

# Implementing Behavioral Energy Change (BEC)

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## ABSTRACT

Many sites pursue very large efficiency gains, converting old equipment to newer, more efficient models in the belief that this will potentially provide large savings. But often these savings do not occur to the planned degree, for many reasons, including operational or personnel issues. Other times we don't realize, or are slow to realize, that significant conservation savings could be cheaply achieved if we could only get employees to perform at work the same correct energy behaviors they perform at home—or some other simple work practice changes.

In either of these instances, people are often both the strongest and weakest link in the energy reduction chain, and they can very often make or break the meeting of energy reduction goals. At some sites, experience has shown that behavioral energy savings might be 10% or more of a site's total utility budget, so we know this should be addressed. But when it comes to people and energy, the "squishy, yet hard" question is, How can we best to go about attacking energy reduction through behavioral change?

This article will present how to best use the "human element" when it comes to energy management and reduction, through application of typical behavior-based methodology. We will present the classic considerations of any behavior modification program, evaluating the common definitions, terms, and principles. We will then apply behavior based techniques to actual energy reduction examples, showing real world methods and results.

## INTRODUCTION

In a previous article, I discussed the difference that I see between conservation and efficiency, while providing some examples and methods to further address conservation energy savings. In that article, I gave ten reasons why conservation/energy reduction opportunities are not typically considered more often. In summary, and in no particular order:

1. Manufacturing inertia, or "We've always done it this way!"
2. Site personnel are often too busy and miss conservation opportunities.
3. It is not their personal money which is involved at work.
4. Site personnel do not think conservation will make much of a difference.
5. You will never see conservation savings in your utility bills.
6. Conservation is often hard to evaluate, or to put "hard" numbers to.
7. Site personnel do not know what to do to achieve this conservation.
8. Old wives' tales still abound.
9. Sites are hesitant to address behavior issues.
10. Conservation projects are not typically supported by vendors or utilities.

In perusing this list, you might notice that a very large number of these have some direct or indirect relationship with human interaction. For example, consider:

- #1: "Inertia," or "We have always done it this way." ("And now you want me to change, after all these years? Get Serious! Why should I?")

- #7: Personnel do not know what to do to achieve this conservation change. (People cannot do what they don't know to do, or know how to do.)
- #3: It is not their personal money which is involved at work; and #4: Personnel do not think conservation will make much difference. (In these cases, employees are actually making value decisions in their minds before taking action, or perhaps no action.)

Actions in these cases are actually behaviors—what we decide to do or not to do—and the resulting actions are measurable. But the real question, given all the above, is How do we get the desired actions to occur?

A very good way to address this 10-item list is to view the issue from a slightly different perspective—how we as humans evaluate and make decisions and actions, or *behavior based* (BB) decision making.

This article will describe how to apply BB principles to energy change, as well as provide examples along the way.

## PRECURSOR: BEHAVIOR BASED SAFETY PROGRAMS

Among other things, I have been involved for many years with application of behavior change principles to safety programs. I have seen this work very well, reducing incident rates dramatically when all else seemed to have failed.

A basic understanding of behavioral change, energy or safety or otherwise, should begin with a common understanding of why organizations or individuals seek change at all in the first place, or what I like to call the *basic change equation*.

## THE CHANGE EQUATION

Somewhere along the way in my work experience, I came across a simple sort of equation/explanation that can describe so many of our activities and actions that it is rather scary. Organizations, or people for that matter, will only change for two reasons:

- They want to
- They have to

So how many of us want to change our actions or behaviors? The simple answer is that very few people want to. So often, it comes down to *having* to change, as dictated by some external force (government, front office, supervisor, spouse, etc).

For us to be much more open to and want change, there are other parts to the overall change equation that must be considered for any true change to occur, summarized as follows:

$$C = D + S + V$$

Where:

- C = Change
- D = Dissatisfaction with present condition
- S = Steps to make the change
- V = Vision of changed condition, the end point

(I apologize to the organization I learned this from; I cannot remember who or when, or I would give credit. I only know that considering this equation works for all true change.)

