Purchasing Energy in a Dynamic Market

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ABSTRACT

Reliable and reasonably priced energy is a critical need for any business enterprise. The larger a venture, the higher the sensitivity of energy cost for its financial health. Energy costs have risen steadily for last dozen years, according to the U.S. Department of Labor (DOL) actual data, and will continue so for next 20-25 years, forecast by the U.S. DOE. Energy cost has been a factor in siting decisions for energy-intensive production or process facilities, as seen in migrations from the industrial belts in north to the southern states where energy was cheaper. To their credit, the utility companies and local government authorities formed economic development councils to attract local business growth, and they showed positive results. That is the supply side of the market: energy providers and promoters. On the demand side, end-users should also hone their skills to get the best out of the market. The good old days of state-regulated price stability have been replaced by a high degree of price volatility. Buyers look at the energy market for the best rates to keep their energy costs down, as do utilities; both compete in the same market. Understanding trends and projecting the future is essential for the energy managers and buyers today. When states set the cost rates, they were stable, so it was easy to fit the cost into business models. In today's market, the end-users have to compete more effectively in their product market.

Some details will be different for large users than for those with small or medium demand, but all can benefit from the broader choices today, including those opened by deregulation. It has been tested in various mixes in most states and the results have been different on users, large and small. Many states refined their open choice rules after trial phases, now concluded. Only one element in the equation is not fully stabilized at this writing—the true market demand, as businesses scaled back below normal capacity since the 2008 economic downturn. The market has partially recovered from the depths of 3-4 years ago, but the demand is still skewed from the true market potential. This will change, we all hope, and

the prices will move upward to their true position. This is time to know the market and be ready to seek the best possible costs for next purchase.

INTRODUCTION

The general context of this article is traditional energy resources—electricity, natural gas and vehicle fuels—as these three sell or trade in the market. Alternate energy sources such as solar, biomass, or other renewable energy products are not included, as the theme is to explore the market for large energy purchases. If an enterprise purchases alternate energy forms, it likely will be small compared to the total energy most typical large commercial, industrial or institutional users purchase or manage in their portfolios. The mix of these three commodities will vary from one user to the next depending on the business mix so one solution will not fit all situations. Still, for the purposes of this article, some general outline has to be drawn to present the theme without veering off to all possible or logical details in all situations. The article is intended for large-scale energy users, but most of the discussion can fit medium-size users and possibly many small-scale users because the market dynamics do not change from one user to another. Differences will be in relative priorities, and how an energy manager can balance them and find opportunities in the market that could be leveraged to fit those priorities. If appropriate, any distinction will be discussed if it is based primarily on the scale of use.

This article has not included coal in the discussion, although coal is a vast energy resource in the U.S. Nearly 90% of the coal production goes to electric power companies, and about half of U.S. electric power generation is from coal-fired plants. This has been shifting in recent years as gas prices dropped to record low levels in a decade; many utilities are now using natural gas for power generation instead of coal. In fact, 2012 was the first time that natural gas caught up with coal as the primary fuel for power generation. It will likely continue in that direction for next several years. It is also presumed that the majority of those in the Association of Energy Engineers (AEE) forum may not buy coal for energy as end users and that coal may thus not be aligned to the interests of a majority in this forum. Also, buyers can shop for coal prices only at the open market, unlike electricity and natural gas where buyers have the option of choosing from the utility companies' rates or from the open market. If electric power companies use natural gas for power generation, it is a small share

of the total market volume when other end users of natural gas in residential, commercial, and industrial sectors are counted. Natural gas is an item of discussion in this article because even large non-utility users of natural gas, such as the U.S. military, hospitality services, schools and colleges, housing materials, food and, metal processing, use natural gas.

The demand for energy has grown far beyond projections made 15-20 years ago. Although most of this surge came from the Asian countries, U.S. energy production has lagged behind the local demand growth for over two decades, causing an imbalance within the U.S. market, which has changed the market dynamics by itself during the last several years. It has been compounded further by the transformation of the business world from local economies to a global economy, which produced a steady strain on purchasing power in all areas of the economy. Business costs have been more difficult to rein in for last 20 years. As costs have been rising in all sectors of the economy, high-level decision makers typically focus on cost of materials and labor, then on payroll costs and often next on the debts the business is obligated to meet. Businesses have practiced this set of priorities traditionally for decades, and it has served fairly well as a reasonable model for product and service cost. A further fact is that, until recently, the cost of energy has been relatively low, which justified including energy cost with those traditional priorities. As the industry has been facing more challenges, businesses should look at every opportunity to manage their business costs through all available choices. The intent of this article is to discuss how the cost of energy has changed in the last 20-30 years and the opportunities that now exist to control rising costs of energy and improve competitive positions by leveraging choices in the market. In general, the U.S. industry has been slow to recognize the full dynamics of managing energy costs in the open market and to re-assess where it should be in the set of priorities. This article will walk through the market elements that are at play today and sketch a plan to bring energy costs down without compromising the operational needs of an enterprise. Key elements going through this are: the sensitivity of energy costs to the business; operational latitudes; market forces and options; and strategies for an energy portfolio, including defining needs, purchasing resources, and managing the energy needs for the business.

Starting with recent trends, Figures 1 and 2 give some national statistics.

A note should be added to Figure 2. The local utility charted is from the author's local area, which happens to be in the lowest quartile in cost

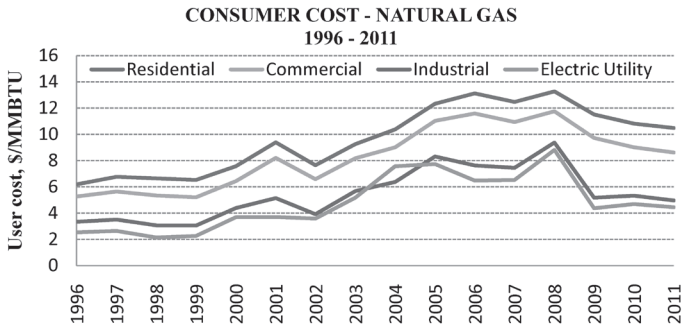

Figure 1: U.S. national averages for natural gas retail price [Source—American Gas Assoc.]

