The Interfaith Coalition on Energy

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Principles in Analyzing Energy Use in Buildings

By Andrew Rudin

Using less electricity and fuel in a building reduces the cost of operating it. There is no link, however, between using less energy in one building and producing less environmental damage worldwide. Using less energy lowers the cost of energy for everyone. Because they are traded commodities, others will use the electricity and fuel we don't use, and at a lower cost.

Most buildings are continually used, such as homes, apartments, hospitals and businesses that are always open. Heating and cooling contractors, utility representatives and energy surveyors often misapply advice and technology that works in continuously occupied buildings to intermittently used buildings. Greater energy efficiency may be more important in continuously occupied buildings. Controls (turning things off) may be more important in intermittently occupied buildings.

Funds for investments in techniques to lower the use of electricity and fuel can be found in processes that are not directly related to energy. Examples include avoiding sales and excise taxes, obtaining tax refunds, replacing oversized water meters, changing electric rates and obtaining lower cost fuels.

Each building is unique. Not only is each building separately designed and built. Each has a different location. Each has been renovated, often with the guidance of different design professionals from the original. And each is operated with different personnel, with different biases and opinions, served by different maintenance contractors and vendors. Unique buildings require unique analyses.

Our attention is drawn to end uses of energy, rather than to the where energy enters the building. The point of entry for energy into buildings is in spaces that are not respected or appreciated – usually dark, dirty basement rooms. Just as our hearts and major arteries are more important than our capillaries, the utility rooms, meters, boilers and air handlers are more important that light bulbs, windows and radiators. For example, adjustments to the efficiency of boilers and chillers can be much more cost effective than insulation, particularly in intermittently heated buildings.

In order to provide helpful advice about the energy used by your building, data and measurements are more helpful than estimates or rules of thumb.

Data on electric and fuel consumption can be analyzed in various ways:

- Fuel usage can be compared to heating degree days.
- Fuel use in the summer (non-heating season) may be for cooking food and heating domestic hot water.
- Electric usage can be separated into air conditioning, base load (lights, fans, pumps, office equipment) and electric heating.

Here are some of the measurements that can be made:

- Electricity used by 110-volt appliances – refrigerators, freezers, ice machines, soda machines, copiers, computers, water coolers, coffee makers.
- Boiler/furnace efficiency – chimney suction, carbon dioxide, stack temperature, smoke
- Carbon monoxide in flue gas (for safety)
- Temperature of various rooms, compared with outside temperature
- Intensity of artificial light
- Temperature of domestic hot water
- Tons of air conditioning
- Fuel input to heating systems

Comparing one building's annual energy use with averages from others provides a lot of useful information. We can find buildings that use relatively little electricity and/or fuel per square foot per year, and then we can learn the factors that cause low use. One building must be compared with similar buildings in similar climates. Here are some categories to investigate, described in units per square foot:

- Square feet of heated and/or air conditioned floor space
- Kilowatthours or electricity
- Therms or CCF of natural gas
- Gallons of fuel oil
- Peak annual watts of electric demand
- Fuel input in Btus per hour
- Square feet of floor area per ton of air conditioning
- Hours use of demand (yearly average of month by month kilowatthours divided by kilowatts, not per square foot)

Information gathered by measurements, observations, discussion and data analysis needs to be communicated clearly to those who can lower a building's energy use. This includes people who adjust thermostat settings, control the operation of lights and work with contractors and vendors.

A helpful report can help building owners and operators to:

1. compare their energy use to similar buildings
2. determine energy cost per square foot of space
3. note the safety of electrical/mechanical systems
4. reduce energy costs
5. confirm application of maintenance contracts

6. understand how energy systems function
7. support proper stewardship
8. educate maintenance staff
9. learn about investments with reliable return
10. qualify information from vendors
11. assist function of property committees
12. understand energy billing procedures
13. show changes in energy use and cost over time
14. increase comfort, and
15. inform facility operators on mechanical/electrical systems

The effectiveness of the site visit and report are increased if the building operator can provide four items before the tour of the building:

1. any blueprints of the building, particularly mechanical and electrical,
2. easy access into each and every room,
3. knowledgeable people present for the survey, and
4. a list of energy-related problems concerning the building.

Packaging an energy survey report in a binder gives the report a long-lasting quality. To make the report clear, it is helpful that at least one other person read and comment on it. Separating parts of the report with dividers shows its reader how the analysis has been organized. Sections could include:

1. A description of the buildings and rooms within them, how they buildings and rooms are used, and how the energy systems serve them,
2. An evaluation of how much energy is used in the buildings, temperature recordings, comparisons to similar buildings,
3. A summary of the best ways to invest effort and funds in lowering energy costs, with costs rounded to the nearest $10, $100 or $1,000 to convey the usual imprecision of estimates,
4. A detailed description of each of the concepts listed in that summary,
5. At least one year of electric and fuel consumption, with water consumption as well, if appropriate, and
6. A section of supplementary information including information from vendors and manufacturers, descriptions of techniques, pricelists, photographs of the buildings.

In general, several principles can guide the recommendations:

- Choose products that are readily available from local suppliers.
- Avoid cutting-edge technology, currently geothermal heat pumps and photovoltaics. Let the for-profit sector do all the experimentation.
- In intermittently used buildings, control of energy use is generally more important than improved efficiency of end uses of electricity and fuel.

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