The Difficulties of Developing and Selling Energy Innovation

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"Everything That Can Be Invented, Has Been Invented"
Charles H. Duell, 1899

Technology development is ubiquitous; it permeates our lives at every turn, yet we are usually unaware of its origins. We simply take for granted that computers will double in speed every 18 months, and new cars will have more features without ever considering how this progress occurs. Is it that we subconsciously believe there is a God of Technology that creates this? Or, just as we dodge the child's question, "where did I come from?", are we content that innovation just is, with no further explanation needed?

While we may be unaware of its origins, we certainly know its importance. For industry, technical advances are critical to sustaining profitability and even to simply remain afloat. Since prehistory, through the industrial revolution, and up to today, technological progress has defined our society and our lives. And while it may not be the oldest profession, it must surely be a close second.

Yet for all its worth, technology innovation has a remarkably difficult time penetrating into most mature industries. Neal Schwartz, while the plant manager at Wabash Alloys put it, "The discovery of fire was the last great invention in our industry". Managers responsible for the bottom line have always been reluctant to take on a new technology because of the risk of it not working.

Consider Iridium, a global communications company that launched 66 satellites at a cost of about $6 billion in the hopes of capturing the mobile communication market. It took too long to get into a suspect market with inadequate technology. Now bankrupt, Iridium's effort will produce nothing more than a very expensive fireworks display as they deorbit each satellite. Is it any wonder that companies are loath to invest in new technologies?

Energy Energy Everywhere
But Not a Drop to Save

And for energy projects, the situation is more difficult still. An example, that many engineers may find familiar, illustrates this. On conducting a plant energy audit, you uncover numerous areas of obvious waste and opportunities for energy savings. You diligently analyze and prepare a report on these plums, eagerly expecting management approval. But to your surprise, they express no interest and decline each recommendation. "Ah", you say regrouping, "you didn't understand what I just said. These projects have short paybacks and life cycle costs to die for". The burley, cigar

chomping plant manager looks about as impressed as a cop listening to a motorist trying to talk his way out of a speeding ticket.

In refusing your attempts to save them money, the managers may appear to have closed minds when, in fact, they are making rational, well thought-out decisions.

First of all, let me debunk life cycle costs, which play well at cocktail parties and conferences, but don't hold a milliwatt of sense in plant operations. It is the plant manager's budget that dictates how much he can spend. Unlike the good witch in Tomie de Paola's Strega Nona, managers do not have a bottomless pasta pot that they can keep scooping into each time a plate needs to be filled. Their budget is limited and all projects must compete for the same money. NASA took this to heart with their "faster, better, cheaper" approach to building spacecraft, because "we can't afford anything else". Billion dollar programs were replaced with multi-million dollar ones with, admittedly, mixed results.

Next, it is the manager's responsibility to spend his budget in ways that will increase the company's value, which almost always means increasing productivity, not reducing the energy bill. That's how plants make money, by selling more product, not by changing light bulbs. Projects that only reduce energy are tough to justify when there are other competing projects that can increase sales. In the 1950's, the Pilkington Brothers revolutionized the glass industry by developing a process to make flat glass (windows, windshields, etc.) called the Float Process. By 1975 this process had captured essentially the entire flat glass market because of its improved quality and production rates, not because of its energy savings.

Finally, whenever managers install innovative equipment, they are rolling dice since any process change designed to save energy risks upsetting production if it doesn't work. Even at current natural gas prices, energy costs make up only a few percent of the product value in most industries. For instance, the energy use for making auto parts from scrap aluminum is about 3000 Btu per pound of product. At $6 per MMBtu for natural gas, this amounts to less than two cents per pound, on a product that sells for 60 cents per pound, or about 3%. Saving a percentage of this energy, at the risk of upsetting production, has a risk to reward ratio of over 100. That is, for each dollar of energy saved, over 100 dollars of production will be at risk. Industry managers, with their jobs and pensions on the line, will not be terribly eager for such challenges.

