CSU Wagga Wagga

Electrification Feasibility Study

Electrification Roadmap

Priority Areas

Three priority areas were identified to explore electrification scenarios for the campus.

Murrumbidgee Village and Cottages

- Student accommodation at Murrumbidgee Village and cottages are estimated as the largest gas users on-site (~30% of CSU consumption).
- Student accommodation is also critical to campus financial performance, therefore, ensuring cost-effective and future-proof delivery of heating and hot water is a high priority.
- Equipment fit out is approaching end-of-life in the next 5 years
- Masterplan status: **Continue occupation**

Library (B13)

- Currently estimated at ~6% of total CSU site consumption.
- Boiler plant in northern end (2 x Raypak boilers) are approaching end-of-life in the next 5 years. Hot deck/cold deck system is aged.
- Masterplan status: **Maintain & enhance**

Veterinary Diagnostic Labs (295)

- Currently estimated at ~3.5% of total CSU site consumption.
- Boiler plant and HVAC equipment are approaching end-of-life in the next 10 years.
- Masterplan status: **Maintain & enhance**

Laundry Equipment

Fully electric & heat pump dryers available from Alliance Laundry

10 KG ELECTRONIC COIN OPERATED STACKED ELECTRIC DRYER

Features and Benefits

- Durable, easy to use controls for low maintenance costs, well suited to high volume multiple operator applications.
- Payment options available - Coin, Token, Credit card and Payment App.
- 100% front service dryers reduce maintenance time and costs ensuring maximum availability.
- Stacked dryers maximising space utilisation.
- Super robust steel control console well suited to heavy handed operators.

SPECIFICATIONS

DIMENSIONS	
CAPACITY	10 kg (x2)
WIDTH	683 mm
DEPTH	711 mm
HEIGHT	1,986 mm
DRUM VOLUME	198 litres (x2)
NET WEIGHT	120 kg
OPERATION	
CYCLES	5 cycles, 4 fabric temperatures
CYCLE INDICATOR	Yes - Insert Coin, Drying & Cool Down
CYCLE TIME	Variable to suit desired vend price
CONTROLS	Touch push button controls
ACTIVATION	Coin, Token, card or Payment App
HEATING ELEMENT	4,000w
MOTOR	1/3 hp, 0.25kw (x2)
ELECTRICAL	20 amp single phase (x2)
CONSTRUCTION	
DRUM	Galvanised
OUTER CABINET	Steel

Our single pocket tumble dryers are designed with fewer moving parts, so that you'll face fewer maintenance problems and less wear and tear. We make it easier with a large, easy-to-clean lint compartment and a heavy-duty door hinge designed to withstand heavy usage. Uncomplicated. Uncompromising. Unmatched. Enjoy heavy-duty construction that will provide reliable operation for years to come. Our tumble dryers are designed with fewer moving parts, so that you'll face fewer maintenance problems and less wear and tear. We make it even easier with a large, easy-to-clean lint compartment and a

SHP345 HEAT PUMP ON PREMISE SINGLE TUMBLE DRYER

SKU: SHP345

Commercial Heat Pump Tumble Dryer

For laundry operations not suited for the added cost and installation of sufficient ducting, Speed Queen Heat Pump tumble dryers deliver an efficient solution. The Heat Pump tumbler line does not require any vent ducting as 100% recycling of waste air through rapid cooling removes moisture while rapid heating results in the reintroduction of heat into the drying cylinder.

Speed Queen's Heat Pump tumblers reduce energy by more than 70% compared to similar tumble dryers saving your laundry operation utility costs. Minimal electrical infrastructure is needed as only 3.6kW (12,284 BTU/hr) of total power input is required. This advanced 3 phase Heat Pump Design – delivers the performance you expect from Speed Queen Equipment, with the Energy Savings a modern business demands.

Features

- Standard self-cleaning system uses condensation to rinse heat exchanger decreasing amount of lint and foreign contaminants for cleaner linens and decreased maintenance.
- Steel shaft and dual bearings extend the life of your machine.
- Optional humidity sensing prevents over drying.
- One central belt tensioning system allows for ease of service.
- Optional mechanical washing system uses pressurized water to efficiently clean the heat exchanger.
- Optional reversing for large items.
- Error messages are displayed on the control for efficient and effective servicing.
  Temperature can be freely programmed in one degree

Electrification Analysis:
Murrumbidgee Village & Cottages

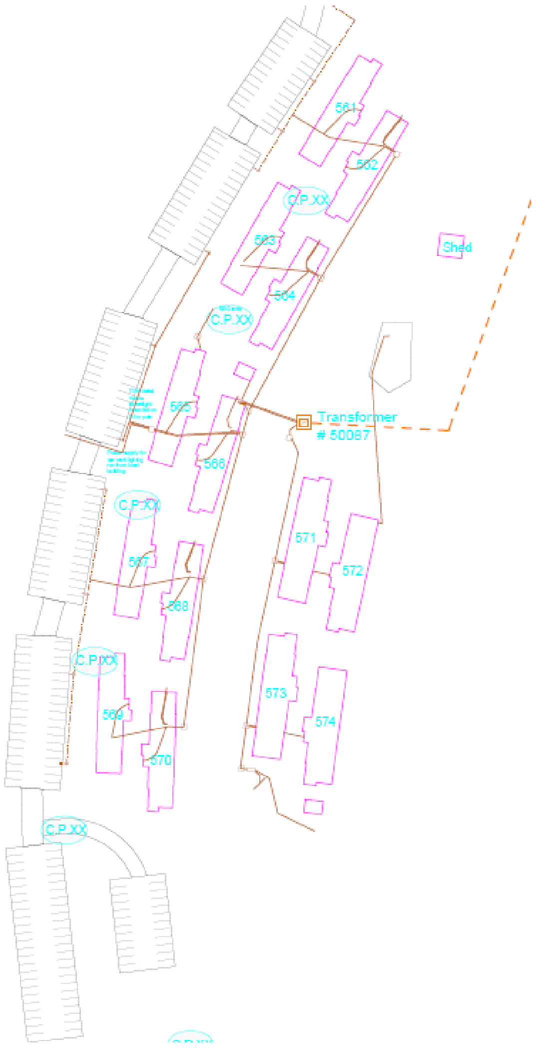
Murrumbidgee Village
Electrical Infrastructure

2XE

Summary:

- Murrumbidgee Village Precinct fed by 750kVA transformer
- Each building supplied by a 63A 3-phase breaker in the main switch board
- Data snapshots (last 4 months) suggest a maximum demand of 10kW per building
- No expected supply constraints based on design specs (Need final confirmation of Transformer LV Board)
- Solution requires a new electrification switchboard for each building fed from existing internal switchboard (to supply DHW and HHW)

Level	Location of read	Rating (A)	Power (kW)	Supply capacity (kVA)	Identified peak demand (kVA)	Indicative spare capacity (kVA)	Required Capacity (kVA)	Required Capacity (kVA) w/ diversity	Remaining? (kVA)
Precinct	Transformer capacity			750	140	610	376	188	422
MDB (10 buildings)	Transformer LV board	630	420	435	100	335	268	134	200
MDB (4 buildings)	Transformer LV board	250	166	173	40	132	77	38	94
Building	MDB	63	42	44	10	34	27	13	20
Laundry	MDB	80	53	55	20	35	27	14	22



