Understanding electrification of agriculture

Produced for Powercor

April 2025

Forethought Outcomes

Contents

Introduction

Regulatory reset proposal program

Background
In late 2021, Powercor, CitiPower and United Energy (distribution networks) began a comprehensive community engagement program to shape their regulatory proposal. Beginning with broad and wide exploration that identified the key needs and preferences of customers which sit under the four themes:

1. Affordability and Equity
2. Reliability and Resilience
3. Energy Transformation
4. Customer Experience

The community engagement program progressed to a deep and narrow engagement conducted in 2023 and 2024 that adopted a more targeted approach; exploring, testing, and understanding rural and regional customer preferences and priorities. These in-depth engagements surfaced several key priorities, which have been used in the development of the final regulatory proposal and specific initiatives to respond to these priorities.

Please find a copy of each network's draft regulatory reset proposals linked below.

- CitiPower
- Powercor
- United Energy

The test and validate engagement roadmap can be found on the next page.

This program
Following the release of the final regulatory proposal on January 31st, Powercor have invited its rural and regional customers, specifically those that operate in the agricultural industry, to assess the alignment of the proposed initiatives to their needs and preferences shared in previous engagements. This community engagement program was designed to understand the current and future needs of farmers as they navigate the energy transition, ensuring those who feed the state have a voice in shaping what matters most to them. The insights gathered will inform ongoing discussions with the Australian Energy Regulator (AER) as Powercor's investment plan continues to be refined.

Involvement of Forethought®

Forethought® is an independent Marketing, Analytics and Strategy organisation, with teams that specialise in research and engagement within multiple industries, including Energy.

Forethought has significant experience in the energy industry, including conducting customer and stakeholder research and engagement with organisations across the full value chain, including electricity generation, distribution, transmission and retail services. It partners with clients to provide an independent customer voice, ensuring that the customer is always at the forefront of organisational decision-making.

Forethought was selected for this program based on expertise across utilities, as well as research and engagement capability to independently design and facilitate community engagement and objectively report back on the needs and preferences of customers across the network.

Engagement context

Potential influences prior to and within the consultation period were events that took place in both the lives of customers and within the wider electricity sector. We hypothesise these events impacted customers' preferences and perceptions.

Some customers reference several of these events throughout the discussions:

2025

- Victoria proposed cutting solar feed-in tariffs to nearly zero, shifting focus away from exporting solar to feed the grid and closer towards energy storage. 1
- VNI West and the Western Renewables Link progressed amid legal challenges from farmers seeking fairer outcomes, farmers expressed that local input was not valued. 2
- Drought and heatwaves strained irrigation and cooling systems, increasing reliance on electricity during peak stress. 3
- Electrification mandates advanced, with policies targeting replacement of broken gas appliances with electric alternatives. 4.
- On-farm carbon targets and buyer pressure grew, prompting demand for grid upgrades that enable clean tech adoption. 5.

1. PV Magazine Australia, 2025, Victorian regulator to slash rooftop solar feed-in tariffs, January 13 2025, https://www.pv-magazine-australia.com/2025/01/13/victorian-regulator-to-slash-rooftop-solar-feed-in-tariffs/#:~:text=The%20ESC%2C%20which%20is%20legally,cents%20per%20kWh%20in%202024%E2%80%9325.
2. ABC news, 2025, Farmers in path of VNI West transmission line vow to block access to properties, February 20 2025, https://www.abc.net.au/news/2025-02-20/vni-transmission-licence-angers-farmers/104955494?.
3. ABC news, 2025, Farmers in Western Victoria grapple with worst drought conditions in almost two decades, February 22 2025, https://www.abc.net.au/news/2025-02-22/western-victoria-farming-drought-corangamite-weather/104951128?.
4. Engage Victoria, 2025, Victoria's Renewable Gas Directions Paper, February 2025, https://engage.vic.gov.au/victorias-renewable-gas-future.
5. Sustainability Victoria, 2025, Our strategy, 9 May 2025, https://www.sustainability.vic.gov.au/about-us/our-strategy?.

Program overview

This research builds on earlier phases of engagement and follows Powercor's submission of its 2026–2031 regulatory reset proposal. Recognising the unique energy demands and constraints facing rural and regional producers, Powercor initiated this targeted agricultural sector study to strengthen its understanding of on-farm electricity use, infrastructure barriers, and future electrification needs.

Conducted as part of Powercor's ongoing commitment to transparent and inclusive engagement, this work captures the lived experiences of farmers through immersive, two-hour observational interviews conducted on-farm and several virtual interviews. Participants were drawn from a cross-section of agricultural systems, dairy, grain, animal husbandry, irrigation, fruit processing and renewables farming integration, to reflect the diversity of conditions and energy use patterns across the network.

These insights will help Powercor communicate and refine its investment plan, ensuring that proposed upgrades and future initiatives are grounded in the day-to-day realities of farming businesses and communities.

Engagement objectives

- Explore how farmers currently use electricity and how power supply affects daily operations.
- Identify infrastructure and affordability constraints limiting productivity or electrification.
- Understand the specific energy priorities and aspirations across different farming systems.
- Capture real-world evidence of the risks of being left behind in the energy transition.
- Provide a sector-specific knowledge base to support Powercor's ongoing engagement with the Australian Energy Regulator (AER), government stakeholders, and regional communities.

Approach

Consideration was given to recruit participants from a diverse cross-section of the community and agriculture industries across the Powercor network. A diverse mix of agricultural customers from varying sectors was sought, in addition to varied connection types (e.g., SWER lines, single-phase, two-phase and three-phase).

Participation

The community engagement included **19 in-depth interviews** and **two focus groups** with a combined total of **nine participants**, resulting in **28 participants** overall. Most participants operated multi-use farms, as shown in the table below.

Sector	
Dairy	Grain and animal husbandry
Dairy	Animal husbandry
Dairy	Animal husbandry
Dairy	Animal husbandry
Dairy	Animal husbandry
Dairy and irrigation	Irrigation
Dairy processing	Irrigation and produce
Dairy and renewables	Irrigation and produce
Grain	Fruit, veg. and produce
Grain	Fruit, veg. and produce
Grain and irrigation	Fruit, veg. and produce
Grain and animal husbandry	Fruit, veg. and produce
Grain and animal husbandry	Fruit, veg. and produce
Grain and animal husbandry	Fruit, veg. and produce

Notes,
Fieldwork occurred in the months of March and April 2025; Nineteen of the participants (68%) chose not to disclose their affiliation to the feedback provided.

Recruitment

There were three main channels used to recruit participants. These were chosen to ensure that every possible avenue was utilised to attract a diverse group of highly relevant customers to participate. The recruitment process and channels included:

1. An invitation extended to agricultural customers, agricultural representatives and industry organisations. These invites were sent to customers by Powercor.

2. Farmers for Climate Action (FCA) (a movement of farmers, agricultural leaders, and rural Australians working to influence Australia's climate policies) provided significant support, allowing Powercor to extend an invitation to its broad member base of farmers.

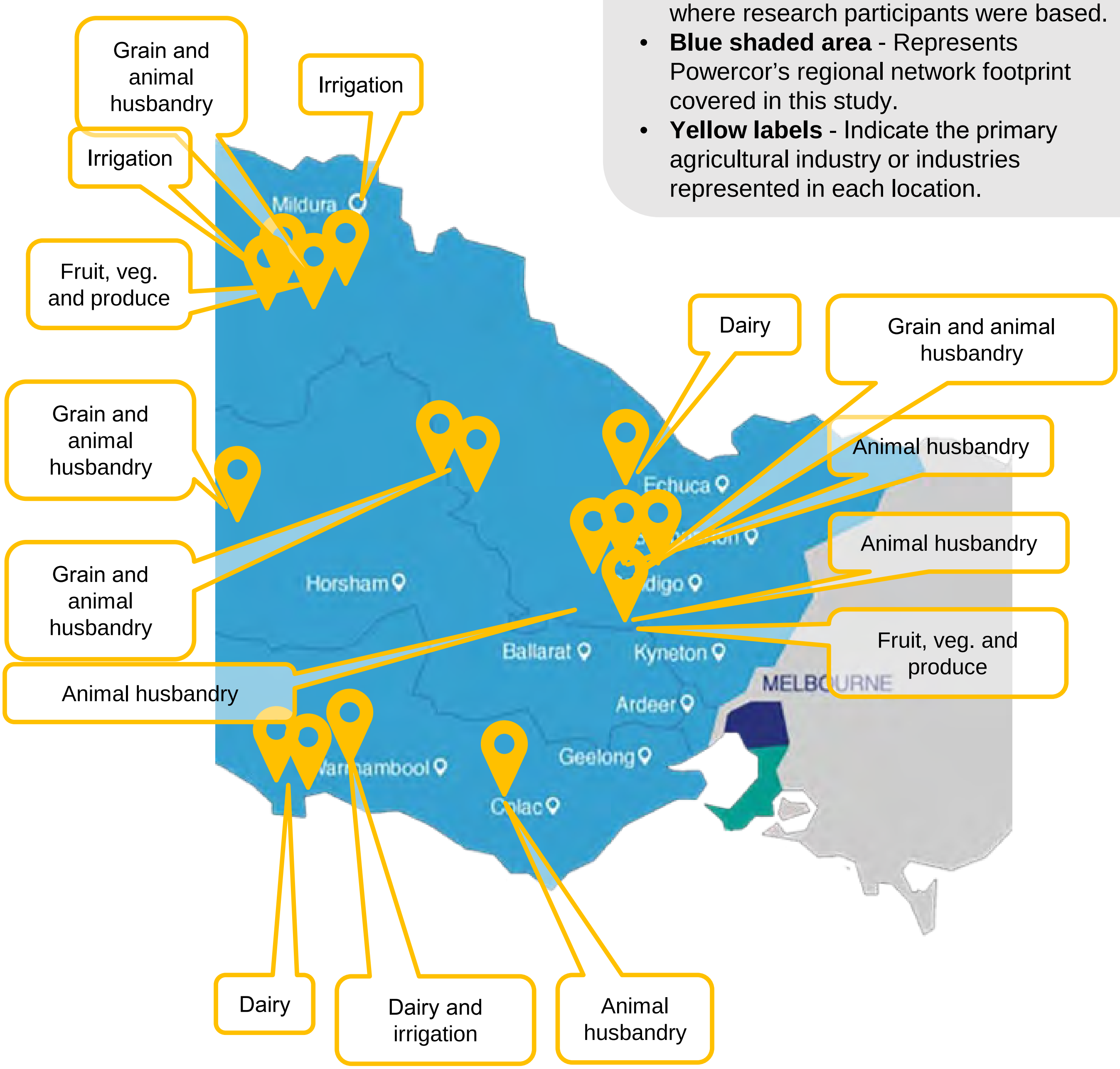
3. The Committee for Greater Shepparton (a not-for-profit, member-funded advocacy organisation) provided support in connecting Powercor with agriculture industry leaders and farmers.

Who participated

Locations and agriculture industries who participated across the Powercor network

Map Key

- **Pin icon** - Denotes a general location where research participants were based.
- **Blue shaded area** - Represents Powercor's regional network footprint covered in this study.
- **Yellow labels** - Indicate the primary agricultural industry or industries represented in each location.



The map above illustrates the broad geographic and industry coverage of participants engaged in this study across the Powercor network. While indicative of the diversity of locations and agricultural sectors involved, it does not reflect the total number of interviews conducted, as some participant locations have been withheld to respect confidentiality agreements and non-disclosure requests.

Methodology

This research explored the lived experience of electricity use across agricultural sectors in Powercor's regional footprint. It captured both the everyday realities and future aspirations of farmers navigating energy limitations and opportunities in an evolving operating environment.

Interviews and focus groups focused on five key themes:

- Day-to-day electricity use – Understanding how energy supports irrigation, cooling, shearing, animal welfare, and food processing.
- Infrastructure and constraints – Investigating how single-phase, SWER lines, or transformer capacity shape decisions.
- Electrification aspirations – Unpacking what farmers would upgrade or automate if the grid allowed.
- Barriers and workarounds – Documenting the systems, manual workarounds, and diesel dependencies that underpin operations today.
- Reception of Powercor's investment proposals – Gauging response to initiatives like the regional and rural equity program, innovation allowance, and Northern Murray harmonics management.

To explore these themes in depth, the research team used a multi-method approach combining on-farm interviews, online focus groups, and review of complementary pilot programs.

1. On-farm observational in-depth interviews

Nineteen, two-hour interviews were conducted on-site with farming businesses across Powercor's distribution area. The on-farm setting enabled researchers to observe infrastructure in context, understand energy priorities firsthand, and explore ideas for the future grounded in lived experience.

Enterprises reflected a wide range of commodities, sizes, and operational models, including:

- Dairy, grain, and animal husbandry producers.
- Irrigated vegetable and fruit farms with packhouses and cool storage.
- Poultry and mixed farms incorporating feed milling or small-scale processing.
- Family-owned farms, vertically integrated agribusinesses, and lifestyle properties.
- Participants included owner-operators, farm managers, intergenerational families, and regional business leaders.

2. Targeted focus groups

Two one-hour online focus groups were also conducted to complement the interview program. These brought together a cross-section of:

- Farmers across dairy, animal husbandry, and fruit farming from different regions.
- Agricultural processors, including dairy and fruit processors.

These sessions enabled shared exploration of infrastructure bottlenecks, perspectives on energy investment proposals, and opportunities for collective planning or coordination.

Together, the interviews and focus groups produced a rich evidence base, grounded in direct experience, informing how Powercor might enable a more reliable, equitable, and future-ready rural network.

3. Farm Trade Australia (FTA) rural energy pilot program

This research complements broader industry efforts, such as the Farm Trade Australia (FTA) Rural Energy Pilot Program, which is actively exploring practical, farm-led solutions to rural electrification. The FTA program is trialing modular, containerised renewable energy systems on dairy and grain farms across Victoria. These systems aim to reduce diesel reliance, improve energy reliability, and lower emissions by offering scalable, relocatable alternatives to costly grid upgrades. Together, these pilots and Powercor's engagement represent parallel responses to a shared challenge: how to ensure regional producers can access fit-for-purpose energy solutions that support productivity, resilience, and long-term sustainability.

IAP2 Spectrum

The level of customer participation in this program was intentional and is highlighted in our depiction of the IAP2 Spectrum shown below. This consultation falls within the 'involve' classification on the IAP2 Spectrum. Customers were involved in assessing specific initiatives of the draft regulatory proposal that would have an impact on farmers, shaping the direction of focus for Powercor when refining the final proposal.

	Public participation goal
Inform	To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.
Consult	To obtain public feedback on analysis, alternatives, and/or decisions.
Involve	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.
Collaborate	To partner with the public in each aspect of the decision-making process including the development of alternatives and the identification of the preferred solution.
Empower	To place final decision making in the hands of the public.

Executive summary

Key energy challenges

Electricity infrastructure constraints, particularly limited access to three-phase power, emerged as the primary barrier to on-farm productivity, business growth, and the transition to electrification across all sectors. Single-phase and SWER (single-wire earth return) line constraints significantly impacted operational efficiency, growth, and the feasibility of electrification, forcing farmers to rely extensively on costly diesel generators. Farmers highlighted critical issues such as reliability and capacity, which directly affect daily operations like irrigation, milking, cooling, and animal welfare.

I'd rather pay for a $20,000 generator than give $50,000 for a power upgrade.“ *Dairy farmer.*

If we've got to spend $1.5 million getting the power here, that allows you to just knock it on the head from day one.” *Grain farmer.*

Energy insecurity also leaves farmers vulnerable during extreme weather events or supply failures. The inability to pump water during outages can lead to cascading losses, not just in productivity, but in livestock health, animal mortality, crop quality and long-term financial damage, causing losses between $29,000 and $100,000 in a single day for some farmers.

