Sarah Clack:

Today we are lucky and fortunate to have Stephan Tait, Sohum Gandhi and Kelly Wickham here to talk about bioenergy. So, I'll just give a bit of a bio on each of them and then we will get into the rest of the session, so I've just put up an overview there. So, our first presenter is Stephan Tait. So Stephan is a senior process engineer at Scolexia and a senior research fellow at the University of Southern Queensland. He's experienced practitioner and researcher in anaerobic digestion and biogas from Australian agricultural residues. Stephan is the lead author and co-author on many reputable academic research and industry publications, which includes the Australian Pork Limited Code of practice for on-farm biogas production and use for piggeries. Stephan's also a dairy effluent system designer as well. So, Stephan's going to be talking to us about anaerobic digestion today.

Sarah Clack:

So, our next presenter is Sohum Gandhi and he's the director of Enriva, a leading Australian company providing energy systems for industries. Since 2005, he's been working within Australia and New Zealand within various industries and has a proactive approach and has helped clients around the region evolving their designs and energy systems. Sohum has been increasingly involved with biomass fuels in an attempt to provide clients with renewable and low cost energy alternatives. His installed projects have assisted people assisted those offset many thousands of tons of CO2 emissions annually and save clients millions of dollars on fossil fuels.

Sarah Clack:

Our last presenter is Kelly Wickham and he's going to be talking about bioenergy in Victoria. So, Kelly's recently joined Agriculture Victoria in the role of Industry Development Coordinator - Energy, focusing on energy technology adoption within the horticultural industry. So previous to this role, Kelly used to work for Sustainability Victoria as part of their investment facilitation support program and assisted projects along the way through the approvals and planning processes, to get the infrastructure on-farm. So, Kelly has also been involved in the ARENA Australian Biomass for Bioenergy Assessment program, as well as the Victorian project manager. So, we will get started now and we will have some time hopefully at the end for some questions. So, we'll get started now and I'll ask Stephan to take the floor and share his presentation.

Stephan Tait:

Thanks so much, Sarah, for the kind introduction. I'm just going to share a presentation now. So, thank you for your attendance to this webinar. We trust that it will be helpful and meaningful for you. The topic of this particular part of the webinar is anaerobic digestion and I would like to start by acknowledging some recent work that we collaborated on with Agriculture Victoria, specifically I'd like to acknowledge Dr. Matthew Knight and Mick O'Keefe from Agriculture Victoria, for their contributions to the dairy biogas information which forms part of this webinar presentation.

Stephan Tait:

I'd like to start just by mentioning the context of this part of the webinar is it provides an overview of anaerobic digestion as a technology type, but it also seeks to give some information about potential low-hanging fruit opportunities in on-farm applications, which is the area that we've started seeing increasing uptake of anaerobic digestion.

Stephan Tait:

So, just a simple overview. So anaerobic digestion, it's a natural biological process, which has been occurring for many millennia and it occurs commonly in effluent and manure management systems. The reason it occurs is because of the organic matter in those systems consume dissolved oxygen, which makes the environments devoid of dissolved oxygen and creates anaerobic conditions. Now, this produces a natural product, a gaseous product, called biogas. In effluent systems, that biogas just makes its way to the surface of the system and dissipates into the atmosphere.

Stephan Tait:

Now, instead we can try to capture that biogas. The simplest form is probably to cover an effluent treatment pond, which I'll talk briefly about later. But similarly, if we were to contain the effluent or manure or other organic matter in a vessel, or a container to exclude oxygen and apply mixing and heating, we're really just facilitating the same natural biological reactions to produce biogas, it's just in a different container, if you like. Now, that biogas contains mostly methane and we can recover the energy from that biogas as I'll mention a little bit more about later, but biogas also contains odorous trace ingredients, such as hydrogen sulfide, and by burning the biogas, whether that be in a generator or a hot water system, a boiler or a flare, we actually turn those odorous compounds into less odorous compounds and this has the ability to significantly reduced odor, which is a major benefit for on-farm applications of anaerobic digestion. Also, when we burn methane, we turn it into carbon dioxide, which reduces its greenhouse impact by 25 times. This has a significant greenhouse emissions abatement benefit as well.

Stephan Tait:

I'll talk a little bit about the anaerobic digester technologies that are available. So, there's a number of anaerobic digester technologies used commercially and the selection of a suitable technology is dependent on two main things. The first one is the characteristics of the organic matter stream that is to be anaerobically digested. Just using the example of manure, the total solids or dry matter content of manure can range fairly widely from a liquid effluent, which is produced in on-farm systems with a liquid flush system, all the way through to predominantly solid materials, such as is generated in a bedding-style system, say in broiler meat production or in beef feed lot manure's case and the suitability of these characteristics then influence the suitable selection of technologies.

Stephan Tait:

So the first technology type, which is now becoming increasingly common in the pork sector is only really suitable for predominantly liquid-based organic matter streams, whereas we require a higher dry matter content if we were to use a complete mixed, heated tank digester. Then there is the plug flow digester, which is less well known and this is essentially a long narrow ditch. The material that's fed into that plug flow digester necessarily should not contain much moisture so that it doesn't settle out, rather moves as a heated plug of material through the digestor. Then at the upper end, there are the garage-style leach bed and batch style systems, which are most suitable for the use with higher dry matter content, organic waste streams. The reason for this being to try and reduce the amount of moisture or water that's required for the process.

Stephan Tait:

Now, using concrete and steel, and this infrastructure is more expensive than for example, having an in-ground clay-lined scenario, which is more common in agricultural applications, and just ranking them in general terms, in terms of relative capital costs, covered ponds are less expensive than plug flow digesters, which are less expensive than garage style, and at the upper cost end would be stirred heated tank digesters because heating and mixing is beneficial by speeding up the digestion process, but it comes at higher capital cost, whereas for an unheated system like a covered anaerobic pond, typically large digester sizes and long retention times are required to get adequate conversion because the biological processes are slower. And covered anaerobic ponds are also not suitable for materials that settle out and/or float, such as fibrous manure, so it may require some pre-treatment.