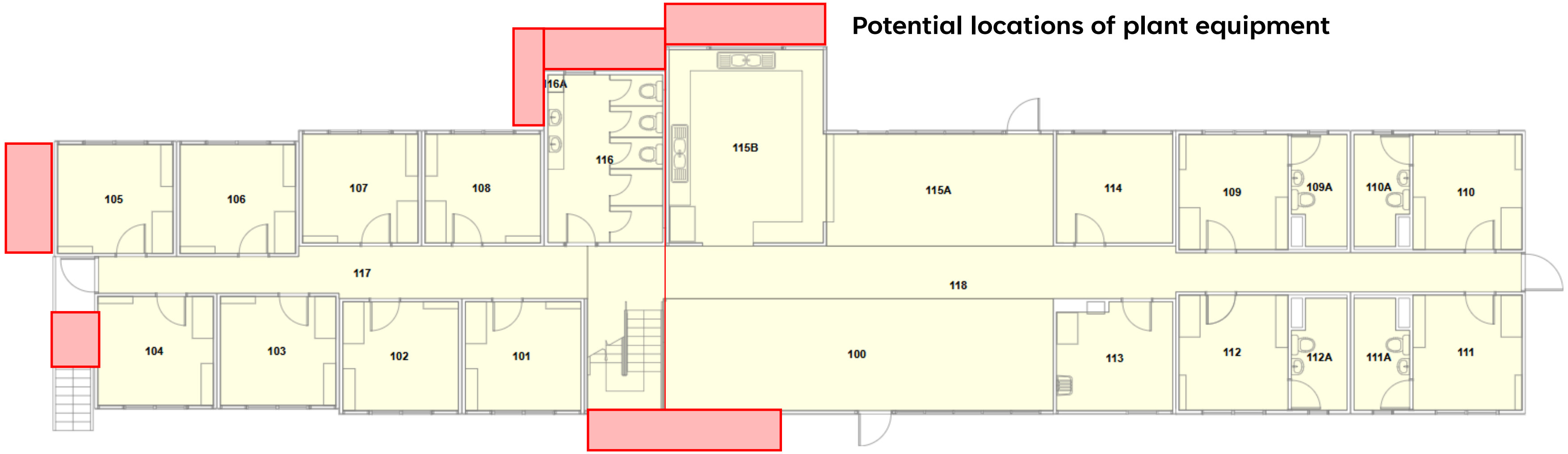
Electrical infrastructure map

Murrumbidgee Village - B564 Switchboard

Murrumbidgee Electrification Summary

Area / Building	System	Proposed Equipment	Gas reduction	Electrical gain	Additional connected electrical demand	CAPEX	Cost saving	Indicative gas replacement cost	Up-lift cost	Payback period (on uplift cost)
			(GJ p.a.)	(MWh p.a.)	(kVA)	($ ex GST)	($ p.a.)	($ ex GST)	($ ex GST)	(years)
Murrumbidgee Village (14 buildings & 2 x laundries)	Space heating	Bank of hot water heat pumps (3 x 14kW) with buffer tank (340L) and circulation pumps – Bathurst Stiebel Eltron used for modelling	1,472	91	**233**	$1,190,000 ($85,000 per building)	$22,416	$420,000	$770,000	34.4
	DHW	Bank of residential scale heat pumps (3 x 6.2kW Quantum) with buffer tanks (3 x 340L) and circulation pump	919	73	**142**	$481,244 ($35,000 per building)	$12,301	$420,000	$61,244	5.0
	Laundry	Speed Queen heat pump dryers (power draw of 3.6kW max)	15	1	**34**	$148,800	-$1,512	$80,000	$68,800	N/A
	DHW	Bank of 3 residential scale CO2 heat pumps with 3 x buffer tanks and circulation pump	33	2	**20**	$68,749	-$403	$60,000	$8,749	N/A

Potential locations of plant equipment



Multi-split refrigerated heating / cooling option

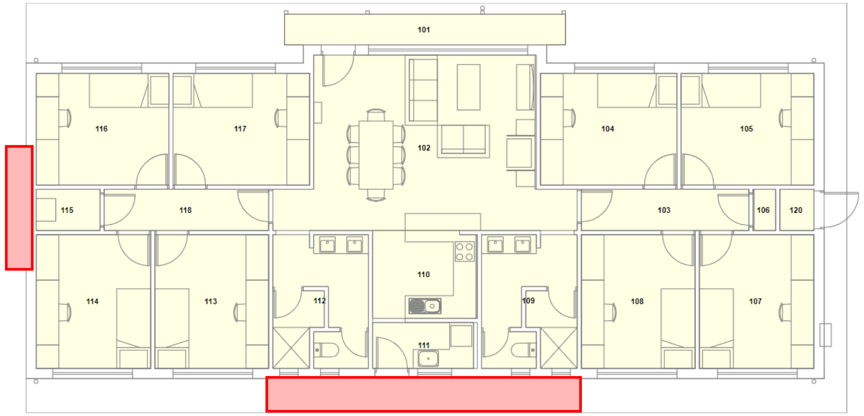
- Similar capex (~$80k per building)
- Significant increase in summer electricity consumption (from refrigerated cooling vs evap) which will negate all gas cost savings
- Significant increase in number of serviceable units

Cottages Electrification Summary

Area / Building	System	Proposed Equipment	Gas reduction (GJ p.a.)	Electrical gain (MWh p.a.)	Additional connected electrical demand (kVA)	CAPEX ($ ex GST)	Cost saving ($ p.a.)	Indicative gas replacement cost ($ ex GST)	Up-lift cost ($ ex GST)	Payback period (on uplift cost) (years)
Cottages	DHW	Single hot water heat pump with buffer tank (330L) and circulation pumps	1,457	101	**91**	$252,671 ($10k per building)	$26,904	$135,000	$117,671	4.4
	Space Heating	Multisplit air conditioners for bedrooms and single splits for larger central areas	4,426	251	**592**	$992,200 ($22k per building)	$72,773	$205,000	$787,200	10.8
	DHW - Laundry	Bank of 2 heat pumps with 2 x buffer tanks and circulation pump	47	4	**4**	$18,600	$733			
	Laundry Dryer	Alliance offer Speed Queen heat pump dryers (power draw of 3.6kW max)	38	3	**3**	$186,000	-$1,559			

Cottages

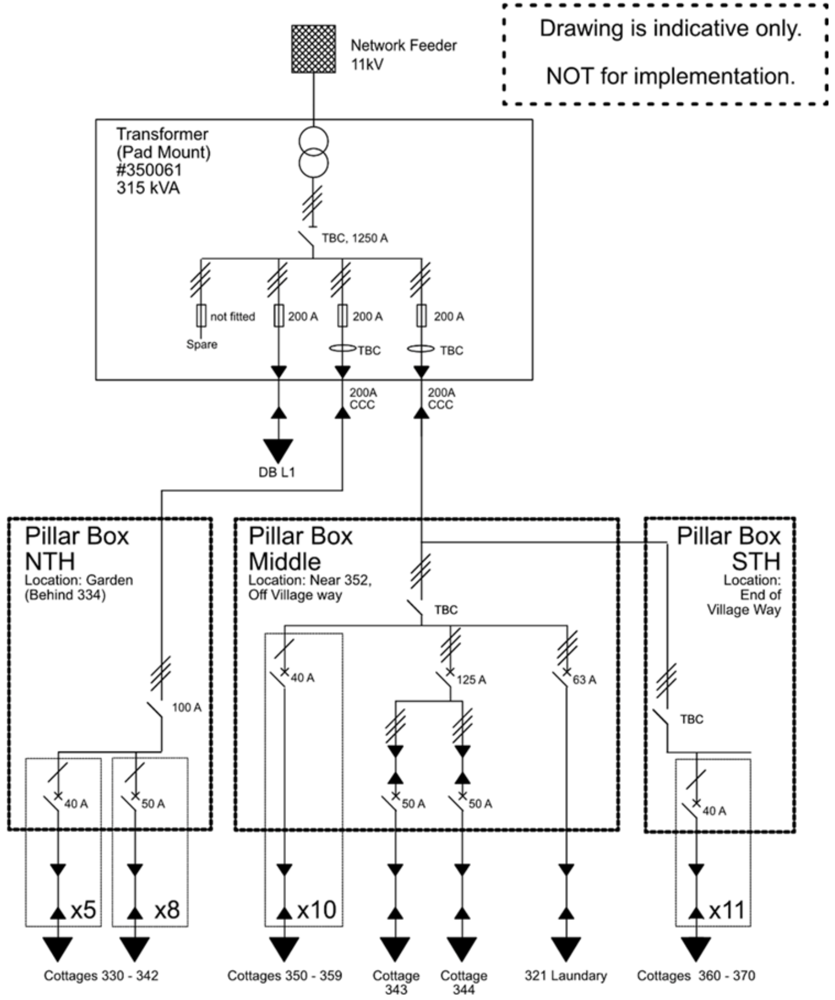
- 41 cottages, 6 or 8-bed configuration, under CSU control (excluding St Martins)
- 14 have already had their hot water services upgraded to heat pump alternatives (Quantum w/ 340L tank)
- Recommend maintain Quantum or similar heat pump solution for domestic hot water. 340L tank at 70deg C will provide six 10-minute showers (excluding recharge).

