SOURCE ENERGY

ENERGY SAVING FACT SHEET

SOURCE ENERGY—DEFINING THE CORE BENCHMARK FOR RANKING A BUILDING'S ENERGY AND ENVIRONMENTAL PROFILES

Source Energy is defined by the processes of energy use and the losses encountered during the conversion of fuel sources to a different state. These processes are defined in major ways by steam production via utility boilers being heated by coal, natural gas, and nuclear fuels with the subsequent use of high pressure steam turbine generators to provide electric power to our homes and businesses. Each of these processes has an energy efficiency and environmental greenhouse gas (GHG) signature that will represent one component of the "source energy" to meet the power demands of electricity. In addition to these major fuel resources, there are renewable or "green" sources (*) such as solar, wind, hydroelectric, and biomass that contribute to North Carolina's Electric Generation Profile. A 5-year snapshot (Table on right) of North Carolina's megawatt hours of electricity production shows the changing energy resource profile of generation. The effects of this transition will provide enhancements in:

Generation Efficiency – kWh consumed to kWh produced for use at our businesses

Generation Diversity – Non-renewable resource use vs. renewable energy use

Electrical Distribution Losses – source to site logistics of grid design and delivery

Buildings are represented by the term Energy Use Intensity (EUI) to account for energy used at the site. This benchmark term includes all the energy consumed by the building conditioned space for one year from electricity (this can be on-site generated but accounted for), natural gas, and propane account billings. More recently, and in the future, there are solar and wind energy applications that provide for the avoidance of conventional energy sources for electricity generation. This will eventually affect the accounting system for source to site as many states such as North Carolina have made legislative commitments for renewable energy use in generation portfolios. http://www.dsireusa.org/incentives/

The EUI term is defined in units of 1000 btus/building square feet-yr (kilobtus/sf-yr). Much effort has been made to establish an average EUI value for a building of a certain age, activity schedule, intended use, and for varying climate conditions at a given location. http://energy.gov/eere/buildings/downloads/doe-commercial-reference-buildings. This average EUI served as a means to compare like buildings to a design basis prevailing at different time periods. Later it became the responsibility for building users of purchased electricity and energy fuels to be accountable for all the energy use in providing the convenience of the site service. (Excluding electrical power distribution losses are retained by the utility supplier.)

North Carolina	2012	2008	% Change
Total Electric Industry mWh	**116,681,763**	**125,239,063**	**-6.83**
Coal	50,932,180	75,814,787	**-32.82**
***Hydroelectric**	3,727,938	3,033,642	**22.89**
Natural Gas	19,302,008	4,177,342	**362.06**
Nuclear	39,385,592	39,776,280	-0.98
***Other**	451,865	315,642	**43.16**
***Other Biomass**	302,342	120,482	**150.94**
Petroleum	178,261	320,221	**-44.33**
***Solar**	139,491	1,801	**7,645.20**
***Wood**	2,262,087	1,799,930	**25.68**

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The US Environmental Protection Agency (EPA) has developed an extensive system for ranking buildings on even terms without consideration for state utility electricity generation efficiency or portfolio transitions. This "source energy" ranking system provides for the conventional building EUI values plus a benchmark ranking (1 to 100) when comparing buildings of like function and schedule. http://www.energystar.gov/buildings/about-us/.

Additionally, the use of renewable energy, often called Green Power (solar & wind in Portfolio Manager) https://portfoliomanager.energystar.gov, has specific terms and accounting processes that recognize the growing use of green power at the site as well as off site. Metering is required for *on-site* or *off-site* green power to account for any significant corrections to the source energy EUI. You must own the *on-site* Renewable Energy Certificate (REC) to receive the benefits of source and emissions reductions. Green Power produced off site does not reduce site or source energy - only the benefits are recognized in the calculations of avoided net emissions. Site Energy use improvements resulting from green power also have noticeable reductions from emissions called greenhouse gases. (Carbon dioxide CO_2, Methane CH_4 and Nitrous oxide N_2O). http://www.epa.gov/cleanenergy/energy-resources/calculator.html. Knowing the annual building consumption of electricity, it is possible to equate a CO_2 equivalency value to GHG resulting from the site energy consumption. The same process is defined for other fuel sources that might be used for heating such as natural gas, propane, coal, fuel oils. Figure 1 at https://portfoliomanager.energystar.gov/pdf/reference/Emissions.pdf .

