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Getting Started with

BUILDING ENERGY MANAGEMENT

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Why You Need to Manage Your Energy Use

If you glance back at recent history, you find that at the dawn of the Twentieth Century, formal Safety programs grew in sophistication as factories and building systems grew in power and complexity. Later, the business world realized that a strong safety program not only protected tenants and workers, but saved costs in lost worker time, lost expertise, legal actions, insurance premiums, and a host of other things.

Environmental Management programs followed a similar trajectory, growing in sophistication as the substances used in, and emitted by, our factories and buildings multiplied and became more toxic. Quality Management, too, was instituted and refined as production lines, and later, supply chains, grew longer and more complex.

In short, formal management systems rise in response to the growing complexity of activities and the built world, and the extent to which that complexity threatens an organization's productivity and competitiveness.

Businesses are now realizing that our energy supplies, and our energy supply lines, are increasingly complex, and represent just such a threat.

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Consider these key energy challenges:

1

PRICE VOLATILITY

The global energy market that has developed over the last 20 years has amplified energy price fluctuations for oil and coal in response to hard-to-predict overseas demands in developing nations.

2

PEAK OIL

While the argument over “Peak Oil” has yet to be resolved, there is no question that the CHEAP oil is gone. The routine inclusion of such high cost operations as deep sea drilling, tar sands conversion, and biofuel production in commercial transactions is clear evidence that the cost of energy has passed a threshold.

3

SOCIAL UNREST

It is no coincidence that dictators reign, and social unrest breaks out, in regions rich in oil. The implications for our energy supply and supply lines are less clear, but add to the uncertainty.

4

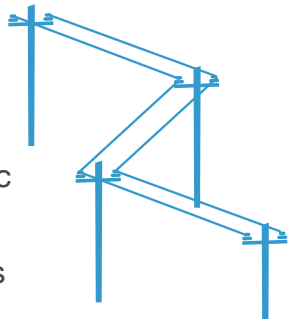
GLOBAL WARMING

For all intents and purposes, this issue is resolved, and the time to take action has come. The form and extent of those actions is less well resolved, but their imminence increases uncertainty in the energy markets.

5

THE GRID

It is no secret that our electrical grid is approaching obsolescence. Or may even be there already. Antiquated technologies combined with new operational requirements (such as very demanding electric cars and highly variable renewable energy inputs), mean expensive upgrading and replacement programs are on the horizon. The costs will be passed along to energy users.



Not convinced? No less an authority on risk than Lloyd's of London recently released a report encouraging firms to actively address their energy use or face devastating price spirals and uncertainty in the energy markets. Lloyd's of London lives or dies by understanding risk. And mostly they have lived for the past 100 years or so. So you have to take what they say seriously.

> "Businesses which prepare for and take advantage of the new energy reality will prosper"
>
> — Lloyd's of London

Their report said bluntly, "Businesses which prepare for and take advantage of the new energy reality will prosper - failure to do so could be catastrophic."

It's worth noting that Lloyd's does not publish these reports as a public service. If you read between the lines, the message they are telegraphing to their customers and potential customers is essentially "If you don't do something to manage your exposure to energy risks, we may not be able to service you in the future."

If they are speaking for insurance companies, that is a pretty frightening message.

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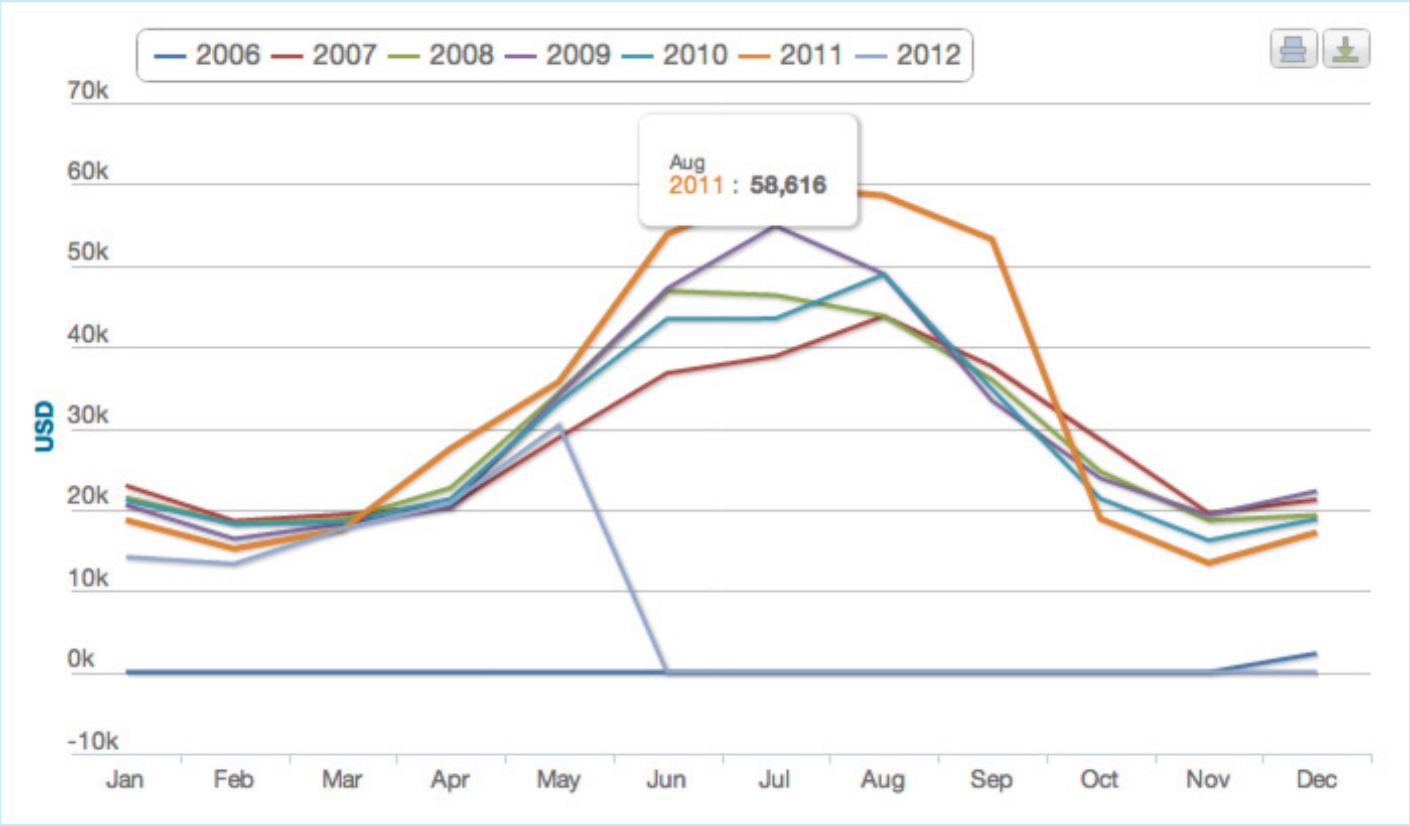
So what is to be done about all this?

