Sarah Clack:

So today, we're talking about solar on-farm. So today, we've got Geoff Lodge, who's CEO of GV Community Energy based in the Golden Valley here in Northern Victoria, where I am also located. And he has been working in renewable energy and energy efficiency projects, including co-designing two solar farms.

Sarah Clack:

So, prior to his current role, Geoff has worked in natural resource management and that gives him a really good, strong, practical knowledge of farming operations. And Geoff has blended his agricultural knowledge with renewable energy and energy efficiency on-farms. And does a lot of work in the solar area with farmers.

Sarah Clack:

So first, we'll have Geoff speak about solar energy on-farm and systems, et cetera. And then, we will have Mario Como talk to us about the solar system on the Ellinbank SmartFarm. So, Mario is a senior project manager with Agriculture Victoria. And has 25 years worth of experience in engineering, project management, production systems, energy and environmental management.

Sarah Clack:

And he's been involved in the Ellinbank SmartFarm and the Tatura Smartfarm with the solar and energy projects which we have going on there under that Agricultural Energy Investment Plan. So, Mario has been involved in the installation and the monitoring of the energy technologies, which are being implemented. So, he's going to give us an overview of the solar system that they've put in at Ellinbank. So, first off, I'll hand over to Geoff.

Geoff Lodge:

Thanks for the opportunity of being able to present material on solar on-farms. It's an exciting space. In the last decade, the landscape has certainly changed in terms of the deployment of solar. Over two and a half million homes have got solar, and it's quite impressive.

Geoff Lodge:

Likewise, in regional areas, we've seen on commercial industrial sites and in more recent time, deployment across the agricultural sector, as the economics have shown it to be a cost effective investment. Today's discussion will cover off on these main areas. Identifying where it's suitable to install solar within the agricultural context and how to get the best out of your solar design.

Geoff Lodge:

I want to cover off on the issues relating to how to connect to the grid and what those processes are. And importantly, what the responsibility is of the client. Can't understate that. If there's many a slip between the cup and the lip. And I know of many cases where projects have stalled because of a lack of understanding of how to get closure on these processes. I'll go through that.

Geoff Lodge:

And as with a lot of things in life, things change, there is no constant, other than knowing there will be change and renewable energy is no different. And it's important not only the technology that is changing, but the processes to get deployment of this technology is also changing. And as with anything, there's always maintenance. There's no such thing as a maintenance-free system. And we'll cover off on that as well.

Geoff Lodge:

So, in terms of where can solar panels go, use your imagination. And it's a good chance there'll be an opportunity to install solar systems somewhere at some time. The series of photos here are just showing what's happening across the landscape, whether it be a utility scale solar farm, some creative engineers putting solar panels over irrigation channels. To the top right, that's a solar thermal system, a variation from the solar photovoltaic systems that we're talking about today.

Geoff Lodge:

Structures such as car parks. You're seeing more and more of them. They're expensive structures, but they are effective in protecting the cars from the summer heat. That central shot is a shot taken in Southern China. That solar array there actually covers a nine-story high building. And the bottom right is floating solar panels.

Geoff Lodge:

So, in terms of the opportunity, we put solar panels within the agricultural context. We're talking about rooftop. And in terms of costing, being able to install solar panels on a roof is one of the most cost effective ways of doing it. Once you step away from the roof and you go into the paddock, you add about a 30% cost because of the additional infrastructure that's required for the foundations and structures.

Geoff Lodge:

The bottom left is an innovative research project that Mario and myself are involved in, in looking at the benefits of providing strategic shade over, in this case, a pear crop. And we're looking at a 50 kilowatt solar array with panels facing the west to shade in the afternoon sun. And other panels there are sitting horizontal. So, there's experimental design there.

Geoff Lodge:

So, it's about being creative and looking at how solar PV can be incorporated into the horticultural context. And the bottom right, we're talking about options of floating panels. I put it still within the novelty context because of the costs associated with it. But having said that, one of our business associates that we're co-designing and building a solar farm, they've deployed a 17 megawatt floating solar array. So, it can be done and is being done at scale.

