Energy–Savings
There is more than meets the lights

enex plan

A Guide

Spring 2016

Contents

Introduction

Starting Out Doing Energy-saving Projects

Most companies that are just starting to find potential sources of energy-savings in their buildings will normally start out with small measures. This allows them to get their feet wet and show positive results so that, in time, they can go onto larger projects. This process allows the companies and organizations to acquire a level of comfort in estimating and then implementing the energy-saving measures without taking large risks. Especially since no company wants to jump into a large project, in which they have no experience.

See the light

For those companies just getting started, implementing measures that are easy to estimate, and easy to implement, makes a lot of sense, and this is perhaps why lighting replacement measures are so popular. After all, lighting retrofits, as we call them, are relatively easy to estimate, are easy to implement, and their payback is generally good. For this reason we often see companies start their energy-saving journey by doing small lighting retrofits in their buildings and then moving on to larger ones.

The more they get comfortable with replacing their lights, the more projects they do. However, one of the most popular mistake that companies make is focusing only on lighting projects and when they do this; they tend to miss a wide range of other energy opportunities. Worse, even for the energy-saving measures that they do in their buildings, many times in the rush to get savings, they cut corners and end up implementing a measure that provides less savings or a poorer payback than other measures would have.

Let us take a typical lighting replacement project.

In most cases, a building owner or manager will receive proposals from various consultants or suppliers to do lighting retrofits. The proposals will often include details of what will be done, how much energy (and money) will be saved each year and finally how much it will cost. There are obviously other clauses like the installation timeline and the warrantees, but let us focus solely on the saving component.

Estimating savings

Many suppliers and consultants will calculate the energy-savings by considering the difference in wattage between the new lamps and the old lamps (lamps and ballasts) and will multiply this by the number of hours that the lamps work in a year. That gives, in theory, the annual energy-saving.

The problem with this calculation is that it is over simplified, and in reality, things are a little different. For example, if the building is located in Miami, chances are that this building requires cooling twelve months out of the year (if the building has cooling of course). In addition, there is a good chance that the building has no heating. If the building owner is replacing the lamps by more efficient lamps, most of the time the new efficient ones will be of lower wattage than the older lamps and they will generate less heat than the older ones.

In addition, less heat generated means less demand on the cooling system. People do not think of this effect because one lamps will not have much of an impact, but if the owner is replacing 500 lamps in the building, these new lamps will have an impact on the cooling loads. A reduced cooling load will have a positive effect on the cost of cooling the building.

Enter the Cross Effects

This is called a “Positive Cross Effect” because replacing the lamps will help the owner save money on cooling, in addition to helping him/her save money on the lighting costs. **The Positive Crossed Effect increases the overall saving of the lighting retrofit.**

Now, picture the same building in New York City or Chicago. During the summer months, the lighting replacement project will produce a Positive Crossed Effect, which will add to the savings. However, what happens in the winter months?

In the winter, the owner needs to heat the building. However, because of the lighting replacement project, the new lamps will now generate less heat in the building, which in turn will require the building is heating systems to compensate for that heat that the previous lamps were generating. This will result in extra heating costs for the building owner and is what we call a Negative Crossed Effect because it reduces the overall savings of the lighting retrofit.

Unless the building owner takes into consideration where the building is located (geographically), the Positive and the Negative Crossed Effect cannot be calculated.

They must always be considered when estimating a project because they can influence positively or negatively the savings (and the payback) of the project in a serious way.

Now, let us assume that the owner has calculated the Crossed Effects and included them in the project. The second thing to look at is lighting

intensity (Lumen/sq-ft and overall Lumens). The reason for this is that no building owner wants to complete a lighting retrofit, only to find out later that the people are complaining from lack of lighting.

Plan the layout of lamps

Calculating the “before and after” lighting intensity both on a per square foot basis and on a total intensity basis will help the owner in the process. A word of caution: While a project might look good on paper, depending on the type of building, the shape, and the height, a lighting replacement can still be a disaster.

It is important to plan the layout of lamps and to consider elements like dark areas and shadows to avoid having problems. The project might call for the same intensity of light in the building than before, but if the distribution is not good, the building might end up with too much light at places and dark areas at other places. It is also important to have a good combination of lamps and reflectors. Some projects call for simply replacing the lamps and keeping the reflectors in place. In most cases, doing a test (replacing lamps in a defined area of the building to see the results before going and retrofitting the entire building at once) can be done quickly, cheaply and will go a long way in saving headaches later.

