Kelly Wickham:

Energy Smart Farming is your 101 to energy efficiency. The Broker Connect pilot takes a bit of a deeper dive into energy efficient opportunities and sustainable energy infrastructure at large. So, that's where the origins of today have come. We wanted to drill into first principles, and one of the very I guess first steps in your journey to energy efficiency is to know where you're starting from, and this particular webinar will drill into that. I'd like to throw open to Dr. Nigel Crump to get things started. Nigel's a potato pathologist with extensive experience working in the Australian potato industry.

Kelly Wickham:

He's general manager and principal scientist for the Australian Seed Potato Industry Certification Authority, which is an industry-based organisation that operates the seed potato certification scheme in South Australia, Victoria, and Northern New South Wales. In addition to seed certification, Dr. Crump oversees the day-to-day operation of the Toolangi Elite Business, which produces GO potato mini-tuber and tissue culture plantlets. In addition to the general manager of his AuSPICA role, Nigel makes significant contributions to the Australian and international potato industry through as many adjunct roles, which include deputy chair of United Nations Economic Commission for Europe, specializing in sea potatoes and director Royal Potato Congress, as well as director of deputy chair of Potatoes Australia Limited.

Nigel Crump:

I was going to talk to everyone today very cheekily about the seven Ps of energy manage measurement and monitoring. It's really the first steps to assessing energy efficiency and the seven Ps, I wonder if anyone could guess. If we're in a live presentation, we might be able to talk about that, but the seven Ps... actually, my slide show is going forward. The seven Ps stand for proper prior preparation prevents piss poor performance, and that's really what we are been doing in our systems in using AgTech to actually capture energy efficiency. It's one thing to capture energy efficiency. It's another thing to actually capture the productivity and maintaining our quality.

Nigel Crump:

Just a little bit about, I'll speak of the company I work for. It's a not-for-profit organisation. It's been in operation since 1994. As Kelly said, our primary role is on seed certification. And what we've done there with ag technology, we've focused a lot on traceability, but we also have another business called Toolangi Elite, which produces the high health foundation seed material that's used for the potato industry. About 50% of Australia's potatoes start their life with us, and this is where we've used a lot of monitoring and measurement to actually get that prior preparation, the proper prior preparation so that we maintain our production. The Toolangi Elite Business uses tissue culture, so just running through a little bit about what the business does.

Nigel Crump:

We use this tissue culture as high health virus, free material that gets multiplied up into poly tunnels. These are insect proof poly tunnels, where we grow the potatoes as they would be growing the field. We grow many thousands of these plants in various settings. And at the end of the day, this is what we're actually producing these small G zero, generation zero minitubers. And as I said before, there's over half a million of them being produced there at Toolangi, and 50% of Australia's foundation seed supply. There's something like 430 cultivars in our tissue culture collection that we utilise. But in any production system, it's just like Forrest Gump. "Mama always said: Life was like a box of chocolates. You never know what you're going to get."

Nigel Crump:

We never know what we're going to have until we actually start measuring it, and that's what we needed to do in our production systems. And there is this always this balance between productivity and innovation. We can have something that's very energy efficient, but if it affects our production, we can't adopt it. We've spent a lot of time actually making sure that we get this right. One thing we actually wanted do in our AgTech target was that we didn't want a system that worked on the pump and then something worked on the greenhouse, and something then worked in the laboratory, and something worked on the cool room. We wanted one platform. We wanted one management system. I didn't want to learn different systems, and the staff didn't want to learn different systems for different operations.

Nigel Crump:

We partnered with Arcoflex, which is a company in Boronia, and our local electrician, Seco Electrical. And we actually devise these programs. We've got a little bit crazy. We've got over 155 sensors and controls, managing all aspects of pumps and cool room's pressures and water flows, and all this stuff. And I'm only going to go through a few examples of these there today. The systems become quite elaborate and that's why it's good to have that partnership between an engineering firm, or software development firm such as Arcoflex and our local electrician in Seco Electrical, and also just working together. Here's one of our systems from one of our polyhouses, which controls all the parameters and monitoring.

Nigel Crump:

The Arcoflex system then gave us data that we could actually use. As I said, that box of chocolates, we're actually working out what we needed to actually understand. Here, we're understanding temperature and water movement and electricity use in those polyhouse. But more importantly, as I said before, we could move quite quickly between any operation. Here with a click of a button, we can move between a pump shed, the seed lab or a given polyhouse. And that's what we actually wanted to utilize here, and we've done that quite successfully. To give some examples in energy efficiency as that's what Kelly had asked me to talk about, these examples, here's our cool room.

Nigel Crump:

We store for most of the year about all of our production at any one time. We have close to a million dollars worth of product in cool store, waiting for dispatch and distribution. What we used to internally here, we used to maintain our temperature. The sea potatoes are stored at three degrees, but these internal fans in this image here were running 24/7 all the time. The evaporator fans were running. We're actually able to identify using the monitoring system of looking where our temperatures is, and looking what fans are coming on. We're able to reduce that fan time by 75% running time. Now, those fans are only coming on five minutes up while the compressor is running and five minutes thereafter.

Nigel Crump:

We're able to reduce that use on those internal fans. But more importantly, we're able to assess what that had on the quality. And this is actually showing you a graph the light blue line is showing you the time that the compressor is off, and the dark purple is showing the actual temperature of the cool room. And we can see that the compressor is off a lot of the time, which means those internal fans are also off that the temperature is running quite consistent. We can see the compressors only running for less than 25% of the time, and the sea potatoes are stored at three degrees. And we've actually captured that inefficiency by making fans turn off accordingly, but still maintaining that temperature balance.