Geoff Lodge:

In terms of optimising the interception of the solar arrays, they're combinations of fixed panels or tracking. In this case, I've got a shot of a solar farm that has bi-directional tracking. So, not only does it track from an east to a west direction, but it also tilts and changing the pitch to take advantage of both the summer and winter pitches that are occurring.

Geoff Lodge:

The important thing and reason I've got this photo is, as soon as you introduced tracking, you must have more spaces between your solar panel arrays because there's a lot more shading that's intercepting. Now, it's relatively new technology being deployed in the Goulburn Valley.

Geoff Lodge:

There's a shot here of a site near Tatura, that is a bi-directional tracking system. And this photo is looking south. So, the panels are currently facing west. And you can see it's late in the day. You do have some shading on those panels. Had there been more space between it, you would have taken more advantage of that. But late in the afternoon, it's not critical.

Geoff Lodge:

But the other piece of infrastructure, in this case, you've got a security fence in addition to the ground mounting equipment. And the payoff is you get about 25% increased yield with a single access tracking. And about 40% increased yield with a bi-directional. Agriculture Victoria is doing some field trials on this particular site, and we'll get in confirmation of what those benefits are.

Geoff Lodge:

But the key attribute of a tracking system, it's about flattening the curve. So, if you look here, typically in this blue line is the typical profile of fixed solar panels facing north. Typically, at about a 25, 30 degrees pitch. By having the tracking panels, what you do is you take more advantage of the morning and the afternoon sun by tracking the sun with those panels.

Geoff Lodge:

So, you get not only an enhanced output, but a more dispersed output. And this is beneficial, particularly for situations where it's difficult to shift the load of electricity. And this is well-suited for pressurised irrigation systems, where you don't want to compromise the delivery of that irrigation water chasing the cheaper electricity. Primarily you irrigate to maximise your production. And something like these tracking systems are well-suited for that type of application.

Geoff Lodge:

In terms of getting the most out of solar, the orientation and pitch of panels. And I'll just touch on the more common situations of a roof mounting. And if we start with the top left, the panels are flat to the roof. And a very neat installation, and you can see there's sufficient gaps between those panels. So, you can get access to them for cleaning and maintenance. I do see many installations where you have very difficult access to get into the panels. It means you lose some of the roof space to not be able to use it for solar, but it's about some good planning and taking advantage of that space.

Geoff Lodge:

The other thing is being mindful that if you look along here, you can see screw lines, the purloins under there, and that's where the rails are that are supporting the panels. And that can be a limiting factor as to where you put the panels. And some roofs, because of the configuration of where the purloins and rafters are, it becomes a limiting factor where the panels go. I'll come back to that issue in a moment.

Geoff Lodge:

But in this case, the pitch of that roof is about between five and 10%. For me, I look at that design and it's problematic in that it, in my view, is too flat. It's very neat, aesthetically pleasing, but it would be better if it's got a pitch such as the other two photos. So you get better interception of the sun and you get better air cooling, you get air flow under the panels because the panels generate heat. So having them on tilt frames, they will be cooler. And they'll be more likely to be self-cleaning. So, any rain, silt, dust will wash off those panels. So, that's important.

Geoff Lodge:

The other thing is that if you have these flatter panels, you have water pooling on the panels, particularly if you've got framed panels and it increases the risk of water penetrating into the panels. And that's not good. The other thing I've got to note here on this slide is that a reminder that silicone sealants in full sun, they last about 10 years.

Geoff Lodge:

Early installations, particularly with some of those switching gear, silicone was exposed and there weren't covers. And many systems failed because moisture got into those circuit breakers. The design standards have certainly improved over the last decade. And it's standard procedure to be covering those circuit breakers and switching gear from direct sunlight.

Geoff Lodge:

In terms of matching inverters and panel capacity, there's a lot of flexibility, but this is where a good designer can identify the sweet spot between the inverters and the panels. But typically, what you see is more panel per the inverter. So, you might typically, have a 20 kilowatt inverter but you might actually have 23 or 25 kilowatts worth of panel. So, a 20 kilowatt inverter, 25 kilowatts worth of panels. And that can be operated within a sweet spot.