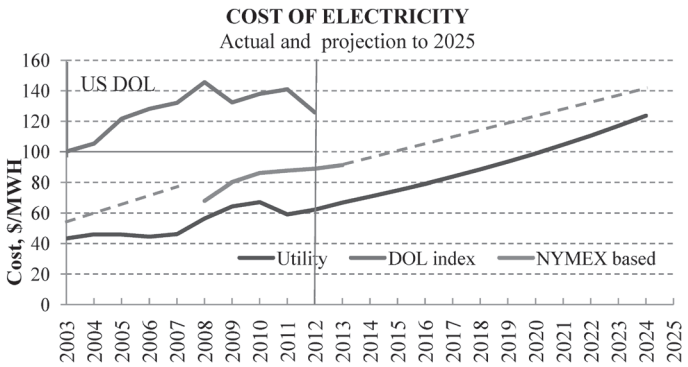

Figure 2: Retail price – DOL = national average; NYMEX = regional; utility = local power co.

throughout the U.S. This line can shift widely from the localities of highest cost to lowest cost within the U.S., but the trend will most likely be the same. Readers should substitute data for their local geographical areas.

Even though energy managers and purchasers may not use such charts, they know that prices of all energy commodities have been going up every year from their own experiences. The plots are actual costs for the past years and a forecast model for the future. Electricity and natural gas are traded as futures at NYMEX/CME (Chicago Mercantile Exchange). Electricity trades actively for a year to two ahead, beyond which there is usually very small volume trading. For reasons of relative market stability, natural gas is usually more active into the future years than electricity. The CME is open for futures trading in natural gas for 5-10 years.

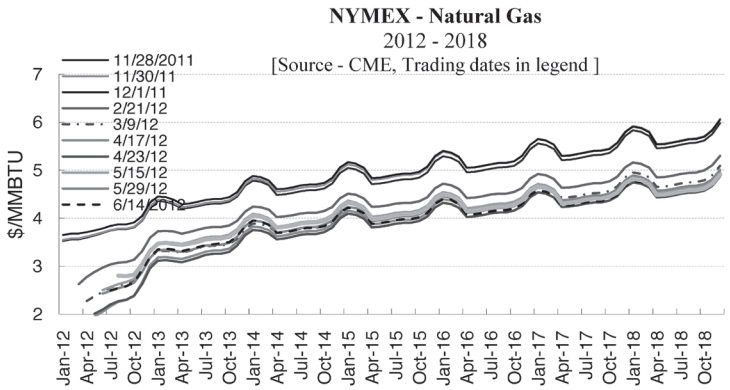

Figure 3: Natural gas on CME trading floor for futures

Figure 2 shows PJM (PJM Interconnection LLC)-based costs for electricity for a year ahead, then extended as projections. Figure 3 shows actual settlements for natural gas for six years, showing the difference in market confidence, which will be addressed later in more detail as a basis for making future purchasing decisions.

The charts are briefly explained to clarify some semantics and set the context for the purpose. Figure 1 and later data from the U.S. Department of Energy (DOE) define sectors of the economy as it fits their use of the data. A semantic factor here is the definition of "sector" as used in various circles. Some analysts use "public sector" and "private sector" for their purposes by source of funding, but the original definition was by three sectors of economy—primary, secondary, and tertiary, based on stages of progress from harvesting of the raw natural resources to the end product for consumers. The U.S. Department of Commerce (DOC), the Bureau of Economic Analysis (BEA), and a few others still use those distinctions for their purposes. As the U.S. economy shifted its balance from manufacturing to non-manufacturing, the term "service sector" was coined. There are more than three; Standards & Poor's breaks the market into 11 sectors. But the discourse is not about competing definitions of words, it is about buying energy in the most cost-efficient way in today's market. Keeping that in focus, all charts show clearly that energy cost has been going up for every one of us regardless of our place in the economy. A majority in this forum may usually see the cost of electricity at the top of their energy portfolio, followed by natural gas, and then by fleet fuel, so details in this article are addressed in that order. Another segment of

business—information technology (IT)—will be recognized here because of its growth in last two decades and sustained presence as U.S. commerce adjusted to a global economy. IT is part of the service sector in the economy but the reason for suggesting its own recognition is for the high energy intensity for IT equipment and services relative to most other constituents in the service industry. Forum members with large IT operations may have recognized the energy cost burden from IT systems on the total energy budget. It can be verified that local utility companies see high kW demand surges any time a locality develops IT hubs or operation centers; northern Virginia is a good example from recent years. It is also presumed that IT interests are present in this AEE forum. Electricity is addressed in relatively more detail in the article due to the cost burden to the energy purchasers.

So, what's the plan? "There is always a best answer" sounds like a cliché, but it is true. The best answer can vary among energy managers by business priorities and diversities; still the path to the answers will have a common pattern for all because the ground rules are same for all. An excerpt from a report by the U.S. Congressional Research Service (CRS) on energy speaks directly to the energy costs for doing business:

> *Energy supplies and prices are major economic factors in the United States, and energy markets are volatile and unpredictable. For both these reasons, energy policy is of frequent interest to Congress. [1]*

If it feels comforting that Congress is on the ball, even more impressive is where this statement was in the report—the opening lines on page one! We cannot really relax thinking that our Congress will make the plans; we have to do it ourselves. One can perhaps bet confidently that CRS reports did not say such words twenty or thirty years ago. Without getting into the details of all the changes in last few decades, suffice it to say that many basic elements of our economy have changed, and the energy components had to undergo many adjustments and even some total changes. Using words from the CRS excerpt, energy markets were both stable and predictable once, but not any longer. Years ago, the utility market was so stable that people invested their future or retirement savings in utility stocks; they were as solid a bet as government funds were. The business leaders' decisions could rely on the energy cost component for doing business, and focus on containing the costs of other elements for growing the business. That has all changed; we shall not get our "best an-

swer" for the future by reliving the past. If the past has given us lessons, we need to extract them to plan our future. On that thought, the changes in the last few decades are discussed briefly as they may be of help for future decisions.

