

Technology Provider Question & Answer Panel

Dave Sjoding, WSU Energy Program, Olympia, WA; Moderator

I'm Dave Sjoding, I've worked in the energy side of extension and I'm coming up on 25 years now of experience in the energy field. A couple of things about me—I work in the Pacific Regional Biomass Energy Program. It's a six-state group in cooperation with U.S. Department of Energy. I have worked also on combined heat and power which is what do you do with the waste heat coming off the back end of one of these Gensets. If you would like an additional spot to go for information, I'm going to give you a web site that's called PacificBiomass.org and you'll find in the library a good section on biopower and anaerobic digestion that will give you additional information.

Two things to bear in mind as we go through the question and answers. One of the advantages of biopower is that you're keeping your money within the local economy, within the state economy. You're not then buying power that comes ultimately from out of region or is dependent on natural gas which is now spiking in its price and fairly volatile. We also have a lot of experience, particularly with our three panelists. In the last 25 years I've watched the research and development learning curve on digesters steadily march forward. There is a fact sheet on the table. If you haven't grabbed one, it's called "Have You Asked All the Right Questions?"

Let me introduce the panel. First, Phil Lusk at the far end. Phil actually is one of those who "wrote the book" on digesters. If you go on the PacificBiomass.org web site, he has a whole book there that is a case study of digesters. What did we learn at this dairy, what did we learn in that setup, what were the mistakes, what were the problems, what were the successes and failures. You can get that downloaded off the web site.

I'll take Steve Dvorak next. I was looking at the sweepstakes from the energy title of the farm bill. Who won and worked with Chris Cassidy of the USDA for that? And then here's all these Wisconsin dairies. One, two, three, ten, eleven, twelve, all winning digester grants in this last year. Did that happen on autopilot? No. Behind all of that, someone was putting those proposals together very well.

And then finally, with Mark Moser, he has a famous presentation on interconnection with the utilities. It is a classic. He and I were talking at the break about getting that updated. And that is part of the equation.

There are lots of questions in topical areas and categories that you have here with these three really good speakers. If you pose a question, I will repeat it through the mike and then pass the mike around for the answers so everyone can hear. Who has a question?

Question: What type of setup is best for an arid climate?

Basically it depends whether you're flushing or scraping. Talked about both options. We have a scrape manure digester down in the desert in California and a pretty big key there is that they were vacuuming it to begin with, so we're collecting it at one point. Meadowbrook Dairy picks it up, digests it, and sends it onto a lagoon. The flushing, we favor covered lagoon and if you're flushing in a climate that is this cold we'd probably use some manure concentration and it depends on the individual dairy and how you're handling it. We'd concentrate, probably go with a mixed digester.

I think what you need to ask yourself also is what you want to do with your total farm management. I think we need to look at it from that standpoint. I would tell you that obviously there are different type digesters you can put in, but I think you need to look at what you're using for bedding now. If you're using certain type bedding, what is your cost, what is your disposal cost, what's the value of the liquid manure that comes off your digester which certainly has some increased value, in my opinion. So you need to analyze it as a total system and how does it fit into your farm management.

Next question: Secondary treatment of water so you can use it on farm. What are the economics?

I would love to tell you that we have that perfected, but I can't tell you that. We are still working on trying to do that. We're seeing, as Phil mentioned, that obviously as you digest manure and you decrease the density of it, solids settle faster, and we're achieving that very easily in a two-step lagoon system so we're able to get it much thinner. We're having some difficulty in taking the solids down to below 1% and after we get it down to below 1% to go to a filtration system, that's kind of a no-brainer. Everybody does that. So we're working on that intermediate step. There are actually published guidelines by the USDA on what you can safely give to animals, dairy hogs, whatever, as far as nitrates and everything else, to kill bacteria with ozone or chlorine or so forth, ultraviolet is very well established in the emissible business, so I'd like to tell you we're one step away. If someone has an idea for that one step, I'd really like him to come talk to me.