Sarah Clack:

Geoff, just before you move on, we have had a question. What's the difference in output between the flat and tilted panels in Northern Victoria?

Geoff Lodge:

Yeah, it's a good question. And typically you're looking at, if your panels pitched at about 35 degrees, which is the latitude, so that's the ideal. And if they're facing north, that's your best output. If the panels are flat, you'll lose about 15%. If the panels are facing east or west, you'll lose about 15%. The decision as to when you introduce tilt frames is, anything less than 10 degrees pitch you should be having tilt frames. And introduce tilt frames, and you should get at least 10% improvement in the pitch to make it cost effective.

Geoff Lodge:

I've got this slide here as a follow on to where the rails are and they're following those screw lines. There's now new bracking systems where you can actually put these brackets where the rafters aren’t or the purloins aren't. And instead of having one screw, you've actually got four. And they're approved and can be used to give more flexibility where the panels are located on the roof. So, this is a good advance to give greater flexibility.

Geoff Lodge:

Now, when it comes to load shifting, I want to go through this example. This is a dairy farm and the gray is indicating the electricity use profile coming from the grid. And what's going on is, in the middle of the night, hot water is being heated, being heated in off-peak. And then early in the morning, the dairy is cranked up and the milking is happening. And the combination of running the dairy machinery and chilling the milk.

Geoff Lodge:

And during the middle of the day, there's not a lot going on in terms of drawing electricity from the grid. And then the milking kicks in late in the afternoon. Now, for many years, people have talked about dairy farms are not well-suited for solar because of that energy use profile. Because in the middle of the day, this is when the solar is being generated.

Geoff Lodge:

Now, in years gone by, the value of the electricity going to the grid was sufficient, that even if you had 100% of the solar generation going to the grid, it was cost effective. And you were getting paybacks between six and seven years. That's shifted in the last five years where the value of the feed-in tariff has dropped.

Geoff Lodge:

People were exploring opportunities of running panels facing east and west to try to increase the generation and take advantage of these peaks. When we did our modeling, we found you're still better off having the panels facing due north. In more recent time, with the drop in the value of the feed-in tariff and the introduction of new technologies on improving the efficiency of a dairy operation, it is now cost-effective to be shifting that hot water from off-peak into peak time. And typically, the cost difference between peak and off-peak electricity is now somewhere in the order of around 10%.

Geoff Lodge:

Whereas in years gone by, it was anything up to 500-700% difference. So, it was cost effective to do it and minimal risk if the solar didn't actually capture that heating. So, shifting the hot water into the middle of the day is a good thing, an opportunity for solar.

Geoff Lodge:

The other thing is, a lot of the electricity that's being used in these peaks is about cooling the milk. And we know that the milk is about 37 degrees and got to get it down to about four degrees in about three hours. To do that, you've got heat exchange, you've got cooling plates. You've got technology there to bring that temperature down. And that all requires electricity.

Geoff Lodge:

Storing additional cooling. So you've got thermal massive cool, whether that be glycol, or ethanol, or ice water, is a way of rapidly bringing in the temperature of the milk down. And the solar electricity can be used in storing the energy in cold liquid or cold solar. And in a cost-effective way of bringing that milk down and utilising that electricity.

Geoff Lodge:

Now what's important in looking at this profile is, if you're purely looking at the profile, you would design that site for about a five kilowatt solar array in order to minimise the export. But in this case, we're designing a 20 kilowatt system. We're still getting under the status quo between 50 and 60% export, but the dairy farmer is planning on shifting the load of electricity to heat into the middle of the day. Is buying technology to cool the milk, which will draw more electricity here. And you'll see most of that electricity being consumed.

Geoff Lodge:

The significance of those colors, are that the green is the solar that is being consumed. The red is the solar that is being exported and the purple is the solar that could have been generated, but because of export limitations imposed by the distributor, the inverter actually was turned down and the generation was actually curtailed because of those constraints. By shifting the load into the middle of the day, you utilise all of that electricity.