BACKGROUND

For a starting point, we can go back 50 years or even to post-WWII era as an anchor point. The U.S. economy had definitely established itself as the world's leading economy at the time. Energy cost, as a line item by itself, was always a very low percentage of the total business cost for any enterprise. There are many statistical reports, from the Department of Commerce, and many private sources as recently as 10 years ago, citing the energy cost at 2-3% of the total business cost. It is not clear, however, if methods of defining energy costs were consistent. For example, some may have counted the energy usage cost for processing their finished product and rolled that up with the raw materials cost as the final "product cost." Some may have viewed the building energy costs (including lighting and HVAC for the offices and factories) as part of basic operating cost and rolled it up under their "overhead costs." That information is not easily available to make any definitive statement about the methods. At 2-3% of the total, high precision was perhaps not critical for the final business decisions; it was overshadowed by much larger cost elements like materials, capital costs, fixed asset costs, wages and general overhead. The fundamental business cost formula has not changed, but the mix of factors in that formula has changed over the time. This will be detailed more in the following sections. The relatively low cost of energy was a fact, even if its true share most likely was higher than 2-3%. Even without debating this accuracy when adequate facts are not readily available, its relative weight can still be seen in the effect of two major events in the energy market in the last few decades through real examples.

The first example is the OPEC oil embargo of 1973, which was the first major shock to energy prices on a global scale dating back to our reference time. The U.S. oil industry had good market control, and prices were predictable and stable following the general economic principles of supply and demand. As the U.S. was highly dependent on OPEC oil supply, the embargo forced higher fuel prices and caused turmoil for a year, but overall, the U.S. economy stayed on its path with no major disruption

caused by the oil price alone. This statement needs one clarification because the stock market crash in 1973-1974 overlapped the embargo. The market crashed in January 1973 for monetary policy shifts under President Nixon [2], and it was already volatile when the embargo started in October 1973, nine months later. The embargo ended March 17, 1974, but the market did not stabilize until December of that year. During those two years, the market was on a path driven by the economic policies of the time; the embargo was an added disturbance, not a cause for the economics of the day. The second example is the effects of hurricanes Katrina and Rita. At the component level, natural gas prices doubled and stayed so for a year before receding to a normal range. The charts following reflect the total U.S. economy and aggregate energy profile throughout the period. They do not show any perceptible shock on the price or on the consumption. The U.S. per capita gross domestic product (GDP) continued its general trend following WWII through these periods. It showed that the U.S. economy could ride through the shocks because energy cost as a business line item was at a low percentage. Even if the percentage were higher, it could not disrupt the overall balance of other market factors as they existed at the time. Energy costs from the utility companies were also stable and predictable through this time, as the state utility commissions in all states across the U.S. regulated energy costs through the early 90s.

Note: The 2000 shift in the industrial sector may relate to rate of factory jobs lost to overseas (not analyzed)

Even though the U.S. economy managed to stay its course through these two major shocks, it was a clear alarm that energy prices did not depend solely on the laws of local supply and demand anymore. The term "global economy" was not a common phrase then as it is now even though President Nixon had made his historic first visit to China 40 years ago to expand the economy beyond U.S. borders. The U.S. economy was still bounded for the most part within the U.S. market forces. Other industrialized nations had similar economies and markets. As all industrialized nations became more energy hungry in the following years, something had to be done to cushion against the volatility of the two examples demonstrated. According to the Energy Information Administration (EIA):

> *Volatility matters for all consumers and producers in the economy. Business firms, both energy and non-energy, make investment decisions based on expectations about prices. If decisions are made on the expectation of low (or high) energy prices, and the energy market varies sharply from*

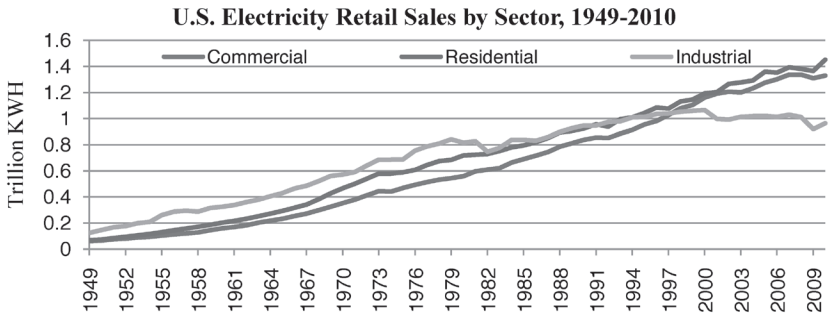

Figure 4: National average, relative effects of embargo and hurricanes were imperceptible.

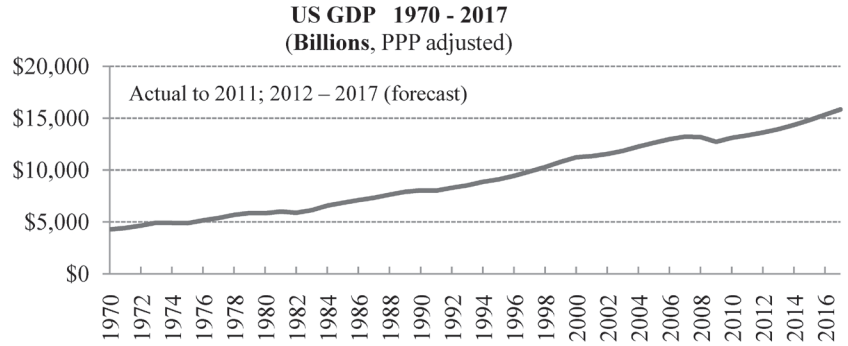

Figure 5: The U.S. GDP in constant dollar purchasing power parity (PPP). Small dips in 1980 and 2008 show recessions in the U.S. economy. Effects of the two example causes are within normal ranges of variance.

> *these expectations, firms may make inappropriate investment and business decisions. Even those firms that expect volatility may be adversely affected by simply putting off a decision until the market is more stable. … The economy would most likely perform better with stable or predictable energy prices, than when the price of energy fluctuates greatly.*

Paraphrasing the last sentence, we could say, "our businesses would most likely perform better with stable or predictable energy prices…" That is the motive force behind this article.

Many initiatives were started after 1973 to absorb the new force of market volatility and promote a return to a more stable state. President Nixon announced project independence (from foreign oil), the DOE was created by President Carter, and many other efforts followed. Within the

U.S., energy deregulation started taking form, with the goal of stabilizing market pricing across all producers and consumers by removing local barriers in all the trading districts. Deregulation also went through some trials and errors in most states. The results were mixed, which added another element of volatility for the energy purchasers. The lesson from this history is that all the causes that brought in the volatility are likely to stay. Our business decisions have to cushion the plans in ways that we can best absorb them. The energy costs are going to continue to rise, as shown in the Figures 1-3, and a high level of volatility compounded with that will make it more difficult to manage business costs.