[without power and water] you could easily burn a couple hundred grand in just a day.” *Irrigation farmer.*

Case study: Energy challenges and vulnerability

“God forbid, if there's a bush fire and you've got stock and powers out and they need water, you know, you can go backwards very quickly. Yeah. Cattle without water for a day... One guy was telling a story the other day of how he had some stock that got out onto a lane and there was no trough, and he came home two days later and some of them died. And the ones that came back just never got back to normal. Their productivity goes backwards. So you financially lose because you're gonna lose so much condition they can never make it up again.

So that there's a direct relationship to power there because... if there is a catastrophe that eliminated power... that could be catastrophic for a farmer because it's not just “are they losing money”, it's actually life and death for the animals... If you wiped out a herd, you know, that's millions of dollars." *Angela Higgins, Animal husbandry, cattle farmer.*

Barriers and drivers of electrification

Farmers across all sectors expressed a willingness to electrify further, but this openness was conditional on improved infrastructure, affordable connection pathways, and confidence in long-term system reliability. Four core barriers and five key drivers emerged consistently.

There's one farm that's building a new rotary area at the minute which exceeds the power requirements of his existing operation. So part of his quote to rebuild that I think is up to $200,000 to put additional transformers and power lines into that place". *Phil Candy, Regional Milk Supply Manager for Fonterra; Member of the Board at Murray Dairy.*

Key barriers

- Many farms were locked out of modern equipment due to limited grid capacity and no viable path to three-phase upgrades.
- The cost of new infrastructure, especially in fringe or remote areas, was simply too prohibitive or outweighed potential returns.
- Electrification was difficult to manage when essential processes overlapped with peak tariffs or neighbouring energy loads.
- Lack of infrastructure and coordination tools forced farmers to stagger operations manually, reducing efficiency and flexibility.

We're not going to buy $100,000 worth of new pumps if the power can't handle what we've already got." *Dairy farmer.*

Key drivers

- Electrification was seen as a way to reduce energy costs and improve operational efficiency.
- Without electrification, some farmers feared they wouldn't remain viable in the years ahead.
- Outdated single-phase infrastructure limited producers' ability to modernise and stay competitive in a rapidly evolving market.
- Electrification was essential to expand production, invest in new systems, or diversify income streams.
- Supply chain partners, customers and government increasingly expected farmers to demonstrate sustainability and energy transparency.

We were nearly neutral with the solar and then we got the next 100 cows and now I'm about a thousand bucks a month."
Dairy farmer.

We've got some situations where the existing infrastructure is single phase and it's not going to handle the amount of electricity that's needed to run the modern equipment that we need."
Dairy Farmer.

Reactions to proposed initiatives

Farmers keenly supported Powercor's proposed regional and rural equity program, innovation fund, and harmonics initiatives, provided they delivered tangible improvements in grid reliability, capacity, and equitable access. The community expressed cautious optimism but emphasised that these initiatives must translate into practical, accessible, and financially viable outcomes.

"**Three-phase would be a game-changer… you could actually plan around it."** *Animal husbandry, sheep and cattle farmer.*

Participants strongly recommended transparent, predictable investment pathways, clearer communication, and the establishment of a dedicated local liaison role to facilitate ongoing engagement and ensure infrastructure alignment with on-farm electrification needs.

"**We installed our own gear to manage the harmonics. But not everyone can afford that… A lot of irrigators don't have that protection… things explode or catch fire before they trip. That's a real risk."** *Irrigation farmer.*

Farmers equally voiced a clear and consistent need, not just for infrastructure investment, but for direct, ongoing engagement with someone who understands their context. The idea of a dedicated Community Support Officer, embedded within Powercor or closely affiliated, was raised independently in multiple interviews as a critical enabler of trust, participation, and practical delivery.

"**I'd love to see someone local, someone we can talk to, not just a flyer in the mail. Someone who gets the farming context and can help us see what's possible."** *Angela Higgins, animal husbandry, cattle farmer.*

Regional implications

Participants clearly linked energy infrastructure quality to broader regional viability, warning that without timely upgrades, rural communities risk economic stagnation, diminished liveability, and population decline. Conversely, strategic infrastructure improvements were seen as pivotal for regional growth, innovation, and resilience.

"**Without electrification, many farms won't be able to compete. The risk isn't just to businesses. It's to families, livelihoods, and the future of regional towns."** *Rachel Napier, Chair of the board of directors, Murray Dairy, dairy farmer.*

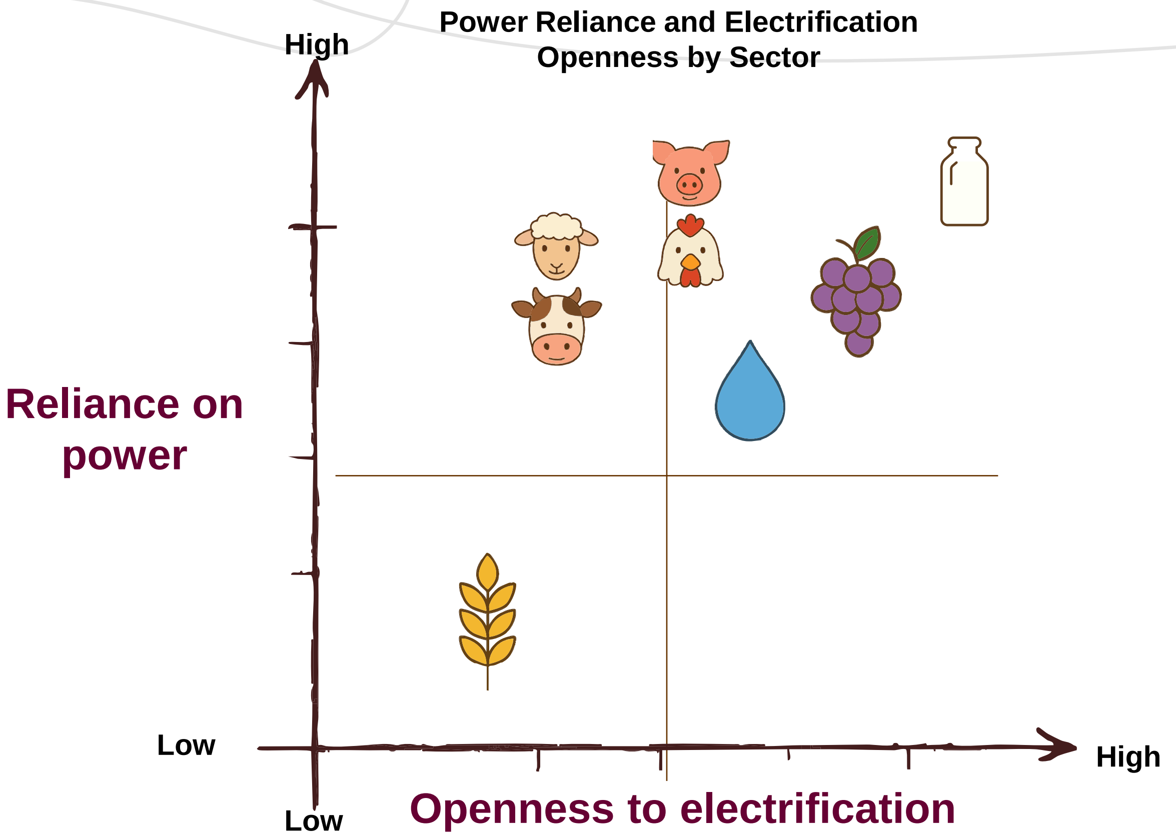
Sector specific insights

This table summarises the lived energy realities of Victorian farmers across five key agricultural sectors. It brings together the core needs of daily operations, the top-of-mind issues shaping their energy experience, and the areas they see as most important for future investment.

Sector	Core needs of daily operations	Issues shaping the energy experience	Important for future investment
Animal husbandry	• Water • Temperature control (Pig and poultry)	• Animal welfare • Reliability and quality • Safety	• Diversification of income (safeguard for the future)
Dairy	• Water (cattle and irrigation) • Temperature control (vat)	• Reliability and quality • Efficiency • Hygiene • Animal welfare • Energy costs	• Upgrades to 3 phase for modernisation, survivability and expansion
Irrigation	• Water • Energy for cool stores	• Harmonics • Demand management • Quality • Energy costs	• Access to 3-phase in fringe or low-capacity areas (especially at Goulburn Murray Irrigation District (GMID) edges) • Opportunity to diversify production • Time irrigation around peak tariffs / solar availability
Grain	• Low supply needed	• Lines too low • Decommission lines • Safety	• Ability to value-add through on-site grain cleaning, feed production, or storage (limited by single-phase power)
Fruit farming and processing	• Quality and reliable power for watering and cool store	• Quality of fruit • Cost – peak demand charge • Interrupted supply damaging equipment • Harmonics	• Sufficient grid capacity to run irrigation and cold chain systems in sync (pumps, fans, chillers, packing lines)

Power reliance and electrification readiness

This visual matrix summarises how different agricultural sectors across Powercor's network relate to electricity today and how open they are to further electrification in the future. Sectors are positioned based on their current **reliance on electricity to operate** (vertical axis) and their **openness to transitioning to electric systems and technologies** (horizontal axis).



Animal husbandry	• Reliant on pumps, fencing, and temperature control, especially in pig and poultry. • Openness shaped by practicality and risk mitigation, not novelty.
Irrigation	• Heavy electric pump use, especially in high-value crops. • Open to electrification if tariffs, timing, and infrastructure improve.
Dairy	• Power use is continuous and non-negotiable (milking, cooling, cleaning). • Openness to electrification linked to desire for modernisation, improved efficiency, sustainability, and reduced outages.
Fruit, veg. and produce	• Strong dependency on energy for irrigation, cool stores, fans, and packhouses. • Pressure from food safety and export compliance drives precision. • Keen to electrify to enhance cold-chain efficiency and reduce carbon exposure.
Grain	• Seasonal and task-based power use; diesel still dominant. • Electrification interest is cautious, more viable in workshops and augers. • Cost, distance to infrastructure, and load limits temper enthusiasm.

Shared drivers of electrification

While each sector faces unique power challenges, five common drivers emerged across all farms. These shared motivations reflect a desire to control costs, modernise operations, and future-proof farming businesses in the face of growing risks and expectations.

Fuel costs

Diesel use was widespread but viewed as risky, costly, and increasingly unsustainable for irrigation, generators, and freight.

"It's not a long-term solution. It's loud, it's expensive to run."
Irrigation farmer

Market pressure and sustainability

Farmers felt pressure to meet sustainability targets and prepare for emissions audits but also desire to achieve their own sustainability goals.

"I wanna do everything I can to be creating a climate resilient farm where we're part of the solution, not the problem. And that's always been balanced against the financial opportunity."
Animal husbandry farmer

Why Farmers Electrify

Shared motivators driving demand for scalable, affordable, and reliable electrification

Efficiency

Many farmers saw electrification as a tool to reduce power waste, ease labour burdens, and cut overheads.

"I was nearly neutral with my power bill, but not anymore. Now with the increased herd and energy use, I'm about $1,000 a month in bills – still good, but I need more solar to get back to neutral.“
Dairy farmer

Growth

Electrification was a prerequisite for summer cropping, irrigation intensification, and on-site processing.

"We could value add by processing stuff here if we had the power, but you're not going to run through some generators to do it."
Grain farmer

Modernisation

Single-phase power limited upgrades, particularly in sheds, pumps, and packhouses. Three-phase was seen as the gateway to progress.

"The whole system's set up for three-phase… but we just haven't got it coming up the road."
Dairy farmer

Sector differences to Powercor proposed investments

While the infrastructure themes were consistent, better reliability, affordable upgrades, and clearer planning, sector-specific needs shaped how producers thought about solutions.

Sector	Regional and rural equity program	Innovation allowance	Northern Murray harmonics management	Community support officer
Dairy	Critical for electrifying pumps and barns. Cited high upgrade costs even when close to infrastructure.	Interested, but only if tied to cooling and milking system upgrades.	Not discussed.	Help navigating complex tariff, connection, and upgrade decisions for core operations like cooling and milking.
Fruit, veg. and produce	Needed for storage expansion, electrified spraying, and seasonal labour automation.	High expectations. Want grid-ready automation, batteries, and storage.	Very important near Mildura/fringe areas. Harmonics already causing resets.	Trusted support to coordinate automation, battery, and storage upgrades with community.
Grain and irrigation	Viewed as transformational. Many ready to electrify if upgrades are affordable.	Focused on solar export smoothing and shared storage.	Very important near Mildura/fringe areas. Harmonics already causing resets.	Guidance on shared infrastructure and upgrade eligibility to reduce risk and improve equity.
Animal husbandry	Seen as enabling future investment in sheds, shearing, and water.	Limited interest unless focused on small-scale resilience (e.g. fencing, bore pumps).	Not discussed.	Advisory support to help smaller farms assess viable electrification options for shearing and water systems.

Cross-sector insights

1. Electricity supply, not technology, is the primary barrier to change.

Across the full range of interviews, participants identified electricity supply, not technology, as the primary barrier to electrification, automation, and long-term operational change. While technological solutions were known and, in many cases, already being deployed elsewhere (e.g. solar systems, electric augers, camera sprayers, centre pivots), the decisive constraint was whether the existing electricity supply could support them.

Participants across sectors described instances where three-phase power would have enabled upgrades, investment in new plant, or consolidation of systems currently dependent on diesel. In the absence of sufficient capacity, projects were postponed, redesigned, or abandoned.

This finding highlights a critical opportunity for impact. Farmers already know which technologies they want to adopt, and in many cases, they're already in use elsewhere. But without sufficient power supply, those tools remain out of reach. What's needed now isn't more innovation, it's the capacity to use what already works. By addressing core infrastructure constraints, Powercor can enable real progress, unlock stalled investment, and turn intent into action.

"I hear there are electric tractors in Europe. But if I can't chill my milk overnight, how am I going to charge a tractor?"

Rachel Napier, Chair of the Board of Directors, Murray Dairy, dairy farmer.

"Every time we shear, I have to turn our house off… to run the shed."

Animal husbandry farmer.

"We actually wanted to set up a boutique dairy… but there's just no way we could get the power we'd need to do that properly."

Carly and Darren Noble, *animal husbandry and grain, lamb and cropping farmers.*

2. Energy use varied, but every sector ran up against reliability and capacity limits.

Each sector uses energy differently, but all face similar challenges when it comes to reliability, capacity, and infrastructure. Despite these variations in timing and magnitude, most operations were served by single-phase supply and relied on diesel as the default fallback. In this sense, the energy challenge was not specific to any one sector; it was structural.

Sector	Load Pattern	Key Energy Uses	Primary Constraints
Grain	Seasonal, intense.	Aeration fans, augers, seed grading, post-harvest storage.	Transformer limits; timing harvest loads.
Dairy	High morning peak, consistent daily.	Milking systems, refrigeration, hot water, cleaning, irrigation, water pumps.	Predictable peaks; outages risk milk loss.
Fruit, veg. and produce, and irrigation	High in summer.	Pressure pumps, fertigation, filtration.	Immediate water delivery; peak-load reliability.
Animal Husbandry			
Poultry	High, continuous.	Lighting, heating, ventilation, automated feeding.	Overnight grid reliance; diesel backup needed.
Sheep And cattle	Low but essential.	Bore pumps, shearing, electric fencing, water systems.	Supply fragility; limited buffer capacity.
Pigs	High, climate-driven.	Heating, ventilation, lighting, waste systems, automated feeding.	Consistent load; infrastructure limits expansion.