I'm going to comment a little bit further on waste treatment. I work a bit outside of the country and advanced waste or secondary treatment has been attempted full-scale in many countries of the world. This is something that today you would not want to try at home. It's expensive, it's hard to operate, it doesn't fit into the typical scope of a farm. This is municipal treatment technology. Don't get your hopes up that you're ever going to be able to treat manure and discharge it to a stream, because basically it's very technically feasible, you just don't have enough money. And I've worked in Japan, Taiwan, where they've attempted this treatment.

I've worked in Holland where Van Aspert and Company built a full-scale regional hog waste treatment plant that discharged drinking water. The minister went out and drank the drinking water and it was great. It was 100% government financed, it was 100% government operated, and when they gave it to the farmers in the area it lasted 3 months with the farms in the area paying the operating costs and then they shut it down. Again, it's all technically feasible. You have to take advantage now that there is the opportunity for catching phosphorus fairly easily because post-digestion it's in the mineral form in solution which is settleable and separable. Not much on nitrogen available yet. Potassium is about 50/50, 50% will settle and 50% won't. In my opinion, this is about where we should be in nutrient concentration with the phosphorus issue.

Question: When a screw press is being used, what's the percent of total solids being removed?

That's kind of a fluctuating target. It depends on each dairy, it depends obviously on what you're feeding the animals. What comes in and what comes out in some ways. If you're feeding a very high fiber diet to your cows versus a high energy diet, it's going to change the ratio, but we're seeing anywhere from probably 35 to 50% removal, probably averaging somewhere around 40%. That's about what we're seeing right now. That's with a typical declining screw press with .5 screen in that, so that's what we're seeing.

I'll second that one and tell you it does depend on screen size and it depends on your feed grind. So I agree. There are some people working with finer screens but it's hard to do. There is a rule also that you probably should think about. Throw this into the mix. The rule of screw presses is, the harder you squeeze, the less you get. So if you're trying to produce 35% dry matter coming out the end of the screen, you're going to push a lot of your solids through the screen. If

you produce a 25% dry matter, you'll capture a lot more solids. That's the way it works. It's been proven. That's the advantage of European research.

Question: In Chile we had the sale of the greenhouse gas or carbon credits. Is that something that can realistically happen here as well?

The Chilean credits were shipped out under the climate change, the Kyoto Protocol Treaty. The United States didn't sign. That type of mechanism is not available here. What's going on currently is a shadow market through the climate exchange in Chicago. There are mainly futures being exchanged amongst people and I'd call it more of a shadow market. Bonneville Environmental Foundation is paying a little bit here, a little bit there. If there's a representative here, they could tell us more about it. One of the things that I would address later is, some very interesting proposals are coming out of utilities. Those utilities, I've had some utilities attempt to seize, I guess would be the proper term, the greenhouse gas credits in exchange for allowing you to hook up, as part of their contract. You give everything to us in the future. And that's actually, it would be a very good thing to do if you were paid for it. In Pennsylvania, the proposal is to pay for it; in Wyoming the proposal was to put a gun to your head and take it from you. I see that as the most likely mechanism for marketing greenhouse gas credits—to and through utilities. It would work great if it's a fair deal for everybody.

Some of my projects, basically I've got a broker who pledges that he can get \$1 to \$1.50 per ton of CO₂ which comes out to \$5.04 per metric ton of carbon, which is almost an insult. If we're really going to have any kind of climate change, I think economic studies show that the price of carbon is going to be significantly more than \$5 per ton, but it is a small market, it's an emerging market, and one that can add a little bit of revenue. I'll talk about that this afternoon.

