IMPLEMENTING BEHAVIORAL ENERGY CHANGE (BEC)

Kevin Vidmar
Vice President of Energy Services
Loureiro Engineering Associates

ABSTRACT

Many sites pursue very large efficiency gains, converting old equipment to newer efficient models, knowing that this will potentially provide large savings. But often these savings do not occur to the planned degree for many reasons, including operational/personnel issues. Other times, we either 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 employees perform at home, or some other simple work practice changes.

In either of the two examples, people are often both the strongest and weakest link in the energy reduction chain, and they can very often make or break meeting your 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 best to go about attacking energy reduction through behavioral change?

This paper will present how to best use the "human element" when it comes to energy management and reduction, though application of typical behavioral based methodology. We will present the classic considerations with any behavioral 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 paper, I discussed the difference that I see between conservation and efficiency, while then providing some examples and methods to further address conservation energy savings. In that paper, I gave but ten reasons why conservation energy reduction opportunities are not typically considered more. 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 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 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?

- Consider #7 – Personnel do not know what to do to achieve this conservation change.
    - People cannot do what they don't know to do, or how to do.

- Consider #3 – It is not their personal money 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 an action, or perhaps no action.

Actions in these cases – are actually behaviors – what we decide to do or not do, and 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 ten item listing is to view this from a slightly different perspective – or how we as humans evaluate and make decisions, and actions, or behavioral based (BB) decision making.

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

Precursor - Behavior based safety programs

Among other things, I have been involved for many years with application of behavioral 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 of 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 working 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 very few people want to. So often, it comes down to we have to change, as dictated by some external force (government, front office, supervisor, spouse, etc).

For us to be much more acceptable to wanting to 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 considering this equation works for all true change.)

So for lasting and desired (e.g., 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 diet, such as egg substitutes instead of whole eggs, possibly take medication, etc.). And usually with this sort of treatment regiment, there is a vision – a goal – to achieve, such as below getting below 200.

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 trying to undergo 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, which I call AERO. I use this wording as it does not use either word – conservation or efficiency. It simply looks for reductions in energy use – however achieved.

With a good AERO visit, the site will start to know where they presently stand against various energy benchmarks, as well as what energy targets to attack, and their level of 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 behavioral changes to suggest, and the real, but still conservative, potential savings. Very often this totals to a very significant number, getting the team's attention.

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

Like many in the energy field, I find it very important to view a site in its unoccupied or "sleeping" condition. During this weekend or 3:00 AM weekday time, you find a great many behavioral based energy items, in addition to typical capital changes. Here are but 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 it is not used
- Lights 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 collector or extraction fans still running
- Mixer motors left on in tanks, when the tank is empty, or mixing not needed at night
- Computer monitors and CPUs – everywhere, with every type of screen saver (which as we know saves no energy)

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

> **Potential Magnitude** - 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. I will revisit the areas a few days later, finding 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 of proper behavior (or perhaps a sensor if you **must** get fancy).
>
> What is the value of this, if 5000 hrs/yr:
>
> 5 KW x 5000 hrs/yr x \$0.10/kWh = \$2500/yr.
>
> Might not seem like a lot, but how many sites could this apply to each year? If 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 – probably savings in the billions of dollars per year!

Once behavior based energy opportunities are identified, the next step is to provide individual and summation savings values. In my paper last year, I described various ways to quickly and fairly accurately arrive at good "Rules of Thumb" (ROTH) for various energy use systems. Example given last year:

> **Motor Example:**
> Consider that a typical three phase 10 HP motor at \$0.10/kWh will cost about \$0.66 per hour to run (at 90% efficient, **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 specifics.

Once a site has this unit cost, on their own they can fairly accurately calculate motor savings from shutting down any size motor for any amount of time.

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 they had this initial ROTH, they initially calculated on their own (with me sitting there):

> 50 HP x 60 hrs/weekend x 50 weekends/yr x \$0.066 = \$9,900 per year, for just this one area, for but one energy use system.

Certainly, if you measured the motors for actual KW, less loading (tank empty) would mean less of a yearly 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.

Another level of dissatisfactions 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 they just got a corporate mandate to reduce energy usage 30% within 3 years. Given their very good equipment and programs already, I strongly suspect the only way they will be able to make their particular goal is to include Behavioral Energy Change (BEC) into their overall revised energy reduction strategy.

