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UNIVERSITY OF CALIFORNIA SANTA BARBARA

CARBON NEUTRAL PLANNING FOR A SUSTAINABLE SENIOR COMMUNITY

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Client:
Valle Verde

GROUP PROJECT BRIEF http://www.bren.ucsb.edu/~vv **SPRING 2011**

Problem Statement

The increase in concentrations of atmospheric greenhouse gases (GHGs) has led to measurable changes in the earth's climate, including an increase in average global temperatures, melting of arctic and glacial ice, sea-level rise, and a higher overall frequency of extreme weather events (*1*). Failure to recognize our effect on the natural environment, and to make drastic behavioral adjustments, may lead to catastrophic and irreversible changes to the earth as we know it. Lacking comprehensive policies at the international and federal levels, local entities have begun to devise their own responses to climate change. Businesses are now looking to play their part as responsible global citizens by reducing their impact on the environment. Valle Verde, a retirement community in Santa Barbara, California, is a leader in this charge. Beyond its past environmental achievements, the organization hopes to reduce its GHG emissions to zero in 2020, thereby becoming carbon neutral.

Significance

The retirement industry is expected to grow rapidly in the coming decades. Currently, the fastest growing age group in the U.S. is composed of individuals 85 years old and older, and 20% of Americans will be at retirement age by 2030 (*2*). There is an urgent need for retirement communities to accommodate this growing demographic, particularly in California where the population of retirees is expected to double by 2030 (*3*). As the elderly population grows, its share of total GHG emissions will grow as well. Therefore, the retirement industry will play an increasingly vital role in our collective effort to mitigate the impacts of climate change. By achieving carbon neutrality, Valle Verde will minimize its impact on the environment, and will serve as an example for other retirement communities and businesses with similar interests.

Background Information

Valle Verde is a non-profit retirement community built on a 65-acre property in Santa Barbara, California. It currently accommodates 376 residents, and is a leader within its industry in the field of sustainability. The community has developed a Green Initiative, which includes programs for solar power generation, green remodeling, energy conservation, native landscaping, water reclamation, solid waste reduction, and alternative transportation. While the organization has received numerous awards for these programs, management is pressing towards an even loftier goal: to become carbon neutral by the end of 2020.

Valle Verde residents.

Photo credit: Valle Verde

Approach

This Bren Group Project set out to help Valle Verde achieve its goal by clearly outlining and following a six-step process:

1. Calculate Valle Verde's current GHG emissions by conducting a GHG inventory.
2. Define carbon neutrality in the context of Valle Verde's management objectives.
3. Evaluate Valle Verde's Green Initiative to the fullest extent possible.
4. Project Valle Verde's GHG emissions to 2020 in order to establish a specific baseline from which reductions can be calculated.
5. Analyze various GHG reduction strategies and evaluate their feasibility and cost-effectiveness.
6. Provide a comprehensive recommendation through which Valle Verde can achieve carbon neutrality by the end of 2020.

To inventory Valle Verde's GHG emissions, we followed the Greenhouse Gas Protocol, which is the industry standard and has been used by government organizations and corporations to measure, evaluate, and manage GHG emissions. The Protocol divides an entity's emissions into three scopes: **Scope 1** includes direct emissions from stationary and/or mobile combustion, such as natural gas combustion and exhaust from motor vehicles, and fugitive emissions, such as leaks from refrigerants; **Scope 2** includes indirect emissions from purchased electricity; and **Scope 3**, which is reported voluntarily, includes all other emissions, such as employee travel, water use, and consumption and disposal of goods (*4*).

Figure 1 shows Valle Verde's operations divided into Scopes 1–3. While each source emits a variety of different gases, the GHG Protocol requires organizations to account for the six major GHGs outlined in the Kyoto Protocol. They are: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) (*4*). Each gas has a different global warming potential (GWP), which is used to obtain a common accounting metric: carbon dioxide equivalents (CO_2e).