The Big Picture

These problems notwithstanding, one cannot ignore industry's huge energy appetite. According to the US Energy Information Administration, in 1999, industrial energy use accounted for 38% of the US total, or 36.5 quadrillion Btu's costing about $120 billion. It has more than doubled since 1950, and except for recessions, industrial energy use has increased continually, and is projected to continue chugging along at an increasing pace. Couple that to the rocket-like increase of gas prices and the chaos gripping electric utilities, what better place is there to mine for gold?

And that's what we do. We target the large energy users. But to make projects go, we have a bag of tools that include a number of items, besides energy savings, that we bring to bear.

Risky Business

In 1992 we were retained by Roth Bros. to locate or develop a dryer that could clean the oils and paints on the scrap aluminum they used as a feedstock in their process. Nothing on the market worked, so we resorted to importing an untested concept from England. Termed, IDEX, pilot-scale tests indicated it could do the job and it could save up to $1,000 per day in energy costs. At an installed cost of over $1 million, the risk however, was too great for Roth Bros. More importantly, it would become an integral part of their process. If it did not work the production losses could be staggering; about $144,000 per day in lost revenue. Under these conditions, convincing Roth Bros. to be the first to buy this equipment might as well have been one of Hercules' Mighty Labors; impossible for mortals.

Nonetheless, we persevered and concentrated on other advantages. The first was its ability to meet the EPA's proposed Clean Air Act Standards. Like a guillotine ready to fall, these standards were poised over the plant manager's heads. Again, the testing showed it could to it.

Using the "if you can't fight them, then join them" strategy we next focused on the unit's ability to increase production. By cleaning the scrap, downstream processes would have a higher product yield.

The dam was starting to crack, but it was still "no".

Deeper Into the Bag of Tools

As we have often done in the past, we turned to government funding for help. After a competitive process, we won $800,000, half from the New York State Energy Research and Development Authority (NYSERDA) and half from the Department of Energy's (DOE) NICE[3] program. The effect of the grant money was to buy down the upfront risk to Roth. We finally got a yes, but it took three years.

The IDEX was installed in 1996 (see Figure 1) and has been operating since. It met the energy and emissions targets we set and it increased plant production by 294,000 pounds per year. Since then, 12 such units have been sold worldwide.

Other People's Money

This project illustrates the government money available for technology development and demonstration. The Federal Government provides research money to private industry for varied reasons and in FY 2001 has earmarked $45 billion for civilian research.

For industrial users, DOE is worth reviewing. DOE is a cabinet level agency and has a FY 2001 research budget of $4 billion. Within DOE is the Office of Industrial Technologies (OIT), headed by Denise Swink, which focuses on industrial projects that

reduce energy and pollution or promote renewable energy. OIT's FY 2001 budget is $184 million, most of which is spent on the "Industries of the Future"; those industries that account for 75% of industry's energy use. Currently nine industries are identified (Agriculture, Forest Products, Mining, Aluminum, Glass, Petroleum, Chemicals, Metal Casting, and Steel) with others being added. Process Heating is currently working its way though the gauntlet and will be anointed soon.

An example of their development funding is the Vertical Floatation Melter shown in Figure 2. DOE and private industry have invested $3.6 million over four years to develop it for the aluminum industry. It uses an approach much different than conventional furnaces and will increase metal yield while greatly reducing energy use.

Three programs within OIT are of more immediate interest. The first is their NICE^3 program which funds first-of-a-kind demonstrations of innovative technologies. Lisa Barnett runs this program, and provides grants of up to $500,000. As in all of their programs, OIT expects an equal match from the recipients, either in cash or in project services.

After the first demonstration, and if you meet OIT's criteria, it is possible to get funding for a second demonstration through its "Emerging Technology Deployment" program which offers up to $600,000.