I particularly like Lloyd's wording: "Businesses which prepare for and take advantage of the new energy reality will prosper …"

I like this wording because it places your response to energy uncertainty right where it belongs. It is not something to be feared, it is something to take advantage of. It is a golden opportunity to employ a focus on energy to sharpen your competitiveness and transform your organization. Think about it. Energy ranks right up there with air as the necessary ingredient in every department of every organization in the modern world. If you want to identify one purchased input that touches every individual in your company, look no further than



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energy. It's a good place for a company-wide conversation.

How you hold that conversation is called an Energy Management Process, or EMP for short. Strategic Energy Management is an approach to proactively managing an organization's energy use, and, more importantly, to bringing about change within the organization so that energy awareness is a self-sustaining part of the culture. I can't emphasize that enough. Too many energy initiatives are the product of one individual's enthusiasm and interest, which is great. Except that as soon as that person leaves or is reassigned, the energy effort withers. A robust EMP persists through changes in personnel, ownership, and management. It is producing energy savings in good times and bad. It extends equipment life, reduces maintenance needs, and generally fine tunes the operation it is applied to. If done properly, it can also energize your workforce, and lead to

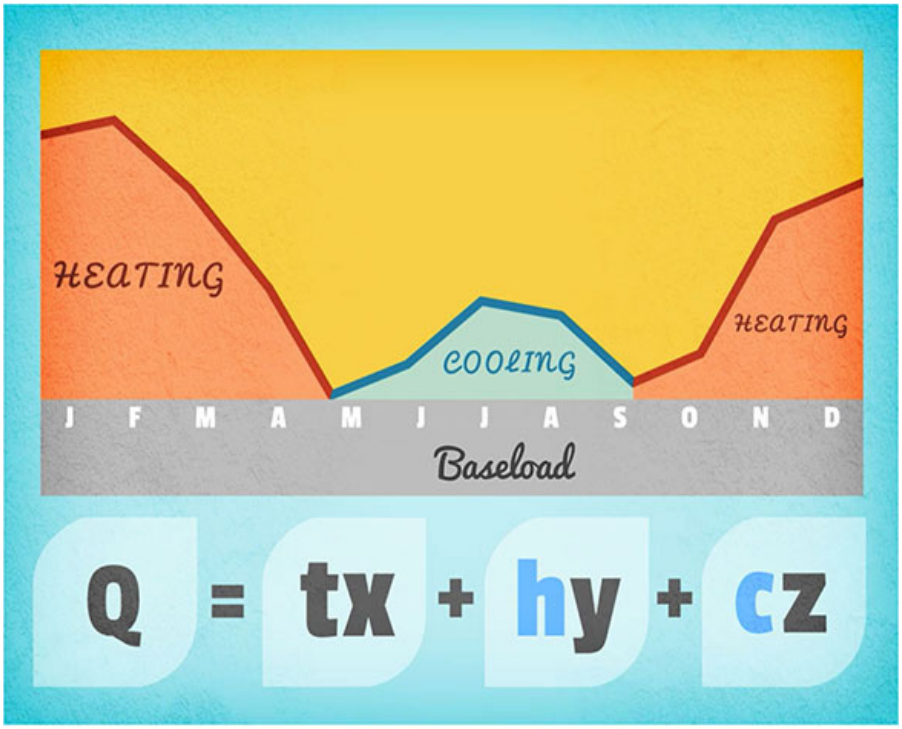
organizational gains in reduced turnover, lower absenteeism, and higher productivity.

Sometimes there is resistance to energy management for a variety of reasons. Most decision-makers believe the solution to reducing energy costs is to seek the lowest available energy prices. Too often, managers fail to grasp the opportunities offered by energy management, which focuses on both consumption and prices.

Energy management also has no traditional place in the typical business' org chart, job descriptions, and performance accountabilities. But recognition of energy management is growing.

In 2009, the International Standards Organization (ISO) fast-tracked a new standard on Energy Management Processes, ISO 50001, aiming to get it drafted and published in two years rather than the typical three. It was considered that important by the participating nations. The US and China jointly petitioned for its creation, with Brazil joining a little later. In 2011, it was adopted by 44 nations worldwide. (In fact, the official ISO-50001 term is Energy Management System, or EnMS. I'm not using that term in this series of articles because it is often confusing to many people who work with Commercial and Institutional buildings who may think it is a form of building automation.)

So, while most organizations won't ever seek certification, there is a guideline for EMP development that can be scaled to fit to any situation. As the future unfolds, the tightness of energy supplies will become increasingly apparent. It behooves any forward-thinking organization to start managing the uncertainties we will face. I hope this series of articles will help you to do that.



Creating Your Energy Profile Part 1

You cannot measure how far you have come unless you know where you have been. That is the realization behind creating an Energy Profile for your organization. The Energy Profile has two fundamental goals: to create an Energy Baseline and to identify credible measures of your improvement from that baseline.

In Commercial and Institutional settings, your Energy Profile may cover a single building, a portfolio of buildings, or an entire campus of some sort. In any of these cases, your Energy Profile should give you visibility at least down to the building level, preferably lower. Dormitories differ from lab space. And offices differ from parking garages. While you will want to report on the entire portfolio, visibility down to the building level will enable you to identify energy projects and solutions, as well as those all-important non-capital improvements.

Your Energy Profile should include your historical energy consumption as far back as you can reasonably determine it, and your present energy consumption. If possible, you should also include a projection into your next few months of energy consumption. We will discuss how later. But Management is constantly trying to see into the crystal ball to avoid or prepare for future business impacts. To the extent you help them do that, you will be welcome in the conference room.

In this series of articles, I want to present the nuts and bolts of what an Energy Profile is and what it takes to create one. I will present detail as we proceed, but let me first present a notional "Table of Contents" for your Energy Profile.

No hard and fast rules here, but the contents for your Energy Profile might look something like this:

CHAPTER 1 - SCOPE DEFINITION

- Scope definition
- Any maps, diagrams, or other graphics that describe the Scope.

CHAPTER 2 - BASELINE ENERGY DATA

- Data sources and notes
- Deference period consumption for each service meter, for each meter reading period, including meter reading dates
- Conditioned floor area for each building in your Scope.
- Reference period activity measures by calendar month
- Reference period daily weather data
- Reference period costs for each utility meter, for each meter reading period

CHAPTER 3 - BASELINE ENERGY MODELS

- Modeling Approach and Rationale
- Baseline costs intensity for a typical weather year and typical activity level

CHAPTER 4 - BASELINE ENERGY USES

- Assumptions and Methodologies
- Energy Uses Definitions
- Energy Uses and Their Consumption (It helps to put these in order)

CHAPTER 5 - FUTURE ENERGY USE AND CONSUMPTION ESTIMATES

- Assumptions
- Explanation of future energy use and consumption estimation methodology
- Future energy use and consumption estimates
- Future energy costs and energy cost savings estimates.

CHAPTER 1 - SCOPE DEFINITION

Be sure to define your Scope. Anyone who is going to review your work needs to know exactly what you included, and what you left out. And make sure you have control over everything in your Scope. You do not want something in your Scope that you cannot influence because, for example, the work is done by a contractor.