3. Producers are adapting around constraints, but it's costly and unsustainable.

Participants reported a wide range of adaptations used to operate within infrastructure constraints. These included:

- **Generator reliance**: Portable and stationary diesel generators were common across poultry, grain, and horticulture sites. Some operations had up to six generators, including units of 65, 85, 140, 210, and 450 kVA. They were used not just as backup, but as primary sources of supply for silo fans, irrigation pumps, or chicken sheds.
- **System modifications:** Several participants downgraded imported equipment to suit their power availability. In one case, a lathe originally configured with a 5-horsepower motor was retrofitted with a 2-horsepower equivalent to run on single-phase power.
- **Load timing:** Where solar was present, operations were rescheduled to coincide with maximum production. For example, grain rolling or seed cleaning was timed to daylight hours to avoid grid draw during peaks.
- **Underinvestment:** In multiple cases, capital was redirected or withheld altogether due to energy uncertainty. One business, which had planned to build a biscuit factory as part of a vertical integration strategy, abandoned the project due to lack of power availability.

While these adaptations allowed operations to continue, they were generally described as temporary solutions that introduced cost, labour intensity, and planning complexity.

4. Farms hosting renewables often cannot access the energy they help generate.

Several participants expressed frustration that while their properties hosted renewable generation infrastructure, such as wind turbines or solar farms, they were unable to access any corresponding improvements in electricity supply.

Despite living next to high-voltage infrastructure or exporting solar into the grid, they remained constrained by outdated or undersized connections.

Others questioned why local infrastructure couldn't be leveraged to support regional electrification.

"If they're plugging into the line here, we should be getting local supply." *Dairy farmer*.

This was framed not as a complaint about land use, but as a concern about value sharing and planning integration. Interviewees questioned why large-scale energy projects could be connected to the network via their region, while local users continued to operate on a constrained single-phase supply.

Where community benefit schemes existed (e.g. sponsorship funds or council rate contributions), they were welcomed. However, producers emphasised that long-term prosperity and sustainability of regional communities would come from infrastructure upgrades that enable productive use, not just compensation.

Some participants also raised the reverse frustration that while they were generating renewable energy through on-site solar systems, they couldn't share this power locally or use it more flexibly across their own operations.

Case study: Opportunity to leverage renewable infrastructure for distribution access

The grain farmer saw a logical and mutually beneficial opportunity for Powercor to collaborate with renewable developers and VicGrid to extend three-phase distribution from renewable substations into the surrounding rural areas.

"If Powercor could work with the renewable energy industry, we could put hotspots of three-phase scattered through areas where there wasn't."

The main substation was described as being close by, and tapping into this could be transformational, enabling local access to the increased supply generated through renewables.

Farmers expressed a strong interest in being part of community-led solutions, asking why excess solar couldn't be directed to nearby homes, dairy sheds, or packing lines. This wasn't just about better use of assets, it was a vision for a more resilient, self-sufficient energy system that kept value circulating in the region.

Beyond individual operations, several participants framed access to distributed renewable generation as a lever for broader regional sustainability. They saw shared access not only as a fairer use of locally hosted infrastructure but as a way to strengthen the resilience, liveability, and economic future of rural communities. By enabling farms, small businesses, and community services to draw from local generation, participants believed energy could function more like water infrastructure, supporting shared prosperity and helping towns retain families, services, and investment. This vision extended beyond compensation; it was about building distributed systems that kept value circulating within the region.

5. Power constraints are shaping business strategy, often in limiting ways.

Energy limitations didn't just interrupt operations, they fundamentally reshaped how farms planned for the future. Across sectors, producers described shelving investment in grain cleaning, refrigeration, automation, or value-adding activities, not due to lack of demand, but because their electricity supply simply couldn't support it. Several shifted toward lower-input models like grazing, or halted diversification altogether.

We could value add by processing stuff here if we had the power, but you're not going to run through some generators to do it." *Grain farmer.*

For many, infrastructure didn't just limit action, it limited imagination. Respondents said they weren't even considering certain innovations because they already knew the power wasn't there to support it. In that way, constrained energy supply wasn't just a technical problem, it was influencing mindset, ambition, and how producers defined what was possible.

Even those interested in going off-grid or self-generating noted the upfront cost and complexity were hard to justify, especially on single-phase supply. Instead of designing their ideal farm, many said they were building only what their existing energy setup could tolerate. The result is a slow but systemic underperformance, not just of individual farms, but of regional economies that miss out on jobs, investment, and innovation. When producers build only what their existing energy setup can tolerate, the broader community loses out on the growth that electrification could have enabled.

6. Transition readiness is dictated by grid access, not just attitude.

Producers across sectors anticipated increased electrification over time. Common areas of interest included:

- Electric vehicles for on-farm and local use.
- Electrified augers, aerators, and irrigation systems.
- Battery-backed solar systems for sheds, workshops, fences and chicken sheds.
- Automation of seeding, spraying, and harvest through GPS and camera-guided machinery.

However, participants were clear that uptake would not be uniform. Properties with sufficient grid access, capital, and capacity to absorb transition risk would move earlier. Those with single-phase supply or isolated connections would likely lag behind.

There was no objection to this reality. Rather, it was raised as a reason for deliberate infrastructure planning, ensuring that network upgrades align with likely uptake patterns and avoid further entrenching infrastructure disparities.

Case study: Anticipated shifts in on-farm technology

Autonomous or man-less spray vehicles were noted by this farmer as on the horizon.

"The robotics will determine tree spacing, turn your sprays up and down, on and off… very high percentage savings on chemicals." *Chris Parham, Southern Cross Farms, fruit, veg., and produce.*

7.1 EVs are appealing, but power supply makes them a distant prospect.

Across farm types, most participants viewed on-farm EVs, including tractors, utes, ATVs, as an appealing but distant possibility, e.g. beyond 10 years. The main barrier wasn't interest, but infrastructure: the current power supply simply couldn't support even modest charging loads.

If we're going to have electric vehicles, we haven't got a hope of charging anything." *Animal husbandry farmer.*

Farmers consistently pointed to three structural gaps:

- Lack of grid connection at paddocks and remote sites.
- No three-phase power, even on some intensive farms.
- Power capacity stretched just meeting current loads.

Some already used electric forklifts and pallet jacks, powered from solar where possible. But scaling up to farm vehicles or machinery was seen as unrealistic without serious upgrades:

If everything that's currently diesel or petrol was battery-powered tomorrow? No way we'd have enough capacity." *Robert Matthews, animal husbandry, lamb grazing and quarry.*

For tractors and heavy-duty tasks like spraying or slashing, performance was a clear dealbreaker:

They just can't generate the amount of power and torque required to operate on a farm." *Chris Parham, Southern Cross Farms, fruit, veg., and produce.*

Many noted that manufacturers weren't yet offering viable options in the Australian context. Until that changed, few saw it as something worth planning for:

We'd jump on it if the economics stack up. But no one's really offering the machinery yet." *Irrigation farmer.*

This signals a major readiness gap: farmers are interested, but the grid is not. Without serious upgrades to on-farm capacity and rural distribution infrastructure, EV adoption will remain aspirational, no matter how attractive the economics or technology becomes.

7.2 Electric freight is a national challenge beyond the reach of individual farms.

Participants were even more skeptical about the prospects of electrifying freight and long-haul logistics. Interest was there, particularly among those managing cold chains or bulk transport, but feasibility was not.

> **There's just no way we could get the power we'd need to do that properly."** *Irrigation farmer.*

Truck charging infrastructure in rural regions was seen as effectively non-existent. Charging time, distance limitations, and lack of battery-swap systems were all flagged:

> **The biggest thing to change would be logistics infrastructure. Being able to support electric trucks with swappable battery systems."** *Robert Matthews, animal husbandry, lamb grazing and quarry.*
>
> Beyond infrastructure, farmers worried about broader resilience. Several linked freight electrification to long-term risk from rising diesel prices:

Ultimately, electrifying logistics wasn't viewed as a farm-level challenge, but as one requiring national-scale planning and investment. The challenge of electrifying freight sits well beyond the farm gate. Until there is coordinated investment in regional logistics infrastructure, including high-capacity charging and battery-swap networks, freight electrification will remain out of reach, despite rising pressure from fuel costs and cold chain requirements.

Case study: Freight Realities in NZ vs Australia

"Fonterra in New Zealand has a fleet of trucks, many of which are electric. But the distance they travel is minuscule compared to Australian conditions… they can leave the factory and do a milk run and be back in 30 kilometres. Our average milk run at the minute per day is 380 to 450 kilometres." *Phil Candy, Regional Milk Supply Manager, Fonterra, dairy, dairy processor.*

8. Without power, towns shrink. With it, they might grow.

Across grain and animal husbandry regions in particular, participants described deep interconnections between energy infrastructure and the social and economic fabric of their communities. It wasn't just about powering pumps or sheds. Access to reliable energy was seen as foundational to retaining people, services, and hope.

> **For one farmer, one operation to be moving along at a good speed, all that money goes into our local town… it creates school kids, money in the community, and community health."** *Dairy farmer.*

Power, meaning both energy supply and quality, was described as a lever that could either accelerate decline or unlock new growth. Without it, producers face higher operating costs, lower productivity, and constrained business models. The knock-on effect would mean less investment, fewer jobs, and younger generations moving away.

Participants believed energy infrastructure upgrades, particularly a three-phase rollout, could reverse this trend by enabling modern operations, attracting new enterprises, and making it viable to live and work regionally. In this sense, energy was not just an operational tool, it was a critical enabler of economic resilience and rural regeneration.

> **If the power keeps dropping out, people won't invest. They'll just move somewhere else."** *Grain and animal husbandry farmer.*

The decline wasn't seen as sudden, but cumulative:

> **We don't have a lot of infrastructure now... if each person pulls back just a bit, the next one does, and the next one... it all compounds."** *Grain farmer*

> **If farming gets too expensive, people will leave. Simple as that."** *Dairy farmer*

> **We just need more people. But if we can't attract more people, if we don't have the power to run factories... that could be a chicken shed on our farm or a biscuit factory in Donald... it's the same thing."** *Grain and animal husbandry farmer*

While telecommunications were also flagged as a barrier to attracting staff and contractors, electricity was seen as the first-order enabler of investment and liveability. As one participant reflected, the impact of Powercor's proposed regional and rural equity program could rival earlier infrastructure investments:

> **Good power will eventually have a similar effect [to water pipelines] in improving the whole area."** *Grain farmer.*

Case Study: Regional risk

"Every single part of our services pulls back just a little bit; it just makes it a little bit harder. Over time, the impact is huge." *Grain farmer.*

This farmer's comment reflects the slow, compounding effect of service decline in regional areas, not just power, but also health, education, transport, and communications.

Each small loss means fewer teachers, less nurse access, longer waits for mechanics and this adds friction to everyday life and makes it harder to attract or retain families, workers, and investment.

Energy access, in this context, is a signal of broader regional health. Without reliable power, services erode, opportunities shrink, and communities struggle to stay viable.

9. Sustainability motivation and market pressure to electrify is rising

Across sectors, farmers voiced growing pressure to decarbonise, driven by market expectations, regulatory momentum, and internal sustainability goals. But while the will to act is real, the path forward is often obstructed by infrastructure gaps and administrative burden.

Supply chain and consumer expectations
Many producers, especially in dairy, horticulture, and premium markets, described a shift in buyer behaviour. Food processors and supermarket chains are increasingly asking for evidence of emissions reductions, energy transparency, and sustainable practices. For farmers, this signals a transition where sustainability credentials may become market access requirements, not just nice-to-haves.

Reporting your emissions… it's not legislated just yet, but the supply chain are gonna gradually ask that of us." *Angela Higgins, animal husbandry, cattle farmer.*

Sustainability frameworks and emission reductions – our customers demand that more… especially with single origin products." *Dairy farmer.*

Anticipating net zero mandates
There was also a strong sense that farms will be expected to meet net-zero standards within the next decade, whether or not current infrastructure enables that transition.

There would need to be significant government support." *Robert Matthews, animal husbandry, lamb farmer and quarry.*

Many said they were actively planning how to shift their fleets, cool stores, or irrigation systems away from diesel, but could not act without scalable grid access and capital assistance. Without electrification, farmers feared they'd be left out of emerging value chains and forced into unviable diesel-dependent models.

The burden of compliance and carbon complexity
For some, the carbon market itself was a source of frustration. Grain producers in particular questioned the validity of carbon accounting tools in fire-prone, variable climates. Others described carbon systems as convoluted and unfair, where decisions made far down the supply chain could double their recorded footprint.

I can double my carbon footprint on the decision by a buyer in an office." *Grain farmer.*

Essentially, I'm a farmer trying to understand carbon credit trading… it's guesswork." *Grain farmer.*

Carbon is problematic for us to pinpoint… our soil carbon will differ so much depending on whether we've got ground cover, a crop, or a fire went through." *Grain farmer.*

Compliance expectations, whether around water, power, safety, or carbon, were increasingly seen as a burden that required time, staffing, and expertise most operations couldn't spare.

Internal motivation to do the right thing

While supply chain pressure was clearly growing, many farmers emphasised that their drive to electrify and reduce emissions was not purely reactive. Across sectors, particularly dairy and animal husbandry, farmers spoke about wanting to be part of the solution, improve operational resilience, and reduce their environmental impact on their own terms. For some, sustainability was tied to farm legacy, soil stewardship, or future-proofing for the next generation.

“**We want to be proactive. We’re not waiting for the government to tell us. We just need the tools to get there.”** *Animal husbandry farmer.*

“**I don’t want to rely on diesel forever. It’s expensive and it’s not where we should be heading.”** *Dairy farmer.*

Farmer recommendations for enabling electrification

Participants provided clear, pragmatic recommendations regarding energy infrastructure and planning. These included:

- Targeted upgrades to three-phase infrastructure in regions with concentrated operations or new renewable development.
- Improved cost transparency for upgrade quotes and connection assessments.
- Formal engagement, that is more frequent and responsive, through a community liaison officer or regional contact with agricultural experience.
- Planning integration between Powercor, VicGrid, and generation developers to coordinate buildout and reduce duplication.
- Recognition of non-commercial value, such as productivity enablement, emissions reduction, and community retention.
- Funding models that support sustainable practices, including solar, battery, and electrified equipment, especially where these reduce diesel use or unlock diversification.
- Innovation initiatives designed in partnership with farmers, not imposed top-down, and underpinned by transparency, local benefit, and replicable outcomes.
- Multiple participants expressed willingness to co-invest or stage their upgrades if given clear pathways and risk-sharing mechanisms.
- Farmers called for a dedicated community support officer. Someone embedded, knowledgeable, and capable of providing contextual advice on funding, energy planning, and upgrade options.

In many cases, farmers were not asking for fully subsidised upgrades, but for predictable pathways to invest confidently. Several participants expressed interest in co-investment models, shared battery solutions, or trial participation; if the offering aligned with operational risk and cost structures.

Powercor investment proposals: cross-sector reflections

1. Baseline expectations: "We're not asking for luxuries, just the basics."

Across all sectors, producers were clear about their expectations: they were not asking for handouts or cutting-edge innovation, but for dependable infrastructure that matched the realities of modern farming. The overwhelming baseline ask was three-phase electricity, not just for today's needs, but to enable long-term investment and resilience.

Farmers across dairy, grain, fruit, irrigation, and animal husbandry described electricity not as a commodity, but as an enabler. Without it, everything from food safety to animal welfare, staff scheduling to market participation became harder, or impossible.

"Three-phase would be a game-changer… You could actually plan around it." *Animal husbandry, sheep and cattle farmer.*

"We've invested where we can, but there's a ceiling to what's possible without more reliable power." *Irrigation, leafy greens farmer.*

"There's three-phase on the highway. We'd still have to pay 60 to 100 grand to get it to us." *Rachel Napier, Chair of the Board of Directors, Murray Dairy, dairy farmer.*

A common frustration came from those who had already invested in three-phase-ready systems, switchboards, cabling, shed design, only to be blocked by connection costs or policy ambiguity. Participants were not asking for full coverage, but for predictable, transparent, and fair access to infrastructure that would let them modernise with confidence.

The message was consistent: power limitations were not about ambition or attitude. They were about capacity. And right now, in most rural areas, the grid could not deliver it.