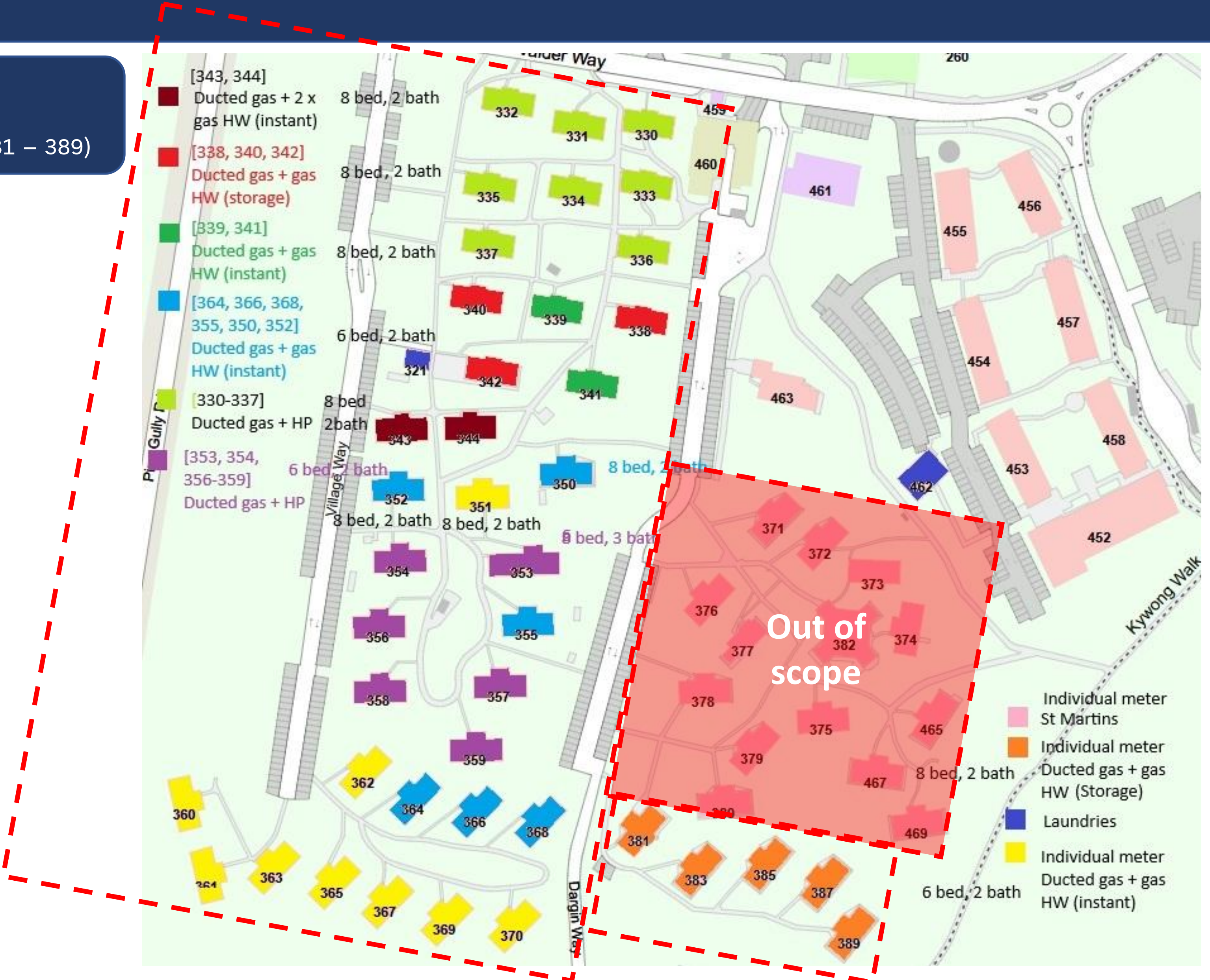


Potential locations of plant equipment

Cottages Elec & Gas Map

- 315kVA transformer (50061) services 36 cottages
- 50kVA pole mount transformer (50075) services 5 cottages (381 – 389)





Cottages

Electrical Infrastructure

Summary:

- Majority of Cottage Precinct (36 cottages) fed by 315kVA transformer
- Majority of cottages supplied with 40A single phase
- Data for the last 4 months suggest a maximum demand of 3.8kW per building (northern pillar box data – already transitioned to HPs)

Level	# of cottages	Location of read	Rating (A)	Supply capacity (kVA)	Identified peak demand (kVA)	Indicative spare capacity (kVA)	Required Capacity (kVA)	Required Capacity (kVA) w/ diversity	Remaining? (kVA)	Required upgrade
Main Precinct	**36**	Transformer capacity	[redacted]	315	159	156	683	342	**-186**	**Transformer upgrade required. Suggest staging rollout and monitoring max demand of new fitouts to assess required capacity. Estimated 750kVA.**
North Pillar Box (330 - 342)	**13**	Transformer LV board	200	138	50	88	147	74	**14**	**New Pillar box (200A supply), new 3 phase supplies to each cottage and new DB**
Middle Pillar Box	**23**	Transformer LV board	200	138	88	50	249	125	**-75**	**New MDB (400A supply), new 3phase supplies to each cottage, new cottages DBs**
Southern Pillar box (downstream from above)	**11**	Pillar BOX	200	138	42	96	57	28	**67**	**Supply cables look suitable for 200A. New MDB Required to meet code. New 3phase supplies to each cottage and new cottage DB**
Cottage DB	**41**	MDB	40	9	4	5	13	7	**-1**	**Not quite enough capacity for fully electric space heating and hot water. Recommend upgrading to 3 phase 63A supplies to each cottage.**
Laundry	**1**	Middle Pillar Box	63	43	10	33	47	23	**10**	
Pole Mount Transformer feeding 5 cottages	**5**	Pillar box		50	19	31	66	33	**-2**	**May require an upgrade to the transformer to accommodate all 5 cottages. New MDB required.**

Note:

- Demand diversity factor set at 50% to align with AS3000

Cottages

Electrical Infrastructure Upgrade Costs

Level	Required upgrade	Cost per unit	Quantity	Cost estimate for total Quantity	% of total	Notes
Main Precinct	Transformer upgrade required. Suggest staging rollout and monitoring max demand of new fitouts to assess required capacity. Estimated 750kVA.	$379,500	1	$379,500	31%	
North Pillar Box (330 - 342)	New Pillar box (200A supply)	$55,000	1	$55,000	5%	
Middle Pillar Box	New MDB (400A supply)	$178,640	1	$178,640	15%	Includes Trenching allowance
Southern Pillar box (downstream from above)	Supply cables look suitable for 200A. New MDB Required to meet code.	$55,000	1	$55,000	5%	
Cottage DB	Not quite enough capacity for fully electric space heating and hot water. Recommend upgrading to 3 phase 63A supplies to each cottage.	$11,605	39	$452,595	37%	Assuming exisiting conduits can be used
Pole Mount Transformer feeding 5 cottages	May require an upgrade to the transformer to accommodate all 5 cottages. New MDB required.	$94,600	1	$94,600	0%	Tx + MDB
			TOTAL	**$1,215,335**	**100%**	

Student Accommodation – Electrification Business Cases

Wagga Wagga – Student accommodation – Electrification business cases (details in appendix)

