Sarah Clack:

Welcome everyone to our second webinar in our energy series. And we've got Gabriel Hakim here today to talk to us about energy efficiency. So, I'm quite excited about today. Gabriel is well known in the dairy industry and in the energy industries. Gabriel's been involved in the dairy industry for over 30 years and has worked with farmers and service providers in areas of mastitis control, milk quality, dairy hygiene, refrigeration, milk machine performance and their interrelationships.

Sarah Clack:

So, from that, Gabriel transitions then into the energy space. So for the last 15 years, Gabriel has been focusing on energy efficiency and sustainable energy technologies and how they can be best utilized in the dairy industry. So, he's got a passion about helping businesses to become commercially clever about their energy. It's going to be fantastic to get Gabriel to share those insights with us today. So today Gabriel is going to be talking about energy use on dairy farms and energy efficiency opportunities for dairy farms.

Gabriel Hakim:

Thanks very much for inviting me today. I can see from the registrations that we've got people today from a whole range of different backgrounds. So I hope that the information that we provide is actually applicable to your situation and your perspective. To keep within the timeframe that we have, I've narrowed the scope to energy use at the dairy only. I acknowledge that there are some, or particularly the irrigation dairy farm where energy use in the dairy comes a very distant second. But today I just want to focus on the energy at the dairy.

Gabriel Hakim:

And why there’s such a focus for energy at the dairy because farmers particularly have been telling me that the energy costs of the energy at the dairy been a significant factor and a significant focus of their attention to try and manage costs. As you can see, over the last 10 or 15 years the cost of power has really gone up. But fortunately the last few months we're starting to see prices come down.

Gabriel Hakim:

The other reasons I've been told that farmers express to me is that they're really uncertain about the information they're getting around energy use. Their concerned about power shortages and power outages. They want farms to become more secure. There is also community pressures in terms of people wanting us to move more and more to renewables. So, there's a whole lot of questions, there's a whole lot of concerns and it's often very difficult to find and navigate this new energy landscape. So, the other thing is that when you do want to make a move often the investment required is quite prohibitive. And so, it really poses quite a few challenges in trying to make a transition.

Gabriel Hakim:

So, what's happening in terms of what farmers have been doing. Well, I would say major response by dairy farmers has been to install PV. And we see systems from 5 kilowatts to now 100 kilowatts going on dairies and I want to talk about that, that's been one reaction. Another reaction or response has been particularly five or six years ago a lot of farmers decide to try and reduce their costs and reduce energy use by taking shortcuts. And that involved things like reducing the temperature of their hot water in terms of adjusting their thermostats, some farms started skipping wash cycles. So for example, in the PM wash they would not do a final hot rinse purely to try and save money. I also notice that scheduling and servicing was being stretched which has its own out challenges and consequences.

Gabriel Hakim:

Some farmers actually do a bit of negotiating and they found a better retailer because as you can recall, especially in the last five or six years there was, you go one to one retailer and they offer you a 35% discount or a 40% discount. And so, there was a lot of discounting and a lot of confusion as well as people try to find a better price. If you think about all these changes are just trying to save on costs. It seemed like a vicious cycle because you can make some savings, and some people made some huge savings, but in the end it's frustrating because you're always chasing your tail because it's really just a passing mechanism.

Gabriel Hakim:

What we're really interested in trying to see is how we can improve the situation by tackling how much energy is used and how well its being used. And that's what I want to focus on today. So where is energy used at the dairy. What I've done here, I've actually presented some information regarding the results of energy audits I have been doing over the last 10 or 15 years. Here's a sample of just over 200 dairy farms that we audited. And what I've done here is I've broken up the energy use of the dairy into seven categories. Milk harvesting and cooling, water heating, cleaning, pumping and feeding and so forth. And there's two dairy types. The yellow one is the conventional milking system dairy and the darker one is the robotic dairies. Because we've done I think, I audited about 16 or 18 automatic dairies.