2. Reception of proposed investments: supportive, but cautious.

Most participants welcomed Powercor's proposed investment programs, especially the regional and rural equity program, but support was rarely unconditional. The core concerns fell into three categories: delivery scale, accessibility, and trust.

High support	Medium support	High support	High support
Regional and rural equity program	**Innovation allowance**	**Northern Murray harmonics management**	**Community support officer**

Regional and rural equity program

The regional and rural program was viewed as essential, especially in high-growth areas like horticulture corridors, irrigation zones, or dairy clusters with rotary systems or barns. But there was concern about how sites would be selected, and whether farms already prepared for upgrades would be left out.

If we had three-phase, we wouldn't even consider off-grid. It would change everything." *Grain and animal husbandry, mixed cropping and sheep farmer.*

The risk is they pick the easy spots and leave the rest of us behind." *Grain irrigation farmer.*

Others had priced network extensions only to find they were unaffordable without Powercor "coming to the party." The pilot was seen as a critical test, not just of infrastructure delivery, but of fairness.

Innovation allowance

The Innovation allowance was broadly viewed as promising, but only if it delivered replicable, farm-ready solutions rather than high-profile demonstration sites. Most producers had little interest in "shiny tech" or marketing pilots. What they wanted were use cases that addressed known problems: voltage fluctuations, export limits, battery feasibility, and automation bottlenecks.

Powercor should look at who's putting stress on the grid and where. Maybe co-fund a battery at those sites. I'd be open to something like that."
Domnic Sergi, fruit, veg. and produce, grape grower and citrus farmer.

There is definitely a lot of opportunity for behind-the-meter infrastructure... we've got a large area where you could put ground-mounted panels or batteries, but getting that back into the network is the cost." *Fruit, veg. and produce farmer.*

Several supported the idea of Powercor-led or Powercor-vetted trials, to help rebuild trust and mitigate the legacy of poor vendor experiences. Others recommended co-design processes with local engineers and retailers to ensure solutions were technically aligned with the grid.

Northern Murray harmonics management

While less discussed overall, the Northern Murray harmonics management was appreciated, especially by growers near Mildura. Many had invested in on-farm voltage smoothing devices or motorised switchboards because grid quality issues were degrading pumps and causing restarts.

We installed our own gear to manage the harmonics. But not everyone can afford that… A lot of irrigators don't have that protection… things explode or catch fire before they trip. That's a real risk." *Irrigation farmer.*

Some requested broader rollout and integration of monitoring tools, auto-disconnect switches, or co-investment in basic protection infrastructure.

Community support officer

Across every region and sector, farmers voiced a clear and consistent need: not just for infrastructure investment, but for direct, ongoing engagement with someone who understands their context. The idea of a dedicated Community Support Officer, embedded within Powercor or closely affiliated, was raised independently in multiple interviews as a critical enabler of trust, participation, and practical delivery.

Producers were not opposed to innovation. They were not waiting to be convinced of the value of electrification or automation. What they needed was guidance through the complexity, someone who could bridge the gap between policy and paddock, infrastructure and irrigation, pricing plans and pig sheds.

I'd love to see someone local, someone we can talk to, not just a flyer in the mail. Someone who gets the farming context and can help us see what's possible."
Angela Higgins, animal husbandry, cattle farmer.

This was not a call for sales or service representatives. Farmers specifically wanted a credible, technically literate individual who could:

- Interpret the implications of network constraints and capacity at the farm level.
- Explain eligibility and application processes for pilot programs and grants.
- Facilitate cost-share models and coordinate group upgrades where feasible.
- Help assess infrastructure feasibility for electrification plans (e.g., solar plus battery, three-phase upgrades, irrigation conversions). Act as a trusted conduit between farmers, engineering contractors, and Powercor planning teams.

In short, they wanted a human face to a complex system, a "translator" who could contextualise technical decisions in agricultural terms.

This role was seen as especially important for small and mid-scale producers, who often lacked the resources or advisory networks available to large corporations. These operators described feeling overlooked or unprepared when navigating energy decisions, and were often wary of vendor-driven advice due to past negative experiences with solar or battery installations.

It'd be nice that Powercor was part of that – how can we as a business partner with Powercor to optimise and work together?." *Fruit, veg. and produce farmer.*

A liaison officer was also seen as a mechanism to de-risk innovation. Many farmers were open to trial participation or co-investment, but only if the offer came with transparency, accountability, and technical integrity. They wanted real conversations, not marketing brochures.

Farmers also expressed a desire for continuity. This was not about one-off consultations or information sessions, it was about sustained relationships over the full cycle of infrastructure delivery, from scoping and approvals through to installation and performance monitoring.

3. Innovation and co-investment: “If we meet halfway, we can build something.”

While many participants described the grid as a barrier, they also saw themselves as part of the solution. Across all sectors, there was a strong appetite for co-investment models, but only where the risks and responsibilities were shared fairly.

This sentiment was especially pronounced in irrigation, horticulture, and grain sectors, where producers often described themselves as "ready to go" with solar arrays, batteries, or electric irrigation, if the grid could keep up.

Some participants had already priced underground cabling or transformer upgrades, only to find the costs prohibitive without shared infrastructure support. They called for models that recognised both the commercial and public value of agricultural electrification, supporting exports, climate goals, and regional employment.

Growers and irrigators suggested shared infrastructure models like:

- Community batteries for irrigation or cool storage zones.
- Smart transformers that could handle local voltage balancing.
- Solar hubs with export smoothing capabilities.

Several suggested that trial funding should prioritise ordinary farms, not only the “hero sites” with large capacity or media appeal. Others argued for tools that make participation easier: template engineering designs, accredited suppliers, or indicative pricing for upgrades.

“**We would have more electric stuff if we had three-phase. We’d have three-phase augers or belts… We won’t expand it... If we’ve got to pay for [power connection], it’ll probably knock the project on the head.”** *Grain and animal husbandry farmer.*

Above all, farmers wanted to feel like equal partners in the energy transition, not recipients of disconnected technology trials.

4. Regional equity: “It’s not a tech issue. It’s a planning issue.”

Across interviews, participants flagged a recurring risk: that only farms closest to substations or major roads would benefit from infrastructure upgrades, while smaller or more remote operations would fall further behind.

The cities will get investment first, and we’ll be left paying more for a system that doesn’t work as well for us.” *Dairy farmer.*

In dairy, animal husbandry, and mixed enterprises, this concern was sharpened by proximity. Multiple producers said they were only “a few poles away” from three-phase infrastructure, but still faced $60,000 to $100,000 upgrade quotes. Others described having invested in switchboards or electrical design, only to have no viable pathway to connect.

Participants stressed the need for rural electrification to be treated as a regional development priority, not just a business case. Several likened the proposed regional and rural equity program to earlier infrastructure programs like piped water or telecommunications: at the time, controversial; in hindsight, essential.

The clearest call was for visibility and predictability:

- Transparent maps of transformer capacity.
- Indicative upgrade costs.
- Tools to assess when and how grid upgrades could occur.

Without this, participants said, rural communities faced slow attrition: fewer young families, shrinking services, and lost investment in both farms and towns.

The risk of being left behind in the energy transition

While the impact of energy constraints at the individual level was clear, participants also spoke powerfully to the broader risks facing rural communities. Here, concerns extended beyond infrastructure and into social, economic, and demographic territory.

Across the board, respondents linked constrained energy infrastructure to declining services and reduced resilience in regional areas. Where investment in electricity failed to materialise, the same was often true for telecommunications, health, education, or roads. Farmers described a slow withdrawal of basic supports: fewer teachers, longer response times from trades, smaller football teams, and fewer reasons for young families to stay.

"Every single part of our services pulls back just a little bit. It just makes it a little bit harder. Over time, the impact is huge." *Grain and animal husbandry farmer.*

Participants believed that a lack of reliable power not only stalled individual farm innovation but undermined regional sustainability. If businesses cannot grow, they do not hire local workers. If families cannot access services, they leave rural towns. And if local infrastructure cannot support modern industry, whether that's a chicken shed, cold storage facility, or a food processor, then future investment will flow elsewhere.

"Without electrification, many farms won't be able to compete. The risk isn't just to businesses. It's to families, livelihoods, and the future of regional towns." *Rachel Napier, Chair of the Board of Directors, Murray Dairy, dairy farmer.*

This was particularly acute in sectors where time sensitivity and perishable goods dominate, such as horticulture and dairy. One fruit grower noted that cooling infrastructure could not be expanded until local transformer limits were addressed. Another irrigator explained that plans to move into higher-value crops were stalled due to voltage instability. In both cases, missing infrastructure translated directly into missed economic potential.

The longer-term risk, as many participants saw it, was bifurcation, not just between large and small farms, but between regions with modern infrastructure and those without. Some explicitly compared electricity infrastructure to past water pipeline projects, arguing that just as water transformed farm viability, so too could reliable energy, if deployed fairly and strategically.

"For one farmer, one operation to be moving along at a good speed, all that money goes into our local town, it creates school kids, money in the community, and community health." *Phil Candy, Regional Milk Supply Manager for Fonterra; Member of the Board, Murray Dairy, dairy processor.*

Many emphasised that this is not a story of despair, but of latent opportunity. Farmers were not asking for full subsidies or risk-free investment. They were asking for predictable, fair, and coordinated infrastructure, so that rural areas could build on their strengths and retain people, skills, and enterprise.

"Connectivity is the bigger issue, by tenfold" *Grain farmer.*

In this way, electricity access becomes a proxy for regional equity. It is not simply a question of what can be powered, but of who gets to participate in the future economy. The energy transition, for many farmers, is not just about decarbonization, it is about inclusion.

Several participants emphasised that future-ready farming communities will require not only better energy infrastructure but also improved telecommunications. Poor mobile and internet coverage was seen as a compounding constraint, limiting the uptake of automation, complicating logistics, and making remote management or monitoring nearly impossible. Beyond operations, it also affected the liveability of regional areas, with younger generations reluctant to return or settle without reliable digital access.

The Rural Infrastructure Spiral

Poor infrastructure

↓

Limited electrification and automation

↓

Farm stagnation or closure

↓

Loss of local jobs and services

↓

Regional depopulation

↓

Decline in rural schools, health, and business ecosystems.

Case examples: when infrastructure sets the limits

While the broader risks of being left behind are well understood at the community level, the real weight of those risks is clearest in the experiences of individual producers. The following case studies demonstrate how constrained or outdated infrastructure can limit investment, productivity, and participation, even when willingness and vision are strong.

Robert Matthews' experience at the edge of Powercor's network reveals how infrastructure gaps discourage innovation, despite proactive land use and a diversified business model. Meanwhile, lessons from Goulburn Valley's water pipeline investment show what's possible when infrastructure is delivered boldly and equitably, unlocking growth, diversification, and confidence across an entire farming region.

Together, these stories illustrate both the risks of delayed investment and the transformational upside of well-planned upgrades. They show that infrastructure is not just about keeping the lights on; it's about enabling regional prosperity.

Case study: Robert Matthews, from mixed farming to quarrying

Location: Meringur, Victoria (edge-of-grid)
Former operation: Lamb and grain
Current activity: Stone quarry, forest sub-letting, sheep grazing

Robert Matthews is a landholder managing a small-scale mixed-use property at the edge of Powercor's distribution network. His current activities include sheep grazing, forest stewardship, carbon sequestration, and operating a small stone quarry that represents the property's primary income stream.

Historically, the land supported grain crops, but production was discontinued due to repeated financial losses. The shearing shed is now used five days per year, drawing minor power loads for clippers, fans, and cooling systems. Most other needs, such as fencing and tool use, are met with solar-powered or battery-based equipment, reflecting the farm's low daily energy footprint.

Despite the modest operational scale, the respondent identified energy infrastructure as a critical constraint on future potential. While the current single-phase setup supports day-to-day activities, he noted that it would not support electrification of his quarry machinery or enable future uses such as electric vehicle (EV) charging, cold storage, or on-farm meat processing.

"If diesel becomes too expensive, or if I can't upgrade the equipment, the quarry's not viable either."

Though not reliant on grid upgrades for current needs, he highlighted that the absence of three-phase power discourages investment in the region. He viewed grid infrastructure as a key enabler of rural participation in the energy transition and expressed support for Powercor's proposed three-phase pilot.

Robert's case illustrates how limited infrastructure does not just restrict current operations, it shapes what rural businesses can imagine, plan for, or pursue. His experience echoes a broader concern raised throughout the research: without scalable, reliable energy, regions like Meringur may struggle to retain or grow productive agricultural and industrial activity.

Case study: lessons from GWMWater Southwest Loddon Pipeline system

Location: Arnold
Operation: Lamb and cropping

While the impacts of energy constraints on individual farms were significant, participants repeatedly pointed to broader, structural risks for regional communities. These risks extended far beyond infrastructure, into the economic, demographic, and social resilience of rural towns.

Many farmers linked grid constraints to a wider pattern of regional withdrawal. Where investment in electricity failed to materialise, other essential services, like telecommunications, health, education, or even trades, were often patchy or declining.

The story shared by Carly and Darren offered a concrete case of how these infrastructure gaps play out. The couple had developed a plan to convert their mixed livestock operation into a small-scale dairy enterprise, an opportunity that would bring diversification, growth, and jobs. But the farm was only serviced by single-phase power. Extending three-phase to the site would cost over $100,000, involve crossing culturally and environmentally sensitive land, and require permissions from neighbours to use existing poles; none of which proved feasible.

We got the shed planned, the switchboard in, but every option hit a wall… you couldn't get three-phase across the hill without going through three other blocks and no one wanted to help."

In the time since abandoning their dairy plan, Carly has seen neighbouring farms sold off to large corporate agricultural enterprises, often interstate or offshore-owned, operating at scale. These conglomerates have no need to connect power to the land because they do not use the blocks for on-site production or processing. Instead, they leverage the land solely for grazing and droving, while consolidating energy-intensive infrastructure (like refrigeration or feed production) at a central hub where three-phase power is already available.

They just use the land to push stock through," Carly explained. "No sheds. No workers. No power. It's not farming the way we knew it."

The flow-on effects are stark. With no people living or working on those farms, local schools shrink, footy clubs fold, and demand for local services disappears. The transformation is not just agricultural, it's civic.

You lose the families, you lose the schools, the businesses, it's the town that dies… and it's all because the infrastructure isn't there to let smaller farms stay viable."

Carly offered a vivid counter-example: before the upgrade, water had to be carted manually, particularly during drought. After the pipeline went in, a reliable supply unlocked new investment, improved liveability, and kept farmers in place. She argued that electricity could have the same effect: "Power could do what the water upgrade did, it could keep people on the land."

What changed as a result of infrastructure investment?
Investments in water infrastructure did not just improve farm operations, they reshaped what was possible. The following changes were observed as water reliability increased:

- Improved reliability of water delivery, eliminating waste and inefficiencies.
- Enabled new types of farming, including higher-value and water-sensitive crops.
- Reduced labour and manual management needs, freeing up time and resources.
- Lowered environmental impact, including salinity and water loss.
- Increased confidence in the future of farming, spurring regional investment.

Carly explained that the transformation was not just technical. It was cultural and economic. The shift to reliable infrastructure sparked a cultural transformation, from reactive survival to proactive growth and long-term thinking for broader the farming community.

"People said it was a waste of money, it was too big. But once it was in, suddenly farms could actually plan. You weren't relying on a channel schedule or hoping for rain."

This story, and others like it, make clear that the issue is not resistance to change; it's blocked potential. Farmers are not asking for free upgrades. They're asking for predictable, transparent, and fair access to infrastructure that lets them grow, hire, and plan long term.

In this way, electricity becomes a proxy for participation in the future rural economy. As Carly put it: "If you can't even get the power, what future are you planning for?"

Carly's reflections suggest that the value of infrastructure, whether water or electricity, extends far beyond immediate cost-benefit analysis. It unlocks ambition. It enables not just production, but participation.

