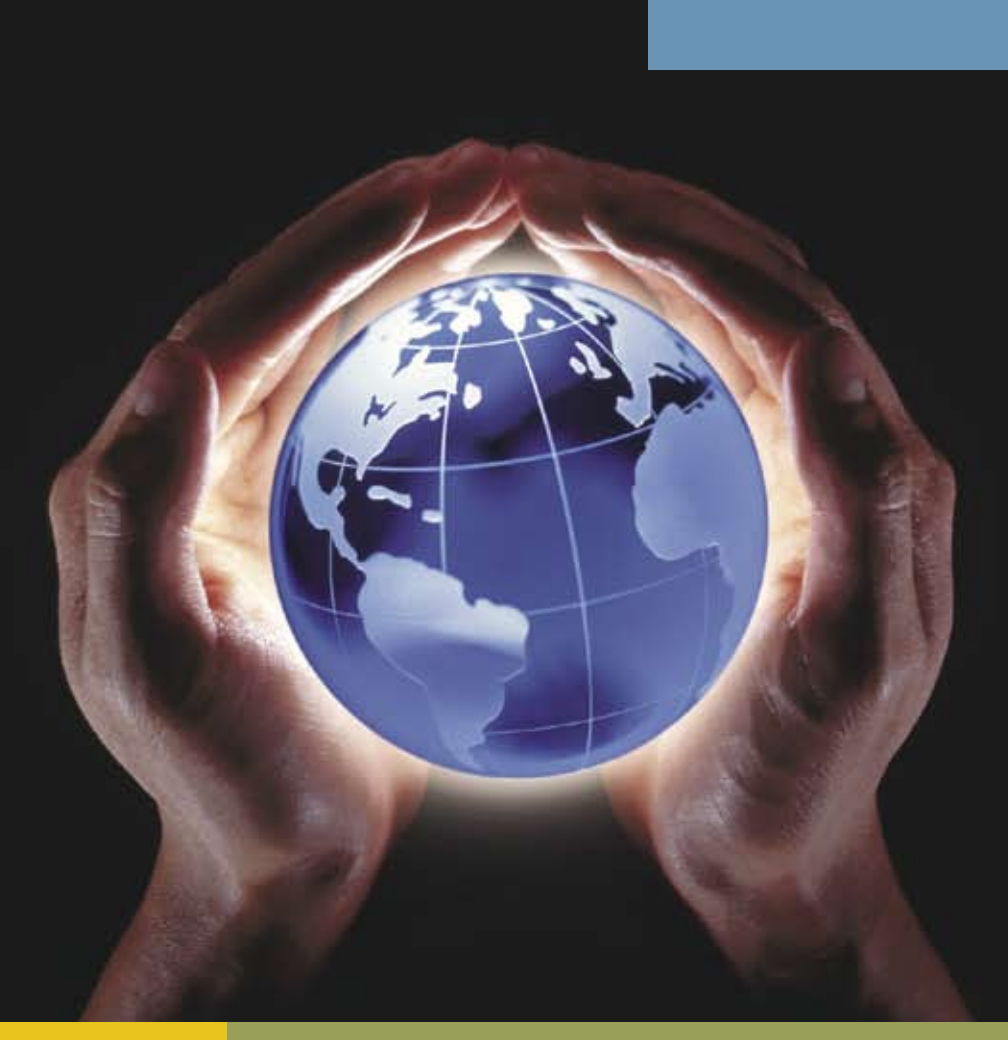


E Energy Awareness

a company of Schneider Electric

t.a.c

Dear TAC Friend,

Our world is currently facing two particularly important trends: rising fossil fuel prices and concerns about climate change. Both of these create strong incentives for energy conservation and are already fueling interest in our energy conservation solutions. I believe we have so far only seen the beginning of the global focus on these areas as well as our success in addressing these global challenges.

The World Business Council for Sustainable Development identified buildings as one of the five main users of energy where "mega-trends" are needed to transform energy efficiency. They account for 40% of primary energy in most countries and consumption is rising. The International Energy Agency (IEA) estimates that current trends in energy demand for buildings will stimulate about half of energy supply investments to 2030. As you know, TAC is well-positioned to deliver the cost savings of better-managed buildings, and to help our customers meet challenging energy efficiency targets.

