Anaerobic Digestion Mini-Series

Episode 1 of 4 | October 2019

AUDIO TRANSCRIPT
"How Can Cow Poop Turn on a Lightbulb?"

Lindsay De May: How can cow poop turn on a light bulb?

Austin Scarborough: How do food scraps power municipal trucks in California?

Abby Bruzas: How are brewery grains used to generate heat?

Lindsay De May: And what do these things have in common?

Abby Bruzas: Well, they all use a common tool, or machine: anaerobic biodigesters.

Lindsay De May: Anaerobic biodigesters?

Austin Scarborough: That's right. We'll mostly just call them digesters -- and they're getting more popular for managing organic waste, whether it comes from a farm, a wastewater treatment plant, a brewery, or your very own kitchen.

Abby Bruzas: And they aren't just popular for organic waste management, they are also used to generate energy from biogas, which the digesters collect as the organic waste decomposes.

Austin Scarborough: All biodigesters collect biogas and use bacteria to decompose organic waste.

Abby Bruzas: And biogas can basically be used for anything regular natural gas can be used for-- generating electricity or heat, or it can be turned into transportation fuel.

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*<<**Nora Goldstein:** Yes. Hi there. This is Nora Goldstein. I'm editor of BioCycle magazine. We're located in Pennsylvania, in the Lehigh valley. In terms of organics management, digesters are the technology that brings energy production into the organics recycling mix.>>*

Lindsay De May: Wait, wait, wait aren't we getting a little ahead of ourselves?

Austin Scarborough: Perhaps we are. We are students at Vermont Law School working with the Farm and Energy Initiative, and we've put together this podcast series to help listeners like you learn about a technology called anaerobic digestion. I'm Austin Scarborough, a 2nd year student getting my JD, or law degree, as well as a Masters Degree in Energy Regulation and Law.

Lindsay De May: I'm Lindsay De May. I'm also a 2nd year J.D. student, but I'm getting a masters in Food and Agriculture Law and Policy.

Abby Bruzas: And I'm Abby Bruzas. I'm a student at the University of Vermont, working toward my bachelor's in environmental studies, and I've been interning all summer with the Energy Institute at VLS.

Austin Scarborough: Our background research on this project led us to a series of interviews with different experts-- people who work with digesters every day.

Lindsay De May: We realized this technology is pretty complicated to understand.

Abby Bruzas: And to operate!

Lindsay De May: And can require the cooperation of people in many different industries to work well.

Austin Scarborough: First, we visited a couple of digesters to learn how they work and to see them in action.

Lindsay De May: Then, we spoke with state regulators, who help implement the permitting and regulatory process for digester operation-- basically the rules for how you can use them.

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Abby Bruzas: We also learned about state laws requiring that less food scraps and organic waste gets disposed of in landfills.

Austin Scarborough: And that made us think about how the organic waste we throw away today can be used instead.

Lindsay De May: We talked to hauling companies that pick up food scraps, and haul large quantities of food processing waste to composting and anaerobic digester facilities.

Abby Bruzas: We heard from companies feeding their digesters cow manure, expired packaged food, and grease.

Austin Scarborough: We learned that too much organic waste isn't just about landfill space- but that it can be a problem for municipal waste water treatment plants, too.

Lindsay De May: So we talked to people operating the systems that deal with our municipal sewage and industrial wastewater.

Abby Bruzas: And, we spoke to companies using digesters to manage organics before they ever become a problem for our waste water treatment plants.

Lindsay De May: We wanted to learn about how biogas from biodigesters can be used. So we spoke with digester owners using their biogas to make transportation fuel, and to generate heat or electricity- or both.

Abby Bruzas: Then we talked to gas and electric utilities offering energy from renewable natural gas to their customers.

Austin Scarborough: Now, we're sharing those conversations-- so that more people understand how all of these pieces fit together, and the benefits that can come from using this technology the right way.

Abby Bruzas: Keep in mind, the interviews were all conducted in different places, some over the phone and some right next to the digesters, so you may occasionally hear some background noise- but that's the sound of organic waste management.