Your Scope may include all of the buildings occupied by your organization and the utility meters serving those buildings. Or it may be only the buildings you own (excluding leased space). It could be defined geographically ("Every building on the west campus."), by purview ("All buildings managed by John Smith's group"), or any way that makes sense

to you. But formally define it or there will be questions later.

CHAPTER 2 - BASELINE ENERGY DATA

A baseline, which is necessary to assess future energy performance, is the heart of your Energy Profile. A baseline for each utility meter at each location needs to be defined in a way that you can confidently account for variations in weather, business activity, occupancy and other significant factors outside of your control. Down the road you will want to know the true impact of your energy management efforts, without wondering if changes in energy use are due to other things.

Where corporate goals exist, the Reference Period should be chosen to align with them (e.g. "XYZ Corp. will reduce electricity consumption by 20% by fiscal year 2020 compared to fiscal year 2010"). If you are free to choose the reference period yourself, pick at least 12 months to get a full seasonal weather cycle. The industry-standard methodology for setting baselines can make use of the greater information over a longer reference period, and 24-months can give a better baseline model if you are working with only the readings from utility bills.

Some things to include here are:

- Data sources and notes
- Reference Period energy consumption for each utility meter within your Scope - electricity, natural gas, propane, diesel, etc. Record it at the highest resolution you can get it, along with the meter reading dates (and reading times too, in the case of interval electricity meters).
- Floor area, in either square feet or square meters, for each building in your Scope.
- Reference Period daily weather data for each location within your scope. Normally this will come from the closest publishing weather stations, taken from available databases. (Energy consumption in any building that is heated or cooled is impacted by weather. You will need this data to understand the relationship.)
- Baseline costs (Costs are a terrible indicator of progress. Rates may change and impact your energy costs even if your consumption is the same. But, still, Management needs to see costs.)
- Reference Period activity measures by month (We'll discuss these later.)

CHAPTER 3 - BASELINE ENERGY MODELS

It's not obvious right away, but Commercial and Institutional buildings often require more sophistication in setting up baselines than Industrial facilities. In many Industrial facilities, the impact of unusually cold or hot weather is masked by the sheer enormity of the energy consumed for production purposes. You can almost ignore it in some places, and limit the analysis to energy intensity based on production volume (which I will discuss below). But not

so with Commercial and Institutional buildings where heating and cooling are quite often the driving energy uses.

In these situations, i.e. Commercial and Institutional buildings, you need to account for at least two outside and uncontrollable variables - the activity level and the weather. Consequently, you cannot show credible progress unless you develop a mathematical model of your Energy Consumption that takes these into account. Without a model, weather and activity differences will mask your progress. And someone can always point out that the weather was different, or it was a “down” year, so any progress you made is suspect.

This is typically accounted for with what’s called a Multi-Variate Linear Regression Model. Linear regression modeling is outside the scope of this paper, but it is not difficult to undertake if you have the data available. Any spreadsheet application has built-in linear regression modeling capability, and Noesis Energy provides it online at no charge. Details of the correct underlying calculations are published as ASHRAE Guideline 14-2002.

A Linear Regression Model is a formula that represents your energy consumption as it varies with your activity level and the weather. You should have a model for each utility meter - electricity, natural gas, propane, etc. For a warehouse operation, your models might look something like this:

- Electrical Energy Consumed (kWh) = (736.5 X # Days) + (34.3 X # Shipments) + (62.2 X CDD)
- Natural Gas Energy Consumed (Therms) = (23.3 X # Days) + (4.7 X # Shipments) + (13.8 X HDD)

Cooling Degree Days (CDD) and Heating Degree Days (HDD) are measures of cooling and heating load imposed by the weather. To learn more about the concept of CDD and HDD, click the definition links or explore the background material on Basic Energy Analysis on this site.

The electrical meter model is simply telling us the magnitude by which consumption increases with the number of days in the period, with the number of shipments made in the period, and with the space conditioning load imposed by the weather during the period.

Similarly, consumption of natural gas for any given time period is expected to increase with the number of days, number of shipments made and the heating load over the period. Cooling load does not affect gas consumption at all unless you are using an evaporative cooler.

You can see how, once you have done the Linear Regression, you can determine what your

energy consumption would have been if you had not done any improvement projects.

Energy Intensity is an important measure of your energy performance. Energy Intensity is basically your total energy consumed divided by some measure of your output or activity over the same period. It is a measure of how much energy "went into" each output, which will be an obvious concept if you're an industrial organization. In some Commercial and Institutional sub-sectors we're used to talking about floor area, but I would encourage you to look hard for other measures of business activity that influence energy use.

I'd like to take a moment to illustrate.

I had a Government client once who had undertaken Energy Management. They built an Energy Profile that included over 50 buildings on a campus. They summed all their energy consumption and divided by the total square footage to get their Energy Intensity, and ambitiously set about improving their energy performance.

At the end of the year, they recomputed their Energy Intensity (kwh/square foot). Lo and behold, their Energy Intensity was actually HIGHER than it was before they had spent all that money on energy projects. Needless to say, the base commander was unhappy.

What happened?

The facility was a military base. The year they implemented Energy Management, they had been called upon to provide significant support to a war effort in the Middle East. They had processed thousands of service personnel and tons of supplies, way beyond their normal operations tempo. The problem was that the square footage didn't change! Energy consumption went up for obvious reasons. But the square footage remained the same. So when energy consumption went up, Energy Intensity went up regardless of their efforts to improve energy performance.

Don't let a similar thing happen to you! You may need to report Energy Intensity based on square footage for comparison purposes across your portfolio or with other buildings in your region. It's a handy number to have. But don't jump to making that your only measure of success without looking deeper. Look for indicators of activity that will capture the actual work that the building occupants are doing.

For the client above, I recommended several options. One possibility I recommended was that they measure Energy Intensity based on the number of Visitor Passes issued over a given time. The number of visitors is generally related to base activity. Or they could use aircraft

arrivals and departures for the same reason. These seem unrelated to energy consumption, but they are reasonable indicators of activity.