Geoff Lodge:

So, the dairy farmers who are going to get energy audits as part of the government incentives, make sure you have the conversation about moving from the status quo of the external electricity usage, to explore the opportunities of shifting the load. And this is important in sizing an appropriate solar system.

Geoff Lodge:

I have covered off on those issues and I'm going to move to the next slide. So, in terms of the key attributes of solar, there's a lot of chatter about Tier 1, Tier 1 companies. And you see this in a lot of tender documents that insist you must have Tier 1 solar panels and Tier 1 inverters.

Geoff Lodge:

Well, it's important to understand what Tier 1 actually means because it has absolutely nothing to do with the quality of the product. It's got everything to do with the size of the company, the manufacturers of those products.

Geoff Lodge:

And there's a correlation between the bigger the company, the more likely they're going to be reliable. The more likely they're going to be in operation in 10 years time when you're calling in on your warranties. That's all it is. There's many good products coming from smaller manufacturers that don't satisfy that definition. So, be mindful that when you're reading the material that is advocating Tier 1. It's only one part of the consideration.

Geoff Lodge:

The other thing is to look at the warranties and I described there were four warranties. And the first one, which is part of Australian standard and it's the performance warranty. And what's that referring to is how well the panel is performing over time, bearing in mind that the panels will degrade. And typically, they'll lose somewhere between half a percent to 1% per year over their life.

Geoff Lodge:

These panels typically, are described as having functional serviceable life for 20 to 30 years, but in practice, they could be operating for 50 years, given their performance degradation rates. But the Australian standards insist that after 10 years they operate at 90% capacity and after 20 years, they're still operating at 80%. And when you look at the specs of different panels, you will see that those figures will, on some products, exceed those two performance yields. So, a good thing to be mindful of.

Geoff Lodge:

In terms of product warranties, you really need to be looking at 10 years or more. In terms of labor, it's variable between one and five years. And the last important one is the phone warranty. And that's just referring to whether they're going to still be in business in 10 years when you're calling on the warranty.

Geoff Lodge:

And having worked in this space for 13 years, more companies have come and gone in those 13 years than exist today. And be very mindful of that. So, when you're in the marketplace, you're shopping around, be very mindful, you get what you pay for. And keep in mind those four aspects of warranties.

Geoff Lodge:

And using a supplier that has a track record is important. And ideally, having local suppliers or local installers, do all to service your products. Very important. I've heard of many stories of Melbourne-based companies coming through the region, offering very cheap products, but not coming back to honor the warranties.

Geoff Lodge:

And the other thing in terms of finance opportunities, there's a lot of very clever marketing products and these zero cost products and you pay later are usually zero benefit. Pay attention to the detail, get your calculator out and do your sums. And the one thing I know working with farmers over the last 30 years is, I know that the farmers are good at maths. Having said that, they still get sucked in with very skilled sales people. Look at the numbers.

Geoff Lodge:

So, I want to touch on the pre-approval process because this is where projects fall over. For a start, the designer, as part of developing the quote and the design, needs to go off to the distributor. Typically, Powercor in this part of the world, to get a pre-approval. That note will expire after 120 days. So there's a sunset clause there.

Geoff Lodge:

And typically, it's based on the capacity of the transformer. Although, things have changed in more recent time as there's been more deployment of solar systems. And what we see now is actually, it's quite difficult to get a system above 30 kilowatts. And this is problematic because there were great opportunities across the landscape to put in bigger systems. But be mindful that you can put in bigger systems, but curtailed with export limitation. But it has an adverse impact on the return on investment, unless you can shift the load and utilise the electricity.

Geoff Lodge:

So, in terms of the process that goes along this line, that for single phase transformers, you have a maximum of a five kilowatt inverter. And I have there the qualifier of exports. So, you can put a bigger inverter in, but then you'll have to put a device in to limit the export to five kilowatts.

Geoff Lodge:

And for three phase, it is now five kilowatts per phase. If you go onto Powercor's website, it still says 10, but it is five. And if you want to exceed those limits, you then have to go into another process of getting a generator deed. And when I say you, it will be your designer will be doing that. Now, the good thing with Powercor, is they don't charge for that process until you get a bigger system above 30 kilowatts. Whereas some other distributors will charge for that process.

