A 2010 Group Project Brief

Synergistic Energy and Water Conservation Strategies for the Commercial Sector

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Synergy Project Overview

Through a series of three hotel case studies, this project quantitatively demonstrates that combined energy and water saving strategies provide simultaneous benefits to similar businesses, utilities and the environment.

Electricity, Water & Natural Gas

- Water-related energy demand accounts for 19% of all electricity consumed in California [i]
- Natural gas demand for the heating of water is 32% of all non-thermal power generation use [ii]
- Electricity generation, and electricity and natural gas end uses are accountable for ~34% of all greenhouse gas (GHG) emissions in California [iii]
- Energy efficiency is the best available method for California to meet future energy needs in the face of population growth and potential impacts of climate change[iv]
- The California Energy Commission estimates that urban water use efficiency may prove to be the largest single supply available for meeting growth in both water and energy demand over time[v]

Our Client, Southern California Edison (SCE)

For our client we investigated how integrated energy and water conservation measures could cost effectively aid them in reaching their energy efficiency goals and GHG reduction targets. We built upon SCE's existing electricity audit by calculating the additional energy savings captured from a series of combined water and energy end use technologies.

Commercial electricity consumption accounts for about 37% of the total electricity sold by SCE

Source: California Energy Commission. (2009). *California Energy Demand 2010 - 2020 Staff Draft Forecast*. California Energy Commission.

Many opportunities to increase energy and water efficiency have yet to be captured.

Despite the inherent connection between the energy required at every step of the water cycle, and the water needed to produce energy, there is a lack of coordinated management between electricity, water and gas utilities.

The Water Process

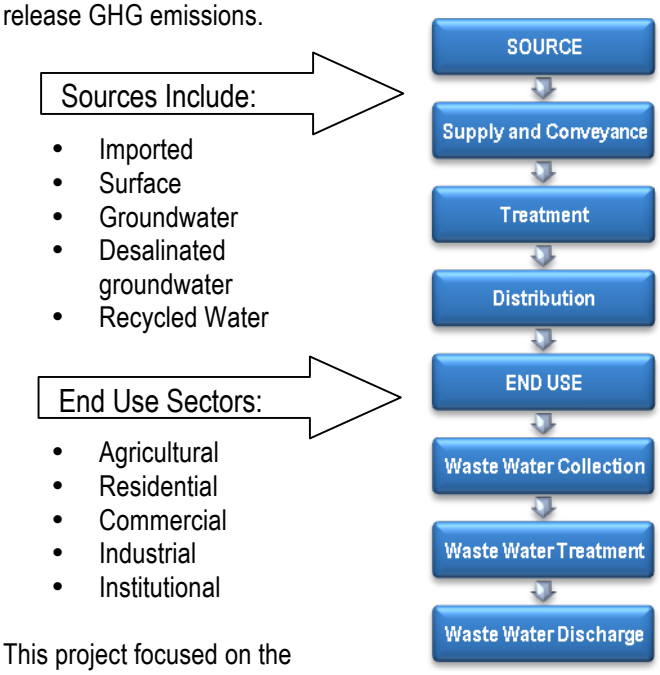
Depending on the region, there are varying amounts of energy embedded in each stage of the water process- many of which release GHG emissions.

Sources Include:

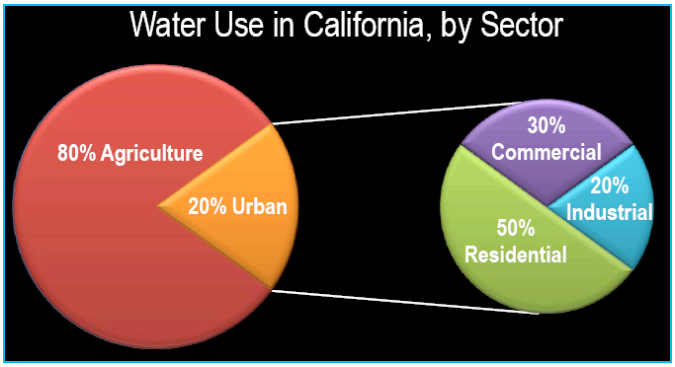
- Imported
- Surface
- Groundwater
- Desalinated groundwater
- Recycled Water

End Use Sectors:

- Agricultural
- Residential
- Commercial
- Industrial
- Institutional



This project focused on the commercial sector, which accounts for 30% of all urban water use in California. [vi]