Gabriel Hakim:

What you find typically, and it's interesting, even over the last 10 years, the energy mix or the energy use mix hasn't changed much on a dairy farm. We still find that milk cooling, water heating and milk harvesting are the predominant users of energy. And depending on the farm, even though it's small farm or big farm, milk cooling still around 30%, water heating is around 30% and milk harvesting is around 18 to 20%. And in milk harvesting the biggest energy user of course is the vacuum pump. Which is usually around 16 to 18% of the total energy use at the dairy. Water heating is around 30% as I said. These are general or variable figures represented by the survey.

Gabriel Hakim:

But what's really important is that you need to find out what's happening on your farm and the best way to do that is through an energy audit. And one that focuses on all these key elements. But the energy audit is only one component is about finding where the energy is used. The real essence or the real insight is looking at how well the energy is being used. So for example, with milk cooling, how efficient is your milk cooling system. Or how efficient is your hot water heating system. So if you do get an energy audit, don't just look at the break up because it's interesting. The challenge is really delving into how well that energy is being used.

Gabriel Hakim:

So, you get your energy audit. You do a bit of assessment, you look at your energy use and how you compare. One way of comparing is looking at a thing that we call energy intensity. Which is basically how many kilowatts you use per 1000 litres of milk. Or we can look at the costing per 1000 litres of milk. The easiest comparison is using the kilowatts per 1000 litres of milk. And the average that we found out of probably 500 audits, is about 50 kilowatts per 1000 litres of milk. This number has been bandied around the industry as an indicator of efficiency, I think it's really just as the word implies, an average. I mean, you can go to some dairy farms that use little power, because they're being frugal. And they can actually get a low intensity but it doesn't mean that the energy they actually use is efficient. So you've got to really be careful on how you interpret these numbers.

Gabriel Hakim:

So, if you’re going to tackle how much and how well, with that there are three steps that we need to do. And the three steps involved, one using less energy, two, an increase in the efficiency and then the third step is how you've then source the cheapest energy. So let's look at the first one here. What do we mean by use less energy. Well, there's two components here. One is about reducing waste and the other one is about reducing demand. And these are really obvious things, they should be the first thing that you tackle.

Gabriel Hakim:

So, stuff like turning off stuff when it's not used. Now here's a very small example. This is a dairy farm in Tassie and now when I did the audit then, I notice this light here. This little in inconspicuous light, which they told me was on all year or most of the year. Now, it only needed to be on for a small period of time. So, by doing that even though was no big numbers it was nearly $300 worth of savings just by one light. Having cooling systems that are well insulated is another way of stopping the heat gain and therefore need for cooling. This tank was outside and you can imagine what happens in summer. This tank here below, the ambient temperature outside was 18 degrees, but when we measure the surface temperature of that tank, it was 45 degrees. And you can feel the heat coming through into the inside the tank. So you imagine the impact that has on cooling. So, these are working at ways to reduce what you're using and also to get rid of waste.

Gabriel Hakim:

The second step's about increasing energy efficiency. Now, what we can do is simply how we do the things around the dairy in a better way. So, energy efficiency is all about achieving the same outcome using less power. Or, another term that gets used is called energy productivity. Which is about using the same energy, but actually getting a better outcome. I'll give you some examples shortly. So how do we actually become more efficient. And here's a simple, simple thing that we often overlook.

Gabriel Hakim:

For example, here's a small refrigeration unit which is at a small goat dairy. Now, this condenser here was inside and there was a whole lot of equipment around here and it could barely work because the air circulating was hot air. That was incorrectly located. Here is an air compressor, now on robotic dairies air compressors are a significant power user. Here's one with a blocked filter and so therefore, it was running probably 20 or 30% more than what it needed too. Here we've got icings on the back of a vat, which indicates that the system is always in service. Therefore, they're using a lot more energy or wasting a lot more energy trying to cool that milk.