Nigel Crump:

It didn't stop there with our cooling. What we've also done is we've put switches on doors, so that we've actually got it making sure that the doors don't get left open for extended period of times, where they're being filled or unloaded. We have buzzers that go off that remind staff to make sure the doors are closed. We also have the doors opening and closing and again, the compressor does not run while the door is open. That ensures that cooled air is not escaped from the cool room. Actually captures more efficiencies in our cool room, prevents a lot of loss of that cool temperature, but it condenses from icing. It improves the storage quality, and we've seen better quality minitubers as a result.

Nigel Crump:

There's another energy efficiency in making the cool room more efficient in its ability to cool those tubers. We also have the lights, there's internal lights and we make sure they're not left on as well, which not only improves our energy very minor, but also ensures our potatoes do not grow green under light conditions. And we have that quality assurance and here again, we can graph that information showing that the doors are open and closed. The temperature is maintained, and we have that control. But also importantly, we have interaction with our staff. It may be a darn buzzer, but the buzzer actually educates the staff on making sure those doors and those functions are actually closed and maintained.

Nigel Crump:

We also have risk mitigation built in here too into the AgTech systems that we're using. And here just with relating to power, I've selected a few from the dashboard, from our Arcoflex dashboard. We're looking at our phase variance, our power supply, whether our generators are running or not, whether there's a phase fail relay in the system, an overload trip. Before, a lot of these things have to be manually assessed and now, we don't have to do that because it's all built into alerts on our system. It actually makes sure that we're actually making sure we don't have that piss poor performance, the parts of the Ps. Another example here is our pump. Every day, I used to have someone go and assess this pump to probably take them an hour and a half.

Nigel Crump:

If they had to drive there, it might be a hundred kilometers of driving, or more they had to do to assess this pump. And now, we can monitor all this and control this remotely. This gives us energy efficiency in what we actually do. We also use UV light to sterilize that water, to make sure it's pathogen free because we have high health potatoes. And we make sure that's actually running. We've had savings here. Previously, that hour and a half every day for manual checks It's now remote management. We have alerts for specific issues. If a phase fail relay, it'll actually email or call the electrician, rather than calling one of us as staff. There's a saving in power and fuel and traveling, but also again, we're maintaining our quality.

Nigel Crump:

We know that our water is sterilized and/or path maintained and pathogen free. Again, we can get graphs from the system and show that our system is actually running the blue line showing where the pump's running, the purple line showing pressure in this particular case. And here, we can actually see where the filters are blocked. It means that we then need to send someone there to replace those filters. In terms of polyhouse lighting and cooling, we're again got our Arcoflex system measuring the luxe that's available on the in the polyhouse, the light levels. We're increasing the photo period for the production, which meant the lights were generally on from 9:30 in the morning to 8:30 at night.

Nigel Crump:

Now with that lux meter, the lights are only coming on when there is low light levels. So, that gives us evenness of temperature, evenness of light, but also we're doing the same thing with the fans. The fans are coming on and off, and we've made it much more efficient in terms of energy use, and making sure things are not being run when they're not required. And this has all being done for our platform. Previously, for example, in the lights, they're continuously on for 16 hours. We're now reduced those hours as required, and the fans and the cool only run according to temperature and a requirement. We've actually improved those efficiencies by putting multiple sensors in play.

Nigel Crump:

What this has actually done it's actually allowed us to do that remote control, so again a labor saving. There's alerts to issues and prevention of failures. We've got unnecessary use of resources. If a fan was left running previously, it'd have to be manually done. Now the system's monitoring and turning on and off as required. We've seen improved production. We're getting more tubers per plant, which is what we need better yields. But at the same time, we're saving energy and our resources. Not just energy in terms of electricity, but also fuel and labor resources. Here's something where we've improved. This is just looking at temperature in one given polyhouse, the two lines of different sensors in different parts of the polyhouse.

Nigel Crump:

And we can see that there are 15 and 10. If we look at the graph on axis on the other side, they more or less overlay each other. We see there's uniformity of the temperature within the house, which means we're getting better product throughout the house, better utilization of our cooling resources, which is actually making a better utilization on our energy demands. One little thing I'll just touch on, we've also picked up on safety on our AgTech platform as well. We have lights on the outside the polyhouse, traffic light system. Basically, if there's a green light, staff are allowed to enter. If there's red light only, there's been a pesticide application which is recorded through the Arcoflex platform.

Nigel Crump:

If there's a red and a green light, it means there's a high temperature warning in the polyhouse. But for staff, it means be cautious and don't spend long times in there. The yellow light will be that the water's been turned off. It allows for a quick assessment by staff as they're walking by if water is on, or water is off. In terms of biosecurity, we've also got alerts there to say whether the two entrance doors are closed. When someone's walking in, one door must be closed between the other, and that ensures that integrity. It also ensures that we're not losing a crop due to a buyer security, or an insect recursion inside the polyhouse. In summary, what we've done in terms of energy efficiency is we've measured.

Nigel Crump:

We've done that prior preparation to prevent the piss poor performance. We've mitigated those production risks to do that and achieve that. Through doing that, we've increased productivity and that's been our key gold all the way along. We can't have the efficiencies captured without maintaining, or improving our productivity of the minitubers. And here, you can those minitubers there on the again enhanced again. We've enhanced safety, not only just in terms of energy safety, but also what I mentioned about the entrance conditions into the polyhouses. We're saved labor, many, many hours of labor in that previously someone had to go to site to actually see what was actually happening.