I think that what we really need to understand is probably the most frustrating thing to all three of us putting in digesters is that every utility that we deal with is different. Without asking them, I'm sure they would agree with me on that. Each area of the country is different. Even in states, utilities are different. We have one, a digester we just started up in Vermont. We have net metering in Vermont so they get paid the price that the dairy gets charged for their electricity. That utility paid an extra 4 cents per kilowatt for a green tag that they bought. That dairy is getting 11.2 cents right now. I could put a lot of digesters in at 11.2 cents, believe me. I also have areas where they're offering 2.9 cents. I don't put too many in at 2.9 cents. So that's probably a frustration. The northeast United States has an energy pact up there with those nine states that's

probably more progressive than we have in the Midwest and, to be honest, more progressive than you have out here in the northwest. I would really like to see that spread; it would make life a little easier, but it's almost what area do you live in and sometimes it's literally what side of the road do you live on.

Question—

Why don't I fill in a few pieces here? You actually have selling of the carbon credit, you also can sell the greenness of the power. In the State of Washington, biopower is labeled by state law as green power; that was legislation passed about 2 or 3 years ago, adding that into the definition. In terms of buying and selling of carbon credits in the northwest, there is the Oregon Climate Trust and they buy carbon credits under Oregon law. They're not limited to the State of Oregon; they will reach out into Washington and around the Pacific Northwest as well. Bonneville Environmental Foundation will sometimes team with them on various funding of different projects. So in that case, what's going on on the greenhouse gas side is, as you burn the methane, it reduces down to CO₂ and methane is about 23 times more potent a greenhouse gas than CO₂, so it's a nice mix there.

Question—

I had hoped it would break that way. So the Van der Haak Dairy, 1.5 cents per kilowatt hour of green tag and then negotiating now for carbon credits.

Question—

I think that's good advice. Don't sell quickly on this one. The \$1.50 is way low in terms of what was offered.

Question: Would you expand on the quality of fiber coming off the screw press and how does that work with different feedstocks?

We're not seeing much in terms of quality variation within a farm. If you add a different feedstock, the differences between farms. Again, it goes back to what you're feeding—an alfalfa or corn base or if you're throwing haylage in; it's all particle size. What you're recovering in the digested solids is lignin and cellulose, so it's the stuff that didn't digest. I don't know if that helps you out.

I think you have to remember that with the digester, what you put in is basically what you get out. Almost every feedstock that you put in—and I'll have to qualify that a little bit—primarily what you would put in won't biodegrade 100%. So you have to remember, first of all,

that if you put in a semi load of something that biodegrades extremely well like sugars or so forth, you'll still have almost one semi load additional liquid going through the lagoon, so you'll have to dispose of it. Sometimes people forget that. We don't do anything with water. The other thing is that if you put in feedstock that has non-biodegradable material, it will all end up in your lagoon, so if you take in things that have additional NPK in them, you will have more NPK in your lagoon. We had one rendering plant in Wisconsin that was pushing us very hard to take their floating grease off their DAF unit and we analyzed it—6% salt. That would all have been in the lagoon. Sometimes you need to analyze what it is. There's nothing wrong with asking for a lab analysis. But just remember, if you put it in, you will have some other issues that come from it. Therefore, you want to get paid for it. Look at it as an organic landfill, organic liquid landfill. We have a lot of people taking semi loads of material but they're getting paid to take it. That's what you need to look at.

Question: With regard to the Tillamook Bay Project, how do the nutrients leave the digester, what's the story after the digestion?

Post-digestion—it's split. The liquids are separated from the solids. The solids are stacked under roof and trucked out of the region. The liquids go into a tank and are returned, about 80% of the nutrients go back to the farm, about 20% nutrient recovery removal—just across the board if you pick an average number. That's the goal of the system.

Question: For farms that put this system in for odor control and to be better neighbors, did they actually succeed in getting there?

Oh, yes, they succeeded really quite well. It's been a very big issue in some of our projects. As a matter of fact, it was the reason for the project. And post-digester installation—it resolved the issue. One of the worst cases I can think of is, we had a hog farm in Pennsylvania in a valley, upwind of a fairly substantial town, and he got there last. He ended up moving his manure on trucks at night over the county line to get rid of it while they were in the process of investigating him and he was in real bad trouble. Post-digestion, he was injecting within 50 feet of the neighbor's backyard lines. In Minnesota, Haubenschild was never actually in trouble for anything. Dennis Haubenschild with a plug-flow digester, but he tells a great story about top-dressing on fresh-cut alfalfa on the second of July at the back fence line of a neighbor who had a barbecue on the fourth of July. So it's more than anecdotal, it's been tested and documented. The

number Phil gave is out of research papers. Every place that we've gone in on that basis, we have achieved the result desired.

