Fuel cells are extremely rare on college campuses, and installations with one-megawatt of capacity are rarer still. The fuel cell power plant at CSU Northridge can boast both of these distinctions, making it the largest installation at any university in the world. The ultra-clean plant produces 18 percent of the campus’s base load electricity, and thanks to a combined heat and power application, electricity is produced at double the efficiency of the nation’s electrical grid.

CSU Northridge pioneered this unique project after commissioning a study to evaluate the effect of campus growth under its 2035 Master Plan on the existing central plant. The 2003 study confirmed the campus’s suspicion that the plant was already nearing its peak cooling capacity, and revealed that all new construction would require individual chiller units, and in some cases, remote heating as well. Not only would capital construction costs increase under this scenario, but the campus’s overall energy efficiency performance would drop. Given that a conventional infrastructure build-out was likely to cost $15 million, the campus began exploring the merits of using fuel cells to self-generate energy.

CSU Northridge projects that the fuel cell plant will generate $14.5 million in net savings on capital growth, energy and maintenance costs over the next 25 years.

After an exhaustive examination of technical materials, economic analyses, numerous site visits and discussions with industry individuals, the campus determined that fuel cell power generation was an economical long-term energy strategy. Analysis showed that a one-megawatt power plant could simultaneously eliminate costs associated with in-building heating and cooling equipment, reduce maintenance costs and lower energy usage per campus square foot.

In addition to the infrastructure and budgetary advantages of installing a fuel cell, CSU Northridge was highly impressed by the technology’s environmental benefits. The project would support the climate protection and emissions reduction challenges set forth in CSU Executive Order 987 and the system-wide ReNew CSU campaign. With both economics and the environment in alignment, the campus decided to install four highly efficient 250 kW molten carbonate fuel cells. At the time, the next largest installation at any academic institution was a single 300 kW cell.

CSU Northridge is thought to operate the 11th fuel cell plant 1 MW or larger worldwide. Photo: CSUN.

Most of the environmental gains achieved by fuel cells over utility-generated power arise because the technology uses electrochemical processes to convert fuel into electricity. With no combustion taking place, fuel cells can produce electricity with nearly zero particulate emissions. The ultra-clean technology installed at CSU Northridge also reduces greenhouse gas emissions by 69 percent compared to the same amount of energy generated by the California electrical grid. This translates to 6400 tons of carbon dioxide emissions per megawatt-year and over 100 tons of other greenhouse gases prevented from entering the atmosphere annually.
The campus has amplified the plant’s positive environmental impacts by installing a combined heat and power application. Thermal energy that would otherwise be rejected as waste heat is recovered and used to warm the student pool and provide nearby facilities with heating and domestic hot water. This element raises the plant’s 47 percent electrical efficiency to an overall efficiency of roughly 80 percent. Capturing such a large percentage of the energy content in natural gas allows the university to use less fuel overall and avoid additional emissions beyond the fuel cells’ inherent non-combustion emissions savings.

Self-generating electricity has proven to be a highly economical energy strategy for CSU Northridge. With all expenses and utility incentive funding considered, the cost of electricity generated by the fuel cell is very nearly equal to the price of utility-purchased power. The plant has also increased the campus’s overall energy efficiency performance by 13.3 percent. Had the university chosen to install in-building chillers and forgo pursuing this innovative system, its overall energy usage per gross square foot would have increased by 3.8 percent. The energy performance gains made possible by the fuel cell installation will save operational expenses and soften the campus’s environment impact for the next quarter decade.

LESSONS LEARNED

Every fuel cell site researched by the campus took a proprietary approach to ownership where the manufacturer owned the fuel cell and agreed to a performance contract. CSU Northridge chose to deviate from standard industry practice and purchase its installation outright. This produced a notable financial advantage over proprietary ownership by enabling the campus to competitively bid the fuel cell equipment and by shifting the risk of self-installation and generation to the campus.