Geoff Lodge:

So, it adds a delay to the project. You'll be given a generator deed. It's a contract that you'll need to sign with the distributor. You've got a month to think about it, and then it will lapse. And then you'll have to go through the whole process again. But if you sign and complete and send the forms back to Powercor, you've got a six month window there to get on and finalise your design and get it commissioned.

Geoff Lodge:

If you're not happy with the decisions that Powercor made, there is a review process, but it costs you about $790 to get that done. Many of our clients have gone through that process and the review has been favorable for them. Typically, Powercor may adopt a conservative approach under review. They will find there is an opportunity for you to have a bigger system. So sometimes it's beneficial to do that review. So, in terms of post installation, I can't read the top line. Can you just tell me what it says, Sarah?

Sarah Clack:

Commissioning of installation.

Geoff Lodge:

Fantastic. Thanks. Okay. So, the next part of this process is the system has been installed. The installers have to go through a process, a commission unit. So they get an independent licensed electrical inspector to come in to make sure that the system complies with all the electrical safety requirements and design.

Geoff Lodge:

And this is an important part. You are dealing with electricity. Get it wrong, people get hurt. There's paperwork, of course, that goes with that. And the solar installer must submit that paperwork. And in this case, we're talking about Powercor. So, it goes into the Powercor's portal. It triggers a process. And the process is that Powercor then contacts the retailer, your retailer, and then asks them for this electrical works request, or EWR.

Geoff Lodge:

And what it does is it then triggers the process as to whether your meter needs to be reconfigured. And this is a conversation that the retailer has to manage. The weak link in the chain is that if the retailer doesn't respond, Powercor doesn't do anything. The process actually stalls. So this is where you need to be on the phone and making sure that after about a two week period, you phone your retailer to make sure Powercor has contacted them. And the electricity retailer has activated and reviewed the configuration of your meter and got that process going.

Geoff Lodge:

Some sites have meters that are privately owned. Their owned by a third party. Powercor doesn't own it. So, the electricity retailer will then have to activate that process. And that's another delay, it's another complication. This is the painful bit because the installer is not able to engage the retailer. You as a client have to do this. So, this is the weak link in this process. You need to be diligent.

Geoff Lodge:

Similarly, with the feed-in tariff, about two weeks after the system has been installed and commissioned, you then get on the phone and you talk to your retailer about a feed-in tariff contract. Again, you need to follow through on that. Again, the installers can't do that on your behalf.

Geoff Lodge:

In terms of maintenance. They're not zero maintenance, but there's not a lot of work. And that depends on the site. Dusty sites, typically farms, you've got probably once a year you give them a hose down. But don't do it on a hot day. You don't want cold water on hot glass. Remember, the solar panels get hot. Not only because they're sitting in the sun, but because they're generating electricity. If it's not dusty and you've got the pitch greater than 10 degrees, then maybe once every five years. If you see any lichen or bird poos, then you clean that off.

Geoff Lodge:

In terms of with your system's operating to specification, you can do it manually by understanding, from the conversations you had with your designer, what you can expect to be generating and just keeping tabs on that. You will have monitors on the inverters. The more modern models don't have displays, which is a good thing because it reduces the risk of another thing going wrong. But then you've got to have Wi-Fi connectivity and it connects to either your computer or your phone.

Geoff Lodge:

Be mindful that, because of the variability and instability of the grid, you can anticipate that your system will crash maybe once every two or three years. So, this is why you need to be diligent, whether it be manually or with the monitoring systems, to make sure your system is operating. And a very common fault is moisture gets into circuits somewhere and causing a problem. I'm going to close off on that one, Sarah, and hand it back to you.

Sarah Clack:

Thank you, Geoff. We will definitely have time for questions. I'll pass over to Mario now, so Mario can present on the work that they have done at Ellinbank. Yeah. So, I will just get up the presentation from Mario and hand over to you, Mario.