They run generators on movie sets in the middle of nowhere. You can make it as quiet as you want to make it. It's not that expensive. Basically one of the rules of the engine generator room is, keep the door shut. If you keep the door shut, sound doesn't travel very far. So that leaves you with exhaust noise and then it's the type/quality of silencer you use on it.

Question—

There's nothing left to turn over. You've cooked all that stuff out. That's what you're trying to do, those are the fines that are biodegradable. They go to sleep in the winter, the bacteria wake up in the spring, cause the pond turnover. Once you've removed that material, even if the pond flips with the thermocline, it's not bringing anything up.

Question: If a community is complaining about the smell, is it at all common for the community to chip in to help pay for the digester or does it all fall on the dairy farm?

Actually it's a great thought, but I haven't seen it yet. No. You get in a situation like that, it's just a lot of pressure. The problem is if it's a community—we've seen this before—you'll get a whole bunch of people involved and then they have like a self-feeding organism. Those are tough. Those you end up spending a lot more time on, lots and lots of people time. The technical issues are fairly simple as far as the digester goes. But it's a lot of keeping people happy. I'm sure you are all in this business and know how it goes.

I'm not aware of any community that has chipped in but I will say that probably, at least formerly, the number one reason that people talk to us is because of odor control. And then when we do a proforma income statement, we never mention the cost benefits of that, which is kind of unique. So we do it for odor control but we don't assign any economic value to that. But it's definitely one of the primary reasons that people are putting in digesters.

Just to reiterate, the rule of thumb is that which smells bad is the food source for these anaerobic bacteria. If the digester isn't doing its job, odor control is problematic. Now once again, it's something everybody wants but it's kind of like the weather. We continue to talk about it but nobody can really do anything. Our talk this afternoon is generally a zero balance on an income statement, but I read a study last year that NYSRDA (New York State Research and Development Authority) did and, basically, for an 800-head dairy in upstate New York between,

say, Rochester and Syracuse, they estimated the value of odor control on that farm was \$8,000 per year.

I was just sitting here thinking. You have a few projects running, you have to think about it a while. There was a situation where the community chipped in on it, but that was at Cal Poly San Luis Obispo, where the farm built a new dairy and a new lagoon right on the edge of campus. I'm talking about 500 yards from the edge of campus, and it was stinky. Nobody could deny that. And what happened was the chancellor's wife liked to jog on that road. And so she didn't like the smell, so she went home and one thing led to another, and the Department of Public Safety got hold of me and we designed a digester and then they put in for some grants and they cost-shared it with the university and the grants. That's a different type of a situation.

And that is the other pathway. There are some grants available that will help provide for some of the costs and that's the energy title of the farm bill, section 9006, and I think the next round is gearing up in the spring for application, if I have that correct.

Question: How do these systems work with regard to air quality, particularly ammonia and hydrogen sulfide?

Well, hydrogen sulfide is fairly straightforward. You're going to catch the hydrogen sulfide coming out of the digester and send it in the engine or not. We're sending it to the engine any place where we're not going to discharge in excess of the local limits. Other than that, we can scrub for it. And we haven't scrubbed for it in about 15 years. We're gearing up on some systems now where we're in the permitting process. It looks like we will be putting some scrubbers on. The biggest concerns right now are with air sheds and the NO_x limits—that's the one that everybody can smell and that's the one they're after. So far, the ammonia issues are interesting. As far as the digester affecting ammonia loss later, it depends what you had before. If you look at the NRCS field waste management handbook, and you look at the ratings of ammonia loss from a lagoon, it's rated 80% from the get-go. In most cases, if you're able to put in an anaerobic digester and reduce the size of your storage to just that of dumb volume, and the designers know what I mean. You fill and draw storage where you plan on drawing it down completely every year, you'll reduce your ammonia loss because you'll get it out on the field and into the soil before it gets a chance to leave. There are some other interesting mass balance questions that, what happens if you conserve ammonia when your farm was designed with ammonia loss in mind.

