



VOLUME 1 · MANAGEMENT SUMMARY

Advanced Energy Audit

Where the energy goes, what to do about it, and what it is worth.

Demo Foods (Pty) Ltd (fictional)

Food processing: bakery and cold storage · Gauteng, South Africa (fictional site)

FICTIONAL DEMO

Demonstration report. Demo Foods (Pty) Ltd is a fictional company; its site, bills, readings, quotes and rates are invented to show the audit method. It describes no real client.

PREPARED FOR Demo Foods (Pty) Ltd (fictional)	PREPARED BY Thabiso Kali, Certified Energy Manager	AUDIT PERIOD July 2025 to June 2026	REPORT DATE 19 October 2026
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DATA LEVEL SUMMARY · SET PER SYSTEM, NEVER PER SITE

Level 3 Interval data	Refrigeration and chillers	12% of energy
Level 2 Equipment register	Compressed air · Steam and boilers · Process heat · Motors, pumps and fans · Lighting · HVAC and offices	82% of energy
Level 1 Bills	Electrical supply and tariff (demand, power factor, NMD)	all electricity

Standard: ISO 50002-1:2025 detailed audit; ASHRAE Standard 211 Level 2, refrigeration at Level 3.

PREPARED BY

Thabiso Kali, Certified Energy Manager (AEE)

WEBSITE

thabisokali.co.za

STATUS

Demonstration

01 · THE ANSWER

Firm measures cut the energy bill by R867k a year (7%) for R951k of capital, paying back in 1.1 years. A further R2.42m a year is indicative: it is kept separate, and never added to the firm figure, until site data confirms it.

ENERGY BOUGHT A YEAR 6,912 MWh ASSUM Electricity 43% · LPG 56% · Diesel 1%	ENERGY COST A YEAR R12.33m MEAS July 2025 to June 2026, from the bills	AVERAGE COST R1.78 /kWh Electricity R1.67 · LPG R1.86 · Diesel R2.27	ENERGY ACCOUNTED FOR 95% CALC 3 of 3 balance points close within tolerance
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FIRM

7 measures · site data, ±20% or better

ENERGY BILL SAVING, YEAR 1

R867k a year · 7.0% of the bill

ENERGY SAVED 556 MWh 8.0% of energy bought	CAPEX R951k budget estimates and quotes	NET SAVING R841k after running costs
NPV AT 12% R4.58m over 15 years	IRR 95% nominal	PAYBACK 1.1 years simple, on net saving

Measures M23, M7, M20, M4, M3, M2, M1

INDICATIVE

16 measures · confirm before committing capital

ENERGY BILL SAVING, YEAR 1

R2.42m a year · 19.6% of the bill

ENERGY SAVED 1,305 MWh 18.9% of energy bought	CAPEX R2.03m budget estimates and quotes	NET SAVING R2.41m after running costs
NPV AT 12% R19.34m over 20 years	IRR 125% nominal	PAYBACK 10 months simple, on net saving

Measures M12, M13, M8, M15, M16, M9, M18, M10, M14, M17, M19, M22, M11, M5, M21, M24

Firm and indicative are separate cases and are never added together. Firm savings rest on site data (±20% or better); indicative savings rest on an assumed input or a wider ±, so confirm them with the data on page 6 first. Savings are sequenced within each system and valued at average rates from the latest 12 bills.

A KEY FINDINGS

- 01 Tunnel ovens (31%) and refrigeration (12%) use the most energy; losses and conversion take 11% of what the site buys.
- 02 The energy balance closes within tolerance at every balance point; 5% of the site's energy is unaccounted and stays visible as such.
- 03 The strongest firm measure is M23, LED lighting retrofit: R1.41m NPV.
- 04 The largest indicative prize is M12, insulate bare steam pipe, valves and flanges (R4.31m NPV); its saving is ±37% and rests on an assumed input, so confirm it on site before committing capital.
- 05 Better data on steam and boilers (level 2 to 3) would narrow the ± on its savings by R252k a year.

