The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Doing Due Diligence

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To people who follow the energy industry closely, it's a common occurrence to come across announcements from companies proclaiming to have developed the key to the 'next big thing' — for solving the world's energy crisis. Maybe they say they can take any sort of waste biomass and turn it into fuel — ethanol, diesel, pyrolysis oil, mixed alcohols — at very low cost. Or they say they can produce renewable electricity at a price competitive with coal.

The layperson reads the news release and is curious: "Is this real?"

When I am asked to comment on a press release, I try to be cautious with my opinions until I have peeled the onion a bit. There are technologies with real potential, and just because a company hypes their technology doesn't mean it won't work. So my opinion on technologies that I haven't particularly studied will tend to be general and conservative.

But let's say you are interested in becoming a stakeholder in the process. You could be a private investor, a government entity, or you could be someone from the media who is interested in sorting out hype from reality in order to protect potential stakeholders (such as taxpayers). That requires quite a different level of investigation than rendering an opinion based on a press release, and many people don't know where to start.

In my own experience, perhaps 90% of the stories you see promoting various technologies are at least exaggerated. So how do you separate fact from fiction and wishful thinking from reality?

Understand the Levels of Scale and the Hurdles that Come With Each Step

It is a huge challenge to take results that were achieved in a laboratory and scale those up through a pilot facility to a demonstration facility to a commercial facility. Each of those steps is a gate, and each of those gates will stop most technologies from advancing to the next gate. Skipping steps — for instance jumping from the lab to a demonstration size facility — greatly lowers the probability of success while putting much more money at risk.

There are no hard and fast rules on the borders between these particular facilities; one person's pilot facility may be another person's demonstration facility. In general, I think of lab experiments as consisting of one aspect of a technology at scales of ounces or milliliters. Piloting moves up into scales of pounds or liters per day, and will incorporate more pieces of the puzzle into the experiments. Demonstration facilities reach the realm of barrels per day (1 barrel = 42 gallons), and are typically integrated facilities designed to demonstrate that all aspects of the technology work — in conjunction with each other — at that particular scale.

A facility producing 10 barrels a day (150,000 gallons per year) is demonstration size; one that produces 1,000 barrels a day is on the low end of commercial size. To put those numbers into perspective, the average size of a corn ethanol plant is just over 4,000 barrels per day and the

average size of an oil refinery in the U.S. is 125,000 barrels per day.

Data Omitted From the Press Release: How and Who to Get it From

Before you even get to ask questions, you may be asked to sign a secrecy agreement. This is a legitimate and necessary step for companies who wish to protect against someone running off with their technology and starting a competing company, or leaking proprietary information to competitors. A secrecy agreement will give you access to information you might never obtain otherwise, and you will often find out very quickly that what companies tell you privately is different from their press releases. On the other hand many companies that are out promoting their technology and trying to get funds will answer many questions before asking for a secrecy agreement — and ideally you want to learn as much as you can before signing an agreement.

Of course if you are a reporter doing an investigative story, you will never sign a secrecy agreement. You are just going to have to dig a little harder to find answers to your questions. In my case, I fall into both categories. I sign secrecy agreements with companies whose technology we may be interested in developing. I do not write about those companies. The technologies I do write on are based on information I have been able to glean through some of the methods I detail below.

As you dig for information, generally the first people you will encounter are those promoting the technology. They will probably be careful and very optimistic with the information they provide. What you really want to do is ultimately talk to an operator or technician who is involved in the day-to-day operation of the process. They will be the ones to tell you about potentially significant issues.

First Questions

The first question to ask is “At what scale has this process been demonstrated?” But that’s just a start, because you will get misleading answers and people will withhold information. They may not tell you that they only simulated some parts of the process. For instance, a biomass gasifier produces synthesis gas (syngas), but there can be problems with the gas quality because of tar formation. If a simulated syngas is used in lab or piloting experiments (e.g., bottled hydrogen and carbon monoxide were mixed together to produce the syngas), that tar issue can be conveniently ignored in the lab and yet be a show-stopper for a commercial plant.

So you have to dig into the details. You want to know the scale of the process that has been demonstrated, but then you also want to know how many consecutive hours it has been run, and you want to know the source of the raw materials and the composition of the final product. Ask about the nature of byproducts and waste products as well. Product quality and waste disposal are both issues that have bankrupted companies attempting to commercialize a process.

Know the Limits of Computer Modeling

Next you have to ask about the assumptions that they are using to model a commercial plant. What is the scale-up factor between what they actually demonstrated and what a commercial plant will be? What are the production volumes in each case? How were the costs estimated for construction of a commercial plant? Have they attempted to skip steps in the scale-up process (e.g., going from lab or small pilot to small commercial scale)? If they are running at lab or small pilot scale and projecting their production costs for a commercial plant, I generally never take those numbers seriously. There are just too many hurdles between the lab and commercial scale. Small lab scale problems often become much bigger problems at demonstration scale.

