Power Quality & Energy Efficiency

IN A 30bbl BREWHOUSE

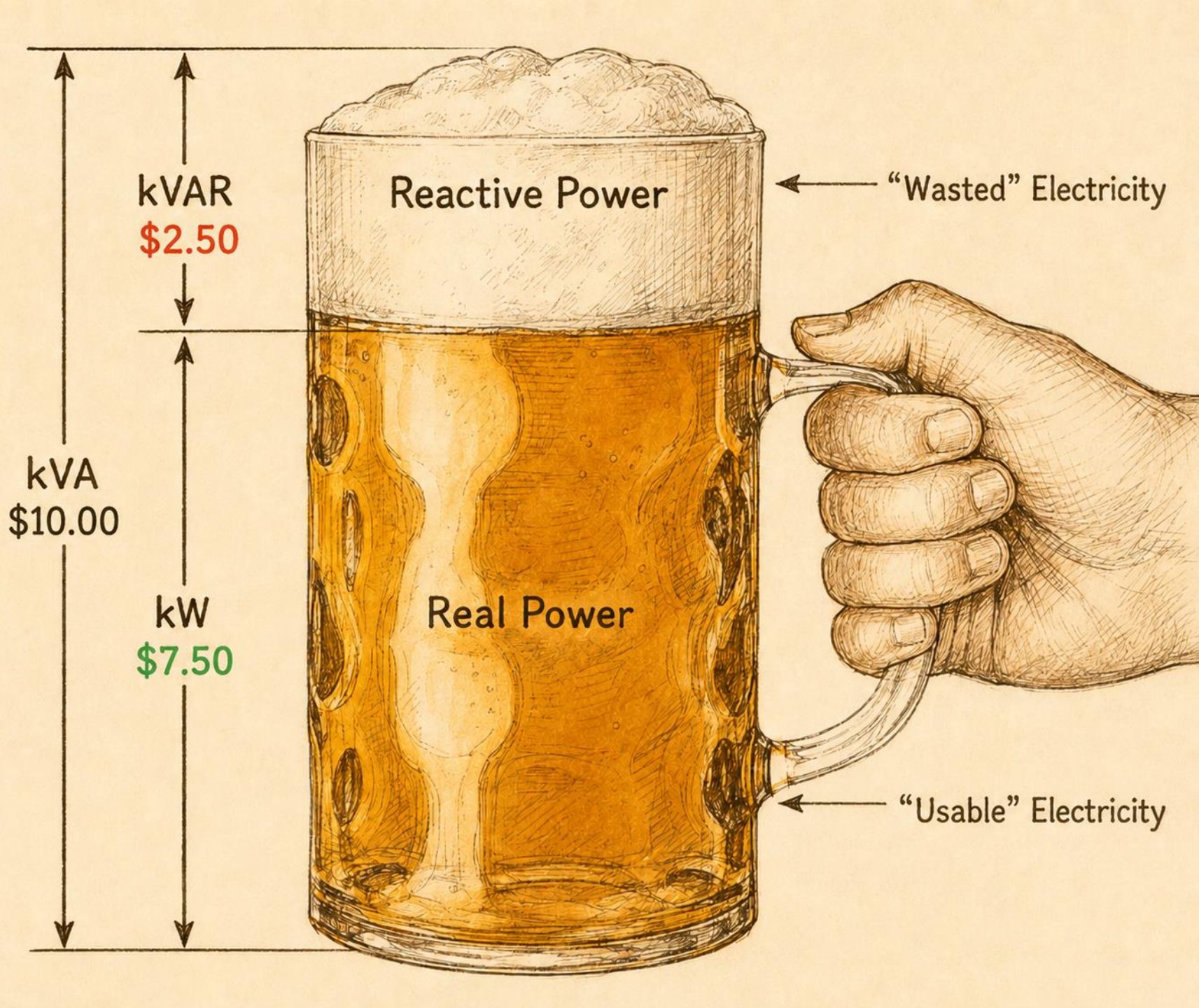
From Milling to Distribution

Power Management Control System (PMCS)

Technical Overview

PMCS Power | www.pmcspower.com

Smart Energy and Power
Performance Guaranteed
Immediate Proven Results.