B WHAT WE RECOMMEND

- 01 Approve the firm measures (M23, M7, M20, M4, M3, M2, M1) for R951k. They pay back in 1.1 years and need no further data; obtain quotes for the 21 measures still on budget estimates before ordering.
- 02 Confirm the indicative measures (M12, M13, M8, M15, M16, M9, M18, M10, M14, M17, M19, M22, M11, M5, M21, M24) within 2 months. Collect: fuel flow and steam flow (or feedwater flow) over 1 to 2 weeks; burner firing logs or gas meter readings by hour against the batch schedule. Then decide on R2.03m of capex.
- 03 Do not proceed with M6 as scoped: negative NPV at 12% once the earlier measures on the system are in.
- 04 Agree the M&V plan before work starts: an IPMVP option per measure (Volume 2) and the baselines, which pass ASHRAE Guideline 14 (CV(RMSE) 2.2% against 15%).

Process heat and steam take 57% of the energy

Metered supplies on the left, end uses on the right, losses falling away. The unaccounted remainder is never forced into an end use: it leaves the diagram as its own hatched arrow.

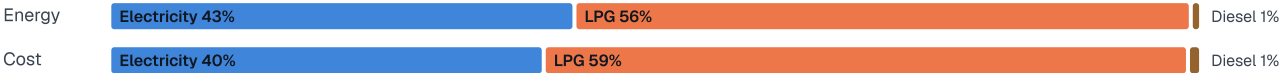
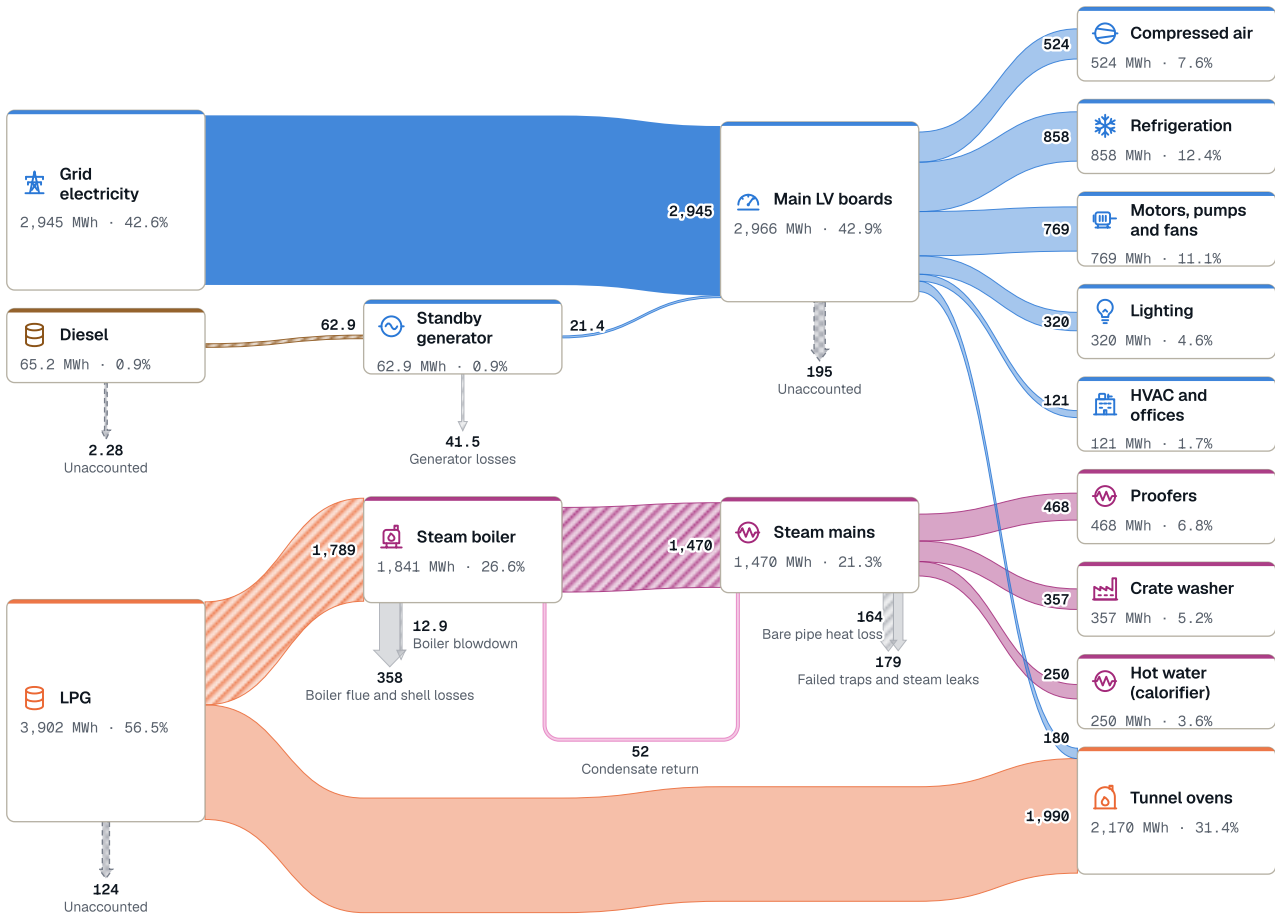
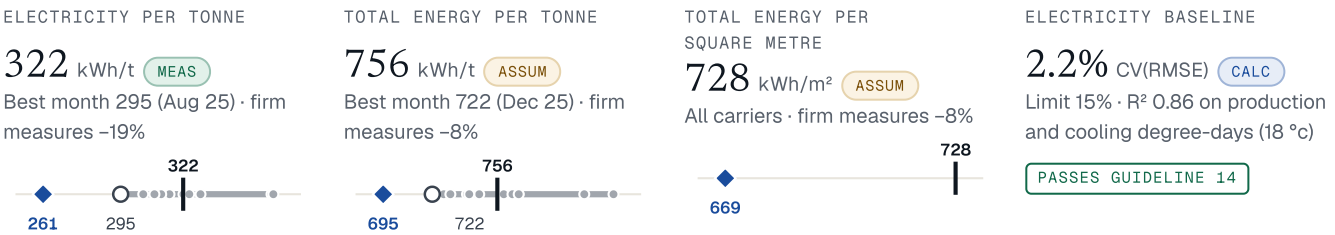


