

ULI Sustainable Communities Initiative Council: Best Practice Case Study

# Lake Forest II Aquatic Facility Cogeneration System



|                         |  |
|-------------------------|--|
| <b>Location</b>         | Lake Forest, CA  |
| <b>Size</b>             | 26.7 Acres   |
| <b>Date constructed</b> | August 2012  |
| <b>Uses</b>             | Community Recreation Facility  |
| <b>Facility</b>         | Fitness, recreation, and clubhouse buildings; adult pool, two Junior Olympic pools |
| <b>Serves</b>           | 3,436 households   |

## Introduction

Cogeneration is a simultaneous heat and power production system using one primary fuel, such as natural gas. This technology is commonly used for facilities to produce their own electricity, while capturing excess heat for other thermal needs. The aquatic facilities under the Lake Forest II Master Homeowner’s Association require a substantial amount of thermal heat and electricity due to their constant use by the community. A cogeneration system was applied to the facility with the purpose of reducing on-grid electricity usage, as well as total heating and electricity costs for the aquatic facilities.

Cogeneration technology has been around for more than 100 years and on-going improvements in emission control systems have made the technology viable for an increasing range of applications, both small and large. As a result, these systems are highly competitive with other clean energy technologies, such as Photovoltaic (PV) and Thermal Solar systems for their low cost to install, low cost to operate and low carbon footprint.

## Drivers for sustainability achievement

The Lake Forest II Master HOA led the initiative for a more sustainable heating and power supply for their aquatic facilities, with significant support from the HOA staff members. Prior to the cogeneration system, only one pool was heated in the winter months due to significant heating cost. The new cogeneration system allowed all three pools to be heated, while significantly reducing on-grid electricity usage and total operational costs.

## Triple bottom line of sustainability benefits

### Economic

Prior to the cogeneration system, electricity costs averaged \$140,000 a year and natural gas cost averaged \$40,000 a year, while heating only one pool year-round. After installation of the cogeneration system, the facility was able to heat all three pools year-round and still produce a net annual savings of approximately \$34,000 a year. A major portion of the cogeneration cost savings occur due to reduction in monthly on-grid electricity demand from approximately 118 – 130 kW to 60 – 65 kW. The installation of the cogeneration system also qualified the HOA for a new small commercial gas rate, reducing the per-unit cost by 50 percent. The system requires routine preventative maintenance and capital reserves for equipment replacement that costs approximately \$1.70 per hour of operation. However, the new system also allows for operational and maintenance cost savings with less frequent service and longer life expectancy of the pool heaters. The maintenance costs are built into the net annual savings figure.

Since the HOA purchases electricity from Southern California Edison (SCE) on a Time-of-Use (TOU) basis, the cogeneration control system incorporates demand response and predictive control algorithms to follow the building electrical load, thereby reducing costs associated with both consumption (kW-hrs) and demand charges (kW). The current TOU electricity rate schedule includes \$0.075 off-peak, \$0.15 mid-peak and \$0.38 on-peak cost. Demand and TOU savings run approximately \$2,000 a month in the winter (eight months of the year) and \$7,000 a month in the summer (four months of the year).

### Environmental

The cogeneration system at the Lake Forest II Aquatic Facility allowed a reduction of on-grid electricity consumption by 50 percent, while natural gas demand nearly doubled. This shift toward greater use of a cleaner energy source reduced the facility's carbon footprint by 54 percent. The cogeneration system produces 75 kW of electrical power and 147 kW of heat, equating to a total system efficiency of approximately 80-90 percent compared to the typical combined efficiency of 58 percent for on-grid electricity and natural gas. The annual emissions of carbon dioxide associated with the aquatic facility electricity usage reduced from 362,795 pounds to 166,372 pounds. The sulfur dioxide emissions reduced from 99 pounds to 45 pounds and electricity consumption from 231 pounds to 106 pounds. This reduction is equivalent to the annual greenhouse gas emission of 18.6 passenger vehicles or electricity use of 12.3 houses.

### Social

The facility is accessible to HOA residents and their guests and serves approximately 200 visitors a day with peak summer days reaching 1,000 visitors. The three pools are used by 4-10 people an hour throughout the year and 20-30 people an hour during the summer. The club sponsors a competitive swim team (Lake Forest II Dolphins), which consists of approximately 50 swimmers in the winter and 150 swimmers in the summer. The heating of all three pools in the recreation facility allowed for increased

usage of the aquatic complex and additional recreational benefit to the community. Overall, the cogeneration system provides an opportunity for increased community recreation, interaction and education in sustainable energy management.