Gabriel Hakim:

The third step is about increasing the energy, sorry, about how you check get the cheapest source of energy, often that's renewable. As we know now, renewable energy is the cheapest source of energy. So, the response has been people put on solar PV, but it's not really a fix. I mean, solar PV is a good source of cheap energy, but what happens, let’s look for the typical dairy farm. This graph shows you the power use during the day. So here we start around 10:30, 11:00 at night what happens. The hot water service turns on and starts heating water. That continues to about 1:30ish and then it’s probably at the temperature, but this between 1:30, 2:00 to about 4:00 is just maintaining that temperature.

Gabriel Hakim:

On this typical dairy milking starts at around 4:30. And here we have when all the equipment is being used and then the same thing in the afternoon. In the middle of the day, we have very little power consumption. So, this graph hole causes some issues. Here we've got all the equipment being used. And therefore, we're seeing demand charge is coming into the dairy industry, this causes us to have higher demand charges. When we put a PV system on this is what typically happens. Most of the energy was generated obviously is in the middle of the day. Some dairy farms have got the ability to put panels to face more westerly and they can catch more of the afternoon sun. And therefore, offset some of the energy used in the afternoon.

Gabriel Hakim:

But still, most of it is not utilized and therefore, it only gets exported and therefore you offset the cost of power. Really, it's a pricing thing but as many of you will know, or have heard in the media, that there is some challenges now with so many PV systems supplying power for the grid. That there are a lot of export restrictions going on and with the price that people are receiving for their exported power, is reducing the overhead price, it's now down to six cents per kilowatt. So, this really creates a challenge and that's why PV systems are great if you're going to use them strategically. And in this example, you don't get very good use of your PV investment.

Gabriel Hakim:

So, if you really want to drive down energy costs and by reducing your energy use and improving your efficiency, you've got to do these things first. Because if you don't do these and then you go to try and get your PV system or your cheaper energy source, then you're wallpapering over the energy waste. You're wallpapering over the inefficiencies. Which means you need a bigger or more energy to cover those things, which often results in a much higher or much larger PV system.

Gabriel Hakim:

So, what are some practical things to do. Okay. Now, believe it or not in 1994 we wrote a book about cooling milk on dairy farms and I am sad to tell you whilst cooling can be really efficient, we still see a lot of dairy farms where the basics of cooling efficiency aren't being undertaken. So, often farmers they can't tell whether their plate cooler is working for example. It makes things hard. So for about three bucks you can get a temperature sticker, which is like a fish tank sticker. Put that on the water inside and put another one on the milk outside, on where the milk comes out of the plate cooler. Check that the coolants and the milk flow in opposite direction. These are basic things to do.

Gabriel Hakim:

For those of you who have got the large industrial plate cooler. The difference between milk coming out and the water going in should be two degrees. So, waters going in at 18 degrees the milk should be coming out at 20 degrees all the time. For those with farms with the older style plate coolers, usually a lot smaller, it is a three degree difference. So, the thing about plate coolers is it's the cheapest way of cooling milk. Because you're getting away from the bore or getting water from the stream. And that bore water is usually around 16 to 18 degrees, so that means you can get milk in vat at about 20 degrees. But we have seen these things not work very well and milk goes in at about 26 or 27 degrees.

Gabriel Hakim:

Most of the time we found that they're, instead of two degrees and instead of three degrees, it's more like six degrees difference or seven degrees difference. So, for every million litres of milk, if you just did that you'd save almost 400 bucks a year. So if you're doing three million litres of milk a year, just by doing this simple improvement here, you save around 1200 bucks off your electricity bill.

Gabriel Hakim:

Here's a prime example. We put some stickers on this plate cooler on this dairy in western Victoria and the expectation was a two degree difference between milk coming out and water going in, it was actually ten degrees. By improving that, it could reduce the bill by nearly $1350 and that was back in 2018. I asked the farmer why was this the case and the problem was, that's how it was installed back in 1998, so 20 years the plate cooler has been working the wrong way. So, you can do the math’s there to see the impact that’s had.