Her support for Powercor's proposed regional and rural equity program and innovation allowance was not based on personal gain. It was regional:

"It made it possible for more than just the big players to grow. It gave smaller farms a chance to expand, diversify, and survive the bad years."

Just as water reforms reshaped agriculture and rural life in the Goulburn Valley, she believes the same could happen with energy, if investments are made boldly and equitably.

Industry specific insights

Dairy

Life on the land lived experience

"You can't chill milk with a generator"

Phil Candy, Regional Milk Supply Manager for Fonterra; Member of the Board at Murray Dairy

"We've got about 150 farms in the network, and the setup's pretty consistent. Milking, cooling, pumping, all run on electricity. And when the power goes out, we feel it. I'd say outages have at least doubled in the last year. Used to be maybe once a month. Now it's five or six.

One farmer lost 58,000 litres when the vat stopped cooling overnight. Milk hit temperature. Had to dump it all. That was $29,000, gone. We paid that out. If they tell us, we credit them. If they don't, they wear it. And most farms don't have the capacity to store more than two days of milk. They're running tight.

We've been offering rebates, five grand for generators, but they're not a fix. They might keep milking going, but they can't run the cooling at the same time. Farmers are forced to choose. That's not a system; that's triage.

I've seen farms install solar and batteries, thinking it'll solve it. Then they realise they can't get through milking. I've got four sites now where they finish milking, switch to solar, and two hours later the system's flat. It's not their fault as they were sold something that didn't match the load.

And when they go to upgrade. They're quoted $100,000 to bring three-phase power across a paddock. It kills confidence. If we had better supply, reliable, higher capacity, we'd see investment. Rotary sheds, barns, maybe even biogas. But until that happens, everyone's running just to stay in place.

This isn't just about milk. It's about keeping the whole system afloat."

Farm context and daily operations

Electricity underpinned every stage of dairy operations, shaping productivity, physical layout, workforce scheduling, infrastructure investment, and overall viability. Daily activities such as milking, feeding, animal welfare, and sanitation were tightly structured around consistent, reliable power.

Across farms, energy use was concentrated in three key zones:

1. The dairy: The primary load centre

Milking sheds represented the heart of dairy energy use, with two daily milking sessions, typically at 5:00 AM and 3:00 PM, placing the highest demand on electrical systems. During these windows, multiple machines ran concurrently:

- Vacuum pumps and pulsators on herringbone or rotary platforms
- Milk cooling and refrigeration systems, including plate coolers, glycol tanks, milk vats, and compressors.
- Hot water systems for cleaning and sanitation
- Lighting, overhead fans, and control systems

If power goes out, I can't wash the milk tanks – you can't wash with cold water. I don't have a backup generator, but I rely on the power being stable." *Dairy farmer.*

Of these, milk cooling was especially power-hungry. Based on site metering undertaken by energy consultants working with Dairy Australia, cooling systems accounted for approximately 20 to 25% of total daily energy use on a typical farm. However, other farmers believed it accounted for even higher percentages of their energy use. This load was particularly high during the first milking of the day, when milk entered vats at around 30°C and had to be rapidly chilled to 4°C.

Cooling is the biggest single energy draw for most of these [milking] sheds, especially in summer. It's short but intense." *Dairy and renewable energy consultant.*

Afternoon milking typically involves lower energy demand, as milk enters pre-cooled systems and ambient temperatures are reduced, requiring less energy to maintain the target temperature. At this stage, compressors activate only intermittently, creating a distinct trough in demand compared to the sharp morning peak.

However, it is still significant enough to exceed most on-site solar generation capacities. Consequently, even farms with solar were typically reliant on grid or diesel power during milking periods and governed by their livestock - milking and calving needs.

Farms with automation or rotary systems also reported increased load due to programmable feeders, wash cycles, and system controllers, all of which activated during or immediately after milking. Some had adopted load scheduling practices, deliberately running less critical systems later in the day to reduce pressure on transformers or avoid circuit trips.

2. Irrigation and auxiliary loads
Outside of milking and housing, farms also drew electricity for irrigation systems, particularly where bore pumps or centre pivots were in use. Some had shifted irrigation to solar-assisted daytime use, but in many cases, diesel-powered systems still dominated due to flexibility and the high cost of electric pump installation.

Other regular draws included:
- Feed mixing systems (grain rollers, augers)
- Water and effluent pumps
- Electric fencing
- Domestic loads (hot water, refrigeration, home appliances)

“**We try to run the feed rollers when the solar is strongest. But morning and evening, there’s no choice. That’s grid power**.” *Dairy farmer.*

These systems, while less intensive individually, added up to a significant secondary load, particularly on farms that also operated seasonal cropping or housed workers on-site. This is why a lot of farmers relied on diesel generators as a backup energy source.

“**If we don’t have power, we can’t pump water… cows don’t make any milk if they don’t drink**.” *Dairy farmer.*

For half of the dairy farmers engaged, 70% or more of a farm’s energy load was electric, particularly dairy operations, while tractors, irrigation, and crop production remained diesel-based due to limitations in electric machinery. As one respondent explained:

“**You can’t put your irrigation source where you want it to be… electricity is too expensive to provide at that point if it’s not already there**.” *Dairy farmer.*

The other half of dairy farmers engaged were running their operations predominately on diesel.

Case Study: Farm Trade Australia (FTA) - Irrigated dairy farm
Overview
A 500-hectare irrigated dairy farm milking 600 cows across 300 hectares of milking platform and 200 hectares of fodder crop. The farm uses a split calving system and is expanding 5 to 10% annually.

Energy Profile and Challenges
Dairy operations make up 90% of energy use, with heavy demand during milking and chilling. The farm runs two three-phase connections and a 55kW solar system, now five years old and underperforming.

Key challenges include:
- Frequent outages affecting milking and chilling, risking milk quality and animal health.
- Rising electricity costs squeezing margins.
- Diesel-powered irrigation on a block with no grid access.

Goals
- Improve reliability to protect animal welfare and product quality.
- Reduce diesel use and lower irrigation costs.
- Enable growth while meeting sustainability targets.
- Prepare for emissions reporting aligned with milk buyer expectations.

3. Barns and housing: a new energy frontier

A renewable energy consultant with 18 years' experience, including 11 with Dairy Australia, shared detailed insights into the dairy industry's evolving energy demands.

Larger farms were increasingly adopting climate-controlled indoor housing for cows. Driven by animal welfare and climate pressures, this model offered benefits such as reduced heat stress, improved feed efficiency, and better hygiene, but significantly raised energy demand.

These barns required continuous operation of ventilation, lighting, and cooling systems. Ventilation alone could consume up to 150 kWh per day during summer.

“**There are operations now where ventilation is running non-stop… 24 hours a day, every day. That's 150 kilowatt hours just to keep the air moving**.” *Dairy and renewable energy consultant.*

Lighting added further load, particularly where programmable LEDs mimicked daylight cycles to support lactation. While these systems enhanced productivity and animal comfort, the consultant stressed they imposed a constant base load that many farms, especially those on single-phase or SWER lines, could not support without major grid upgrades.

Power use as a design constraint

For many participants, energy availability was not just a utility, it shaped what was possible. Shed upgrades, herd expansion, and barn development were all planned within the constraints of local power infrastructure. Several had pre-installed three-phase cabling and switchboards in anticipation of upgrades that never came.

“**There's three-phase on the road. I've got the switchboard ready. But to bring it across the paddock, it's $80,000**.” *Dairy and irrigation farmer.*

In some cases, this led to under-utilisation of equipment, or the need to schedule operations based on transformer capacity, delaying irrigation, deferring feed preparation, or using manual systems during outages. One farm even described coordinating milking times with a neighbouring property to avoid simultaneous power draws on a shared SWER line.

Electrification and future needs

Nearly all participants expressed interest in further electrifying their operations, particularly stationary systems like irrigation pumps, feed mixers, refrigeration units, and effluent management infrastructure. The motivation was consistent: reduce diesel dependence, improve operational efficiency, and align with emissions reduction goals.

Most farms had adopted solar (5–32 kW), and only one farmer had installed batteries, due to high costs and limited capacity. Most cited inadequate infrastructure, poor experiences with vendors, and regulatory barriers as major deterrents. For example, many farms had solar systems but were limited to 5 kW export due to transformer restrictions, undermining both ROI and self-sufficiency.

“**We're making power during the day, but we've got nowhere to send it**.” *Dairy farmer.*

On some SWER lines, neighbouring farms had to coordinate milking times to avoid concurrent power draws, a workaround that reflected both the fragility and the hyper-local impact of infrastructure deficits.

Electrifying corporate versus family-run farms

Contrast emerged sharply between corporate dairies and family-run farms. Large operations, particularly those backed by superannuation funds or multinationals, had invested millions in full electrification, motivated not only by energy savings, but by corporate emissions targets. One consultant described a $6.5 million project that electrified three dairies in South Australia.

“**They did that for two reasons. One, cost saving. But secondly, and probably more importantly, was emissions reductions**.” *Dairy and renewable energy consultant.*

These operations benefitted from access to advanced energy systems: grid-interactive batteries, on-site solar generation (up to 550 kW), and participation in national grid services markets.

Electrification and future needs

Emerging revenue models

Corporate operations were already tapping into multi-revenue energy models, including:

- **FCAS (Frequency Control Ancillary Services**): Battery systems that stabilise grid frequency in real time, paid by AEMO.
- **Avoided TUoS (Transmission Use of System) payments**: Revenue for reducing transmission load during peak demand by generating energy locally.
- **Retailer peak shaving contracts**: Agreements with energy retailers to draw on stored energy during spikes in grid usage.

"**It's a really, really cool system. The customer gets paid… and at the same time, the system's helping AEMO prevent blackouts**." *Dairy and renewable energy consultant.*

Such technical stacks made electrification not just viable, but profitable, for those with the capacity and capital to engage.

Barriers to electrification

For the majority of family-scale operators, five recurring barriers were identified:

1. **Grid limitations** – SWER and single-phase supply limited both the capacity to electrify and export solar.
2. **High upfront costs** – Even with grants, battery systems capable of replacing diesel remained economically unviable.
3. **Performance limits** – Solar-plus-battery systems often failed to cover early morning and evening milking sessions.
4. **Vendor mistrust** – Several farmers cited high-pressure sales tactics and misleading performance claims.

   “**They get told to bugger off or farmers relent and sign, and then they get shafted… You could say you’re interested and come back three days later to find a hot water service installed**.” *Dairy farmer.*

5. **Confidence erosion** – Power unreliability was eroding trust and stalling investment. Participants were reluctant to buy new electric pumps or expand capacity if the current grid could not support existing operations. This concern was compounded by the awareness that regional residents were also electrifying their homes, putting even greater strain on the grid.

“**We’re not going to buy $100,000 worth of new pumps if the power can’t handle what we’ve already got**.” *Dairy farmer.*

What farmers would electrify if they could

In an unconstrained scenario, participants said they would prioritise:

- Full replacement of diesel irrigation pumps.
- Electrified feed and grain processing systems.
- Temperature-controlled milk vats and water sanitation.
- Electric side-by-sides or quad bikes for staff.
- Biogas from effluent ponds as a supplementary energy source.

Farmers were also highly community-minded, often looking at infrastructure upgrades as a means to supply excess power generated back onto the grid to support their local communities.

Automation and adaptation

Dairy farms had begun adopting targeted forms of automation, not for transformation, but for practicality. Farmers prioritised systems that delivered tangible efficiencies without increasing risk.

Common examples included:

- Irrigation scheduling via phone apps
- Automated grain rollers and feed mixers
- Temperature monitors and compliance alerts for milk vats.
- Semi-automated milking systems

These systems streamlined daily routines and allowed workers to manage key tasks remotely, such as activating pumps or mixing feed when solar was available.

It's all automated… from the mobile phone one of the workers can sort out the irrigation pattern and turn the pump on." *Dairy farmer.*

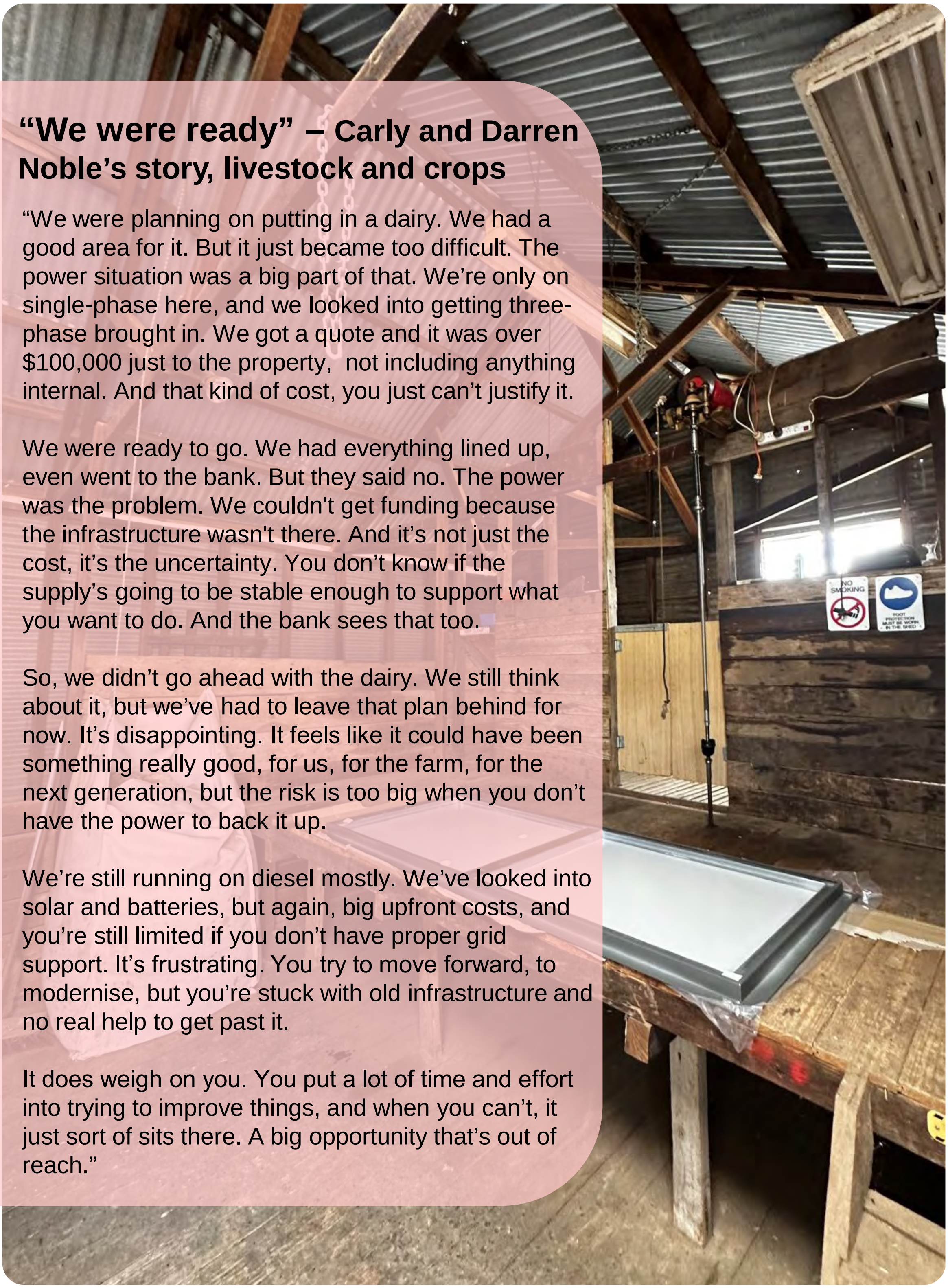
However, the appetite for more advanced automation, like robotic milking or AI-driven systems, remained limited. Farmers cited power reliability, digital literacy, and animal welfare risks as key barriers.

There's no bloody way I'd use virtual fencing. If it breaks and the cows get out, who's responsible?" *Dairy farmer.*

Ultimately, automation was most successful where it complemented, rather than replaced, human oversight and where the infrastructure could support it.