Area / Building	System	Proposed Equipment	Confidence in design / calcs	Gas reduction	Electrical gain	Additional connected electrical demand	Est. CAPEX	Cost saving	Indicative gas replacement cost	Up-lift cost	Payback period (on uplift cost)
				(GJ p.a.)	(MWh p.a.)	(kVA)	($ ex GST)	($ p.a.)	($ ex GST)	($ ex GST)	(years)
Murrumbidgee Village	Space heating	Bank of 3 hot water heat pumps with buffer tank and circulation pumps	High	1,472	91	**233**	$1,190,000	$22,416	$420,000	$770,000	34.4
	DHW	Bank of 3 heat pumps with 3 x buffer tanks and circulation pump	High	919	73	**142**	$481,244	$12,301	$420,000	$61,244	5.0
	Laundry Dryer	Alliance offer Speed Queen heat pump dryers (power draw of 3.6kW max)	Moderate	15	1	**34**	$148,800	-$1,512	$80,000	$68,800	N/A
	DHW - Laundry	Bank of 3 heat pumps with 3 x buffer tanks and circulation pump	Moderate	33	2	**20**	$68,749	-$403	$60,000	$8,749	N/A
Cottages	DHW	Single hot water heat pump with buffer tank (330L) and circulation pumps	High	1,457	101	**101**	$252,671	$26,904	$135,000	$117,671	4.4
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	DHW - Laundry	Bank of 2 heat pumps with 2 x buffer tanks and circulation pump	Moderate	47	4	**4**	$18,600	$733			
	Laundry Dryer	Alliance offer Speed Queen heat pump dryers (power draw of 3.6kW max)	Moderate	38	3	**3**	$186,000	-$1,559			
			TOTAL	**8,405**	**525**	**789**	**$3,338,265**	**$131,653**		**$1,813,665**	**13.8**
	Cottages Electrical Infrastructure upgrades						**$1,215,335**				

Note:
- CAPEX is based upon quoted hardware costs + estimated electrical install and ancillary equipment costs + contingency factor
- Above CAPEX excludes electrical infrastructure upgrades (cottage electrical infrastructure upgrades included on separate line)
- Cost saving is heavily dependent on the increase in maximum demand caused by new equipment. An annual demand diversity factor of 20% was used p.a. across peak, shoulder and off-peak demand.

Electrification Analysis:
Building 13 (Library Stage 1 & 2)

Building 13 - Library

Overview – Stage 1 & 2

Building summary

The William Merrylees Library (Building 13) is a teaching / learning / research space at CSU Wagga Wagga. It is brick veneer construction with concrete floors and tile roof. It was built in 1970 and does not have heritage status.

System	Est. Area (m^2)	Overview	Cooling Capacity (kW)	Heating Capacity (kW)
Stage 1	1,824	Hot Deck / Cold Deck system servicing 4 floors with 2 x AHU's in level 5 plant room. AHUs are supplied with chilled water by a 300-400kW air cooled chiller, and heating hot water via a 430kW natural gas hot water boiler.	350	430
Stage 2	3,834	Stage two' includes 8 watercooled packaged AC units for air handling and cooling (2 per floor). These vary in cooling capacity from 50kW to 100kW. Downsteam from these packaged units, there are heating hot water coils for heating air which are supplied by a natural gas hot water boiler on lvl 5.	580	380

B13 Lvl 3 Floor Plan – Stage 1 and Stage 2 serviced areas

Current challenges

- Central plant equipment (chiller & boilers) nearing end of life and will require replacement in the next 5 years.
- Stage 1 (hot deck / cold deck) is a very inefficient form of HVAC with poor control
- Stage 2 heating coils and valves nearing end of life and have failed recently
- Desire for greater zoning and control across the Library area serviced by these units

Stage 1 Boiler

Stage 2 Boiler

Building 13 - Library
Electrification Options

	Revised central solution		Transition to VRVs
Option	**Option 1:** Single duct induction VAV with reheat	**Option 2:** Reverse Cycle Packaged Air Conditioners with closed condensate loop	**Option 3:** Multiple VRV units with ducted FCUs
Service	Space heating & cooling	Space heating & Cooling	Space heating & cooling
Solution overview	• Central AHU supplies cool air to each zone. • VAV box throttles air flow to control the zone temp. • Each box includes hot water reheat coil supplied by central heat pump	• Each reverse cycle unit operates independently heating or cooling its own zone. • Units reject or absorb heat from the shared condensate loop. • If too much heat builds up (too many units cooling), the cooling tower rejects it to the atmosphere. • If the loop gets too cold (too many units heating), a heat pump adds heat back. • Thermal storage can buffer large swings, reducing how often the tower or boiler needs to run.	Install reverse cycle VRV to deliver heating and cooling
Pros	• Simple, proven system • Centralized maintenance • Good for large open-plan spaces • Flexible zoning via VAV boxes • Can provide humidity control	• Integrate thermal storage for heat recovery • Good individual zone control • Energy efficient due to shared thermal load • Scalable for buildings with mixed use • Reduced simultaneous heating/cooling load	• High energy efficiency (especially with heat recovery VRV) • Excellent zone-level control • Flexible for retrofits and expansions • Quiet and compact indoor units
Cons	• Simultaneous cooling and reheating wastes energy • Large ductwork space required • Less efficient for diverse thermal zones • Central system failure affects entire building	• More complex system design and controls • Higher initial installation cost • Requires cooling tower and boiler infrastructure • Heat imbalance risks without proper load diversity • No humidity control	• Higher capital cost than conventional systems • Proprietary components can limit supplier options • Requires skilled technicians for servicing • Limited by refrigerant pipe length and capacity per outdoor unit • No humidity control

Indicative CAPEX Range

$1.5m to $3.8m

Case study:
ChillBank Enables Electrification of Heating Plant Despite Electrical Demand Constraints

CHALLENGE

Like for like replacement of the gas boiler was not aligned with Flinders University's Sustainability Strategy, but electrification would have pushed electrical demand beyond local network capacity and significantly increased the total cost of replacement. Furthermore, space was limited.

SOLUTION

Consulting with HVAC specialists at System Solutions Engineering, Flinders was presented with 4 different electrification options:

- 3 x 200 kW heat pumps (the most expensive solution, requiring a connection upgrade)
- 2 x 200 kW heat pumps with 200 kWh of sensible storage (expensive & floorspace limited),
- 1 x 200 kW heat pump with 400 kWh of sensible storage (cost effective but floorspace limited)
- 1x 200 kW heat pump with 400 kWh of latent heat storage from an Isothermix™ ChillBank™

RESULTS

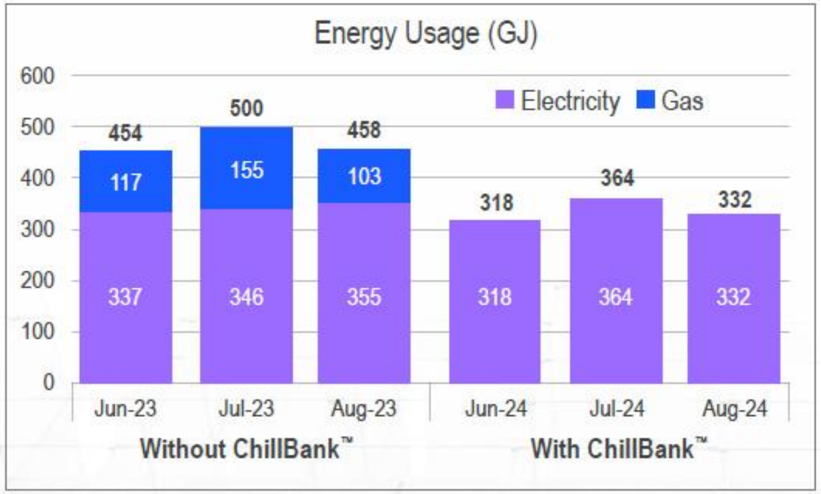


Figure 1. Energy usage before and after ChillBank™ installation with heat recovery

Complete removal of gas heating from the Mark Oliphant Building was achieved without increasing electrical load, alongside a significant reduction in overall energy usage.

Building 13 - Library

Electrification Options

Indicative CAPEX Range:

$1.4m to $3.8m

B13 Recommendations

- Proceed with detailed design of preferred solution
- Systems Solutions Engineering who have been implementing thermal storage solutions (case study provided) at other university's are keen to be considered as a detailed design partner.

Electrification Analysis: Building 295 (VDL)

Building 295 – Vet. Diagnostic Lab

Overview

Number of serviced floors		1
Estimated floor space		1,260 sqm
Domestic hot water	System type	2 x 3 x 27kW continuous hot water units with a 330L storage tank (potable and non-potable) – 162kW total
	Service area	Entire building
	Location	Lvl 2 plantroom
Space heating	System type	Air-cooled chiller and 225kW boiler servicing AHUs in ceiling plant
	Service area	Entire building
	Location	External plant enclosure
Estimated natural gas use		**843 GJ**
% of natural gas use		**3.6%**

B295 DHW bank (right)

B295 Boiler (right)

Building 295 – Vet. Diagnostic Lab
Domestic hot water uses

2XE

DHW

- Based on the equipment across the lab, the existing 160kW of hot water capacity seems far more than necessary.
-
- 2XE recommends install hot water meters to track hot water consumption and identify peaks before finalizing a design, however it is expected that 2 x 3 heat pumps with 300L storage would be more than enough hot water for the site.