To ensure that we are well equipped to manage these new opportunities and TAC's energy business, TAC Energy University is launching a global energy awareness training program. Through this program, every employee in TAC will learn more about the energy business, how the energy industry impacts our planet and our lives, and what TAC and Schneider Electric can do to save our customers money and energy while having a positive impact on the planet.

Arne Frank
CEO

TAC Energy Awareness

As a world leader in building automation, TAC is uniquely positioned to help our customers reduce energy use which helps the global energy issue and our customers' bottom line. To become a global leader in energy management we must first create an energy culture within TAC — this course is the first step.

Course Outline:

I. Introduction

II. Energy Principles

- How energy works, where it comes from and how we can reduce usage

III. Energy and the Environment

- The three challenges: Increasing demand, pollution and global warming

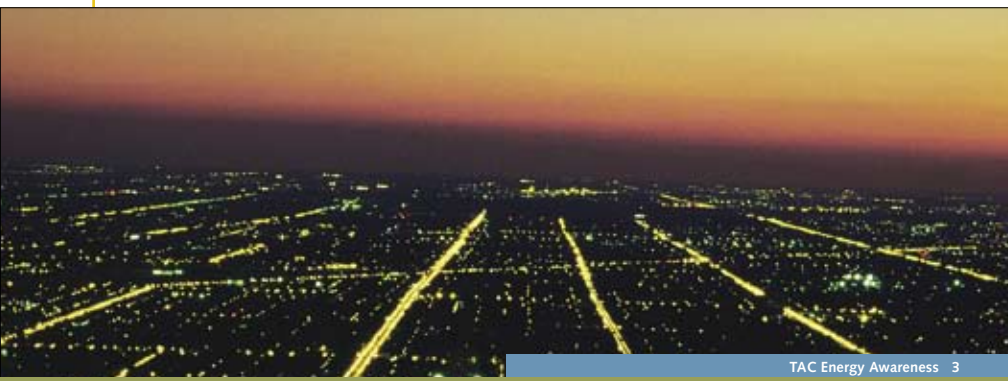
IV. Importance of Buildings and Energy Management

- Buildings and energy usage; the great opportunity in buildings to positively impact the environment

V. TAC and Schneider Electric Offerings for Energy

- How TAC and Schneider Electric can help companies save energy and money

VI. Review and Conclusion

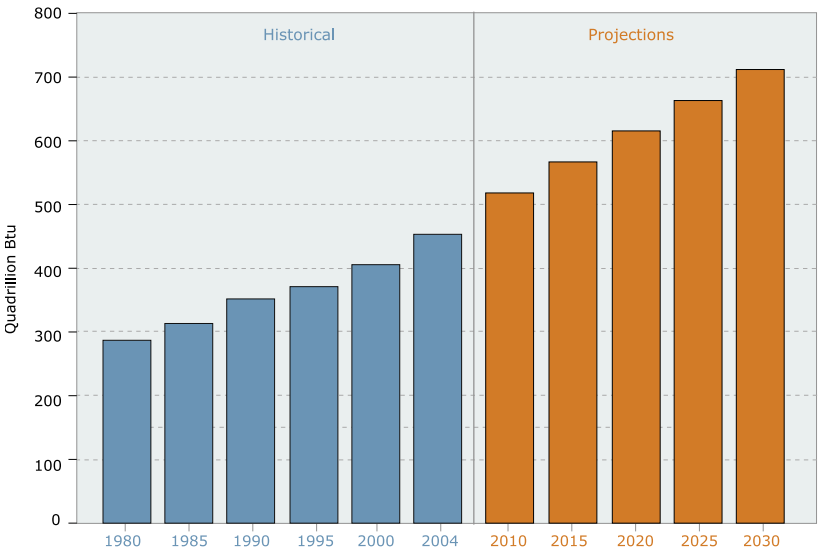


I. Introduction

Increasing importance of energy

Global energy use in 2004 was approximately 447 quadrillion British thermal units (BTUs), which is equivalent to about 80 million barrels of oil per day. And world energy consumption is expected to almost double in the next 25 years.

World Marketed Energy Consumption, 1980-2030



source: International Energy Outlook 2007. Energy Information Administration

This issue presents some unique and serious challenges. Our society is dependent on energy to maintain or to increase our quality of life. Yet the very production of energy threatens our quality of life too, since it leads to global warming and pollution. New technologies must meet the challenge of producing energy at this rate in a cost-effective way without polluting the environment.