Animal husbandry

Life on the land lived experience



“We were ready” – Carly and Darren Noble’s story, livestock and crops

“We were planning on putting in a dairy. We had a good area for it. But it just became too difficult. The power situation was a big part of that. We’re only on single-phase here, and we looked into getting three-phase brought in. We got a quote and it was over $100,000 just to the property, not including anything internal. And that kind of cost, you just can’t justify it.

We were ready to go. We had everything lined up, even went to the bank. But they said no. The power was the problem. We couldn't get funding because the infrastructure wasn't there. And it’s not just the cost, it’s the uncertainty. You don’t know if the supply’s going to be stable enough to support what you want to do. And the bank sees that too.

So, we didn’t go ahead with the dairy. We still think about it, but we’ve had to leave that plan behind for now. It’s disappointing. It feels like it could have been something really good, for us, for the farm, for the next generation, but the risk is too big when you don’t have the power to back it up.

We’re still running on diesel mostly. We’ve looked into solar and batteries, but again, big upfront costs, and you’re still limited if you don’t have proper grid support. It’s frustrating. You try to move forward, to modernise, but you’re stuck with old infrastructure and no real help to get past it.

It does weigh on you. You put a lot of time and effort into trying to improve things, and when you can’t, it just sort of sits there. A big opportunity that’s out of reach.”

Farm context and daily operations

Electricity use on animal husbandry farms was low in volume, but high in consequence. Unlike energy-intensive dairy systems, these properties relied on modest but mission-critical loads, mostly invisible until failure.

Across cattle, sheep, and mixed livestock operations, electricity enabled essential tasks such as:

- Bore and tank pumps supplying drinking troughs.
- Solar or battery-powered electric fences for grazing management.
- Power to shearing sheds, including lighting, fans, and wool presses.
- Feed preparation using small grain rollers, augers, and mixers.
- Workshop tools for fencing and machinery repair.
- Even domestic power use could compete with farm operations.

Several participants reported switching off homestead appliances, like kettles or dishwashers, when shearing or pumping was underway. The line between personal and farm capacity was often blurred, revealing how close many systems ran to the limit.

Electricity demand surged during key seasonal events. Shearing and lambing placed sudden, high loads on fragile systems (the combined operations of the farm with machinery on a single-phase supply), often compressing 400 kWh of usage into a single week. Farms without three-phase or generator backup reported shutting down homes to prioritise shed operations.

“**We have to turn off the house when we shear.**” *Animal husbandry, sheep and pig farmer.*

Pig farms added further load during winter, when heat lamps or mats were needed around the clock to protect piglets. These were sometimes solar-backed, but diesel generators were still essential to carry the overnight demand.

In cropping and cattle enterprises, power use spiked during short planting and harvesting windows, particularly for water carting, feed prep, and mechanical repairs. When neighbouring properties were also drawing power, especially on single-wire earth return (SWER) lines, brownouts and voltage drops were common, occurring several times in a month during this period.

What made energy usage in these systems precarious was not its scale, it was its precision. Farms did not use much power, but they needed it exactly when it mattered. Power loss was rarely an inconvenience, it risked animal welfare, ruined feed, delayed labour, or endangered staff.

Electricity-powered water pumps were vital across all operations, especially in cattle systems where livestock required constant access to clean water. Outages left animals without water for hours, an unviable risk in summer.

“**If cattle don’t drink, it’s not just production, you lose the mob… You’ve only got a few hours in heat before you start seeing signs**.” *Animal husbandry farmer.*

Some adapted by investing in high-mounted tanks and gravity-fed systems. Others used SMS alarms or checked pump cycles manually at dusk. But most had no fallback beyond hauling water or moving animals, both slow, inefficient, and resource-intensive.

Cattle farm water loss during summer outage

One participant lost water access to two thirds of their cattle during a 36°C day following a three-phase voltage drop that tripped the main bore pump. The alarm failed to trigger, and water was not restored until the following evening. Several cows collapsed from dehydration-related stress, and one heifer died. The farmer now manually checks pump operation each evening.

Electric fencing, often powered by solar or battery units, was widely used for rotational grazing. Yet in treed landscapes, fences were regularly shorted by falling limbs or bark, especially after storms. On larger cattle blocks, this meant stock escaping into cropping paddocks or roads, risking animal health and vehicle damage.

"Trees go down, and the fence goes with it. The cows aren't waiting… they're through before you know it." *Angela Higgins, animal husbandry, beef cattle farmer.*

Even farmers with solar-powered systems reported spending hours fault-finding, replacing batteries, or manually resetting fence energisers during winter.

Nearly all animal husbandry participants were serviced by single-phase power. Many ran equipment across hundreds of metres, through uneven terrain, without any smart switching or remote monitoring. For those further out, SWER lines were the norm which they felt were unreliable, low-capacity, and costly to upgrade.

With automation largely unviable, farmers adapted through routine manual intervention: Running machinery sequentially to avoid overload.

Using generators for shearing sheds, but only with two-person startups and hour-long warm-ups. Scheduling tasks around sun hours to make the most of solar. Repairing fences by hand in the dark to meet rotation schedules.

This level of adaptation spoke to deep resilience but also revealed a system under long-term strain. With no slack in capacity, every outage triggered a chain reaction: lost water, compromised fencing, delayed shearing, or, in the worst cases, livestock death.

Case study: Rotational grazing and fencing risks

On a densely treed cattle property, Cattle farmer, Angela Higgins, transitioned to solar-battery-operated fencing units after repeated power dropouts during storms left her livestock vulnerable. The mains system was too easily tripped by fallen timber. However, the trade-off was constant monitoring.

Animal husbandry farms had, by necessity, developed intricate systems of workaround routines. These were not temporary fixes; they were the operating model. Many farmers spoke of "scheduling around the sun," load-shifting manually, and designing infrastructure around power limitations rather than production needs. Farmers were realistic that this was part of operating and living regionally and were willing to accommodate to an extent. However, when it impacted their ability to earn revenue, increased time or bottom-line costs, it became the most frustrating for them.

Farmers commonly relied on:

- Gravity-fed water tanks to bypass pump reliance during short outages.
- Battery-powered fencing tools and energisers, often carried in utes to remote paddocks.
- Horse teams or trailers to move fencing supplies when quad batteries failed.
- Wool presses operated manually during outages to keep shearing on schedule.
- SMS alarms and visual pump checks to confirm overnight water flow.
- Portable solar panels and battery banks used to charge hand tools or fence batteries.
- Solar pump timers rotated manually in response to weather forecasts.

These practices were embedded in daily and seasonal routines, especially on larger or more remote properties, where power loss meant hours of downtime or animal welfare risks.

Generators played a central role, but their use came with strict limits and logistics:

- One sheep operation used a 65kVA generator for shearing and lighting that required two people to start and an hour to warm up.
- Another ran three generators across multiple blocks, requiring rotating fuel deliveries and careful coordination to avoid overlap.
- Pig producers reported rotating pens and using blankets when heat lamps could not all run at once during cold snaps.

Farms routinely sequenced operations, never shearing and pumping at the same time, never washing down while crutching was underway. Most participants acknowledged this as part of operating in a regional setting and were willing to adapt. But when these constraints began to cut into revenue, extend work hours, or increase operational costs, tolerance turned to frustration. The issue was not the compromise, it was the compounding effect on business viability.

Electrification and future needs

Across the animal husbandry cohort, most participants expressed a strong willingness to electrify more of their operations, provided the infrastructure could support it. This openness was not speculative; it was grounded in practical motivations: lowering diesel costs, reducing maintenance complexity, and aligning with evolving emissions expectations in supply chains.

However, that willingness often ran up against the limits of what was practically feasible on their properties. Many respondents noted that their interest in electrification was conditional, not just on affordability, but on basic availability of reliable power. For some, interest was dormant rather than absent.

"**We'd do more, but there's no point looking into it if the power can't support what we already use."** *Animal husbandry and grain farmer.*

Several farms had already adopted low-power electric systems, solar for fencing or water pressure, battery-charged tools, or LED lighting. But for larger loads or infrastructure-wide upgrades, enthusiasm remained tempered by realism.

Where would they electrify first?

If energy constraints were lifted, participants had a clear sense of priority areas for electrification:

- **Water pumping systems**: Especially for cattle operations, where water supply is critical to animal survival. Electric pumps were preferred for their ease of use and low maintenance, if the grid could support them.
- **Feed handling and grain processing**: Lamb operations noted electric augers and grain rollers as candidates for upgrade, particularly during lambing and drought feeding periods.
- **Shearing sheds**: Electrifying clippers, wool presses, and ventilation fans was a common aspiration, especially on farms currently relying on diesel generators or outdated systems.
- **Light-duty electric vehicles and tools**: Small feed carts, four-wheelers, or side-by-sides were considered feasible electrification candidates, though their charging needs were beyond what most farms could currently supply.
- **On-site value-adding**: One pig, goat, cattle, and sheep producer had plans to construct a small on-farm abattoir to increase profitability and diversify income. The move was seen as critical to the long-term sustainability of the enterprise, allowing for vertical integration and better market resilience. But the farm sat at the end of a long SWER line, and no grid upgrade was feasible. The immediate alternative for the farmer was a fully diesel-powered facility. While committed to the project, the farmer was clear that with access to reliable electricity, they would do it differently.

Despite a clear sense of where electricity could deliver value, there was an even clearer consensus that current infrastructure could not keep up. Most participants were connected to single-phase or SWER lines, with little room to accommodate additional load. Voltage drops were common, especially at the far end of lines, and some farms couldn't run more than one or two tools or appliances at a time without tripping the system.

The idea of layering in new electric pumps, feed systems, or vehicles felt implausible for many.

"We're already pushing it just with the lights and the kettle." *Animal husbandry, sheep and cropping farmer.*

Others described deliberately not upgrading electric systems, even when needed, out of concern that the grid couldn't support them.

The physical spread of paddocks and fencing infrastructure added further complications. Few systems could be wired efficiently across a large property without substantial investment in cabling, switchboards, or off-grid backup systems.

For most animal husbandry farms, especially those with mixed operations or part-time management, automation was seen as unnecessary. Simplicity was a virtue. Several participants described their farms as lifestyle-scaled or "deliberately manageable," structured around labour they could handle without needing complex systems. Automation was something larger farms might need, but not something that fit smaller enterprises.

There's no point automating when there's not much to automate."
Animal husbandry, lamb and cropping farmer.

Even when participants acknowledged potential benefits, there was little appetite to overhaul working systems. Traditional infrastructure, such as manual gates, basic pumps, and gravity-fed troughs, was considered reliable and easy to fix. The idea of adding software, sensors, or dependency on apps for critical farm functions felt risky.

I just don't want to be in a position where if it breaks, I'm stuffed and the cows get out." *Angela Higgins, animal husbandry, cattle farmer*.

This mindset was especially strong when applied to fencing or animal control. While some had heard of virtual fencing technologies, none expressed interest in adopting them.

Several participants flagged a lack of digital confidence, especially among older farmers, as a barrier to advanced technology. Even those who used apps to monitor pumps or manage finances didn't see themselves managing large automated systems or data platforms.

I know there's people out there using those things [like drones or software], but I wouldn't know where to start." *Animal husbandry, sheep farmer.*

Some participants also cited unreliable mobile or internet service as a basic infrastructure gap. This made even simple remote-control technologies harder to justify, particularly in areas where the network signal was unreliable.

There was consistent recognition that automation made sense for larger businesses. Participants often referenced other farms or enterprises that had gone further down the automation path and said they understood the logic, just not for themselves.

I can see why the big guys are doing it, but for us it's just not necessary."
Animal husbandry, lamb and cropping farmer.

In short, automation was not resisted ideologically but was widely viewed as irrelevant for the scale and structure of these operations.

Irrigation

Life on the land lived experience

“Controlling my demand”

– Angelo Lamattina, Lamattina Carrot Farm

“Nearly the whole operation is electric. We’re sitting at about 95 to 98 percent.

We’ve got solar, about 1,500 kilowatts, which gives us the opportunity to keep our demand during the day down where we need it to be. We’re probably using somewhere around about eight times more power during the day in production... and then at night, it’s a lot less.

We’ve tweaked our refrigeration system to run everything about half to three-quarters of a degree colder… that residual cooling gives us a platform past the 7:00 AM mark.

We’ve got a generator that we use for peak lopping and if the power goes off… it’s only lopping a little bit off the top, not a huge amount.

Controlling my demand is critical for me. I change it 10 minutes before because I don’t want it to come up at 7:01... and then I’ve got to pay for it.

If you accidentally go up for five minutes in that 15-minute increment... you’re paying for it for the next 12 months. In summer, I’m paying $11,000 plus another $12,000 on top… that’s $24,000 to $25,000 over and above the power bill.

We use a lot of variable speed drives… instead of dragging a lot of power off the grid all at once, it’s more gentle when it starts. That’s better for my equipment and for the grid.

If something happens down at the river and I don’t have power, I can still irrigate from the dam… it gives me two or three days buffer here.

The main thing for me is controlling my demand.”

Farm context and daily operations

Across the three irrigation enterprises, electricity was not just an input; it was the infrastructure around which everything else was built. Irrigation dictated daily schedules, labour planning, machine usage, and business risk. Where electricity faltered, operations stalled.

In the leafy greens operation, electricity-powered towable centre pivots delivered constant moisture to spinach and salad crops harvested multiple times a week. Yet the farm ran on a single-phase supply, limiting how many systems could run concurrently. Resetting pivots manually was routine.

“**We've had times where you can't run two pumps and a grading line at once. It just trips.”** *Irrigation, leafy greens farmer.*

The carrot operation had progressed further, operating at “95 to 98 per cent electric.” Pumps fed fixed pivots, and refrigeration and processing lines were all grid-connected. Operations were meticulously aligned with solar and tariff cycles.

“**If we go over our peak in that 15-minute window before 7 a.m., it costs us for the rest of the year.”** *Irrigation, carrot farmer.*

The grain producer on the fringe of the Goulburn Murray Irrigation District had electrified partially where pumps were electric, but pivots ran on diesel. Expansion plans were on hold.

“**If I had all the water I need and a bit more power, I'd go full electric with fixed pivots, full circle.”** *Irrigation, grain farmer.*

For these producers, irrigation wasn't just about productivity, it was a lever for transformation. With reliable water and sufficient energy, even marginal or rain-fed land could be reimagined. Grain growers described how limited water access had historically constrained them to low-input crops. But with electrified irrigation, their cropping options could "explode exponentially", unlocking the potential for broccoli, garlic, high-value pasture, or even small-scale horticulture.

The shift to irrigation was also framed as future-proofing. Access to dependable water and the energy systems to move it meant resilience in the face of dry spells, climate variability, and shifting market demands.

"If I could run full pivots," one grain grower said, "the options would be almost unlimited."

But that vision hinged on infrastructure. For all three businesses, power constraints, whether single-phase lines, tariff limitations, or inadequate transformer capacity, remained the bottleneck. Irrigation was ready to scale; the network was not.

Key insights related to irrigation loads and energy integration

Insight: pumping drives peak load
Electric water pumps were the single largest power draw on all irrigated farms. Whether lifting from rivers or pressurising pivots, these pumps dictated both energy intensity and operational timing.

- Most irrigation began early morning, aligning with crop needs but exposing farmers to peak tariffs.
- Grid-connected pumps were common, though not all farms could electrify pivot movement due to trenching costs and single-phase limitations.
- Load control required careful scheduling, and in many cases hybrid systems (grid plus diesel) were used for flexibility.

"Pumping is the big one… when the crop needs water at 6 a.m., you're still on the grid."
Irrigation, leafy greens grower.

Tariff exposure shapes daily decisions
The carrot operation showed the highest level of energy integration, using solar and variable speed drives (VSDs) to flatten load and avoid costly peaks.