Gabriel Hakim:

When it comes to heating water most dairy farmers have the old hot water services, Wilson or an instant hot water and they're really, really inefficient. Okay. For every unit of energy that you put in, you're only going to get one unit of heating out. The unfortunate thing also, they've got poor insulation, so we've measured up to 20% heat loss. 27% of the energy gone in to heating the water is lost through inefficient insulation or poor insulation. A lot of farms need to check the temperature, if you're coming out in the morning and you're seeing steam coming out of the top or the heater is boiling, that consumes a whole lot of energy.

Gabriel Hakim:

In fact, to make water boil you need almost 550 times more energy than you do to get it from 85 to 86 degrees but that's a real problem. I've seen a lot of farms where the thermostat is up to 100. You don't need that. And in fact, if you put water into a milking machine at 85 degrees, at 50 kPa the water will boil. And the steam will be generated. Cleaning performance will be reduced and you'll damage the vacuum pump.

Gabriel Hakim:

So, the typical dairy farm say uses 1200 litres of hot water, this unit is costing you round around $6000 a year to heat water. There are better ways to do this. For example, commercial heat pumps. Now I hear, once I mention the word heat pump everyone cringes and says, "Oh, they don't work their hopeless." And because a lot of people had bad experiences with the Quantum heat pump that were installed six, seven, eight, nine years ago. And the reason why a lot of those failed because they were installed incorrectly, pumped incorrectly. And they weren't maintained the way they should have been.

Gabriel Hakim:

But if you get a commercial heat pump, one unit of energy you can get up to about nearly five units of heating. So that's a huge difference. Also the tanks are really well insulated. The heat loss if very small, so you're not wasting heat. So for the same amount of heating you're using 75% less energy. So, the same 1200 litres of hot water and these heat pumps, the new commercial ones, will heat to 80 or 90 degrees. So for our 1200 litres of hot water a day we could save nearly four and a half grand a year. By installing these systems the paybacks around seven and a half years. And if you get on to the AEIP grants and you can get 50% towards this then your payback is less than four years.

Gabriel Hakim:

Variable speed drives. Now I see a lot of farmers wanting to put in VSDs on milk pumps because, and we all know the reasons. Really, for three and a half grand I can't see the benefit. A lot of these systems cost between three and five grand to install. I really can't see the benefit. The claims that about milk cooling improvements yes, but really if you fix the plate cooler you shouldn't have a problem. If you do want to go down this track, why not consider a butterfly valve with a hole drilled into it as a flow restriction. As a way of restricting the flow. For 200 bucks you can achieve the same outcome.

Gabriel Hakim:

For vacuum pumps it's a very different story. For those farms that have two vacuum pumps for example, a lot of the old rotaries built in the 90’s or if you look at your test report form, and you've got excessive in reserve or your vacuum pump run for more than five hours a day or if you got a double up dairy with pulse action, you're a really good candidate for a vacuum pump. Or a VSD on a vacuum pump. Also, blower vacuum pump. They're ideal for VSDs or for those oil ring vacuum pumps you can also slow down the pump. It just might be the cheaper option.

Gabriel Hakim:

So, here's, I want to show you an example this is a farm in the Western Victoria, which has just installed a VSD on a vacuum pump. A vacuum pump with a blower type vacuum pump. The dairy is a 50-unit rotary with cup removers and milking about 600 cows. The average daily consumption of the vacuum pump was around 48, 49 kilowatt hours a day. The VSD was installed on the 4th of February. And after that the daily consumption almost halved. So, it would be worth a savings there of around 9000 kilowatts and almost 1500 bucks. And with a 3.8 year payback before any grants or whatever. So that's a really good example of how VSDs can work. The other thing is that VSD on this vacuum pump have reduced the demand charges as well.

Gabriel Hakim:

So, what do we do about people’s solar For those farms that have got solar, for those farms that want to put solar how do you do it. Well, you have got to actually change the way we do things at the dairy, you have got to change your thinking. You have got to think "How can we move this load into where the sun shines." So you have got to challenge why you do things. You need to look at the whole dairy because there's more than one piece of equipment, so let's focus on what we can do.