The Idea? Keeping It Simple Works!

Know what to buy—precisely, not generally

Know who is out there—utility with regulated rates, and open market with competing deregulated rates

Choose how to buy

The idea is to plan leverages in a dynamic energy market. The end-users cannot control all the market forces, which trigger the elements of market volatility, but there are items an energy manger can control within his or her business domain that will influence a final price. It starts with recognizing those factors within control of the energy manager and those outside. The next essential steps are to define precisely what to buy and when to buy, before going to the market searching for best rates; both are usually within the energy manager's control. It is similar to looking for a car in general, or looking for the best price on a specific model and options that fits the buyer's needs more closely. It is a total change from the days when state commissions regulated prices; they set the rates and assigned service territories to utility companies throughout the state. We did not need any preparation, had open purchase orders, and paid for whatever we used at the rate already set for us. We now have the latitude to purchase at the regulated rates, or to buy on our own terms. In general, prices will rise when the economy grows, causing demands to rise ahead of the supply. The three commodities have different behaviors summarized next, and details of the plan will be fleshed out with the preparations, and tailored to precise operational needs of the business. A few items have been suggested in the next paragraphs to help define those needs. An energy manager can determine the details of the purchase and the timing, then shop for the best price in the same way as

one does for any competitive price solicitation. This was the very essence of the deregulation movement. It was presumed earlier that among the three energy commodities, electricity probably ranks at the top in cost for most members of this forum, then natural gas, followed by vehicle fuel. The market trends are addressed next in that order.

Electricity

The U.S. DOL index shows the average retail price for electricity in recent years in the preceding figures. The DOL held 2003 as the index at 100, and charted the average price for subsequent years from that index. The index rose every year, from 100-140 in eight years, an average annual rate of 5%. The downward shift in the chart in 2008 reflected the downturn of the U.S. economy, when demand for electricity was severely lowered because of many idled production plants and delayed expansions throughout the U.S. It started rising again after 2009 as the industry took advantage of the troubled asset relief program (TARP) and other recovery relief programs. The economy still is not fully recovered but has resumed the 5% rate of increase. It is expected that the rate of increase will rise above 5% as the recovery gains more ground and will retain that higher rate for some time. Before the 2008 downturn, the electric power industry was forecasting a power shortage starting about 2014 in some parts of the country. This threat has been averted, but just temporarily. Immediately as the economy gets into a good rate of recovery, demand will rise ahead of the supply, which can add another element to the volatility in the market price. Many utility companies have been buying power from the grid or IPP to meet their summer peak demands. The utility companies, FERC and all power grid operators are actively engaged now to rein in the demand, as is evident in the recent outburst of market interest in demand response programs, smart meters, and other tools which will help companies face the challenges of the day. Today's energy manager has these tools also for defining purchase plans and hedges for energy prices.

The U.S. DOL data is an average portrayal of U.S. energy market. As we all know, the local rates are different and swing widely from one end of the U.S. to the other. The rates follow local market forces in our own business districts. For example, at the national level, most FERC regions have the reserve margin at levels higher than the targets, but that may not be the case at local levels, and one district may be more sensitive to the peak demand than the next. One major point in the preparation is to know the sensitivity of energy cost in the business locality.

Natural Gas

Natural gas has gone through several price swings in recent years. The effect of Hurricanes Katrina and Rita raised the price for about a year. Another steep increase came in 2007-2008 driven by speculative market demand, but the prices have dropped steadily since. From a high of $11 in 2008, it has traded at about $3 from summer of 2012, dipping at some points to under the $3 mark. The market was oversupplied for some time, and the new exploration from hydraulic fracturing (fracking) is long-term, so the prices are likely to remain at moderately low ranges in the near future. The uncertainty remains on the timing for full economic recovery and the rate of demand growth in the coming years (short-term).

Fleet Fuel

This is the most unpredictable of the three energy costs, as the market is a mix of domestic and global forces, unlike the other two. Production of electricity in the U.S. is almost entirely from domestic resources: coal, followed by gas, nuclear, and hydropower. In the last 10 years or so, petroleum has accounted for about 1% of power generation in the U.S. The U.S. is self-sufficient in natural gas resources also. Because of the high share of imports in the oil market, its price is likely to remain subject to high volatility until the U.S. can successfully curb the share of imports.

These last paragraphs outlined the general market behavior in recent years, noting the elements of uncertainty that can affect the price. The following sections will address how to counteract these effects, to a degree that the energy manager can plan and control what is within his or her reach. The two questions for these preparations are: what to buy and how to buy it.

WHAT TO BUY—The Energy Profile

The core thread in the preparations is to know how the commodity is to be used for the business as precisely as possible. The logic is that uncertainty in the price is a direct quotient of uncertainties in the balance between market supply and demand. Market supply is quantified fairly accurately based on generating capacity, active drilling rigs, and other precise production information at the supply end. The market demand on the other hand, is a perceived estimate, a "best guess" from the market based on prior history or comparable cases. The energy manager is on the

demand side and is in a position to remove the guessing to a large measure for his or her portfolio, the level of precision depending on the core needs of the business and the latitudes in adjusting its operations, while still meeting the business targets. It may be a good way for most buyers to view the total needs by separating the "base load" and the "variable load." The base load is the demand which is set by the long-range plans of the business, like energy costs for a million-square-foot production plant itself to produce a full capacity of widgets the business aims to market. The variable load is that part which changes because of market cycles, weather, and short-range goals. Those changes generally are short in duration, such as changes with monthly or yearly production orders depending on the consumer base the business supports, e.g. monthly targets, seasonal demands, etc. In simple terms, the total energy cost (Y) is:

$$Y = A + BX,$$

where
A is the fixed cost for base load,
B is the activity level and X is the unit cost for production.
A is fixed;
B is variable;
X is semi-variable, as unit cost may change when production volume changes. For fixed output, X is fixed.

The energy manager can review actual consumption data for the past 3-5 years to see the energy usage profile for his business. It is very likely that the pattern will be stable enough to give a level of confidence for the size of the next purchase, as the actual following figures show.

