Energy Conservation Is an Ethic

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Professionalism means different things to different people. For some, professionalism in engineering describes a method of charging for services; others believe it simply describes a credential achieved. But *Webster's Collegiate Dictionary* defines "professional" as: "...characterized by or conforming to the technical or ethical standards of a calling requiring specialized knowledge and often long and intensive academic preparation."

Thus, a "professional" is a person who can be so described.

Just what is it that the mechanical/electrical engineering professional does to earn that title?

In a way, the engineering professional hasn't had good "press" or public relations for the past 150 years. It started in the early to mid-19th century when Maxwell, Sadi Carnot, Diesel, Otto, and the other thermodynamicists and energy engineers unlocked the secrets to turning the resources of the world into the slaves of mankind. Since that time, the mechanical/electrical engineering community has held the goose that laid the golden egg. And somewhere within that community, they became so intent upon serving humanity in the short run that they lost sight of their long-range responsibility.

This is a good news/bad news story, and, as society stands here today, they cannot be too critical of their performance over the past 150 years. The mechanical/electrical engineering professionals have provided humanity with a massive population of "mechanical slaves." That analogy is borrowed from Oscar Wilde, who wrote in an essay in 1894:

"The fact is that civilization requires slaves. The Greeks were quite right there. Unless there are slaves to do the ugly horrible uninteresting work, culture and contemplation become almost impossible. Human slavery is wrong, insecure and demoralizing. On mechanical slavery, on the slavery of the machine, the future of the world depends."

The result of our success in creating this mechanical slave is the world in which we live today. We have the mechanical slave at our bidding to wash our clothes, cook our food, wash our dishes, move us about over long and short distances, stoke our fires, keep us cool, clean our homes, operate our factories, perform complicated calculations at unbelievable speeds, keep our records, and on and on. Oscar Wilde could not have envisioned, in his wildest dreams, the prophetic significance of that statement.

It is not within the context of this article to expound on the influence of technology upon the state of mankind—the social structures, economy, and human relationships. In his book, *The Fifties*, David Halberstam, discussing the sociological revolution unfolding in the fifties, said:

"The list of technological and scientific changes that transformed America in those years (the fifties) is an extraordinary one—the coming of network television to almost every single home in the country changed America's politics, its leisure habits, and its racial attitudes; the arrival of air conditioning opened up southern and southwestern regions; the early computers were transforming business and the military; the coming of jet planes revolutionized transportation."

And that was but one decade! And in one country! So, looking back, the engineering community can bask in the knowledge that they did a pretty good job. They certainly changed the world.

But going back to Oscar Wilde's mechanical slave—the mechanical slave, like the human slave, needs food. The food for the mechanical slave is energy. The most available energy sources, those that are most readily available and which we have been using for these 150 years, are the *nonreplenishable energy resources of the earth*.

Now, returning to the topic of *professionalism*, and paraphrasing the definition for engineering professionalism:

Engineering professionalism is characterized by conformance to the technical and ethical standards related to the practice of engineering.

The technical standards are self-evident. So, focusing on the ethical standards, the definition of ethics is "...a set of moral principles or standards."

Now, consider our situation as we stand

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on the launching pad of the 21st century. The engineers, urged on by societal desire for a better life, have moved mankind from the cave to a world in which "culture and contemplation" abound. But they have done so at a very high cost. They have put us on a course of depleting the resources that feed our slave and of simultaneously destroying our fragile environment.

Make no mistake about it. It is the engineers who have achieved this! And, as professionals, they have a moral obligation to address this problem. No one else has the skills or the *ability*. And, if the problem goes unaddressed or unsolved, it will mean the end of civilization as we know it or as we would like to envision it.

The reason why the governmental bodies in the United States and Canada require professional engineers to become registered is to put some legal muscle in the "... moral principles or standards…." In most enabling legislation, the words used refer to the public safety or public welfare. As a result, engineers have the professional responsibility to consider the safety and welfare of the public.

Energy and the environment, however, have not been considered any more than a design parameter. This article's thesis is that these two issues must be elevated from "design parameters" to " moral standards." (In fact, in most cases energy has not even been considered a design parameter—only the *cost* of the energy has been considered a design parameter.)

Little consideration was given to energy in the 1950s and 1960s. Then, following the oil embargo of 1973–74 and the so-called energy crisis resulting from it, an enormous amount of attention was given to energy in ASHRAE and in the engineering community as a whole for a few years. Then, as prices stabilized again, and the energy producers miraculously found reserves and told the world no problem existed, "energy" was returned to the back burner.