Mario Como:

Good day, all. My name is Mario and I'm delighted to be part of the solar farm webinar and sharing information and the experience that we've had at this site. Today, I'm going to go over the Ellinbank solar battery system installed at the Ellinbank dairy Smartfarm. I was the project manager for the install.

Mario Como:

Just a quick summary about Ellinbank. Ellinbank has a herd of about 450 cows and produces up to 11,000 litres of milk a day. So, just the system. The system capacity is a 99.2 kilowatt. And I'll explain why we chose 99.2. We have 248 solar panels, each at 400 watts, a 110 kilowatt inverter, a battery system of a 100 kilowatt hours.

Mario Como:

Metering, we went over and beyond with metering. We've got solar metering, battery metering, grid metering, load metering, and metering three of the buildings that are on site. There's grid protection. The grid protection is a compliance. It senses when the grid is off and safely shuts the solar off and automatically reinstates it when the grid power is on. And that's to ensure that we don't have a current flow when there's no power on site.

Mario Como:

The building. So, structurally certified to take the load of the panels. We selected a particular building for that reason and for other reasons. We added walkways, access ladders and hand railing. This is to ensure that we can go up and do any maintenance if we have to. Also visually inspect, but also, we can get visitor's up there and demonstrate and show them the unit.

Mario Como:

The panel orientation. Geoff touched upon the reasons why we look at the angle or the pitch. We've got 50% of the solar panels at 15 degree pitch and 50% at zero to five degrees. So, just to visualize the site, the solar panels are placed on a building called the animal house. And we selected the solar panels to go on this particular building because it's facing north, there was plenty of room, was no skylighting. The roof area behind that did have skylighting and it had a little bit of shading. On the photo on the right-hand side shows the inverter set up, as well as the battery set up. And the next slide, will show the battery.

Mario Como:

So, the battery is a 100 kilowatt hour battery system, lithium-ion. The state of charge, which means how low it goes in terms of discharging, is quite low. And that's one reason why we selected lithium-ion. Also, very safe system in terms of fire hazards and all that. On the right, there's metering. So we metered the main grid, but also three buildings. And it gives us a good idea where the power is flowing. And also, metering on the solar system and battery.

Mario Como:

So, the photo on the left, which is the first photo, shows the grid protection of the system. And that's a radio frequency controlled unit. So, as soon as the power goes off, the system will shut down for safety. And we also have a diesel generator that kicks in.

Mario Como:

You can see the access ladder that we've positioned, the walkways and handrails. So, quite easily get around. And in terms of compliance, fully compliant. So, we're two meters away from the edge of the roof. And also, have installed handrailing on the 15 degree pitch roof.

Mario Como:

Now, in terms of just explaining why we selected a... The 15 degree pitch is almost perfect. I know Geoff was saying 35 degrees, but anything between 15 to 35 is almost perfect. We selected not to put the solar panels on a pitch on the other roof, mainly because it would've occupied a much greater area because we have to allow for shading.

Mario Como:

Also, within our budget, the cost of actually creating the stands that configure the pitch will also add to the cost. And with a 12% efficiency reduction, we thought that was the way to go. I think Geoff mentioned 15%. We're currently monitoring the efficiency of the system. It has peaked at 102 kilowatts when we have had full sunlight irradiance, which is very pleasing to us.

Mario Como:

The next slide demonstrates our energy monitoring system. So, we've got the electrical meters, which services the dairy feedlot buildings and the animal house, as well as the main meter. With the online systems, the solar inverter provides a very good online system to capture the data and also the status and faults. So, we're monitoring using the online system as well.

Mario Como:

And also the battery. We have the battery monitoring system. And you can see the state of charge is at 66%. And what we currently have, if you look at the green part of it, you'll see it fully charged at night. And then it released its charge at 7:00 AM. Milking occurs at six to nine o'clock. So we're trying to take advantage of the peak period costs there.

Mario Como:

We're also trying to recharge during the solar production period. And then, trying to fully during non-peak hours. So, we're trying to shift that load, but we're still experimenting with the battery trying to get the best out of it. Next slide.

Sarah Clack:

So, just before we move on. So, using the grid power as well during that off-peak time to charge the battery, as well as having the solar to charge the battery?