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Austin Scarborough: There's one more voice you'll consistently hear. That's Genevieve Byrne, our staff attorney, who helped us conduct our interviews.

Lindsay De May: Okay, so back to biodigesters… what are they anyway?

Austin Scarborough: A biodigester is a tool used to break down and recycle organic waste. In doing so, it can redirect waste that was destined for the landfill, and turn it into fertilizer and fuel.

Abby Bruzas: Here's Bill Crossman, the Director of Anaerobic digestion at Vermont Technical College on the benefits of digesters and how they can help us meet our environmental goals.

*<<**Bill Crossman:** Well, I think the, the waste elimination is a big benefit. And the conservation of nutrients, if you can use them somewhere, is a big benefit. And the fact that it generates 24 hours a day and if you can use the waste heat from the engine to heat a building or whatever, that's a huge benefit too. So it has multiple benefits. Properly incentivized, I think it's invaluable way to get rid of waste. I'm mean it, it takes a waste and turns it into something valuable or two things, two or three things that are valuable really as opposed to just land filling of waste and all those nutrients. >>*

Lindsay De May: Hold up. With all of this talk about waste, nutrient pollution, and emissions, let's first run through what these environmental goals are that everyone's been talking about. And then let's tie in how digesters to help with that.

Austin Scarborough: Sure, so we are considering how digesters help or hinder efforts to generate clean energy, reduce water pollution, and decrease greenhouse gas emissions.

Abby Bruzas: According to the International Panel on Climate Change -- agriculture, electricity production, and industrial processes like waste management are the largest emitters of greenhouse gases worldwide.

Lindsay De May: Digesters can help reduce emissions from all three of those sectors- agriculture, energy, and industry.

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Austin Scarborough: And nutrients from organic waste systems are a problem for our water supply. They can clog up ecosystems, cause dangerous algae blooms, and even kill fish.

Abby Bruzas: Digesters can help water quality by improving manure management, and recycling the nutrients in manure-- and other organic waste-- back into fertilizer.

Austin Scarborough: When we put organic waste into landfills, we are burying something useful, and leaving it to emit greenhouse gases as it decomposes.

Lindsay De May: So organic wastes, like manure and food, are causing pollution, in the form of greenhouse gas emissions and water degradation. How exactly do biodigesters help all of this?

Abby Bruzas: So, biodigesters take in organic matter, which is a lot of things, like food scraps, animal manure, beer brewing waste, spoiled milk, cheese whey, stale donuts, you get the picture. Really, it includes anything biodegradable, or "biomass," that comes from a plant or animal. When we put them in a digester, these organic materials are called "feedstocks."

Lindsay De May: Okay, so everything we throw into a digester is called feedstocks because it's *feeding* the bacteria. But, this just sounds like everything I'd throw in a compost pile.

Austin Scarborough: Right, compost piles are actually a type of digester. But in this series we'll be talking exclusively about *anaerobic* digesters, which is essentially a compost pile trapped inside a closed chamber without oxygen.

Lindsay De May: Right-- anaerobic means without oxygen and aerobic means with oxygen-- like aerobic exercise makes me need to breathe more oxygen.

Abby Bruzas: By keeping feedstocks free of oxygen, the bacteria in the anaerobic digester will create biogas, which mostly consists of methane. The biogas is captured, cleaned, and used as a renewable fuel.

Lindsay De May: It's a direct replacement for fossil fuel natural gas, right? Biogas can do anything natural gas can do.

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Austin Scarborough: Exactly-- something you'd never be able to do with compost. Not to mention, compost won't efficiently break down all kinds of organic waste.

Lindsay De May: Gotcha, but why do I have to be in an oxygen free environment to make biogas?

Abby Bruzas: The bacteria that produces biogas can only live in an oxygen-free environment. As the bacteria eats the feedstocks, they burp out methane gas, sort of like a cow as it munches on grass.

Lindsay De May: But if an anaerobic digester produces methane and carbon dioxide, I thought both of those were greenhouse gases… why do we want to produce more of them?

