What is a Key Performance Indicator (KPI)?

Commercial building energy usage is driven by choices made in design, operation, and by tenants. When making choices to reduce energy usage these actors are primarily interested in one question—“How am I doing?” Put another way, “What impact are my choices having on energy usage in this area that I have control over?” A consistent set of KPIs can help answer these questions in a cost-effective manner.

KPIs are accessible numeric metrics of energy usage or observed building characteristics that can be associated with better- or worse-than-expected energy performance (i.e. lower or higher energy use). Much like KPIs in other business organizations, these are intended to yield the best information for the least cost and analysis time using the available metered data and observable characteristics. For a commercial building this process helps to keep energy usage as low as possible by providing feedback to those who influence energy usage: the designer, operator and tenants/occupants.

Examples of KPIs using whole-building monthly data:
Above, a comparison of the Energy Use Index (EUI) to the California End Use Study (CEUS) using the Energy IQ Tool, and the FirstView® software tool indicators, on right.

As commercial building techniques improve and technology costs decrease there is an opportunity to include standardized analysis to new construction and even add to existing buildings. This guide, created by New Buildings Institute (NBI), provides an overview of the KPI approach and answers some basic questions. More detailed information can be found at www.newbuildings.org/kpi, including detailed specification language that designers and owners can use in construction documents to specify this approach for their project.

What are KPIs and how are they used?

In general, KPIs are calculations of energy usage over a period of time. These calculations may be simple or complex. The resulting metric is made meaningful by comparisons to expectations, either historical, ‘like-type,’ or the expectations of a design model. The figure below demonstrates the comparisons for simple Energy Use Intensity (EUI), which is the total energy used by the building in a given year divided by the gross square footage of the building.
Key Performance Indicators for Commercial Buildings

The building characteristics serve to make the comparison against ‘like-type’ buildings more accurate. The figure below demonstrates this concept.

The resulting KPIs and comparisons are used by the appropriate audience in a simple tracking fashion. Detailed calculations are done by a software tool. The result is simple, directed feedback.

As an example of a typical KPI, we can look at the EPA Portfolio Manager score. The EUI of a commercial building is compared to a national set of ‘like-type’ building data based on simple building characteristics, in this case the size and use-type of the building (and a few other pieces of information). The resulting KPI, the “Portfolio Manager Score,” can be tracked year to year and contributes to performance feedback, which is often done as part of a simple energy management information system (EMIS) software tool. Since this KPI is very general it will provide some feedback to the designer and operator but will likely provide less guidance to a tenant in the building who can’t “see” their influence in the score.

Who uses KPIs?

Driving toward very low energy usage in commercial buildings requires best practice in design and construction, operational management and, increasingly, more attention to the plugged-in equipment and actions of building occupants. KPIs for commercial buildings need to match the interest and need of each of these audiences using the energy and building characteristic data at hand. We categorize KPIs by three broad audiences that may contain similar actors. These are the ‘users’ of KPIs.

<table>
<thead>
<tr>
<th>Audience Categories</th>
<th>General Feedback Description</th>
<th>Similar Audiences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designers</td>
<td>One-time or infrequent feedback that accounts for operational and occupancy conditions but accentuates design evaluation.</td>
<td>Owners/Managers</td>
</tr>
<tr>
<td>Operators</td>
<td>Regular feedback that assess operating conditions and acknowledges limitation of design. Feedback takes into account the influence of occupants.</td>
<td>Building Auditor</td>
</tr>
<tr>
<td>Tenants</td>
<td>Regular feedback but specific to equipment that tenants can influence; typically only plug loads and lighting; either for the whole building as an aggregate or just their rented space.</td>
<td>Owner-Occupants</td>
</tr>
</tbody>
</table>
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KPIs help ensure that design and construction efficiency strategies improve, operators have energy use targets, and occupants receive meaningful feedback that allows them to take action. Each of these audiences needs different information at different times. The KPIs specific to each audience represent the energy usage of systems or equipment the audience can influence through efficiency choices and actions, and depends on the available meter data.