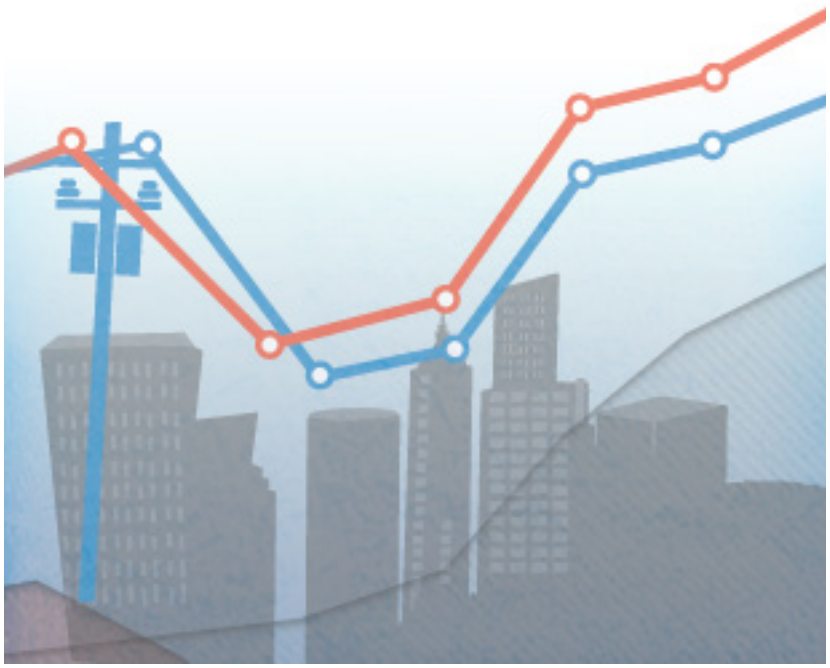
On a server farm, you may compute Energy Intensity based on terabytes of throughput. In the Food Service business, it may be meals served. Or it might be overnight stays in a hospital. In our sample warehouse above it was shipments. There may be two or three measures that seem reasonable. Try them all. The process of creating the baseline models will tell you which one(s) have a statistically significant influence on energy use. Those are the ones you want to record and work with. However you decide to do it, make sure you can get historical records of these values and can continue to collect them on a monthly basis. If not, make sure someone starts tracking them immediately.

Check out the training material and try out the free tools. If you get stuck, talk to a specialist.

The contents of this section of your Energy Profile should include:

- Modeling Approach and Rationale
- Typical local weather at each site. ASHRAE publishes typical daily weather data for many sites across North America.
- Normal activity levels at each site. Look at recent patterns, discuss with peers, then pick reasonable values. Precision will be impossible, and in any case the baseline models will take variations into account when you're doing future comparisons.
- Scope Baseline Energy Model for each site by utility meter . This "granular" information is used to build up the other following pieces.
- Scope Monthly Baseline Energy Consumption for each energy source at each site (electricity, natural gas, etc.) at normal activity levels, using typical local weather.
- Scope Total Monthly Baseline Energy Consumption for each energy source at normal activity levels, using typical local weather (i.e. add up the monthly values for all the sites).
- Baseline Costs (Scope total, by utility revenue meter and by energy source) at normal activity levels, using typical local weather.

In my next installment, I'll continue describing the contents of your Energy Profile.



Creating Your Energy Profile Part 2

In Part 1, I outlined how to organize and develop your Energy Profile. (So that you are aware, this is called the Energy Review in the ISO standard. The word choice had something to do with translation needs.) In this Part 2, I want to continue mapping out the contents of your Energy Profile, where you will pull together all aspects of your energy picture.

In Part 1, I presented the first three chapters of an Energy Profile, namely Chapter 1 - Scope Definition, Chapter 2 - Baseline Energy Data, and Chapter 3 - Baseline Energy Models. Let's proceed from there.

CHAPTER 4 - BASELINE ENERGY USES

Your Energy Uses are the applications that consume energy at your facility. Domestic water heaters are one example. Cooling systems and lighting systems are others. Define them in a way that makes sense to you. (But don't designate every single light fixture and outlet as a separate Energy Use! You will never get done!)

You will find yourself "drilling down" on various Energy Uses as you identify and implement improvement projects. So typically they are defined as something whose energy consumption can be determined or measured

separate from the facility's total consumption. Your large energy consumers can be identified as Energy Uses individually. Lesser energy consumers can be lumped into "outdoor lighting" or "heating" or some other system level identification.

Buildings that are more than five or ten years old generally have at most two or three meters tracking the whole operation. Most have only one for each utility. So you may need "submeters" or "data loggers" to capture some of the data you need regarding specific Energy Uses. Speak with your maintenance department or service contractor if you need help with this. Or call your utilities. Many of them have incentive programs or equipment libraries that you can tap into for these kinds of efforts. It is a lot easier than it sounds.

It may take a few weeks or months to collect a reasonable record of how much energy each of your Energy Uses is consuming. Your building may already have a Building Automation System (BAS) that records and even develops trendlines for your energy consumption.

In buildings with large point uses, they may be separately measured. If there are no obvious large energy consumers, separate measurement is not essential. In some cases, you can make sample measurements that will allow you to calculate energy consumption that you can't measure directly. For example, if lights and computer equipment are on the same circuit in an office, a weekend visit will allow you to shut down all computers, and run the lights for an hour or so, measuring the energy consumed. You can then subtract out the energy consumed by the lights on an hourly basis, and estimate what the computer equipment is using.

Keep in mind that you should be able to add up all the energy consumed by your Energy Uses and get the total energy consumed by the facility. This is an important "sanity check." You should be able to get within 10% to 15%. If not, review your analysis and see what you missed.

If your building is of common construction and use, public reference material and online tools can help you estimate those uses that you are unable to measure.

Your Baseline Energy Uses chapter might have these contents:

- Assumptions and Methodologies (Explain any assumptions and calculations you made to get your estimate of energy consumed for each Energy Use.)
- Energy Uses Definitions (Call out specific circuits if you can, otherwise identify the rooms, systems, or parts of the building you have identified as your Energy Uses.)
- Energy Uses and Their Consumption (It helps to put these in order from greatest consumption to lowest consumption. Be sure to convert all consumption values to