Gabriel Hakim:

First of all, what we don't want to do... There's a real drive to put in huge chillers because people really keen to get their milk down to four degrees by the time it hits the vat or six degrees. The problem with this is huge chillers mean huge power requirements and often the PV system you can't neutralize this because this happens during milking. Not in the middle of the day. A different way of doing that is we can load shift, we can actually create a thermal battery, we can use a system which is a third of the size, we can run that during the day using the solar and therefore we can reduce the cost of cooling milk by 30, 40, 50, 60%. With heating water the old way is really the old way and it's an inefficient way.

Gabriel Hakim:

36 kilowatt or even two 18 kilowatt units, we can do the same job with 6.7 kilowatts, still get 90 degrees. But the other thing is, now because it is only 6.7, we can actually do it here, using our solar PV whereas in this instance we can sort of do it but it doesn’t actually do a very good job. The other question around heating water is, do you really need 90 degrees. We actually don't. So, here's a system, which is a reuse system, it's been going now for five, six years. It's low temperature, so it's around 50 degrees for one of the units. And this here is one to two kilowatts per day if that, so the cost is easily reduced.

Gabriel Hakim:

I just want to finish up now with how you bring it all together. So here is a dairy, it's a typical dairy, 40 units and double-up. In 2016 it was about 18 years old, it was about 300 cows and the annual power consumption was 123,000 kilowatt hours. The farmer and I got together and we decided to build a, we had two options: to build a new rotary following traditional way which is bigger hot water services, et cetera, et cetera. And with some efficient stuff like a VSD on the vacuum pump. That was typical, but instead we opted to do a really energy efficient dairy. So the farmer built a 50 unit rotary with every bell and every whistle. We've got milk metering, we’ve got cow ID, we've got condition scoring cameras. They have a big office with a lunchroom, a computer system with everything that opens and shuts. There’re security cameras running, all sorts of stuff. The interesting thing was that we also increased the number of cows on the farm and milking (time) went down.

Gabriel Hakim:

So, after a year or so, 18 months later I went back and we did a review. Now here’s the original dairy 123,000 kilowatt hours. If we built a traditional rotary dairy, we would see the power use would be around that 164. On this dairy we're actually using less than the old dairy. A good proportion of that is coming from the 45 kilowatt solar system, which we use 80% of the energy that's generated. The outcomes been, well we've got more cows, more milk, but we had a dramatic reduction in the bills. We've also reduced the energy intensity of this dairy. The dairy was completed in October 16 and you can just see what happened with the bills in the ensuing months.

Gabriel Hakim:

So, I want to wrap up now. Some of the myths that we encounter. We don't need hot water, we don't need 90 degrees. We don't need these high temperatures to really clean the milking machine effectively. But you just can't turn down the thermostat, you need the right wash program to do that. It is a huge saving if you go from 90 to 40 you can halve your heating costs with no real change in the cleaning costs. You can also then use things like heat pumps and preheaters and therefore make huge savings there as well.

Gabriel Hakim:

Don't opt for a huge glycol chiller I have some at around 120 kilowatts because they say that's the only way to cool milk. Well, it's not. We can do things with... So let me go back here. With this dairy we opted for the 12 kilowatt chiller. Everyone said we couldn’t cool the milk unless we had a 85 kilowatt chiller. We've done the same job using probably 20% the energy that would have been used with a chiller. So, make sure that the plate cooler is working. Most people, like I said, are sourcing water from a bore which is easily around 17, 18 degrees. That's really the cheapest way to cool milk using that external source.

Gabriel Hakim:

So, let me just wind up now. So how do you make it work for you. Well, it's obvious. Don't do number three first, do number one. Then do this component before you put your solar on but also, have a way of monitoring what you do. Don't just set and forget. We did 29 dairy farm audits in Queensland not long ago. Of the people with solar PV on their rooves we found that 70% of those solar PV systems weren't working and the farmers didn't know about it. So, you need to monitor and you need to fine-tune. Then you need to go again. Here's an example, of a monitoring system at the dairy that we talked about, the rotary dairy where we constantly monitor stuff to make sure it's working efficiently and effectively.

