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Beyond the USGBC's LEED v3 standard: Examining Net Zero Energy Buildings

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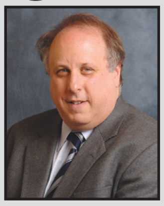

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First introduced in 1998, today USGBC's LEED v3 standard is everywhere from single family residences to class A office buildings. Two months ago, GSA upgraded minimum requirements for new federal building construction from LEED Silver to LEED Gold certification. While a great step forward for the U.S. and Canadian construction industry, critics often complain the LEED points system is not stringent enough and allows developers to green wash buildings that barely exceed ASHRAE 90.1, which is the default energy standard of most U.S. jurisdictions.

European high energy efficiency building standards such as Passivhaus (Germany) or Minergie (Switzerland) ignore all the less quantitative environmental goals of LEED such as alternative transportation or indoor air quality, and focus on one component only ENERGY. Passivhaus standard has three simple metrics:

1. Annual heating/cooling energy usage per square meter;
2. Annual primary energy usage per square meter; and
3. Hourly air change rate.

Net Zero Energy Building (NZEB) is the logical next step in sustainable design & construction. In the U.S. and Canada, NZEB is defined as a building where the amount of energy generated by on-site renewable energy sources equal the amount of energy used by the building. In European NZEB, carbon emissions generated from on-site or off-site fossil fuel use are offset by the amount of on-site renewable energy production.

NZEB is achieved by a combination of two strategies. Strategy 1 is on-site energy generation such as point of use renewable energy from solar, hydro, biomass, wind & geothermal. Strategy 2 is building energy use reduction, increasing building systems efficiency and reducing occupant energy use. Some of the renewable technologies below may be familiar to you; others are more commonly used in industrial or utility applications.

Solar: Photovoltaic; solar cooling; Rankine cycle turbine; and fiber optic lighting.

Hydro: Tidal; wave motion.

Biomass: Bioethanol; biodiesel; and agriculture waste.

Wind: Turbines.

Geothermal: Ground loop heat pump; thermal power plant; and thermal storage.

While LEED covers many strategies used to reduce building energy consumption, two common ones used to achieve NZEB are not emphasized: Tenant engagement and natural ventilation. Designing the building to encourage tenants to take stairs can reduce elevator electrical use. Education and voluntary action of building tenants can greatly reduce office power use along with energy star equipment and smart outlets. Smart outlets can be set on a schedule, can sense power draw when charging ends, or turn off computer peripherals automatically when the desktop is shutdown. For moderate climates, NZEB buildings are designed with operable windows and outdoor temperature and humidity monitoring sensors to alert tenants when outdoor conditions allow natural cooling instead of using mechanical systems.

As part of GSA's goal to reduce power usage and utility bills in new facilities, JFK&M was commissioned to study the feasibility of constructing a NZEB building in a southern U.S. building. Most NZEBs are built in northern climates with long heating seasons. This is because it is much easier to super insulate the building to retain heat than ejecting it during cooling season. Ventilation rates required to meet ASHRAE 62.1 also cause problems because outdoor air dehumidification equals a higher cooling load. Another issue we came across is the lack of sufficient local utility network infrastructure to feed excess power back into the grid during off hours.

Majority of power for the building will be provided by a cogeneration plant with excess heat used by an absorption chiller for cooling. A solar thermal collector array will also take advantage of the southern locale to supplement heat for the absorption chiller. During weekends and moderate cooling days, a thermal storage system will collect chilled water for later use. Thermal storage can also help alleviate the lack of utility infrastructure. When a building requires less power than generator capacity, instead of turning off the generator, electricity is used to power electric chillers for cooling or recharging the storage tank. The monthly electric bill for the existing building in the study is approximately $1 per gross s/f per month; we estimate a new NZEB will reduce that by 80%.

As LEED becomes the de facto standard for more and more companies and municipalities, nationwide NZEB adoption will be the next step in green buildings and bring us closer to oil independence and a truly sustainable future.

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