Lifespan

Among other things that should be considered, is the lifespan of the new lamps and their location. Lifespan and location of the lamps can influence the project in a few ways. For example, a supplier might propose lamps that is low cost but will need to be replaced more often. Depending on the cost of labor and the time it takes to change the lamp (which depends often on its location), the building owner should be able to calculate which lamps to buy. In addition, depending on the location of the lamp, a building owner might decide to take a different quality of lamp.

For example, if the lamp is located right above a production unit, which runs 24/7, replacing the lamps might be difficult, especially if there is a need to disturb the production people (or even worse, to interrupt production). In addition, if the lamp is critical to the operations or to the security of the workers, the building owner will need to consider this in making the lamp selection. A lamp that is located at the entrance of a production equipment for example is normally more critical than one lamps located in a maintenance shop or in the inventory area.

Now we can see that a simple energy-saving project such as a lamps replacement can have a number of components that are not always taken into consideration. In addition, because of this, the natural tendency of building owners or managers to start with lighting retrofit and continue by doing only that is not always the best.

In energy-savings, there is more than meets the light.

A typical building can have numerous potential energy-saving opportunities. While they all help the building owner or manager save money by reducing the amount of energy consumed in the building, some add more value than others do. There are over 40 families of energy-saving measures that can be implemented in buildings. While a typical building will not be able to have all measures implemented, most buildings will be able to have anywhere between a few (four or five) to over a dozen. Since each building is, different it is important to do a detailed building audit for each building and not attempt to apply a one size fits all approach.

Savings are not always about saving energy

While most of the energy-saving measure acts to reduce the cost of energy usage, by reducing the energy consumption, some will actually help save money without modifying the consumption at all.

For example, if the building can be penalized for having a poor power factor, improving the power factor to eliminate the penalties might be a great saving measure even if it does not reduce the energy consumption. By adding power factor correctors (commonly referred to as Capacitor Banks), the building owner, or manager can eliminate the penalties for a low power factor and generate savings on the utility invoices. This can result in an easy to do project with a great payback.

Other measures can be made to save on labor. For example, if you have to rely on external entities such as maintenance companies for maintenance and repairs in your building or leased space, a simple item such as a lamp replacement can become expensive, especially if you are billed for having a person change one or two lamps in an area. In this situation, it might be worth to invest in long life lamps. The cost of the lamps will be higher but if they save you the cost of replacing them each few months, there could be savings. A simple cost lifecycle cost analysis should help you make the best decision.

Combined measures

Some measures, when well implemented can combine savings in more than energy. Take water, for example, some projects can produce a saving in both water consumption (sometimes both at the consumption and the discharge level) and in energy at the same time. This would be the example of a system with an evaporative water tower; in some cases, it could be possible to replace the system with a closed loop system and save both energy and water.

While each project needs to be evaluated on a case-by-case basis, the important thing to remember is that there is a wide range of projects, which can reap many benefits.

Adding value to a building

It could be argued that all energy-saving measures will help to add value to the building. After all, any measure that makes the building less costly to operate is positive for the building. Any owner would welcome a reduction in the cost of utilities since it makes the building less expensive to operate and if the building is leased, it makes it more competitive. However, since no two energy-saving measures will bring in the same savings, the same applies to the benefit attached to the measure. **Some energy-saving measures will generate great savings and have a great payback but the overall benefit to the building is minimal.** This is often the case with retrofits of equipment that has a short life. The payback might be good, but if the equipment needs to be replaced in two or three years, it does not add great value to the building in the long term. On the other hand, some energy-saving measures will have slightly longer payback, but since the new equipment has a long lifespan (for example 25 years); the benefit to the building can be significant.

Other measures that can be applied to the building

There are other measures, which while saving energy, help the environment more than others do. For example, measures, which make usage of passive energy (wind, solar, water), have the double advantage of reducing energy and helping the environment at the same time. For example, if a utility provider supplies a building, which uses coal as its main source of combustible to produce electricity, solar panels on the building, this will reduce the building's energy costs, but it will also help the environment because electricity produced by solar is less polluting that energy produced by coal. It also reduces the carbon footprint of the building.

Equipment, operation, or behavior?