II. Energy Principles

What is energy?

Energy is defined as work that is done.
Power is defined as the rate at which work is done.

Some common Energy Conversions:

- 1 Watt = 3.412 BTU/hr = 3600 J/hr
- The basic unit of electrical energy is the Watt-hour, or Wh.
- 1 Wh = 3.412 BTU = 3600 J

So:

- 1 kWh = 1000 Wh = 3412 BTU = 3.6 MegaJoules
- 1 MWh = 1000 kWh
- 1 GWh = 1000 MWh
- 1 kW = 1000 W
- 1 MW = 1000 kW

Energy contents of fossil fuels:

- Coal ~ 2.5 million BTU / metric ton ~ 2.64 billion Joules / metric ton
- Crude oil ~ 5.6 million BTU / barrel ~ 5.9 billion Joules / barrel
- Oil ~ 5.78 million BTU / barrel ~ 6 billion Joules / barrel
- Natural Gas ~ 1,030 BTU / cu. ft. ~ 38 million Joules / cu. m.
- Liquid N. Gas ~ 2.5 million BTU / barrel ~ 2.6 billion Joules / barrel

Notes:

Energy sources

The energy sources that we use every day are divided into two groups:

- **Non-renewable —** an energy source that cannot be replenished in a short amount of time. Examples are coal and oil.

- **Renewable —** an energy source that we can use over and over again, and that can be replaced naturally in a short period of time.

Fossil fuels are generally an inexpensive and easy way to generate energy. Coal is the most common energy source that is converted into electricity. While fossil fuels generate a large amount of electricity with a small amount of fuel, they generate pollution.

Nuclear energy generates power inside a nuclear reactor through nuclear fission using uranium. While nuclear power generates a large amount of electricity rather inexpensively, historic events have created some worries in the public eye and waste is difficult to dispose of.

Hydropower uses flowing water to spin a turbine that generates electricity. This is a clean and safe method to generate electricity but this method can have significant impact on the areas surrounding the site.

Geothermal power comes from heat energy that is buried in the ground. Pipes are buried under the surface to exchange the heat. The earth provides an unlimited amount of energy but development and maintenance costs can be high.

When the wind blows across a large windmill, the blades turn and energy can be created. This "free" source of energy produces no pollution but requires a large amount of wind and space for the windmills.

Biomass, which includes wood, garbage and agricultural waste, can be burned to produce energy. This source of energy is abundant but can result in some air pollution.

Conservation and efficiency are key to meeting the world's energy needs

Despite the growing use of renewables around the world, they may never provide "the" answer to all of our energy problems. Today, renewables remain less cost-efficient and more difficult to use than oil, gas, and coal. That means that figuring out how to use less energy — **through conservation and efficiency** — is key to meeting the energy needs of our world. This needs to become an ingrained value worldwide — on the individual level, the corporate level and the governmental level. TAC, and our owner, Schneider Electric, have many solutions to conserve energy.

III. Energy and the Environment

Three major energy challenges

In the coming years, society will face three major challenges with regards to energy. These challenges will drive new technology, the discovery of new energy sources and energy conservation.

- **Increasing demand** will put pressure on existing energy sources. In the next 100 years, energy needs of the world will triple, driving changes in how we generate energy and how we use it.

- **Pollution** is another challenge of energy today. Many of our existing sources, such as fossil fuels, create air, water and soil pollution. This pollution includes volatile organic compounds (VOCs), nitrogen oxides and sulfur dioxides. These pollutants can contribute to smog, acid rain and water pollution.

- **Global warming** is caused by an increase in the greenhouse effect. The greenhouse effect is not a bad thing by itself — it's what allows Earth to stay warm enough for life to survive. But over the long-term, the man-made and uncontrolled increase in the greenhouse effect could lead to dramatic changes in the earth's climate.

Notes:

How big is your footprint?

Though scientists warn that global warming will likely continue for centuries because of the long natural processes involved, there are a few things we can do to decrease the effects. Basically, they all boil down to this: Don't use as much of the stuff that creates greenhouse gases. Cut down on your use of fossil fuels, and cut down on your use of the electricity generated by them.