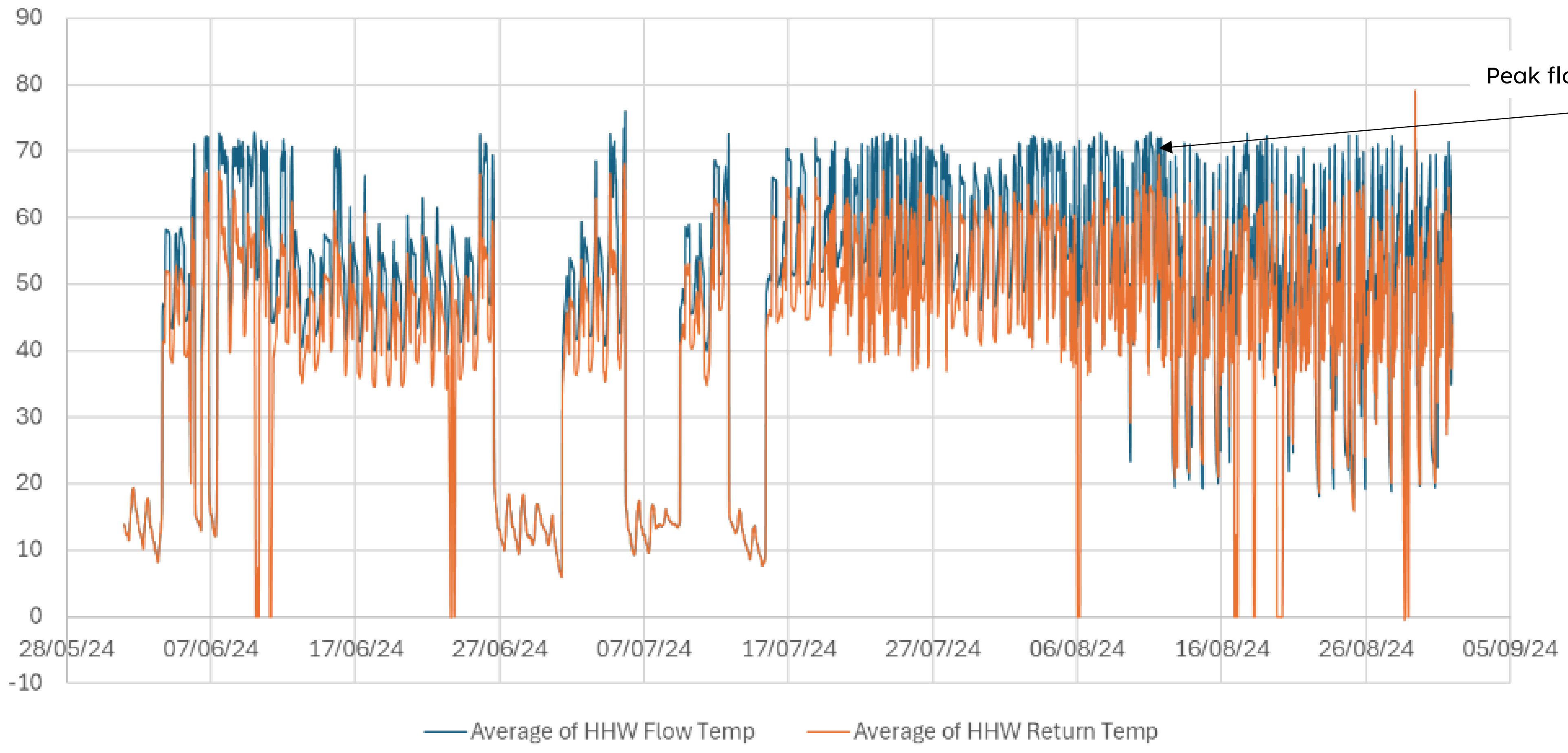
VDL domestic hot water users

Potable vs non potable	Equipment	Temperature	Litre per minute	Quantity	Use time per day (min)	Total DHW use (L/day)	80degC use
NP	Post mortem Karcher (HDS-C 8/15E		12.3	1	15	0	
P	Hand wash troff	42	7.5	6	5	225	93.5
NP	Room drain	70	10	1	30	300	253.8
P	Washing Machines	80		2	2	300	300.0
P	Showers	42	10	3	30	900	373.8
P	Sinks	40	5	5	10	250	96.2
P	Laboratory sink	40	7.5	9	10	675	259.6
P	Lab hand wash	40	5	9	10	450	173.1
					Total	3100	1550

Karcher – independent from HW (30kW 3-phase)

Building 295 - Vet. Diagnostic Lab
Boiler Data

Boiler Flow/Return Temperature Data (Winter Months)



Peak flow temperature ~70°C

Average deltaT during winter months is ~6°C

Building 295 – Vet. Diagnostic Lab

Space Heating

B295 Boiler – 225kW (70°C)

Electric Boiler

- Readily achieve 70°C set point temperature
- Average COP of 0.98
- Low Hardware CAPEX ($50,000)
- More electrical infrastructure upgrades required and greater impact to maximum demand

Heat pump:

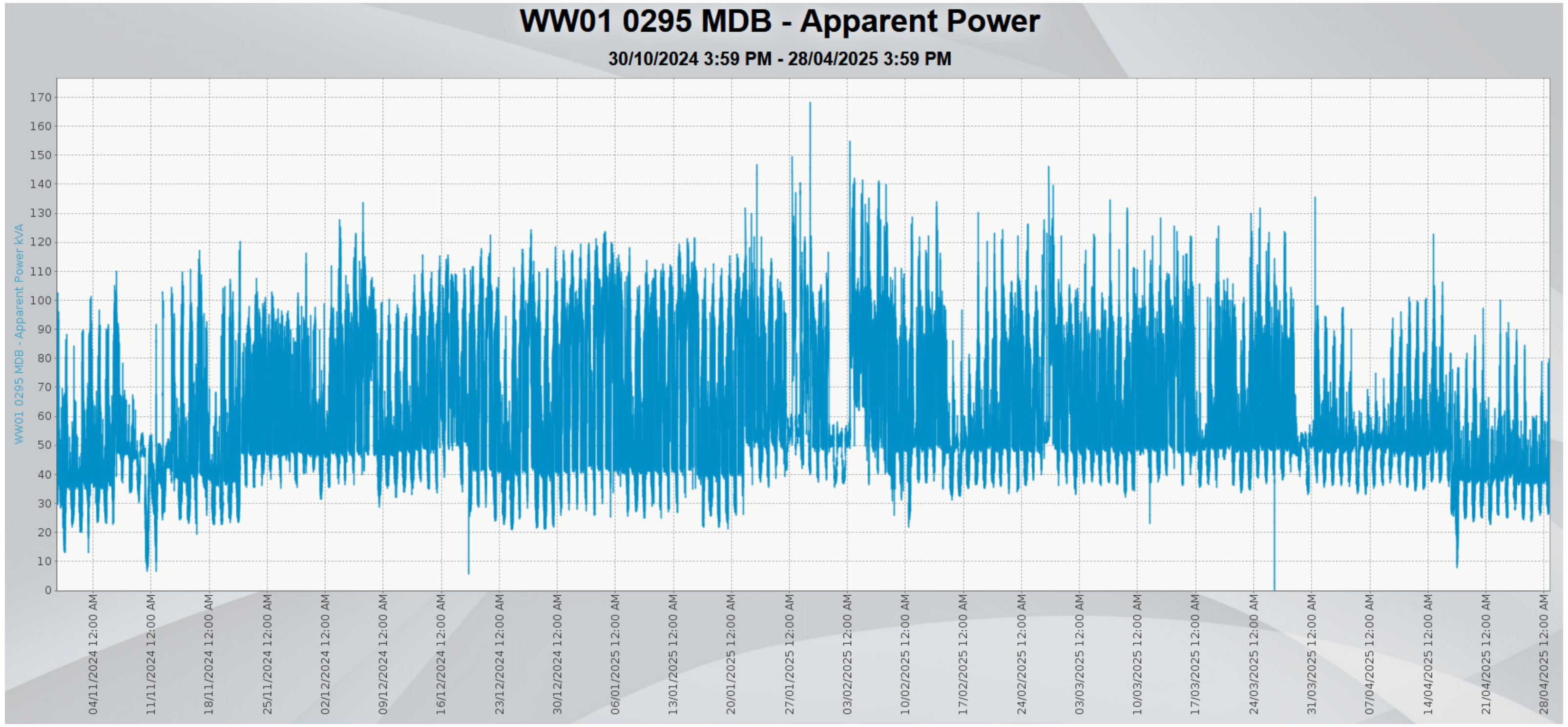
- R290 heat pumps can achieve 55°C, with special High Temperature models able to achieve a 70°C set point temperature
- Struggle with low delta T's associated with heating hot water systems – fail to perform unless AHUs and heating coils reconfigured for lower temperatures resulting in lower return temps.
- Average COP of 3.14
- High Hardware CAPEX ($150 - $250k)
- Less electrical infrastructure upgrades required compared to direct boiler