Nigel Crump:

We now have that built into our AgTech platforms. We've enhanced our biosecurity, and we have evidence of that through that alarm system, through the doors. But most importantly and I suppose it's what we're talking about today, we've demonstrated through what we've been doing here. And we'll continue to do it because we now have the evidence to do it. We know what box of chocolates we have under the Forrest Gump system. We know how we can capture that energy efficiency, and we'll continue to do that. And we can actually challenge ourselves to do it even better. With that, I'll leave a night view of some of our polyhouses, a dust view there of our polyhouses, and I'll hand it back to Kelly. Thank you again Kelly for the opportunity to present. Thank you.

Kelly Wickham:

Great. Thanks Nigel, that was brilliant. I'm going to allow the one burning question that was pretty enlightening to be honest. Giant asks, "Thanks for the presentation. Is there any waste generated in the polyhouses?"

Nigel Crump:

Yeah, we have waste. We have waste, the potty mix. We only use once. So, that's our biggest waste that we actually repurpose that to go back to home garden, so that's actually repurposed. All our plastic from our system is actually recycled, so that's actually done through GT Recycling in Geelong, so our plastic pots and our plastic covers. Our bulk of soil bags are also recycled. Our water, we have very minimum water waste as well. Our runoff is captured, and it does go into swell drains. There's grass that grows in those, but that's only real. And we do monitoring for the nutrient runoff on those as well. We don't throw away any nutrients in our system.

Nigel Crump:

In our tissue culture lab as well, we've recently just acquired Green Lab Accreditation, which is an international program, looking at energy efficiency and waste monitoring as well. I think we're one of the few tissue culture labs to actually have that in Australia at the moment. And I challenge everyone to do that. It's an absolutely great system to get involved in, the Green Lab System.

Kelly Wickham:

And probably top of the top of the charts. And would you say that you're communicating what you're doing to the growers that you are providing C2 on energy efficient measures and the...

Nigel Crump:

Absolutely, sustainability has become a major driver of any agricultural practice. Our customers, the likes of McCains and Pepsi and snack brands and others, and they're looking at their platform and their footprint as well. And we've got to be demonstrating we've done that. And that's why this is a great initiative that we've been going through to try and actually one, measure what we are doing, but then two, measure how we can improve what we're doing.

Kelly Wickham:

All right. Just responding to one of the questions, because I wanted to actually hold off Nigel until we got to the finish and had of a more of a quorum of a conversation between yourself and Stephen Soutar as well if that's all right.

Nigel Crump:

Look forward to it Kelly.

Kelly Wickham:

Excellent.

Nigel Crump:

Thank you.

Kelly Wickham:

Thanks, that was brilliant. Yeah, looking forward to going deeper into that in next time round. We're going to throw over to Stephen Soutar. He's an electrical engineer with 40 years' experience and specializes in the design construction and management of automated and remotely controlled energy wastewater and irrigation systems. After being an engineer in Australian Paper, Stephen founded Latrobe Valley Engineering Services, a company specializing in the process control and automation of water and wastewater treatment plants across Eastern Australia.

Kelly Wickham:

With desperate need for advanced innovation in the growing energy marketplace, Stephen founded Alternate Energy Innovations and applied this extensive automation knowledge to the energy sector, using his forward-thinking approach to develop smart energy solutions for now and into the future. Great, right over to you Stephen. I'm looking forward to it.

Stephen Soutar:

Okay, thanks very much for the intro Kelly and welcome everyone. Okay. Yeah, I'm Stephen Soutar. I'm the engineering manager at Alternate Energy Innovations. I'm a process automation engineer. And as Kelly said, I started at Australian Paper which is about five minutes away about 40 years ago and developed the other two companies that he mentioned. AEI is an engineering based company. It's located in Morwell right near all the power stations. It's probably appropriate that we get involved in energy systems. And our aim at AEI is to allow you that is the operator to control your time, your cost, and your future. What I want to talk today about is implementing new technologies on the farm, renewable energy that needs to be more than just the supply, install, and forget.

Stephen Soutar:

And like many systems in the past, that's been the case. I want to talk to you about an engineering approach that we've done at Wilandra farms. I want to talk about on farm microgrids, and how they work and can be valuable in the future. And I want to talk about the future of power which is working with the power network and being involved in flexible demand, which is a mixture of the current demand management load shifting and life pricing. Where have we been? This is really just to indicate that VS drives was something that we've probably used for 20 years, or nearly 30 years. Probably a bit less in farming, but it's really important that we use them correctly.

Stephen Soutar:

Now, the aim of the VS drive supplier in the last 20 years is to sell you a VS drive, and really the aim should be to use it properly. Whilst they can solve all problems that people think, they can solve a lot of them, but you have to get it in the right circumstances with the right control strategy. And I really question how many VS drives have been installed on farms that are providing the expected benefit. And I think that's probably fairly low, because you really need to know how to use them properly. So where are we now? We're on a similar path with solar. The sell is let's put it everywhere. It'll cut your power across. In my view in reality, that's ideally suited in some cases, but not all, but when optimised can significantly cut power costs.

Stephen Soutar:

And the optimisation is the critical bit, and how many solar systems have been installed that are not meeting the expected benefits that you had in mind when you install it, and we'll go through some of the reasons why that might not be happening. And where are we heading? Probably more importantly, we're about, according to the battery people, to put a lot of batteries in everywhere and there's no doubt this will happen. But again, the critical thing is that everyone says put them on all your solar systems, further cut your power costs, but my view's simple. Before thinking about a battery system, optimise the efficiency of your process first, optimise the usage of your alternative energy, and then think about putting a battery in.