The concept of an ecological footprint is a way to roughly measure the impact of a person's choices on the environment. People have become so accustomed to their diet, cars, homes, and energy usage that they don't realize that the Earth will not be able to provide the needed resources indefinitely.

Calculate your carbon footprint

Start with 3 points to cover emissions caused by government spending of your taxes on industry, health service, military, etc. **3**

Energy use in your home

- Does your electricity come from a renewable source, such as a wind turbine? If so subtract 1/2 point
- Do you set your thermostat low? Is your home well insulated? Do you have double glazing? Do you only turn the heating on when absolutely necessary?
  If you answer yes to at least two of these, take off 1 point

Food and diet

- Do you follow a vegan or vegetarian diet? Score 2 points
- Do you eat meat occasionally? Score 3 points
- Do you eat meat regularly? Score 4 points
- Do you eat meat with every meal? Score 5 points

Transport — do you travel:

- usually by car? Score 2 points
- sometimes by car? Score 1 point
- mostly by public transport? Score 1/2 point
- mostly by walking or cycling? Score 0 points
- by plane, ever? For each two hour flight add 1 point

Holidays — when you last went on holiday did you:

- stay in the state or country? Score 1/2 point
- stay on your continent? Score 1 point
- go somewhere off of your continent? Score 2 points
- If you went by car: add 1/2 point
- If you flew: make sure you've included your flight in the transport section above.

Materials and Waste

The consumption of material goods and the production of waste is normally the largest part of a footprint. Average waste is 2 black bags per week. Do you have:

- more than average rubbish? Score 12 points, or 6 if you recycle
- average amount of rubbish? Score 8 points, or 4 if you recycle
- below average amount of rubbish? Score 4 points, or 2 if you recycle

TOTAL add up all your points to find your score:

Rate your carbon footprint score

Under 5 = excellent!
You are living in one world — a truly low footprint lifestyle. If everyone lived like you, then human and non-human existence could be sustainable and equitable. About 69% of the world's population has an ecological footprint in this range.

6 to 10 = well done!
You are close to having a low footprint lifestyle. Even so, if everyone lived like you we would still need more than one planet to sustain us.

11 to 20 = not so good!
If everyone lived like you we would need 2 or 3 additional planets to sustain us.

21+ = oh dear!
If everyone on the planet lived like you we would need 3 or 4 additional planets to sustain us. About 5% of the world's population has an ecological footprint in this range.

CO_2 emission averages per person:

Luxembourg	**21.6**
United States	**20**
Australia	**17.3**
Canada	**16.5**
Finland	**12.7**
Germany	**10.5**
Denmark	**9.7**
Japan	**9.5**
United Kingdom	**9.2**
Norway	**8.3**
Italy	**7.8**
France	**6.3**
Sweden	**5.9**
China	**2.9**

CO_2 emissions per country in tons per capita. Source: www.timeforchange.org

How can I reduce energy consumption?

Circle two to three of the items below that you could do this week to limit your energy use.

1. Reduce, reuse, recycle. One example is to print and copy on both sides of office paper; then recycle it! Paper represents more than 70% of office waste.

2. Here are some things you can do around the house!

a. Replace a regular incandescent light bulb with a compact fluorescent light bulb — they use 60% less energy. This simple switch will prevent the release of about 300 pounds of carbon dioxide a year.

b. Install a programmable thermostat — programmable thermostats will automatically lower the heat or air conditioning at night and raise them again in the morning. They can significantly cut the amount of energy you use and save you $100 a year on your energy bill.

c. Move your thermostat down 2° in winter and up 2° in summer — almost half of the energy we use in our homes goes to heating and cooling. You could save about 2,000 pounds of carbon dioxide a year with this simple adjustment.

d. Clean or replace filters on your furnace and air conditioner — cleaning a dirty air filter can save 350 pounds of carbon dioxide a year.

e. Wrap your water heater in an insulation blanket — you'll save 1,000 pounds of carbon dioxide a year with this simple action. You can save another 550 pounds per year by setting the thermostat no higher than 50°C (122°F).

3. Drive less — walk, bike or carpool. You will save one pound of carbon dioxide for every mile that you don't drive.

4. Do not leave appliances on standby — use the "on/off" function on the machine itself. A TV set that's switched on for 3 hours a day (the average time Europeans spend watching TV) and in standby mode during the remaining 21 hours uses about 40% of its energy in standby mode.