At a conceptual level, if every energy manager had this information—within a reasonable level of confidence—the total base load and variable load could be tallied up to the market for total energy need from the demand side, and the supply side can then respond with just as much precision as possible, such as knowing how many plants to run and when, how many rigs to run and when, which will meet the market demand precisely, minimizing wasted resources and costs. At this conceptual plateau, the supply and demand are balanced, which removes the uncertainties in the price. We have seen that even force majeure does not throw this balance perceptibly and for a long. This concept is not likely to happen across the land, but an energy manager can take the reins for his or her business. The end product is a purchase specification, precise in defin-

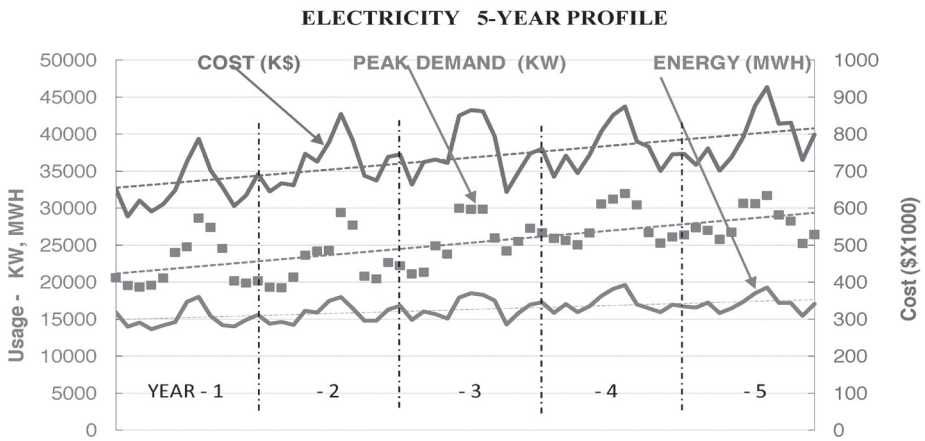

Figure 6: General consistency of usage profile year-to-year. Base load (A) increased as the campus had multi-year expansions.

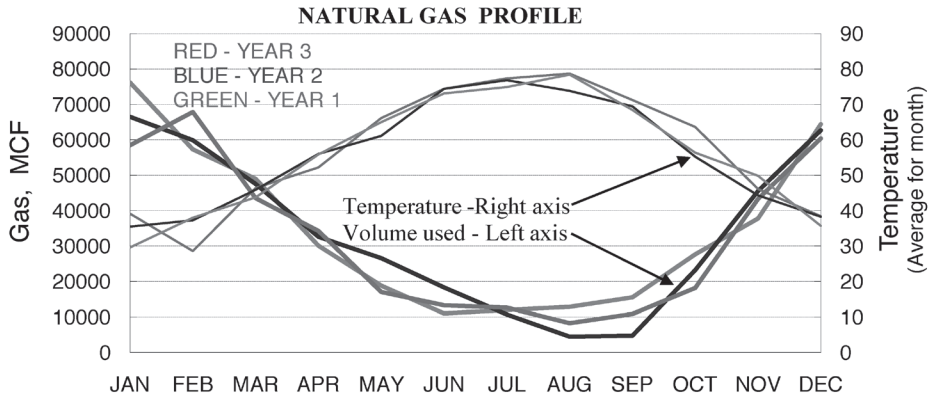

Figure 7: General consistency of gas usage profile year-to-year. A, B were virtually unchanged.

ing the demand profile and the energy consumption profile with as little extra margin as the business decides to include as its risk allowance. The market price will likely be tailored precisely to that specification without a need for the vendors to cushion their price offers for uncertainties. This logic is simple, but the preparation needs diligent work. The energy manager should segregate the various large pockets of energy usage for determining the sensitivity in each segment of the business for varying energy price; it is quite possible that each segment can be tailored on its own to

build up the total profile. Managing the energy usage is part of the energy manager's domain, and this knowledge will help in defining the hedges that can help the total energy cost. Recognizing that energy consumption depends directly on the weather, which is also a variant, consideration of the weather is discussed next. An average may be drawn by reviewing past years' usage profiles. The local weather data can be tallied with that to assess the correlation between the usage and the local weather, by degree-days for example. For almost all cases, it will show that unless there was a long spell of hot or cold temperatures with several degrees of variance from normal, a few degrees of variance in temperature from one year to another does not change the profile much from the average (Figure 7). The average drawn from 3-5 years' history should be a fairly reliable indicator of future usage.

The equation Y = A + BX allows the agility to fit future needs as changes take place, such as business expansion. Such agility is helpful, as the cost model does not have to be re-invented for every change. The energy manager may find it useful to allocate the fixed energy costs and variable energy costs to A or B in planning for demand-side management if possible within the operational latitudes. It also opens the door to take advantage of the program rewards of demand response programs in the market. Good energy management program is always a central piece for the business, not just for technical operations, but also in controlling purchase costs. Some typical profiles are shown next to illustrate why or how the demand and cost interact, first by weather (Figure 8a) and next by operational flexibility (Figure 8b).

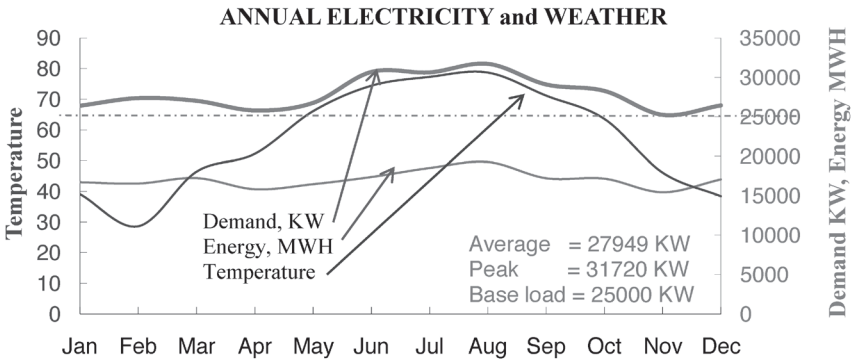

Figure 8a: In a commercial public facility, summer cooling added 25% to base demand kW