Stephen Soutar:

And in the future, we'll we be saying we've put a lot of batteries in but haven't created the benefit. So the common link in all these is the sell. The aim of the person selling it is to sell you equipment and not a solution. So each individual piece of equipment works well in the ideal environment, but all can work very well in an engineered, automated, and optimised system. And the key word here is system and I believe the system is the bit that enhances the chance of you achieving the expected benefit. Just want to go back to a diesel generator to show the difference between where we were and where we're heading. The diesel generator is a scheduled controlled generation source that you can go and stop and start. And it will run at the generation level of the devices and the loads you connect to it and you can meet any of the patterns chain to the side.

Stephen Soutar:

Renewable energy is the exact opposite. It's completely unscheduled generation. On one day, it can be perfect. On the next day, it can be not too bad. On the next day, it can be very ordinary and on the next day it can be terrible. And in fact, you control nothing about it, you just get what you get. So when you put solar with fixed power loads, so a fixed power load is an example of that is pumping to a pivot. So the load doesn't have to be perfectly constant. It just means that you don't have over what the load is and it remains fairly steady. So the percentage of load power supplied by the solar is very, very important. Too low a load can be very costly.

Stephen Soutar:

If you look at the graph in the top left here, that's almost the ideal situation. Down these sides here, you could be starting to get into trouble if you're moving load from off peak to these areas here. Because as you have less solar generation creating the power you're using, the higher the cost is, especially during the weekdays when you're on peak. So when the profile of the solar gets worse, you're spending more time when you're creating a lower percentage of your load from the solar. And obviously, on a really bad day, you're almost saving nothing from the solar, but you're using on peak power. So in the case of the last one on the bottom right here, you'd be far better off operating at night.

Stephen Soutar:

Obviously, if you've operated at night and then you're in the daytime, then you're always going to be better off by using it, because that will still be the cheapest. Just a quick graph, and I won't go into it too much detail. Basically, the blue bar is the percentage of the load power that's supplied from the solar. So as you move to the right, the percentage of load supplied from the solar is less. The orange figure going up here... Well, sorry, I'll just back one. The orange line coming up here is the cost of operating on peak. Obviously, as you supply less of the load from solar, the cost increases and it gets to the stage about halfway or around there where you might as well operate at night and get the feed in tariff during the day.

Stephen Soutar:

This graph is fairly dependent on the ratio of on peak, to off peak network tariffs. And for those that live in Gippsland where we live, we've probably got one of the worst ratios of on peak versus off peak, which is about four to one. It's typically two and a half to three. So the critical thing is just make sure that you are not operating fixed load systems on solar during the day when you have low levels of solar generation, rather than operate at night. So just move back to operating at night and get your feed in tariff during the day. The impact of solar sizing is actually fairly critical. If you undersize solar, then you decrease the percentage of load power supplied from the solar, and you increase the chance of reducing your profit.

Stephen Soutar:

You can see there, because we've raised the power usage from before to above the solar generation, then you are going to make less money out of that if you want to operate it during the day, compared to at night. The same goes if you oversize solar systems, that can result in a higher cost of installation and excessive power to the network and therefore, that may not be a benefit. And I think people need to understand the future that feed in tariffs are probably heading close to zero, rather than where they are now. They've been dropping for a significant amount of time. And I think in some states, they might already be zero.

Stephen Soutar:

And the other thing that is significant I believe is on dairies. A lot of people don't believe they get the benefit of solar on dairies, and I think one of the key reasons is that people size, the solar on the dairy to suit the profile that exists today, and often it's limited. The solar provider may tell you that you should limit to 29 kilowatts, and usually that's to make his life simpler, not necessarily give you the best answer. There's often a limited roof space. And then when you shift load, later from off peak to on peak using a time clock, which is what is often done with water heaters, then you further decrease the percentage of load power supplied from the solar. When you increase this bit in the middle here, you move further away and have a lower percentage of power generated from solar.

Stephen Soutar:

And therefore, you further decrease the profit you make. What I want to talk about now is an engineered approach to a system we've installed at Wilandra farms, which is owned by Wilco and Sandra. It's 150-hectare organic dairy farm, and it's located in Clydebank in Eastern Victoria, which is near Sale. This is the existing farm assets and we'll just go through this relatively quickly because I want to look at a particular part of it, but all of the system was fully manual when we first got there. It has four main connections to the power grid, which we call NMIs. And it basically has fixed power operations. So fixed power operations mean that the pumps operate basically at a constant power rate, and that may even be the case if they have a variable speed drives.

Stephen Soutar:

In this case, and this is only part of the system, the river pump can pump to the pivots or to the dam. The bore pump can pump to the pivots or the dam. And there's also a diesel pump that pumps from the dam to the pivots and basically, that's all fixed power or manual. In this project, one of the key things we've done is provide a mixture of power applications. And that is we change some of the fixed power applications to variable power applications. Now, the river pump only pumps to the dam. The bore pump only pumps to the dam, and two new floating pumps were installed on the dam that now pump to the pivots. They are all fitted with variable speed drives.

Stephen Soutar:

Interestingly, even the ones that are fixed power which is the one that pumps to the pivot, they're fitted with variable speed drives, but they're fitted with variable speed drives so that we can operate at a constant pressure at the pivot and therefore, optimise the energy used. But when it's running, the energy will pretty much be fixed. What the variable pumping systems allow us to do is vary from about in this case, from say 10 to 45 or 10 to 37 kilowatts and that means we can operate them at any power rate that we want to. And because we now pump to the dam, rather than direct to the pivot, we can run them at any time even when we're not irrigating.

