Energy Design in the Year 2031

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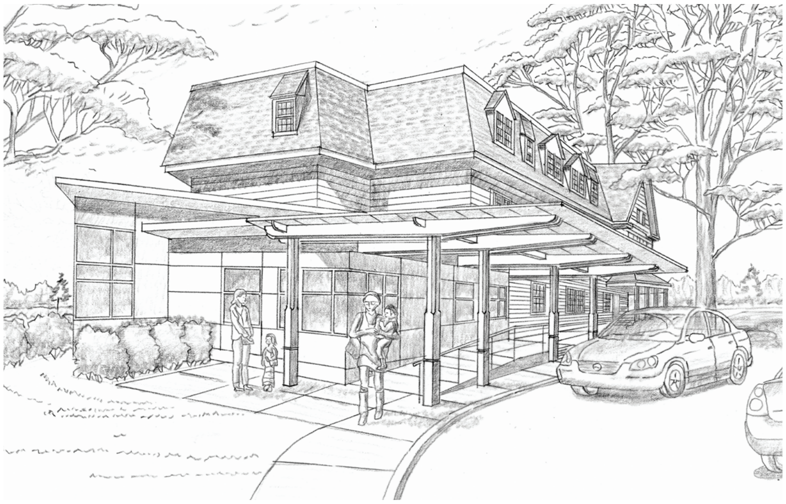
Energy was on more people's minds thirty years ago, when the oil embargo and subsequent economic shock injected environmentalism into consideration of the built environment and led the building industry to challenge traditional thought. The crisis passed and efficient building design fell off the radar for most, which can clearly be seen in the Citicorp (now Citigroup) Center in New York, designed during the energy crisis of the 1978 with a south facing sloped roof intended for solar panels, only to have the actual solar panels dropped from the project as the crisis passed

Hugh Stubbins and Associates, Citicorp Center, New York City, 1978.

Let us take a minute to reflect on the design process as it might be in the year 2031, after twenty more years of construction activity. More specifically, let us compare the present situation with building systems design in the future, when the next Citigroup Center type building may contain solar panels.

As the popularity of sustainable practices continues to increase within the architecture profession, the focus on energy savings through engineering design will be the key driver of ideas and actions. Princeton University predicts the cost of energy will increase **5% each year.** That would mean the energy costs for a building will double in about 14 years and triple in about 22 years. The value of providing an energy audit and economic payback analysis on engineering investments will also double and triple during that time, and it will become one of the more important aspects of major design efforts. Investments in energy saving strategies will not only pay for themselves but could also pay for portions of renovation by the year 2031. This will be a stark contrast with the present day, when relatively cheap energy makes the first time costs of truly sustainable engineering investments difficult to justify. This explains the low popularity of paying for auditing and economic studies of engineering system designs in both new and renovation projects. **This will change.**

Tools are currently available to pinpoint better the energy savings that come through engineering analysis, to present this data in a way that is easy to understand and also easy to measure, and to test a project after it is built. These tools will continue to improve as we approach 2031. Performing an energy audit of a building currently means examining the energy usage, either through utility bills or supplemental energy



Buell Kratzer Powel, Libertae halfway house and family home, renovation and expansion, Bensalem, PA, 2009-2010.

Target Energy Performance Results (estimated)			
Energy	**Design**	**Target**	**Average Building**
Energy Performance Rating (1-100)	34	75	50
Energy Reduction (%)	N/A	24	0
Source Energy Use Intensity (kBtu/Sq. Ft./yr)	204	131	174
Site Energy Use Intensity (kBtu/Sq. Ft./yr)	86	55	73
Total Annual Source Energy (kBtu)	3,094,292	1,985,722	2,630,517
Total Annual Site Energy (kBtu)	1,303,644	836,597	1,108,253
Total Annual Energy Cost ($)	$ 32,561	$ 20,896	$ 27,681
Pollution Emissions			
CO2-eq Emissions (metric tons/year)	151	97	128
CO2-eq Emissions Reduction (%)	-18%	25%	0%

Facility Characteristics	Edit
Space Type	**Gross Floor Area (Sq. Ft.)**
Residence Hall/Dormitory	9,300
Office	5,850
Total Gross Floor Area	15,150

Estimated Design Energy			Edit
Energy Source	**Units**	**Estimated Total Annual Energy Use**	**Energy Rate ($/Unit)**
Electricity - Grid Purchase	kWh	223,600	$ 0.110/kWh
Liquid Propane	gallons	5,900	$1.35/gallon

NOTE: Values are 59% Electricity – Grid Purchase and 41% Liquid Propane. The Target & Average Building energy use for this facility are calculated based on fuel mix of input estimated energy use.

