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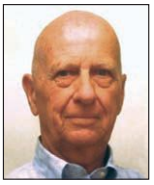
On the Precipice of a New Energy Source?

Steve Jacobs, COO, and **Patrick Leach,** CEO, Decision Strategies; and **David J. Nagel,** CEO, NUCAT Energy

Steve Jacobs is chief operating officer of Decision Strategies and has more than 30 years of experience in the oil and gas industry. His specialty is evaluating market opportunities for new and existing technologies and companies. He earned BS degrees in psychology and education from Oklahoma State University. Jacobs is an energy information ambassador for SPE. He moderates and lectures at numerous events around the world.

Patrick Leach is chief executive officer of Decision Strategies. He is a recognized expert in risk management and decision making in the face of uncertainty, and has published and presented numerous papers on these subjects. He is the author of *Why Can't You Just Give Me the Number,* an executive's guide to using probabilistic thinking to manage risk and make better decisions. Leach earned a BS degree in geomechanics from the University of Rochester and an MBA degree from the University of Houston.



David J. Nagel is chief executive officer of NUCAT Energy. Previously, he was a member of the senior executive service and leader of the physics division at the US Naval Research Laboratory, where he managed experimental and theoretical research and development efforts. He has also been a research professor in the department of electrical and computer engineering at George Washington University with a focus on low energy nuclear reactions. He received a BS degree in engineering science, an MS degree in physics, and a PhD in materials engineering.

In the late 1850s, the whaling industry was in a veritable boom in the town of Lahaina on the Hawaiian island of Maui. Business was great, and many in the whaling industry believed that increased demand would continue for decades to come. But in 1859, oil was discovered in Titusville, Pennsylvania with a well drilled by Edwin Drake. The rest is history.

That was 150 years ago. A small but increasing number of people around the world believe we are on a similar course, except this time it is the petroleum industry that might be threatened. As with any emerging technology, critical challenges must be overcome and a significant effort lies ahead to convince a world of skeptics that a new source of energy has been discovered and will be important.

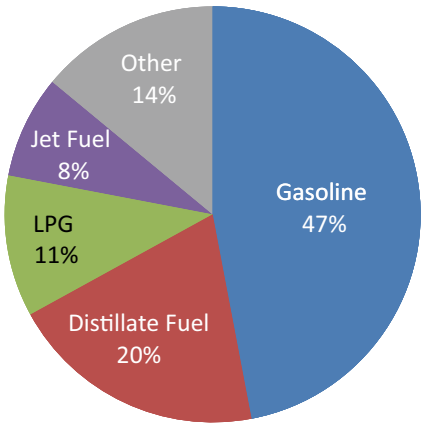
The potential new source of energy is low-energy nuclear reactions (LENR). With any discussion of a new technology, caution is advised. The world of LENR is filled with mystery, contradiction, gross speculation, misinformation, slippery timelines, and skepticism that sometimes spill over into outright denial. Healthy skepticism on LENR (or any new technology) is a good thing, but so is an open mind. If LENR is for real—and many well-qualified physicists believe it is—it will not only change the petroleum industry, but also significantly affect almost every aspect of our world. Some call it "the new fire."

In 1989 at the University of Utah, Stanley Pons and Martin Fleischmann announced they had discovered a cold fusion process that would ultimately result in cheap, limitless energy. The outcome from these cold fusion efforts became widely known and well documented, primarily because other researchers were unable to replicate the results from the initial experiments. Cold fusion was (and is) viewed as impossible by many in the scientific community. Although the research did not cease, it was largely ignored. For the past 20-plus years, a small number of scientists have been diligently working on what could eventually become a hugely disruptive technology.

According to *New Energy Times,* "LENRs are weak interactions and neutron-capture processes that occur in nanometer-to-micron-scale regions on surfaces in condensed matter at room temperature. Although nuclear, LENRs are not based on fission or any kind of fusion, both of which primarily involve the strong interaction. LENRs produce energetic nuclear reactions and elemental transmutations, but do so without strong prompt radiation or long-lived radioactive waste." ("Strong interaction" and "weak interaction" refer to the strong nuclear force and the weak nuclear force, which—along with electromagnetic force and gravity—make up the four basic forces in nature.)

The Basic Process

There are several versions of LENR being developed using different reactants and processes. The basic process of LENR is not well understood, but some experts have stated that it works as follows: Nano-sized particles of nickel, pressurized hydrogen, and a catalyst are heated in a small reactor to the point at which weak interactions between the reactants cause transmutation (i.e., some of the nickel is converted to copper). Considerable excess heat is emitted during this process. Once the reaction becomes self-sustaining, the input power can be reduced significantly and



Oil consumption by product (2010). Transportation and heating applications are most threatened by LENR. ***Source: Energy Information Administration.***

excess heat (up to 650°C) is generated in the range of five to 30 times the input energy. This can be used to create steam, which can then be used for heating and/or generating electricity. The reactants are inexpensive and ubiquitous; during operation, the system emits no greenhouse gases; when turned off, there is no radioactivity; and the unit will allegedly generate electricity for a few cents per kilowatt hour. Now that is a disruptive technology.