Stephen Soutar:

That's just one of the things of interest if you are running a system at the moment, you may actually find that adding or enlarging a dam may give you a better result than installing a battery, but that's probably another discussion for another time. And this is the AEI SmartBox App. The AEI SmartBox is our product that controls all of this and it allows you to control different applications, set schedules for today, tomorrow, and over morrow. And it allows you to look at trending and alarming. This is the end result of the solar and automation at Wilandra in the main power plant area. So this graph shows the operation of 150 kilowatts of solar which is the green. The lined area in the middle is the power used, and the orange is the feed from the grid.

Stephen Soutar:

So it's from the grid when it's above the line, and to the grid when it's below. And the system has 56 kilowatt hours of usable battery. And I'll explain what that's for shortly, because it's not for what you would normally use it for. The process is now fully automated and for this test, the batteries were actually off. And the reason for that was we wanted to see how it performed, without the batteries providing the role that they did. The key thing to notice from this is the usage of solar is extremely high. So in fact, the usage of solar is 90%. So, 90% of the solar was used, and 10% was put back into the grid. And pretty much, the reason it was put back into the grid was that we were generating more power than we could use.

Stephen Soutar:

On this particular day, which is the perfect solar day, the load was powered by 94% solar and 6% grid. Now, those numbers are very high for any solar system. And the reason we're able to do that is we have variable and fixed load. So from an efficiency point of view, this is a very, very high efficiency in the use of renewable energy. By creating flexible demand that is variable and fixed power applications, we can pretty much make the load follow any renewable power generation that exists in a day. Now just to explain what the batteries used for, what the batteries used for is to smooth the generation out, so that the control can work better. So, all the high and low peaks that come through the solar generation, they can be smoothed out and allow for less switching between which applications are running.

Stephen Soutar:

So you don't want to be turning a pivot on and off too much, but it's not too bad to let the variable power demand applications run for significant times. Again, a very high use of alternative energy in all cases. What we did next on the Wilandra farm is we looked at using a microgrid. And the reason we used the microgrid is because we couldn't use the top end of the solar that was left. We had excess solar and how could we use that? Now remember, the excess solar might be higher when there's not only a need to do some of the irrigation processes and therefore, we may end up with 50% of solar used. But obviously, if it's not connected to this particular transformer, where the solar is being created, then we don't have a use for it.

Stephen Soutar:

All we can really do is put it back into the grid and contribute to the problem, that we all know about which is too much renewable in the system that may not be being used. So this is a complicated graphic, but I'll simplify it for you. In the middle here is the power generation system and that's where the power is being used today. And what we have the ability to do with the control microgrid is if we have a spare 10 kilowatts of power at the transformer, that the main transformer in the middle here. We have the ability to move exactly that amount of power to the NMI up the road or in this case, on the other part of the farm. And we can use 10 kilowatts into the river pump at exactly the same time. And the reason we can use 10 is the river pump is a variable power application. It can run from about 10 to 45 kilowatts. When we have 20 kilowatts of excess solar at the transformer, we can then change that to 20 kilowatts being used to pump to the dam.

Stephen Soutar:

So what we can end up doing is getting close to a hundred percent usage on the farm. And therefore, because there's no excess alternate energy or renewable energy, there'll be no impact to the outside power network. Just looking at that and then looking now at the national grid, basically what is happening at the moment is that we're moving from customers to participants. The national energy, our networking has changed and will continue to change. So we're moving from a large conventional power plant base, which is obviously scheduled controlled and relatively stable. And it can pretty much match any load that the total customer base creates, and now we're moving to 100% renewable energy which is largely unscheduled, uncontrolled, and can't always provide the response we need. And it doesn't matter how you look at it. The network needs help and AEMO the operator will need many customers to become participants. One way of becoming a participant is to be involved in live pricing. And the way live pricing makes you a participant is that when the market is low in price, that usually means there's an excess of renewable energy in the system.

Stephen Soutar:

And if you move your irrigation to take use of that low price, then you are using more renewable energy and helping to move the network back into a controllable space. So in this case, this particular system is installed at McAlpine's dairy farm in Woodside in Eastern Victoria. It has a 90 kilowatt bore pump feeding four center pivots, which were very old. And it supplies water to a dam on another part of the property. It's got four fixed and one variable power application. You can set the scheduled hours as we discussed before, and now the whole system is fully automated and saves significant time for the farmer in operation. This is just an example of a weekend, where we have the orange line is the base price for power off-peak. The gray line is the live price of power in Victoria on that weekend. And the blue is the kilowatt hours per 30 minutes of the pump system running. So, what happened when the price was low during this period here, the pump system ran. And when you compare it to fixed off-peak pricing, the system ran at 39.5% less than fixed pricing. We did have a bit of a failure in the middle there and missed an opportunity. If that had been used, it would've been 52% less. And when you compare usage charge and demand charges, it runs at about 35 to 43. Now the result will depend on where you're running, how often you're running. But basically, if you can operate equipment based on the live pricing market, when it's low, there's potential to save significant money.

Stephen Soutar:

But moving forward, the answer is flexible demand. So demand management is becoming flexible demand. So demand change requests typical lasts for a couple of hours. So, that's a period of time where the network is in a bad state, and action needs to be taken. Conventional demand management is usually high demand in the network, and that's handled at the moment by texting people to reduce the load in the household and then they'll receive a payment. And it even got to the stage one time in Victoria, where Australian Paper the paper mill next to us which is the largest pulp and paper mill in Australia was asked to shut for a day, and they were paid for a significant amount for shutting.