Abby Bruzas: So, we aren't really producing more... biogas is actually produced all the time when we send our organic waste to landfills. When trash is dumped in large piles, the organic waste beneath the surface of the pile gets suffocated, and it breaks down anaerobically.

Austin Scarborough: And as the waste pile eventually decomposes, it changes shape, and the trapped biogas gets released as a pollutant in our atmosphere.

Lindsay De May: Biodigesters basically allow us to capture this gas that will probably be produced anyways and use it to meet some of our energy needs... instead of using fossil fuels.

Abby Bruzas: Exactly, capturing this biogas allows us to take full advantage of the resources we have, without bringing any additional carbon dioxide and methane into the system.

Austin Scarborough: You know, the American Biogas Council also sees a lot of potential for growth of the this industry. They have identified over 13,000 potential sites for biodigester development, including livestock farms, water resource recovery facilities, landfills, and even food-scrap digesters.

Abby Bruzas: And in a 2014 study, the National Renewable Energy Laboratory estimated that the methane potential from these types of sources in the United States

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could displace about 5% of the natural gas we currently use for electricity and 56% of the natural gas we use for transportation.

Austin Scarborough: That reminds me, in his book Drawdown, American Environmentalist Paul Hawken lists 100 Solutions to Reverse Global Warming. Solution #30 is using large Methane digesters for electricity generation. This could replace coal, oil, and other natural gas power plants.

Abby Bruzas: Yeah, he projects that by 2050, large digesters could provide 69.8 gigawatts of energy capacity.

Lindsay De May: What the heck is a gigawatt?

Austin Scarborough: Good question, Lindsay. One gigawatt can power about 700 thousand homes each year. If we were to use Paul Hawken's prediction, that would mean digesters could make enough energy to power 49 million houses a year!!

Lindsay De May: I see, so the energy potential of biogas is a pretty good alternative to natural gas, AND using digesters allows us to capture this gas, which would otherwise be polluting our atmosphere.

Austin Scarborough: Exactly! And there are many different uses of biogas. Raw biogas can be used to generate heat on-site to heat buildings, power boilers, or to heat the digester itself, which keeps the bacteria inside warm.

Abby Bruzas: We visited the Montpelier Waste Water Resource Recovery Facility, which uses biogas from municipal sewage and industrial organic waste to heat buildings, as well as to maintain the temperature of one of their digesters. Chris Cox, the chief facility operator there tells us more:

*<<**Chris Cox:** This building is our dewatering building, and the buildings that are kind of in between all the tanks - it's kind of built in there- those both are heated with the methane gas, in the winter, when they need heat. And our primary digester, the largest of all three digesters is heated. We keep that, so it's a 300,000 gallon tank, and we keep it right around a hundred degrees Fahrenheit. So that's a lot of material, and we're always cooling it off cause we're feeding it in new material that's not a hundred degree, so there's a lot of thermal demand there.>>*

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Lindsay De May: The Montpelier facility is undergoing an organics-to-energy upgrade that will allow them to process additional organic waste, and produce more biogas.

Austin Scarborough: That upgrade might include installing a combined heat and power system. That would allow them to not only heat the digester and surrounding buildings, but to generate electricity at the same time.

*<<**Chris Cox:** There's three options that we're strongly considering. The first one is electricity, so they call it combined heat- it's CHP. combined heat and power. So we would heat the buildings that we can, we would heat the digesters and then the leftover gas we'd run through a turbine and produce electricity. And the options with what to do with electricity are various. You can use it onsite, or you can sell it to the grid and get paid more for it. >>*

Austin Scarborough: Biogas is an especially useful tool for generating electricity.

Lindsay De May: Abby, could you run us through how that works?

Abby Bruzas: Essentially the natural gas runs through a generator, where it combusts to spin an electromagnet which produces the electrical current.

Lindsay De May: Simple enough so far.

Abby Bruzas: And that electric energy can then be used on-site, or mixed in with the electric grid for use by others.