FIGURE 1 Energy flows, July 2025 to June 2026 (MWh a year)



Source: bills for every carrier (top-down) and the equipment register, system models and logged data (bottom-up); balance per ISO 50002-1:2025, never forced. Lighter flows are estimated, hatched flows assumed. Volume 2 §4 has every flow and node.

FIGURE 2 Energy performance indicators



Benchmark: the best month of the audit year (internal); no external sector benchmark is in the project file. Baselines per ISO 50006:2023, fit statistics per ASHRAE Guideline 14-2014.

02 · WHERE THE ENERGY GOES: WHEN IT IS USED

71 MWh a year runs above the baseload outside operating hours

The 30-minute readings of Main incomer, utility AMR half-hourly show the shape of the day behind the monthly bills: what runs all the time, what follows production, and what is left on after hours. Gaps in the data are left out, never filled.

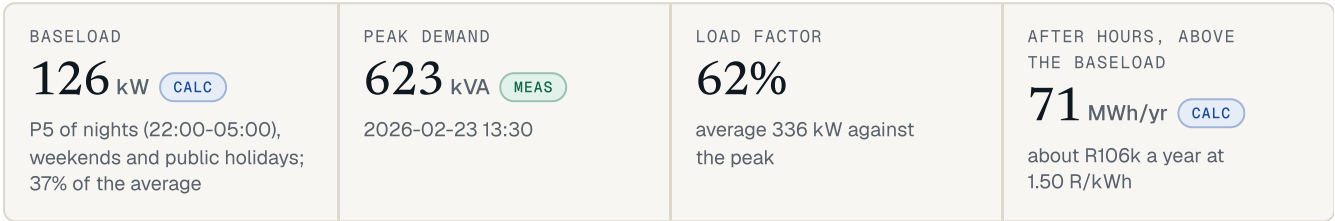
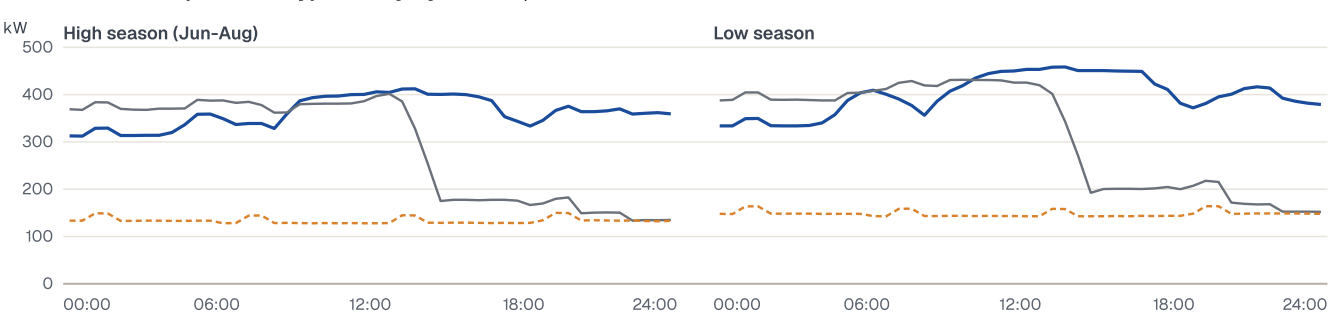
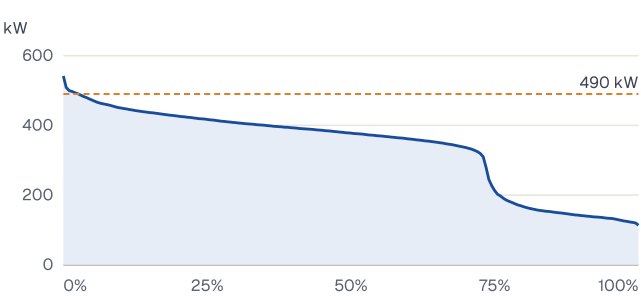