So for lasting and desired (“I want to”) change to occur, you must really consider all three parts of this equation. For example, if you have high cholesterol, you will not lower it unless you first are dissatisfied with this finding. Only then will you even listen to the steps to take—change your diet, such as egg substitutes instead of whole eggs; possibly take medication; etc. Also, with this sort of treatment regiment there is usually a vision/goal to achieve, such as getting one’s weight below 200 lbs.

This same equation applies to all change conditions. You will typically never make a true change unless you have all three parts, starting first with *dissatisfaction*. If you are not sufficiently dissatisfied with the present condition, then there is no need to identify steps or a future vision. I believe this is especially true if one is attempting Behavioral Energy Change (BEC).

## GETTING DISSATISFACTION—THE STARTING POINT

A site or its team must first be sufficiently unhappy with its present energy or utility condition. Very often this occurs through an outside assessment of energy reduction opportunities (AERO). I use this wording because it uses neither the word *conservation* nor *efficiency*. It simply looks for reductions in energy use—however achieved.

With a good AERO visit, the site personnel will start to know where they presently stand against various energy benchmarks, as well as what energy targets to attack and the level of potential savings. With BEC, it is very important to identify and quantify the behaviors that could be addressed, as well as sufficient detail on the potential savings. At a typical site, one can easily document exactly what behavior changes to suggest, as well as the real (but conservative) potential savings. Very often this totals to a very significant number, getting the team's attention.

The point is, the starting point for behavior based energy change must be a strong enough level of dissatisfaction. So, step one—get them dissatisfied.

### **Identify Behavior-based Opportunities**

Like many in the energy field, I find it very important to view a site in its unoccupied or “sleeping” condition. During the weekend, or at 3:00 a.m. on a weekday, you find a great many behavior based energy items, in addition to typical capital changes. Here are some typical examples that might sound familiar:

- Compressed air leakage is over 50% of total air usage, and compressed air leaks at night are often from tools and tool connections where there is a manual shutoff conveniently right next to the tool—but not being used.
- Lights are left on, even when they are instant on/off like T-5 and T-8. This could be in restrooms, receiving, shipping, bench lights—you name it.
- Dust collectors or extraction fans are still running.
- Mixer motors are left on in tanks when the tank is empty or when mixing is not needed at night.
- Computer monitors and CPUs are everywhere, with every type of screen saver (which we know saves no energy).

There are so many more, but you generally get the picture.

### *Potential Magnitude*

Consider the magnitude of such oversights. For example, at a typical manufacturing site I might turn off at least 5 KW of simple lighting during my visit—lights which are on in motor control centers, remote control rooms, compressor rooms, training areas, generator rooms, and more. Revisiting the areas a few days later, I might find that most, if not all, of these lights are still turned off. This shows me that these really do not have to be on; it could very well just be a matter requiring proper behavior (or perhaps a sensor, if you must get fancy).

Note the value of this at, say 5000 hrs/yr:

$$5 \text{ kW} \times 5000 \text{ hrs/yr} \times \$0.10/\text{kWh} = \$2500/\text{yr}.$$

That might not seem like a lot, but how many sites could this apply to each year? If at a thousand similar sites, then this could be over \$2.5 million in wasted cost each year—for just this one behavior, with just one energy use system (lighting)! Accounting for *all* the different behaviors with energy use systems, all sites, and then employee homes as well for the same things, we are probably looking at savings in the billions of dollars per year!

### **Provide Savings Values**

Once behavior based energy opportunities are identified, the next step is to provide individual and summation savings values. In an article last year, I described various ways to quickly and fairly accurately arrive at good “rules of thumb” (ROTH) for various energy use systems. An example given last year is:

Consider that a typical three-phase, 10-HP motor, at \$0.10/kWh, will cost about \$0.66 per hour to run (at 90% efficiency, if 80% load, PF = 1). Scaled, this means that it costs about \$0.066 per HP-hr, a handy starting ROTH for motors at this cost and these specifics.

Once a site has this unit cost, savings from shutting down any size motor for any amount of time can be calculated fairly accurately.