Stephan Tait:

In terms of biogas uses the most common is to either flare, and this reduces odour and also reduces carbon emissions, which under circumstances for eligible projects allow them to earn carbon credits, which has a potential sale value. If we were to seek to harness the energy content, we might use a hot water system or a boiler, or we might use an electrical generator. Really this is trying to move away from the status quo of ever-increasing energy costs to just simply offset our onsite energy demand, or if we had an excess, which I'll talk about a little bit more, we can export energy to the grid, specifically the most common is electricity.

Stephan Tait:

This introduces a really important balancing act between the energy supply that's available from biogas and the demand that's onsite at the facility. The reason for this is because the relative value of biogas energy exported is much lower than the cost savings value that can be incurred by using the biogas to displace behind the meter or onsite energy demand. This is illustrated in this graph here, and I do apologize for this for the small font, but on the Y axis, we have kilowatt power demand at a facility and the orange line is 24-hour daily power demand. What we can very quickly see is as is typical of most facilities, that the load or demand of electricity varies. This be if we switch on mechanical equipment and/or different heating requirements because of ambient climate.

Stephan Tait:

The green area here demonstrates how biogas is being utilized, in this case, in two generators to try and offset as much of the area under the curve, which is the energy demand at this particular site for electricity. The white areas where our biogas generators are not large enough to meet all of the peak demand. In that case, we need to purchase electricity from the grid. The green area is above the line is where we have an excess of electricity and this introduces an important balance that the sizing of the biogas use equipment, so that it's large enough in order to displace an adequate amount of the onsite energy demand, but it's not too large so that we have a large proportion of the energy needing to be exported. This is because biogas generators comfortably, according to the manufacturer specifications typically only operate down to about 7% of their plate capacity, below which either they have to be switched off or alternatively, if they were to operate without the demand onsite, have to export, and again, at lower value because of the export tariffs being relatively low.

Stephan Tait:

One thing that I wanted to highlight here though, is that obviously with biogas, unlike other renewable energy sources, the biogas is available 24/7. So it does introduce the opportunity for us to try and balance demand and supply as best to displace as much of our onsite energy as possible.

Stephan Tait:

The other important consideration is the availability of biogas energy. I want to just demonstrate two concepts here in the scenario of dairy manure. Now in Australia, we have dominantly pasture-based systems when it comes to dairy production. That is shifting slowly for a small proportion of the industry towards intensive housing, where the cows are housed indoors, but with pasture-based systems only a small proportion of the daily manure output is actually deposited on concrete surfaces where it's collected from. Now, if we have more manure, we have more organic matter and that translates into more biogas because it's the organic matter component that is converted into biogas energy. On the other hand, depending on the diet of the cows, and also sometimes when the manure is stored for longer times, and incurs volatilization losses, the actual intrinsic methane potential because of differences in biodegradability for the manure also varies.

Stephan Tait:

So here we have an interplay then, for in order to meet the energy demand at a dairy, for hot water only or hot water and milk cooling, we need a certain proportion of the daily manure output of the cow to be captured, so this is the percentages in this table here. If the material has a higher methane yield, then we need less material to offset the onsite energy demand. Whereas the opposite, we need more, a higher proportion of the daily manure, or we need to meet that organic matter biogas demand with other organic matter sources.

Stephan Tait:

Now, as is pretty clear here, with pasture-based systems, typically we're capturing about 10% of the daily manure output. So, we require a fairly large or fairly high methane yield to meet the onsite energy demand. But as we move indoors with a proportion of the industry, we're moving in this direction where we're starting to capture something of the like of 40%, and so it becomes clear that very soon in such a system, we actually have enough biogas to meet the onsite energy demand. We don't really need a very high yielding material to provide the onsite energy demand anymore.

Stephan Tait:

I want to shift gears a little bit and talk a bit about where the potential low-hanging fruit opportunities still are in Australia. The first is probably the most commonly known example of biogas because of recent applications, is in pork. This is where Australian piggeries produce a liquid effluent, which is amenable to treatment in a covered pond system. That produces biogas, which can then be used onsite for electricity generation and hot water production, or the electricity can be exported. Interestingly, when biogas is captured this way, it has the ability as I explained before about fugitive methane emissions being turned into carbon dioxide, that it can actually reduce pork supply chain greenhouse gas emissions by 60% or more. So, it also for eligible projects, enables them to earn carbon credits.

Stephan Tait:

Want to demonstrate the importance of economies of scale here with two case studies, the first being a fairly large piggery, which invested $980,000 or so, in 2011-2012. They had a very profitable project, which paid back in two and a half years, also depending on carbon credits in LGCs to support their revenue streams, generating around 270 kilowatts of electricity with hot water recovery.

Stephan Tait:

The second case study, which was much smaller, invested a smaller amount, but yet significant investment in 2017 and had a moderate payback of six and a half years. So, very clearly here, it becomes clear that there is an economy of scale at play. And the second case study is what would could be considered a moderately sized piggery, and the first is a large size piggery. So a fair proportion of the moderate to large size piggeries can potentially harness biogas profitably.

Stephan Tait:

The next example, which is a scenario analysis is capturing effluent from an intensive dairy housing system. That is generated by flood washing of alleys, screening that effluent and using the screened liquid faction in a covered pond system to try and keep the capital costs down and to produce electricity onsite for heating, cooling, and other.

Stephan Tait:

As is shown on this graph here, there is also economies of scale at play here and for cow house systems of about a thousand cows, we're looking at for this scenario an estimated payback of something like seven and a half years, which quickly goes down to five years, so the project's becoming quite profitable for much larger sized systems. So, this is a good low-hanging fruit opportunity, which will likely see increasing application.

Stephan Tait:

The other area which I just wanted to briefly touch on is a centralized co-digestion facility. This facility very importantly relies for its feasibility on the cost of transport, but also gate fees that could be received for diverting material away from landfills, where a levy's incurred. The important considerations here, if these were to be on-farm are biosecurity and also the suitability of the waste type in terms of its moisture content and material handling properties, in terms of matching that to the digester, which is installed.