5. Don't let heat escape from your house over a long period — when airing your house, open the windows for only a few minutes.

6. Buy local produce. That reduces the amount of fossil fuels required for the transportation of products from other parts of the country or the world. It also reduces the amount of plastic and paper products consumed in the packaging of such far-traveling products.

7. Set your computer to go to sleep instead of using a screensaver. You'll use 70% less electricity.

8. Eat at least one vegetarian meal a week. The international meat industry generates roughly 18% of the world's greenhouse gas emissions.

9. Bring your own (reusable) canvas bags to the store. Globally, we use as many as 1 million new plastic bags every minute at a cost of 2.2 billion gallons of oil a year.

10. Support the creation of wind, solar and other renewable energy facilities by choosing green power if offered by your utility.

Turn to page 20 to see how Schneider and TAC can reduce energy consumption.

IV. Importance of Buildings and Energy Management

Buildings use more than 40% of the world's energy

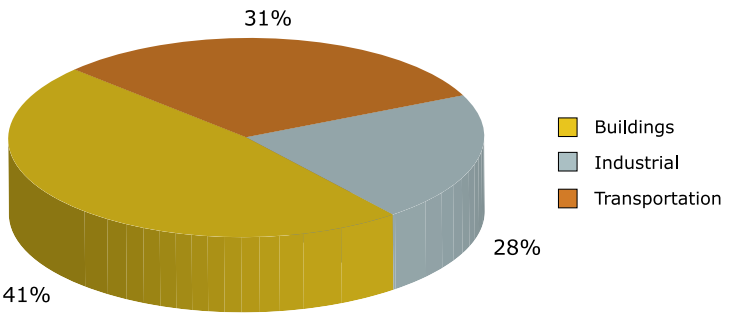
The absolute figure is rising fast, as construction booms, especially in countries such as China and India.

With TAC's knowledge and experience, we can help companies slash the energy their buildings use.

Energy management is the application of technical and economic principles to the control of energy use and energy cost at a facility. The primary goal of energy management is to save money on energy expenses, thereby increasing profits and improving energy productivity.

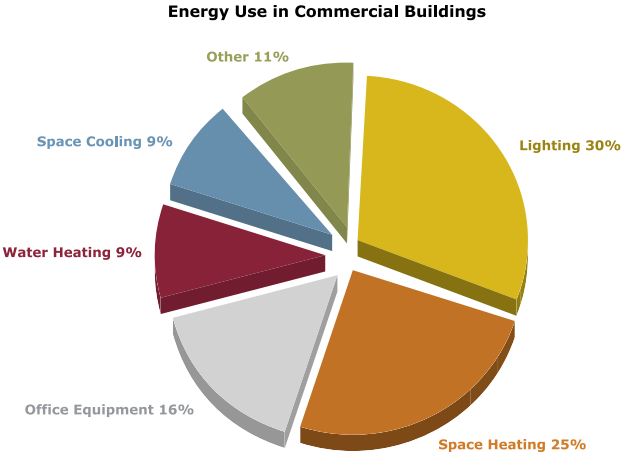
Saving money on energy bills is attractive to businesses, industries, institutions, and individuals alike. Customers whose energy bills use up a significant part of their income, and especially those customers whose energy bills represent a substantial fraction of their organization's operating costs, have a strong motivation to initiate and continue an on-going energy cost control program.

Global Energy Use by Segment in 2004



Source: Commission of the European Communities, Action Plan for Energy Efficiency: Realising the Potential

How can you conserve energy in a building?



Source: Energy Information Administration, 1995, www.eia.doe.gov

Energy Management Systems (EMSs) control energy-consuming building equipment to make it operate more efficiently and effectively.

Lighting
Lighting consumes over 20% of the electricity produced, and is responsible for about 35% of a typical building's electricity use. Much of it is wasted due to poor lighting design, inefficient lighting equipment, and poor controls.

HVAC/Mechanical
Since HVAC systems are responsible for the largest chunk of a building's energy use — from 30% to as much as 50% of the total — even small increases in equipment efficiency will result in large savings.