One site I visited had over 50 HP or mixers running all weekend—in empty tanks. The loading of the motors was certainly less than the above ROTH, but just using this ROTH as a first pass created great initial dissatisfaction at the site. Once the personnel had this initial ROTH, they calculated on their own (with me sitting there):

$$50 \text{ HP} \times 60 \text{ hrs/weekend} \times 50 \text{ weekends/yr} \times \$0.066 = \\ \$9,900 \text{ per year, for just this one area in one energy-use system.}$$

Certainly, if you measured the motors for actual KW, less loading (tank empty) would mean less annual cost. However, this initial figure certainly caught people's attention and raised the dissatisfaction level immensely, as there was no value at all from running these motors on the weekends. Even at half the value, this was completely unacceptable to the site team.

### **Corporate Mandates**

Another level of dissatisfaction occurs as a result of corporate mandates. Many corporations are signing up for energy reduction levels such as 3%, year over year. These sorts of mandates make for instant dissatisfaction, especially if tied to site or personal performance measures. I recently had a client, already with very good energy systems and controls, state that a corporate mandate had been recently received to reduce energy usage 30% within 3 years. Given their very good equipment and programs already, I strongly suspect that the only way they will be able to make their particular goal is to include behavioral energy change (BEC) into their revised overall energy reduction strategy.

### **VISION—WHAT YOU WANT TO BE WHEN YOU GROW UP**

By thorough on-site systems evaluation, I might often find 5-10% of total potential site energy savings related to potentially simple, behavior based issues. However, I would explain that this is usually the tip of the behavioral energy change iceberg. A good number of sites I have worked with have achieved much greater savings once they have gone down the true BEC path. In fact, I have a saying that works with any behavior based program:

The right program, with  
The right people, for  
The right amount of time, provides  
The right level of change.

I use this saying because, as noted above, true change takes many things—but especially *time*. Ever heard of anyone changing a habit overnight?

With this as a backdrop, very often I will work with the site to brainstorm behavioral energy changes, using the affinity process. Coupled with my findings (starting point only) and perhaps a bit of energy systems training specific to their site conditions, the site team then truly gets to see the *vision* of where they could potentially go with the right program for the right amount of time.

The vision, or future state, is often, but not always, numeric—a dollar value or percentage. Some site teams have decided to make this more general. At one site, the future vision was, “We think about energy and the environment everyday.” This vision was ultimately backed up with numeric goals.

## STEPS TO ACHIEVE THE VISION—THE HARD PART

Up to this point, the process has actually been easy. You have, either on your own or with outside assistance, identified and quantified the general or specific opportunities. As a result of this, or a corporate mandate, your team is dissatisfied with the current condition. You think you know what you want to be in the future. Now comes the hard part—what’s the program, and all its steps, to get you to the end point?

I have performed energy work with sites using the Six Sigma or Kaizen process, which have many common elements. Using the Six Sigma process as an example, there are five general steps:

- Define the problem.
- Measure the size of the problem.
- Analyze how to solve the problem.
- Implement/improve—make changes.
- Control your changes; ensure that they are correct and stay in place.

Some organizations view this as three general steps:

- Gap analysis—where you are and where you want to be
- Gap closure plan—how to close this gap
- Control plan—how to keep the gap closed

These are all generally similar. The point is that we are following a true program. We have defined the problem and along the way become dissatisfied with our existing case. We have decided to continue down the change path by measuring the size of the problem so that we can know what the future state (vision) can be. Now we must hit the middle step—an analysis of how to solve the problem, or a gap closure plan.

#### ABCS OF BEHAVIOR CHANGE

For change to occur, you have to set up the change correctly. One way to do this is by following the *ABC change model*, where:

A = Antecedent—that which triggers, causes, or allows the behavior

B = Behavior—the action performed (or not performed)

C = Consequence of the action

Figure 1 shows how the classic model generally flows.

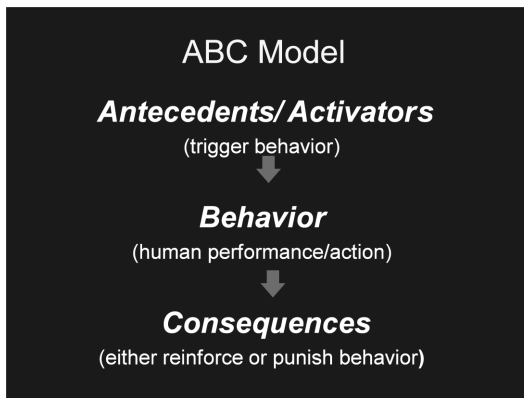


Figure 1. Classic model of behavioral change

### **Antecedent**

For proper behavior to occur, you need to ensure that you have set up the systems to easily allow the action to occur in the first place. These are called antecedents, or activators. Some people define these as a *person, place, thing, or event that happens before a behavior takes place that encourages performance of that behavior*. In other words, activators only set the stage for behavior or performance—they don't do it and they don't control it.