Stephen Soutar:

So what flexible demand management means is that you still have the normal demand management, which is reduced load. And then in this case, we can shift the load back in time... well into the future. And then there's also the possibility now that you'll be asked to increase load on a certain day, because the level of renewable generation is higher than expected. And then there's the potential to shift that load forward.

Stephen Soutar:

So if you were planning to irrigate tomorrow and the next day, you could be paid to bring that load forward and do it today. Where does that fit in with farming? I think farming and flexible demand can go hand in hand, and that the farming sector can be a large participant in the flexible demand management area, especially with irrigation loads and water transfer loads. Clearly, we wouldn't want to drop off the dairy and say, ‘Sorry, you got to shut your dairy because we've got to cut the demand down,' but there's ways of getting around that and use that as part of the system with both generators and batteries. And these application loads can automatically be reduced, that's shift the load to later or increased shift the load to earlier with little or no impact on the irrigation schedule. In critical circumstances, shutting farm loads around the town may mean that the town power stays up.

Kelly Wickham:

Stephen, do you think you can wrap it up in about a minute?

Stephen Soutar:

Yep.

Kelly Wickham:

Okay.

Stephen Soutar:

Just quickly cover the capabilities of the SmartBox which we've basically covered through the documents. It can control irrigation, control power management, control the micro grid and be involved in flexible demand management. And that's my contact details. Thanks very much for your time.

Kelly Wickham:

Great, thanks Stephen, that was timely. That was absolutely brilliant and well, we've seen this... personally, I've seen this in living color having gone out to Wilandra farms. It's quite impressive set of installations there, something that we would do well to mimic across dairy to be quite frank in the pasture-based systems. The more barn style systems have other opportunities.

Nick O'Halloran:

Thanks very much for both of you for that, but yeah, that was a really, really interesting system Stephen, incredible to see it all put together like that. I guess my one question is really around the irrigation scheduling, and how that's now being achieved. Is the system doing all of the irrigation scheduling, and is that scheduling, does that come at the compromise of, is power now the focus as opposed to the water? Because there's certainly situations where I think that could be a bit of a problem, particularly in hotter climates where irrigation systems aren't close to their capacity in terms of being able to keep up with crop water demand, but yeah, who's managing the irrigation scheduling now?

Stephen Soutar:

Yeah, well that's a really good question. One thing that always needs to be key in irrigation systems on farms is that irrigation is the critical bit. It doesn't matter what happens, the irrigation must occur and must occur when it's required. One of the things that we've been working on at a couple of farms is we now have about eight soil moisture meters installed on a farm, and some weather sensor equipment as well. And that is helping the farmer and will continue to help the farmer in making sure the schedule is met. But as long as we know what the schedule is, we can fit it in both with alternate energy and live pricing and potentially in the future, maybe even a mixture of both. But the critical bit always is that you have to meet the irrigation schedule. The aim is to meet it at the best energy cost structure that you can.

Nick O'Halloran:

Yep. I think it's really good, you don't want to get into a situation where you're waiting for the solar to reach its potential and all of a sudden, you realise, "Oh gee, the crop's out of water and I've got to go flat out for the next week anyway to keep up." Yes, so managing that will be interesting to see how that's done particularly in the peak of summer.

Stephen Soutar:

Yeah, I think one thing that does need to be discussed in the future is the design approach to farming going forward I think needs to change to adapt to alternate energy. And that in the future will mean that instead of designing an irrigation system that may need say 22 to 24 hours, we'll be designing them to need 16 to 18 hours, so that we give a bit more flexibility in being able to use the power more effectively.

Nigel Crump:

Can I come in on that question there as well? I just thought that there's actually an input there. The agronomic aspect of the crop two would be interesting to actually have some monitoring there, and then maybe you're going to water ahead of time to suit when that solar suits to me. As opposed to in the past we're irrigating it when it was convenient or whatever as the crop demand, but by measuring the water profile, we might be able to say that the water could come on early, which gives you a broader window of renewable energy use.

Stephen Soutar:

Yep. Yeah, I absolutely agree with that Nigel. I think that applies both to using renewable energy and also using live pricing.

Kelly Wickham:

I've got one from Peter Morris, and I think it's directed at Stephen. What was the cost payback period for the change to microgrid and additional pumps?

Stephen Soutar:

We will go through that process with Wilco and Sandra in the next couple of months, but one of the assessments that I use which is really easy to determine how effective the system is, is if you install 150 kilowatts of solar and you effectively use it all, then you have the maximum benefit that can be achieved.

Kelly Wickham:

Hundred percent.

Stephen Soutar:

My focus in looking at what return you get is more orientated at are you effectively using what you're using and also are you improving efficiencies? And the system we've installed there has improved efficiencies in a couple of ways. Transferring water from the dam, we actually found that there was a valve that was left in the same position for running to the pivot as running to the dam. Wilco found that that could be completely open now, and we could reduce the cost of pumping to the dam. I think it went from about a 37 kilowatt to about 10 kilowatts to do the same water transfer. The other thing we do is we control pressure at each pivot, and that allows it to run the pump at optimum efficiency for that system. And it needs to do that because it pumps to different pivots the design requirements of each pivot is slightly different. We need to be able to do that.

Kelly Wickham:

Nigel, just got one for you. Have you engaged with the Victorian Energy Upgrades folk about including some of those monitoring devices into the prescribed activities?

Nigel Crump:

No, we haven't. We haven't had anything. Really, our main focus has actually been building it with the team that we've had. We didn't find anything off the shelf. We've had to build it from scratch at this stage, but now I think people should be looking at it, because it's definitely got other uses. And I know the guys are using it in dairies and chicken houses for animal health and all sorts of things as well.