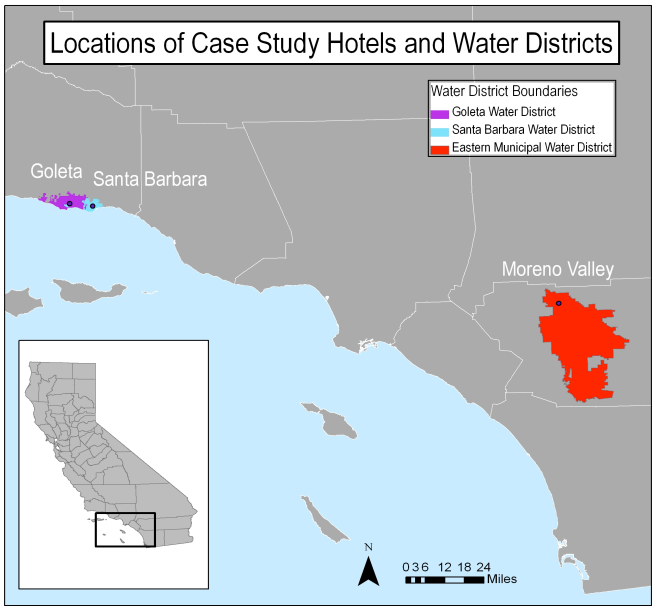
Selecting Hotels as Case Studies

Tourism is of great economic importance in California, making hotels one of the largest and fastest growing industries in the state.[vii] Hotels utilize a variety of end-uses that apply to many other commercial businesses. From landscaping to laundry, our savings analyses highlight opportunities for commercial businesses to save money and resources.

We partnered with three of SCE's hotel customers to perform a combined energy and water audit that quantitatively captured electricity and natural gas savings opportunities associated with water conservation at the end-use. The three hotels we selected offered an interesting contrast due to their unique mix of water supply sources, age, and current resource efficiency practices.

Regional Differences in Water Supply Source

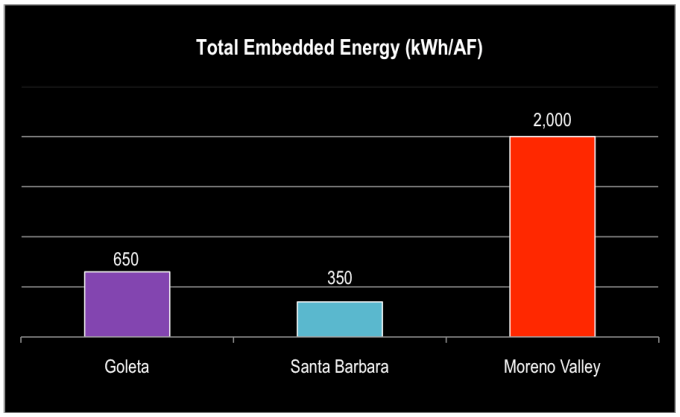
To demonstrate specific water-related energy savings for our case studies, it was important to understand the unique water source mix and water production processes used in each location. The amount of energy saved through water conservation varies depending on the energy intensity of transporting water to that location. Additional embedded energy savings also depend on the energy consumed during the pre-treatment, distribution, and wastewater treatment processes at each water district.

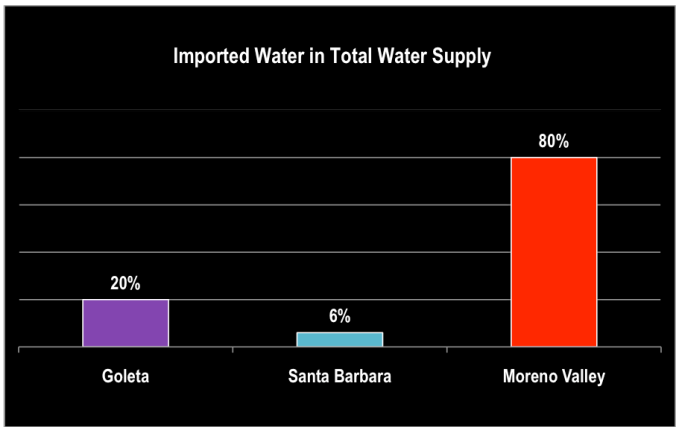


Data source: (National Atlas, 2009)

Our case studies are in Santa Barbara, Goleta, and Moreno Valley. Moreno Valley is in a region that predominately relies on energy intensive imported water transported from either northern California or the Colorado River. Therefore, each gallon consumed has significantly more embedded energy than a gallon of water consumed in Goleta or Santa Barbara.

Goleta and Santa Barbara are regions that mainly draw from local gravity-fed surface water or groundwater.





Synergy Auditing Methods

We designed our audit with the intention of quantifying the energy related to water end uses not currently captured within SCE's electricity audit. We estimated the annual water and energy consumed by our targeted commercial end-use categories at each hotel by combining historical occupancy data and utility bills with our own measurements. SCE performed a comprehensive electricity audit at each case study hotel which allowed us to compare our results to their reported savings.