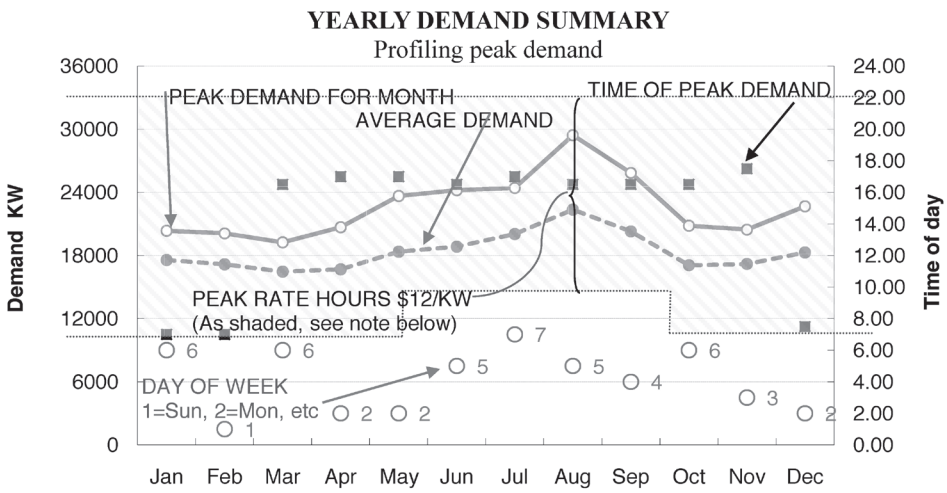

Figure 8b: Time of peak demand affects cost. Ex: Peak hour = $12/kW, off-peak = 60 cents/kW.

These figures were included to suggest that the energy usage profile will have a pattern that is generally consistent from year to year as long as activity levels (B in the equation) are consistent. The other information in these figures is that the final cost depends on the time of use, which should be considered in preparing the purchase specifications to give a level of precision in the requirements. A general outline form for collecting the basic electricity and gas data follows.

The usage summary may be charted in the format below as each of these elements affect the final cost by their own weights in the total mix. Further level of details may be added as the energy manager may choose, to monitor the actual usage against the base contract and for leveraging the open market options or the utility rate schedules.

Electricity	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
On-peak kW/MW													
Off-peak kW/MW													
On-peak kWh/MWh													
Off-peak kWh/MWh													
Peak hour													

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HIGH PERFORMANCE BUILDINGS: A GUIDE FOR OWNERS & MANAGERS

Anthony Robinson

High Performance Buildings: A Guide for Owners and Managers, is a template - a blueprint for action for those making decisions about how to improve the energy efficiency and performance of new or existing buildings. It is designed to have broad appeal, both for the seasoned veteran facility or energy manager and for the new manager alike, but can also be utilized as a practical desk reference by professionals such as architects, engineers, and construction managers. The book provides an objective and orderly approach to what is often a complex, costly and time-consuming process. The full spectrum of topics relevant to achieving optimum building performance is addressed, including analysis of overall building energy use and performance, building commissioning, applicable codes, standards and rating systems, building envelope, onsite power generating options, optimizing performance of building mechanical and electrical equipment, and importance of effective building operation and maintenance practices. It is thorough in its topical scope, technically accurate, yet concise. Fundamental principles are discussed and illustrated with case studies.

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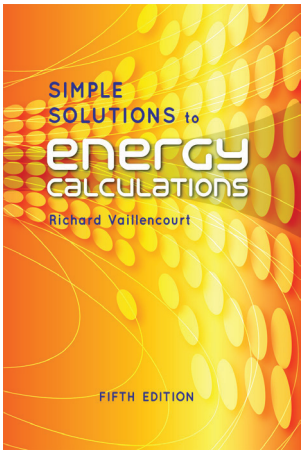

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Natural Gas	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Base load													
Space heating (seasonal)													
Other services													
Peak demand													

The fleet fuel price will likely be based on the contract volume for most users in this forum. Monitoring by months or times might not be required, except for airlines and trucking/delivery services or the transportation sector in general.

For the total profile, latitudes in IT operations may be explored as it can help lower peak kW demand, e.g. the extent of system redundancy. Even in idle standby status, IT equipment consumes considerable energy. For a mid-size commercial complex this author analyzed, the cost was about $400,000 per year (in 2004) at $8 per month per workstation.

BUYING OPTIONS

Once the usage data package has been gathered, the next step is to look for the best price. The two basic choices are a) the local utility company at their published tariff rates, or b) competitive bid in the open market.

Local Utility

The utility companies generally have an array of tariff schedules aimed to meet various energy usage patterns of their constituency. In general, they offer a good variety of choices, and will perhaps fit the needs of most small and medium-scale users at fairly reasonable cost rates. One benefit for this choice is that tariff rates do not change at the discretion of the utility, offering some level of stability. The nature of this stability has changed recently because of market forces. Relative to the past ten years, the number of rate cases at the state utility commissions hit record highs for last three consecutive years. The energy manager may keep that in mind, but still, the price is not as volatile as in the open market. Choices that most utility companies offer are described below; the energy manager may find that one of these will fit well with his or her business needs. The utility companies may have different menus to offer, even within the same state, but they all offer choices for their large-scale users. If business

activities can be flexible to meet the rate structure, it should optimize the costs. For example:

— Time of use (TOU)—If the operations can flex to fit the window of time in the tariffs;

— Curtailable service (CS)—If the business day has many idle hours during the day;

— Thermal storage (TS)—If the campus has a high cooling load, and can be shifted, TS can help.

These are a few examples to suggest that the energy manager may find the best answer within the rates the local company offers with a level of reliability and stability. Besides the advantages mentioned, this may also relieve precision monitoring and controls of energy use at the campus that may be warranted if buying from the open market. The energy manager will find it beneficial to have the energy profile by demand rate and consumption by the hour and the day for best results, to monitor conformance with the rate schedule selected.

Open Market

The main difference between buying from a local utility and from the open market is that for open market, total usage needs to be quantified in advance. The open market trades energy by specific units, and the contract will require specific values in the market units for the total quantities to be purchased. Monthly distribution of the annual total is part of the preparation; it helps traders distribute the cost by weighting for a balanced average. The contract may include sections on variance from the base value of the contract. Tight controls on the variance return a favorable market price. A subset of this choice is to join an "aggregator," a new entity born after deregulation that acts as the agent for several purchasers and negotiates a lower rate from the commodity sellers by the aggregate bulk of the purchase. Savings from the bulk purchase are then passed on to all participating members. A "council of governments" is a fairly common form of this entity in many jurisdictions. The states also license individuals or private companies to act as aggregators. There is a threshold limit, in general, when a business may find the best economics for the purchase by going to the local utility or to the open market, and it will vary from one company to the next. It may be safe to say, however,

that if a company pays its energy bill in the millions, the open market will come out as a better choice in most cases. Some of the following details may help the selection for large energy users.

