



## Carbon Footprint and the Existing Building

Neil Gifford

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By now you've heard the constant barrage of global warming information and it is almost a daily news issue. But to quote an old saying, "What does it mean to the common man?" Or another way of asking the question might be, "Did you think about CO<sub>2</sub>, Carbon Footprint or reducing emissions today?" If we did one of those national polls you always see referenced on television, I wonder if the average person even realizes the relationships between themselves and CO<sub>2</sub> or would they give you a puzzled look when asked to define carbon footprint.

In case you have been on some remote island without television or internet for the last two years, here are a few statistics as quoted by "The Good Sheet", number one for the week of September 11-17, 2008. This information is compiled from the Alliance for Climate Protection, the EPA, the DOE and other organizations:

- Safe levels of atmospheric CO<sub>2</sub> is no more than 350 Parts Per Million and we are currently at 385 Parts Per Million
- The world average for CO<sub>2</sub> emissions is 9,600 pounds per person per year, the US average is 44,400 pounds per person per year
- Total US CO<sub>2</sub> emissions by sector is Transportation at 34%, Industrial at 28%, Residential at 20% and Commercial at 18%
- The highest producers of CO<sub>2</sub> emissions in the Residential and Commercial sectors are heating at 47% and lighting at 32%
- Air conditioning and refrigeration make up 11% in the Residential sector and 10% in the Commercial sector

So, to solve the CO<sub>2</sub> problem all we need to do in the US is:

1. Stop driving cars to reduce 76% of the 34% in the Transportation sector which will also reduce the 28% petroleum refining of the 28% Industrial sector.
2. Reduce the heating level temperatures this winter by two degrees or more.

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3. Work four days a week at the office or work from home to reduce the lighting and heating loads on large buildings plus keep the car in the garage.

This really doesn't sound all that bad does it?

For those of you who are trying to figure out if we are making light of a serious subject or really trying to get your attention, just consider it our way of asking does Carbon Footprint and CO2 emissions really matter to you? And if it does, how can smarter buildings help in this cause?

As the above statistics show, courtesy of Starbucks and [www.good.is](http://www.good.is), both residential and commercial buildings have a big impact and the existing building market is where some of the biggest gains can be made. There are many ways to decrease energy, increase utilization and value of existing buildings, all of which can contribute to the CO2 reduction. Ten kilowatt hours per day of electrical usage equates to 2.1 tons of CO2 per year so every kWh saved from the electrical grid, every BTU savings of heating and just about every new smart building technology that can be applied will help in the effort of CO2 reduction.

As engineers and technologists, Smart-Buildings focuses on how we help with the application of everything from alternative energy solutions to IT infrastructure design to the latest in wireless device networks to software platforms that operate buildings more efficiently and effectively. The number of products and solutions available and being developed on a global basis is extremely large, continues to grow every year and many of these products are not typically applied particularly in existing buildings.

A typical approach has been to replace an aging piece of mechanical equipment, upgrade lighting or building control systems based on incentives, energy funding or other economic drivers; however, it has been the rare exception where a building upgrade was evaluated from a holistic perspective with a focus on CO2 reduction. But the good news is more and more owners are applying for LEEDS-EB certification and there are more cost-effective ways to achieve modernization of older buildings using a wide variety of new technologies.

Our goal is to help owners who not only want to create smarter buildings for economic drivers but also want to make as big a contribution as possible to the direct and indirect impact to Carbon Footprint reduction. With the owner's goals, we take a top-down holistic perspective in evaluating every piece of equipment from all operational aspects, assessing electrical supply and load size utilization, and every operational system of hardware and software.

The Smart-Buildings newsletter last month highlighted areas of focus in existing buildings but did not approach the subject from a Carbon Footprint perspective. If we are beginning to sound like a broken record of repeating ourselves it is because of the importance of the subject. Owners are faced with hard decisions but there has never been more economical technology for the owner to take advantage of, if you know where to look. When meeting with one owner, who had been told it would cost \$4.50 per square foot or more for a variable dimming lighting system, we advised him of multiple systems available for as little as \$1.50 per square foot. Changing out 1.5m square feet of older lighting while adding the

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ability to have new levels of control, having the energy information to show the results and translating the energy savings information into carbon reduction information is an example of the necessary steps we all need to take to have any chance at having a positive impact for future generations.

If you are a building owner with a modern temperature control or building automation system you most likely schedule the start up and shut down of the mechanical equipment and maybe even lighting circuits. But most commercial buildings have tremendous heat gain at night even during the winter due to no ventilation and electrical loads that still generate heat at night in addition to the heat trapped in return air ceiling plenums. We have surveyed buildings where the temperature exceeded 90 degrees at night and the cooling system went to 100% of load the next morning and it took all day to pull the temperatures down. On very hot days the cooling never got out of 100% load.

A holistic approach to this problem evaluates all the interdependencies of the mechanical load, the electrical and plug loads, the control system capabilities and the KW and kWh usage based on the existing sequence of operation. The goal is to integrate the control system, the power monitoring and all heat and CO2 generating related systems into a higher level software platform for energy and CO2 information management to create an entirely different start up and shut down strategy to eliminate the heat gain, reduce the kWh and therefore the CO2.

Some types of strategies may have been tried in the past and referred to as Optimal Start/Stop, Building Optimization, Night Purge and other strategies but the problem has been lack of adequate information from all loads and systems, inability to integrate multiple systems and limitations in the controllers of building control systems to implement multiple strategies based on a higher level of information. The technology is now economically available in both hardware and software to be able to implement more sophisticated strategies to answer the call for reduction of the Carbon Footprint of our buildings and save on operating expense.

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