Vision – or what do you want to be when you grow up

Through thorough on-site systems evaluation, I might often find 5-10% of total site energy savings that is related to potentially simply behavioral based issues. However, I 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 behavioral 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, as true change takes many things as noted above, **but especially time**. Simply put, behavioral change takes some amount of 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 potential "vision" of where they could 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 ultimately was then backed up with numeric goals.

Steps to achieve the Vision – or the hard part

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, it has 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 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 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 we know what the future state (vision) can be. Now we must hit the middle – Gap Closure plan or Analysis of how to solve the problem.

ABCs of Behavioral 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)
C = Consequence of the action

The classic model generally flows like this:

ABC Model

Antecedents/Activators

(trigger behavior)

Behavior

(human performance/action)

Consequences

(either reinforce or punish behavior)

Antecedent/Activators

For proper behaviors 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 you to perform that behavior.**

In other words, activators only set the stage for behavior or performance - they don't do it and they do not 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. Consider 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?
- How to shut them off?
- Who is to shut them off?
- 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 if they shut them off?

If you do not have these sorts of antecedents in place, or 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 end of shift. 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 that follows:

How many sites can say they have such clearly marked panels?

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:

- **Activities are measurable** – you either do something or not, both of which are "action" events
- **Behavior is not attitude**. It is true that you will better 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 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:

> **Events that follow behaviors that increase or decrease the likelihood the behaviors will occur again in the future.**

There are different elements to the consequences that should be evaluated. For example,

- Does the consequence reinforce the behavior or punish the behavior? Consequences can be positive or negative. As human beings, we prefer positive consequence to negative, as positive better reinforce our actions. We should always look to be positive, first, and then only proceed to negative consequence if truly necessary.

- Is the consequence to occur soon or at some distant time? Humans believe that consequences that occur sooner than later are more important overall. This is why they say feedback, which is actually a consequence, should typically occur sooner as opposed to later.

- Will the consequence actually happen? It is better for behavioral change to know that if X happens, then Y will also happen – every time. If we are 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 is when a parent says to misbehaving teenager - your 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?)

In the lighting example discussed earlier, let's look at all these aspects together.

First, here are 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!

Here is the whole Behavioral Energy Change Profile for this one requested behavior. The yellow shaded boxes show consequence support for the behavior, while the gray 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		**Too dark to exit safely**	**P**	S	C	I
Value Determiniation		Cup of coffee from machine at month end	R	S	C	I
Panel well marked		Progress chart on wall	R	S	C	U

Some comments

- In addition to the four categories of consequences, as humans, we might weigh some as being more important than others. For example, the one grey shaded cell above notes how it might be too dark to exit safety, which punishes (with a HUGE P) the requested behavior. Even though all the consequences are generally supportive, this one negative 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 on the right. It 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! And to many, we talk a great green game, but do not really back it up with our day to day behaviors.

- Notice the one consequence above, which is yellow all the way across. At one site I worked at, for every month 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. As a consequence, it hit all the high points, in that it was:
    - Certain to occur, if people did their behaviors correctly
    - Occurred soon after month end
    - Reinforced positively the actions
    - Was thought of as important – enough – by employees. In fact, you should have heard them when this did not occur (i.e, We want names!!)

Typical Behavior Detail?

The example shown 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, and defining and communicating this exactly (just like a six sigma problem statement should be very well defined). You must then ensure 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 from the department example, sometimes it really pays, in detail, to see why someone is not doing what you want, as it is often a very easy correction if you take the time to review it per the process.

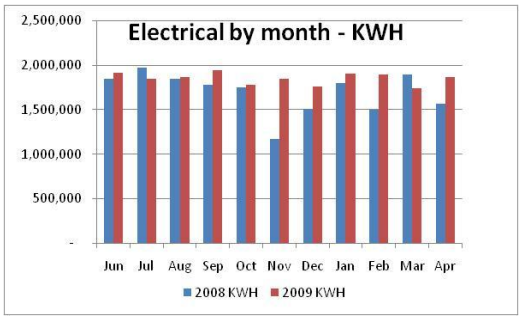
Addressing WIIFM, as a consequence

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 employee that they view as sufficiently positive, you will get better chance of getting your desired behavior.