Type of Resource Used by Each Targeted End Use			
Category	Water	Gas	Electricity
Ice Machines	X	-	X
Dish Washers	X	X	X
Pools	X	X	X
Washing Machines	X	X	X
Faucets	X	X	-
Shower Heads	X	X	-
Landscaping	X	-	-
Toilets	X	-	-

Synergy Auditing Results: Hotels

We explored retrofit scenarios for our selected end use categories at each hotel and developed recommendations that ranged from behavioral suggestions to technological upgrades. We only suggested retrofits that are cost-effective over the lifetime of the technology under current usage rates. Modeling a range of future increases in utility prices did not affect the retrofits recommended. However, additional rebates provided by utilities could offset upfront costs and encourage even more resource savings from costly retrofits.

Estimated Annual Resource Savings with All Cost Effective Retrofits				
Hotel	Water (gallons)	Natural Gas (therms)	Electricity (kWh)	Lifetime Savings
Goleta	306,000	7,400	11,500	$69,000
Santa Barbara	1,047,500	23,700	10,000	$226,000
Moreno Valley	446,500	2,000	16,000	$54,000

Each hotel receives a tailored report outlining our recommended retrofits and several best management practices to consider at the facility. Even with the variance in age and current practices, common retrofits for each hotel are related to faucets, pools and irrigation. We found the largest potential savings at the Santa Barbara hotel because it is an older facility with less efficient existing technologies.

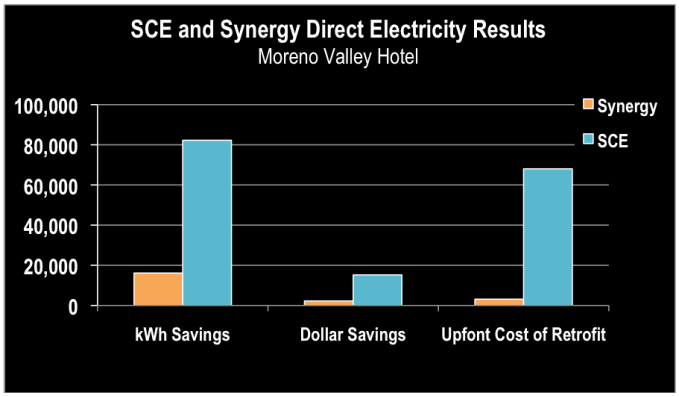
Type of Recommended Retrofits		
Goleta	Santa Barbara	Moreno Valley
Faucets	Faucets	Faucets
Pool	Pool	Pool
Irrigation	Irrigation	Irrigation
Showerheads	Showerheads	
	Toilets	
	Laundry	

Our recommended retrofits saved GHG emissions from the reductions in natural gas, energy embedded in water, and direct electricity use. The energy and GHG reductions from the recommended retrofits at our case study hotels offer added opportunities for SCE if these savings are incorporated into their existing electricity audits.

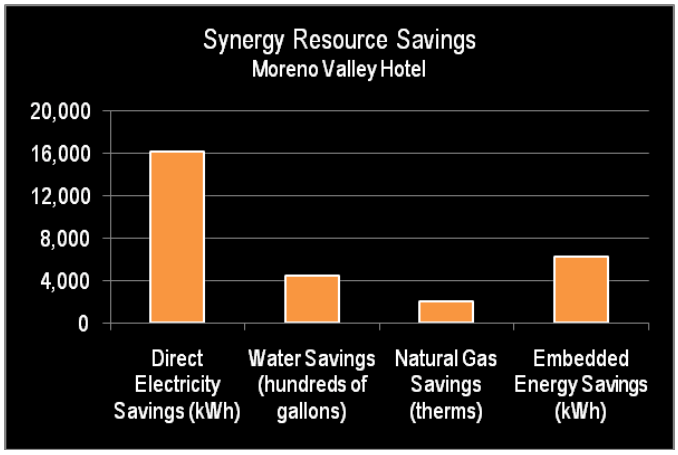
GHG Emissions (metric tons CO2 equivalents)			
	Goleta	Santa Barbara	Moreno Valley
Before Retrofits	90	230	30
After Retrofits	45	100	10
GHG Savings	45	130	20

Synergy Auditing Results: SCE

The retrofit results that we present to SCE focused on direct electricity, embedded electricity, natural gas, and GHG emissions savings. We also reported the monetary savings accrued to the customer through reduced utility bills. We have highlighted the results from the Moreno Valley hotel below. Even though we calculated savings over the lifetime of each retrofit, our savings reported are only for the first year to allow for direct comparisons with SCE's auditing results.