How are smart meters involved, and what are the ‘building levels’?

Metering equipment has become much less expensive and more ubiquitous, especially in high performance buildings. In addition to whole-building electric and natural gas metering there is increasing use of sub-meters that monitor specific subsections, systems, or equipment in the building. The problem is that there is no consistent set of recommendations on how to use sub-meters and the data they produce. Most buildings use general guidelines from a rating system (in some areas energy codes make recommendations) which leads to different interpretations of what is sub-metered and makes it difficult to apply lessons learned.

NBI designed the KPIs with increasing levels of detail and specific recommendations to address the type and frequency of data collection in which owners or designers would be interested. Level 0 represents a minimum set of whole-building data: i.e., monthly bill electric and gas data for the whole building. Level I remains at the whole-building level but utilizes advanced metering interval data for electric use (though still less available for gas use which remains monthly). Level II represents a basic sub-meter level that captures the most variable energy use in the building—plug loads. Level III is where several systems are sub-metered.

<table>
<thead>
<tr>
<th>Level</th>
<th>Energy Use Measured</th>
<th>Interval of Energy Use Information</th>
<th>Can I get all the required data using smart utility meters?</th>
<th>Applicable to New Construction (NC) or Existing Buildings (EB)?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Electric</td>
<td>Gas/Fuels</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Whole Building</td>
<td>Monthly</td>
<td>Monthly</td>
<td>Y</td>
</tr>
<tr>
<td>I</td>
<td>Whole Building</td>
<td>15-minute</td>
<td>Monthly</td>
<td>Y</td>
</tr>
<tr>
<td>II</td>
<td>Whole Building with Plug Load System</td>
<td>15-minute</td>
<td>Monthly</td>
<td>N</td>
</tr>
<tr>
<td>III</td>
<td>System Level</td>
<td>15-minute</td>
<td>Monthly</td>
<td>N</td>
</tr>
</tbody>
</table>

Why use KPIs?

KPIs are an accessible and consistent set of indicators that can be tracked by designers, operators and tenants. In the course of NBI’s work studying the measured energy performance of commercial buildings we saw that there were no cohesive recommendations for analysis of energy use, particularly at when more detailed metering and sub-metering is in place. Energy codes are beginning to address system metering requirements for commercial buildings, but these requirements do not presuppose any consistent analysis strategies. Here we suggest protocols for both aspects—design and analysis.

KPIs are applicable to existing and new construction, though new construction offers much greater opportunity to employ more detailed analysis. Existing buildings were not often designed for easily gathering energy usage, such as tenant plug loads, to be measured in a small, affordable number of meter points.

KPIs recommended for existing buildings represent a simple set of data that is a good starting point, particularly for designers and tenants. Operators and savvy owners will likely want more detailed information via other monitored points and specialized EMIS vendor services to ensure that things are working day in and day out.
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Are any other monitoring points needed?

KPIs, and the metered points on which they are based, represent a good starting point for commercial building energy management at a reasonable cost. There are many useful strategies for metering, monitoring and assessing specific systems and equipment in commercial buildings. This is especially true in larger commercial buildings where the complexity of the HVAC system leads to complex issues that in turn lead to energy waste. For example, monitoring kW/ton in chiller equipment is a very common strategy.

There are many new vendors of EMIS software that can leverage the available meter data to provide more advanced analysis than these KPIs. These come at a higher cost but have potential to provide great value for many commercial buildings.

What should I do if I want to design a building to access the KPIs?

NBI has created sample specification language that is available at: www.newbuildings.org/kpi. The documents provide guidance that owners or designers can include in a bid for energy metering and monitoring systems. The specifications are organized by levels—0 through III—according to increasing cost.

As commercial building techniques improve and technology costs decrease there is an opportunity to build in standardized analysis to new construction and even add to existing buildings. This guide, funded by the California Energy Commission's PIER program, provides an overview of the New Building Institute’s KPI approach and answers to some basic questions. More detailed information including specification language that designers or owners can use in construction documents to specify the exact approach for their project, can be found at: www.newbuildings.org/kpi