FIGURE 2B Load profile: a typical day by season, mean kW each 30 minutes



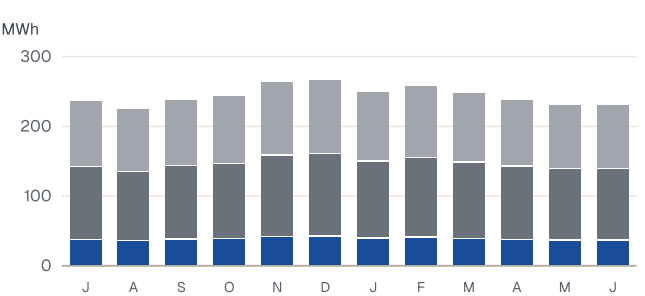
Source: Utility AMR portal export for the main incomer, July 2025 to June 2026 (fictional, made by a seeded generator); 365 days, 99.98% complete: a good year. Time-of-use split: peak 16.0%, standard 44.0%, off-peak 40.0% on the default Eskom-style schedule (verify against the current tariff book). Volume 2 §3.6 has the data quality, load duration, heatmap and the check against the bills.

FIGURE 2C Load duration: every half hour, highest first



Above 490 kW for 229.0 h a year: 257 kWh on the worst day, the size of the peak a battery would shave.

FIGURE 2D Energy by month and time-of-use period (MWh)



Outside the operating hours (Production schedule: 24 h Monday to Saturday 13:00, idle on Sundays and public holidays (fictional)) the site averages 160 kW. Of the energy above the baseload, Saturdays carry 41 MWh, Sundays and holidays 30 MWh a year. The data reconciles with the bills: 12 of 12 months within $\pm 2\%$ of the bill; over 12 whole months the interval data is -0.04% against the bills.

■ 03 · THE PROJECTS

23 measures are worth doing: 7 firm, 16 indicative

Ranked by NPV within each case. Each saving is worked out on the plant the earlier measures on its system leave behind, so there is no double counting inside a system.