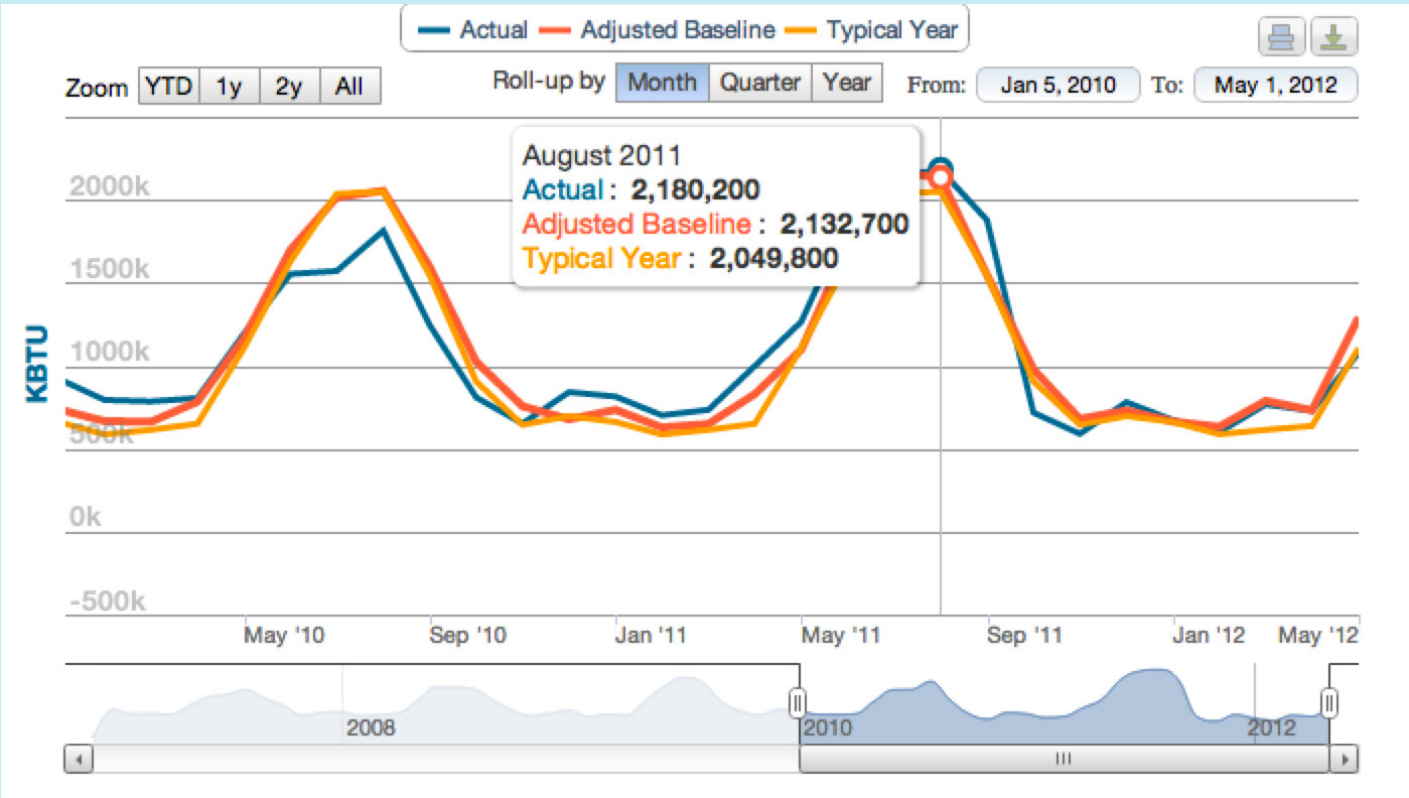
the same units so people can see where the energy is going.)

CHAPTER 5 - FUTURE ENERGY USE AND CONSUMPTION ESTIMATES

This is the tricky part. But a regularly updated Forecast of energy consumption really helps you determine if you are on track with your understanding of your energy profile. Also, as mentioned earlier, forecasts attract Management attention. And that is precisely what a persistent energy initiative requires.

So, how do you come up with an energy consumption forecast?

In simplest terms, if you know your Baseline Model you can get the activity projections and typical meteorological year data for the closest weather station, and plug them in to get the expected monthly values. The numbers you end up with here (for any utility meter) are a projection of the Baseline energy consumption. In other words, it represents the energy you



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would expect to consume if you made no improvements.

If you have energy improvement projects scheduled, however, you should subtract out the expected energy reductions from those projects for each month of your projection. This gives you a Forecast of your energy consumption.

Similarly, if you know there will be some equipment changes, or an addition to the building structure, you should add in the expected energy increases from those changes. Items like that are known as Baseline Adjustments, and they should be well documented.

You may, at this point, wish to present all this information in a series of graphs as well. And definitely you should project energy costs and energy cost savings (vs the Baseline) so that Management sees the value of the program directly.

So this chapter of your Energy Profile might include:

- Assumptions
- Explanation of future energy use and consumption estimation methodology
- Projected Baseline energy consumption (monthly, without savings estimates)
- Monthly savings estimates from energy improvement projects
- Monthly Baseline Adjustments expected from changes to the building structure or additional equipment
- Forecasted Energy Consumption (monthly, including savings estimates)
- Forecasted Energy Costs and energy cost savings estimates (both monthly).

With this, you have pretty much completed your Energy Profile. It is not, however, set in stone. Obviously you should update at least the Forecasted Energy Consumption on some regular basis, quarterly perhaps, or semiannually. Also keep an eye out for Baseline Adjustments such as a new and drastically different tenant or operation in a building, and document them. Otherwise you may find energy use increasing despite your best efforts to manage it just because something new is happening.

In my next installment, we'll talk about your energy hogs - how to find them and how to handle them.

Finding and Wrestling Your Energy Hogs

Every facility has energy hogs. We call them your Significant Energy Uses, or SEUs. You probably have a good idea of what they are already. You will focus your energy improvement efforts on these SEUs. And you will identify new ones to add to your list as you get the first ones under management. So don't pick too many all at the beginning. You will be overwhelmed and ineffective. Pick the ones that matter.

For obvious reasons, you want to keep a careful eye on your SEUs. First of all, they use a lot of energy, so it stands to reason that the energy saving potential is greater. This is not always true. But it usually is.

Secondly, if something goes wrong with one of your energy hogs, it can consume a lot of energy before you realize it. So it pays to keep regular tabs on their performance.

The identification of SEUs could be included in your Energy Profile (after your Future Projections), or it could be a standalone document. There are actually several reasons for choosing a system or piece of equipment as an SEU.

To identify SEUs, go through the Energy Uses list you developed in your Energy Profile. Clearly, the largest energy uses should be on your list of SEUs. But remember, these

are where you will focus your efforts. So you may also pick some that are in the middle range of energy consumption, but that have relatively large number of components. Often a complex system or piece of equipment will hold potential energy savings that just require a little investigation to see. We'll discuss that in a later article.

Finally, you may pick a system or two that has a lot of visibility, even if the energy savings are not all that great. Having a high visibility SEU gives you the chance to make improvements that everyone can see. This is important in giving the organization ownership of the energy initiative, and helps it persist after you are gone. It also keeps it in front of Management. In a Commercial or Institutional building a lighting upgrade is a good choice, either spread throughout the work areas or in a prominent common area.

You (and whoever comes after you) will be identifying SEUs on a regular basis, perhaps annually, perhaps more frequently. If you are uncomfortable doing this, work with your maintenance staff or contractors, energy consultants (perhaps through energy audits), or your utility. To make sure that this gets done in a consistent way each time, you should write down your methodology, whatever it is. If you want to say "We chose one for its high energy consumption, one for its complexity, and one for its visibility," that's fine. Or you may have had some kind of poll amongst maintenance people or tenants. Or some directive from Management. Whatever it was is fine. This doesn't have to be a treatise. Just make sure people can understand the rationale so that the next time they know how to get started if you're not there.

Once you've identified them, it's time to get to work investigating their characteristics. This is what makes an Energy Management System different from the typical energy audit/project implementation cycle. Your goal is to analyze and understand precisely how a given system or process is using energy. So now, you need to more or less duplicate the analysis you did for the facility, but you will do it for each SEU. Again, if you are uncomfortable doing this, work with your maintenance staff or contractors, energy consultants, or your utility. Energy management is a team effort!

Start by generating graphs of each SEU's energy consumption broken down by source. How much electricity did it use? How much natural gas? What does the consumption look like over the course of a month? A year? How does it relate to shift changes? Activity levels? In other words, what's really going on there? Why?