### Financing details

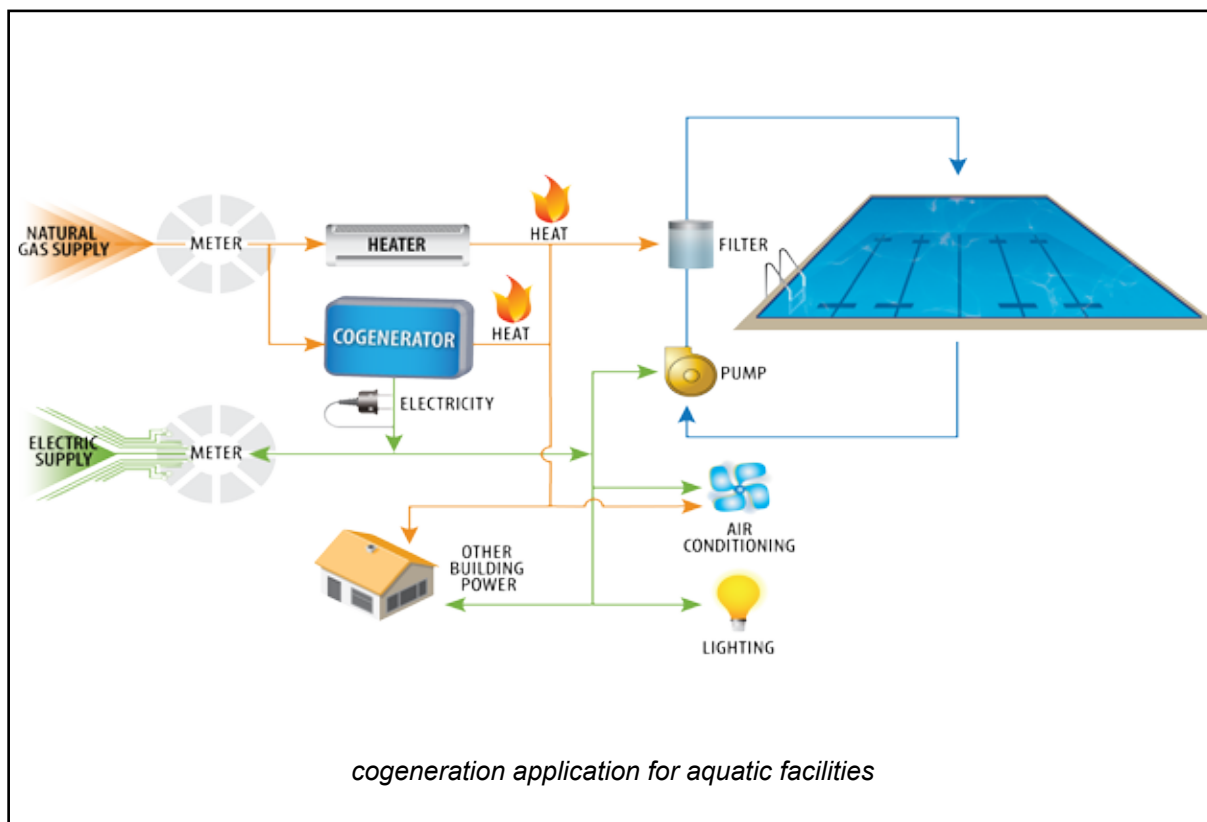
The overall capital cost for the project was \$225,800; including design, engineering, permitting, equipment procurement, installation and commissioning of the system by PACE Advanced Water Engineering. No new facilities were required to house the new system resulting in no new construction costs.

### Innovative system features

The cogeneration system consists of a 75 kW module installed in the existing pump room, requiring no additional space. Electricity generation and pool heating are operated automatically on a customized control system where power and heat are only generated when they can be consumed, saving money compared to on-grid sources. The automated control system allows remote monitoring, control and data collection using an iPad, iPhone, or computer using a secure internet connection.

### Measured performance data

The cogeneration control system continuously monitors and records real-time site demand, power production, thermal production and net energy savings. The real-time data is used to adjust power and heat generated at various demand periods, as well as to create a demand profile for specific times of the week. Real-time savings are continuously calculated based on current electricity and natural gas rates. System data monitoring and analysis is performed by PACE Advanced Water Engineering and Tecogen, while monthly utility costs are analyzed by the HOA.



## Conclusion

The Lake Forest II Master Homeowner’s Association (HOA) is comprised of 3,436 households and a central recreation facility including a fitness building (4,300 sq ft.), recreation building (1,900 sq. ft.), main clubhouse (20,000 sq. ft.), an adult pool (2,200 sq ft.), and two Junior-Olympic pools (3,350 sq. ft./per). The Lake Forest II Aquatic Facility cogeneration system effectively reduced on-grid electricity usage and the annual cost of heating and electricity. The new system allowed all three pools at the recreation facility to be heated throughout the year, while maintaining a considerable net annual savings. This clean energy technology enabled the HOA to meet the triple bottom line of sustainability with an increase in electricity cost savings, a reduction in the facility’s carbon footprint and an increase in the community usage of the aquatic facility.



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|                            | Pre-construction | Post-construction         |
|----------------------------|------------------|---------------------------|
| Monthly Electricity Demand | 118-130kW        | 60-65kW                   |
| Commercial Gas Rate        | Current          | 50% reduction             |
| Number of Pools Heated     | 1                | 3                         |
| Facility Carbon Footprint  | Typical          | 54% reduction             |
| Annual Operation Cost      | Typical          | \$34,000 / year reduction |
| Annual O&M Cost Savings    | None             | 20-30%                    |



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## Acknowledgements

2014 Best of the Best Award recipient

PACE Advanced Water Engineering

Sources: <http://pacewater.com/services/environmental-water/controls-instrumentation/lake-forest-ii-sun-sail-club-swimming-complex-cogeneration-system/>

ULI Orange County/Inland Empire District Sustainable Communities Initiative Council