According to one researcher, the amount of energy released from 1 gram of nickel would be equivalent to about one barrel of oil. Heat (in the form of steam) and electricity will be the main products. In addition to residential usage, plans exist for commercial and industrial heating/electrical systems. An attractive application is the production of clean water, including desalination systems. Eventually, LENR technology could be used in transportation (e.g., vehicles, aircraft, and ships).

No doubt the skeptics—and even some of the open-minded—reading this article are now cringing. But current LENR efforts are not dependent upon the outcome of just one development effort; there are a number of LENR programs under way in Europe and the United States. Universities and government agencies involved include Stanford University, Massachusetts Institute of Technology, NASA, and the University of Illinois, and several private companies in Greece, Italy, and the US are also developing LENR technologies. Positive results and improved performance have been reported by the research teams, with at least four companies stating that they are in the early stages of commercial development. A small number of LENR unit manufacturing plants are reportedly being built in Europe and the US, and at least two companies have said they will begin marketing their systems later this year. If this is a hoax, it is a remarkably widespread one, involving organizations of high integrity with no obvious motivation to fool the public and quite a lot to lose in terms of reputation.

But even if a hoax is ruled out, other challenges exist, including accepted scientific explanations of LENR, better refinement of control systems, reliable operations, and a distribution/service infrastructure to maintain LENR units that would presumably be located in every business and neighborhood. There is also the nontrivial issue of full-cycle net energy gain (the LENR process may be energy positive once running, but hydrogen is a key ingredient in LENR; there are no earthly sources of free hydrogen, and it takes energy to separate it from the oxygen atom in water). There will also be regulatory issues and intellectual property challenges that may slow the pace of market penetration in the coming years. However, if this technology is for real, the value proposition for LENR will be incredible.

The best known LENR effort currently under way is by Italian Andrea Rossi and his energy catalyzer. He has developed a LENR system that reportedly is ready for commercialization. Although Rossi has had to change a number of delivery dates for his "E-Cat," he appears to be making progress. He stated in mid-April: "We have already made all the engineering of the production line in the two factories we will set up (one in the US, one in Europe) ... I think that it will take from 6 to 12 months after the certifications will be done to start the production."

The Impact

If proven to work, what impact would LENR have on the petroleum industry? It is difficult to say for certain, but it would undoubtedly be significant. The vast preponderance of oil is used for transportation and heating (**Fig. 1**), which would now be competing with LENR. While there still would be a need for petrochemicals and other applications, collectively these end uses represent less than about 20% of each barrel. Natural gas would not fare much better; its main applications are heating and electricity. If LENR works, the impact on the petro-

leum industry, power generation, and coal industry would be enormous. Even wind farms and other emerging alternative energy technologies could not compete economically with LENR.

So what can be done to prepare for LENR? First, watch it closely and do not let skepticism blind you. When the Wright Brothers flew their first plane at Kitty Hawk, North Carolina, the scientific community reportedly argued for years after the fact over whether a heavier-than-air craft could actually fly. Even the most obvious evidence was not enough to make some people abandon their preconceived notions of what was possible. Drake had to battle similar skepticism when he drilled the first oil well; many people in Pennsylvania called it "Drake's Folly."

It is also important to evaluate the specific impact that LENR would have on an individual company. How well positioned is your company to weather such a disruptive storm, or to capitalize on these potential opportunities? If LENR becomes a reality, you do not want to fly blindly into the side of a mountain. Investigate creative ways for your company to participate in the LENR market. While this new technology will be disruptive to a number of industries, there will also be business opportunities in the manufacturing, installation, and servicing of LENR systems in multiple applications and sizes around the globe. Millions of LENR units of varying sizes will be required because of the distributed nature of this energy technology.

There is a probability that LENR may never emerge as a reliable, new energy source. If not LENR, then what? Eventually, some other technology is bound to come along with a much superior value proposition than hydrocarbons. It is not a matter of if, but when, this will happen. There was nothing the whaling industry could do to halt its pending decline, and the same will be true when a new technology makes our current approaches to energy generation obsolete. It is vital for a company to have a strategy development process that recognizes and characterizes uncertainty, and deals with complexity appropriately, including potential game changers such as LENR. Such an approach places companies in a stronger position to mitigate risk and capture opportunities as our complex, unpredictable, and surprising future unfolds. **JPT**