I think that there is a lot of data to be acquired on that and it's a very complex question. The H_2S , we do actually drop out quite a bit in the gas stream when we do the condensation removal and it actually comes out as H_2SO_4 which is water soluble, so we basically are taking out of the air emissions that way. A lot of the nitrogen will actually go to ammonium which is water soluble and it stays there. I think the other thing that we're seeing is that, because we can put it on growing crops, the plant uptake is so much faster. I really think that we're getting a lot less total dairy loss because we're using it faster with the plant. Sooner or later it's going to break down into nitrogen gas but we're trying to get it to the plant. The other issue is, and maybe we cheat just a little bit on this, but if you go to a farm that has a digester you really don't see a crust on the lagoon. So we don't have the issue of breaking that crust all at one time where you get that massive odor for 3, 4 or 5 days. We maybe spread it over 365 or a little bit more.

Question: Further information about phosphorus removal through the digester process.

What I was referring to as total phosphorus compared to raw manure versus the percentage that goes to solids versus the percentage that goes with the liquid after the separator. I would have to say that I've never looked at comparing that to separated raw manure. I think that's your question. I can't say I can answer that because I haven't looked at that. I haven't done that.

I haven't done it but Cornell University has. They looked at a comparison between two farms and two farm management systems—Double A Dairy, which is the digester, it's one of ours, and somebody with a conventional management system. So that paper is published. It's Peter Wright Pro Dairy.

Question: Two questions for Steve—one is, what are the units of measurement for the coliform data in his presentation and, was anything done in addition, like a pretreatment, to deal with it.

Well, first of all, let me say that I'm an engineer and not a microbiologist. I believe that they're using plate counts, that's what they're doing. I can give you, we have the data with us, we can certainly give you a copy of it and you can look at it yourself. Your second question is that we don't do anything to the separated solids except digest them. We don't do anything, we aren't drying, we aren't doing anything else except separating them. No composting.

Question—

Well, I think actually it's extremely safe. First of all, bacteria need moisture to grow and this bedding surface dries extremely well. I think if you look at it, what the cows lie on, the surface, is extremely dry. And that certainly helps. When you look at the fact, and we have data on that, that klebsiella, the lactose fermenter bacteria, are nondetectable in a plate count. They obviously can't do any better than nondetectable. Everything that gets contaminated with cow manure, whether it's sand or anything, obviously once it's contaminated the bacteria will grow. That's why everybody has to change bedding on a certain rotation. This actually, I think we're finding because of the nature of the bedding and the fact that we've done a good job of biodegradation and we've removed the, I call them binders, but the starches and the proteins and the carbohydrates, things that actually make manure sticky. The reason that raw manure is a cow pie, and it is a cow pie, is because it has so many binders in it. And the reason is that when it comes out of a digester that it runs like contaminated water but it does run is that we've removed the binders. It also means that when we remove the binders, we took them off the surface of the fiber, and that surface of the fiber therefore has really little or no binders left to absorb the urine and so forth from the cow, and we find that actually in some cases we're doing better than sand after three or four days. Technically I believe that's why.

Question: A chemical processing question—it's total dry matter in versus BTUs out is essentially the gist of it.

Again, a lot of our systems have been studied. Those studies are published. The ones that are probably the best are Cornell where they're doing a materials mass balance on a system. I think University of Minnesota did one on Haubenschild's, I think we put one out years ago on Craven's—on the Oregon web site. Then I'd go to the Cornell one; they had graduate students out there weighing baskets of stuff.