For example, let's say that you want the last person on a shift to shut off the lights (bench and overhead) prior to leaving for the weekend. Does the employee:

- Know you want them off?
- Know why you want them off?
- Know the value of shutting them off?
- Know where to shut them off?
- Know how to shut them off?
- Know who is to shut them off?
- Know which exact lights to shut off?
- Have a reminder system to shut them off (exit checklist)?
- Have unquestioned authority/responsibility to shut them off?
- Still have enough light to exit the area of the building after shutting them off?

If you do not have these sorts of antecedents in place, or have not answered these questions, you cannot expect to get the proper behavior/action (lights turned off) at all times.

One site was experiencing problems getting the lights shut off consistently at the end of shifts. Once we identified all the appropriate antecedents (including enough light to exist safely), this problem was solved without spending anything on timers or sensors, or other, expensive systems like a building energy management system. One end result of this work—other than large, no cost, energy savings—was very well identified electrical panels and systems throughout the site, such as the example shown in Figure 2. How many sites can say they have such clearly marked panels?



Figure 2. A clearly marked panel

### Behavior

As you can tell by now, behaviors are the actions that take place. Some people define this as *any directly measurable action that a person does*. Some key points with this are:

- *Activities are measurable.* You either do something or do not do something, both of which are *action* events.
- *Behavior is not attitude.* It is true that you will more likely get your desired behavior if the person has the “proper” supporting attitude. However, proper attitude is not absolutely required for proper behavior. For example, I once had a supervisor that I did not particularly like, and I probably had a bad attitude (though outwardly hidden). But I did everything I was instructed to do, so my behavior, as measured by performance reviews, was absolutely acceptable.

### Consequence

The third part of the behavioral change model is consequence, often defined as an *event that follows behavior that increases or decreases*

*the likelihood that the behavior will occur again in the future.*

There are different elements to a consequence that should be evaluated. For example,

- Does the consequence reinforce the desired behavior or punish undesired behavior? Consequences can be positive or negative. As human beings, we prefer positive consequences to negative ones, as positive ones better reinforce our actions. We should always look to be positive first, and then only proceed to a negative consequence if truly necessary.
- Is the consequence to occur soon or at some distant time? Humans believe that consequences occurring sooner rather than later are more important overall. This is why feedback, which is actually a consequence, should typically occur sooner as opposed to later.
- Will the consequence actually happen? It is better for behavior change to know that if X happens, then Y will also happen—every time. If unsure of linkage, then humans will view the consequence as being less significant.
- Will the consequence be viewed as important or unimportant? If relatively unimportant, then the consequence has no meaning. (My favorite example is when a parent says to a misbehaving teenager, “You’re being punished, go to your room,” where there is a computer, TV, internet, cell phone, etc. So what is the importance of this punishment again?)

For the lighting example discussed earlier, let’s look at all these aspects together.

First, some consequence possibilities:

- Supervisor stating, “Good job turning out the lights”
- Board notice showing % of lights turned off appropriately
- Tracking chart showing overall site energy levels decreasing over time
- Cup of coffee for job well done

- Incentive compensation—money if site or department energy goals met
- Too dark to exit department safely!

Figure 3 illustrates the whole behavioral energy change profile for this one requested behavior (turning off the lights), including some consequences, most of which are mentioned above. The lighter boxes show consequence support for the behavior, while the shading shows non-support.