You want to clearly distinguish between how much of the process has actually been proven and how much has been simulated with computer models. I saw a recent question posed by a renewable energy developer: Isn't it true that you can prove a technology through modeling? The answer to that question is ABSOLUTELY NOT! In fact, the reverse is true: You prove a model by actually demonstrating that the process gives results consistent with the model. But some people will present model results as if they represent reality. Models are merely guides; a model won't tell you whether a process will work or not. It will give you some guidance, but ultimately you have to take the results from the model and actually run the process. That is how you prove a technology (and validate a computer model).

Biomass Feedstock, Economic Assumptions, and Energy Requirements

You need to ask about the presumed source and cost of the biomass that will be used. As I identified in Bad Assumptions, I believe the assumption of a long-term supply of cheap, free, or even negatively-priced biomass is one of the most unrealistic assumptions companies make, and yet the assumption that commonly results in those claims of $1 or $2/gallon biofuel.

So I want to know what the economics look like if the biomass costs are similar to the cost of hay. I want them to tell me about their costs if the biomass is $100 per ton (and I expect elusive or misleading answers). It is true that there is a lot of wood in the U.S. that has been killed by the pine bark beetle, but it still costs money to process those trees and move them to a facility for conversion into fuel.

The energy requirement for the process is a very important issue, but one that is not generally easy to dissect. But you want to know the types of energy used in the process, as well as the energy balance for the process (the energy of the fuel out over the energy it took to produce it). People will omit all sorts of energy inputs when stating an energy balance. They will assume that they will burn waste biomass in the commercial plant and thus assume low external energy inputs. They won't count the energy that it takes to grow and transport biomass, and they won't count the energy inputs to move the fuel to the customer. When you see someone claim an energy return of five or ten to one for a renewable process, those are often the kinds of assumptions they are making. (While it is true that the the economics of using coal as a primary energy input for making fuels may be attractive even if the energy balance is poor, such a process can't rightly be labeled renewable).

Competitors and Former Employees Can Be a Source of Valuable Info

I also want to know about predecessors and competitors. Very little is invented from scratch; almost everyone builds off of previous work. So who came before and did similar work? Who is doing similar work now? How is their work better than that of others? Then you ask the same questions of competitors. This is a very effective tool for sniffing out problems. Competitors are always happy to tell you what is wrong with the other company's process. On the other hand, many will insist that they are so unique they have no competitors. Don't fall for that.

Talk to former employees. If there are skeletons in the closet, they may tell you where to look (especially if they are disgruntled). The difficulty here is that they may not be willing to go on the record, but they can provide leads. For instance, an employee will likely be bound by a confidentiality agreement, but that doesn't prevent them from pointing you to a specific bit of information in a patent that doesn't mesh with the company's public claims.

Bring up the company in casual conversation and see where it leads. I did this on a recent trip, where a manager relayed to me that many years ago he had worked for a company that was claiming a breakthrough in turning natural gas to gasoline. I mentioned this process, and he said "Yes, it works but the gasoline has a very high aromatic content." That was the first time I heard that particular revelation, and yet many countries have very low aromatic allowances for their gasoline. Hence, this was a potential show-stopper, or in any case a good bit of information to have as I continued to investigate the company.

Read Between the Lines and Use Common Sense

Claims like *"Ideally suited for landfill waste"* sometimes mean *"Our economics only work if we are getting paid to take the biomass."* A statement like *"Perfect for co-locating with a power plant"* can mean *"We need cheap steam."*

Are there patents or patents pending? If so what are the patent or patent application numbers? Find out if *"patent pending"* means *"Some day we hope to get around to filing for a patent."*

There will often be specific technical claims that may be outside of your particular area of expertise. For instance, someone claims to be able to run a car on water. You may not have the technical foundation to understand why this isn't what it claims to be, but you can find lots of information on the Internet that breaks the technical issues down. You can also consult with someone who knows the area. Sometimes you can locate a free opinion. You may see a quote from a professor who is skeptical of the process. Contact them for further information.

Beyond the technical questions, there are the obvious signs. Do the company's claims appear to be grandiose? If yes, this is a warning sign. Most companies making grandiose claims do not deliver. Do they issue press releases for fairly trivial developments? For instance, I saw a recent press release from a company claiming that a university had validated their (seemingly inflated) claims. Yet there was no actual detailing of which claims were being validated, nor exactly what the results of the university study were. It was a press release designed to draw attention without actually conveying any useful information.

Summary

To break this down into a short "cheat sheet", here is a summary of some important questions that you want to ask. Try to corroborate answers by talking to employees or competitors.

1. At what scale has the process been actually demonstrated, and is the process currently running?
2. What is the source of raw materials for the process?
3. What is being done with the product?
4. What are the primary energy inputs into the process, and what is the energy balance?
5. Will there be intermediate scale-up steps before a commercial facility is built?
6. What are the key assumptions for a commercial facility (e.g., size, cost of production, location)?
7. What is the presumed source and cost of biomass for a commercial facility?
8. Has the process been proven on that specific biomass?
9. What are the patent or patent application numbers relevant to the process?
10. What prior work is most similar to yours, and who are your perceived competitors?

If you manage to get honest answers to those questions, you will be well on your way to burrowing through the hype to understand the true potential of a process.