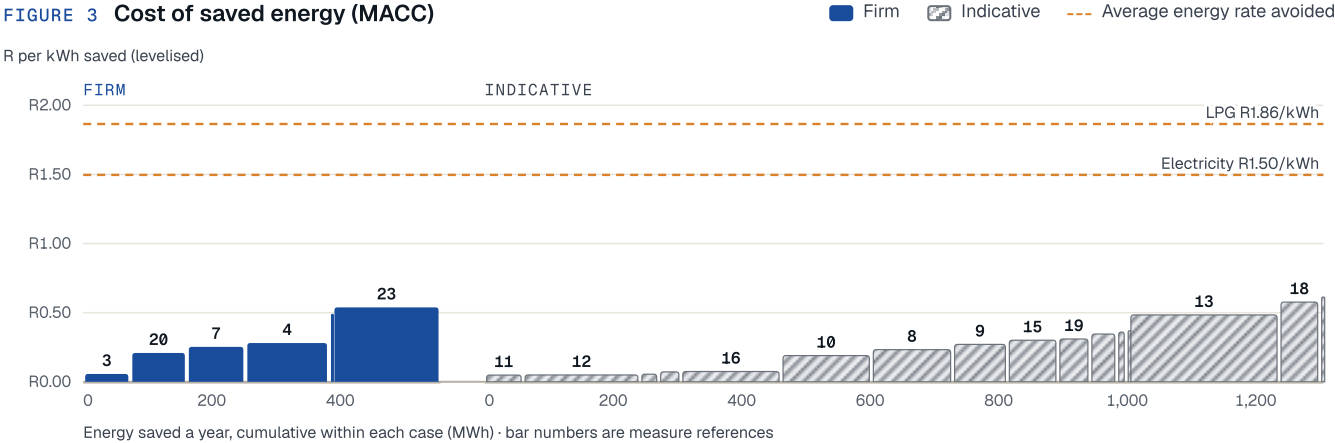
Table 1 · Recommended measures (year-1 values; NPV at 12% over each measure's life)

RANK	MEASURE	SAVING A YEAR	MWH A YEAR	CAPEX	NPV	IRR	PAYBACK	SAVING BASIS
FIRM FIRM: FROM SITE DATA								
1	M23 LED lighting retrofit	<u>R252k</u>	168	R512k	R1.41m	56%	2.0 years	EST ±19%
2	M7 Floating head pressure on the refrigeration plant	<u>R136k</u>	91	R130k	R909k	113%	11 months	EST ±19%
3	M20 VSDs on the oven-hall extraction fans (2 × 22 kW)	<u>R132k</u>	88	R98k	R898k	141%	9 months	CALC ±10%
4	M4 Compressed-air leak repair programme	<u>R195k</u>	130	R45k	R665k	387%	3 months	EST ±17%
5	M3 Switch compressors off outside production	<u>R110k</u>	73	R15k	R441k	above 500%	2 months	EST ±17%
6	M2 Power-factor correction	<u>R35k</u>	–	R136k	R217k	31%	4.0 years	CALC ±10%
7	M1 Run on fewer transformers at light load	<u>R8k</u>	5	R15k	R47k	61%	1.9 years	CALC ±15%
Firm case (not added to the other)		R867k	556	R951k	R4.58m	95%	1.1 years	
INDICATIVE INDICATIVE: CONFIRM BEFORE COMMITTING CAPITAL								
1	M12 Insulate bare steam pipe, valves and flanges	<u>R339k</u>	182	R67k	R4.31m	above 500%	2 months	ASSUM ±37%
2	M13 Heat pump instead of steam for hot water	<u>R460k</u>	234	R770k	R4.06m	68%	1.7 years	ASSUM ±47%
3	M8 Refrigeration heat recovery: a desuperheater for hot water	<u>R236k</u>	126	R200k	R2.28m	126%	10 months	ASSUM ±44%
4	M15 Flue-gas economiser	<u>R147k</u>	79	R177k	R1.72m	91%	1.2 years	ASSUM ±26%
5	M16 Tune the burners on ovens, fryers and dryers: Tunnel oven burners (2 ovens)	<u>R291k</u>	156	R13k	R1.16m	above 500%	1 months	ASSUM ±26%
6	M9 Boiler combustion tuning and O2 trim	<u>R159k</u>	85	R85k	R1.06m	185%	7 months	ASSUM ±26%
7	M18 Recover oven flue heat: Tunnel oven burners (2 ovens)	<u>R118k</u>	63	R248k	R992k	55%	2.1 years	ASSUM ±49%
8	M10 Steam trap survey and repair	<u>R262k</u>	141	R42k	R985k	above 500%	2 months	ASSUM ±67%
9	M14 Return more condensate	<u>R78k</u>	42	R250k	R803k	48%	2.5 years	ASSUM ±29%
10	M17 Insulate the crate washer's soak tank and fit a lid	<u>R54k</u>	29	R11k	R561k	above 500%	2 months	ASSUM ±33%
11	M19 Variable-speed drive on a throttled pump (pump and system curves): Cooling-water and process pumps	<u>R75k</u>	50	R83k	R480k	97%	1.1 years	ASSUM ±23%
12	M22 Occupancy sensors in intermittently used areas	<u>R52k</u>	35	R14k	R380k	377%	3 months	ASSUM ±34%
13	M11 Repair steam leaks	<u>R112k</u>	60	R7k	R282k	above 500%	1 months	ASSUM ±46%
14	M5 Duct the compressor intakes to outside air	<u>R22k</u>	15	R36k	R195k	69%	1.6 years	ASSUM ±39%
15	M21 Synchronous or cogged belts instead of V-belts: Oven-hall extraction fans	<u>R9k</u>	6	R20k	R45k	50%	2.3 years	ASSUM ±37%
16	M24 Widen HVAC set points	<u>R6k</u>	4	R6k	R21k	117%	11 months	ASSUM ±37%
Indicative case (not added to the other)		R2.42m	1,305	R2.03m	R19.34m	125%	10 months	
NOT RECOMMENDED								