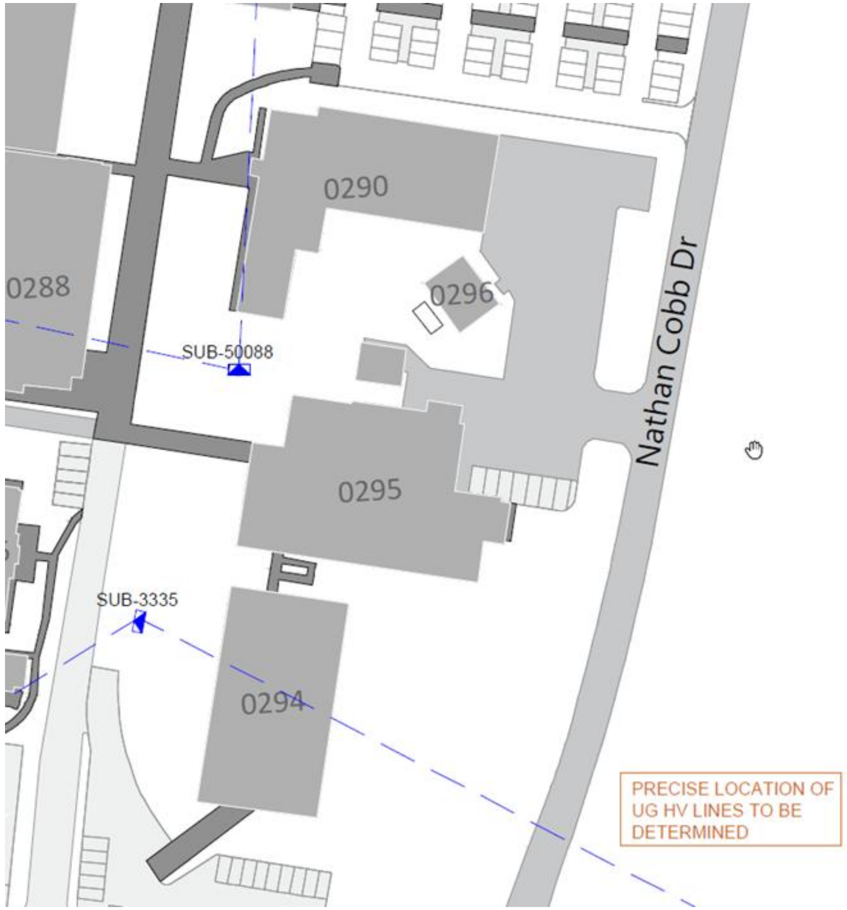
VDL

Electrical Infrastructure

Summary:

- VDL fed by 500kVA transformer
- Main Distribution Board not observed on site
- Peak demand currently 170kVA – enough remaining capacity for electric boiler
- MSSB2 which supplies chiller does not have sufficient capacity to supply new heat pump / electric boiler

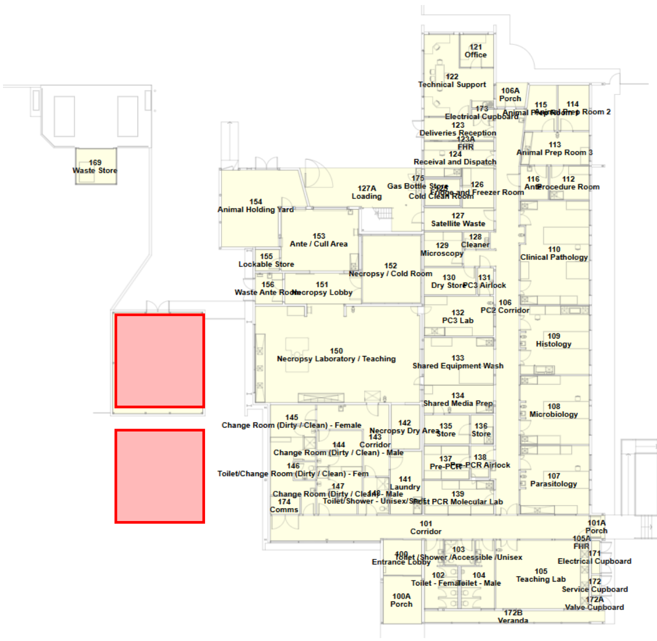




Electrical infrastructure map

VDL Electrification Summary

Area / Building	System	Proposed Equipment	Gas reduction	Electrical gain	Additional connected electrical demand	CAPEX	Cost saving
			(GJ p.a.)	(MWh p.a.)	(kVA)	($ ex GST)	($ p.a.)
VDL	Space heating	Electric hot water boiler - 160kW w/ 100kWh of thermal storage	612	**145**	**160**	$236,400	-$10,540
VDL	DHW - Potable	Bank of 3 heat pumps with 3 x buffer tanks and circulation pump	115	**9**	**10**	$34,375	$1,834
VDL	DHW - Non Potable	Bank of 3 heat pumps with 3 x buffer tanks and circulation pump	115	**9**	**10**	$34,375	$1,834



Potential locations of plant equipment

VDL

- Must confirm hot water demand via metering – existing system appears significantly oversized
- Electrical infrastructure requires upgrade to supply electric space heating
- Potential to transition to a heat pump but requires investigation of reducing HHW setpoint temperature from 70°C to 55°C.

Building 295 – Vet. Diagnostic Lab
Central heating plant potential

Opportunity

- The VDL is located near a number of other buildings that utilize central boilers and chillers, namely, B290, B288 and B289.
- There is an opportunity to establish a central heating system that is connected to these buildings over time.
- Challenging at this point in time given the scale of VDL. Could look to establish central plant as 288 and 289 are nearing end of life.

VDL and surrounding buildings Master Plan

Electrification Roadmap

Electrification Roadmap Overview

2XE

Cottages Electrification

- Cottage 343 and 344 electrification
- Ongoing upgrade to electrical infrastructure (including transformer upgrade)
- Staged upgrade of cottages to reverse cycle multi-splits & DHW heat pumps

Murrumbidgee Electrification

- Staged upgrade to heat pump hot water for space heating over time
- Upgrade to heat pump DHW units over time

B13 Electrification

- Engage design consultant to finalise design for Stage 1 and Stage 2
- Plan and undertake upgrades

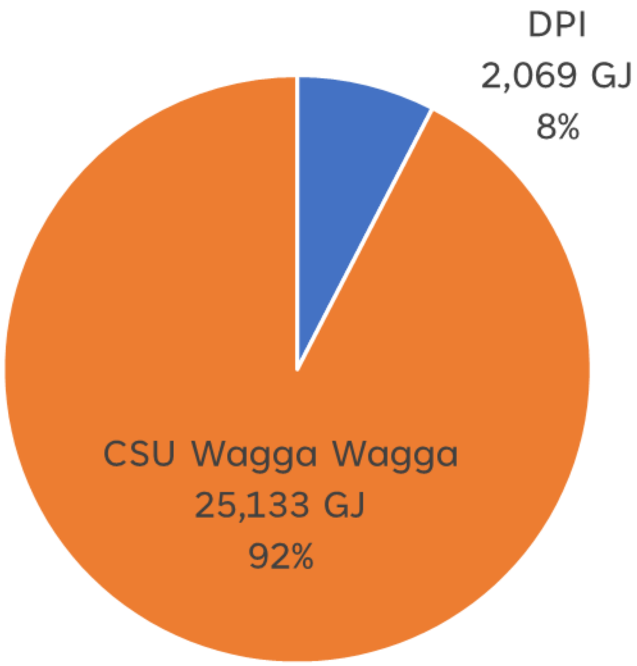
VDL Electrification

- Install DHW water meter to accurately measure peak and average hot water demands
- Upgrade DHW and boiler