Austin Scarborough: Digesters, as opposed to other sources of renewable energy like solar and wind, are really consistent.

Lindsay De May: What do you mean by consistent?

Austin Scarborough: Well, digesters are cookin' 24/7 and producing a pretty stable amount of biogas, so we can rely on them to generate electricity, when other sources aren't as readily available.

Lindsay De May: Okay, I see, since the sun doesn't shine at night or it's not always windy.

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Abby Bruzas: Exactly. And think about coal and nuclear plants, which are big centralized sources of electricity serving lots and lots of people. If a plant shuts down, we lose a huge energy resource all at once. Digesters and other renewables like solar and wind give us sources of distributed energy- so when one thing isn't working, we can fill in with another.

Lindsay De May: Wait, so we can use biogas to heat buildings and generate electricity-- I heard we can also use for vehicle fuel?

Austin Scarborough: We sure can!

Abby Bruzas: Woah there Austin, before you use it, you have to clean it up, since raw biogas still has some contaminant gases and excess moisture that can't be used.

Austin Scarborough: Later, we'll hear from Tim Taylor with the Sacramento Clean Cities Coalition about using digester gas for vehicles.

Lindsay De May: So, can I just go fill up my Chevy with some biogas from a digester, right?

Abby Bruzas: Not quite. You usually need to get a new vehicle that can run on biogas, and we'd need to have biogas stations where you can fill up the tank.

Austin Scarborough: Federal incentives steer a lot of biogas toward putting it into our natural gas pipeline system. There are gas utility companies that purchase renewable natural gas and offer it as a more sustainable option for their customers.

Lindsay De May: Wait, renewable natural gas? Is that different from biogas?

Abby Bruzas: Good catch! They are different. Raw biogas can't be injected in the pipeline because it contains some contaminants. It needs to go through a series of steps to be converted into renewable natural gas. Raw biogas also has less methane content than natural gas, only 45-65% depending on the feedstock.

Lindsay De May: Does removing the contaminants improve that methane content?

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Austin Scarborough: Yeah. Once it's processed, the gas has a methane content of 90% or more, which is how high it needs to be to inject into the gas system.

Abby Bruzas: The United States has a HUGE network of existing natural gas pipelines, which move natural gas to power plants and to homes and businesses that use gas. Once it meets certain standards, biogas is called "renewable natural gas" and can be put into those existing pipelines for the same uses.

Lindsay De May: If a portion of the natural gas we currently rely on could be replaced with biogas, that should mean we can rely less and less on fossil fuels, right?

Austin Scarborough: Right! Using biogas for almost *anything* can reduce our use of fossil fuels. But it can also be challenging and expensive to get a biogas project up and running, and there are different costs and benefits to each of these uses that we'll get much farther into in later episodes.

Abby Bruzas: Since we're going to be discussing the uses for biogas and the specifics of digester operation in detail later, I think it's a good idea to focus in on why organic waste is in need of management in the first place, and how digesters can help with that.

Austin Scarborough: Good idea, Abby. In addition to the multiple energy benefits, anaerobic digesters can help improve water quality by managing nutrients from organic wastes that are polluting our waterways.

Lindsay De May: And by organic wastes polluting our waterways you mean...

Austin Scarborough: Think agricultural runoff on farms, leachate from landfills, and overflowing waste water systems.

Lindsay De May: Oh yuck! Those are massive environmental concerns. How could digesters help with those?

Abby Bruzas: Well, first digesters help redirect the waste so that fewer problematic nutrients go into these systems, but they also help break down and stabilize the organic material, just like how a compost pile helps turn rotting food back into usable soil.

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Austin Scarborough: And reusing the recycled organic material on farms reduces the amount of new fertilizer, or nutrients, that farmers need to buy.

Abby Bruzas: But, we can't really understand this water quality issue- or how digesters can help-- without talking about WHY certain organic materials pollute our water in the first place. These materials have a high organic load. Chris Cox explained how the organic load of wastewater limits the amount of waste his plant can process.

