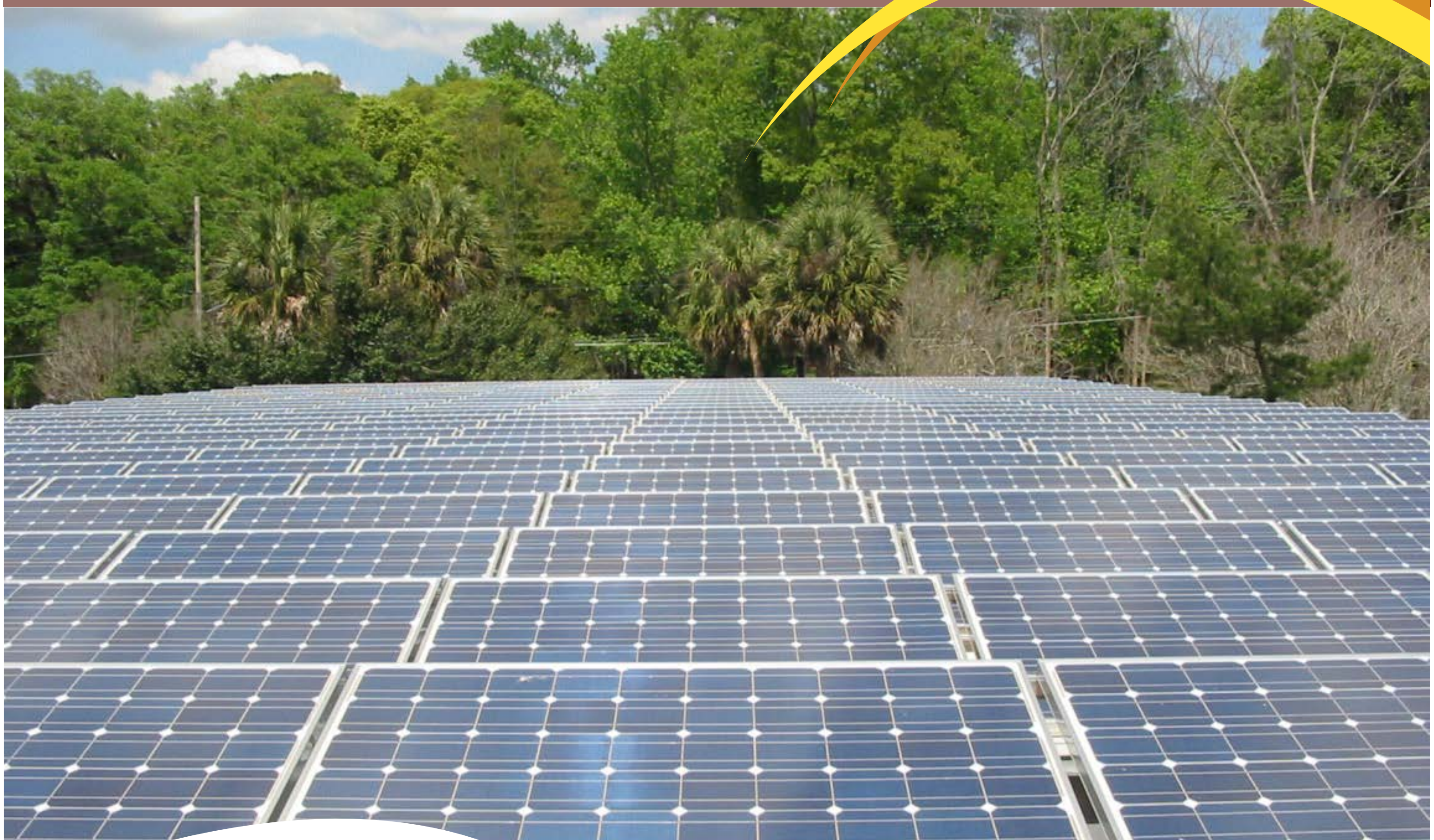
Leon County's Sustainable SOLAR ENERGY Demonstration – at the Leon County Extension Center



Solar Photovoltaic Panels
integrated with
Closed-loop Geothermal Heating and Air

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Powering High Efficiency Retro-fits with Renewable Solar Energy

The Sustainable Building Demonstration Center is powered by renewable energy from the sun. The solar photovoltaic (PV) panels are mounted about 10 feet above the ground on a steel beam structure, which allow them to serve a second function as shaded parking. The solar array is a 60-KW system, which supplies enough energy to meet the 13,289 square-foot building's annual power demand through a "net-metering" arrangement offered by City of Tallahassee Utilities.