The third is OIT's "Plant Assessments", headed by Eric Lightner. This program offers up to $100,000 for assessments on ways of improving plant energy, emissions, and productivity. Visit OIT's website (www.oit.doe.gov) for details on these and many other programs and resources.

Not to be outdone, various state governments offer funding for industrial projects somewhat similar to DOE. Probably the largest is NYSERDA, mentioned above. With an R&D budget of $35 million, they provide grants up to $250,000 for NY State companies to demonstrate technologies and lesser amounts for plant assessments. Ameritherm, Inc. developed a radio frequency induction heating process with NYSERDA funding that quadrupled their sales and tripled their employment. NYSERDA's web site is www.nyserda.org. Other states have similar programs, so depending where you are located you should check into it.

In the past, electric utilities were eager to offer incentives to their customers for load reduction. It was paid for by the rate payers, not the utilities, and it was politically correct since it avoided the construction of new power plants. Known as Demand Side Management (DSM) programs, they fell out of favor when deregulation raised the ugly spectra of competition, real or imagined. Now, with blackouts rolling across California, it doesn't take a seer to predict a resurgence of these dormant programs. In fact, Governor Pataki just announced that NY would double their budget on electric conservation. NY has an excellent DSM program which is also run by NYSERDA.

Low Hanging Fruit?

The available funding is substantial but not always easy to reach. Most of these programs are competitive; sometimes with only a one in ten chance of winning. Formal proposals are usually required which are reviewed and ranked by scholars and industry experts. If you believe you qualify, then I suggest you take a flyer on it. If it seems daunting, then contact experts in your area. They can advise and help you navigate the process.

The Little Company That Could

At Energy Research Company, we are developing a laser system to measure the feedstock and product chemistry for industrial use (see Figure 3). We conceived of and own the idea. Yet being a small business one would guess we do not have the resources to play with the big boys and that our efforts would ultimately tank. Not so – it is easy to duplicate the firepower of large corporations, simply by partnering. We are working with DOE, other funding agencies, a university, a national lab, various consultants, a glass company, and a steel company. Our partners provide money, facilities, real-world experience, consulting, and any number of other services sorely needed. That's how it is done.

Of course, keeping these diverse players focused on a core path, each with its own agenda, could be another one of Hercules' Mighty Labors. Yet we manage and by so doing have completed a good many successful projects.

When Good Projects Go Bad

Ever have a bad day? There are some projects that have years of them. We had the textbook project with all of the ingredients mentioned above: funding, a good technology, the right partners, production as well as energy savings, and more. However, twenty-eight years of experience has taught me that every silver lining has a cloud and this was just going to be one of those. First came the client's management changes; a new president, a new CFO, another new president, a new engineer, then another. It was like watching bungee jumping. Next, problems with, and a reorganization at, our chief vendor added to the fire. After 4 years and two contract extensions we still have not installed the equipment. Yet the project is fundamentally sound and we will continue to press it.

The Mother of Invention

So who does the innovating for industry? It used to be large companies, with extensive R&D departments, would lead the way towards innovation. In 1947 it was Bell Telephone Laboratories that invented the transistor, which is the backbone of our current information revolution. Similarly, Dupont changed from an explosives company into a multinational chemical company by inventing nylon, synthetic fibers and so on. And why did they? Well, if necessity is the mother of invention, then profit must be its father. Dupont had sales of $27 billion in 1999.

Today things are different and the short term view of quarterly profits has largely stifled innovation at large companies. With the restructuring, downsizing, rightsizing or whatever euphemisms are currently in vogue, large companies have been shedding their

R&D departments faster than a dog shakes off fleas. While Dupont was reinventing itself, industrial research expenditures were increasing by 7.4% per year. Those heady days ended when by 1988 industrial research money was actually declining by 1.3% per year and this trend has continued through 1995 at least[1]. Much of the cutbacks have been occurring in manufacturing industries. Since 1991, IBM, AT&T, GE, Kodak, Texaco, and Xerox have cut $1 ¾ billion from their annual R&D budgets[2].

