PDHonline Course G227 (2 PDH)

How to Establish an Effective Energy Management Process

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Course Content

Introduction

Global warming, greenhouse gases, carbon footprint….what's all this about? At the heart of it all is energy consumption. Thus energy management and energy conservation will improve environmental results while saving $$$$. Now, a common sense guide to energy management along with real world tips to conserve energy and save money…..whether in your business, home or other facility. This course is a practical approach to implementing an energy management process that will really work and save you money while making a positive impact on the environment.

In the mid-1970's there was an oil embargo against the U.S. During those months we all took energy conservation measures….not for politically correct reasons, not for altruistic reasons, not to save the environment, not for global warming…NO! It was to conserve energy so we'd have enough to keep our homes warm, gasoline to drive our cars, electricity and other energy to operate our manufacturing facilities. It was a serious issue. Our church actually voted to set the thermostats at 55 degrees and wear coats in winter. We car pooled instead of driving to work everyday. The company I worked for at the time instituted extreme energy conservation measures just to insure that we could keep operating. Yes, it was really like that.

What happened? The truth is we failed to learn the lessons. When energy became readily available, we went back to our old habits. Now a few decades later the problem is once again before us. Only this time in environmental issues and energy costs more than simply just an availability issue. Energy costs are a significant cost for families and businesses. Energy utilization and waste is not only a cost issue, but every bit as important as an environmental issue today. So, "going green" can save "green $$$." Let's begin the journey. We will look at energy management as a process and then develop a sound energy management process model for your business.

Energy Management as a Process

First, what is a process? A process is "any set of events working together to produce an outcome." A process has inputs and outputs. Energy Management is just another process to consider.

There are at least three factors that make energy management and conservation a priority today:

1. Economics
2. Environment
3. Regulatory Issues

The **economics** make it relevant to all businesses:

- Research shows that companies generally can save 5-15% on energy costs rather quickly by implementing an energy management process.
- Eventual savings of >30% are usually obtained when EMP's are implemented

Source: Guide to Energy Management, Capehart, Turner and Kennedy, CRC Press, 5th edition, page 3.

What about environmental concerns today?

- The item *du jour– Global Warming*
- Greenhouse gases, primarily CO_2
- Global climate change
- Acid rain
- Ozone depletion
- Total environmental impacts

While these are not equally relevant to all businesses, one can readily see the implications of environmental impacts and energy consumption. One measure that is gaining prominence today is the "carbon footprint" which can be determined from your energy use and we'll go into more detail about that measure later in this course.

An effective **Energy Management Process** involves, at a minimum:

1. Top Management commitment
2. An energy policy that is understood and measurable
3. Leadership at all levels of the organization focused on energy use
4. An Energy Management Representative and an energy management team that are functioning effectively
5. Understanding "where we are" with energy use and carbon footprint
6. Understanding the building systems
7. Implementing low cost/no cost common sense energy conservation measures
8. Establishing realistic energy management targets and objectives

Energy Management Overview

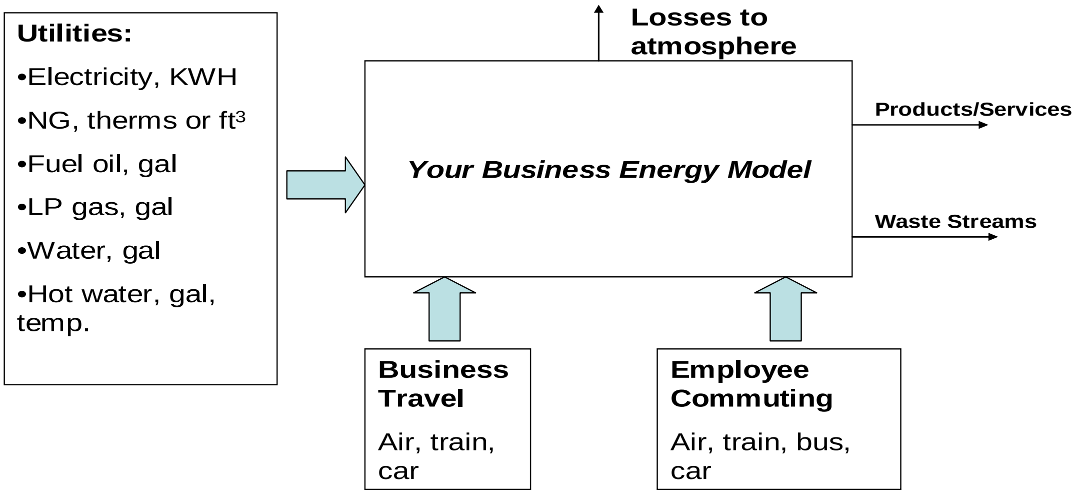


Figure 1: Energy Management Overview

This depicts what is known as a "boundary" approach. This approach considers all the energy factors that cross your boundaries. Applying a sound engineering approach combined with an energy management process and involving employees will help your business improve environmental performance while reducing energy consumption. The reality is you'll be adding pure profit to the bottom line. A win-win!