General cost rate structures of electricity and natural gas are briefly described next. The utility tariffs have separate rates for demand and consumption charges, and any pass-through charges allowed by the state commissions. The open market rate structure is based on the consumption volume alone, for example, by $/MWh for peak hours or off-peak hours.

Electricity

For large users, the electric utility bills usually consist of three major components: a kW demand charge; a kWh energy charge and a fuel cost charge. Each bill usually has a few more items but they are small. The three major ones affect the final cost in specific ways, and need to be placed in context of the business operations. The regulated tariffs will show that the kW demand charge is very high (dollars) during the peak demand hours, but drops to a low value (cents) during non-peak hours. The kWh charge will also show similar high and low rates. This is shown in Figure 8. The preparations should tabulate demand and energy charges by the off-peak and on-peak hours. The energy manager can purchase on-peak MWh and off-peak MWh at different rates from the traders to find the best aggregate cost. If buying from the utility instead, the energy manager can install operational controls to curtail the kW demand during the on-peak hours by shifting times, if possible, of some parts of the business activities.

Natural Gas

Relatively speaking, it is much simpler to prepare a purchase package for natural gas than it is for electricity. For natural gas, the energy manager should assess the business activities to see the base load and the variable loads and the seasonal variances through the year. Both sides of the market, the utility company and the traders in the open market, sell natural gas in essentially three categories:

1) Firm or uninterruptible supply—For those whose activities must have the services at all hours every day
2) Interruptible services—For those who have alternate means of maintaining activities if gas services cannot be delivered for such

things as system pressure, network problems

3) Curtailable services—For those who can pare down activities at some level, but not totally stop them

The three types of services come at different cost rates. The usage profiles may help shape the purchase package to find the best final cost.

For campuses with large loads for space heating or cooling, the effect of adjusting the temperature set points should be considered. Also, if the campus does not have dual-fuel capacity, it may be a good investment to add that.

Fleet Fuel

Of the three commodities, this is the most unpredictable; the local laws of supply and demand do not fully control the price movements. The market, meaning both buyers and sellers, knows that, and that awareness has added a new degree of uncertainty in the pricing in last few years. The oil market has more speculative traders today than just a few years ago, and the speculative trading volume has reached a high enough percentage of the total volume to add an artificial layer to the price. It is not the purview of this article to analyze how long this may continue, however the oil prices may remain as they are now for some time. The best path to purchase oil is to buy as much in advance as possible if the market goes low, and to buy through aggregators like the council of governments or similar bodies. Airline companies and trucking/delivery services typically do so, and build in some hedges. Their volumes require some form of hedging. For the average commercial or industrial users, the purchasing package can go for a straight buy. Figure 9 shows a snapshot of the oil market; the downward shift in 2008-09 is from the effects of the economic downturn.

THE DECISION TO BUY

At this point, technical requirements have been defined, utility rates and open market options have been reviewed, and then a decision is to be made for where to buy and when. If the procurement process favors purchasing the service from a local utility, no further planning is needed. Account managers for the utility company will generally help set up the purchasing agreement for the energy manager at the best rates. If the de-

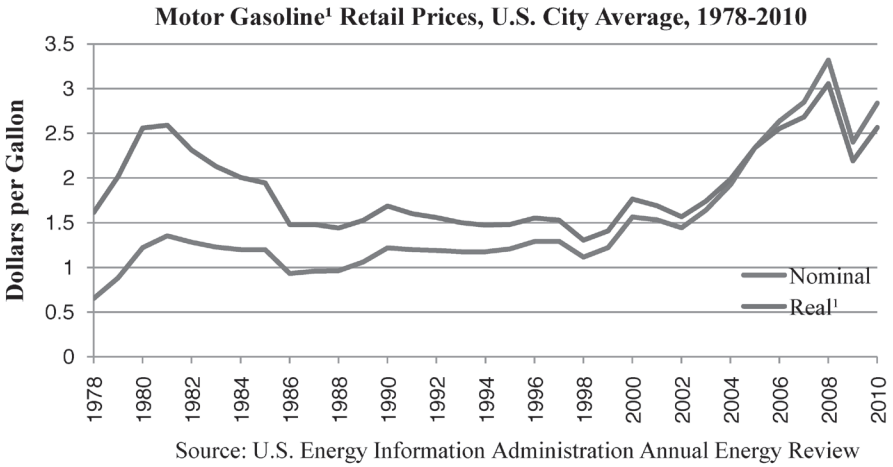

Figure 9: Overall path of gasoline price to end-users, national average.

cision favors an open competitive bid from the market, one further step is suggested—to prepare the purchasing process as a two-step competitive bid. The reasons are twofold—service reliability and price. Each state wrote its own deregulation laws, so they vary from one user to the next. The basis is therefore explained in a general outline without specific reference to any one particular state. Deregulation has existed a few years in every state, and it is still evolving in some ways. At present, the market rules allow an aggregator to divert gas or electricity volumes from the nominated end-user to other parties in some conditions. Contract documents should address such conditions, specify the terms of curtailing one's service, and stipulate the financial consequences of the decision. It is necessary in a contract to define supplier and buyer responsibilities in case there are conditions outside their control, such as disruption in the interstate pipeline supplies or in the local distribution network. It must be said that most reputable, established service providers in the deregulated market always try to serve their customers with minimum disruption, but there can be traders who may choose to sell nominated volumes at spot market prices to other users who are in short supply. That is driven by profit motivation first, not customer loyalty, and is done often enough to make a mention of it in context of service reliability. If the contracted quantity is not delivered, its effect may be to scale down production, buying at spot market price, or any mix of other impacts—all of which add to the business costs. This can become a question of reliability in the price

(and service), which is the focal point for this article. The starting premise of the article was for a reliable and reasonable price. This step is about the reliability. Second, the price in the open market varies every day, by the hour, and even by the minutes more often than a buyer may like. The open market has some general seasonal patterns of high and low trading prices, which are fairly consistent with the time of the year. For example, gas prices will tend to go up in the fall as late buyers prepare to buy their gas supplies for the heating season ahead. The gas price would typically drop for future months' trade if purchased in March-April after a normal winter. A harsh winter or a mild winter will shift the March-April timing depending on the storage volumes and the injections as was anticipated before the winter. Advance preparation should help get a better price, and to the extent possible, the purchase price should be set in advance of the need. The two-step process can address the reliability aspect and the pricing aspect in separate stages of the bidding process.