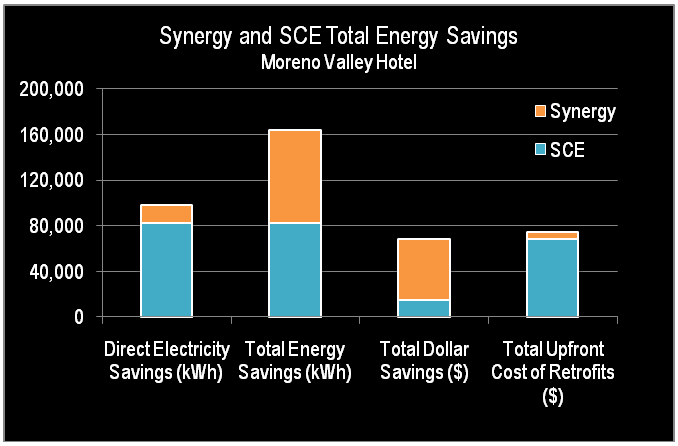


SCE found more direct electricity savings than the Synergy audit was able to capture at the Moreno Valley hotel. The recommended retrofit that saved direct electricity at this hotel was through the installation of energy efficient pool and spa lights. SCE recommendations include installation of a programmable thermostat on the existing HVAC system, and several lighting retrofit measures throughout the hotel.



Our combined audit found significant resource savings in terms of direct electricity, water, natural gas, and embedded energy in water. The embedded energy savings represent about 1/3 of the direct electricity savings at the Moreno Valley hotel. Due to the energy intensive imported water in this region, the embedded energy savings for the Moreno Valley hotel are at least 45% higher when compared to the Goleta or Santa Barbara hotels.

Summary of Results for SCE

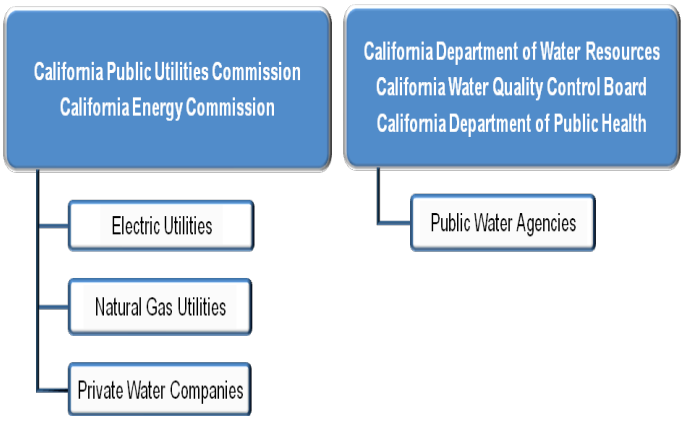


We found considerable potential for resource conservation opportunities with combined energy and water audits. We added 20% direct electricity savings to the amount that SCE found at the Moreno Valley hotel. Additionally, our Synergy audit doubled the total energy savings found by SCE, and captured 70% more cost savings with retrofits which are only 9% of the upfront costs of SCE recommended retrofits. The total energy savings include direct electricity, energy embedded in water and natural gas (therms converted to kWh).

While most of our results are more relevant to water and natural gas utilities, we found additional measures that SCE can incorporate into their audits to realize more direct electricity savings. For example, energy efficient pool lights and reducing the running time of pool pumps can save a significant amount of direct electricity.

Potential Opportunities for California Utilities, Businesses and the Environment

The current regulatory environment in California separates the management of electricity, water and natural gas utilities.



- Our project demonstrates the value of coordinated resource management by quantifying the combined water, electricity and natural gas saved with a single retrofit that traditionally only calculates one type of resources savings.
- In scenarios where water, natural gas, or electricity savings potential are high, utilities could cooperate to offer joint rebates that may further entice efficient upgrades.
- As commercial businesses become aware of the savings associated with combined resource conservation measures, they can save money by making more informed decisions related to investments in efficient technologies.
- Concentrated efforts by the state, utilities, and businesses to integrate energy and water conservation strategies will lead to important reductions in resource consumption throughout California.
- Under the current regulatory structure there is not a mechanism for utilities to receive credits for the energy savings and greenhouse gas reductions from energy embedded in the water cycle.

Conclusion

California has ambitious energy and water conservation goals and GHG reduction targets. Our results show that coordinated resource management should be considered as a part of a successful conservation strategy by capitalizing on cost effective resource savings opportunities. The savings we identified at our three hotel case studies suggest that significant energy and water conservation opportunities exist across the commercial sector in California. Our savings and recommended retrofits varied by hotel, but cost effective energy and water conservation technologies such as faucet aerators; low flow showerheads; pool pumps, lights and covers; and efficient irrigation systems offer large potential savings. Through quantifying the synergistic savings across all resources, these measures often prove to be cost effective for end users, and assist the utilities and the state in achieving efficiency goals.

Acknowledgements

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[iv] California Energy Commission & California Public Utilities Commission. (2003). The State of California Energy Action Plan.

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[vii] Dean Runyan and Associates. (2009). California Travel Impacts by County, 1992-2007.