In your home, these same principles can apply, although in a simplified format that will help you save money on your utility bills.

In retail operations, offices or other businesses, the approach can be modified to fit your needs and improve your environmental impact as well as save money.

1. Top Management Commitment (and involvement)

The first step in establishing an energy management process involves management commitment. Top management must set the vision and lead the effort. Resources will be required, so that makes it a management issue. True, it can be done from "the bottom up," but most likely you will not get the benefits you expect.

2. Establish the Energy Management Policy

As with any effective enterprise wide policy, the energy policy must begin with top management and involve leadership and employees throughout the organization. Borrowing from the ISO 9001 model, the policy should contain at a minimum:

- A clear statement of understanding energy use
- A commitment to conserving energy
- Minimizing or reducing the environmental impact

The energy policy should also:

- Involve all employees in the process
- Provide a framework for goals and objectives or targets

The energy policy should be deployed and understood by all employees as well as how it relates their job.

To summarize, the energy policy should enable you to clearly and concisely communicate the policy to all employees so it can be understood. Next, it should provide the framework for setting measurable targets and objectives and finally, it should guide you to continual improvement in energy management and utilization. Sounds sort of like an ISO 9001 quality policy or ISO 14001 environmental policy doesn't it?

A sample energy policy could be:

"*We will be environmentally and economically responsible energy users at XYZ Company by implementing planned energy conservation measures with results targeted at reducing environmental impacts while reducing energy costs in our facilities."*

This simple policy statement includes all of the requirements mentioned above, is easily communicated and understood by all. It cannot just be a philosophical statement if it is to be effective in guiding the organization. Of course, unless the policy is followed it is useless.

The energy policy should be introduced in a "kick off" type employee meeting with top management emphasis. Otherwise, it's just another statement.

3. Provide Leadership at all Levels

Leadership is essential for an enterprise-wide energy management process to be effective. This is more than "lip service" by top management, it is involvement in the process.

Defining the energy policy is a function of management. Articulating the vision and implementing the energy policy is about leadership.

Energy conservation and energy management are important strategic initiatives in many organizations. They are usually the ones who are effective in improving their environmental impacts while saving money on energy costs. Those organizations who simply issue forth an edict to unit managers to “save energy” will usually not be successful.

The leader’s role in energy management is to:

- Articulate the vision of implementing the energy policy
- Being visible and communicating with employees in every unit of the organization
- Appointing the Management Representative and Establishing the energy management team
- “Walking the talk” with energy conservation
- Answering questions
- Providing the resources to implement the process
- Lead the organization in establishing targets and objectives
- Providing feedback and recognition for successes

So, actually the leader’s role is not really different from daily leadership opportunities!

4. Appoint an Energy Management Representative and Establish an Energy Management Team that will Function Effectively

A significant **responsibility of leadership** is appointing a **Management Representative** for the energy initiative and establishing the **Energy Management Team.**

The Management Representative is the “champion” for energy conservation and environmental improvement related to the energy management process. This person should be a member of management and have access to the senior or top management of the organization. The primary responsibilities of the Energy Management Representative include:

- Leading or facilitating the energy management team
- Understanding the overall energy management process
- Knowing the energy use of the facility
- Communicating the energy policy and energy use information within the organization
- Encouraging the implementation of energy conservation
- Insuring that top management is aware of energy conservation measures being implemented

- Providing information to assist management in setting energy management goals and targets
- Reporting the results of conservation efforts to top management and other interested parties

The **Energy Management Team** should be a cross functional team of knowledgeable people who will guide the implementation of the energy management process. When selecting team members, it is suggested that first you seek to find volunteers. Today, most folks are interested in energy conservation, so you may find more than enough volunteers.

The team should include representatives from technical and non-technical, maintenance, production, and generally all areas of the business.

The Energy Management Team will collect and analyze data, brainstorm energy conservation measures, work with others in the organization to help implement ideas, communicate within the organization and provide support and leadership for the overall energy management process.

5. Understanding "Where We Are"

Next, understand "where you are today." Several key measurement factors to consider are:

• Electricity	KWH
• Natural Gas	ft3 or Therms
• LP Gas	Gallons
• Oil	Barrels or Gallons
• Gasoline	Gallons

These units are typically converted to BTU, British Thermal Unit; and 1 BTU = amount of energy needed to raise 1 lb. of water 1º F. The BTU data can also be used to develop benchmark indices for a business and even for particular process areas within a business.

Well, you ask, "how does that relate to my world?" Let's take a quick look at some common conversion factors:

Unit of Measure	BTU Content
1 KWH	3412 BTU
1 ft3 NG	1000 BTU
1 Therm NG	100,000 BTU
1 BBL Crude Oil	5,100,000 BTU
1 Gal LP Gas	95,000 BTU
1 Gal Gasoline	125,000 BTU
1 Gal #2 Fuel Oil	140,000 BTU

Figure 2: Conversion Factors

Gathering the Data

It's time to begin the process of collecting data to learn where you are with energy utilization. This may take some effort, but it will be rewarded with results!