Gabriel Hakim:

You’ve got to manage your system and then there is other equipment and then you can deploy equipment such as solar diverters. Or systems where you can capture the solar energy and you can divert to other uses. So, there's equipment around to use, but this equipment should be used at this point, which is number three. You need to do these things first if you really want to make an impact.

Gabriel Hakim:

So, finally, I'd just like to wrap it up and just say look, I encourage all farmers to participate and get involved with the ag energy investment plan where you can get some grant funding to do energy efficiency work. It's really, really fantastic because it's one for one. I think you would be silly not to take it up. And there is additional information on the Dairying for Tomorrow website as well.

Gabriel Hakim:

So, Sarah, it's been a bit of a rush. It would be good if we could open it up for questions than we'll go from there.

Sarah Clack:

Fantastic. Thank you Gabriel. That was absolutely fantastic. I have heard you speak once or twice before and it has always been fantastic to listen to you speak with just the wealth of knowledge you have there. It's always great. We do have a few questions that are coming through at the moment. We've got one from John. That is, would it be possible to use heat from milk to get hot water with a heat pump?

Gabriel Hakim:

Yes. John for example, this farm here we've got an extra plate cooler and we are doing this on a new farm where were using them before milk goes through the traditional plate cooler we're capturing some heat off the milk into the plate cooler into this rinse tank so were achieving 32 degrees in this tank. This is one way of capturing heat from the milk. And of course, the other way is to put a heat recovery unit on your refrigeration unit. This really goes well with farms that have got a year-round or split calving pattern because it is dependent on milk flow and you can achieve say 50 or 60 degree water through the heat recovery unit.

Sarah Clack:

Awesome. Fantastic. Hopefully that answers your question there John. We've had a question come through from Helen. She's just wondering what about any new technologies that are on the horizon that we should be aware of. So is there any new energy technologies on the horizon that we should be aware of that'll be suitable for dairy?

Gabriel Hakim:

Yes. There's some exciting stuff that's sort of on the cusp, but the issue that we have or my issue with new technology even though I love it, the reality is we need a robust no nonsense technology to work on dairy farms. And so for example, we’re looking at building refrigeration units that use DC mode rather than AC mode. And that's a hugely efficient way of getting the energy from say a PV system or wind turbine and directly cool milk because you don't have to go through transformers. And DC mode is far more efficient.

Gabriel Hakim:

The other ways that we're thinking of, and I am involved with a few renovations where the new technology is actually not that fancy, but it's really valuable where for example, let me go in here. When you have a monitoring system that captures information. The next step, I reckon, is using that information to make decisions. And this is a power diverter here from energy smart water for example, we've said, "Hey look, we've got excess power, the hot water service has been heated can we divert power to do another job on the farm?" So that's where I think the next opportunities. Using that energy from the sun PV system and getting it to do jobs that may not be based on a timer or a schedule, but it's based on what's really happening.

Gabriel Hakim:

So, the hot water doesn’t need heating for example, on the shed here we've got the chiller unit running through the day. It cools a body of water, which is our thermal storage battery, now that might finish cooling by say 1 o’clock in the afternoon. The sun is still shining, what other job can we do now because it's a sunny day. Well we’re actually going to tell it to turn on this other condensing unit, which is used for the first plate cooler so we're doing other jobs. Or we can turn on the feed mill and actually… turn on the grain crusher and crush some grain. So the next step for me I think is being smart on how you use the energy you are generating on your farm because I think most dairy farms that have a PV system may only actually utilize 20 or 30% of power that they generate. And the rest gets exported or gets limited so how can we be clever about how we use that.

Sarah Clack:

Fantastic. That's great Gabriel. Yeah, definitely with our solar especially because our highest demand periods in dairy aren't during that middle of the day when we're generating that solar. Being innovative with how we use that is definitely something we need to be thinking about.