Stephan Tait:

So in conclusion, hopefully the talk provided you with some idea biogas can provide 24/7 renewable energy. Biogas use is also able to reduce odour and greenhouse gas emissions considerably, that's a major benefit and there are various digestor types, depending on the cost and waste characteristics. The potential low-hanging fruit opportunities, which we'll likely see increasing uptake in, and then that important consideration of balancing onsite energy mined with the biogas energy availability. That concludes the talk, thank you.

Sarah Clack:

Thank you for that overview of anaerobic digestion Stephan, that was great. It's good to see that there is some good potential in agricultural systems. So, I'll pass over Sohum next. Sohum's going to talk about thermal bioenergy, and if you have any questions, please pop them in the chat box and we will answer those during our question session at the end. So, I hand over to you, Sohum.

Sohum Gandhi:

Thanks for that and thanks to AgVic for inviting me to do this presentation. I will try and go through this nice and quick so I don't put anyone to sleep and then maybe there'll be some time for questions at the end. So, if you see something on any of the slides that seems relevant, then we can talk about it later. Quickly, Enriva got over 18 years of experience. I personally grew up in Canada, did my first project here in Australia in 2003, it was a greenhouse and protected cropping heating system. Since then, I've been working in the energy for industry space, with the majority of our clients being in that protected cropping arena and our projects to date offset hundreds of thousands of tonnes of CO2 emissions. So, just there's some articles about some of our projects, just so you know that we're legitimate and I'm giving you real information about real projects. So, a lot of our clients are producing food for the shelves of grocery stores and our business plays a role in delivering a particular technology that allows them to do that.

Sohum Gandhi:

Why biomass? Probably most of the viewers are aware of that already, so I won't stay on this too long, but literally, carbon via photosynthesis is absorbed from the air and that's stored essentially like an energy battery in the biomass. That's the original source of fossil fuels and combined with millions of years of heat and pressure. But in terms of the biomass, we've essentially captured the energy from the sun over time, and then we're going to use that energy with the bioenergy plant. Because you are capturing the CO2 and then releasing the CO2, it's considered carbon neutral. If you were to be clear-cutting forests or other methods of getting your biomass, of course it wouldn't be carbon neutral, but that's not what we're talking about in biomass. Australian forests are sustainably managed with the growing carbon stock and typically, it's the low cost scraps of the industry that have the economic potential of becoming a fuel for a bio-energy plant.

Sohum Gandhi:

In protected cropping, there's lots of things to consider. I won't go into that too much, but whether the load is heating a greenhouse or some other energy user, some other industrial commercial energy user, in the case of a protected cropping structure, we need to look at the load. So what is the structure, are there energy screens? What's the temperature profile? Peak load demand, what sort of crop? And every site is different, different climate, different requirements, therefore different plans and equipment to serve the purpose.

Sohum Gandhi:

I mean, there's many considerations and obviously for these types of industries, the energy requirement is huge. It's a major one of their costs, so making those high level decisions is very important. What type of fuel are you going to use? In this protected cropping industry there's often a CO2 fertilization going on, that's a different feature as well, which makes it makes a large difference in the options chosen and considered. Then with these sort of projects, they can be major capital infrastructure projects, so making the right decisions upfront has decades-long impact on the business and on the environment.

Sohum Gandhi:

So, I'm going to jump into three real projects. These are just projects that seemed suitable for this presentation. This is firsthand information, these are the clients they're the owners and the instigators of the project and Enriva is the principal technical partner. So you're getting the information directly, it's not third-hand information. So, this is JS Ewers in New Zealand, we are in the third, I'd call it the third phase of the project. They had 30 megawatts of coal power, coal heat power, and in New Zealand, there's a government mandate to end coal usage and there's ETS for fossil fuel ... penalty for using fossil fuels. So this project has been going on for a few years and because it's such a longstanding site that's developed over decades, they had coal plants all over the place. As they added the new hectors of greenhouse, glass house, they added new coal plants. So, there's over kilometers, coal plants, and there was eight of them totaling 30 megawatts.

Sohum Gandhi:

So, the first stage of the project was integrating all of that, so that the potential was then there available to convert it to a renewable energy source. So, the next few pictures are that stage of the project, which is now complete and then the stage that we're working on right now is adding the renewable energy plant.

Sohum Gandhi:

This is this sort of equipment that we were looking at that was there, this decades old equipment, and it's not bad. I mean, it looks bad, but it was well maintained. Part of being renewable is not throwing away your equipment, maintaining it, keeping it going and they did that for decades. They had eight plants that looked like different versions of this, but because they're fossil fuel plants, they wanted to evolve or modernised.

Sohum Gandhi:

So, lots of design planning, as I said, all those plants are spread over kilometers, combined across their site and it wasn't ... Back in the '70s or whenever the first crop went in, it's not like they had a vision that they would be at 10 hectares of high-tech protected cropping at some stage. So it wasn't so much a failure of planning, it's just how it is and how it happened in the success of the company, and they ended up in a position where, well, the energy infrastructure didn't make sense anymore. So, lots of planning and that's a big part of it. And then, okay, we've got to now get this show on the road. So, there ended up being 14 containers of goods in the procurement. We had to combine and tie in all that ... integrate the energy system as per the plans that we had designed. This is what it looked like onsite. It was a big deal, it was a lot of trenching to get the insulated pipe all the way around the site so that we could bring all the energy into one combined point, create energy storage, and have an entry point for the new renewable energy plan.

Sohum Gandhi:

So, big works. That's the slab going down for a two million litre heat storage tank. That's the installation and erection of that tank, so it's 12 meters tall and insulated. This is the manifold. In the background of my video right now is this completed manifold. It is where we integrate all the plants together, a couple of aerial views of the pipe work going in. As I said, this goes around for kilometers around the property, but this is back at the manifold building.