First, you'll need to get an accurate picture of your energy consumption. For some organizations this is very simple and for others it may take significant effort.

At this point we're interested in the "big picture" approach to the environmental impact and energy consumption factors associated with these various streams as opposed to detailed analysis of each energy system within your business. One could dissect each stream and internal processes, but that should come much later in the energy management system. For now, let's focus on the overall picture of the business. Additionally, we'll need some other basic information about the business. An approach that I use in consulting with a variety of organizations involves what is known as the "building envelope" as well as the general model illustrated earlier. To facilitate gathering data and information, I use the chart shown below and modify it to particular situations:

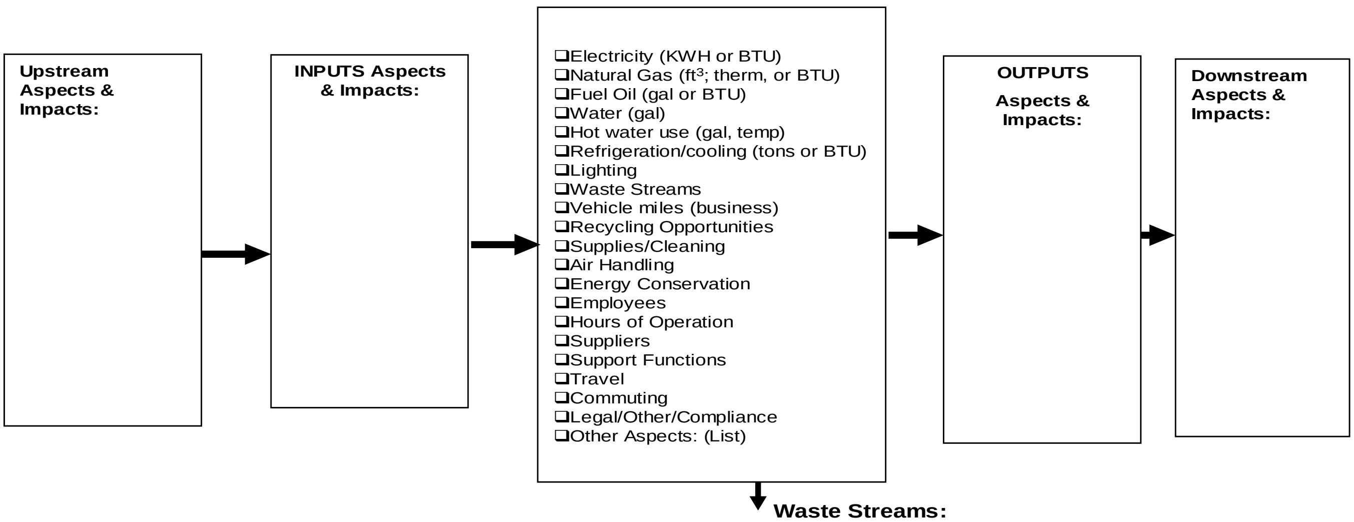
Environmental Impact Analysis

Location: ____________________________ **Facility:** _____________ **ft²** _______________ **ft³**

Address: _____________________________ **# Employees:** ____________ **Hours:** ___________

Date: _________ **Contact Info:** ___________________________

Factors to Consider



Consider: 1) aspects associated with Air, Land & Water; 2) minimizing/preventing pollution; 3) compliance; 4) communications; & 4) improvement.

Management Methods, Inc., Decatur, AL

Figure 3: Energy and Environmental Worksheet

And,

Environmental Impact Analysis

Location: ____________________________

Address: _____________________________

Date: _________

Facility: _____________ **ft²** _______________**ft³**

 # Employees: ____________ **Hours:**___________

Contact Info: ___________________________

Factors to Consider

- ❑Electricity (KWH or BTU)
- ❑Natural Gas (ft³; therm, or BTU)
- ❑Fuel Oil (gal or BTU)
- ❑Water (gal)
- ❑Hot water use (gal, temp)
- ❑Refrigeration/cooling (tons or BTU)
- ❑Lighting
- ❑Waste Streams
- ❑Vehicle miles (business)
- ❑Recycling Opportunities
- ❑Supplies/Cleaning
- ❑Air Handling
- ❑Energy Conservation
- ❑Employees
- ❑Hours of Operation
- ❑Suppliers
- ❑Support Functions
- ❑Travel
- ❑Commuting
- ❑Legal/Other/Compliance
- ❑Other Aspects: (List)

Flow Chart and Utilization:

Consider: 1) aspects associated with Air, Land & Water; 2) minimizing/preventing pollution; 3) compliance; 4) communications; & 4) improvement.

Management Methods, Inc., Decatur, AL

Figure 4: Alternate Energy Worksheet

For most businesses, setting up a simple spreadsheet where you will record the data and work with it to give a big picture will usually be the simplest and most effective approach.