Mario Como:

Yeah, there's a bit of a balance. It needs some grid power, but we're trying to... It's been six months now. So, we're doing a reflection on how we best configure the battery. So, the battery has smarts and goes into automatic mode. So, it does use some of the peak power during the day.

Mario Como:

So, I wanted to give a cost to the system and I've put it in terms of a dollars per kilowatt and a percentage. So you just have to multiple it by 100 and it gives you the cost of what's been spent on your items. So, the solar panels cost about 20% of the project. The inverter was 3.6%. Now, the solar panels and the inverters, the inverter can increase to about 5%. Solar panels can come down.

Mario Como:

We chose a known brand solar panel. And with the inverter, we've gone to a very reputable brand. We could have gone for a much more expensive inverter. The battery system about 34.8% of the project costs. The metering, additional metering was 3.2%. The solar inverters and the battery do provide their own meeting online system. But we went and got some extra metering specifically for educational purposes and also, recording where all the power is going.

Mario Como:

Walkways. Walkways are 14%, which is worthwhile money spent, I feel, because it's easy access. If we do have any issues, we can get on the roof quite easily. And also, for our purposes, educational. For farmers or for other people that want to attend sites and see the system. Installation materials, protection and other was about 24.4% of the cost.

Mario Como:

So, it was about $2,500 per kilowatt. And just touching on the renewable certificates, we chose a systems below 100 kilowatts, where the installer can claim the renewable certificates, which suited our budget as well for that reason. Above 100 kilowatts, you have to actually manage the renewable certificates yourself. And maybe Geoff can explain a bit more on that.

Mario Como:

And just touching on the system. Production, emission reduction and payback. So, payback about five to six years, and we'll be monitoring that as we go. The dairy farm energy use was 340,000 kilowatt hours. The solar production is 145,500 kilowatt hours. We're using all that solar on site. We're not exporting any of that. So, we're getting a 42.8% drop in terms of energy use on the site. And once again, we'll be monitoring that.

Mario Como:

In terms of emissions, tonnes of CO2, on that particular part of the dairy it's going to be about 42.79% drop in emissions. I think that's it. And can answer any questions. Thank you.

Sarah Clack:

Awesome. Fantastic. Thank you for that, Mario. So, I'll open it up for questions now. So, we have had one question come through so far. And it is, is it possible to power a whole house by solar that's generated on-farm, and that's say in an off-grid situation?

Geoff Lodge:

Yes, is the answer. And you would need battery storage as part of that scenario that was just presented. And those sort of configurations have been around for decades. The good thing about the available technology that's in the marketplace, is it's a lot more cost effective and the maintenance is a lot lower than conventional battery systems. So, it certainly does work.

Mario Como:

And once again, you've to size the battery because a five kilowatt hour battery would only last so long. And depending on your home, how much it consumes, it could quite easily deplete quite quickly.

Geoff Lodge:

And if I can just make another comment. In terms of the cost effectiveness, if you're off-grid, it's a totally different scenario compared to if you're on the grid. And even though it's very popular for the investment in battery storage, both for domestic and commercial applications, the economics still struggle. Even with the government grants and incentives in play.

Geoff Lodge:

The promising news is that the technology has improved to the point that the serviceable life of the batteries are now pushing out 15 years. But even so, you're still struggling to break even. There will be some scenarios where it does, but in the main, it's still not an attractive proposition.

Geoff Lodge:

And you may be motivated for reasons other than the return on financial investment. And it is a way of shifting the load and reducing your carbon footprint. But in that context, you might also want to look at what other investments you can do to reduce your carbon footprint.

Geoff Lodge:

And for most of our clients, we caution and suggest that you delay investing in battery storage and look at other operations. Particularly, that there scenario that I described, there are opportunities of spreading the load which is more cost effective at the moment.

Sarah Clack:

Fantastic. Thanks, guys. There is a question here for Mario. What was the battery warranty for the batteries you guys have installed at Ellinbank?