*<<**Chris Cox:** It was designed to handle 4 million gallons a day. We handle about 2 million gallons a day. So, as far as hydraulic loading, we're at about half of what the engineers designing this facility for. And that was, they build it up for future growth. The other thing that they, when you build a facility, they look at it as organic loading so you can, you can build the tank so big to handle so much flow through it, and that's where our 4 million gallons a day comes in. But there's also organic loading, and that's back to this BODs, which is very important. The biochemical oxygen demand. To handle more organics we need, we would actually need to have more bio reactors and that's where we have our aerobic bugs that eat organics. So you have hydraulic loading and, and organic loading, those are the two main basis for building a facility. You need to know what your organic loading is going to be and you need to know what your hydraulic loading's going to be. >>*

Lindsay De May: So, it's not a matter of how big their tanks and pipes and pumps are-- that's hydraulic load. They can't take any more organic material because it would kill the bacteria in their treatment system.

Austin Scarborough: Right, so new businesses, like breweries or food processing plants, might not be able to send their waste water through the municipal system without removing some of the organic load- and digesters can help with that. Nora Goldstein from BioCycle Magazine helps to explain.

*<<**Nora Goldstein:** But in terms of the beverage and food processing industries, anaerobic digestion within their production facilities has become extremely valuable in lowering the biological oxygen demand and the chemical oxygen demand and the volatile solid in their wastewater streams. And so they are able to improve their operations in some cases, expand their production without expanding their footprint too much. >>*

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Austin Scarborough: So BOD, or Biological Oxygen Demand, basically represents the amount of "food" in each kind of feedstock. If you feed them too much high-BOD material at once, the bacteria will probably kick the bucket.

Abby Bruzas: Technically, BOD is the amount of dissolved oxygen that aerobic bacteria will use up as they eat, or decompose, organic waste. Chemical oxygen demand, or COD, is a bigger number than BOD, since it measures everything that will help use up oxygen.

Austin Scarborough: Eric Fitch from Purpose Energy told us why anaerobic digesters are useful in managing BOD and COD in waste.

Abby Bruzas: In fact, Fitch founded Purpose Energy in 2007 to help the food and beverage industry manage waste that would otherwise create an organic load problem for waste water treatment plants.

*<<**Eric Fitch:** So there's a few advantages there to the anaerobic system. One is you don't have to dissolve that oxygen, and dissolving that oxygen comes at a high cost, especially with very concentrated waste would require a lot of oxygen. So you can eliminate that cost. And then the other thing is, since you're making methane gas, the methane's got some value, you figure out how to convert it either into heat or thermal energy or to electricity. So you know, for a high strength waste, the anaerobic system is better because your operating costs is lower and you've got the revenue potential.>>*

Lindsay De May: Ok, so anaerobic systems don't need oxygen to break down organic waste, which makes it cheaper and easier to help manage organics with high BOD or COD levels.

Austin Scarborough: Right. Waste water treatment plants have trouble with "high strength" organic waste, things like 10,000 pounds of melted ice cream. They have to put extra oxygen into their system, to make sure their bacteria don't die.

Lindsay De May: Kinda like the bubbler in my fish tank?

Austin Scarborough: Exactly! Now we'll let Nora finish explaining how using a digester helps food and beverage processing companies improve water quality efficiently:

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*<<**Nora Goldstein:** Putting in an anaerobic digestion phase reduces the BODs and the CODs and enables them to meet the water quality discharge requirements. And then the biogas- if they're currently using natural gas in their boilers, they can use the bio gas without a whole lot of cleaning to run their boilers and if they're generating electricity, they can circulate that heat back into their food production processes. Um, so there that is sort of the epitome of efficiency with water quality.>>*

Lindsay De May: Ok, that all sounds really cool. But I thought the water quality problem had to do with nutrients? Remind me how nutrients come into play here. Abby Bruzas: Sure thing. Neither aerobic or anaerobic processes remove phosphorous, nitrogen, or other nutrients from the decomposed organic waste. Nutrient pollution leads to an explosive growth of algae and bacteria in the water. As the algae is broken down, the oxygen dissolved in the water is used up, and anything in the water that needs oxygen to survive starts to suffocate.