Many knowledgeable people have said that energy conservation is simply an economic issue, by which they mean one to be considered as any and all other economic commodity issues. When considering the alternatives on a given building project, they would say, the value of energy should be considered in terms of the present cost, and energy-saving concepts should be considered in terms of the economic return on investment (ROI) as they relate to the energy costs. The basic thesis of this article is that that concept is invalid. It is that *energy conservation is an ethic.*

The Energy Situation

Most people have heard the arguments *ad infinitum* about the energy situation, but a brief summary is as follows:

- The energy reserves of the earth are being depleted at an exponentially increasing rate.

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• There will be a serious shortage of readily available reserves in the not too distant future.

• Many of these reserves are well beyond the control of the countries that represent the largest consumers.

• Loss of the energy needed to power the economy and lifestyles of the consuming countries would be an economic and social disaster of unmeasurable proportions.

• The engineering community has the ability to design machinery to use differing amounts of energy to accomplish the same purpose; compared to most current practices, significantly less energy *could* be used to accomplish the same results.

• Properly applied design philosophy will result in lower investment costs for systems that use less energy.

The last two points demonstrate the total control that engineers have in the matter, and these issues are not well understood and accepted. Perhaps the best way to demonstrate the issues stated in the last two points, is a case history example shown in the sidebar.

In summarizing the energy situation, engineers spent the 19th century exploring and developing technological concepts and principles and the 20th century changing the course of the human race through the development of a world society and economy that is totally dependent upon that technology and is becoming more so every day. The problem is that technology, in turn, is dependent upon a continued source of energy and a delicate environmental sink, both of which are depleting rapidly.

The Alternatives

Looking at the alternatives, if the engineering community does not take the lead in the conservation of energy resources and the protection of the environment, who will? All of the economic forces of our society are directed at *using* energy, not *conserving* it. Thus, business and government leaders will always encourage the continuing consumption of energy (although this encouragement is usually well concealed) because they see it as good for business. But remember, the continuance of our quality of life and a healthy economy is the primary long-range objective, and an economy only grows on pro-

A Simple, Logical Solution

At a Midwest university in the mid-1990s a new research building was planned. The building was to contain some laboratory facilities, and much of it was to house research animals. The requirements for the environment for research animal housing are controlled rigorously by federal guidelines and regulations— not the least significant of which is that large quantities of ventilation air are required and the temperature/humidity control range is stringent.

There was a central steam plant on the campus, and early in the design process, the administration of the university asked the design engineers what the requirements for steam demand (power) for this building would be— to which the designers responded "110,000 lb/h (13 860 g/s)." The owner countered that that quantity of steam power would not be available and challenged the designers to figure out how to accomplish the same end result with only 40,000 lb/h (5040 g/s). (The administration people themselves were engineers who understood the energy ethic.) Following some effort, they did it— from 110,000 lb/h to 40,000 lb/h by simply thinking it was important. In addition to that, *the overall investment cost following the exercise was significantly reduced*. These startling results were achieved, not by the application of new high-technology breakthroughs, but by simple well-placed logic in design decisions, including:

- storage system for domestic hot water,
- minor changes in tolerable temperature and humidity,
- lowered room ceiling heights,
- refine accuracy of calculations and removal of excessive safety factors,
- rearranging the air-handling systems to reduce fan pressure, andthermal energy requirements
- adding return air systems where permissible, and incorporating occupied/unoccupied control cycles for all non animal-housing spaces,
- matching air-handling systems to spaces of similar usage,
- using air-to-air heat recovery for all ventilation air, and
- purchase chillers on life-cycle basis.

The last measure had no effect upon the steam load but did significantly reduce the electric power and energy. The end result was that the steam load was reduced from 110,000 lb/h to 38,340 lb/h (4830 g/s), and the chilled-water load was reduced from 3,600 tons to 2,975 tons (12 660 W to 10 460 W) with related reductions in energy use in most cases. Other benefits for the owner, of course, were that the construction cost was reduced, and the operating/owning cost was reduced! (It might be added that the same design approach was taken for all of the other building energy systems with similar success.) ■

ductivity. A lot of people are getting rich practicing business techniques that are detrimental to the economy. Remember this—what is good for business is not necessarily good for the economy, but what is good for the economy is always good for business.

A simple example: Someone builds a building that consumes excessive energy. Aside from the fact that the energy ethic has been violated, the building will cost more to operate and will most likely cost more to build. If this is an office building, the tenant will have to spend more money to rent it, but, since he or she is in the goods and services business, his/her product will cost more. Thus, an inflationary spiral. So no one benefits, including the developer—he/she may not be able to rent the building and his/her venture may fail. Untold examples of such business failures exist in the commercial building markets.

To head off an economic and societal collapse of unbelievable proportions, we must move into the 21st century committed to the ethic of maintaining our socioeconomic systems, while reducing the rate of depletion of the world's energy reserves and preserving the environment.

