesign and approval from Regents
- Allows for addressing transportation energy consumption
- May be more appealing to funding sources for larger project

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Education Center

- Funding sources from state, federal agencies and potentially regulated utilities
- In-line with University and Community College mission.

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Building America Research Project Locations
http://www.eere.energy.gov/buildings/building_america/cfm/project_locations.cfm

California Energy Commission
http://www.energy.ca.gov

Carmel Partners
http://www.carmelpartners.net

Database for Energy Efficient Resources (DEER)
http://www.energy.ca.gov/deer

Database of State Incentives for Renewables & Efficiency (DSIRE)
http://www.dsireusa.org

Davis Energy Group
http://www.davisenergy.com/

FCIC Energy Efficient Mortgage Home Owner Guide
http://www.pueblo.gsa.gov/cic_text/housing/energy_mort/energy-mortgage.htm

Flex Your Power
http://fypower.org

iGreenBuild.com
http://www.igreenbuild.com

Pacific Gas & Electric
http://www.pge.com

PowerLight
http://www.powerlight.com/

PVWATTS - A Performance Calculator for Grid-Connected PV Systems
http://rredc.nrel.gov/solar/codes_algs/PVWATTS

Savings By Design
http://www.savingsbydesign.com/

UC Davis Energy Efficiency Center
http://eec.ucdavis.edu

UC Davis - West Village
http://www.westvillage.ucdavis.edu/community/plan.html

USDA Nat'l. Resources Conservation Service Enviro. Quality Incentives Program (EQIP)
http://www.nrcs.usda.gov/PROGRAMS/EQIP/

Urban Villages - Home
http://www.urban-villages.com

US Green Building Council
http://www.usgbc.org