Measurement of Behavioral Energy Change

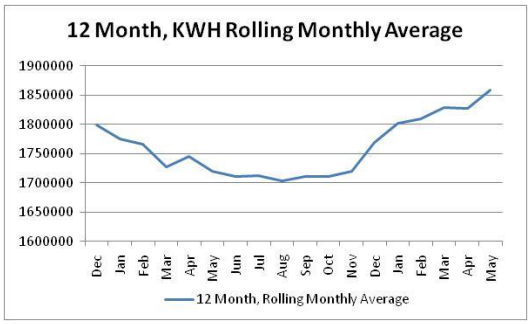
Behaviors must be measured, or there will be no long lasting change. There must be feedback, the more specific and positive the better.

Many sites simply will have their monthly metric for energy use, which is not related to production or weather, or normalized in any way. I have seen the following sort of metric at many sites, when they are trying to show energy change.



There is no way from these typical 2 year monthly comparison graphs to really tell if, at facility level, if BEC is assisting at all. The bulletin board simply has this posted, with no discussion – because what could you discuss.

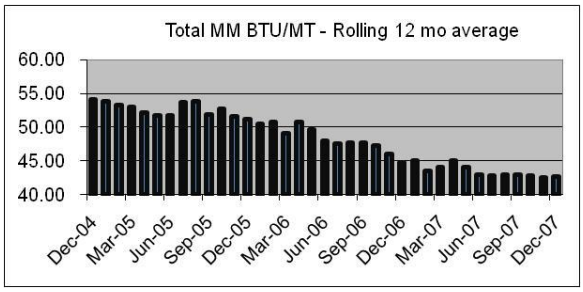
Better might be to see how this as a rolling average, such as this 12 month rolling average example:



But this shows terrible results! We can't show this! How can we tell if we are saving with BEC?

There must be better metrics. Actually, the best full facility metrics for behavioral change need to be normalized somehow, to remove weather and production related events. Here is the 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 this 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 its BEC and efficiency programs, which it did.

Two final things about this example graph:

- It demonstrates my earlier saying – you get the right results with the right program, and the right people, over the right amount of time.
- And the best news, as shown at the far right of the graph, it appears all the BEC and other changes stayed in place. They were now an ongoing positive habit.

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

- Days/ month when all lights off at shift end
  - Notice this is stated as a positive, not a negative (e.g., not - days when lights left on)
- Number of shifts/month when all personal cooling fans off at shift end (as found by a site's 5 S system – a great systematic example)
- Number of pneumatic tools where its supply is shut off at 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, and they then wanted to dig for further reductions and savings opportunities on their own.

Final notes on metrics:

- I can absolutely guarantee that something not on will save you money over it being left on wastefully.
- Thanks to these laws of physics, you will save money no matter if it can be seen in the overall facility metrics or not.
- This behavioral savings, especially locally, can be calculated for potential positive reinforcement (savings), and:
- This will ultimately show in the full facility metrics IF they are properly prepared. I truly believe this.

Closing and Summary Points

- Behavioral Energy Change (BEC) 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, of Change = C = D + S + V, where:
  - D = Dissatisfaction
  - S = Steps to achieve change, and
  - V = Vision of proposed condition
- You need to think of the three classic parts to behavioral energy change to get best, and most consistent results – using 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 behavioral 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.

About the author:
Kevin Vidmar is the Vice President of Energy Services, for Loureiro Engineering Associates, a full service environmental, remediation, health, safety, energy, building systems, design, installation, and construction firm with offices in Plainville CT, Merrimack NH, and Wakefield RI. Mr. Vidmar has 26 years of industrial experience, and has worked

with well over 200 different world-wide manufacturing sites on their energy reduction opportunities, including Behavioral Energy Change, energy reduction through Six Sigma and Kaizen programs, as well as the more typical conservation and efficiency changes. Mr. Vidmar has a B.S. degree from Miami University, and a M.S. degree from Vanderbilt University in Environmental and Water Resource Engineering. He is a Certified Energy Manager, a Certified Energy Auditor, and a Certified Carbon Reduction Manager.

Contact information:

Kevin Vidmar
Vice President, Energy Services
Loureiro Engineering Associates
100 Northwest Drive
Plainville CT 06062

kvidmar@loureiro.com
401-965-7608