Lindsay De May: Just like too much organic load at the waste water treatment plant *overwhelms* their bacteria!

Austin Scarborough: That's right. Excessive runoff of nutrients, has had some devastating impacts in many areas including the Gulf of Mexico, the Chesapeake Bay, and even Lake Champlain, here in VT.

Abby Bruzas: And the water can become toxic to wildlife.

Austin Scarborough: Oh yeah, several dogs have died after swimming in Lake Champlain during an algae bloom.

Lindsay De May: WHAT!?

Abby Bruzas: Crazy right?

Lindsay De May: So how do anaerobic digesters help stop phosphorus and nitrogen from entering waterways, if the actual digestion process doesn't remove them?

Abby Bruzas: Good question. Once feedstocks have been processed by an anaerobic digester, and the biogas has been removed, what's left is digestate.

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Lindsay De May: And digestate is...

Abby Bruzas: Basically, it's a nutrient-rich slurry that can be used as fertilizer. Here's Bill again, talking about the digestate that comes out of their digester:

*<<**Bill Crossman:** Well, we test it for NPK which is a nutrient value in order to factor that into our nutrient management plan.*

***Genevieve Byrne:** So what does NPK stand for?*

***Bill Crossman:** Nitrogen, phosphorus and potassium. So it's the three numbers you see on a fertilizer bag.*

***Genevieve Byrne:** And is your, is your digestate relatively comparable to fertilizer that you might buy in the store?*

***Bill Crossman:** Because it's a liquid, it's more dilute. The real advantage is, without a digester, a farmer would be spreading manure, which the nutrients aren't mineralized, not as easily absorbable by the plants. Whereas the digester mineralizes the nutrients, and they're highly absorbable. You know, anecdotally we've been told we were getting amazing yields on our field from it. >>*

Austin Scarborough: So, digesters are capturing those nutrients and diverting them from water streams where they'd be a pollutant, and then making them usable for agriculture. So we replace new fertilizer inputs with recycled ones.

Abby Bruzas: Using digestate on our farmland can also make our soils healthier.

Austin Scarborough: It improves plant growth and helps with soil's ability to retain water, which reduces the need for irrigation, as well as soil erosion and nutrient runoff.

Lindsay De May: Wait, this is starting to sound like compost again...

Abby Bruzas: Sort of. How we use digestate can change depending on what feedstocks, or organic materials, we're putting into the digester. And unlike compost, we usually separate digestate into a liquid and a solid part.

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Austin Scarborough: The solid part of digestate can be dried to produce fertilizer pellets, put into compost, used as a soil amendment, or used as bedding for animals.

Lindsay De May: The nutrient management benefits made me understand why digesters are so popular on farms.

Austin Scarborough: Me too! Digesters are often thought of as an energy technology-- we focus on the fuel they can produce. But managing nutrients and improving water quality is one of the biggest drivers of digester development.

Lindsay De May: Earlier in this episode, Austin said that digesters are an "increasingly popular tool for managing organic waste." Does that mean there's a trend towards *building* digesters or *using* ones we already have?

Abby Bruzas: Both, actually! The US has definitely made big investments in building digesters, but there's also a focus on maximizing the use of the digesters that we already have, which the EPA estimates are processing at an average of 80% capacity.

Austin Scarborough: In 2015, the EPA estimated that there were only 250 anaerobic digesters operating on livestock farms, 60 stand-alone digesters, and 1,200 digesters at waste water treatment plants, but only 240 of those last ones are digesting outside waste.

Lindsay De May: Soo, if I did that math right, really, there are a little 500 digesters taking in food waste? That doesn't sound like a lot. How long have anaerobic digesters been in use?

Abby Bruzas: The technology has been around for centuries in Europe, where it is widely used today.

Austin Scarborough: But the first anaerobic digester in the US wasn't actually built until World War II. Even then, they didn't get much attention until the last decade or two as people are more and more aware of climate change and looking for sustainable solutions to recycle our waste.