Utilities:

Data for about 24 months of utilities will be needed to give an accurate picture of your energy use. Collecting this data could be time consuming, but is relatively simple to do in most cases. Here is an example of a simple spreadsheet to facilitate gathering the data:

Energy Use and Costs					
Location: ______________________			Contact info: __________________		
Building Square Feet of conditioned space: _______________					
Month	**Electricity (KWH)**	**Cost ($)**	**Natural Gas**	**Cost ($)**	**Water (Gal)**
Jan-06					
Feb-06					
Mar-06					
Apr-06					
May-06					
Jun-06					
Jul-06					
Aug-06					
Sep-06					
Oct-06					
Nov-06					
Dec-06					
Jan-07					
Feb-07					
Mar-07					
Apr-07					
May-07					
Jun-07					
Jul-07					
Aug-07					
Sep-07					
Oct-07					
Nov-07					
Dec-07					
Total	0	0	0	0	0
Monthly Average	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Figure 5: Energy Data Collection Format

Electricity. Gather 12-24 months of electric bills. List use by month for this time period. Two years is optimum so as to begin to see the effects of seasonal influences. However, the EPA Energy Star approach requires only 11 contiguous months of data. A two year period will tend to level out a seasonal aberration that may have occurred in one month or year. Record the KWH use/month and graph to see cycles. For example:

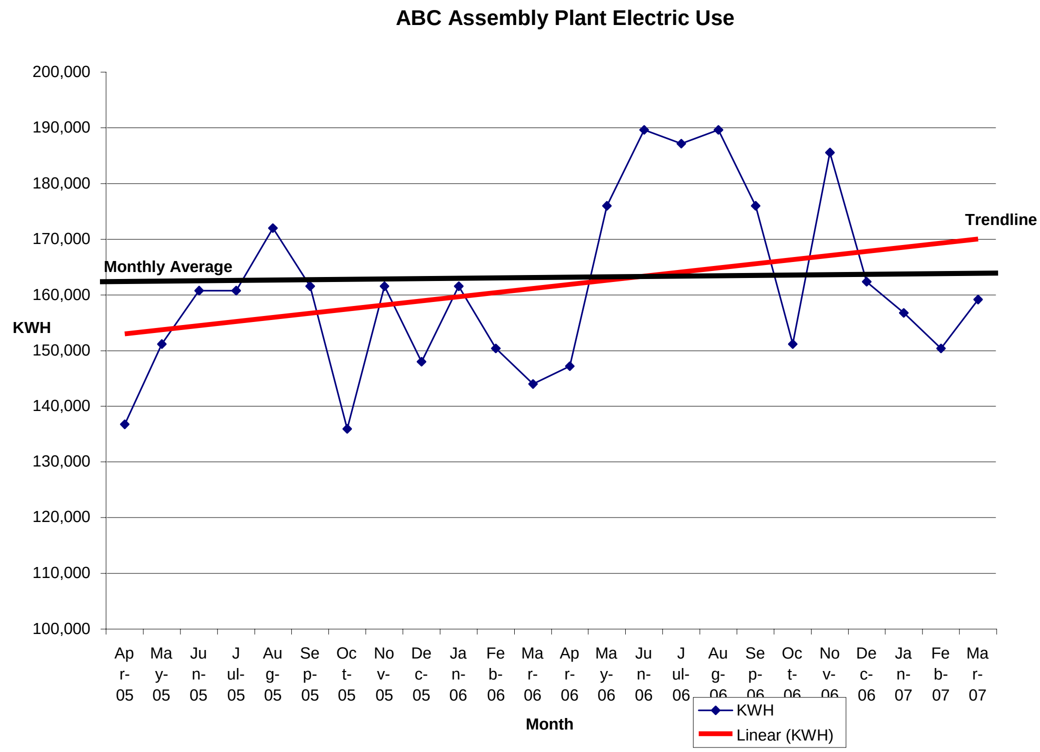


Figure 6: Sample Graph of Electricity

If you want to go much deeper than a simplified analysis, then you can go to the Heating Degree Day and Cooling Degree Day approach which is beyond the scope of this class. For a simple, common sense and effective approach it is usually more practical to look for trends in consumption and identify your large users of electricity.

In a multi-floor office or retail building it could be escalators that run too many hours/day are contributing to energy waste. Elevators are known energy "hogs." In a later section we will illustrate calculating the effects of a particular energy user like these. Some process units are high energy users. Evaluating these and considering recycling of heated gases can make a difference, but these in depth approaches are beyond the scope of this class.

The KWH can be converted to BTU in order to calculate various energy indices. Using the information combined with Environmental Protection Agency (EPA) data for electricity generation, we can convert this information to "greenhouse gas" impact; CO_2 impact and/or Carbon Impact. Typically, we just determine the CO_2 since it is the major contributing factor to global climate change concerns.

Note: The EPA conversion factors are posted on their website at www.epa.gov and www.epa.gov/otaq/greenhousegases.htm. These are very useful websites for assistance in determining environmental impacts.

