Living in a Carbon-Constrained World

A while ago, somebody showed me data on a superefficient house in Texas. Indeed, it was efficient on a per-square-foot basis, but then I noticed that its floor area was 6,000 ft^2! The house's total energy use was actually higher than that of an average Texas house. Efficient? Perhaps. Low-energy? No. Should *Home Energy* publicize this kind of house as a model for others? We're not sure—occasionally we do publish articles about large homes, but usually we discuss them in the context of a specific builder's work or a utility program that applies to homes of all sizes.

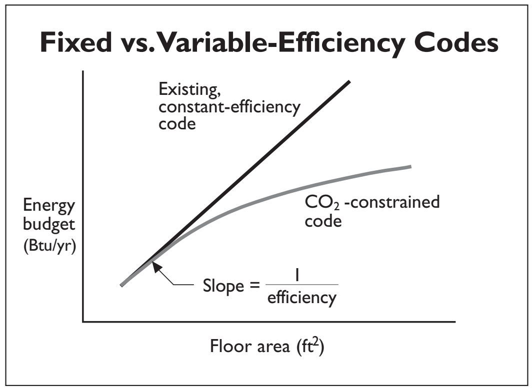

Figure 1. In a code constrained by CO_2 limits, efficiencies would be required to increase as houses get larger, thus limiting total CO_2, rather than just CO_2 per ft^2.

The paradox between energy efficiency and low energy use appears elsewhere, too—with the growing size of modern, more efficient refrigerators, for example. The distinction may seem academic, but it won't be in a CO_2-constrained world. If international agreements limit our CO_2 emissions (and there's a good chance that they will in years to come) then they will in effect also limit consumption of nonrenewable energy. In this scenario, the bottom line will be actual nonrenewable energy use. High efficiency will still play a key role: maintaining our high standard of living and amenities.

The implications of this change in objectives are only slowly being recognized. One example is in the complex area of codes and standards. Most building codes are designed to achieve a certain level of energy use per ft^2, regardless of the size of a house. This looks like a straight line in Figure 1. The slope is the building's efficiency (in Btu/ft^2 per year). The "efficiency" standards for refrigerators look the same, although the efficiency is expressed in terms of appliance volume. But a standard seeking to constrain CO_2 emissions would look different: a curve rather than a straight line.

Put another way, a large house's energy efficiency would be higher than a smaller house's energy efficiency. This approach makes sense, because it's easier to make a large structure or appliance more efficient than it is to make a small one more efficient. For example, it's always easier to make a two-story house more efficient than a one-story house with the same floor area, because there is less surface area for heat loss and gain. This kind of geometric benefit suggests that a mild variable-efficiency code—a slightly curved line—would not be difficult to meet. (Indeed, if computers had been widely used earlier, a variable-efficiency code would probably have been developed to account for geometry, but back then, we were still prisoners of graph paper and rulers.) More likely, controlling emissions will require a stronger approach. This might go so far as to say that larger houses can use no more energy than small ones use.

Is a stronger variable-efficiency code technically feasible? Probably. Besides stimulating development of many new high-efficiency technologies, an emissions-based code would be a boon to renewable-energy technologies (whose use would not be restricted). These technologies would supply much of the difference between the old, fixed-efficiency requirement and the new, variable-efficiency requirement.

The implications of switching to variable-efficiency codes and standards are too broad to be covered here. They are also politically charged. For example, a variable-efficiency code implicitly sets a "reasonable" level of energy use, above which extra measures must be taken to save it. Who decides what is reasonable?

I certainly don't have answers. My point is to demonstrate that new problems will require new solutions. Some of those solutions will be technical, but others will cross over into societal and life-style decisions.

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