Source Energy – Portfolio Manager and Conversion Factors

Every 3 to 5 years, the EPA Portfolio Manager is updated to reflect the source to site energy ratios that allow a building's site energy use (kbtus/sf-yr) to be converted to source energy. The average for 2007 to 2011 is shown below. The example to follow shows the transition from site to source EUI and GHG's.

https://portfoliomanager.energystar.gov/

Energy Type	U.S. Ratio
Electricity (Grid Purchase)	3.14
Electricity (on-site Solar or Wind Installation	1.00
Natural Gas	1.05
Fuel Oil (1,2,4,5,6,Diesel,Kerosene)	1.01
Propane & Liquid Propane	1.01
Steam	1.20
Hot Water	1.20
Chilled Water	1.00
Wood	1.00
Coal/Coke	1.00
Other	1.00

Example of Site to Source EUI

- Elementary School Building Area - 61,785 sf
- Annual Electrical Use - 592,554 kWh (grid purchase)
- Annual Natural Gas Use – 8,959 therms
- Site (Electricity) – 592,554 kWh x 3,412 btus/kWh/1000 btus/kbtu = 2,021,794 kbtus/yr
- Site (Natural Gas) – 8,959 therms x 100,000 btus/therms/1000 btus/kbtu = 895,900 kbtus/yr
- **EUI (Site)** = (2,021,794 + 895,900) kbtus/yr/61,785sf = **47.2 kbtus/sf-yr**
- **EUI (Source)** = {(2,021,794 x **3.14**) + (895,900 x **1.05**)} kbtus/yr/61,785 sf = **118.0 kbtus/sf-yr**

Greenhouse Gases (eGRID) pg10. Figure 5 @ Virginia/Carolina - 143.5 kg/mbtus
https://portfoliomanager.energystar.gov/pdf/reference/Emissions.pdf

(*The eGRID GHG emission value represents the profile of electricity generation for that region noting that nuclear, hydro, solar, and wind are not contributors of GHG.)*

GHG (Electricity) = 143.50 kg/mbtus x 2.2 lbs./kg x (2,021,794 kbtus/yr)/1000 kbtus/mbtus/2000 lbs/ton=
318.1 tons CO_{2eq} GHG/year

Greenhouse Gases (NG) – using http://www.epa.gov/cleanenergy/energy-resources/calculator.html.

GHG (Natural Gas) = 8,959 therms and find **52.4 tons CO_{2eq} GHG/year**

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The building EUI is now defined by source energy and its environmental effects from electricity production (offsite) and natural gas heating (on site). It is possible to compare on a regional basis and national basis the ranking of this building with other buildings of similar function and climate conditions.

Portfolio Manager - Ranking the Building According to Trends

EPA's Portfolio Manager has developed an Energy Star database of trends that allow the ranking of buildings according to sector specific analysis – energy influencing building property characteristics and climate conditions around the United States.

http://www.energystar.gov/buildings/about-us/research-and-reports/portfolio-manager-datatrends

In our elementary school example, it is possible to not only compare Source EUI, but also to see the range of property characteristic values that influence the EUI.

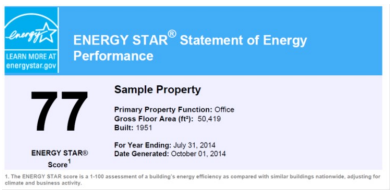
http://www.energystar.gov/sites/default/files/tools/DataTrends_K12Schools_20150129.pdf

- Energy Star Ranking (1 to 100) —A range of scores based upon property characteristics.
- Portfolio Manager Median—A histogram for EUI comparison: 1) Incremental distribution of properties in 10 kbtu/sf-yr segments for each EUI median in each building grouping; 2) Number of buildings in each median EUI group.

Property Characteristics and Climate Conditions

- Building Square Footage
- Computers in use
- Refrigeration Equipment in use
- Cooking Facilities in use
- Type of Schools Elementary, Middle, High School
- Climate Conditions – Heating and Cooling Degree Days

For a given EUI, a range of Energy Star Scoring (1 to 100) is possible according to property parameters and climatic conditions. The Portfolio Manager program will compute the final Energy Star Score based upon climate conditions that are prevailing during the year of data entry. The Energy Star score card will include some of the information as shown below.



Energy Consumption and Energy Use Intensity (EUI)				
Site EUI	Annual Energy by Fuel		National Median Comparison	
75.7 kBtu/ft²	Electric—Grid (kBtu) Natural Gas (kBtu) Propane (kBtu)	2,453,824 (64%) 1,273,766 (33%) 91,000 (2%)	National Median Site EUI (kBtu/ft²) National Median Source EUI (kBtu/ft²) % Diff from National Median Source EUI	103.5 247.6 -27%
Source EUI			Annual Emissions	
181.2 kBtu/ft²			Greenhouse Gas Emissions (Metric Tons CO2e/year)	311

About This Fact Sheet

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