And here's where a lot of efforts bog down. The reality is that most operations do not have visibility into their energy consumption at such a low level. You should be prepared for some difficulty here, and some push back. Be prepared, but do not be deterred. If you

are not technically oriented and need support, make sure to engage your technical people (maintenance techs, engineers). Present the situation as a puzzle and ask for their help sorting it out. Make friends with your utility's account representative. They often have incentives and support programs you can tap into.

Here is a quick look at some strategies you can use to pick apart your energy consumption on this lower level.

SUBMETERS

Submeters are simply meters (electrical or gas) that, instead of measuring the energy used by the whole building, are located to measure just the energy consumed by a specific piece of equipment or system. Pick large variable loads, (e.g. chillers or large fans and pumps with VFDs). Before installing new meters, check to see if the equipment has (unused) metering within the existing controls. This is common, and means that you just need to collect the output data. This can be done by the Building Automation System or a simple standalone data logger.

SPOT METERS

Spot Meters are temporary meters with some amount of memory for short term data logging. There are many designs and models, but essentially they can be installed and uninstalled easily. Many utilities have a lending library of spot meters for just this kind of situation, where you need insight into a specific energy use. The utility may provide installation. Alternatively, you may call on an energy specialist or one of your maintenance contractors.

SAMPLING

This is useful if you are trying to sort out plug loads. You can purchase (or borrow from your utility) a small box that plugs into a wall outlet. Then the computer, lamp, or refrigerator is plugged into the other side of the box. The box measures how much energy passes through for as long as you leave it in place. So, for example, you can use this box on a different person's computer each day for a couple of weeks, get some idea of what the average computer consumes, and multiply by the number of computers to estimate their contribution to your overall consumption.

CALCULATIONS/ESTIMATES

Calculations can be pretty good estimates of the consumption of a specific energy use. Lights, for example, are pretty steady energy consumers. If you know the power rating of a light fixture, you can pretty closely determine how much energy it consumes in a given amount of time. Then it is just a matter of multiplying by hours it is on and the number of fixtures in the building to get "fixture-hours" of operation. You can also use your energy profile to visualize the "summer extra" and "winter extra" (e.g. the increase in natural gas used in winter months) and assign it to cooling and heating systems. Finally, if your building is of a common construction and use,

published studies by DOE and others can help you allocate end uses that you can't measure directly or calculate based on unit counts.

Once you've identified your SEUs and their specific energy characteristics, make sure you understand WHY their energy consumption looks the way it does. If you can understand this, then ways to reduce energy consumption become much more obvious. Each situation is different, so it is difficult to generalize about solutions here. Look for behavioral solutions (turning things off, turning things down) and behavioral causes (unauthorized adjustments to thermostats, fans, or lights, etc.). Look for time-of-day influences. Look for correlations with maintenance intervals. In other words, energy is consumed in response to activities. Make sure you understand the connections.

In a general way, however, there are a couple of things you should advocate for once you have identified your SEUs.

MONITORING

As I mentioned earlier, if your SEUs start having a problem, they are likely to consume a lot of energy. And no one may even realize it for a long time. It is worth monitoring your SEUs, if not continually (which is easily done by computer now), then at least weekly in some manner. Set up a schedule. Line it up against your monthly performance report (Actual Energy Use vs. Adjusted Baseline Energy Use) so that you can more easily see which loads may be contributing to unexpected consumption increases.

MAINTENANCE TRAINING

It is just not true that all equipment is alike. One way to reduce energy consumption is to get the maintenance people training in energy efficient maintenance techniques. This kind of training is often available for free or a very low cost from utilities. They usually call it something like "Track & Tune" or "Continuous Energy Improvement." Ask, and get the maintenance people trained.

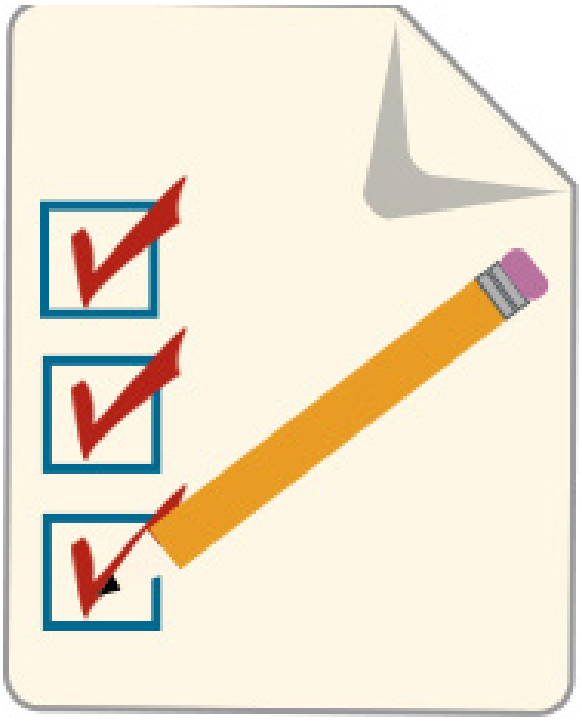
OPERATOR TRAINING

A bit of a no-brainer here, but it is amazing how seldom it happens. The person operating your building should have specific instructions for turning things off, turning things down, and generally running the building with energy awareness. If your cleaning people are responsible for turning off lights and other equipment, reporting hot water leaks, checking thermostats, make it a formal (i.e. written) part of the job. If your operator sits at a console managing a portfolio of buildings, they need written responsibilities as well. These are the non-capital energy savings!

So now you should be able to create your organization's Energy Profile. This is the foundation of your Energy Management System.

In the next installment, I want to discuss setting your energy goals. In some places this is the sole prerogative of management. In others, it

bubbles up from below. But regardless of how your organization works, you need to be in a position to influence it.



Setting Organizational Goals

In previous installments, I discussed building the foundation of your Energy Management Process (EMP). That foundation is called your Energy Profile. It is the technical underpinning of all you do to manage your energy.

We need now to step back a few steps and discuss how to set energy goals.

I have heard people say, “We don’t need goals. We’ll just do everything we can.” I’ll state bluntly that this approach doesn’t work. The fact is, that we are ALL already doing everything we can. It’s just mostly not energy-related. We are ALL busy with a multitude of tasks and projects. If another responsibility comes your way, and there is no goal to be measured against, then that responsibility will get shoved to the bottom of the pile, and won’t be addressed. You need goals.

You need to set goals at several levels. Let’s discuss the topmost level first - the organization-wide goal.

Ideally, your highest management level will set the energy goal for everyone. This dynamic is important. If your top management is seen setting a goal and providing direction and resources to achieve it, then everyone in the organization takes it more seriously. You may provide the actual goal to your top management to announce, or you may guide them in identifying a goal. But the organization-wide

goal should be announced by top management, and it should ideally be part of an Energy Policy statement.