Sohum Gandhi:

Finished heat storage tank with the installation and cladding, and those are some large diameter pipes going to one of the particular zones. That's the plant room. So basically in conclusion, on that site, we integrated all those plants together. We decommissioned five of the plants. So by integrating all of those plants and keeping the most modern of them, we were able to decommission positive plants because they were oversized, inefficient, and by the energy integration project, they were not needed. We've just just by the efficiencies gained in doing this energy integration, we've had a 20% energy reduction. So, the project is not just about changing to a renewable fuel, but it's also about increasing the efficiency onsite. So, you can use less fossil fuels, and then you can also replace the fossil fuels. So, by the end of 2022, the new biomass energy plant will be connected to this manifold. So then, the remaining three plants that are still online remain, remaining three coal plants that are still online, will also be decommissioned, so it will be no longer a carbon-emitting site.

Sohum Gandhi:

This is another project. This is in Lyndhurst, Van Wyk Flowers, similar thing. This was a few years back. They were a long-time natural gas user. They're connected to the gas grid there, but the gas price, I think it was 2017, from memory it tripled on them and they just didn't have the profitability in their business to afford that cost. This is five hectares of protected structure. So we came in and had 12 months to come up with an alternate solution so that they could have an energy ... So it was financially-driven, an energy supply that was affordable. So, that's the original equipment, those are gas boilers. They worked fine. They don't look great again, but they worked fine, they wouldn't have been replaced if the gas price didn't skyrocket.

Sohum Gandhi:

Similar to the previous project, we had to integrate everything, put in a plant and there's a whole lot of engineering challenges that go along with that. You'll see here in the next photos, the progress and completion of the project. So, these are technical aspects of the engineering solution that we eventually settled on. Again, it's a biomass energy system and the fuel is waste forestry residues, and manufacturing residues from the local area. So then, all the different challenges come up with handling the fuel, bringing the fuel into the system, processing the fuel, converting it to energy and distributing it to the existing users. So, that's more detail on that. I won't go into those technical ... those specifics, but if there's questions on it, I can answer it. There's a lot of concrete and steel and designed to get at this point.

Sohum Gandhi:

Similar heat storage tank as the last one. Again, the purpose of the heat storage tank is so that you can essentially have an energy battery with advanced biomass plant, it is capital intensive. So, you want to reduce the size of the plant and by having a battery, it's analogous to a battery, you can run a plant at a lower output for more hours, thereby it being a smaller plant and your battery, or your key storage in this case allows you to give peak loads or sustained loads while you have a plant that's running it as smaller output, 24/7. That's the purpose of the heat storage tank.

Sohum Gandhi:

So same thing, one of the biggest exercises here is the hydraulics, making the hydraulics work, connecting everything onsite and retrofitting an old site is a lot harder than a greenfield site. Unfortunately, when you're trying to fix something or tie into something, it's like renovating an old house versus just building a new one. It's a lot more challenging.

Sohum Gandhi:

So, this is the advanced plant that we put in there. Polytechnik is the manufacturer of this, they're an Austrian company with a base in New Zealand. It's an advanced biomass plant, which essentially converts the waste wood or the waste biomass into energy, hot water in this case. Completed install, I can go into details here, if there's any questions, but in the interest of time and allowing Kelly to speak at the end, I will just go through that real quick.

Sohum Gandhi:

You've got the furnace there in blue, and the pink part on top is the actual heat exchanger. It's got automated cleaning on it and in the background, you can see the emissions control module and air pre-heater.

Sohum Gandhi:

So again, this was completed a couple of years ago now, three I think, and we turned off the gas, had about a four-year payback in terms of the gas savings versus the capital investment. It's scheduled to offset 60,000 tonnes of carbon emissions. That's where the fuel goes in.

Sohum Gandhi:

This is a small project called Chislett Farms, closest town of significance is Swan Hill in Victoria. This is an example of a smaller, protected cropping business. Well, not so much that the business is small, but the heated space is small. Typically with small plants in the space of biomass energy, it's hard to make them stack up financially, just the economy of scale is not there.

Sohum Gandhi:

So what happened on this project in order to make it work, they don't have gas onsite and because it's so remote, the LPG cost is astronomical.

Sohum Gandhi:

So again, for financial reasons, we looked at biomass. To make it stack up, we essentially did a pre-build plant, including the plant room, overseas, designed everything, 3D modeled everything, designed it, including the hydraulics, electrical, everything. Pre-assembled it overseas in a factory, disassembled it, shift it in containers and then reassemble it onsite. So this is just some shots in their greenhouses. This is the 3D modeling part of the project, the building's got a fuel store. In the top is the hydraulics here. Heat storage tanks are back here, much smaller and manufacturing here, fabricating in the warehouse, everything, we just basically marked it out and built it as though it was sitting onsite and then disassembled it. Onsite, essentially we put the slab down. So it reduces the site cost a lot, which is a major issue with smaller projects, because it just becomes such a big part, the capital doesn't stack up otherwise on the small projects.

Sohum Gandhi:

So, we did the slab and the internal heating hydraulics in the greenhouses. Then while that was happening, the goods were being transported to site. Here they are being unloaded and installation onsite is essentially re-installation, putting back together what you just took apart. And that's it.

Sohum Gandhi:

So, that's the picture on the bottom left, is the fuel bunker, which is what he's loading here on the bottom right. We started with a red gum sawdust, which is a very powdery, fine sawdust and currently they are using olive pits as their fuel source, so we changed over the settings and they're now on olive pits. So it's just some photos of handover commissioning. It's all plugged in through the ethernet cable, so I log in right now and check the settings. Anytime there's some fine tuning, fuel changing, or troubleshooting, we've got all the parameters online and that's normal nowadays, and that's the finished plant. That's what it looks like from the outside.

Sohum Gandhi:

So, this is an interesting project because it's 500 kilowatts, which is small for a commercial scale, yet it was still economical because of the methodology used. Whereas normally with the larger sort of projects that were in the previous examples, wouldn't stack up on such a small project, but in this case it did, because of this methodology. So, that is the end of my presentation. Any slides here that you want to ask some questions on, we can look through and have a chat about it. These projects are very doable. They are challenging. So, if they're being touted as, as being easy, that probably requires a bit more research to understand what you're up for, but they are doable, though they are challenging and they do require a lot of homework because every site is different. Thank you.