Building Envelope
A building's envelope, or shell, consists of its exterior walls, roof, foundation, doors, windows, skylights, dampers, and other openings. Energy-efficiency improvements to the shell include the addition of insulation to reduce heat transfer; tightening measures to reduce air infiltration; and window upgrades or treatments.

Life cycle thinking

Energy Management minimizes operation cost, which is 75% of the life cycle cost of the building.

If owners and builders were to look at their facilities over the entire operational life, they would begin to see their buildings as an investment and not just a shell to house their business. Investing in their facilities can actually create a return, especially in terms of energy savings.

Light bulb vs. compact fluorescent

Have you ever stood in the store looking at all of the light bulbs to choose from? Some bulbs cost about $1 or 1 Euro while others cost 10. This is the same decision that building owners face in design and construction of a facility. How do you decide? This exercise will show you the true cost of bulbs and explain the concept of life cycle costs.

Let's compare two light bulbs for 10,000 hours of operation (around three years).

An incandescent bulb costs .43 Euro and lasts 1,000 hours so you will need 10. A fluorescent bulb cost 9.95 Euro and lasts about 10,000 hours so you will only need one.

Additionally an incandescent bulb uses about 60 Watts per hour while a compact fluorescent uses about 9 Watts per hour. Let's assume that electricity costs are .15 per kiloWatt hour.

With this information, complete the following tables:

10,000 Hours	Incandescent Bulb	Compact Fluorescent
First Cost	.43 X 10 Bulbs = 4.43	1 Bulb X 9.95 = 9.95
Total Watts Used	60 X 10,000 =	9 X 10,000 =
Convert to kWh (Total Watts/1000)		
Cost of Electricity (kWh X Cost of .15)		
Total Cost (First Cost + Cost of Electricity)		

You can see that over the life of the bulbs, the compact fluorescent bulb has a much lower cost. In addition to the cost of the bulb and electricity, you can look at the pollution generated by the electricity used to light each bulb.

Pollution per kiloWatt-hour:
Carbon dioxide CO_2 . . . 680 grams
Sulfur dioxide SO_2 . . . 5.8 grams
Nitrogen oxides NOx . . . 2.5 grams

10,000 Hours	Incandescent Bulb	Compact Fluorescent
Total Electricity Used	600 kWh	90 kWh
Carbon dioxide 680 grams per kWh		
Sulfur dioxide 5.8 grams per kWh		
Nitrogen oxides 2.5 grams per kWh		

For a sense of perspective, it takes one tree a full year to convert 6,000 grams (or 6 kg) of carbon dioxide into breathable oxygen.

Programs and legislation

Kyoto Protocol

In December 1997, delegates from all over the world worked toward a universal agreement to reduce greenhouse gas emissions. According to the Protocol, the responsibility for reductions falls mostly on the shoulders of developed nations (since they caused most of the emissions in the first place).

Representative Countries & Energy Usage, 2002

Country	Population in Millions	Energy Consumption in Quadrillion BTUs	Energy Consumption Per Person in Million BTUs
China	1295	43.2	33
India	1050	14	13
United States	288	97.4	338
Brazil	176	8.6	49
Pakistan	150	1.8	12
Russia	144	27.5	191
Bangladesh	144	0.6	4
Japan	128	22	172
Nigeria	121	0.9	7
Mexico	102	6.6	65
Germany	82	14.3	174
France	60	11	183
United Kingdom	59	9.6	163
Italy	57	7.6	133
South Korea	47	8.4	179
Canada	31	13.1	423

Source: Energy Information Administration, www.eia.doe.gov

EU Energy Directive

The European Energy Performance of Buildings Directive came into force on January 4, 2003 and was designed to meet the Kyoto commitment by minimizing energy use in buildings across Europe. The European Union (EU) identified the building sector as a top priority with potential energy savings of about 28%. This reduction would cut the total EU energy use by 11%.

LEED

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System is the accepted benchmark for the design, construction, and operation of high performance green buildings in the United States. LEED is a voluntary performance program that promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality.

TAC helped the Genzyme Center earn a Platinum certification under the LEED Building Rating System. This facility is widely considered a showcase green facility.