> "I have heard people say, "We don't need goals. We'll just do everything we can." ...this approach doesn't work"
>
> — Paul Birkeland

Organizations vary in their aggressiveness in goal-setting. In their seminal book Built to Last: Successful Habits of Visionary Companies, James Collins and Jerry Porras advocate for setting "big, hairy, audacious goals," or BHAGs. In their study, they found that firms that set really challenging and exciting goals are also the most successful at achieving them. They outline several kinds of BHAGs, and conclude that regardless of what kind of BHAG you choose, specificity is critical. Nice words such as "To Be the Best Automobile Company In the World" do little to inspire creativity in the organization. But a goal such as "To Sell More Cars with Higher Customer Satisfaction Than Any Other Automobile Company" has quantifiable measures of success. Such goals drive an organization and each of its members to think creatively about their collective and individual efforts.

Energy, of course, lends itself to easy quantification. In the Industrial world, the US Department of Energy set up a program called Superior Energy Performance, or SEP. Any industrial organization can become SEP certified by setting up a formal Energy Management System and committing to the goal of a 25% reduction in Energy Intensity over 10 years. So there's a benchmark of an aggressive goal for you. Members of the Northwest Food Processors Association have committed additionally to reducing their collective Energy Intensity by 50% over 20 years. So there are precedents for setting goals at these levels that you can present to your own management. When setting your goals, be clear about the Reference Period and the end period too (e.g. "To reduce electricity intensity by 20% and fuel intensity by 25% per unit floor area for calendar year 2020 compared to calendar year 2010".
Alternatively, you can set an organization-wide goal based on cost reduction targets. If

top management already has a cost reduction program in place, and there are relevant cost reduction goals, you can adopt those goals, convert them into energy intensity reduction goals, and work from there. (It is critical to set the goal in terms of energy intensity, and NOT energy costs. Energy costs will vary as rate structures, activity levels, and weather change. You cannot be held hostage to impacts that are beyond your control.)

Finally, it may happen that top management simply throws the question back at you, "What would YOU set as our goal?" What an opportunity! As a point of departure for your recommendation, you should be aware that average energy intensity reductions amongst early adopters are generally of the order of 10% to 15% in non-capital savings, and another 10% to 15% if capital projects are implemented. Some got more, some less. It depends on 1) how creatively and aggressively your organization is accustomed to behaving, and 2) where you are starting from. (If you just moved into a newly constructed building it will be more difficult, but not impossible, to identify savings opportunities.)

So, top management has set organization-wide goals. Now what?

There is controversy at times in management circles about the best way to allocate goals to lower levels, or even if they should be allocated at all. (Indeed, some argue that setting goals at all limits what an organization can accomplish. But that's not part of this discussion.)

You need at this point to assess your organization's readiness and abilities to accept and achieve lower level goals. Sometimes an organization's real inspiration resides at the top of the effort. (In this case in YOU.) Sometimes leadership can be found at all levels. Only you can judge that. Just keep in mind that you are not delegating the responsibility to meet the organization-wide goal. That is, and will remain, yours.

If you DO decide to allocate goals, appointing a "building lead" or "zone lead", each with his or her own goal, can be very helpful if you are working with a campus or building portfolio of some sort. (Just be sure they do not isolate themselves and their ideas.) But also consider unconventional allocations. For example, you may break them down into capital and non-capital improvement goals, and set up two teams to address them. (Just be sure that the two teams share and coordinate regularly in the Energy Team!)

You may also choose to partially allocate goals to departments or shifts and have them compete in achieving the goals. (As we'll discuss in a later installment, one of the best ways to see energy consumption reduced is to make energy costs part of each department's

budget rather than having them paid out of "overhead.")

Or you can, of course, try each of these approaches in a year-by-year rotation. It never hurts to shake things up a bit.

EMP Components & Identifying Opportunities

People ask me all the time how to identify energy-saving opportunities, especially the non-capital variety. We all just love them.

If there were a silver bullet here, a list of things to investigate, I'd give it to you. But the real answer is that if you have the right EMP components, your organization will identify the opportunities in a way that no outside auditor or consultant can. And when I say "your organization" I mean your staff, your various maintenance contractors, and maybe even your tenants. Reach where you need to in order to include the insight and expertise you need. Let me give you an example of how dynamic this situation can be.

A food processing company I've worked with started a strategic energy management process that included (rightfully so!) an employee suggestion system. Now this company was pretty conscientious about energy consumption already, and already had projects reviewed, prioritized, and lined up. The plant engineer had come up with the idea of putting motion sensors in the bathrooms to turn off the lights when no one was in there. A quick analysis determined (for him) that it wasn't worth the cost and effort.

When the employee suggestion system kicked in, however, four of the first fifteen suggestions were to put motion sensors in to turn off lights when no one was around. The difference was that each suggestion came in with a different list

of places where they could do this effectively. Workers from different parts of the operation saw opportunities in different places. We weren't just talking bathroom lights anymore! Taken together, these suggestions amounted to pretty significant savings. But that's not all.

> *"If you have the right EMP components, your organization will identify the opportunities in a way that no outside auditor or consultant can."*
>
> — Paul Birkeland

These suggestions were taken up and discussed at an Energy Team meeting where the local utility happened to have a seat at the table. The utility rep jumped right in and told them that they have a program that pays all the hardware costs for motion sensors to turn off lights. The cost effectiveness of the project was now pretty apparent. But that's still not all.

The Energy Team Leader, who was a really sharp person and an excellent manager, saw right away that acting on employee suggestions so quickly would let other employees realize that this effort and these suggestions were being taken seriously. There was a long term, non-energy benefit to be had here. And the project was approved.

The moral here is that without a suggestion system, this opportunity might have remained in the trash basket. Without a formal Energy Team meeting, it would have remained in the 'capital-required' pile. But with both of those things in place (and a savvy manager), this project became a slam dunk.

So let me give you a quick list of EMP components and the kinds of opportunities they may drive out.

ENERGY TEAM

This is maybe self-evident, but let me use the opportunity to drill down on critical Energy Team components.

a. **People** - I'll not say much here except to remind you that to find opportunities throughout your organization you need involvement throughout the organization. Make sure you

have a cross-functional team, not just the engineers or maintenance department.

b. **Action Plan Form** - Projects, both capital and non-capital, should be formally opened, processed, and closed by the Energy Team. Each proposed project should get its own Action Plan that includes estimated cost, estimated savings, justification (cost benefit), estimated implementation schedule, assigned personnel, verification method, and terms for closeout.

c. **Energy Team Notebook** - In the course of the Energy Team activities, you will have to figure out how you are going to do things. For example, how are you going to assess, respond to, and implement employee suggestions? It's best not to have to reinvent the wheel each time you open the Suggestion Box. Keep an Energy Team Notebook that all team members have access to, where you write down these kinds of procedures as you develop them. It may not uncover energy saving opportunities directly, but it will give you more time to tend to other activities that will.

EMPLOYEE COMMUNICATIONS/SUGGESTION SYSTEM

Maybe I've said enough about this already, but I don't think so. A suggestion system - one that is respected and used - turns up amazing opportunities. These are the people doing the work. You can pretty much bet they have thought of better ways of doing things. But don't stop there. As Energy Manager you should go out a talk to people at their desks, in the mechanical rooms, in the cafeteria. Such direct communications sometimes yield direct results. But all of them yield long term employee engagement that will be invaluable.