Most people tend to think that energy-saving measures are always about replacing equipment. After all, the equipment retrofit measures represent a huge part of the energy-saving potential in a building. However, they also represent the bulk of the cost to implement. Other energy-saving measures should not be discounted, as some can come with great payback, simply because their cost is close to nil.

Take operations, for example. The most obvious change we can do in a building in relation to operations is modifying the schedules of operation. The schedules are what tell the building systems and equipment when to start and stop. There are a few types of schedule modification that can be done on building systems and equipment. First, there are the schedules that go with the building operations per say.

For example, if people come into a building in the morning, one would expect that the lobby lights be on or come on when people walk in, so the schedule of operation of the building should allow for this. Heating and cooling systems should also be scheduled to provide comfort for the first person coming into the building in the morning. However, even if the schedule of operation of the building is fixed (non-flexible), building operators can still tweak some of the schedule of operations in order to reduce the costs.

A simple example is the case where all the people in the building stop working and exit the building at a certain time. In this case, closing the ventilation a few minutes before the time all people leave the building will not provide any discomfort to the people but could save money on the systems.

The same thing can be applied in the morning, where the systems could be programmed to start a few minutes after the bulk of the people might have entered the building. For those worried with the quality of air in the building, they could install air quality sensors to override the schedule of operation and start systems earlier (or allow to run later in the evening) than planned. Such schedule changing measures come with very little cost and can provide very short payback period.

Other measures that can be made to modify the schedule of operation of a piece of equipment relate to a situation or another equipment.

For example, if an office tower opens at 06.00 am in the morning and people start to park in the underground parking, the ventilation fans need to be working in order to evacuate the air contaminated from the cars exhausts and bring in fresh air. However, these fans might not need to be working all the time. If the building occupants arrive from 06.00 to 08.00 am and from 08.00 am until noon, there is virtually nobody in the parking; the fans might not need to work all the time. In this situation, installing a simple air quality detector and interlocking it with the fans could do the trick. Regardless of the time of day, if the quality of the air hits a certain level, the detector will tell the fans to start and continue until the quality of the air reaches a certain level again. Such a measure can be done at a very low cost and could have a great payback.

There are many energy-saving measures, which play with the schedule of operations by either slowing down or stopping an equipment. Some are for standalone equipment and others are for equipment related to another one. For example, if a production unit has an auxiliary piece of equipment tied to it, if that auxiliary equipment can be stopped when the main equipment stops, there could be savings. Often companies install auxiliary equipment and let them run 24/7 without linking them to the main piece of equipment. Whether they are lamps, evacuators, blowers, pumps, motors or other, if there is no need for them the main equipment is stopped, might as well have them stopped as well.

Waste

Some saving measures that deal with operations influence the amount of waste. For example, an air compressor system that provides compressed air for the building systems of an office or a manufacturing plant. Overtime, the air compressor network will begin to leak. After a number of years, it is not unheard of to have 50 percent of the compressed air lost in hundreds (or thousands) of miniature holes or through various connections that were added overtime. Air leaks might not represent much individually, but taken together if the system lost 25, 30, or even 50 percent of the compressed air, that means that the compressors need to work 25, 30 or 50 percent of the time more than really needed. In many cases, the company adds more (and larger) compressors over time, without doing any air leak analysis. Once a leak analysis is done and the leaks are repaired, many companies are surprised to learn that they now have too many compressors and/or that these are often too large for their needs.

Any place where waste can be found and corrected is a good source of potential saving.

The last area for energy saving is behavior. We kept this one for the end, but it is often the first place to start, simply because it is by far the less expensive one to implement, although not always the easiest one to keep doing. **Behavior measures simply consist of anything that the people in the building can do to save energy by changing the way they do things.** Something as simple as closing the lights of their office in the evening, or closing the lights of a meeting room after a meeting. Closing a computer on a desk after work. Small changes which when done for an entire building can quickly compound into a substantial energy-saving measure. The problem is not that people want to waste energy, but that

they simply go about their day without giving it much thinking. In addition, if there is no incentive in place it might be a challenge to get people to change their habits. Sometimes implementing something as simple as providing feedback to the people can help the process. **When people think they are making a positive impact, they are more likely to continue doing it.**

As we see, there are many other types of projects, which can be applied to a building than simply replacing lamps. However, the logic is usually the same; finding an equipment or a situation which is found as being not very efficient and replacing the equipment (or changing the situation) for a more efficient one.