The factors for electricity generation vary by geographic location based on the generation source fuel mix. For example, in New York the factor is 0.86 lbs CO_2/KWH of electricity and in IL it is 1.16 and in Texas it is 1.46. Multiply your total KWH/year by the factor to determine the amount of carbon dioxide gases your business is adding to the environment from electricity. We'll do a similar calculation for each of your utility and other impacts to determine your "carbon footprint."

(Note: EPA Energy Star format does not account for the specific location because it is used to allow comparison of buildings and not for determining carbon footprint. It is a valid approach for simply comparing buildings independent of geography, but is limited in many instances of understanding environmental performance.)

To determine an overall effectiveness or use index, convert the KWH to BTU by multiplying the KWH x 3412 BTU/KWH.

The **Energy Use Index (EUI) is a benchmark value of the BTU/ft^2-yr.** There are published tables of data for benchmark comparisons. A multi-facility organization may also use this to develop internal benchmarks.

Some organizations include the energy cost and track a benchmark like energy cost/sq. foot. This can be very helpful in determining the economic impact of your energy conservation efforts and is a highly recommended approach.

In this course, we will focus on the Energy Use Index (EUI) as a measure of overall energy effectiveness (see the section beginning on page 16).

Natural Gas. The next step in our data collection journey is to gather the NG use for the 12-24 month period as in the electricity use. The data is generally provided in terms of ft^3 or therms. A therm is 100,000 BTU. A ft^3 is 1000 BTU, so a therm is also 100 ft^3. Graph the data as before to look at trends and seasonal influences. An illustration is:

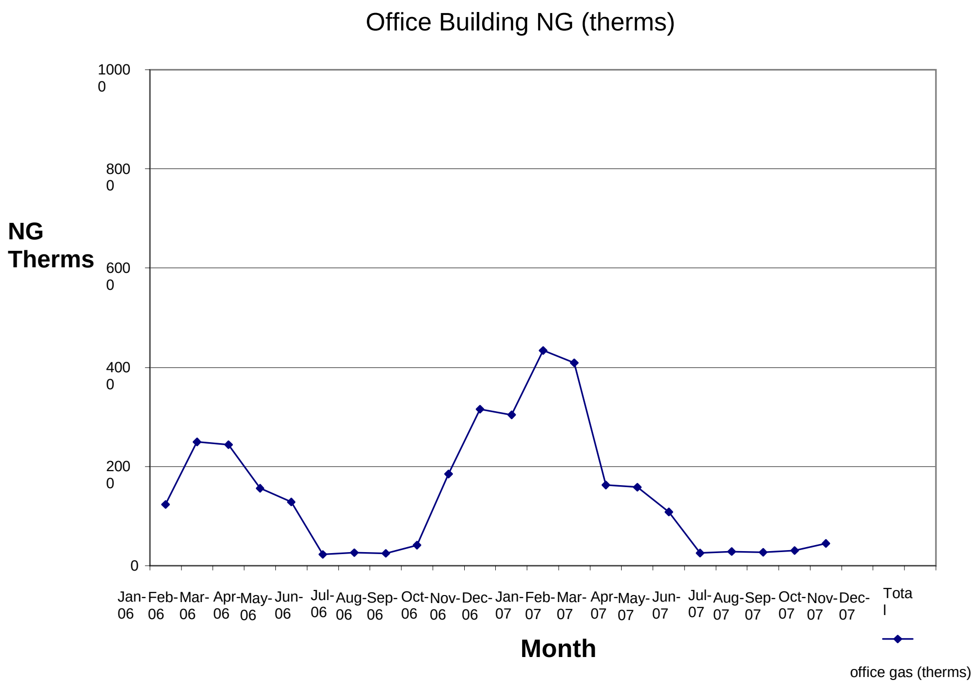


Figure 7: Sample Graph of Natural Gas use

Now, we'll follow the same pattern as before and determine the environmental impact by multiplying our total NG use by the factors for CO2. Example: **One therm of NG will generate 11.9 lbs CO_2.** Thus, we can now determine the environmental impact of NG use.

Since we've developed the pattern, you can now apply the same methodology to fuel oil or LP gas should you use those in your business. The conversion factors to BTU are in the table on page 6. From these factors we can determine the environmental impact.

Cost data can also be used. We'll look at the energy cost index in a later section of this course.

Employee Business Travel or Operations Related Travel

If we want to determine our total environmental impact, then in many businesses employee travel must be considered. In some cases it is important to consider what we will call "operational travel." For example, in a TV station the news organization must travel extensively by car and/or news truck to cover events as they happen. In the course of a year, the environmental impact can be significant. In one specific I observed a client situation where over 50 tons of CO_2 emissions were accounted for by the operational travel. General business travel can be significant as well.

There are a variety of factors involved here: mode of transportation, i.e. air, train, bus, car; relative distance traveled, long vs. short haul trips; and, the total number of employee trips per year. This can get complicated and is best illustrated through an example.

Travel Example: In one company, ten employees took business trips this year for a total of 72 business trips during the year and there are 14 business owned vehicles used for employee travel. These trips are categorized as follows:

- 10 air, Chicago to Little Rock, round trip, short haul
- 4 air, Chicago to London, round trip, long haul
- 58 car, total mileage 125000 miles, est. mpg = 25
- 14 business owned vehicles; gas bills show 5700 gallons used per year

Are you ready to dig into it? Well, no time like now to get busy.