CAL25	CAL26	CAL27	CAL28 onwards

APPENDIX:
CSU Wagga Wagga Natural Gas Overview

Natural Gas Baseline (Oct 23 – Sept 24)

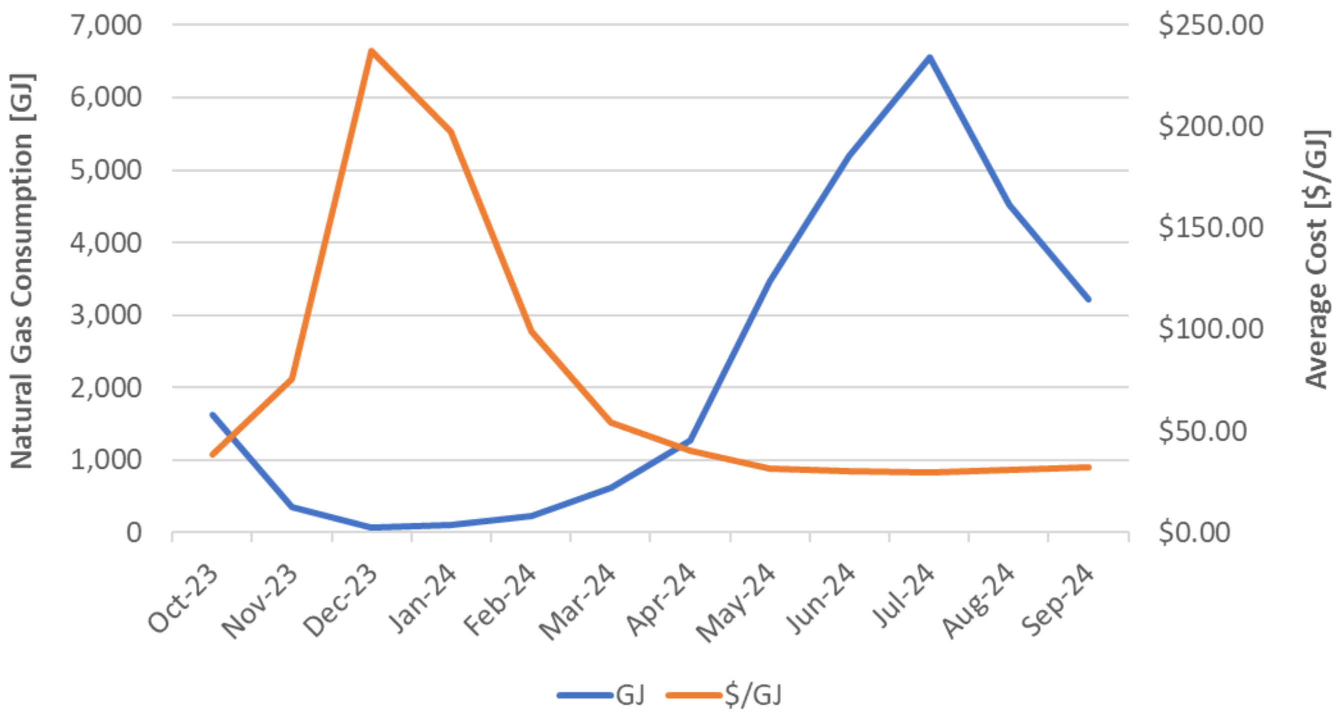


CSU WW – Natural gas use by site

CSU WW – Natural gas baseline (Oct 23 – Sept-24)

	Consumption and cost			GHG Emissions (tCO_2-e)		
Source	**Consumption (GJ)**	**Cost ($ p.a.)**	**Average price**	**Scope 1**	**Scope 3**	**Total**
Main Utility Supply	**27,202**	**$936,284**	**$34.42**	**1,402**	**381**	**1,783**
DPI Main Supply	2,069	$54,137	$26.17	107	29	136
CSU WW Site	25,133	$882,147	$35.10	1,295	352	1,647

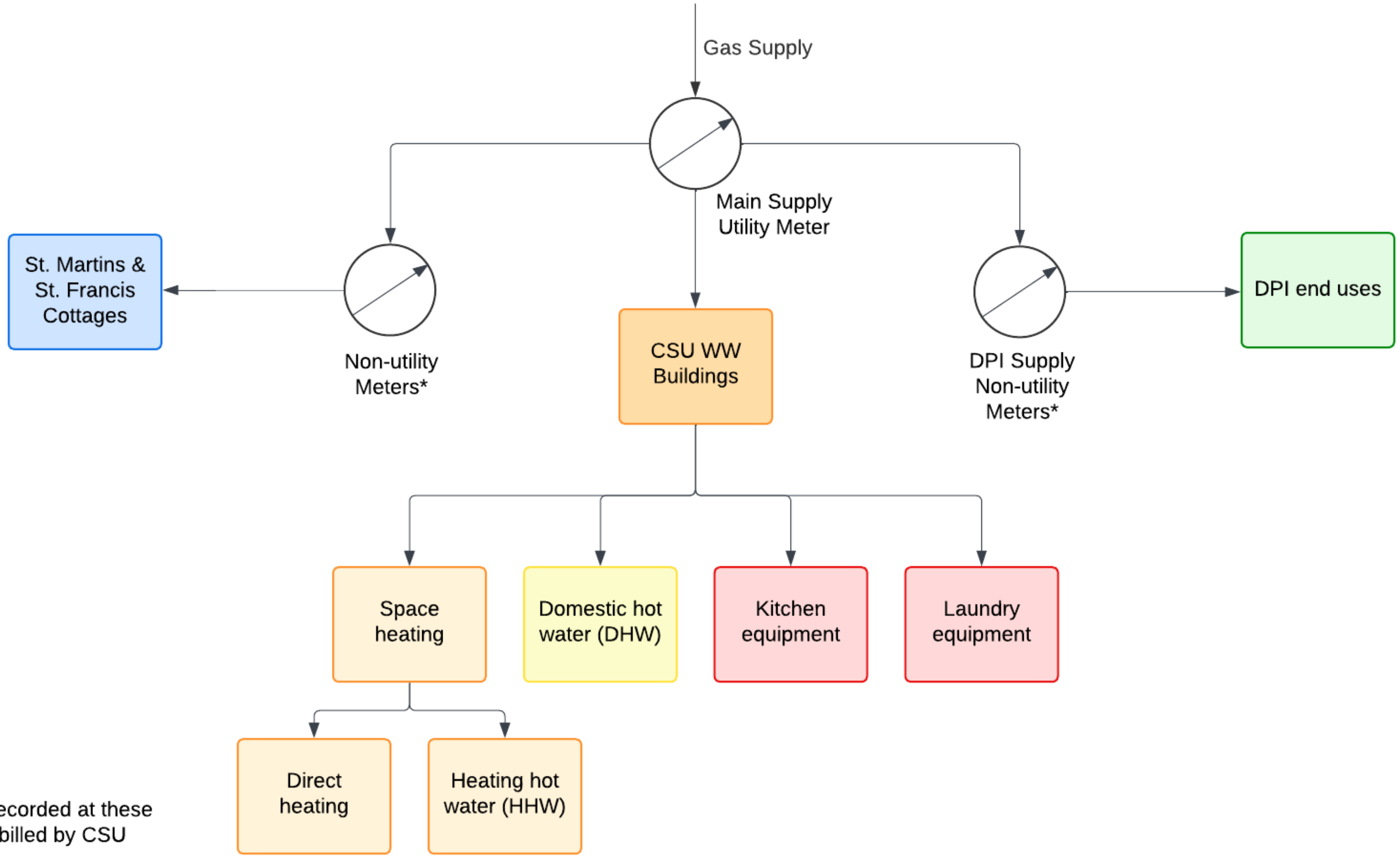
Natural Gas Consumption Profile (Oct 23 – Sept 24)