RANK	MEASURE	SAVING A YEAR	MWH A YEAR	CAPEX	NPV	IRR	PAYBACK	SAVING BASIS
–	M6 Variable-speed trim compressor Negative NPV at 12% once the earlier measures on the system are in	R17k	12	R519k	–R336k	–1%	29.9 years	ASSUM ±21%

Saving basis: the weakest input behind the saving and its ±. Measured, Calc (calculated), Est (estimated: a reading or judgement on site), Assum (assumed: a default to replace). Capex is a budget estimate unless the measure sheet shows a quote.

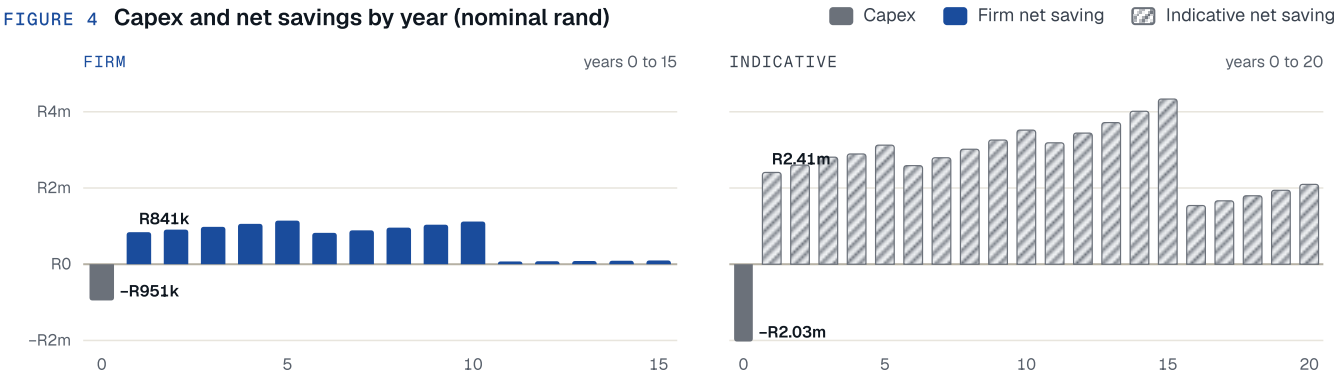
FIGURE 3 Cost of saved energy (MACC)



Levelised cost of saved energy = (capex × CRF + Δ running cost) ÷ kWh saved a year, CRF at 12% over the measure's life (LBNL method). Bars below a dashed line save more than they cost on energy alone. Not on the curve: M2, which saves no kWh (its value is in demand, capacity or time-of-use charges).

Firm measures pay for themselves in 1.1 years; the programme takes 19 months

FIGURE 4 Capex and net savings by year (nominal rand)



Year 0 is the capex; each later year is the saving less running costs of the measures still within their life, escalated at 8% a year. Savings stop at the end of each measure's life (the steps), with no replacement modelled. Portfolio maths per lib/ecosystem (NPV, IRR, payback).

A FUNDING OPTIONS

Own capital

The firm measures repay R951k in 1.1 years: funding them from the operating or minor-capex budget avoids finance costs and starts the savings soonest.

Section 12L allowance

A tax deduction per kWh saved, verified under SANS 50010 by an accredited M&V body. It has a sunset date: confirm it applies to the assessment year before relying on it. It is not counted in these figures.