Savings come from other sources than only retrofits, operations, and behavior.

In addition to the standard retrofit projects operations or behavior change, there is a source of saving that many companies and organizations fail to fully capture: Rightsizing.

What is rightsizing?

Rightsizing, in the context of energy saving projects, is about having the proper size of equipment for your building. While an equipment that is too small will often be felt rapidly (and replaced or other equipment added), an oversized equipment might go unnoticed because it will continue to provide the service to the building.

Too much of a good thing

Many equipment, when oversized, do not operate at the optimal efficiency. For example, a chiller or a boiler will operate at optimum efficiency when they are running at full capacity. The efficiency rapidly diminishes when the equipment is running at less than full capacity. In order to increase the efficiency, the equipment must be properly sized to be allowed to work at or close to maximum capacity as often as possible.

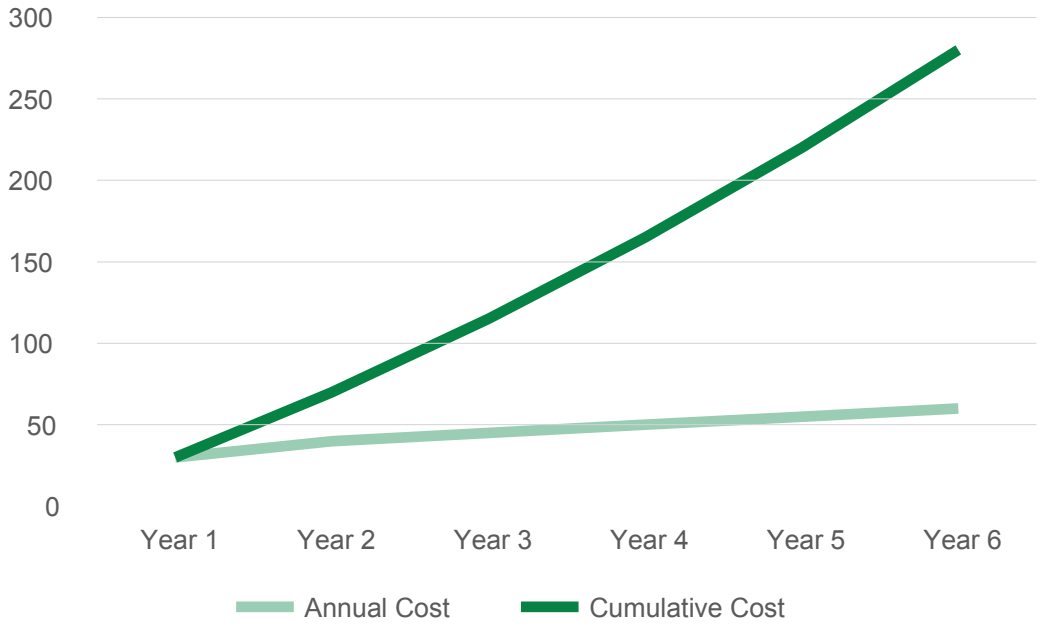
Designers, engineers, and other people sizing the equipment in buildings have a tendency to size the building equipment to account for extreme temperatures of the environment, such as hot summer days or cold winters. After all, no professional wants to find out that, the building systems are undersized and that the occupants are unhappy about being too cold

or too hot. The result is that the vast majority of time the equipment is working below its optimal efficiency range, at low efficiency. And low efficiency means that the equipment is more costly to operate.
In addition to this, equipment that are larger than needed, cost more to acquire, so proper sizing an equipment in order to avoid having it oversized not only makes it more efficiency from an energy consumption perspective, it is also less expensive to purchase.