Sarah Clack:

Thanks for that, Sohum, and in the interest of time, I will get Kelly to pop up his presentation. We have had quite a number of questions and some great questions are coming through, but we'll just leave them to the end there. So just, yeah, Kelly's getting his up, so I'll pass over to Kelly.

Kelly Wickham:

Okay, we'll get straight into it. So just a few points. I just want to cover just a few points about what's happening across Victoria and just wanted to thank Sohum and Stephan for some really informative information there. We could have gone all day on just the projects that are across the state, but we'll just give you a summary of what's happening in Victoria with respect to bioenergy.

Kelly Wickham:

This first slide just represents some of the resources that are online within the government of Victoria related straight to bioenergy, so there's links within these images back to resources like business cases and information sheets as well, so we can make this available for you afterwards. As it stands today, Victoria's got a very diverse economy and the status of bioenergy in the state represents that diversity. We've got bioenergy facilities in aged care facilities, paper and recycling, food and beverage manufacturing. There's even a biofuel producer up near Barnawartha and interestingly, that diversity in the Victorian economy stands to reason. While we only represent 3% of the landmass, the agriculture in Victoria here, I think it's something in the order of 27% of all food and fiber exports comes out of Victoria. 32% of all of our exports from prepared foods come from Victoria. 77% of all dairy exports come out of Victoria, and 50% of all horticultural exports come out of Victoria as well. So, vast diversity, but a huge strength in agriculture, which I'm just flagging the huge opportunities that are represented for bioenergy as well.

Kelly Wickham:

Today, we've got examples across all types of technologies, biomass, boilers, anaerobic digestion, combined heat and power. We've even got a gasifier that has been previously funded by Sustainability Victoria. We've also got a series of supporting programs that look at grants and funding packages that support normally infrastructure, rather than some of those pre-development cost support that's necessary to getting to construct.

Kelly Wickham:

I think what's required is that we need more structural support and that might come in the form of feed-in tariffs or mandatory targets and whatnot. So, that's on the horizon, but in the meantime, we still do support bioenergy here and there. It's quite ad hoc at the moment and compared to other jurisdictions, bioenergy's actually still, after 10, 15 years of its mention during the renewable energy target when John Howard was around and it was supposed to stand as a beneficiary of that renewable energy target, it still plays a rather niche role, which is, I think quite interesting. Just look across some of the other jurisdictions, look at those green elements here and Denmark, see the green components there. That's all renewable energy and 23% is bio, interesting everybody thinks it's all about wind and solar. Wind particularly in Denmark, the home of wind.

Kelly Wickham:

Sweden, you got what? 30 plus percent renewables and 24% of that coming straight from bioenergy. Brazil, again, 40 plus percent. Most of that's biofuels, but again, bioenergy is a big deal in many other jurisdictions. And yet here we go, Victoria is very representative of the rest of the country. So don't know what's happening there. We've got a long way to go. We've got experts around the place like Sohum, and Stephan and many, many more that can get us there. We just need the right settings, I think.

Kelly Wickham:

So these are current systems in place across just agriculture. There's about 30 bioenergy facilities in the state but these 10 represent what we've got in agriculture. So we've got a biofuels producer, on-farm biofuels producer to piggeries that had deployed AD. We've got an AD unit at a dairy farm but I think it's been pulled for another project and they're looking at reconfiguring that so they can get better use, higher use, of the effluent streams that are onsite and looking at co-digestion of course, to pump up the biogas volumes, which Stephan alluded to earlier, which will make a better business case.

Kelly Wickham:

Then the rest of these here are much like what Sohum's done. A couple of these projects are Sohum's as well. There's three of those, I think, are Sohum's, so biomass, thermal advance systems that provide heat for largely protected cropping, but not entirely, Meredith Dairy is the exception there.

Kelly Wickham:

So yeah, just going back to that point about how we support bio. We've been funding projects since 2011, and even before. The photo I showed you earlier in the top right-hand corner was back at Tatura wastewater treatment facility, so that goes back to renewable energy support fund of 2007, I think it was. The sustainability fund put two million into Visy's recycled paper plant. That's a 15 plus million dollar product, I think it's a bit more than that, sorry.

Kelly Wickham:

Kia-Ora Piggery, that came from sustainability fund support. It's just a covered lagoon, pretty simple, yet effective. They've got reconditioned Ford engines there, producing the energy on that site. So, just goes to show you how amazing these things can be configured. Western Water is a co-digestion unit, so they basically refurbished an old digester there. We put in some integrated systems there to make sure that food could be brought onsite to co-digest with sewage, pumping up the volume of biogas there as well. For the first time ever, we convinced our governance team to support a project at its development cost phase. So, that's an upwards of six figures to get to construction. So, we're talking about approvals and contract arrangements for fuel suppliers, the whole nine yards. It's a very expensive process, that step. And for the first time ever, we were able to support largely what's an NGO, or a community group, in getting through to hopefully construct at Castlemaine, that's a long way off, but we're pretty confident about that one.

Kelly Wickham:

Again, highlighting, so those are all one-off support packages. One of Sohum's projects, the Van Wyk he showed before, has actually been incentivized through the Victorian Energy Upgrades scheme, the M&V scheme, which basically pays for greenhouse abatement per tonne. I think there was in the order of a half a million dollars produced for that program alone, based on the value of VEECs at the time, or Victorian Energy Efficiency Certificates, which today would be worth three times that, over a million dollars. So the project on the cards right now, the ESC's looking at, that could generate in the upwards of $1.3 million in VEEC. So this is not to be forgotten. It's a really good incentive program, but it's all behind the meter, nothing to the grid counts, it's all behind the meter. So again, going back to that structural support, I think we need something a bit more sustained and more strategic to really drive investment in bioenergy in Victoria, which may be on the horizon.

Kelly Wickham:

Just that last little graph on the bottom there just shows we've got two major policies were pushing for beyond the climate change and renewable energy targets, but also a circularity target and bioenergy facilitates all of those, not like any other technology that I can think of. So if you can think of one, let us know, but bioenergy ticks all the boxes and emerging developments, Ray's online there, we just spoke to Ray earlier today, he was saying that Skipton's on its way to commissioning. So that's a replication of what happened at Beaufort, the biomass thermal project, 200 kilowatts or so for Beaufort. Skipton's going to be a little bit more than that, but they're using for the first time ever straw pellets, which is pretty exciting.