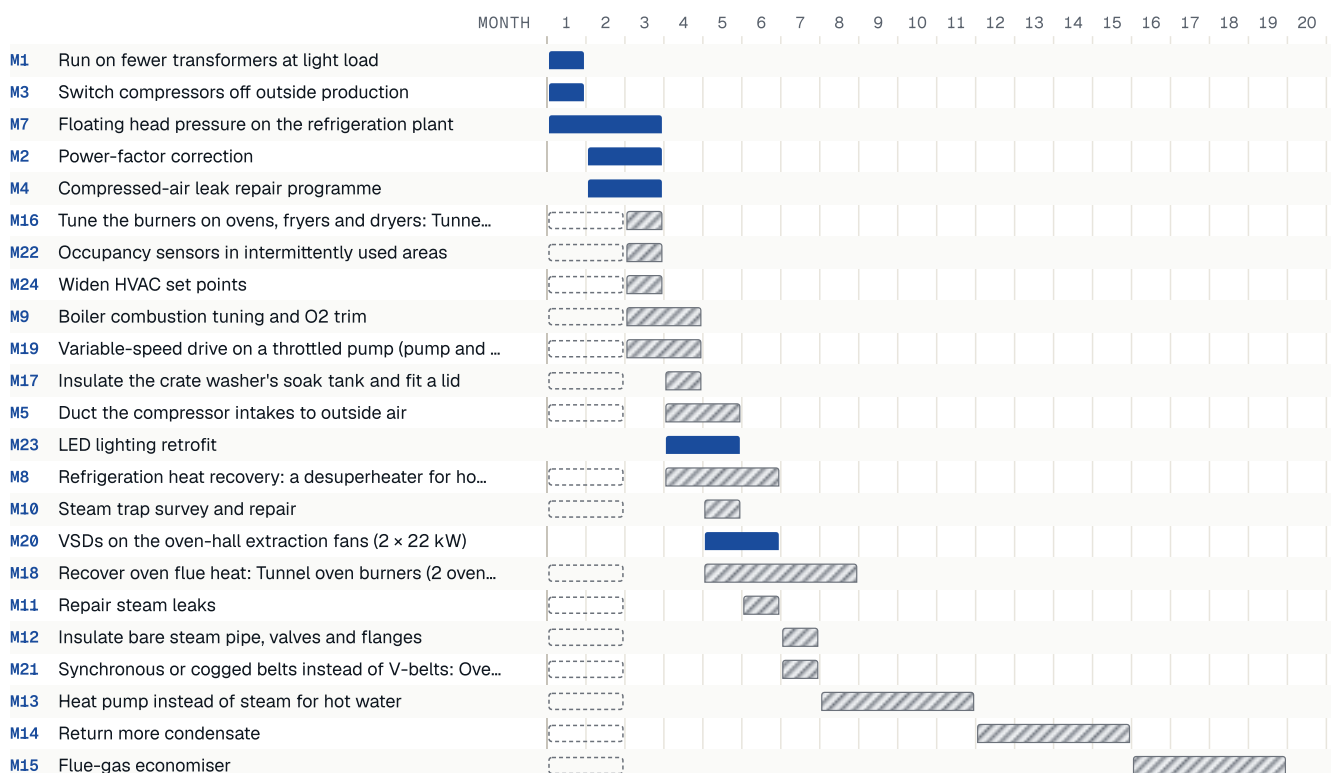
Financing view (for lenders) §8

A 5-year annuity loan of R665k (70% of the firm capex) at 11.5% costs R182k a year. The firm savings cover it 4.61x in the weakest year (average 5.41x, target 1.30x); equity IRR 241%. Rate assumed: confirm with the bank.

Energy performance contract

An energy services company funds and installs, paid from a share of the verified saving. It suits the indicative steam measures once confirmed, and needs the M&V plan in Volume 2.

FIGURE 5 Implementation timeline (months from approval)

 Firm
  Indicative


Dashed outline: confirm the indicative measure first (collect the data). M&V reporting runs 12 months from each completion.

Durations from each measure's lead time; measures on one system follow their sequence (behaviour → controls → maintenance → retrofit → technology → heat recovery); systems run in parallel. Firm measures are complete by month 6.