Clinton Climate Initiative

As a pioneer in energy conservation and management, TAC is one of six world-class companies to join the Clinton Climate Initiative in an effort to help cities around the world improve the energy efficiency of buildings and decrease greenhouse gas emissions. Urban areas are responsible for approximately 75 percent of all greenhouse gas emissions in the world. Therefore, reducing energy use and emissions in cities is fundamental to any effort to slow the pace of global warming.

As part of CCI, TAC will audit buildings, engineer efficiency measures, implement retrofits, provide performance guarantees of energy savings, and work on an ongoing basis with CCI to lower total system costs. We will help gain back wasted resources while at the same time ushering in a new era in social responsibility.

V. TAC and Schneider Electric Offerings for Energy

Schneider Electric solutions help people make the most of their energy

There are three areas to be addressed in commercial energy use:

- The planning of energy efficient buildings and systems in new developments
- The refurbishment of existing buildings and systems to make them more energy efficient
- The use of buildings; and the energy saving regimes of the owners, tenants or occupiers

Some energy services include:

Assess

- Site audits and consultation to locate potential energy conservation measures

Measure & Analyze

- Power metering to limit demand cost and save money
- Collect and analyze data so that customers can make better energy decisions

Plan & Recommend

- Financial analysis and return on investment (ROI) validation to determine the financial benefits of investing in the facility
- Prioritized step by step planning to reduce energy and implement projects

Improve & Implement

- Products that can save energy: lighting control, variable speed drives, power quality correction, load shedding, peak shaving, process control, building automation, etc.
- Services that can save energy: engineering, project management, etc.

Control & Report

- Monitoring to ensure energy savings

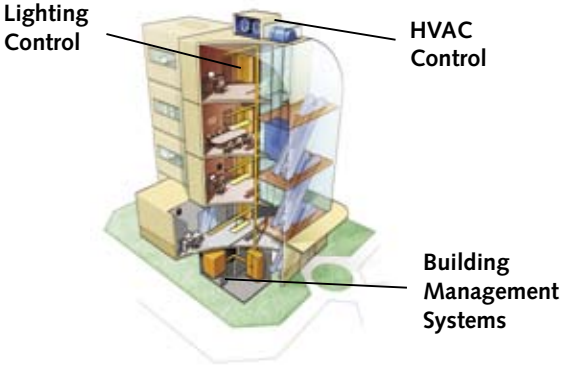
Schneider Electric solutions for energy efficiency

Metering solutions — enable monitoring of energy consumption and demand to prevent electrical system downtime and reduce energy usage. These systems reduce energy costs by avoiding peaks in demand. This can save 2% to 4% on the energy bill.

Lighting control solutions — a lighting control system can reduce energy cost by 50%. Lighting solutions can begin as very local and small solutions, such as timers, occupancy sensors and time scheduling. More complex lighting solutions include intelligent lighting control, integrated building automation and the use of daylight to supplement artificial light.

Motor control solutions — a variable frequency drive is a system for controlling the speed of a motor by varying the power supplied to the motor. Most pumps and fans run their motors at full speed and the power supplied is kept constant. This means that the energy consumption decreases very little when the need in the building decreases — the motor stays constant all the time. Because we know that the need for cool air varies by time of day and occupancy of the building, you can see that the potential for savings is huge.

Advanced building automation solutions — provide advanced building automation systems provide a single interface for Schneider Electric products. The TAC product lines can integrate multiple energy conservation measures to maximize energy savings.



TAC has two specific offerings to meet a customer's energy needs

Performance Contracting helps publicly funded entities make capital improvements. These customers, such as schools and universities, require a financial guarantee to secure funding, since capital improvements are rarely funded in the budget. Performance Contracting is sold exclusively through the Energy Solutions division.

Cameron University in Oklahoma, US, was experiencing poor cooling, causing occupant discomfort and high utility bills, resulting in high operating costs. TAC addressed these issues by installing a building management system, new energy-efficient lighting, and high-efficiency boilers. The university will save more than $500,000 in annual utility costs thanks to a $6 million energy saving performance contract with TAC.

TAC EnergyEdge is sold to private entities that are driven to reduce energy costs and operating expenses. Private entities, such as commercial office buildings, can fund projects from their annual budget and do not require third party financing or a guarantee. EnergyEdge can be sold by TAC and Schneider Electric direct channel offices or by the Systems business.