Kelly Wickham:

DEVO, so that's the Delorean Victoria One anaerobic digester at Stanhope. That's several million dollars, that's looking good at the moment. I think their EPA may have given them the tick, we'll know more about that in the coming months. Resource resolution was supported through SV. They've got EPA approval. I'm not entirely sure what that is, but that's another significant anaerobic digester if that goes ahead. So that the projects of high intensity, the capital costs are emerging and that might be a lot because of the market conditions of today.

Kelly Wickham:

We're still waiting on the announcement of the National Bioenergy Roadmap, which will point us in the direction of biomethane to grid. We're looking at industrial thermal heating and obviously getting into bioenergy to support that. It's also going to point to sustainable aviation fuels as well. So, much on the horizon. Once that's released, I think that's been with the minister for a few months now, but we'll get there in the end.

Kelly Wickham:

Victoria has got its own gas substitution roadmap, which biogas will play a significant role in delivering against. That's underdevelopment as we speak for release in 2022, hopefully. As we speak also, there's an evaluation going and it's taking place on the $2.3 million Waste to Energy Fund. The only reason why I mention that is because as part of that, the team is looking at best practice global incentives, leverage programs and policies I should say, that government can deploy to drive investment in bioenergy. So, watch out for the results of that. Hopefully we'll see a whole lot more as a result. I just wanted to present just to let you know I'm on board with AgVic, and we're looking at serving the entire agriculture industry at large, supporting them through the bioenergy development investment stage and looking at business cases, feasibility, you name it. We're looking at a service for all of ag in bioenergy. So thanks for that, Sarah.

Sarah Clack:

Thanks, Kelly. And also thanks to Stephan and Sohum for their presentations. I am just going to pop in the chat there the evaluation form, just noting the fact that it's five to one and I understand if some people do have to potentially leave, but we do have a fantastic list of questions here. So, we will get started on those questions. I'll just ask Sohum and Stephan to turn their webcams back on and we'll get started on these questions. So, the first question I have got is for Stephan. Does the energy content of cow manure indicate low digestion efficiency of the cow? And are there any products to improve cows digestion efficiency that you're aware of?

Stephan Tait:

Yeah, that's a good question. Yeah, look, the digestion efficiency of cows is probably not my area, but it is correct in assuming that they are correlated. So yeah, certainly if their digestion efficiency increases, then there's less biodegradable material at the back end. So yeah, thanks for that question though. But yeah, maybe I'll have to defer the question in relation to better diets to some others that are more qualified.

Sarah Clack:

Fantastic. Thanks for that, Stephan. There is a comment here. "Thanks for the insightful presentation on AD. I do however, wonder the economic feasibility of citing AD systems in rural farms. Livestock manure's prone to NH3 inhibition and co-digestion has been recommended as an appropriate approach to enhance the efficiency of the process. Are carbon-based substrates readily available on these farms? If not, does the cost of transportation of such substrates to livestock farms being considered for these systems?"

Stephan Tait:

Yeah, thanks for that question. Yeah, there's probably two challenges here. The first one is the transport costs as was mentioned. The reality is that if those materials were not available within the very near vicinity of those facilities, then the transport costs would likely be prohibitive. So we're talking probably 10 kilometers or less, so very close vicinity of the facility. So, that's the first one.

Stephan Tait:

The second one which touched on ammonia inhibition is to some degree resolved by the way that a liquid-based system works. So there is a significant amount of dilution that naturally occurs in these digestion systems and that helps to overcome some of those limitations just simply by diluting the ammonia out.

Sarah Clack:

Thanks, Stephan. There was a question that came through while Sohum was presenting before, when he was talking about the New Zealand example. There was a question that came through from Alex about what was the investment cost?

Sohum Gandhi:

Well, the New Zealand example to date has been, say round numbers, two million, but we haven't implemented the biomass renewable plant section of that yet. So, they have got some funding. They have got a 50% funding from EECA, the body in New Zealand there. So, the total investment now for the next stage is earmarked at approximately eight million.

Sarah Clack:

Thanks for that, Sohum. So there's quite a large investment going in there into that one. So, there's a question here for Stephan. What are the impacts of novel methane-reducing feeds like seaweed on the methane potential of ruminant manure and how will this impact the percentage of deposited manure required for operation of biodigesters?

Stephan Tait:

Yeah, thanks. Look, it is true to say that the large majority of agricultural greenhouse gas emissions does originate from rumination, so it's not from the effluent management system. I did mention that the great example in the pork sector there were, because of proportionately less emissions in the animal, it means that a greater saving in overall supply chain emissions can be essentially realized by introducing a biogas system. But that's not the case across agriculture as we know. So, in terms of seaweed and feeding secrets are ruminants. Again, this is a feed-related question and unfortunately it's not my area, yeah.

Sarah Clack:

Thanks for that, Stephan. Just as we've reached one o'clock, I understand if people do need to leave as that was our advertised time to end, just please encourage people to complete the evaluation, because that gives us some really valuable feedback about how you enjoyed this presentation, and also hopefully can give us insights into what you're looking for later, but if it's okay with Sohum and with Stephan and Kelly, just we'll continue on with the questions. So, the next question was for Sohum. How large does a glass house operation needs to be to make bioenergy scenarios viable?

Sohum Gandhi:

There's no rule of thumb for that. It depends on your budget, essentially your capital scenario, but I can tell you typically. Yeah, typically under one hectare, it'd be unlikely to get a advanced biomass energy plan to stack up. Even at one hectare it's tricky. However, that last example I showed was defying that situation. That was, I think, off top of my head, 3,000 square meters of heated area, so 0.3 of a hectare and we managed to make that stack up with a very good return on investments, say around three, four years. Sorry, payback of three, four years, but again, there's so many different parameters.