ENERGY TRAINING PROGRAM

a. **Energy Awareness Training** - This should be for everyone so that they know what you, as an organization, are trying to do. It can be formal training upon being hired, or a brown bag lunchtime thing. In leased space, let tenant organizations know that you would like

to include their staff. Get them involved in your efficiency program too.

I really encourage people to take this one step further than "energy awareness." You can make these people into your eyes and ears pretty easily with this kind of training. In short, make them realize that if they feel something hot, there's probably energy being wasted. If they feel something cold, probably the same. If something is rattling or hissing or whistling, you're probably wasting energy. IF the employees just learn to report these kinds of things, you will be miles ahead.

b. **Maintenance Training** - I've mentioned this already, but your maintenance people or contractors should take advantage of no-cost or low-cost training from your utilities on keeping equipment energy-efficient. Utilities usually call this kind of program "Track & Tune" or some such name. Ask your account representative. There are energy saving opportunities to be had as part of your regular maintenance program is your maintenance people are trained to see and respond to them.

c. **Operator Training** - This is difficult to generalize about, but it should be one of your EMP components just the same. Figure out who is doing the "operating" in your organization. Sometimes the janitorial staff is responsible for turning out lights or turning down thermostats. Sometimes an organization has a central control room where things are managed remotely. Maybe you have sites where service contractors are making energy decisions for their own convenience, not for your energy budget. Other organizations do other things, and, in truth, the responsibilities are often spread over a disparate set of individuals who don't even know each other. No matter. Figure out who does what, and make sure they are formally aware of what they are supposed to do and how to do it. Because the chances are that they are missing energy saving opportunities every day.

ENERGY EFFICIENT BUYER/PROCUREMENT PROGRAM

The long term energy performance of your organization depends upon the people doing the buying. Too often, when the time comes to buy a new boiler or air conditioner, it is because the old one has died. Everyone's hair is on fire, and the purchase specifications, or the engineer, simply say "Buy the closest thing they have to the last one." So the Buyers do, and the organization is stuck with another poorly performing piece of hardware for another 15 or 20 years. And keep in mind that most building designers significantly oversize equipment to avoid having to do very much analysis during the design phase. So buying 'the same thing' is a recipe for energy waste. This doesn't have to be.

First of all, have the engineers do some research on the newest systems to replace those you may need. (Check with your utility

again for information and incentives.) Keep a formal “Major Equipment Succession Plan” that outlines what to do if a piece of major equipment fails. Update this plan on a regular basis. Your utility may volunteer to send you updates as they become aware of them.

Use Life Cycle Analysis to include equipment life and operating costs in the cost/benefit analysis in your Major Equipment Succession Plan. Better yet, work with your procurement department to make LCA part of their standard buying assessment process.

Make sure your procurement people are aware of this document and will consult it when a major piece of equipment must be purchased. I have no data, but I suspect that major equipment replacement is one of the single most missed energy saving opportunities in the developed world.

Next time I will discuss checking your performance and calibrating your plan.

Checking Performance

At the end of the day, you want to be able to trumpet your achievements far and wide. So does your management team. Imagine the horror of some skeptical party probing your results and asking questions to which you have no good answers. This is the scenario we want to avoid by checking our performance.

People usually think of checking performance as checking the energy savings achieved in some way. And that is a big part of what needs to be done here. But always keep in mind that, if done properly, your Energy Management Process (EMP) itself is continually being improved. That is the less complex topic, and I want to address that first.

If you look back at the last installment, you will see a list of critical EMP components. Now, think of metrics to track for each of those components, and you will have something to check your EMP performance and report to management with.

Here's a quick list of components and possible metrics:

The message here is that continuously improving your organization's EMP and keeping it productive is a goal worth tracking and celebrating. Don't ignore it in favor of just reporting energy metrics.

CHECKING PERFORMANCE OF YOUR EMP

EMP Component	Possible Metrics
Energy Team - People	• Number of departments represented on the team
Energy Team - Action Plan Form	• Number of projects formally reviewed
Energy Team - Energy Team Notebook	• Number of contributors to Notebook • Number of times Notebook was accessed
Employee Communications/Suggestion System	• Number of suggestions received • Number of suggestions that resulted in successful projects • Energy & cost savings due to suggestion system • Number of employees who submitted suggestions
Energy Training Program	• Number of employees who have received Energy Awareness Training • Number of reports of “leaks” of any kind. • Number of maintenance people who have received “Track & Tune” training • Number of operators who have received operator training.
Energy Efficient Buyer/Procurement Program	• Number of pieces of equipment covered by the Master Equipment Succession Plan • Energy saved since the last piece of major equipment was replaced.

You will, of course, also need to check and verify your energy performance. This can get very technical, but let's view this from the management standpoint.
In the previous installment, I stated the need for an Action Plan for the Energy Team to use in identifying, reviewing, tracking, and closing out energy improvement projects. One of the entries in the Action Plan Form is an estimate of the energy savings for the proposed project. One need not be an engineer to recognize the need to confirm that the project did in fact yield the estimated savings, and if it did not, why not.

Many people feel that in order to do this, they simply need to track their Energy Intensity. Logically speaking, this is so. The difficulty is, however, that no matter how well you modeled your Energy Intensity, no matter how many uncontrolled variables you took into account, there is so much noise and uncertainty in organization-wide data, that it is practically impossible to reliably "see' the savings from any specific project in the Energy Intensity. Changing a light bulb is NOT going to be recognizable in your Energy Intensity estimate. That's an extreme case, but where the dividing line is is uncertain.

So how DO we check our energy performance?

First of all, each Action Plan should include a verification method. Will a submeter be installed as part of the project? Will we borrow a data logger from the utility? Everyone should know what is going to be done.

If you project is part of one of your Significant Energy Uses (SEUs) (See installment four), then you should already have some kind of monitoring or measurement equipment in place. Checking the performance of your energy improvement project is straightforward. The Energy Performance Indicator (EnPI) you

identified for that particular system or machine will keep you informed.

Projects that are not being executed on one of your SEUs may be a little more difficult, especially if they are behavior-change projects.

In general, take a look back at installment four again where I listed strategies to determine your energy consumption characteristics on lower levels of your operation. They are all applicable here. They are Submeters, Data Loggers, Sampling, and Calculations/Estimates. These strategies, or some combination of them, can be used to verify your energy savings for individual projects.
In Commercial and Institutional buildings, it is valuable to monitor energy performance at the whole building level, using metering and billing information from utility companies. Make sure your process takes proper account of weather, activity levels, and changes to the facility, otherwise there will be questions and doubts. Noesis Energy offers free tools that use industry-standard processes and calculations (as published by ASHRAE and EVO) to make this job as easy as possible.

Does this sound like a lot of work? If so, you are still thinking of Energy Management as something YOU do. You aren't yet thinking of Energy Management as something your ORGANIZATION does. This is why we made sure to get management support for the EMP effort to begin with.

There are people in every organization, or associated with very organization, with the interest and skills to accomplish these tasks. Recruit your co-workers, recruit your utility, find you allies, and get to work!

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