Basis: (The conversion factors are again from the EPA web-site)

10 short trips at 500 miles each; total of 5000 miles x 0.64 pounds CO_2/mile air travel for a total CO_2 contribution of 3200 pounds or 1.6 tons.

4 international long haul trips; 19200 miles each at 0.39 pounds CO_2/mile = 7488 pound of CO_2 or 3.74 tons.

58 car trips for a total of 125000 miles @ 25 mpg = 5000 gallons of gasoline @ 19.4 lbs CO_2/gal = 97000 lbs or 48.5 tons CO_2.

5700 gallons of gasoline were used for travel in company vehicles;
so 5700 X 19.4 = 55.3 tons CO_2.

Thus, **travel generates a total of 109.1 U.S. Tons of CO_2** per year.

Employee Commuting

Not all businesses are interested in determining the impact of employee commuting, and the EPA Energy Star program does not consider this impact. However, it is an impact that some organizations choose to include to fully understand their total impact; and, to determine if there are steps that could be taken to reduce those impacts via incentives or other approaches. Returning to the energy crunch of the mid-1970's referenced earlier; during that time many organizations encouraged car pools or van pools and made work hour and even shift change accommodations in some cases. Of course, the issue then was availability of gasoline. Today the issues are cost and environmental impact. Both are important.
For completeness, we will consider the effects of commuting using an example from a large city with mass transit:

Commuting CO_2 Emissions				
Means of Transportation	**Office Commuting**	**CO_2 Impact**	**ABC Assembly Plant**	**CO_2 Impact**
Subway	Basis: 14, electric subway; ave of 3 miles, 6 miles roundtrip; 240 days/yr	26,772 lbs or 12.1 metric tons	Basis: 175 total employees; 80% commuting by subway; 2/3 work 2-4 shifts/week or ave of 3 shifts/week for 52 weeks/yr, electric subway; ave of 3 miles, 6 miles roundtrip; 1/3 @ 240 days/yr	Total of 155, 184 subway miles/yr which = 155,184 x 1.328 lbs CO_2/mile = 206084 lbs or 93.5 metric tons
Train	Basis: 4; electric trains; ave of 15 miles; 30 roundtrip; 240 days/yr	35,392 lbs or 16.1 metric tons	N/A	
Bus	Basis: 1; ave of 3 miles; 6 roundtrip; 240 days/yr	0.1 Metric Ton	Basis: 175 total employees; 20% commuting by bus; 2/3 work 2-4 shifts/week or ave of 3 shifts/week for 52 weeks/yr, ave of 3 miles, 6 miles roundtrip; 1/3 @ 240 days/yr	7032 lbs CO2 or 3.2 metric tons
Walk	Basis: 2			
Total		**28.3 Metric Tons**		**96.7 Metric Tons**
Note: Research and calculations reveal that a 747-400 or an Airbus A340-600 will				
create CO_2 emissions of 400-460 metric tons per round trip NY-London at 75-100%				
load factors.				

Figure 8: Example of Commuting Effects on the Environment

Once the information is tabulated, we can determine the total impact in greenhouse gases from our utility consumption by adding the data from all sources together to get the total.

Carbon Equivalent and CO_2 Conversion Factors

The EPA conversion factors are posted on their website at www.epa.gov and www.epa.gov/otaq/greenhousegases.htm. These are very useful websites for folks who want to determine their environmental impacts.

Converting Between Carbon Dioxide Equivalents and Carbon Equivalents

The conversion between CO_2e and CE is directly related to the ratio of the atomic mass of a carbon dioxide molecule to the atomic mass of a carbon atom (44:12).

- 1 metric ton carbon equivalent = 3.667 metric tons of CO_2 equivalent.
- 1 metric ton of CO_2 equivalent = 0.2727 metric tons of Carbon equivalent

Here is an example of a business with the major sources identified and reported in terms of their total carbon footprint:

Estimated Carbon Footprint			
XYZ Company			
Environmental Aspect	Location		
	Office Area (Metric Tons/Yr)	Assembly Plant (Metric Tons/Yr)	Satellite Office (Metric Tons/Yr)
Utilities, Metric Tons	31.7	756	16.2
Employee Commuting, Metric Tons	28.3	96.7	9.3
Travel, Metric Tons	86.1	N/A	76.8
Total Metric Tons CO_2	146.1	852.7	102.3
Metric Tons CO_2 /employee	7.3	4.9	12.78
Metric tons CO_2 utilities/sq ft	0.005	0.018	0.008
Metric tons CO_2 commuting/employee	1.41	0.55	1.16
Metric tons CO_2 Travel/employee	4.3	N/A	9.6
Energy Use Index (EUI; lower is better)			
Benchmark	53	22.7	53
Actual	8.3	38.7	17.8
Note: EUI presented in CO_2 format			

Figure 9: Example of Carbon Footprint Determination

The Energy Use Index

The **Energy Use Index (EUI)** is a measure of the energy efficiency of a building, company, organization or location. It can be based upon **BTU/ft^2-year or tons CO_2/ft^2-year.** The industry accepted and benchmarked value is the BTU/ft^2-year. To determine the EUI for your operations, simply convert the energy used to BTU's as discussed previously and then divide by the square feet of conditioned space. Benchmarks are available in a variety of reference books and on the internet at the EPA Energy Star web-sites.