Sohum Gandhi:

They're not on a natural gas pipeline. Coal's not an option, both by choice and by location. So their alternative or the comparable would be LPG. Because they're remote, it's a five-hour drive from Tullamarine, even LPG is ... Well, LPG's always expensive, but it's extremely expensive. So, then the payback becomes very good because you're comparing a local fuel supply, which in their case was red gum sawdust, and then olive pits, which is almost no transport costs because it's next door, to LPG. So your parameters there give you a very good and very quick payback, and that was 3,000 square meters.

Sohum Gandhi:

But typically, yeah, it's a hectare or multiple hectares. So yeah, when you do have a small project and limited investment capital, it can often be ... You can look at it and say, "There's no chance." There's no chance unless there's some government funding or something, or the investors or the company owner has a real mandate in renewability, that the project could go ahead. It wouldn't be low-hanging fruit for a real small project.

Sarah Clack:

Thanks for that Sohum. I've had a message come through from Matthew Knight who has just said that seaweed and other additives to feed for cattle that reduced methane within the rumen, methane production within the rumen, don't have an impact on the anaerobic digestion within a digester. So, just to answer that question for Stephan there, Matt's just jumped in to do that one. All right, so next question for Sohum, how much of the onsite produced biomass, for example, surplus plant material, waste food products, can be captured as a fuel for the protected cropping-type biomass plants?

Sohum Gandhi:

It's a good question and it comes up a lot, but we don't normally bother because it changes the complexity of the plant, the plant as in the equipment. It's a very small percentage of your annual consumption in terms of biomass. So you would be redesigning your plant to use onsite waste, which may account for a fraction of a percent. Then there's some challenges with, say it's a vine waste of the spent crop or whatever. There's chlorine levels and different things in the leftover plant material that has to be considered because they have an impact on the internals of the plant. So, if you have a high chlorine biomass, you then can be producing hydrochloric acid in trace amounts and stuff like that, which can degrade internal workings.

Sohum Gandhi:

So it's typically not something that you would go and spend another, I don't know, million dollars just for a number, to up-spec your plant so it can take a percentage of its fuel from the waste onsite. It's more about, well, what is the volume of fuel? Say 20,000 tonnes a year or something like that, where are we going to get that? Is it next door? Is it nearby? Is it a waste stream, so is it cheap? And then you focus on that as your spec for the fuel so that you can end up with an economically feasible project. But it's a good question, it comes up, it does come up.

Sarah Clack:

Yep and that's the question that I had too. So we've got another question for you, Sohum. What is the waste slash byproduct output of these biomass plants? And is there a use for these byproducts?

Sohum Gandhi:

It depends on what you put in. So if you're talking virgin biomass like forestry residue or something and depending on the nature of that forestry residue, it dictates what the ash output is. So you can determine the ash by testing your fuel, your input fuel. So you could have a very clean wood chip, which it has way less than 1% ash content. In which case, if you put a hundred tonnes through the plant, you're going to have one tonne of ash, or far less than that if it's a very clean fuel. If it's a dirty fuel, if it's got dirt in it, lots of bark leaves, that ash content will go up and the ash can be used on site and it's normally used onsite as a crop amendment. I mean, as a small percentage, it's even been used onsite for road base materials, for roads that are constantly being built, compacted road base for around the property and things like that. It doesn't normally go offsite.

Sarah Clack:

Fantastic, thanks for that, Sohum. And there is another one for you too, Sohum. What was the cost comparison between the onsite construction and the offsite construction of that 500 kilowatt system? And what's the payback period for that?

Sohum Gandhi:

That payback period was around four years. Don't quote me on that, I have to check the numbers. Again, when you're working out the payback, you're kind of like, "Well, what's the LPG?" In that case, it's LPG, the baseline cost. So is it 25 bucks a gigajoule? What is the landed costs of the renewable fuel that we're using? Is it five bucks gigajoule? Those numbers are always changing. So therefore, the payback is always changing depending on how you look at it, but four years would be safe to say.

Sohum Gandhi:

And in terms of actually building an onsite, really more commercial scale plant, the price comparison is, well, it was pointless, it would add an extra million or something and on that smaller project, forget about it. So, when you do that upfront analysis, you know right away, or for us, we know right away that it's not going to be a financially achievable project to even go down that path. So therefore, you don't waste everyone's time in getting tenders together and speccing up this other scenario that it's never going to be possible.

Sarah Clack:

Does location also have an impact on that cost, since they're up towards Swan Hill way?

Sohum Gandhi:

Yep.

Sarah Clack:

If it was closer to Melbourne, would that cost have been smaller for doing the onsite works?

Sohum Gandhi:

Yeah, yeah. The remote nature of the site definitely encourages you to want to drop something on site and walk away because you can't even get the screw if you need a screw. I mean, I mean, it is a farm, so they have their own workshop and capacity onsite because they're used to being independent, but yeah, everything can be quite difficult. You send a package there and it ends up at a post office and you're like, "Oh, I sent you the packages at the post office." It's like, "Oh okay. Yeah, that's just down the road is 50 kilometers away. It's at the next post office." So, there's logistical challenges with sites that are that remote, but in terms of the running costs, it's really about the fuel supply.

Sohum Gandhi:

So if there's a saw mill or in this case, an olive process, olive oil producer down the road, then that makes all the difference, in which case it can be in Melbourne or it could be anywhere. It's just that scenario at that location.

Sarah Clack:

Yep, fantastic. And that brings it back to the point that we need to really be doing it as a case-by-case situation and looking at particular sites and the specifics for that site. All right. So Kelly, we've got one for you. So, with the imported inputs for bioplants, e.g. wood chips, waste straw, food waste, where does the EPA sit on these coming onto farm? We are still having issues with farms being able to import for sufficient compost. Do the biomass generators require similar EPA and planning approval to import feedstocks?

Kelly Wickham:

So, anything over a hundred tonnes per month, it immediately triggers an EPA interest. Anything that's liquid has to be registered with the EPA, as well. As Stephan knows, liquid wastes are treated a completely different way and are considered a reportable priority waste now, here in Victoria. So they're managed in a completely ... the highest level of management is required. So transport tickets from the beginning to where its origin, to the point of which is being processed and with woody biomasses, it's anything over a hundred tonnes per month that needs to be flagged with the EPA as well.