Antecedents (causal event - trigger)	Requested Behaviors	Consequences (result of behavior)	Consequence specifics			
			Reinforces or Punishment	Timeframe Soon or Distant	Predicability Certain or uncertain	Significance Important or Unimportant
End of Shift Checklist	Turn off Lights at end of shift	Feel Good, "Green"	R	S	C	U
Habit from Home		Incentive Comp at end of year	R	D	U	I
Company Vision		<b>Too dark to exit safely</b>	<b>P</b>	S	C	I
Value Determination		Cup of coffee from machine at month end	R	S	C	I
Panel well marked		Progress chart on wall	R	S	C	U

Figure 3. Behavioral energy change profile for “turn off lights”

Some comments on the profile in Figure 3:

- In addition to the four categories of consequences, as humans we might weigh some as being more important than others. For example, one dark-shaded cell notes how it might be too dark to exit safely, which actually punishes (with a *huge* P) the requested behavior. Even though all the other consequences are generally supportive, this one undesirable consequence might be enough to stop the requested behavior from occurring. Obviously, this needed to be addressed from an OSHA/safety perspective, but I hope this shows the value of viewing all these aspects together and understanding and weighing things appropriately.
- Be careful of the “green” consequence listing, as shown on the first line, in the shaded cell to the far right. This might be important to you, but you have to consider how important it is to the persons you are asking to do the action. To this particular person, “going green” was totally unimportant! Many may talk

a great green game but not really back it up with day-to-day behaviors.

- Notice the one consequence that is lightly shaded all the way across. At one site I worked at, for every month in which the energy metric was at or below the pre-set and fully communicated goal, we simply “opened up” the beverage machines so that cups of coffee and soda were free for that one reporting day each month. This was not a big cost but was a very effective positive reinforcement for all the associates at the site. In terms of being a consequence, it hit all the high points in that it:
  - Was certain to occur if people performed their behaviors correctly
  - Occurred soon after month’s end
  - Positively reinforced the actions
  - Was thought of as important by employees. (In fact, you should have heard them when this did not occur; i.e., “We want names!”)

#### TYPICAL BEHAVIOR DETAIL?

The example discussed above illustrates what is often, but not always, the typical level of detail for pursuing behavioral energy change. The most important part of BEC is ensuring what you want done, defining and communicating this exactly (just like a Six Sigma problem statement should be very well defined). You must then ensure that you have the proper antecedents in place, as well as the proper supporting consequences. If you make the action easy to do, with the correct antecedents and enough typical consequential support, you will very often succeed without going into tremendous detail.

However, very often it is of great value to pursue the complete analysis (similar to the lighting example) so as to get familiar with all the thought aspects and generate overall common antecedents and common consequences. Also, as we learned from the dark exit in the example, sometimes it really pays to go into detail to see why someone is not doing what you want; often a very easy correction will be found if you take the time to review per the process.

## ADDRESSING WIIFM AS A CONSEQUENCE

With any change program, it is best to spend sufficient time thinking about “What’s in it for me?” (WIIFM), from the employee perspective. If there is something in it for the employees that they view as sufficiently positive, you will have a better chance of getting the desired behavior.

## MEASUREMENT OF BEHAVIORAL ENERGY CHANGE

Behaviors must be measured, or there will be no long-lasting change. There must be feedback, the more specific and positive the better.

Many sites will simply post their monthly metric for energy use, unrelated to production or weather, or normalized in any way. I have seen the sort of metric shown in Figure 4 at many sites as an attempt to show energy change; however, there is no way from such a graph to really tell if, at the facility level, BEC is assisting at all.

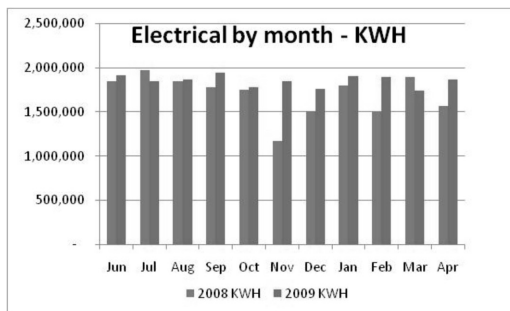


Figure 4. Typical 2-yr. monthly comparison graph of electricity use

Often the bulletin board simply has something like this posted, with no discussion, because, after all, what could you discuss?

It might be better to show this as a rolling average, such as the 12-month rolling average example in Figure 5.

But this (Figure 5) shows terrible results! We can’t show this. How can we tell if we are saving with BEC?