INTEGRATING SOLAR PHOTOVOLTAIC WITH CLOSED LOOP GEOTHERMAL

To reduce the number of solar panels needed to meet "net-zero," half the building's heating, ventilation and air system (HVAC) was upgraded to closed-loop geothermal technology. It uses the earth's relatively stable temperature down to 90 feet of depth to reduce the mechanical energy needed to cool the building's air in summer, and heat it in winter. A system of pipes carries water through vertical loops in 60 bore holes underneath grassed parking. Passive heat transfer of at least 5° F underground lessens the mechanical system load.

This geothermal HVAC system is approximately 30-40% more energy efficient than a conventional heating and air system. And the cost of installing geothermal to save a dollar's worth of electricity is less expensive than the cost of installing solar PV to save the same dollar. Since HVAC dominates electric bills in Florida, integrating the two technologies makes sense if one is going to invest in solar PV.

achieving “net-zero” through net metering

The Demonstration Building’s solar PV ground-mount array has 253 panels, each of which can produce up to 240 Watts. As a distributed producer of electricity, the building exports to the grid any instantaneous excess of electric energy not consumed by the building. Conversely, when the instantaneous demand for power exceeds the array’s output (which happens on cloudy days and at night), energy flows from the City’s grid as if the array weren’t present. The electric meter runs in both directions to calculate the energy flow, and keeps track of the “net” surplus exported or imported. This function is called “net metering.” The net meter serves as an automated energy-flow accounting ledger.

The 60 kW array is sized to produce a net surplus of energy during the shoulder seasons (spring and fall) when the building’s HVAC system runs fewer hours per day. Electric energy credits in kW accumulate. During the heavy heating and cooling months (summer and winter), the building/PV array “system” will run a net monthly deficit, and draw energy credits from the net meter’s ledger.

WHAT DOES “NET-ZERO” MEAN?

If the net energy consumption from the electric grid for any rolling twelve-month period is zero, the building has achieved “net-zero” status, which means it produces as much energy as it consumes.

WHAT HAPPENS IF THE BUILDING BECOMES A NET ENERGY PRODUCER?

Beginning with the 12-month anniversary of installation, any net surplus in kWh generated ***over the preceding 12 months***, as determined by each billing period, is *not* carried forward as an energy credit any longer, and becomes a donation of energy to the City of Tallahassee Utilities.

"NET-ZERO" AND PEAK DEMAND

- Achieving net-zero in operation of the building will not zero out the electric bill. Because the Extension Center is a commercial customer with a peak demand that historically has exceeded 25 kWh/month for at least one month in every rolling 12-month period, it also pays a "peak demand charge."

- This charge is based on the highest computed demand that a commercial "peak-demand customer" such as the Extension building places on the City's grid each billing period. It is computed automatically. Rolling thirty-minute averages are compared to determine the one with the highest peak.

- Solar PV installations typically shift peak demand to nighttime uses, but a cloudy day in summer or winter can also set the peak.

The building's peak demand for all but one of the billing cycles since installation of the energy retro-fits has been under 25 kW/month. But in the July 2012 billing cycle it was 27 kW, which keeps the building in the category of being a "peak demand customer" for at least another 12 months.

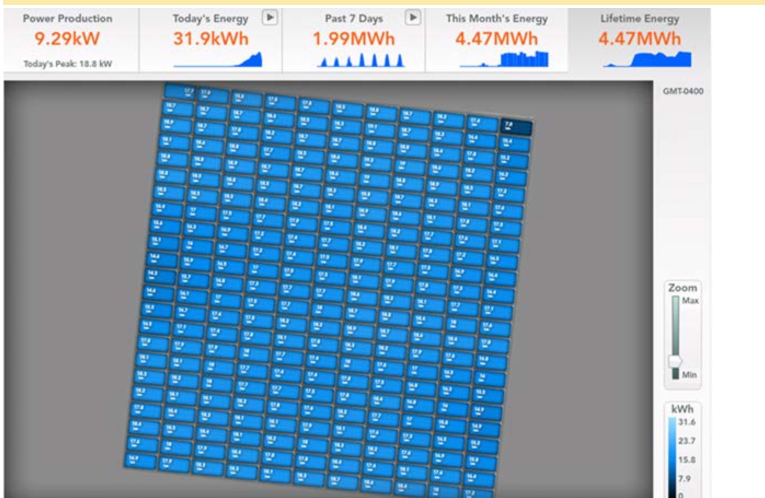
The 253-panel array covers 6120 square feet of area. The building's flat roof was not engineered in 1960 to withstand the wind load force generated from roof-mounted solar PV panels – or even their weight at 60 lbs/panel. So a roof-mount installation was not an option. Instead of consuming 6120 square feet of land in the style of a solar farm, the array was installed in the airspace above pavement. An unplanned side benefit has been gaining a large pavilion that blocks ¾ of the sunlight while admitting ¼. The array provides shaded outdoor exhibit space for biannual garden open houses and other events, plus shaded parking for staff.