Sarah Clack:

Thanks for that, Kelly. There's another question they've directed it at Sohum, or Kelly, or both. What types of agricultural producers do you see having the greatest potential for using thermal biomass combustion boilers? Do most of the projects require sites to source waste feed stock from the surrounding area?

Kelly Wickham:

So, I'll go first because Sohum will have a much more substantial value add than I will. But we do know about in Victoria, completing the biomass assessment, by far the greatest opportunity sits with straw residues. In the Grampians Barwon region, the high rainfall sectors, not so much the Mallee, where the low rainfall areas, where we want to return those nutrients to soil, there's over two, three million tonnes out there out west that could potentially be captured for thermal energy, and for CHP, you name it and it could also be digested, but those materials are burnt off every year in situ, which is a ridiculous waste. So yeah, there's a couple of million tonnes that we could capture in the wheat melt, down in the high rainfall zone area, the best opportunity. I'll leave the rest to Sohum.

Sohum Gandhi:

So yeah, a lot of our projects are forestry residues or timber processing residues. Like I mentioned, that project that I showed near Swan Hill was olive pits. We've done macadamia shells. It depends on the region of course, and it depends on what's close to site. There are exceptions, but most of our projects are not funded by anyone but the client, but the business, and they're typically small or maybe at the most medium sized businesses. So they're all about the payback or the return on investment. So, it's about looking at the low-hanging fruit opportunities. So yeah, theoretically, there is a lot of stuff out there that can be gathered. There's even lots of waste in the forest that's burned off, but the cost for people to go out there, collect it in a systematic way while abiding by the laws and regulations, and then bring it to site, may be completely prohibitive.

Sohum Gandhi:

Natural gas prices since that peak that I spoke about, they have come back down and coal is still reasonably cheap, well, very cheap. So, if you can't beat that, it's not a project. So it's all about finding that source that's near or next to site and can land onsite for a price per gigajoule that's way less than the alternative fossil fuel. It has to be way less than the alternative because that's where you get your payback from that savings. So, it's a low-hanging fruit sort of scenario. But yeah, in agricultural waste stream, there's a lot of woody agricultural waste that can work in these sort of systems. Typically, you want it to be from a processor though, you're not going to go and pick up olives from the farm and take the pit out, if the olive pits work because this factory, this producer is making ... they're crushing it and they're making olive oil and they have a machine that then extracts the pits in a high volume scenario, so you have mountains and mountains of olive pits, same as almond producing, same with the wood chips and the residues that saw mills or timber product manufacturers.

Sohum Gandhi:

I mean, we did a project in WA, which was next to Wesbeam. Wesbeam's a big LDL manufacturer in Australia, and they had mountains and mountains of dry chip. So the client essentially got himself a truck and moved the chip two kilometers over to his site, and had a near to free fuel. That project was also next to a gas-powered substation. So there was a massive gas main line up across the front of their property, natural gas, but it still was a much better payback to do the waste stream because of the site, the local scenario there. So that's it from me, thanks.

Sarah Clack:

Thanks Sohum, and Kelly-

Kelly Wickham:

One more point on that is that even having said that, the wheat residues are the biggest opportunity, going back to what Sohum said. Half of our projects in Victoria there are wood waste fueled, but we've got projects that are using grape marc, almond husks. There's a business case being developed for olive pip use, all of it's useful, without a doubt.

Sarah Clack:

Fantastic. Thanks for that, Kelly. We have got one last question that has come through, unless we get a few more come through here and thank you for those that have held on too, we're still got 29 people on, so it's great to see. The question that we've had come through is what is the moisture content limit for drying biomass prior to combustion compared to using anaerobic digestion to achieve the highest yield per tonne of dry matter? So in other words, what is the amount of energy used to dry the biomass and is that potentially more than the energy yield gains? So what's that balance? So yeah, what moisture content ... Yeah, what is that balance between that being that ideal moisture content and making it work?

Sohum Gandhi:

So, I can go first. So, for the sort of the technology and equipment that I've been speaking about, I can answer that for that side of things, but again, bioenergy is such a massive umbrella and I'm really only speaking about one particular part under that umbrella, which is more of a woody or agricultural biomass energy source. In our projects, because they're normally large commercial projects, we don't do any external drawings. So, we design a plant that works with the available fuel at the available moisture content of what it's going to be on site. So we have projects that use forestry residue, for example, up to 60% moisture content. The drying happens once it's inside the plant, of course, before the pyrolysis gasification and combustion stages occur. So, there's not a separate drying process.

Sohum Gandhi:

If there was a separate drawing process, then yes, that question could be answered. If you're making wood pellets and you're drawing the fuel before you make the wood pellets, then yes, you could work out that energy content that you're inputting into the drawing process versus what energy the fuel is then producing onsite. But as a net calorific value figure input, and even with a high to very high moisture content, you still be upwards of 80%, 85% efficiency on the system. Even with those high moisture content fuels when based on a net calorific value. I don't know if I answered ... I'm not sure exactly where that question was angled, but that's what I thought.

Sarah Clack:

Kelly, do you have anything to add there?

Kelly Wickham:

No, he's the man of experience. Mine would be completely theoretical. Darryl Scherger is probably online, he could give a few insights to that, but I think that's pretty much quantifies it, what they say.

Sarah Clack:

Stephan, did you have anything to add in there?

Stephan Tait:

Yeah, look, I was just going to say with anaerobic digestion, anaerobic digestion really is more suitable for wetter materials. So it's a technology that's suited at materials with a moisture content of 70% or higher. So yeah, I just wanted to add that.

Sarah Clack:

Thanks for that, Stephan, and looking at the questions there, we haven't had any more come in, but we've had some great feedback in there as well come through, but I would like to call it to an end since we've gone about 20 minutes over time. I'd like to thank Stephan, Sohum and Kelly for their time today, and especially for their time with us going over time today and being quite generous there in giving us that extra time. Also, thank you to everybody that's online, we've still got 27 people online, which is great to see, and it's great to see so much interest with over a hundred registrations for this particular webinar. So thank you to all of you.