So, there must be better metrics. Actually, the best full facility metrics for behavioral change need to be normalized somehow, to re-

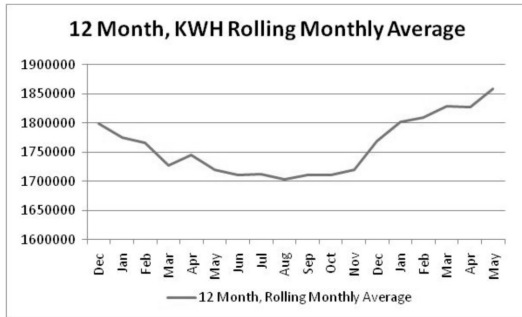


Figure 5. Rolling average of electricity use by month

move weather and production-related events. Figure 6 is an example from a site I have worked with that normalized to metric tons of production, showing the results achieved with BEC and efficiency changes over a sufficient length of time (3 years).

There are potential problems with Figure 6 as well, such as in the summer of 2005, where you see increases in this metric when production fell. However, for this team, this actually just meant they had to work harder in all the team’s BEC and efficiency programs, which they did.

Two final things about this example graph (Figure 6):

- It demonstrates my earlier saying—you get the right results with the right program, and the right people, over the right amount of time.
- The best news is shown at the far right of the graph; it appears

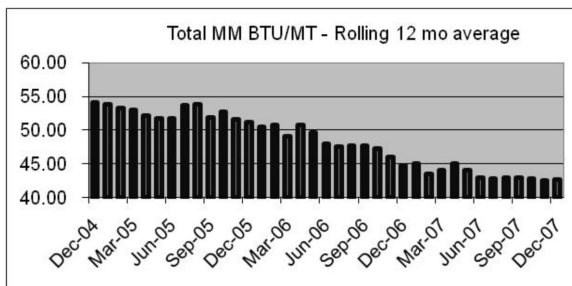


Figure 6. Rolling average of electricity use by month, normalized to metric tons of production

that all the BEC and other changes stayed in place. They were then an ongoing positive habit.

Up to this point we have covered total facility metrics. However, the best metrics are local in nature. These will communicate to the employees sooner and better how they, individually, have performed. The BEC team should define its local metrics around the behaviors that it has defined as making a difference. Consider simple positive metrics like:

- Days/month when all lights were off at shift end. (Notice that this is stated as a positive, not a negative; i.e., not days when lights were left on.)
- Number of shifts/month when all personal cooling fans were off at shift end (as found by a site's 5 S system, a great, systematic example).
- Number of pneumatic tools with their supply shut off at the end of use/shift.

Just setting these three behavior metrics at one site saved over \$10,000 per year—without any real cost. There was another huge, added benefit in that this success got people really excited. They then wanted to dig for further reductions and savings opportunities on their own.

### **Final Notes On Metrics**

- I can absolutely guarantee that something being off will save you money over it being left on wastefully.
- Thanks to the laws of physics, you will save money, whether it can be seen in the overall facility metrics or not.
- The behaviorally-induced savings, especially locally, can be calculated for potential positive reinforcement.
- I truly believe that such savings will ultimately show in the full facility metrics *provided* the metrics are properly prepared.

## CLOSING AND SUMMARY POINTS

- Behavioral energy change is a process, and like all change processes, it is best applied in a very specific way to get the best results.
- No change will happen, especially BEC, without first addressing all the aspects of the general change equation,  $C = D + S + V$ , where:
  - C = Change
  - D = Dissatisfaction
  - S = Steps to achieve change
  - V = Vision of proposed change
- You need to think of the three classic parts to behavior change to get the best and most consistent results. Use the ABC model:
  - A = Antecedents
  - B = Behavior
  - C = Consequence
- You should prepare *local* behavior metrics as much as possible for showing positive consequences.
- If you select the proper local behavior metrics, you will get positive local results, and hence positive overall site results for your facility metrics.
- BEC just might be the missing piece to bring together all the elements of a site's energy use reduction plan.

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### ABOUT THE AUTHOR

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Kaizen programs, as well as the more typical conservation and efficiency changes. He has a B.S. degree from Miami University and an M.S. degree from Vanderbilt University in Environmental and Water Resource Engineering, and he is a Certified Energy Manager, a Certified Energy Auditor, and a Certified Carbon Reduction Manager.

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