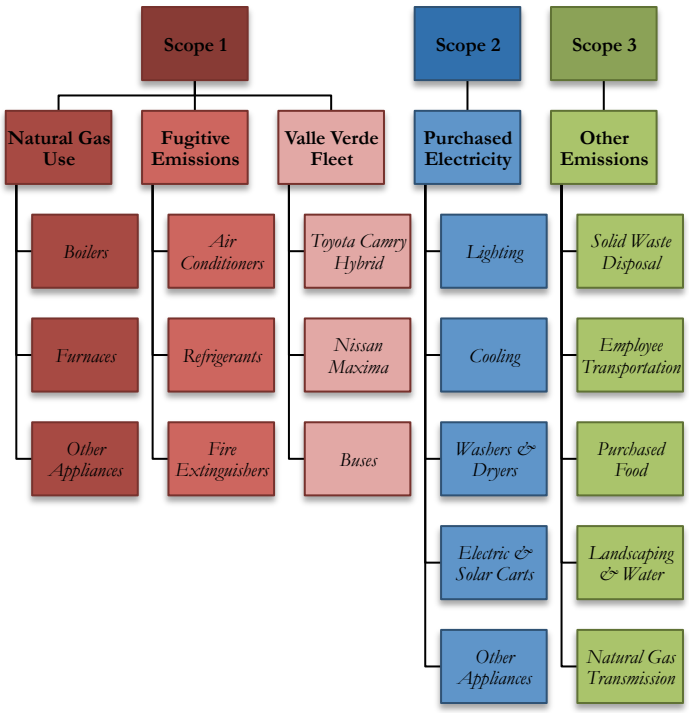

Figure 1: Valle Verde's operations divided into Scopes 1–3

Defining Carbon Neutrality

There are various ways to define carbon neutrality depending on management objectives, the scope of the project, and the availability of data. According to the GHG Protocol, Scopes 1 and 2 are mandatory for reporting purposes, while Scope 3 is voluntary. Given this, we consulted with Valle Verde and decided that our definition of carbon neutrality is when net annual GHG emissions from only Scopes 1 and 2 equal zero.

Greenhouse Gas Inventory

During fiscal year 2009–2010, Valle Verde emitted an estimated **1,494 metric tons** of carbon dioxide equivalents ($MTCO_2e$), which is equal to the annual GHG emissions of 293 passenger vehicles (*5*).

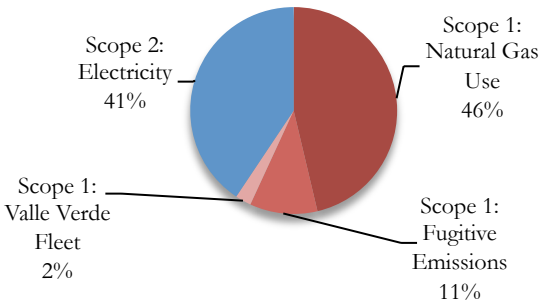

Figure 2: Valle Verde's emissions from Scopes 1 & 2

Valle Verde's Scopes 1 and 2 Emissions (FY 09–10): **1,494 MTCO$_2$e**

The largest source of Valle Verde's emissions was natural gas combustion for heating spaces and water, followed closely by purchased electricity (Figure 2).

When comparing Valle Verde's FY 09–10 per capita emissions to California's 2008 per capita emissions, it is clear that Valle Verde residents have smaller carbon footprints than the average Californian (Figure 3) (*6*).

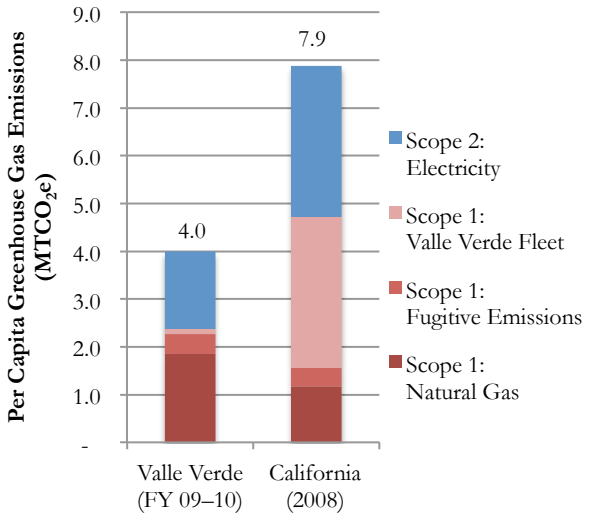

Figure 3: Valle Verde and California per capita emissions

Although we did not consider Scope 3 emissions in our primary GHG inventory, we did conduct a comprehensive inventory, which included all three scopes, to get a more complete picture of Valle Verde's contribution to climate change. This inventory yielded **4,361 MTCO$_2$e**, with 65% of these emissions generated from Scope 3 sources.

The Green Initiative

In order to measure Valle Verde's progress thus far, we evaluated the Green Initiative within the context of GHG emissions. We assessed the effects of the solar panel system, LED lighting, ENERGY STAR appliances, dual pane windows, electric carts, the campus hybrid car, and other sustainability programs. Our calculations estimated that Valle Verde's efforts have already reduced its annual GHG emissions from Scopes 1 and 2 sources by 542–755 MTCO$_2$e (36–51%). This analysis provided us with valuable insight on the effectiveness of the strategies, which allowed us to identify those that could be expanded.

2020 Emissions Projections

In order to estimate the emissions reductions necessary for Valle Verde to achieve carbon neutrality in 2020, we projected our primary GHG inventory results out to that year. We examined six potential methods to predict Valle Verde's 2020 Scopes 1 and 2 emissions, and choose to use the most conservative estimate of 1,648 MTCO$_2$e.