The Energy Cost Index

Another measure of energy use is the **Energy Cost Index (ECI),** which is simply the total energy cost ($)/ft^2-yr. To get this number, simply total your energy cost for the 24 month periods as noted earlier. Next, determine the monthly or annual average and again divide by the square footage of conditioned space. This index can give you information as to how costs may be increasing due to utility cost increases, but more importantly will provide you with a basis for measuring the impact of energy conservation measures in the "language of management" which is simply $$$.

Understanding the Building Systems

Evaluate your facilities. Determine the square footage of conditioned space (heated and/or cooled), as this will be used to determine the energy use index (EUI). Create an inspection checklist that will enable you to identify the major building systems, processes, process units, energy loss factors, etc. Here is an example of a simple spreadsheet with instructions to aid you in going forward with this approach:

Energy and Environmental Assessment				**Location: ___________________________**
Energy/Environmental Assessment Checklist				**Contact Info: ________________________**
				Date: ____________________
Energy	**Monthly Average**	**Units**	**Cost**	**Comments/Questions**
Utilities				24 months if possible/seasonal influences
Eelectric		KWH		Location specific factors for greenhouse gases
Natural Gas (NG)		ft^3 or therm		A therm is 100 ft^3
Fuel Oil		gallons		Most locations will not have fuel oil
Liquid Propane (LPG)		gallons		Most locations will not use LPG
Water		gallons		This is just a check on consumption especially with droughts
Other				This could include gas or diesel for back up generators
Building	**General Info**			
Size		ft^2 total/conditioned		Use a drawing if available
Walls				Look for leaks, gaps, openings, insulation
Roof				Look for leaks, insulation, type of roof
Insulation				Check for attic, outside walls, piping
Doors				Look for gaps, cracks, improper seals, type, etc.
Windows				Check for leaks, seals, damage
Cracks				Record location; size; etc.
Openings				Record location; size; etc.
Temperatures				Record temperature and thermostat settings in various locations
Operations and				
Processes				
Major processes				Identify major processes and energy used in them
Significant users				Identify major consumers of energy
Hours/days				168 Hrs or 7 days/week 24 h/d for stations
# people and hours				The building loading can affect temperature setpoints.
Systems				
Heating, Ventilation, Air Conditioning (HVAC)				Maintenance; efficiency; PM schedule; records; controls; thermostats tied to each unit
Boiler/Steam				Maintenance; efficiency; inspection records; controls
Thermostats				#, location, settings, areas controlled, type (digital, etc.); placards posted
Lighting				Type of lighting; illuminance (measure or judgment)
Hot Water				Temp., amount, uses, volume
Compressed Air				Check on compressor; hours of operation; size of unit; use
Motors				Escalators; elevators; pumps, etc if large users; note
Environment				
Indoor air				air flow, space heaters, fans, contaminants; temp. humidity
Impacts (Identify)				Identify the significant contributors to environmental issues
Recycling				Paper, batteries, other; tons of paper; # of batteries, etc.
Permits				Verify that all required permits are up to date, including Boilers and elevators
Other				
Total Impacts	**Convert to $CO_{2/Month}$**	**Annualize Tons**		
Energy Consumption				Total electric/ng and other
Operations Travel				Get actual gas gallons if possible; use mileage if not; include
Other				If anything else is considered in the impact
Total				Calculate total impacts in greenhouse gases (CO_2)
Safety				
Evacuation				Verify current evacuation plan posted
Fire extinguishers				Verify up to date inspections
Roof				Access; ladders; trip hazards; leaks
Offices				Trip hazards
Comments/Notes/Open Issues				

Figure 10: Sample Energy Assessment Checklist

7. Implement Low Cost/No Cost Energy Conservation Measures

From the building systems and building envelope checklist you will have already identified the significant issues related to the building. For example a 24" diameter exhaust vent open to the atmosphere exhausting heated air to the roof; thermostats set on heating in one area of the office and on cooling in another area; or, in a process unit, 23 steam traps blowing through; leaks in heat exchangers, control valves on boilers not operating properly; a gap of ¼" x 24 feet on an outside garage door, etc. You get the idea. Use the information to identify the energy conservation steps you can take. Here is a brief overview of a number of low cost/no cost opportunities in most operations or buildings:

- **Low Cost/No Cost Energy Conservation Considerations**
- **Thermostats**

1. Set all thermostats at 68-70º in winter and 72-75º in summer. This simple change can be worth up to 5-10% savings on energy. There may be some thermostats set on heat and others on cooling within the same building. Set them all alike and encourage people to leave them alone.
2. Post placards on all thermostats to provide information to users. A sample placard is shown below. Using these on each thermostat coupled with leaving the temperatures set could yield closer to 10% than 5% in savings.