- Irrigation and refrigeration were scheduled with precision, shutoff before 7:00 a.m. was non-negotiable.
- Diesel generators were used pre-emptively to bypass demand spikes, maintaining energy cost predictability.
- VSDs reduced pump wear and smoothed electrical draw.

"We shut the system down at 6:45 a.m. every morning, no exceptions… go over once, you're paying for it all year." *Angelo Lamanttina, irrigation, carrot farmer.*

Limited power = constant trade-offs
On less automated farms, energy limits forced strict load balancing.

- Pivot irrigation and seed cleaning couldn't run simultaneously due to power limits.
- Farmers manually scheduled tasks to avoid tripping systems, especially during overlapping demand windows (e.g. watering plus packing).
- Forgetting what was running could derail the entire day's schedule.

"If you forget one system's running and turn on another… bang, you're out."
Irrigation, grain farmer.

Irrigation is the start of a chain
Irrigation wasn't an isolated activity; it triggered a cascade of processes across the farm.

- Watering cycles dictated cooling, grading, and packing timelines, especially for perishable crops like carrots.
- In hot weather, system synchronisation was critical to avoid overload or product spoilage.
- Cold storage and irrigation systems were heavily interdependent: water in the ground meant carrots in the coolroom within hours.

"It's not just water, it's timing. It's making sure we don't fry a pump or blow the line when the packhouse is running." *Angelo Lamanttina, irrigation, carrot farmer.*

Electrification and future needs

Across the board, the message was clear: electrification was not resisted, but neither was it pursued blindly. The desire to electrify further was widespread, but infrastructure constraints, capital costs, and commercial uncertainty kept many systems out of reach. As one participant summarised:

In a perfect world, we'd do it. But we're not in a perfect world, are we?" *Angelo Lamanttina, irrigation, carrot farmer.*

CARROT

At the carrot operation, the shift to electricity was deliberate and strategic. "We did it for efficiency, not ideology," the respondent said. "We looked at every part of the operation and asked: does electrifying this save us money or give us control?"

The result was an operation where nearly everything, pumps, cooling, packing, and logistics, ran on grid power, supported by solar and diesel generation.
Yet even here, some systems remained untouched. Pivot movement was still hydraulic, diesel-powered.

We considered trenching cable to the pivots, but the cost per metre was a joke. You'd need to rip up half the farm." *Angelo Lamanttina, irrigation, carrot farmer.*

Trucks and heavy field equipment also remained diesel-based.

You lose too much payload, the tyres wear out quicker, and you don't gain on cost," *Angelo Lamanttina, irrigation, carrot farmer.*

Electric tractors might work overseas, but we're nowhere near that here." *Angelo Lamanttina, irrigation, carrot farmer.*

Battery storage was another area of hesitation. The carrot grower was exploring options for early-morning demand smoothing, but only if the financial case stacked up. "We're not going to throw money at it because it's new," they said. "If the battery doesn't make more sense than diesel, we're not doing it."

LEAFY GREENS

On the leafy greens farm, electric pumps had been integrated, but limitations in grid capacity and cost kept several systems diesel-reliant. "We'd love to go full electric with the pivots and the seed shed," the irrigation farmer said, "but we're on single-phase. It just wouldn't cope." Even simple upgrades, like electrifying grain transfer or adding cool storage, were blocked by transformer constraints.

GRAIN

In the grain enterprise, electrification of pumps had occurred, but pivot movement and all machinery remained diesel-based. The reasons were both technical and financial. "We're spread out. You'd have to cable kilometres to get power to the second pivot. And until we know what's happening with water rights, we're not investing in anything major."

Attitudes toward future electrification

Despite major infrastructure limitations, all three operators expressed clear aspirations to electrify further, but only when doing so made operational and economic sense. Their interest wasn't speculative; it was grounded in real use cases and planned upgrades that had been deferred due to network constraints, upgrade costs, or pricing risk.

What they want to do and why they can't yet

- Leafy greens: electrify storage and shift packhouse to solar.
  "We've already got some of the gear. We just can't run it all at once."

- Grain irrigator: move to full pivot irrigation and expand into summer cropping.
  "There's no point diversifying if you can't get the water on when it counts."

- Carrot: remove last diesel dependency by installing batteries.
  "We're there, pretty much. But if we added batteries, it would only be to get rid of the diesel in the mornings."

What's holding them back

- Grid limitations and upgrade costs make staged expansion infeasible.
  "We know what we'd do. We just can't justify doing it." *Irrigation, leafy greens grower*

- Infrastructure gaps are shaping what's farmed, not just how.
  "If I have access to the water I need, I'd look at going full pivot with electric drives, maybe even summer cropping." *Irrigation, grains farmer*

- Technology performance and price, especially for logistics, isn't there yet.
  "We're not betting the business on an electric truck that can't haul a full load." *Angelo Lamattina, irrigation, carrot farmer*

Decision-making is based on constraint, not resistance

- These farmers don't need convincing, they need enabling.
  "Decision-making is based on constraint, not resistance… These farmers don't need convincing, they need enabling." *Irrigation farmer*

- Energy decisions are shaped by limitations, not aspiration.
  Power scheduling, load-shifting, and diesel fallback systems are all dictated by what the grid can handle, when tariffs hit, and how solar peaks align with daily demand.

Snapshot table: aspirations vs constraints

Enterprise type	Aspirations for electrification	What is blocking It
Leafy greens	Solar-powered grading shed and cold storage.	Cannot run multiple systems at once; too costly to upgrade to 3-phase.
Grain irrigator	Full pivot irrigation, summer cropping, potential for high-value diversification.	Access to water and power is limited; infrastructure cannot support added demand.
Carrot grower	Add batteries to eliminate diesel use during early peak.	Energy pricing; cautious about investing in unproven EV logistics.

Automation and system integration

Automation played a growing but uneven role across the three irrigation operations. Its uptake was strongest where systems were already electrified and energy availability was reliable. Where energy supply remained limited or unpredictable, automation was either constrained or avoided altogether.

On the carrot farm, automation was deeply integrated into daily operations. “We run everything through the main controller, from the pump curves to the cooling cycles,” the respondent said. Cooling systems were pre-programmed to ramp up before tariff thresholds, and variable speed drives were used across all pumps. “We’re not just automating for convenience. It’s about managing risk and cost.” *Angelo Lamanttina, carrot farmer.*

Remote monitoring was used extensively. Pumps were equipped with sensors that alerted staff to pressure anomalies, while refrigeration and packing systems were synced to internal power demand schedules. This precision allowed for real-time responsiveness during high-pressure periods, such as summer heatwaves or early-morning harvests.

At the leafy greens operation, automation was in place for irrigation scheduling and basic telemetry. “We’ve got our soil moisture meters linked up, and we can log in from the ute to adjust watering,” the respondent explained. However, further automation, like automated grain transfer or cooling, was considered too risky given the single-phase supply. “You can’t automate if the power trips when you switch on a second pump.”

In the grain enterprise, automation was used for precision agriculture purposes: GPS-guided air seeders, automated spraying sections, and remote pivot monitoring. Full remote operation, however, was still aspirational. “I’d love to sit in the house and control the pivots, but we don’t have the capacity yet,” the farmer said. “Plus, you need rock-solid power. One outage and the whole thing shuts down.”

Overall, automation was valued, but only when it fit the realities of the energy system. Farmers were clear. They wanted reliable, integrated tools that supported production without overcomplicating it.

Case study: Unlocking irrigation potential on the Goulburn Murray Irrigation District fringe (GMID) – grain irrigation farmer

“If I’m able to access the water sources around my property, then I could finally realise the vision I had as a young man.“

On the fringe of the Goulburn Murray Irrigation District, one mixed grain and irrigation farmer is ready to expand, but infrastructure is holding him back. Although the property already operates with a blend of flood and centre pivot irrigation, the full vision involves fixed electric pivots on every circle, powered by scalable and reliable electricity.

Currently, this vision is constrained by:

- Legal ambiguity over local water rights, which, if resolved, could unlock vast areas for cultivation.
- Prohibitive underground cabling costs, forcing the continued use of diesel to move irrigators.
- Anxiety about future energy reliability, especially if transmission infrastructure like VNI West is built without delivering local benefits.

Despite having upgraded to three-phase a decade ago, the farmer fears regional growth could strain the system unless investment keeps pace. The stakes are high: missing a key irrigation window during a hot spell could wipe out a $400,000 wheat crop.

This example highlights why GMID fringe areas are emerging energy hotspots: fertile ground, access to irrigation, and strong grower ambition, but bottlenecked by policy, supply, and investment gaps.

“Fringe country… that’s where the electricity demands will go up.”

Fruit, vegetable and produce

Life on the land lived experience

"Every second that cool room's off…" – Domenic's story

"We're table grape producers, primarily. We have a little bit of citrus, but table grapes are what we do fundamentally.

This is an irrigation district, so we have a patchwork quilt of little farms, about 15. Each of those has about a 12.5 to 30 kilowatt pump site. Our pumps, our cool rooms, all electric. All the power tools now are battery. Our forklift and pallet jack are battery-powered. We've electrified what we can.

We're bringing fruit in at field temperature, and then we have to bring it down to zero overnight… That's where the big power usage is.

I was having brownouts from January. I was getting poor quality power, and, you know, with all this sensitive equipment, stuff trips out. If our pre-cooler trips out late enough in the morning, the fruit hasn't had time to sort of heat up too much before we need to lid it… but it can impact quality. It's not like the fruit explodes, but it has an effect. So it was a bit of a pain. Every second that the coolrooms are off is impacting the quality of the fruit.

There've been situations, not on our farm, but others, where power has gone out to irrigation sites during critically hot periods. That can really stuff you. If you miss that critical irrigation, a crop could be done.

We've got a lot of solar on the roof, often exporting back into the grid. Wouldn't it make sense if Powercor had a battery around here instead of sending the power off who knows where?

It's not about disconnecting yourself from the grid. It's just about reducing those pain points - peak amps drawn, peak power usage."

Farm context and daily operations

Fruit farming and post-harvest processing in northern Victoria encompass a wide range of production systems, from traditional orchard operations to fully electrified hydroponic facilities. Among the participants in this research were growers and managers working across citrus, stone fruit, table grapes, almonds, and high-tech tomato farms, each shaped by distinct energy profiles and operational models.

While irrigation remains a foundational energy load across all operations, what distinguishes the fruit sector is the layering of energy-intensive post-harvest processes such as cooling, grading, and packaging. These steps are critical to preserving product quality, particularly for export markets, and often occur within tight timeframes immediately after harvest.

The timing and rhythm of operations varied significantly across participants. Table grape and stone fruit growers described peak workloads between January and May, with 24–48 hour windows for post-harvest cooling and dispatch.

We're bringing fruit in at field temperature, and then we have to bring it down to zero overnight… that's where the big power usage is." *Domenic Sergi, fruit, veg. and produce, grape and citrus farmer.*

By contrast, hydroponic operations ran year-round, driven by continuous planting, harvesting, and packaging cycles. These facilities were almost entirely electrified and operated more like industrial processing plants than traditional farms.

"Everything is electric. There's no petrol, no gas," noted the manager of a high-tech tomato greenhouse.

Despite these differences, all enterprises shared a common energy logic: they were tightly choreographed around irrigation schedules, harvest windows, and cold chain requirements. The reliability, timing, and quality of electricity supply directly influenced not just productivity, but product viability and downstream pricing.

Cooling and post-harvest: the dominant load

Across all fruit operations, post-harvest cooling infrastructure emerged as the most critical and energy-intensive system. Unlike other agricultural sectors, where irrigation is often the dominant energy draw, fruit producers must manage both water and temperature, sometimes simultaneously, within narrow operational margins.

Table grape and stone fruit growers described how harvested fruit, typically at ambient temperatures of 25–35°C, had to be cooled to near 0°C within hours to preserve shelf life and meet export standards.

If you don't bring it down fast, you risk softening, reduced shelf life, or rejections at the port," *Domenic Sergi, fruit, veg. and produce, grape and citrus farmer.*

His site operated five cool rooms powered by a 400-amp three-phase connection, with compressors ranging between 15 and 40 kW.

The stakes are high: failure to cool properly can result in claims, market loss, or compromised pricing. "It's not like the fruit explodes," he added, "but it has an effect… maybe some claims. It adds up." Grape grower.

The sensitivity of cooling systems also introduces vulnerability. One orchardist described how a power flicker forced a full system reset, costing three hours of recovery time and risking missed freight windows.

Cooling loads tend to peak in the late afternoon and early evening, often outside solar production windows, meaning reliance on grid power is unavoidable. Even operations with rooftop solar reported that the contribution to refrigeration loads was limited.

Hydroponic operations pushed this profile further. One enterprise operated on a 1,750 kVA transformer, running robotic trolleys, pre-pack lines, and electric forklifts around the clock.

"Everything we do, trolleys, trains, forklifts, sorting lines, it's all electric," the farmer said. In these cases, cooling is not just a post-harvest step, it's embedded in every stage of the operation.

Case Study: Reliability challenge
Fruit Orchard participant

"We went from having three or four flickers a week to nearly nil."

After repeated flickers tripped their cooling systems, causing 3-hour downtimes, the orchard worked with Powercor to install strobe lighting to deter fruit bats, a previously unaddressed reliability issue. This small intervention delivered a major operational benefit and builds the case for micro-interventions with macro value in post-harvest operations.

Irrigation and energy coordination

While post-harvest cooling dominates peak energy loads, irrigation remains the structural backbone of fruit production, especially in summer, when both water and power systems are under pressure. Irrigators across citrus, almond, and table grape farms described large-scale water pumping from rivers and bores as the most sustained and predictable energy requirement across the season.

Southern Cross Farms, a major operator managing over 1,000 hectares of citrus and almonds, framed irrigation as “the large-scale, baseline demand,” with river and bore pumps accounting for the bulk of usage outside the harvest period. Drainage and frost mitigation infrastructure added further load in some regions, particularly on lower-lying or poorly draining soils.

The spatial layout of farms added complexity. “**Our pumps are down on Crown land, river frontage stuff,… we can’t install solar there, so it’s grid or diesel only**.” *Fruit, veg. and produce, farmer.*

This misalignment between generation potential and demand centres restricted the feasibility of energy self-sufficiency.

Timing was also critical. On many farms, irrigation pumps and post-harvest cooling systems ran in parallel, often during early morning or late afternoon windows when temperature and humidity dictated urgent response. Without sufficient infrastructure, farmers faced forced scheduling decisions that risked delays or lower product quality.

Some operators employed variable speed drives (VSDs) to manage surge risk, while others relied on diesel for redundancy. Despite strong interest in electrifying more of their irrigation systems, most agreed that doing so would require access to additional transformer capacity, three-phase lines, or cost-sharing models to extend viable service to outlying water infrastructure.

Electrification and future needs

Across the fruit sector, the commitment to electrifying fixed infrastructure was clear, but practical limitations remained.

Southern Cross Farms estimated that 95–98% of their operational systems within Powercor's network were electric, including irrigation, drainage, workshop tools, and processing facilities. Diesel was used only for mobile plant or where grid access was impossible.

"Use of diesel is only if there's just no service available." *Chris Parham, Southern Cross Farms, fruit, veg. and produce farmer.*

Likewise, a greenhouse tomato farmer had electrified nearly every aspect of its operation, from water pumping to robotic trolleys and packing lines, supported by a 1MW solar array.

"Everything is electric. No petrol, no gas." *Fruit, veg. and produce farmer.*

But even in this advanced setting, grid backup remained essential, particularly for heating requirements during seasonal extremes or when solar couldn't meet demand.

For smaller or less vertically integrated growers, full electrification was less feasible. One table grape producer had electrified all irrigation and post-harvest systems but drew a firm line at vehicles.

Tractors and sprayers remained diesel-powered, with most participants citing cost, runtime, and torque limitations as barriers.