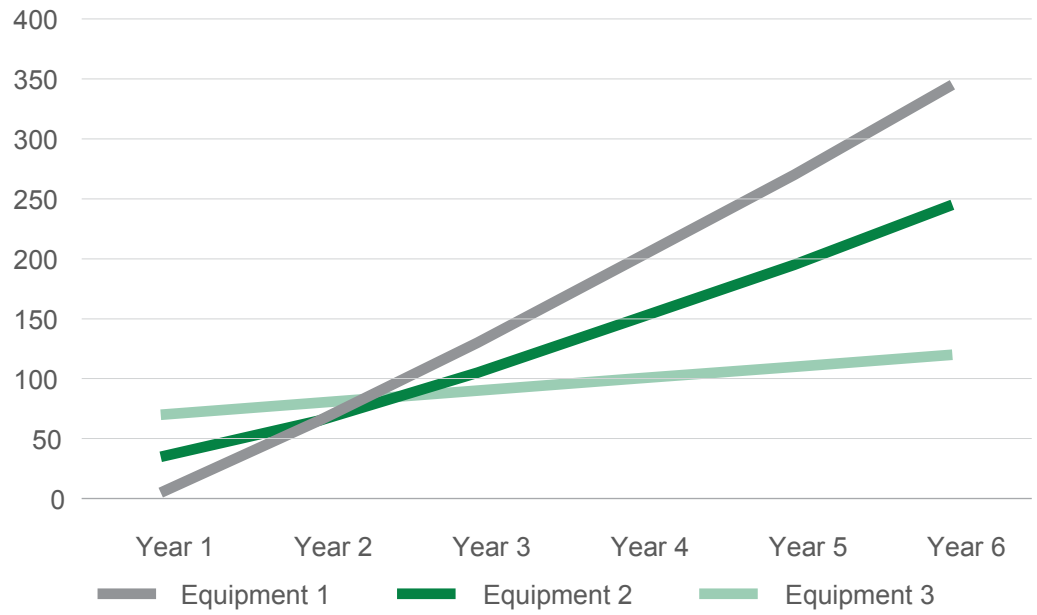
Suppose you started by looking at a piece of equipment and decided to replace it with a newer and more energy efficient equipment. Your first step was determining what equipment you wanted to use. The second step was right sizing the new equipment. Now you at the equipment selection step. If you have a number of options with equipment of the same size and similar specifications, deciding on which equipment to purchase is not always easy. The traditional method of equipment selection is doing a request for tender and inviting vendors to submit their proposals. Once you have the proposals, the logic is to select the less expensive equipment. However, until you integrate the cost of energy and maintenance in the decision process you do not really know if you are selecting the less expensive equipment, you only know which equipment is the less expensive at acquisition, so on day one.

Using Lifecycle Cost

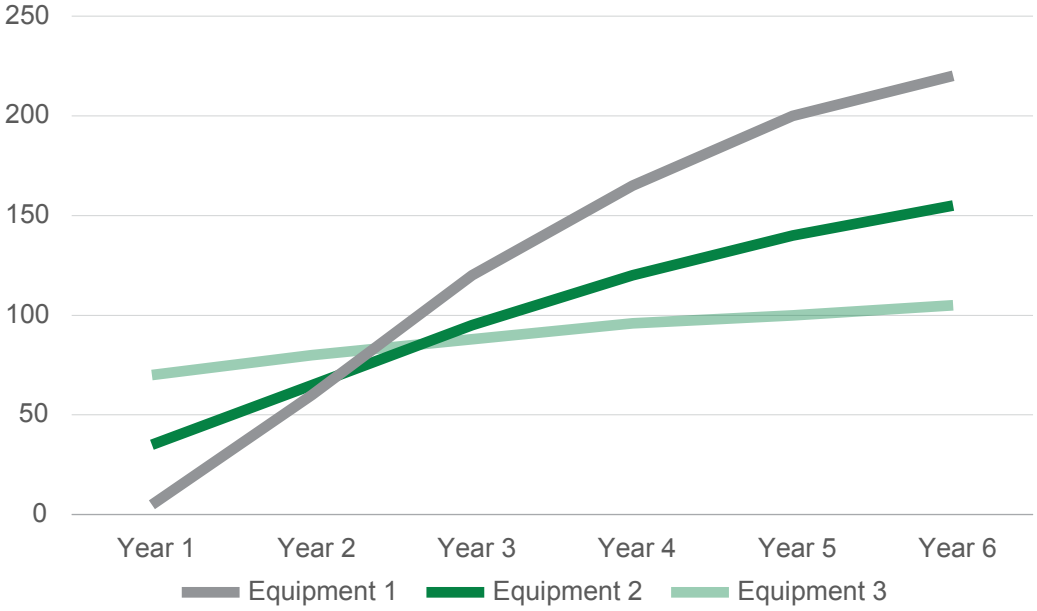
A lifecycle cost will take into consideration all the elements that you need to consider when selecting equipment. In order to calculate the lifecycle cost, you need to know the cost of the equipment as well as the cost of operating it each year. This means that you need to calculate the cost of energy that will be needed to operate the equipment as well as the maintenance cost. Once you have these elements, you can chart a life-cycle cost analysis by showing the annual and the cumulative cost of the equipment each year.