Key observations:

- Gas use is highest in winter and lowest in summer, aligning with seasonal conditions
- Monthly gas consumption was in highest in Jul-24 (coldest mean monthly temperatures) at ~6,550GJ.
- Natural gas prices increased significantly in Dec-23 before declining in Mar-24

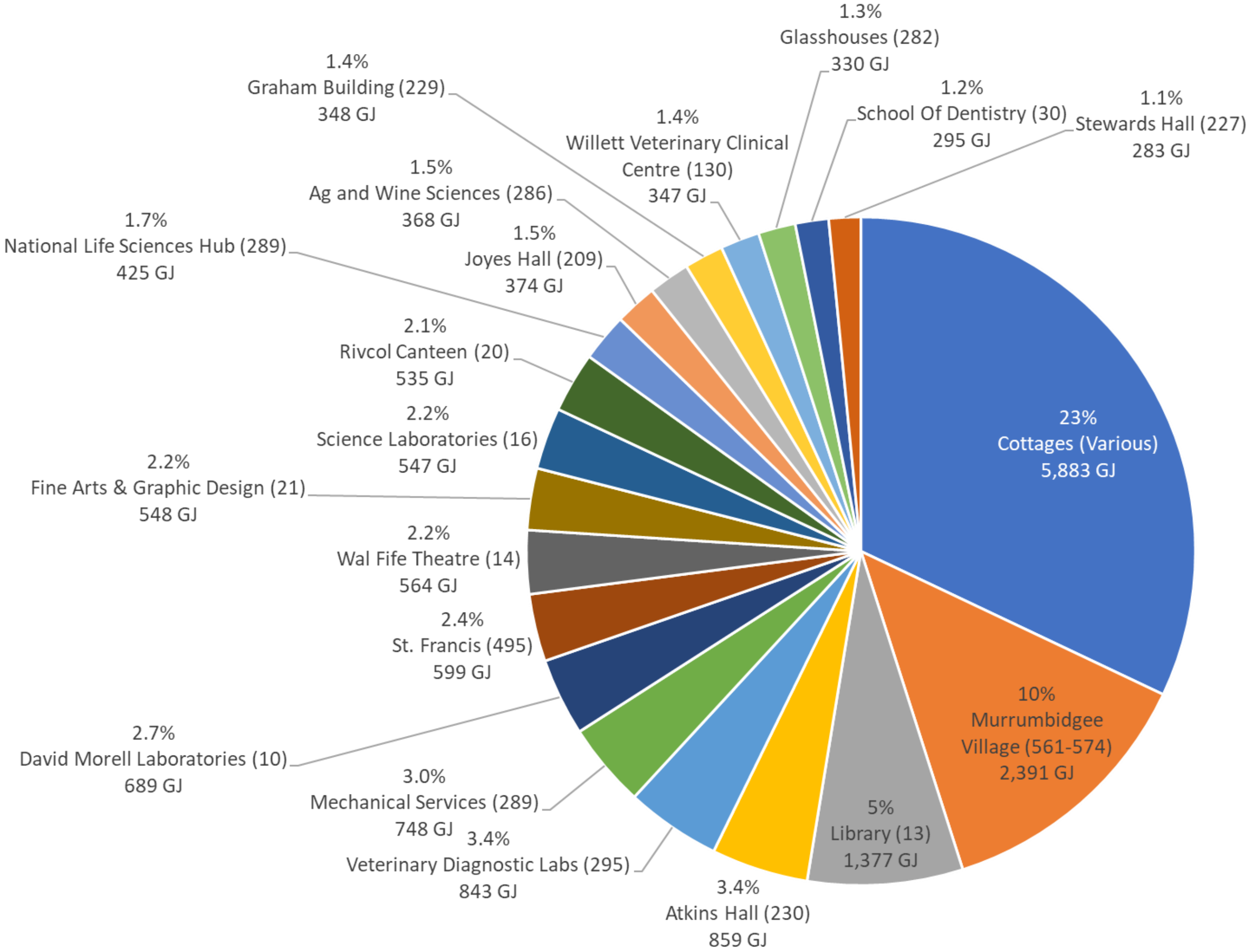
Where is natural gas used?



*Consumption recorded at these meters is on-billed by CSU

CSU Wagga – Natural gas use summary

Natural gas use breakdown by building – Top 73%



CSU Wagga Wagga – Estimated natural gas breakdown by building

Natural gas use breakdown by building – top 60%

Building	Calculated Consumption (GJ p.a.)	% of site	Master plan status	Current gas usage	Electrical infrastructure	Equipment life
Murrumbidgee Village (561-574)	2,391	10.1%		Accommodation blocks with gas use for hydronic heating and hot water.	TBC	16 years
Library (13)	1,377	5.8%		Central boiler plant servicing hot deck/cold deck system.	Spare capacity identified	Raypak boilers: 17 years Modulair boiler: 9 years
National Life Sciences Hub (289)	1,182	5.0%		Central boiler plant to serve space heating. Large bank of instantaneous hot water units for labs. Small amount of gas for direct use in labs.	Spare capacity identified	12 years
Cottages (364, 366, 368, 355, 350, 352)	1,154	4.9%		6 x Cottages with ducted gas heaters and instantaneous hot water.	Some upgrades required	Ducted gas heaters: ~14 years
Cottages (330-337)	934	3.9%		8 x Cottages with ducted gas heaters and electric heat pump hot water units.	Some upgrades required	Ducted gas heaters: ~12 years
Atkins Hall (230)	859	3.6%		Central boiler plant to serve space heating. Large commercial kitchen and a small number of outdoor gas heaters.	TBC	Heating fan coil units: 30+ years
Veterinary Diagnostic Labs (295)	843	3.6%		Central boiler plant to serve space heating. Bank of instantaneous hot water units.	TBC	14 years
David Morell Laboratories (10)	689	2.9%		Mix of central boiler plant and ducted gas heaters.	TBC	30+ years
St. Francis (495)	599	2.5%		Metered gas use. End-use details unknown.	TBC	Unknown
Wal Fife Theatre (14)	564	2.4%		Central boiler plant to serve space heating. Electric storage hot water.	TBC	20+ years

Natural gas use breakdown by building – top 60% (Cont.)

Building	Calculated Consumption (GJ p.a.)	% of site	Master plan status	Current gas usage	Electrical infrastructure	Equipment life
Cottages (338, 340, 342)	550	2.3%		3 x Cottages with ducted gas heaters and gas storage hot water (not confirmed).	Some upgrades required	Ducted gas heaters: ~12 years
H.R. Gallop Gallery and AgriPark (21)	548	2.3%		Mix of central boiler plant and ducted gas heaters.	TBC	Central boiler: 19 years AHUs: 30+ years Ducted gas heater: 20+ years
Science Laboratories (16)	547	2.3%		Building is serviced by multiple evaporative/gas heater units.	TBC	Ducted gas heaters: 20-30+ years
Rivcol Canteen (20)	535	2.3%		Central boiler plant to serve space heating. Small commercial kitchen.	TBC	Central boiler & AHUs: 30+ years
Cottages (353, 354, 356-359)	526	2.2%		6 x Cottages with ducted gas heaters and electric heat pump hot water units.	Some upgrades required	Ducted gas heaters: 14 years
Cottages (339, 341)	376	1.6%		2 x Cottages with ducted gas heaters and instantaneous hot water.	Some upgrades required	Ducted gas heaters: 12 years
Joyes Hall (209)	374	1.6%		Building is serviced by ducted gas heater units.	TBC	Ducted gas units are currently being replaced with reverse cycle heat pump units.
Ag and Wine Sciences (286)	368	1.6%		Building is serviced by ducted gas heater units.	TBC	Ducted gas heaters: 20+ years
Graham Building (229)	348	1.5%		Central boiler plant to serve space heating.	TBC	Central boiler: 20+ years Radiators: 30+ years
Willett Veterinary Clinical Centre (130)	347	1.5%		Supplied by LPG tanks, central boiler plant to serve space heating.	Spare capacity identified	Central boiler: 16 years
Total	**15,114**	**63.8%**				**B290 gas evap being replaced**