Kelly Wickham:

Yeah. Sandra online who's got that Wilandra farms as well. There's a question here from Jared Leak at the Australian Alliance for Energy Productivity. "Can these systems incorporate solar PV forecasting? E.g., delay irrigation by one to two days because higher solar PV is forecast." Hmm.

Stephen Soutar:

Well, the answer is yes it can, providing we can obviously get the correct forecasting information. And I think the more we use moisture analysers and get used to interpreting them, we can do both. Bring load forward if there's a good day before we were expecting to irrigate because my understanding, and I'm not a specialist in this area, is that there's a window where you need to irrigate. And if you do it a day early or a day late, it's probably not all that critical, providing you keep the water volume between certain limits. Yes, you can all do all that. And going forward, the more we can do that, the more the farming sector can provide benefits to the national grid.

Kelly Wickham:

Just I'm going to hold off on Joe's question for now because it's a bit of a can of worms question. I'm going to go straight to Nick's real quick. What is the current cost of batteries per kilowatt hour?

Stephen Soutar:

It was about a thousand dollars per kilowatt hour I think is the figure used around the place. I'd have to get an update for what it is now the... there's no doubt there's significant price changes in any electrical equipment that's on the market at the moment. I think VS Drives have gone up nearly 12% in the last three months.

Kelly Wickham:

A question for Rob Rohrlach. "Thanks for the brilliant description of flexible data and control. Is there a plan to include a Bureau of Meteorology weather input to the SmartBox itself?

Stephen Soutar:

Yes, we certainly, what we are doing at the moment Rob is we're doing that monitoring ourselves and looking at the impact of it. But the more we can do that in the future, the better. I mean I noticed one of the other questions was about how does the dam get used as a battery, and this fits in with what you are talking about as well Rob, because what the dam does at Wilandra is allow us to disconnect the connection between a pump and the irrigator, so that the pump that's pumping to the dam can pump when it wants. And the dam provides us volume that allows us to do that. Instead of storing energy and using it later to pump which is what you do with a load shifting battery, the dam means we don't have to shift the load. We can do it when the energy is there.

Stephen Soutar:

So what we can find and we're doing it say, and we've been doing it in a plant in Adelaide at a golf course is there's no wind in Adelaide today, and the price is quite high, but there was wind on the weekend. We pumped extremely hard on the weekend, and the dam provide you the ability to pump less during the non-windy day.

Kelly Wickham:

Okay. The other one was came from Nick was, how is the SmartBox and live market work together?

Stephen Soutar:

Well, basically what happens is the SmartBox gets information from AEI central which is in a cloud that's connected to the AEMO pricing system. So we get an update every five minutes, and we get a projection of what the expected cost is likely to be typically for the next 24 hours. And we put all of that together with the schedule that's entered by the farmer, and we work out when the system should irrigate. And obviously, that changes through the day because if you've ever watched the energy market, it can tell you it's going to be $10,000 of megawatt hour. And then three hours later, it might tell you it's going to be $150 of megawatt hour, and the system just has the ability to analyse that data and work out when is best to irrigate. It's obviously not a perfect solution because we can't project the future, but it gets it fairly close most of the time.

Kelly Wickham:

And Nigel, if you look back on all the monitoring that you're doing on those as we say today, what does it look like in five years' time? What is it that we're not going to know? What's the biggest limitation say going forward?

Nigel Crump:

The biggest limitation to us in the past what was internet connectivity. That seems to be a thing that's moving on now. We've got good internet systems with mobile towers and what-not. Moving forward, I think it's the imagination, it's where we can get... for example, at the moment, we're looking at solar moisture in pots. I mean there are solar moisture systems in field systems. But trying to get something in a 10-centimeter pot, we've tried a number of different factors, or different systems, different probes and just trying to get them to work. I think the more you can actually think of in terms of what you can actually measure and minimise variation, the better it's going to become, and that's limited to anything.

Nigel Crump:

I mean we haven't even got a probe that could look into the plant itself. I mean there's a lot of systems that are looking at the light meters on plants and that sort of stuff and looking at how we can improve growth. I mean we've been really doing the mechanical and engineering side. There's an entire biological side that I could see that's going to happen into the future.

Kelly Wickham:

Huge opportunities without a doubt. We got a question from Robert Welke, the foremost expert on irrigation systems.

Robert Welke:

Kelly, thanks. Stephen, thanks very much for that presentation, most inspiring. As some of you may be aware, I was involved in the very original energy audit on the Wilandra. And there was some amount of hydraulic optimisation that we are able to achieve, that's no doubt contributed to the long-term energy savings. But typically without giving away Wilandra's annual electricity cost, what percentage reduction in the annual electricity costs have you been able to achieve?

Stephen Soutar:

That's a good question, and I think Sandra's on the line, and she might have been able to answer that a little bit better than me, because she's probably paid the bills, but obviously depends a little bit on what the irrigation season is like. And it's been fairly wet in this area, so that would have an impact. And as I said before, the main thing that we can focus on is whether the alternate energy is being effectively used or not, but certainly there was an expectation that given a reasonable irrigation season that we would be down around I think about the 20% area of what they were originally using. And Sandra may have a better idea of that than me.

Sandra Jefford:

Hi, I think that's what we will achieve, but this has been such an unusual season in that our average annual rainfall here is about 600 mil. And last year, we had 839 mil. So far for this year, we're well ahead of normal rainfall. Yeah, it's very different and also, we're still waiting for the wind turbines to arrive. And we think they'll make a big contribution to the energy as well.