Step 1 should be in screening prospective bidders/suppliers on past performance, length and diversity of experience, total volumes, total accounts served concurrently, and similar other details as will help the energy manager assess the provider's reliability standards. Through this first step, the energy manager can make a short-list of qualified bidders who will be allowed to participate in Step 2 of the bidding process. The analysis in Step 1 is for performance, not cost.

Step 2 is when the qualified bidders will be invited to offer their best prices. As most providers will likely have different formulas for their overheads and margins, and the market changes by the hour and day, all prices should be invited at the same date and time to compare all offers on the same scale. Because of the market again, the prices offered will most likely be valid for a very short time, such as a day or even less. A price valid for a longer time may come at a slightly higher cost, as the traders will cushion their prices for the unpredictability of the longer time. Energy managers will have to be prepared to act swiftly if the price is a reasonable reflection of the market.

One further note about the pricing is that a multi-year contract will usually bring a lower annual unit cost than one purchased for a year or less. The best place to look for assessing this is the recent pricing of commodity futures in the market itself. The economic recovery is going to gain strength; the uncertainty is about its pace. That uncertainty has affected the long-term pricing in the market. For large-scale users, the total annual savings may favor a multi-year contract if their totals are in millions. For

small or medium-scale users, a shorter contract term of commitment may fit their business priorities better than a longer term. It is possible to do an exploratory study by drawing 1-, 2-, and 3-year strips from the market for a fictitious contract term, and proceed from that study.

At this stage, all small-volume users may take an extra step by checking with the Small Business Administration (SBA). The SBA works closely with the U.S. DOE on many assistance and rebate programs, within a threshold of typically 200 kW peak load. The programs vary, but the goal is common—to help small businesses with energy costs for their business. [www.sba.gov]

CONCLUSION

A general map has been presented with options available for purchasing energy in today's market. To prepare for the best price requires detailed and diligent analysis. It is beyond the scope of this article to address all different mixes of tariffs across all states, districts, or different trading zones for the open market, and suggest a general formula at the end. Most of the preparatory details discussed here are in the utility bills. Most utility account managers will also help the local companies go through the billing elements, as the utilities have an interest today in managing their demand loads across their whole territories. An energy manager can follow the same theme to refine the campus energy program for the best-cost rates.

One choice that has not been included in this article is building one's own electric power plant. This option is worth considering for all large-scale and many medium-scale users of electricity. In today's business, any user with a demand load in 30-40 MW range or higher should study the viability of this option. Until about 10-12 years ago, it was not as attractive a choice as it is today. It is not included here for two reasons: first, the topic is outside the context of purchasing energy, and a second stronger reason is that a working discussion on this topic will entail a article on its own—it may be a topic for another day. The general context and few strong reasons are briefly outlined here if any reader wishes to explore it.

1. **Monopoly**: Years ago, there were limitations on having one's own power plant. The net effect was to make return on the investment (ROI) difficult; it did not make for a good business strategy. The landscape has

changed and most of the traditional power companies have adjusted to that. It is possible to recover the cost today in a more acceptable timeframe.

2. **Technology**: It is possible to build a power plant today that will deliver significantly higher production efficiency than was available years ago. A combined-cycle or CHP will have much higher efficiency than most of the power plants at the utility scale. This means lower operating costs and quicker ROI. Emission may not be an issue with today's technology.

3. **Cost stability**: Natural gas is in very stable production scale in the U.S. now, and will remain so for some years to come. The industry forecast is that the U.S. has enough reserves to be self-sufficient for longer than 100 years. That is a definite advantage for long-range visions or strategic planning.

4. **New revenue**: Plants should be sized for more capacity than the campus demands, as the excess capacity can be marketed at fairly high profit margins to the grid, IPPs, or local utilities. This can be a steady annual revenue stream, which will accelerate cost recovery or paying down any debt from the capital investment. Revenue will increase steadily with a long-term gas purchase by holding production cost down, as the product market ($/MWh) would climb (see Figure 2).

5. **Users**: This option is suggested for high-end users because of the high capital cost. It is a long-term investment, perhaps with ROI of 8-9 years or more depending on size, options, and local rates, and may not fit with strategic business priorities for some organizations.

THE ENERGY MANAGER

With all the changes in the energy industry in last few decades, the role of an energy manager has also added new dimensions. Without exact data, energy costs for an enterprise today is probably at or above a median of 10% of its total operating budget, especially for high-end users. It may be in the top five costs as a line item after payroll, debt burden, capital assets plus one or two more elements depending on the business. The relationship between operating demand and energy cost has been

detailed with examples in this article. The energy manger has to now blend technical expertise with a good grasp of the financial side of his or her domain. Energy savings and savings in the purchase cost can be an iterative cycle when the savings are invested back into the process or the facilities to improve efficiency in the total business operations. Closing this discussion with a line from the opening paragraph, energy has to be one of the higher priorities for a business to compete more effectively in their product market. Balancing the technical and financial dimensions, an energy manager can elevate the priority of energy at the corporate decision tables, showing sensitivity of energy cost on the total business for forward vision and success.

Good luck.

Acknowledgements

Historical data and future projections have been excerpted from the following sources:

American Gas Association; www.aga.org
Chicago Mercantile Exchange/NYMEX; www.cmegroup.com
U.S. Department of Energy; www.doe.gov
U.S. Energy Information Administration; www.eia.gov
U.S. Department of Commerce, Bureau of Economic Analysis; www.bea.gov
U.S. Department of Labor; www.bls.gov
Energy Independence and Security Act (Public Law 110-140)
[1] CRS report RL 31849, Congressional Research Service.
[2] *Slow Collapse of Gold Standard* (Bretton Woods) and *Nixon Shock* c.1971

ABOUT THE AUTHOR

Anup Deb received a degree in electrical engineering, obtained a P.E. registration and is a Senior Member of AEE. His professional work has been primarily in the field of energy in diverse settings—turnkey design, engineering and construction for petro-chemicals, design-build-operate power generation plants as OEM, and consulting engineering on many diverse industrial and commercial projects. He has been in the aviation industry with a major hub U.S. airport since 1994, and looks over the energy portfolio for his employer. Views expressed in this article are his personal views and do not in any way reflect his employer's position. Contact information: Phone: (703) 585-1502; Email: anup.energy@ymail.com.