Mario Como:

Battery warranty is 10 years. And we looked at that when we selected our battery. So, we looked at local support. So, the companies got support in Sydney and Adelaide. And we've already had to use it once, where we had the battery fully discharged. Yeah. So, make sure that there is support and a good warranty behind it. Sometimes you do have to pay a little bit extra for the warranty, but yep, 10 years.

Sarah Clack:

Fantastic. Thanks for that, Mario. I've got a question for you, Mario, because I know that there is exciting stuff happening down at Ellinbank with the energy. What are some of the interesting things you're doing with the solar energy onsite as part of your demonstrations?

Mario Como:

So, with the milking process and we're trying to just make sure that we're getting the best out of the solar and it's getting to the areas where it's most appropriate. So, at the moment just monitoring the system. But within the dairy itself, we are setting up more efficient chillers, more efficient hot water systems. And mind you, we're having to replace the existing hot water systems. So, we're taking the opportunity to go away from the standard electrical hot water system to a CO2 heat pump system, which should save a quarter of the energy.

Mario Como:

So, those sort of things. But we're monitoring incoming water temperatures and that sort of thing. So there's quite a bit going on there. We're also doing hydro, trying to get electricity out of hydro and wind, and that sort of stuff. So, it's all pretty exciting.

Sarah Clack:

No, it definitely is. It definitely is exciting down there with some of the stuff you're doing at Ellinbank. Yeah. And hopefully, yeah, there's more opportunities over time for farmers and service providers to engage in some of the findings that are coming out of Ellinbank. So, keep your eyes pealed as there will be stuff over the life of the project coming out about the technologies. So, we've had a question here about, what is the typical life of a battery? And what are options for disposal of the batteries?

Mario Como:

Yeah, that's a good question. And at the moment, a typical life will be 10 years. So with the lithium-ion, we've charging this specific particular battery because of the warranty, guarantee and some history behind it. But because it's a new playing field. It's been around for quite a while, but technology has increased. So, there's more smarts, there's better performance. We're able to control the battery status a lot better. So yeah, I'd say 10 years, but I'll have to do a bit more research on that as well.

Geoff Lodge:

Just to add to that, Mario, the lifespan of the battery is defined not in time, but in cycles. And it depends on the depth of discharge and just the history of the use of the battery, which can have an impact as well. But I do take your point that the technology has improved. The lifespan has certainly extended. It was only five years ago you typically were looking at, under normal operations, between five and seven years. Whereas now, you're talking between 10 and 15.

Geoff Lodge:

In terms of the recycling. I reckon that's a great question. And it's certainly problematic. There's research underway on how to dismantle and capture the components within the battery, but you're not seeing any commercial scale wide application of recycling batteries. And that's a problem.

Geoff Lodge:

It's similar with solar panels. There is a company in South Australia. There will be more popping up in due course but it is problematic. It's deemed e-waste, so it's banned from landfill in Victoria. I think that's a very good move, but there's an emerging opportunity to capture and recycle that must be deployed.

Geoff Lodge:

In turn in terms of, I guess, on the theme of recycling and embedded energy, because many of the manufacturers of those solar panels come from renewable sources, their carbon footprint is very small. And in most cases, the embedded energy will be back to zero in twelve months. In many cases, it's less than six months. This is really impressive, but the weakness in all that process is end of life and recycling. That's what's critical that must happen.

Mario Como:

And just touching on that point with the Toyota hybrid and the lithium batteries in those sort of systems. There's very good recyclers out there that are currently recycling the batteries. You just have to put a process in place and just make sure you're compliant to the disposing of the battery, which is EPA requires that approval. You can't just throw a battery to landfill. So, batteries I think are pretty good and easily recyclable at the moment.

Sarah Clack:

Yes, so I would like to thank Geoff for presenting today on solar opportunities on-farm. And some of those things that farmers have had some issues finding information about, about that process of connecting to the grid and those other things around maintenance, et cetera. Where some farmers have come unstuck in the past with their solar systems.

Sarah Clack:

And thank you to Mario for giving us a fantastic overview of the solar system that has been installed at Ellinbank. And I am sure that over the next few years, we'll be hearing lots about that solar system and a lot of the other energy technologies that have been happening on-farm at Ellinbank.