Taken alone, a chart representing the cumulative cost of an equipment will not mean much. However, if you are comparing a number of similar equipment and you plot all of them on the same chart, you can rapidly find which equipment is the best one to purchase in your situation.



Some equipment will appear as less expensive at the beginning, only to become more expensive (sometimes the most expensive one) over time.
Some people like to fine tune the lifecycle cost analysis by introducing the element of discount rate to take into consideration the influence of time on money. Applying a discount rate, to the chart, will modify the cumulative lifecycle cost line on the chart. The higher the discount rate being applied, the more the lines on the chart appear to curve rapidly and strongly. This is because the discount rate reduces the amount each year, especially in the final years of the analysis.



For additional information on discount rates and how they affect analysis read – **Financials for Energy–Saving Projects** – published by Almiranta and available at www.almiranta.com

The lifecycle cost analysis is a great tool to help select which equipment to purchase. It can also serve as a justification tool for purchasing equipment, which may not appear to be the less costly at the time of purchase. For example, most companies have policy to invite a minimum number of vendors when purchasing equipment. Once they receive the pricing from the vendors, the policy is to select the lowest price (cheapest) equivalent. However, until you integrate the cost of energy and maintenance into the analysis, it is hard to determine which vendor is the lowest price. The only element that is known is the cost of acquisition. Once we integrate cost of maintenance and energy into a lifecycle cost analysis, it becomes easy to find which vendor is the lowest price over a predetermined period.

Maintenance cost can be a plus or a minus

One element that we mention in the lifecycle analysis is the cost of maintenance. Maintenance cost can have a substantial impact on the overall cost of an equipment over its lifespan. However, properly estimating its cost over a number of years can prove more challenging than it seems, simply because there are many factors that can come into play here. First, there is the quality of the equipment (poor quality equipment might require more maintenance than good quality one). Then there is the level and quality of maintenance being performed. For example, a company that has regular preventive maintenance done on an equipment might be able to identify potential breaks before they happen, preventing larger costs.

While there are tools available to predict and price maintenance, estimating maintenance cost over a period of years remains difficult and is probably something sitting between art and science. This is why the best method to conduct lifecycle analysis is to be estimate the maintenance cost as best possible and to refine the analysis by correcting these estimates when possible. Over time, that experience will help you get better at estimating the maintenance cost of a particular equipment.

Conclusion

Energy-saving projects provide great opportunities for companies and organizations to reduce their cost and improve their bottom line. Many companies that elect to start the process of finding and implementing energy-saving measures will probably want to get their feet wet by starting out with sure bets, and few measures are as popular as lighting retrofits. However, replacing lights should be viewed as the very first step in a process to save energy, as there are many other areas to explore.

While it is perfectly normal for companies to want to start out by doing lighting replacements, they should not stop there. The world of energy savings includes many families of potential measures, and in most buildings; there are often numerous sources of energy savings for companies to find and implement, if they only take the time and invest the effort.

About Almiranta

Almiranta Corporation markets an online (SaaS) business productivity suite of software under the name ExPlan Suite, which helps companies plan capital expenditures, manage real estate leases, and reduce their energy consumption. Almiranta Corporation's energy saving software, EnExPlan stands for Energy Expert Planning and is a complete do-it-yourself energy software that is affordable, intuitive, easy to use, and allows both technical as well as non-technical people to find, help implement, and track their energy savings without the need for specialized engineering firms or consultants.

EnExPlan gives the user the same knowledge that energy consultants have in order to do energy calculations to perform simulations. This enabled the user to come up with the best recommendation for any building.

See the full product features at http://www.almiranta.com/enexplan.html

For more information contact us at info@almiranta.com
or visit our site at http://www.almiranta.com

Would you like to receive free energy saving tips?
Visit our blog at http://www.almiranta.com/blog.html and signup for our free newsletter that gives new ideas on how to better save energy, do energy saving projects, and reduce your carbon footprint.

ALMIRANTA

186 Rue de Normandie
Suite 101
Boucherville (Quebec)
J4B 7J1 Canada

Toll Free: 1 (800) 688 7511