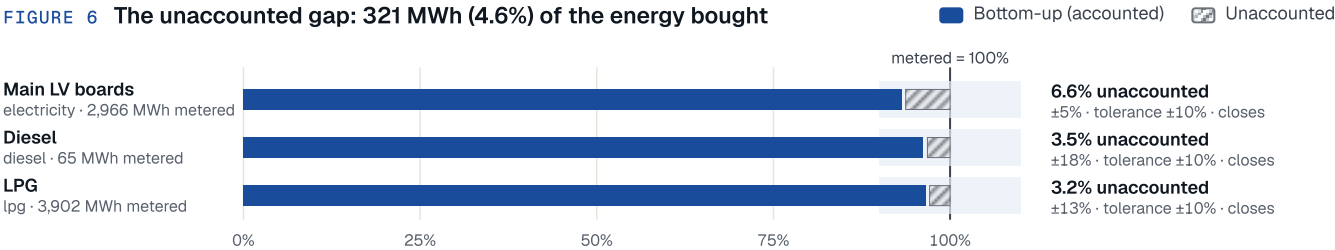
What the numbers rest on, and what would firm them up

Table 2 · Data level per system (set per system, never per site)

SYSTEM	DATA LEVEL	SHARE OF ENERGY	TYPICAL ±	MEASURES
Electrical supply and tariff	L1 bills	43% all electricity (supply side)	±30%	M1 ^F M2 ^F
Compressed air	L2 equipment inventory	8%	±20%	M3 ^F M4 ^F M5 ^I M6 ^x
Refrigeration and chillers	L3 interval data	12%	±12.5%	M7 ^F M8 ^I
Steam and boilers	L2 equipment inventory	26%	±20%	M9 ^I M10 ^I M11 ^I M12 ^I M13 ^I M14 ^I M15 ^I
Process heat	L2 equipment inventory	31%	±20%	M16 ^I M17 ^I M18 ^I
Motors, pumps and fans	L2 equipment inventory	11%	±20%	M19 ^I M20 ^F M21 ^I
Lighting	L2 equipment inventory	5%	±20%	M22 ^I M23 ^F
HVAC and offices	L2 equipment inventory	2%	±20%	M24 ^I

F firm · I indicative · x not recommended. Typical ± by level: bills ±30%, register ±20%, interval ±12.5%, process ±7.5%.

FIGURE 6 The unaccounted gap: 321 MWh (4.6%) of the energy bought



Gap = (metered - Σ bottom-up) ÷ metered at each balance point; the balance is never forced. Shaded band: the tolerance (±10%, or ±5% where every node is at level 4).

A WHAT BETTER DATA WOULD UNLOCK

SYSTEM	LEVEL	COLLECT	± NARROWS BY	THEN QUANTIFIABLE
Steam and boilers	2 → 3	Fuel flow and steam flow (or feedwater flow) over 1 to 2 weeks	R252k/yr ±43% → ±27%	Automatic TDS blowdown control; Recover heat from boiler blowdown
Process heat	2 → 3	Burner firing logs or gas meter readings by hour against the batch schedule	R57k/yr ±33% → ±21%	Turn ovens down or off between runs; Recover heat from one process stream to another
Refrigeration and chillers	3 → 4	Process historian or SCADA export (flows, temperatures, pressures) at 15 minutes or finer	R52k/yr ±35% → ±21%	Clean condensers and keep them clear; Raise evaporating temperature where the product allows; Cold-store door discipline and strip curtains
Lighting	2 → 3	Occupancy loggers in intermittently used areas for a week	R24k/yr ±21% → ±13%	Lights-off campaign; Daylight or photocell control; Take fittings out of over-lit areas

B RISKS TO THE SAVINGS

- **Persistence.** Behaviour and maintenance savings slip back without their routine; the surveys that hold them are in each measure's running cost.
- **Interactions.** Savings are sequenced within each system; effects across systems (heat recovery and the steam measures both cut boiler fuel) are noted, not netted.
- **Tariffs and costs.** Savings use average rates from 12 bills; 21 of 23 recommended capex figures are budget estimates to replace with quotes. No kVA saving is claimed unless the measure targets demand.

Report date 19 October 2026. Volume 2 holds the method, data, full balance and one sheet per measure.