Town of Carrboro
Town Hall Building; Century Center Building; Public Works Complex
Defining Net Zero Metrics and Boundaries

November 23, 2020

Background

The Town of Carrboro is considering options for renovating the Town Hall, Century Center, and the Public Works complex. The Town is seeking to develop a long-term renovation strategy while at the same time addressing immediate needs which have been identified by Town Staff. As part of the renovation effort, the Town would like to work towards the energy sustainability goals set forth in the Town's adopted Strategic Energy and Climate Action plan, which includes working toward net zero energy use.

A first step in the process of achieving a net zero energy building is to define the term "net zero" and to establish the criteria for a net zero energy building. This is more than an exercise in semantics, as the definition and criteria chosen can have significant effects on design decisions and project costs. Regardless of the definition chosen, the general approach to achieving net zero is to first conserve as much energy as is feasible, then use renewable energy to offset the remaining usage.

Defining "Net Zero"

The basic idea of a net zero energy building is that, over the course of a year, it has completely offset its energy usage by renewable energy production. Beyond this general concept, there is no single, universally accepted definition for a net zero energy building. The exact definition used for any given project is a choice made by the building owners and project team based on motivations, priorities, budget, building and site characteristics, and other constraints. The US DOE and the National Renewable Energy Laboratory (NREL) have developed a clear framework and guidance to aid owners and designers in choosing the defining criteria for their specific project.

In short, there are two decisions to be made: what metric will be used to evaluate the building's performance (i.e. net zero what?), and what is the boundary within which renewable energy may be generated? Each of these questions is addressed below.

Defining the Metric

NREL has presented 4 options for defining the metric by which a net zero building can be evaluated: Site energy consumption, source energy consumption, greenhouse gas (GHG) emissions, and energy cost.

Option 1: Net Zero Site Energy: A net zero site energy building will offset the energy it uses on site with renewable energy. The energy consumed is seen directly on the building's utility bills. Some owners see net zero site energy as an attractive metric primarily because it is easy to understand and its calculation does not depend on complex factors outside the boundary of the building. This metric steers designers away from natural gas as a heat or domestic hot water fuel in favor of heat pumps or even electric resistance heating.

Solar hot water is often a more attractive renewable energy source than photovoltaics under this metric.

Option 2: Net Zero Source Energy: The source energy metric considers the source of the energy used in the building. For instance, the source energy metric would account not for the electricity used in the building, but for the coal used at the power plant to produce the electricity used in the building. This metric is favored by owners whose primary motivation is to conserve the Earth's fossil-based energy sources and to reduce the environmental damage associated with the extraction of these fuels. Using this approach largely levels the field when comparing natural gas heating versus electric heat pumps.

Option 3: Net Zero GHG Emissions: This metric is based on the GHG emissions associated with the energy used in the building rather than the energy itself. For instance, the GHG emissions metric would account not for the electricity used in the building, but rather for the airborne pollution generated by the power plant as it produces the electricity used in the building. A net zero GHG building might also be called a "carbon neutral" building. Net zero GHG emissions is chosen by owners whose primary motivation is to mitigate climate change. This metric favors the use of natural gas over electricity use, and places high value on producing renewable electricity (e.g. photovoltaic panels).

Option 4: Net Zero Energy Cost: A net zero energy cost building will offset the building's energy cost over the course of a year with renewable energy sold to the grid or other users. This metric is perhaps the simplest to understand, but it may not fit with the Town's Climate Action Plan. The most attractive systems and fuel types under this metric are variable, depending on the comparative market rates of the different fuels.

Defining the Boundary

Any net zero building will require renewable energy either to power the building directly or (more likely) to offset the building's consumption of non-renewable energy. Where this renewable energy can be generated in order to count towards this offset is determined by the building owners and project team. NREL has presented 4 options, in order of decreasing constraint: building footprint generation, building site generation, imported renewables, and purchased generation.

Option A: Building Footprint Generation: This option applies the constraint that all renewable energy must be generated within the footprint of the building itself. A common example of this would be PV panels installed on the building's roof.

Option B: Building Site Generation: Renewable energy may be generated anywhere within the property lines of the net zero building. Under this option, for example, a building may have PV panels on its roof as well as on the ground or on an on-site parking canopy.

Option C: Off Site Renewables: Under this option, renewable energy may be imported from off-site and used on-site. A typical example would be biomass or biofuels used for heating. While not explicitly stated by NREL, it is our opinion that renewable energy generated by a system owned by the building owner and located on land which is owned by the building owner (though not on the building site) would qualify under Option C. An example would be PV panels located on a Town-owned park. This option simply expands options for renewable generation, it does not exclude the possibility that some energy may still be generated on the building or the building site.

Option D: Purchased Generation: This option allows renewable energy to be generated by others and

purchased by the building. This is often done in the form of Renewable Energy Credits (RECs). In this case the renewable energy itself is not necessarily used in the building, but the offsets created by the renewable energy are purchased and claimed by the building owners. Under this option, each of the previous three options may be included in the total mix of generation possibilities.