Gabriel Hakim:

Can I just add in here the cooling system here on this dairy this is a 600, 700 cow dairy. The chillers are the same size as you would put in a 200 cow dairy but were doing the job here. But, in building this dairy we spent 120 grand more than a traditional dairy. The paybacks has already paid for itself, a four year payback. And now we are in front. It's costing only a couple dollars a day to cool milk. And in this case we're also heating water as well off the chiller so heating water is costing only probably a dollar a day max. So it's about how we're using that power making decisions.

Sarah Clack:

Fantastic. Thank you Gabriel. We have had a question from John. And he says, "You talk about the old Wilson hot waters going to about 90 degrees. Any ways of using heat pumps to reach this temperature?

Gabriel Hakim:

Yes. Yes. There's a couple of brands now, which they're commercial heat pumps using CO2 as a refrigerant and they will achieve 90 degrees easily. Okay. So, when you've got two units going the AEIP program is doing some work... Some demonstration sites. We've got one in South Ecklin on farm there is a heat pump going in there. We are going to heat 90 degrees water using a heat pump and that's going to be run predominantly using the solar PV system. So we hope to reduce power consumption by 80%. And then reduce the cost of the power by about 90% because we're going to do most of it on PV rather than doing it off peak, so yes, there are a few systems around. If you want to contact me later, I can put you on to the right people.

Sarah Clack:

Awesome. Fantastic. We do have a couple more questions. So we'll keep pushing on through those questions if that's okay Gabby. And I have muted you just due to there was a bit of feedback happening there. So, we've had a question from Libby. So what about batteries for solar PV systems.

Gabriel Hakim:

So, well Libby. Look batteries are a great idea, I'm a bit biased because I think the cost of buying a battery system for dairy farm use is still not financially viable because you need a lot of batteries, and it's still quite expensive. Even, I have seen prices at 400 bucks a kilowatt it's still not a viable option. There are better ways to think about other types of batteries which are things like thermal storage. And so, rather than doing an electrical battery where you're going to do like a cooling battery. Or a heat recovery system. There just another form of energy storage.

Gabriel Hakim:

I think in the future, three or four years’ time, I think battery will then become a good option. So if you're thinking about putting in a PV system, the question that I'd ask your supplier of the PV system, “is my inverter battery ready?” So when the price point comes it can be done. When I looked at, nearly four years ago, I looked at batteries for that dairy that I just talked about, the rotary dairy, the battery then costs $250,000 to have sufficient battery power to run the dairy side for a day and a half. So, it's not a viable option at the moment I don't think.

Sarah Clack:

All right. Thanks for that Gabriel. We have had a question, what's the rough price of an energy assessment for a farm? And what are the general payback periods for different types of investments?

Gabriel Hakim:

There's two types of energy audits. There is a type one and a type two. Type one, for want of a better word, a simplified one. Type two is more in-depth where give a lot more analysis. Depending on the size the type ones are somewhere around three and a half to four grand. The type two can be anywhere from 10 grand to about 16 grand depending on the complexity. That's with the AEIP program is really good because you get this paid for.

Gabriel Hakim:

In terms of payback, certain equipment like with VSDs on vacuum pumps, like heat pumps, like thermal storage chiller systems I think can vary between five and 12 years, somewhere around there. That's before you get any funding. So, if you can get funding, which is one for one, that brings the payback from say two years and six years. And as I said at the start the big challenge for most dairy farms is the cost of change is so prohibitive because even if you change hot water service from the old Wilson or instant type heat pump. A new heat pumps going to cost you say 30 grand. You can go and by the old system for about 12 grand.

Gabriel Hakim:

But over a 10 year life you're actually going to be far better ahead with the heat pump, but that change is difficult. So, this is where I reckon it’s a really clever move to use the AEIP to help you make that transition. Once you've done that then the sky's the limit because then you can use PV to run your hot water system. But it's too hard to do with the traditional hot water service because you need to have preheaters and so forth.