Lindsay De May: Okay, but still, 500 seems pretty low.

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Abby Bruzas: Well, we shouldn't really be building new digesters until we become more efficient at capturing this waste and figuring out what waste should go to digesters, or to other better uses.

Abby Bruzas: Recently the US has been making strides to turn this waste into a resource. Five states including Vermont, California, Connecticut, Rhode Island, and Massachusetts have mandatory organics diversion laws. Here's Josh Kelly, discussing the law in Vermont.

*<<**Josh Kelly:** I'm Josh Kelly. I'm the Materials Management Section Chief with the Vermont Department of Environmental Conservation and in the Waste Management Prevention Division. And my role is, in this current time, implementing Vermont's universal recycling law, which has requirements for recycling, as well as organic materials, such as leaf and yard debris and food waste. Um, so we're still actively rolling that out and supporting the development of all alternatives for the management of those materials.>>*

Lindsay De May: So, these laws that Josh is talking about… they're making it illegal for me to throw food waste in the trash?

Austin Scarborough: That's the idea. But for now these laws are mostly geared toward huge generators of waste.

Lindsay De May: Like farms and restaurants?

Austin Scarborough: And food processing businesses, universities, etc.

Lindsay De May: And these laws are more or less holding me or the businesses accountable for our trash so that it doesn't end up in the landfill?

Abby Bruzas: Yeah, It's a pretty collaborative effort. States, towns, and waste hauling companies have been working together to create programs to help separate and collect different waste streams.

Austin Scarborough: These laws also exist at the municipal level in a handful of cities across the US, including New York City.

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Lindsay De May: How do they work? Do those states require their waste to be deposited at an anaerobic facility?

Austin Scarborough: More or less. But the logistics can vary. For instance, some states only apply the law to people or companies who generate a LOT of waste, like hotels, while others target everybody.

Abby Bruzas: The implementation of the law can vary too-- residents, like you and me, might take food scraps to a nearby waste transfer station, while larger businesses would have a hauler regularly pick it up.

Austin Scarborough: Vermont's law sets out a hierarchy of beneficial uses for the waste. Back to Josh Kelly.

*<<<**Josh Kelly:** The new law really put the state on a timeline too to get the food waste out of the waste stream. Really. There's many ways that can be managed, and we actually implement and support a hierarchy of uses for food and for wasted food. I'm really trying to prioritize reduction first, and then donation for use by people second, feed for animals and agricultural use third, and then composting and anaerobic digestion together are fourth. Anaerobic digestion can play a role similar to composting in that you can mix the feedstocks together. They can be broken down by bacteria, in this case, anaerobic bacteria which produce methane gas, which is a greenhouse gas, but it's also considered a renewable natural gas.>>*

Austin Scarborough: But Josh pointed out that for large businesses, the process often starts at the bottom of this hierarchy, with composting and digestion.

*<<**Josh Kelly:** Many people who've done this for several years start to find, um, that a generator a, let's say a major hotel resort or a supermarket chain or a restaurant. They often start with composting, or really separating food waste for either composting or digestion. And then once they see what they have been wasting, they start to not only reduce because they realize that it has real dollars. They're seeing a separate line item bill for this compost pickup as opposed to one trash bill they can't make heads or tails of. And then they also find that there's donatable material in there. There's a great case study on the Lenox hotel by the Center for Eco Technologies. Lennox Hotel is in the Boston area. Massachusetts has a similar law to Vermont. Their operations person saying we started with this and realized, you know, that donation was not hard for us. We just had to think, you know, we know how to keep food warm. We know how to*

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cater events. So now they're rescuing a bunch of food that previously had not only not been composted but disposed of not long ago. And sometimes you have to start at the bottom part of the hierarchy and then work back up. >>>

Lindsay De May: So the organics diversion laws aren't only trying to change *where* food ends up, but *how much* is actually prepared and thrown away in the first place.