Infrastructure misalignment was another recurring constraint. One orchardist described how trenching to extend solar from sheds to remote pumps was cost-prohibitive. "You'd need to run copper a kilometre. It just doesn't stack up," he said.

Battery storage had not yet gained traction. Participants noted that storage units often couldn't be placed close enough to high-load systems, such as pumps or cool rooms, to make dispatch effective. Regulatory uncertainty and low feed-in tariffs further discouraged investment.

"You'd put the battery in, but it wouldn't save enough to be worth it," one grower said.

While interest in electrification was strong, participants agreed: grid access, location-specific infrastructure, and fit-for-purpose equipment, not ideology, were the real limits.

"We'd go 100% green if we could. But we need the network to meet us halfway." *Chris Parham, Southern Cross Farms, fruit, veg. and produce farmer.*

Barriers, trade-offs, and energy management

Despite strong enthusiasm for electrification, growers described a complex matrix of barriers spanning technical, financial, and operational dimensions. At the heart of the challenge was not motivation, but feasibility.

1. Peak demand charges and network costs

The most consistently cited barrier was the structure of energy pricing. Participants across the sector reported that 70–80% of their energy bills were composed of demand and network charges, rather than actual consumption.

Our last couple of bills were running at about 75% network and demand charges. Even with solar, you can't get away from that unless you drop your demand at the right time, and we can't. We've got fruit that has to cool." *Fruit, veg. and produce farmer.*

One operator described how a 15-minute spike in load during a heatwave had triggered elevated demand pricing for 12 months, costing tens of thousands of dollars. "It doesn't matter that it's one moment…You pay for it all year." Fruit farming and processing participant

2. Infrastructure gaps and location-based constraints

For many, the geography of farm infrastructure made electrification difficult. Pumps were often on river frontages or remote blocks, far from sheds or solar arrays.

The solar needs to be up near the shed… the pumps are miles away," explained one orchardist. "You'd need to trench under roads or put in a whole new transformer." *Fruit, veg. and produce farmer.*

In some cases, growers reported being unable to access additional capacity despite being connected to the grid. "We've got three-phase, but we're at the limit. Can't add anything without a full upgrade," said a *Fruit, veg. and produce farmer.*

Operational timing and redundancy

Energy scheduling had become a full-time job on some farms, especially those with cold chain needs.

One operator explained: “We pre-chill the cool rooms before 7 a.m. to avoid peak rates. Then we stop everything for 15 minutes. Then we go again.” Horticulture farmer

Others fired up diesel generators strategically, not because they wanted to, but because “it’s the only way to dodge the tariff.” Fruit farming and processing

Despite these workarounds, growers worried about the fragility of the system.

“**It’s not just cost, it’s risk… If the power flicks off, you don’t lose power. You lose fruit.”** *Fruit, veg. and produce farmer.*

Finally, growers emphasised that horticulture is fundamentally different from other sectors. Its time sensitivity, perishable outputs, and compressed labour schedules meant that any energy disruption carried downstream risks to product quality, marketability, and reputation.

“**We’re not a flat-load dairy or a once-a-year cropper… our energy demand is precise. And we need a network that respects that.”** *Fruit, veg. and produce farmer.*

Grain

Life on the land lived experience

Please note that, as no grain farmers were willing to disclose their interviews, this lived experience story has not been taken from an actual farmer. Rather, this has been written as an aggregate of their experiences to protect their non-disclosure.

"You can't run what you can't power", a grain farmer's perspective

I don't use much power, not because I don't want to, but because I can't. We're on single-phase. It's fine for the house and the bore, but anything bigger? Forget it. I've got aerator silos I have to run off generators. Augers, fans, even some tools in the shed, they'd be electric if I had three-phase. But getting it here? We were quoted up to $1.5 million. That just knocked the project on the head.

We've had to turn down grain processing on-farm. I send 1,000–2,000 tonnes off each year that I could be milling myself. It'd add value, reduce cartage, and save time, but you're not going to run a full setup through a generator.

Even machinery decisions come back to power. I bought an old lathe and had to downgrade it from a 5-horsepower to a 2-horsepower motor. Bigger gear is cheaper and better, but I've got nowhere to plug it in.

And the renewables? I've got wind turbines being built on neighbouring land. There's power everywhere, but unless they let us tap into it, it doesn't matter. You'd think if it's being generated here, we'd be able to use it.

Electrification's not some fancy dream, it's practical. Flat-bottom silos, electric augers, maybe even a solar workshop. But until the infrastructure gets here, we're stuck. You can't scale up, diversify, or plan for the next generation if the grid can't keep up.

People talk about modern farming. But if we're still relying on diesel every night, what's modern about that?

You can be as efficient as you like, but if the connection charges keep going up, what's the point?

Farm context and daily operations

Grain farming in Victoria presents a diverse landscape of scale, energy demand, and operational complexity. The enterprises interviewed for this study included multi-generational family farms, vertically integrated businesses combining poultry and grain, and cropping operations experimenting with limited irrigation or on-farm value-adding. While some also maintained sheep or cattle, grain production remained the central organising principle.

A shared feature across these operations was ageing, often improvised infrastructure. Most farms operated on single-phase supply, installed decades ago when domestic-level energy needs were sufficient. This legacy architecture now constrains ambitions to electrify machinery, improve processing efficiency, or invest in automation.

Electricity demand varied with enterprise design. For some, energy use remained modest, limited to lighting, electric fences, bore pumps, and domestic loads. For others, particularly those managing poultry sheds or grain storage facilities, energy was a core enabler of productivity and quality control. But even these energy-intensive farms reported structural limitations, including over-reliance on diesel generators, transformer constraints, and grid-access bottlenecks.

This variability highlighted a core theme: the capacity for electrification and, by extension, farm innovation, was not dictated by willingness or business sophistication, but by the availability and reliability of energy infrastructure. From air-seeders to aerator fans, from augers to animal shelters, the day-to-day operations of grain farmers were shaped less by what they aspired to do and more by what their power supply could accommodate.

Daily operations and power-constrained workflows

Daily energy use on grain farms was practical and task-oriented, shaped by the seasonal cadence of sowing, harvest, and storage. However, infrastructure constraints sharply limited what equipment could be used, when, and for how long, capping on-site processing, delaying time-sensitive repairs, and in some cases, forcing producers to outsource value-adding opportunities that could have increased margins and retained revenue on-farm.

Grain handling and storage:
For many, electrically powered fans and augers were essential to maintaining grain quality post-harvest. Aeration systems were often run nightly for weeks, but few farms had the grid capacity to support this. One vertically integrated poultry and grain business, unable to run fans via grid supply, relied on diesel generators up to 450 kva in size.

We've got aerator silos… we run them off generators because we haven't got three-phase out there." *Grain farmer.*

Workshops and equipment maintenance:
Machinery sheds were a daily hub, yet often constrained by underpowered single-phase connections. One farmer described downgrading an industrial lathe from a 5-horsepower to a 2-horsepower motor just to keep within load limits. Welding and metalwork, critical during planting and harvest prep, were often outsourced or scheduled around other electrical tasks.

Seed grading and value-adding:
Grain producers expressed interest in on-site grading and feed processing, particularly for lamb and poultry feed, but most lacked the energy capacity.

One participant, moving 1,000–2,000 tonnes of grain offsite annually for milling, explained:

We could value add by processing stuff here if we had the power, but you're not going to run through some generators to do it." *Grain farmer.*

Noting the implication here was that they had to outsource the service, which ultimately reduced revenue.

Poultry operations:
Where present, poultry sheds added a second layer of energy intensity. Automated feeders, lighting, heating, and ventilation all ran on electricity. One operation had electrified a chicken shed using 320 kw of solar and 500 kWh of battery, but still relied on diesel backup nightly. Another abandoned expansion plan after a $1.5 million connection quote.

Sheep and mixed farming:
In more traditional sheep–cropping systems, electricity supported water pumps, shearing sheds, and occasional grain rolling. Though less intensive, these tasks often collided with peak load periods, revealing how even "low energy" operations depended on baseline reliability.

Across all cases, daily operations were not just about executing tasks, but managing around power constraints.

Seasonal demands and safety risks

While daily workflows on grain farms are shaped by infrastructure limits, it is during peak seasons, particularly harvest, that energy shortfalls become most acute. Harvest compresses weeks of logistics, storage, and equipment stress into a narrow window, placing exceptional pressure on power systems already at their limit.

Harvest Intensity:
Grain harvest typically involves continuous, round-the-clock work. Headers run non-stop, grain is transported, aerated, and often dried on-site. Equipment wear is high, and workshop repairs increase. Grain must be moved quickly into storage, then cooled to avoid spoilage. This creates a clustering of energy demands: aerators, augers, workshop tools, lighting, and seed graders may all run simultaneously.

Yet few grain farms had the power supply to support this load.

This limitation required careful task scheduling, as running high-draw equipment simultaneously could exceed supply limits, trip circuits, or damage machinery. As a result, key processes like irrigation and grain cleaning had to be staggered, increasing operational complexity and extending labour hours.

Another explained that instead of automating their fans, they had to start and stop equipment manually to avoid circuit trips. Diesel generators filled the gap, but came with high fuel costs and frequent servicing.

Case study: Farmer Trade Association (FTA) participant - broadacre cropping enterprise

Overview:
This operation spans multiple sites and includes significant grain handling infrastructure. The farm uses approximately 270,000 litres of diesel per year, with more than 80% consumed by farm machinery greater than 300 horsepower.

Energy profile and challenges:
The site experiences regular power interruptions, with outages occurring quarterly and minor dropouts monthly. Generator use is extensive, particularly for silo aeration, outloading, and accommodation.

Key challenges include:
- Weak and frequently interrupted grid supply impacts on farm operations.
- Reliance on large generators (up to 110kVA) for critical operations.
- High fuel costs and lack of flexibility in current energy systems, particularly at remote sites due to cost of connecting to the grid.

The farm is looking to:
- Improve energy reliability for grain handling and site operations.
- Reduce diesel dependence through modular renewable systems.
- Deploy containerised, relocatable solutions to suit seasonal infrastructure.
- Prepare for future energy needs as the business grows (electric/hydrogen farm machinery).

Safety risks and legacy infrastructure:
Increased machinery size has also brought energy-related safety risks. Overhead power lines, installed decades ago, now sit perilously low relative to today's headers and augers. One farmer described a near-miss during a night-time run:

"I can remember being in there one night… farming away, going back, tired. All of a sudden I've gone 'shit'… I thought I'd hit that line again." *Grain farmer.*

Others mentioned sagging wires in summer heat, adding further hazard. Despite repeated requests, few reported having lines raised or clearly marked.

One producer took electrical safety into his own hands, personally wrapping dozens of poles on his property to prevent accidents during machinery operations near overhead lines.

"We did it ourselves, wrapped every pole with markers and tape so the forklifts wouldn't clip them. It was the only way to make it safe." *Grain farmer.*

Lack of buffer capacity:
The central problem was not just demand, but fragility. Farms had no margin to absorb surges or schedule flexibility. Power outages, even brief ones, could derail operations for hours, jeopardising throughput and risking spoilage.

"We don't use much power because we can't." *Grain farmer.*

Energy constraints in mixed operations

While many grain producers were purely cropping-based, several ran mixed enterprises incorporating poultry, sheep, or cattle, each introducing additional, and often incompatible, energy demands.

Poultry and grain: high-intensity coexistence

Poultry, in particular, was a game-changer. One vertically integrated operation, producing 1.5 million birds annually, required constant ventilation, lighting, and feeding across multiple sheds. The load profile was continuous and high-stakes: power loss could jeopardise entire flocks.

Despite investing over $1 million in solar and batteries, the operator still relied on diesel every night. Expansion was stalled after a quote of $500,000 to $1.5 million for a new grid connection:

> **That just knocked the project straight on the head... It was going to be between half and one and a half million dollars to put the power through."** *Grain and animal husbandry farmer.*

> **We're relying on it almost every night. The generator starts… because we haven't got a battery,"** Grain farmer

Sheep and cropping: lower loads, same frustrations

In contrast, sheep enterprises had lower daily demand but faced reliability risks during key events. Shearing, typically a 2–3 week operation, required fans, lighting, clippers, and presses. These loads were seasonal but intense, and often coincided with harvest, creating competition for a limited supply.

Electric fencing and water pumps ran year-round. Outages in summer posed immediate risks to animal welfare. As one sheep–cropping farmer noted,

> **If the pump goes, the sheep have no water. That's it. You're losing stock within 24 hours."** *Grain and animal husbandry farmer.*

Incompatibility and load management:

The challenge was not always raw volume, but timing. Grain operations needed energy in harvest; sheep operations spiked during shearing; poultry required it continuously. Yet all ran on shared, underpowered circuits. Load staggering became a survival tactic, but at the cost of efficiency.

> **You're constantly negotiating with your own systems…You run this now, that later. Pray nothing else switches on."** *Grain and animal husbandry farmer.*

Across mixed farms, infrastructure was stretched between divergent needs, none of which could be fully met under current supply conditions.

Electrification and future needs

Across grain-focused operations, pure cropping, mixed livestock, and integrated poultry, there was widespread interest in electrification. But aspirations ran into hard limits: insufficient infrastructure, prohibitive upgrade costs, and a mismatch between available technology and network readiness.

Clear targets for electrification
Farmers consistently identified low-to mid-load systems they would electrify immediately, if infrastructure allowed:

- **Grain augers, aerators, and fans**: key to grain quality and storage automation.
- **Workshop tools**: welders, compressors, and grinders that are currently downsized or outsourced.
- **Seed graders and cleaners**: particularly on farms growing pulses or saving seed for future crops.
- **On-site grain processing**: such as feed milling or cracking grain for livestock or sale.
- **Small electric vehicles**: like utes or side-by-sides, seen as ideal for local farm transport.

“**We would have more electric stuff if we had three-phase. We’d have three-phase augers or belts.”** *Grain farmer.*

Others described value-adding ambitions, such as on-site milling, that were blocked by power limitations:

“**We could value-add by processing stuff here if we had the power, but you’re not going to run through some generators to do it.”** *Grain farmer.*

Case study: Farmers Trade Association (FTA) participant - grain handling facility

Overview:

This facility operates 7-days a week. The site is divided into two distinct zones: a front section connected to the grid with 260kW of solar and a back section powered entirely by two 120kW diesel generators.

Energy profile and challenges:

Despite proximity, the two sections are not connected, limiting the ability to share or export energy. Diesel generator noise and cost are significant issues, and there is no current engagement with electricity distributors or council for potential upgrades.

Key challenges include:

- Inability to operate at full capacity due to weak and frequently interrupted energy supply.
- Prohibitive cost of completing grid connection.
- Generator noise limiting hours of operation and generating community concern.
- High diesel costs reducing the profitability of the back-of-site operations.

The business aims to:

- Expand solar generation into neighbouring paddocks.
- Link both site sections to optimise energy use and improve efficiency.
- Reduce diesel reliance through hybrid or fully renewable systems.
- Explore community energy-sharing models to enhance local energy resilience.

Mismatch between energy ambition and capacity

Electrification efforts were consistently undermined by single-phase limits. Some farms had already pre-installed three-phase cabling, awaiting connection. Others had received quotes upwards of $100,000 to $1.5 million, deemed impossible to justify even on growing properties.

Battery storage offered only partial relief. While some used diesel generation to bypass supply issues, no interviewee described it as a viable long-term solution.

“Solar and batteries wouldn’t be enough to run for more than half an hour… every renewable project still ends with a generator.” *Dairy farmer.*

Stalled modernisation

Without access to sufficient, stable electricity, grain farmers described a situation where innovation was possible, but not practical. They were ready to modernise, automate aeration, electrify post-harvest, reduce diesel, but needed infrastructure to match.

The result was a form of energy-induced stagnation: farmers unable to grow their operations, adopt more efficient practices, or diversify into higher-value activities, not because they lacked the will or ideas, but because the grid stopped at the gate.