Energy use analysis for the Libertae project in Bensalem Township, PA, using Department of Energy "Target Finder" website. The "design" column shows the current building and the "target" column shows

metering, and then modeling that usage and comparing it to the energy use of the building after a theoretical upgrade. If that upgrade is shown to pay for itself through energy savings in a relatively short period of time (depending on how deep the client's pockets are), the upgrade should become part of the design.

To assist in this planning effort, the Department of Energy "Target Finder" website allows building owners and engineers to compare the energy use of their buildings to other, similar buildings in the Target Finder database. As we approach 2031, this database will expand to include all types of buildings of all sizes, making comparison of data even more useful. These comparisons are important because they allow an owner to estimate how much energy he could potentially save, instead of naming percentages with no real life data to back them up. More importantly the website allows the calculation of the actual money one could save by bringing a building up to a level of efficiency that would earn an "Energy Star" rating for the structure. I like to call this amount of annual savings the "money in play," which can be borrowed against for investment in engineering upgrades.

By the year 2031 the website might show data in real time, so theoretical designs could be compared to actual data during all kinds of weather and at various energy price levels. And existing buildings energy could be uploaded to the website to show, in real time, how awful a building was doing compared to its more energy efficient peers. A recent energy project done for the non-profit group Libertae Inc. by Buell Kratzer Powell Architects, through the Community Design Collaborative, used the Target Finder website to demonstrate that an energy savings of twelve thousand dollars per year could be realized by bringing the existing halfway house and family home up to the Energy Star level while constructing an addition. This money would be "in play" to help offset the upfront costs of the upgrades as well as future utility bill expenditures.

By the year 2031 the government may have moved away from energy- producing technologies–such as oil-burning plants and gasoline-powered vehicles– that require the purchase of fossil fuel from overseas. As more elected officials recognize the dangers of the warming environment, they will also move away from energy-producing technologies, such as includes coal- and gas-fired plants that discharge carbon into the atmosphere. It would obviously take government money to make this sort of shift in energy policy, but it's not science fiction to think something like that may happen in the next twenty years. This shift will likely take the form of some kind of tax on CO2 emissions along with a cap-and-trade system to offset these new taxes, which is an idea that has been kicked around Congress for some time.

When some form of energy policy shift does happen, the alternative to carbon-spewing fossil fuel plants will be not only nuclear-, hydro-, and wind-powered plants, but also some form of solar power generation. This could entail a dramatic increase in photovoltaic production and the construction of production facilities throughout the nation, bringing power generation closer to end users, lessening the load on the power distribution grid, and removing the need for large scale plant investments. Solar panels will land on the roofs of the existing building stock of the United States. These photovoltaic systems will no longer be considered "statement" investments or "demonstration projects" for building design, the cost of which is currently hard to justify economically. These systems will be standard practice in the year 2031, and they will have to be integrated into the design process and may inform the design of roof structures, building site orientation, and landscape design.

Currently it is difficult to justify the expense of large engineering upgrades for existing buildings or new designs that incorporate the latest energy technology, because, when compared to baseline buildings, the payback periods are longer than most owners can accept. This is the result of the relative cheapness of electricity, natural gas, and oil. As these commodities increase in price, doubling and tripling from current values, the arguments for new technology become much easier to make. If the paybacks come quickly enough for energy efficient systems to pay for other parts of a project, energy design will begin to inform other aspects of the design, such as insulation, window placement, and maybe decisions about the location and orientation of buildings on the site. The newfound focus on energy will foster in an integrated design process, with engineers involved in the very early stages of design, working with both architects and owners to calculate the amount of money that can be saved by system upgrades, and to make decisions about envelope enhancements, systems placement, and the best ways to achieve the comfort levels desired by occupants. This type of integrated design will be standard practice by the year 2031.

Twenty years ago The Earth Summit in Rio de Janeiro fostered a new focus on environmentalism and a different way of viewing both our built environment and human behavior when designing and inhabiting these environments. Unfortunately the economics conditions needed to implement the sustainable solutions put forth during that summit were absent twenty years ago. As energy codes continue to set aggressive energy benchmarks, and as owners of buildings recognize the economic advantages of investment in energy efficiency, the future may provide a chance to build on that foundation and implement many of the solutions put forward in the past.

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