Abby Bruzas: That's right, they're really trying to create a comprehensive solution to address waste before its made, to feed more people, and more ethically dispose of waste that is produced.

Austin Scarborough: Organics laws have definitely increased feedstock availability for digesters, and have therefore increased the amount of biogas we've been able to capture from things that used to be thrown away.

Abby Bruzas: But the primary motivation for these laws isn't to create biogas-- it is to find a sustainable solution to food waste. States with mandatory organics diversion laws recognize anaerobic digesters as one of the many tools that can keep waste out of the landfill.

Austin Scarborough: Most people are familiar with saving food scraps for compost, which is an easy example of organics diversion. But anaerobic digesters can be useful outside of household food waste. They are often used to manage much higher-volume organics.

Lindsay De May: And these organics never really have to become waste at all, if we use them for something, instead of throwing them away.

Abby Bruzas: Fitch summarized that there are three main categories of waste that digesters handle differently.

*<<**Eric Fitch:** We usually think of there being three different categories. There's municipal anaerobic digestion, which is focused on reducing the amount of sludge that is produced by the aerobic process. There's agricultural anaerobic digestion, which is really about managing manure and trying to recover some of the energy value of the manure. And then there's industrial wastewater treatment, which is, um, we have an industrial manufacturer, specifically the food and beverage industry the byproduct, can have a lot of organic material in it, and typical municipal systems aren't*

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really engineered for or designed for that high organic loading. If we insert an anaerobic digester in between our customer and municipal treatment plant, then we can reduce the overall cost of treating that byproduct.>>

Lindsay De May: So as Fitch says, the type of digester depends on the system it's a part of because managing each type of waste serves a unique goal.

Abby Bruzas: Right. In agriculture, you want to capture nutrients to use again as fertilizer, while in the food and beverage industry, it's important to remove all the organic solids and nutrients from the water so it can be treated by municipal water treatment plants.

Lindsay De May: Purpose Energy focuses on businesses in the food and beverage industry. Basically Fitch is making money by processing that industrial organic waste, and then selling that energy and saving the environment while he's at it?

Austin Scarborough: A handful of other business owners are doing the same and filling a gap to make a profit on the inevitable waste from these industries.

Lindsay De May: Well yeah, it's a genius business model… making a profit off of turning industrial food waste into energy, nutrients, and water.

Abby Bruzas: And that can go for farmers as well. Some companies are building and managing digesters either for a farm or a community of farms to better manage nutrients, and turn a profit on something that would otherwise become a cost to the environment.

Austin Scarborough: I think the best part about this is that it generates income from recycling materials-- emissions and nutrients- that would otherwise pollute our air and water.

Abby Bruzas: If this episode really peaked your interest, or maybe you're now considering investing in your own digester, then--

Austin Scarborough: --Then don't!!!-- there are still far too many things to learn from us first!—hold your horses!

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Abby Bruzas: So DO definitely tune into our next episode where we'll go into a lot more detail into about how different anaerobic digesters work.

Lindsay De May: In episodes 3 and 4, we will address some of the challenges and environmental costs of digester operation, and highlight some projects and companies we think are really exciting. Stay tuned.

Lindsay De May: And for more great discussions about climate change, energy, and the environment, you should listen and subscribe to Vermont Law School's more regularly scheduled podcast, Hot House Earth.

Abby Bruzas: The Farm and Energy Initiative is a project of the Institute for Energy and the Environment in collaboration with the Center for Agriculture and Food Systems at Vermont Law School. We are funded by the USDA National Agricultural Library.

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Abby Bruzas: And thanks to you, for listening!

Austin Scarborough: And remember, waste is only waste if it's wasted.

*<<**Bob Spencer**: Boy, You're about as green as it gets!! >>*

DISCLAIMER

The Farm and Energy Initiative is a project of the Institute for Energy and the Environment, in collaboration with the Center for Agriculture and Food Systems at Vermont Law School, and funded by the USDA National Agricultural Library. Laws regarding the development of biogas and anaerobic digesters can change rapidly. The information presented is for educational purposes only and does not constitute legal advice.

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