Valle Verde's Predicted Scopes 1 and 2 Emissions (2020): **1,648 MTCO$_2$e**

Emissions Reduction Strategies

We researched numerous reduction strategies and narrowed them down by conducting a feasibility assessment based on four factors:

1. The strategy must affect Scope 1 or 2 emissions.
2. The strategy cannot disturb or impose upon resident lifestyle.
3. The strategy must be relatively cost-effective.
4. For existing strategies, there must be room to expand upon the strategy.

Solar water heating already installed at Valle Verde.

With Valle Verde's financial, operational, and institutional constraints in mind, we evaluated the feasible reduction strategies in terms of annual and lifetime GHG abatement potential, net present value (NPV), and cost-effectiveness. NPV is the value that an investment in an emissions reduction strategy will have over the lifetime of the given strategy in today's dollars. This number considers a strategy's costs and

benefits, such as capital and operational costs and decreased energy consumption, as well as the time-value of money, or discount rate. We defined cost-effectiveness as the NPV of a strategy divided by the total amount of GHG emissions it will abate over its lifetime. By viewing each strategy through this lens, we were able to compile a comprehensive plan through which Valle Verde can achieve carbon neutrality in the most cost-effective manner. This plan includes installing additional solar panels, replacing all remaining appliances and boilers with ENERGY STAR appliances, installing more efficient insulation and radiant heat barriers, installing smart meters, and purchasing carbon offsets (Table 1).

Table 1: Recommended strategies to achieve carbon neutrality

Strategy	NPV	Lifetime GHGs Abated ($MTCO_2e$)	Cost-Effectiveness ($/MTCO_2e$)
Residential ENERGY STAR Appliances	$68,730	250	$270
Smart Meters	$146,190	857	$170
Commercial ENERGY STAR Appliances	$29,630	240	$120
Boilers	$40,170	504	$80
Radiant Heat Barriers	$10,970	171	$60
Attic Insulation	$59,600	1,831	$30
Solar Panels	-$18,830	3,160	-$10
Offsets	-$13,260	1,326	-$10
TOTAL	**$323,200**	**8,338**	**$710**

Conclusions

Based on our recommendations, Valle Verde can abate 322 $MTCO_2e$ annually—a reduction of approximately 20%—by way of technology-based strategies. In order to achieve carbon neutrality in 2020 the community will also need to purchase 1,326 $MTCO_2e$ of carbon offsets (Figure 4). By implementing our recommended strategies and becoming carbon neutral, Valle Verde will reduce its impact on the environment, preempt future climate change legislation, and enhance its brand as the leader in sustainability among retirement communities.

Valle Verde can abate 322 $MTCO_2e$, and will need to purchase 1,326 $MTCO_2e$ of carbon offsets to become carbon neutral in 2020.

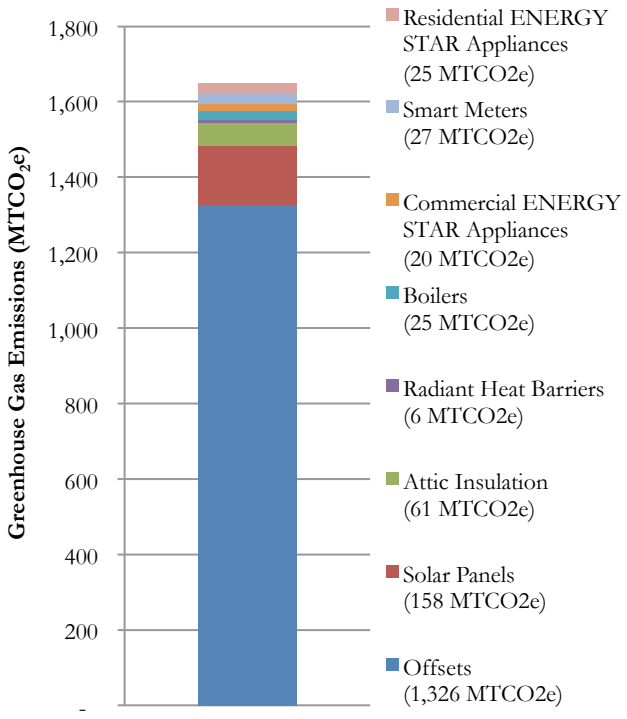

Figure 4: Recommended package of strategies for Valle Verde to achieve carbon neutrality in 2020

Acknowledgements

The Valle Verde Group Project team gratefully acknowledges the support of the Bower Foundation. In addition, we would like to thank the following individuals from Valle Verde: Kathy Abad, Terry Bentley, Paul Childers, John Colt, Jenny Firth, Art Jones, Jeff Krutzsch, Mary Nafius, Ron Schafer, Alexa Steadman, and Suzie Swenson. We also thank Justin Van Mullem of ON Design Architects as well as our faculty and friends at the Bren School: Amy Burgard, James Frew, Roland Geyer, Arturo Keller, David Stoms and Sangwon Suh. We would also like to recognize the support of Cory Clark, David Esquer, Steve Hahn, Maricela Martinez, Stephan Shapiro, Pete Spragins and Linda Zuniga.

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