Kelly Wickham:

I've got to ask this burning question Rob, so hang on two seconds. Two people have asked it, and it's the can of beans one I tried to avoid earlier. How hard is to set up a microgrid Stephen, and will it be done widely in the future and Nick sort of asked the same kind of question: Can anyone do this? What are the system requirements when it comes to the microgrid? I had to ask that, sorry Rob.

Stephen Soutar:

Yeah. Well for me, implementing microgrid's fairly simple because that's what I do for a living. It is fairly simple to implement, but one of the key problems with implementing a microgrid system is to be able to develop the sorts of loads that give you the benefit. So, it's like all these the work that we've been doing on farms, and it's probably something I was highlighting in the very first slides. It's not about the VSDs or the solar or the batteries. It's how you change the process, so that all of those things work together. And therefore, the more you can create loads on the other side of the microgrid that also have flexibility, the more the microgrid can work.

Stephen Soutar:

Will they work in the future? As soon as we can get rid of the constraints that are currently stopping us in actually implementing them everywhere, I think they will be everywhere.

Kelly Wickham:

Really, it's the task to zero net emissions is going to be a lot harder if we can't get microgrid systems up. Rob are you still, did you have another question there, or is that a legacy hand there?

Robert Welke:

No, I'm looking in awe of what Stephen's achieved on this property. It's just a quantum leap different and ahead from where I was going to in my approach. I commend your work Stephen, and I hope we can see lots more of this applied to farms around the country.

Stephen Soutar:

Well, we do have a good base Rob because we had some excellent selection of pumps. And when they're running the pivots with the right flows and pressures, and I think that's made a lot of difference. And it's really just enabled us to expand on that base, create a flexible energy operating farm that just allows renewable energy to work at its optimum.

Kelly Wickham:

Joe's asked the following question about what are those constraints.

Stephen Soutar:

The constraints to a microgrid? Well, at the moment, you can't transfer energy from one NMI, which is one power connection to another under the current network framework.

Kelly Wickham:

So, that's the critical one. It's effectively selling to another NMI is almost like requiring a retail license which is in the order of 50K or...

Stephen Soutar:

Yeah, and there's a lot of work happening in that space. There's a lot of work happening around Heyfield, there's some good work by the group that's doing that with Scott and others. And also, there's a lot of talk and a lot of money being put in by the federal government to allow you to do community power grids. And of course, community power grids can't work if you don't allow microgrids to work.

Kelly Wickham:

Of course, or almost one in the same. Nigel, I just wanted to ask, how translatable is what you're doing with the potato growing across other sub-sectors of... so I'm in the horticulture team and new to it, really like to actually roll out what you're doing across all, you know strawberries and grapes, and how applicable is what you're doing?

Nigel Crump:

Anything that we are doing on our system would be relevant to any closed, protected cropping system or beyond. I mean the conditions for growth would be different. Of course, different plants require different conditions, but the system actually is monitoring what those conditions are and it and it's up to the management team then to decide what systems they need in play. I mean some of the things we've done with airflow in there, which I didn't mention in the presentation by actually increasing airflow at certain times and preventing humidity, we've reduced our pesticide use from multiple sprays to more than zero. Once you understand what's actually happening, you can manipulate the system and actually and work it out. It would apply to any horticulture, whether it be that closed production system or outside.

Nigel Crump:

And I can see from just listening to presentation what Stephen's talking about there, there's an aspect there, the agronomy and the crop that you could actually plug into that system as well.

Kelly Wickham:

Noel Pattinson has got a question, "When it comes to grid harmonics and installing VSDs, who is responsible to resolve it, me or the power company? What may the extra cost be?" Well, I thought that was the network service provider, isn't it?

Stephen Soutar:

Typically, the responsibility for harmonics is with the person who...

Kelly Wickham:

Install it.

Stephen Soutar:

The person who owns the property. And I certainly haven't been made aware of any problems associated with farms. We have had some more analysis done on large variable speed drives tied up with water treatment plants and sewage pump stations and a lot of the big users of power do install harmonics in those cases. A lot of the harmonics is also got to do with how large of transformer is, that's on the system you're connected to. If you have a large transformer, the impact of harmonics back into the grid is significantly less. But that I think in general, it's an issue with bigger supplies and it's certainly, I'm not aware of it being a major problem with farm type, farm size pumps.

Kelly Wickham:

Nigel, if you went back to . .. . all of the things you've done with the monitoring and measurement systems and the benefits of labor savings, which has been realised also at Wilandra by the way, labor savings, safety and everything else, there's a number on the payback's difficult to get to, but how would you characterise that payback in the installation overall?

Nigel Crump:

The payback has been in some ways easy to work out, mostly in the poor performance section. Where a number of times we've saved that cool room, where there's been an ants nest built in a contactor or something like that over the weekend, temperatures increased, the system's automatically sent an email to the electrician it's been resolved, rather than having a half a million dollars' worth of tubers go off. We've had that system. We've had it multiply in the polyhouse system as well, so it's preventing problems before we see them. And then the other investment has been in that consistent temperature, consistent airflow. The labor saving alone has been huge, and then a lot of energy stuff as well so pumps aren't running unnecessarily, lights aren't running unnecessarily. It's tightened up that resource management. If anyone would like to come and see the system of it, I'm more than happy to host anyone up there as well.

Kelly Wickham:

Leigh Clemow, both systems can go through a measurement and verification process to enable creation of VECs, so there you go. We'll have a chat about that and see how we get it on the list of prescribed activities and yeah, touch base with Leigh while we're at it. Thanks for that Leigh, and thanks for everyone to come along, and really appreciate your presentations and the time you took Nigel and Stephen. Definitely want to take it a little bit further in the future if we've got the wherewithal to do so.