With this background, then, it is proposed that there is a new standard of professionalism in engineering, and that is *to practice our profession with an emphasis upon our responsibility to protect the long-range interests of the society we serve and, specifically, to incorporate the ethics of energy conservation and environmental preservation in everything we do*. **There is no infinite source or infinite sink.**

Albert Einstein said it beautifully when addressing an assembly of engi-

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neers and scientists some 69 years ago:

> *"Concern for man himself and his fate must always form the chief interest of all technical endeavors, concerns for the great unsolved problems of the organization of labor and the distribution of goods—in order that the creations of our mind shall be a blessing and not a curse to mankind. Never forget this in the midst of your diagrams and equations."*

The naysayers in the profession may counter that the engineers are to serve the dictates of those for whom they are "employed," the business managers, the politicians, the administrators, the developers, or, ultimately, the consumers. But the engineers cannot use this haven of comfort or justification any more justifiably than the defendants of Nuremberg in 1945, whose defense was simply that they were just following orders.

Ralph Waldo Emerson in 1850 wrote, "Blessed are those who have no talent." Engineers are not so blessed. Engineers, and *only* engineers, are skilled in the art of applied physics necessary to truly understand how to design machinery and systems that preserve the way of life of humanity of the first world and expand it to the civilizations of the third world, while making the most judicious use of the world's energy resources and creating no adverse impact upon the environment. It can be done, but only the engineers understand this and know how to do it.

Another key issue regarding new energy source and conversion technologies is that before these technologies can replace the current ones, the systems that consume the energy must do so much more effectively!

Putting the Ethic into Practice

Because the engineers were self-directed for the past century and a half in furthering the ability of mankind to enjoy "culture and contemplation," and because the energy ethic has not been embraced, with few exceptions engineers and scientists have not been historically considered the societal leaders. The dichotomy of this statement is that the engineers did more to shape the course of history in a positive vein than any other group, sometimes in spite of the so-called "leaders"—they just didn't have good press.

Any number of ways exist that this proposed ethic can be put into practice (some are more aggressive than others; some, unfortunately, will be too little too late; and some may be misguided). One set of guidelines for engineers as they assume this new role follows.

1. Engineers must make every reasonable effort to self-educate, to revisit earlier habits and experiences, to develop a true and thorough appreciation for and understanding of the energy/environmental ethic.

2. Following self-education is the education of others. The educators of engineers must teach the newcomers to the profession in such a way as to instill the ethic as a fundamental part of the science. As stated earlier, the concepts of infinite source and infinite sink must be used with great reservation. Such terms as thermal efficiency, Carnot efficiency, Carnot coefficient of performance, and the like should be framed in terms of their relevance to the energy/environmental ethic rather than simply as esoteric terms in thermodynamics. The students of tomorrow

must enter the business or scientific world with the full understanding that as engineers they have a responsibility to society.

Practicing engineers must, themselves, assume the role of educators. First, those with the knowledge and skills must educate their peers. Then, as an ongoing obligation, engineers must assume the role of educating their clients, employers, employees, legislators, and the public at large (this is a role unfamiliar to most engineering practitioners).

3. Engineers must assume the leadership role in business and interprofessional relations to ensure that the energy ethic is inherent in all aspects of the business community.

4. Engineers must become involved in governmental activities such as legislation, rulemaking, etc., to ensure that federal, state and local laws adhere to the energy/environmental ethic.

5. ASHRAE and other engineering and related societies must become activists in the dissemination of the energy/environmental ethic. The ethic should permeate all publications, papers, seminars, research projects, standards and guidelines.

6. Commercial interests must be restrained in their efforts to abort strict adherence to the ethic to gain competitive advantage. At the same time, care must be taken to bring about any change in such a way as to not create undue burden or hardship on any cooperative sector of business, society, or agency.

7. Probably more than anyone else, the economists must be educated in the unique value of energy. Energy cannot continue to be treated as any other commodity that follows the short-sighted laws of supply and demand (this matter is the most dangerous misunderstanding the modern world has experienced).

8. Above all, the members of the engineering community must stand vigilant to ensure that they are not misled, duped, or misused by other groups or interests as pawns to support their proprietary interests and under the guise of misdirected or unsupported claims of energy conservation or environmental improvement. The engineering profession must hold such interests to acceptable standards of scientific integrity and must assist in influencing legislators to do likewise.

In summary, this article has proposed a new standard of professionalism in engineering, and that is *to practice the profession with an emphasis upon our responsibility to protect the long-range interests of the society we serve and, specifically, to incorporate the ethics of energy conservation and environmental preservation in everything we do.*

This ethic, furthermore, can and should be practiced in such a way as to cause no adverse effects upon mankind or on the world economy. This objective may appear awesome, but, with the proper understanding, commitment, and well-directed dissemination, it is an achievable goal. ■

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