HBOS (Halifax Bank of Scotland) was spending over 26 million Pounds per year on energy at its 2,000 properties around the country, with no company-wide energy strategy in place. Through TAC EnergyEdge audits, energy inefficiencies were highlighted and energy conservation measures recommended. The predicted savings to HBOS in just six months is 345,000 Pounds, and the cost of implementation will be paid back in 12 months.

TAC extended energy services

In addition to the holistic building approach offered by Performance Contracting and TAC EnergyEdge, TAC can offer a variety of energy services to meet the needs of any customer.

- **Return on Investment analysis** includes calculating the energy savings potential and comparing it to the investment needed to obtain those savings. This service is very useful to Chief Financial Officers and other decision makers that look at financial criteria.

- **Long term energy planning** is important for customers in countries with energy costs that have a high increase every year. Budgeting and forecasting energy costs can be extremely important to the customer and their business planning.

- **Remote monitoring** alleviates the worry of customers with a small staff. Via the web, TAC can monitor a building's performance and energy use to make changes or recommendations to the customer.

- **Reporting** is very important in every business — to track performance and predict future costs and revenues. But different information is needed at all levels within the customer's organization. Creating specialized reports for the customer allows decision makers at each level to receive the information that they need to make their jobs easier.

- **Submetering** can help building owners of multi-tenant facilities who struggle with accurate billing. Energy use is one line item that can be easily automated and reported with a TAC energy management system. By submetering the building, reports can be created to bill each tenant for their exact consumption.

- **Regular checkups** are needed to keep a facility running at optimal performance. Even after a comprehensive energy project, an annual audit can locate additional areas for energy savings and fine tune the building.

Saving energy for end users

Doing more with less in universities

Colleges and universities are actually office buildings, restaurants, retail shops, multi-family dwellings, sports facilities, entertainment complexes, and schools rolled into one. The greatest potential for energy savings comes from improvements in building controls. TAC's building automation can regulate off-hour lighting, heating, and cooling across the entire campus. Efficient lighting and dormitory appliances and equipment, improved HVAC systems, and increased use of day lighting are some other measures that can add up to energy savings of more than 30%.

Doing more with less in offices

Office buildings consume operating budgets as quickly as they consume energy. In fact, office building energy bills are the highest of any commercial building type. Energy-smart office buildings incorporate efficient lighting and day lighting systems, as well as advanced windows, roofing, insulation, and mechanical and ventilation systems. These high-performance building designs also consider the use of renewable energy systems, water conservation features, recycling and waste management systems, and environmentally-sensitive building products and systems. In addition to cutting operating costs, energy-smart office buildings can actually enhance the comfort and performance of workers and boost productivity.

Doing more with less in healthcare facilities

In today's healthcare environment, hospitals are competing for customers and continually trying to reduce operating expenses. Hospitals typically operate at very thin margins — sometimes 5% or less — so a little energy savings can mean a lot. Saving a hospital $100,000 in energy is equivalent to $2,000,000 in additional revenue! Typical energy improvements to healthcare facilities range from energy management systems and high-efficiency lighting to air handling units, boilers, chillers, efficient motors, and variable speed drives.

VI. Review and Conclusion

You make a difference working for TAC and Schneider Electric

TAC can help customers operate in an environmentally and economically sustainable way — by helping them reduce their ecological footprint. But the energy problems we face are dire enough that everyone must become involved in trying to solve them. Governments, corporations, individuals — all must figure out a way to use less energy. **How are you going to reduce your ecological footprint?**

Why and how the course was developed

TAC Energy Awareness is a basic introduction to the energy problems that we face in the world today. Starting with the growing demand of energy across the globe, the course also discusses the issues associated with producing energy to meet that demand including limited resources and pollution. Through a summary of basic energy concepts and potential energy conservation measures, we discuss the solutions that TAC and Schneider Electric have to offer to decrease customer energy use.

As a world leader in building management systems, TAC is uniquely positioned to help our customers reduce energy use which helps the global energy issue and our customers' bottom line. To become a global leader in energy management we must first create an energy culture within TAC — this course is the first step.

This material was developed by TAC Marketing and Business Development in conjunction with Human Resources. As part of Energy University, Energy Awareness represents the first in a series of topics that are available for TAC employees. For more information, go to http://EnergyAwareness.tac.com.

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www.tac.com

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