Sarah Clack:

Yeah. Thanks for that Gabriel. We've had a question come through regarding batteries. What's the dollars per kilowatt hour price that makes it viable for dairy farms to utilize batteries?

Gabriel Hakim:

I haven't done the latest figures. I thought, by a number you are going to quote me. I did some work on this about eighteen months ago. And it's changed I think there's a figure around 130, 140 per kilowatt. At that stage batteries were down to about 400 and still, they're coming down again. But also, the challenge is the life of the battery. Everyone quotes these long lives of batteries. But I'll look at the economic life, which is probably 7 years, rather than 10, 12, 15 years. Some battery suppliers will give you 25 year life of the battery. But I don't know enough about that area to, as a general thing you need to go into specifics. And we can't make comparisons like the domestic market, which as you know is homes using things like Tesla batteries and so forth because were an entirely different scale here. And so, the long and short of it is that I reckon at round about 100, 150 bucks is starting to come close, but again on the life of the battery as well.

Sarah Clack:

Thanks for that Gabriel. And when we're considering the costs for different investments and the payback periods are we also considering the stacking of the costs like the savings on demand charges, et cetera when we're looking at those paybacks?

Gabriel Hakim:

Sometimes we do that. A lot of the simple paybacks don't often factor in demand charge reductions. What we find is that, I reckon I may have seen a thousand in dairy farm bills in the last six or seven years. And I would say probably 80% of dairy farm bills that we see there were no demand charges. But demand charges are starting to creep in. On those farms we’ll then look at the impact on demand charges. So, it's really case specific at the level of detail and still the demand charges aren't as huge as other industries, but they are growing. They will become an important factor in the future I think, to include them in.

Sarah Clack:

Is there an opportunity or do you also incorporate bioenergy harvest from biowaste into your energy projects?

Gabriel Hakim:

The short answer is no, but the long answer is yes, we'd like to. There are a couple of people now supplying small units that might be suitable for application on dairy farms. But then again, the thing that I really want to stress here is while there are all these different options, a dairy farm is always bloody busy. And you don't want to then add more and more tasks and responsibilities onto a dairy farmer's workload. So, whilst all these new technologies are fantastic, you got to manage them. And that's why I want to try and keep it simple at the start. We know things like PV and wind work, we can actually track the performance. Whereas with other systems like bioenergy and all these other things fantastic, but then you have got to worry about the feedstock, you've got to worry about making sure the output consistent compared to the load. It's time and thinking power that's required to manage it. It's not a set and forget. So, at this point in time other things are great, but not practical for the dairy farm to go into the store tomorrow and incorporate into the systems.

Sarah Clack:

Fantastic. Thanks for that Gabriel. And I completely agree that the more complexities when it does come to anaerobic digestion and that they're definitely not a set and forget system. So, the other question and the last question we have here. And they said, "Thank you for an excellent presentation. Are there any geothermal heat pump applications in dairy farms in Australia so far to assist with water heating/milk cooling processes? Or, are there any insights into this being a potential?"

Gabriel Hakim:

Huge potential. We tried to get a geothermal heat pump up and running on a dairy farm down in Yarram, this was three or four years ago now. The only supplier. The issue I have with them is, if it breaks tomorrow, who's going to fix it. So you need a local person that can support the service. It is all well and good saying we have got this new kit but when it breaks down on Easter Sunday, you want someone that can come, otherwise you compromise the milk quality. So there is a mob in Gippsland that do geothermal heat pumps. They can only heat water to about 60 degrees and it's a good start. The problem I have is the support. I think as we get more and more into these sorts of systems, we're going to see better applications and more support in the rural areas. If we're going to Melbourne yes, we can see heaps of geothermal heat pumps, but that doesn't help a person down in Warrnambool or wherever you are. Yes, great idea, I really want to get them but I want to see the support come through first.

Sarah Clack:

Yeah. Fantastic. Thanks for that Gabriel. And yeah, that is one of the issues with new technologies and emerging technologies is making sure our farmers have that support so that they can implement them. And if there is a breakdown that they've got someone there to come in and fix the issues for them.