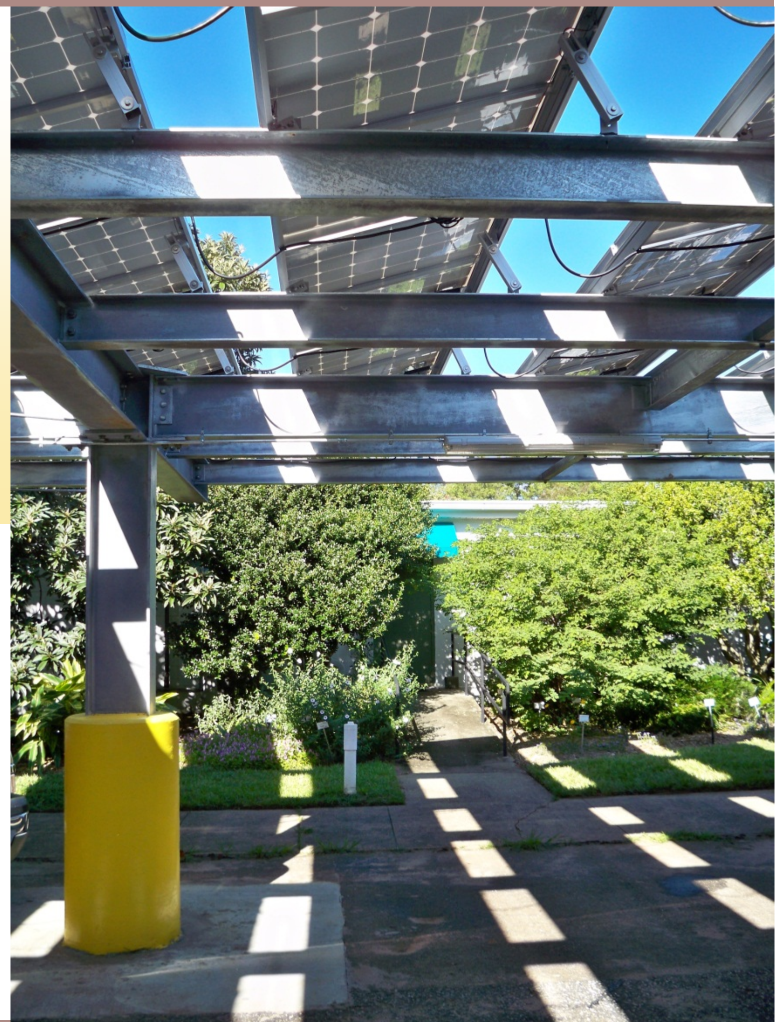
Because the parking-area-array's driveway entrance is from the south, there is clear southern exposure for panels without having had to remove trees that shade the building – trees that reduce heat gain and electricity costs. The solar PV panels are set facing due southward at the fixed angle of 30°, which approximates the latitude of Tallahassee (30° 26' 17" North Latitude). This positioning gives the best annual performance (annualized electric production) for an array with fixed-mount panels. A more expensive mounting system can optimize performance by programming its panels to track the seasonal variation in altitude and azimuth angles of the sun-path across the sky from east to west.

Each of the 253 PV panels has its own inverter, an electronic component that converts the direct current (DC) produced by the solar cells into alternating current (AC). Each inverter is called a "micro-inverter" because of its down-scaled electrical capacity. A micro-inverter produces grid-compatible power right at the back of the panel. Arrays of panels are connected in parallel to each other, and then feed into the building's electrical panel. This arrangement means that a single failing panel or inverter will not take an entire string offline – a major advantage. It also means that whether a given panel will generate power isn't dependent on whether other panels are shaded or not, because there's no string connected in series that must collectively achieve enough voltage to "turn on."

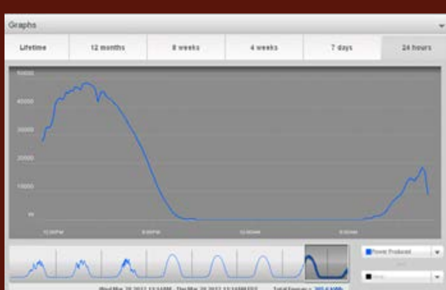
WEB-BASED MONITORING OF SYSTEM PERFORMANCE

A web-based monitoring readout (from the company Enphase) allows real-time monitoring of production by the entire array, and production per panel, over various periods of time (daily, weekly, monthly, etc). The software automatically sends e-mail notification about under-performing and possibly malfunctioning panels. A separate web-based readout (from the company eGauge) graphs the building's real-time power production *vs* real-time power use, over various periods of time ranging from the last 60 seconds upwards to one year.





Leon County Sustainable Building Demonstration



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