Good Things Come in Small Packages

Fortunately, big businesses are not the only ones in the game. Small businesses, especially those with R&D as their focus, are players. Small businesses have a head start as the federal government provides $1 billion annually to them to conduct research. Known as Small Business Innovative Research Grants (SBIR), small businesses are paid to innovate in areas such as energy, pollution, health care and others. The list of R&D small businesses is large so I will only provide a few examples: Energy Research Company (the author's company) is developing a variety of technologies from melters to lasers; Montec Assoc. of Mo is developing coal based technologies; and Vortec of PA is developing vitrifying equipment.

National Laboratories, particularly those run by DOE, are a vast storehouse of technology and expertise. You can tap into what they know or what they have developed or you can partner with them to develop something you need. DOE has 16 national laboratories, most of which are dedicated to energy R&D. We are working with Oak Ridge National Laboratory in developing laser diagnostics and have worked with Brookhaven National Laboratory to develop advanced coatings with both ceramic and metal properties. The people at these labs are usually top shelf, and generally, though not always, easy to work with. How do you work with them? Well, if profit motive is the father of invention, then peer recognition must be the milkman, as that is what often drives researchers at these labs. An excellent web site for more information on the DOE National Labs is www.science.doe.gov/sub/lab_map/index.htm.

Next up are the universities with rigorous engineering departments. Here basic research (the R in R&D) is conducted, which is often used as a springboard by small companies to develop a product for industry. This country is awash in excellent engineering colleges so you should have no trouble finding one that has the expertise you need. Working with them does take some getting used to since, similar to the National Labs, their agenda may be different than that of industry. Still if you persist, (or have another company do it for you) there are some gems to be had.

The Last Word

Innovation happens, though it is neither an easy nor an ordered process. But success is certainly possible if you remember that to sell less, you must sell more. That is, to sell equipment that reduces energy you must provide other benefits as well.

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[1] Varma, Roli, "Changing Research Cultures in US Industry", Science, Technology & Human Values, Vol. 25, Issue 4, Autumn 2000.

[2] Cauley, L., "Corporate Research: How Much Is It Worth?", Wall Street Journal, June 22. 1995.

Figure 1 - The IDEX Dryer installed at Roth Bros.

Figure 2 - Energy Research Co.'s Vertical Floatation Melter

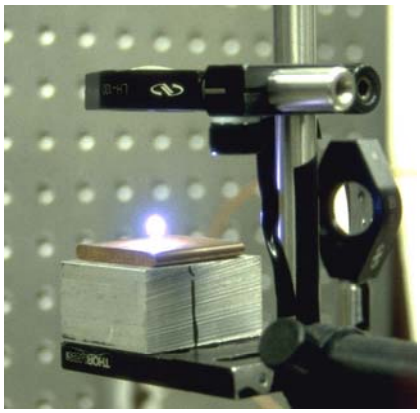

Figure 3 –Laboratory Demonstration showing a laser strike erupting into a glowing plasma ball.

About the Author

Robert De Saro is president and founder of Energy Research Company (ERCo), dedicated to improving industrial energy, emissions, and productivity through intense R&D. Mr. De Saro graduated from the University of Michigan in 1973 and MIT In 1974 with aerospace degrees. ERCo is at the forefront of developing and implementing technologies in the glass, steel, and aluminum industry. The Vertical Floatation Melter, mentioned in the article, is set to enter the aluminum secondary marketplace and reduce the energy use and improve metal yield. ERCo's laser technology developments are continuing to raise the bar and leading the industry on measuring process chemistry and sorting feedstocks and eliminating contaminants. ERCo develops its own technologies, those of others on, and also applies engineering principals to improve plant energy and productivity. ERCo conducts much of its research with funding from DOE, NYSERDA, other agencies, and private companies. See www.er-co.com