This Thermostat Controls: __________

- **Select Heat or Cool**
- **If heat is selected, set at around 68 degrees.**
- **If cool is selected, set at around 74 degrees.**
- **Set the fan to AUTO. If you are leaving for several hours, please turn fan to OFF.**
- **If heating or cooling is not satisfactory, call: _____________**

Figure 11: Thermostat Placard

3. Change to digital thermostats wherever you can
    a. Changing older electro-mechanical thermostats to digital could yield an ROI of 30% minimum and up to 80% ROI in some cases depending on your systems.
    b. Changing pneumatic thermostats to digital on heating systems will also require changing to digital controls on control valves and could be more expensive to do, but the ROI will be in the 40 to 50% range in most cases.
4. Program thermostats for a five degree setback about one hour before maximum building occupancy and then go back to the normal temperature about one hour after maximum occupancy; for example, if you have more people between 12 noon and 6 p.m. then set temperatures to change at 11 a.m. and 7 p.m. This simple change

could lead to 2-5% energy savings, but you can reach the point of diminishing returns if the setbacks are programmed for too long a period of time.

- **Heating Ventilation and Air Conditioning (HVAC)**

1. Identify the thermostats tied to each HVAC unit and post it on the placards at the thermostats so that when a problem occurs it is easily traceable to a unit.
2. Make a master file of all HVAC units and keep the maintenance/preventive maintenance records up to date
3. Insure Effective Preventive Maintenance on HVAC units:
   a. Filters check and change out as needed (usually about 3-4 times/year at a minimum)
   b. Dampers/controls
   c. Fans/motors lubricated and working properly
   d. Coils check and clean as needed
4. If you have a hot water or steam heating system insure the control valves are all properly maintained and the circulating pumps are adequately controlled and maintained.
5. Have your HVAC contractor inspect dampers and controls; and, do an air balance to insure adequate air flow in all areas of your system. This will balance the heat/air conditioning within the building and improve employee comfort.
6. In refrigerated areas, check for proper door seals around coolers, etc.

- **Lighting and Other Considerations**

1. Install motion sensors on conference room lights; offices; low use areas where lights are likely to left on. Cost: ~$/sensor:
2. Change to more energy efficient lighting
3. Consider reducing lighting in hallways and other non-work space areas
4. Evaluate parking lot and exterior lighting. Be sure it is up to minimum standards, but not excessive. Also, consider photocells or timers.

- **Expected Results: (5-15% savings; perhaps up to 20%-30% depending upon your specific situation)**
  1. Cost savings should be 20-30% of your energy cost in an office type environment; and coupled with process energy management energy and dollar savings can mount quickly.
  2. Environmental Impact (Carbon footprint improvement) can be reduced and the effects of your conservation measures calculated in terms of CO_2/yr.

8. Establish Realistic Targets and Objectives

Dr. W. Edwards Deming once said a goal without a plan is a waste of time. So, with the work already done, don't be guilty of wasting time by just setting an arbitrary goal of some kind. Use the data and information already obtained, work with the Energy Management Team and establish realistic goals for energy savings; cost reductions and/or environmental impact improvement. Goals may be related to the overall business or to specific process units. Base them on reality and not just arbitrary numbers.

Energy Performance Reporting

Graphs and other forms of data can be used to report and compare energy performance within your organization. If you tabulate data using a spreadsheet, then graphs can easily be done to communicate improvements. Here is an example of a spreadsheet form that we use in consulting assignments for simplified reporting:

Energy and Environmental Performance			
(Summary Report for each location)			
Facility Information			
Facility Location:			
Address:			
Contact Info:			
Space Use Summary:			
Space Type	**Area (ft^2)**	**Occupants**	**Hours of Occupancy**
General Office Area			
Process Areas			
Warehouse/storage (conditioned space)			
Total			
Total Conditioned Area			
Heating, Ventilation, Air Conditioning (HVAC)			
# Units			
# Thermostats	Type of Thermostats (Digital or other)		
Thermostat Info Posted, yes or no			
Preventive Maintenance Plan or Contract			
Steam System, yes or no	Date of last boiler inspection:		
Hot Water System, yes or no			
Site Energy Use Summary			
Electricity (BTU):			
NG (BTU):			
Total (BTU):			
Energy Use Index			
EUI (Total BTU/conditioned ft^2-yr =			
Benchmark EUI for Nexstar is _____________			
Energy Cost Index			
ECI (Total Energy $/$ft^{2\text{-}yr}$)			
ECI, XYZ Co. Benchmark is ___________			
Environmental Impact			
Energy (tons/yr CO_2)			
Business Travel (tons/yr CO_2)			
Other (tons/yr CO_2)	n/a		
Total CO_2 emissions		Tons/yr	

Figure 12: Example of Energy and Environmental Performance Report

The most important factor of all: Just get busy and save money while improving the environment!