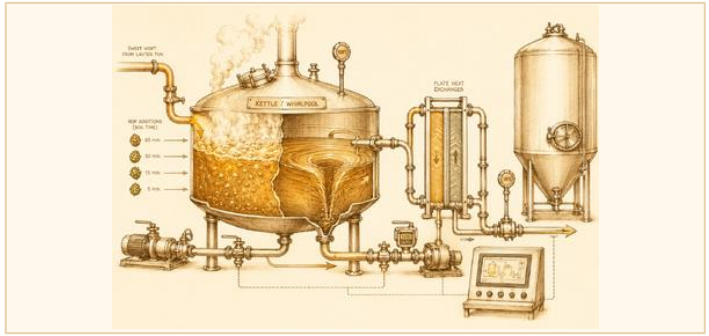
PMCS POWER LLC | www.pmcspower.com | brewery@pmcspower.com

Complete brewhouse scope: grain to storage/distribution

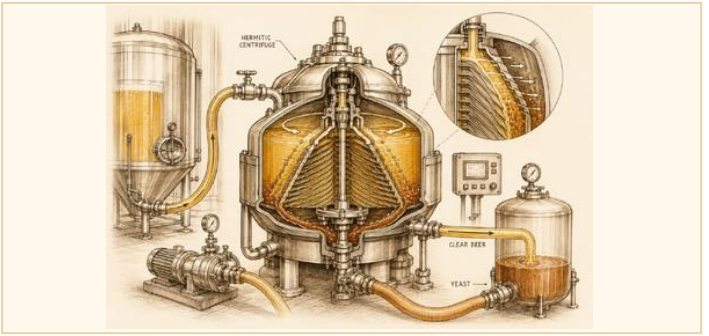
WATER TREATMENT	GRAIN + MILLING	MASH TUN	LAUTER TUN	KETTLE / WHIRLPOOL	HEAT EXCHANGE / GLYCOL	CENTRIFUGE	PACKAGING	COLD STORAGE	DISTRIBUTION + TASTING ROOM



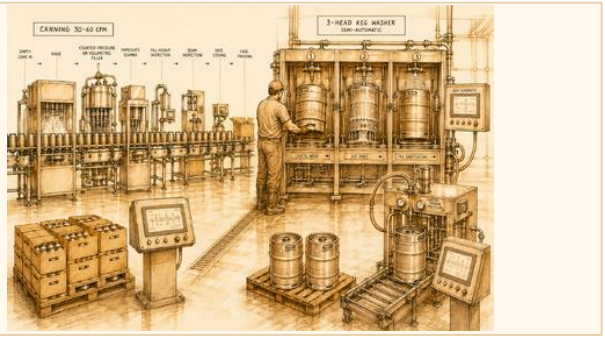
Grain Prep, Mash & Lauter



Kettle, Whirlpool & Heat Exchange



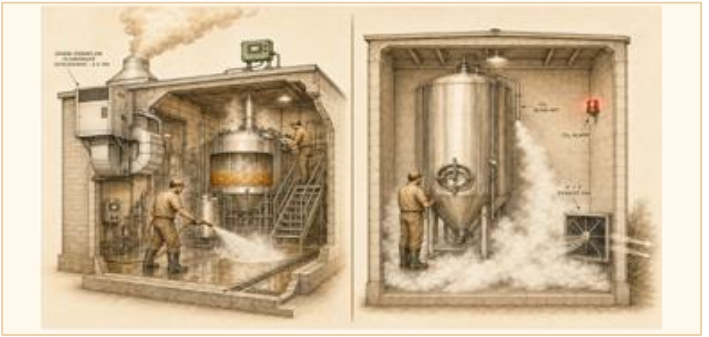
Hermetic Disc-Stack Centrifuge



Canning & Keg Washing



Cold Storage & Finished Goods



HVAC, Steam & CO_2 Safety

From grain handling to packaging and facility-support systems: A planning, improvement, and expansion guide for new or existing facilities

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Electrical backbone: power demands across every stage

A 30bbl brewery is a multi-voltage, multi-current, motor-intensive facility.
Every process stage places unique electrical demands on the distribution system.

Water Treatment
3 HP - 2.2 kW
Softener, RO, delivery pump

Wort Pumps / HLT
12 HP - 8.9 kW
High-temp process pumps

Canning Line
4 HP - 2.9 kW
Filler, seamer, conveyors

Cold Storage
12 HP - 8.9 kW
Two 3–4-ton split systems

Grain Milling
11HP - 8.2kW
Mill motor, augers, conveyors

Glycol Chiller
30 HP - 22.4 kW
Dual compressor

Keg Washer
11 HP – 8.2 kW
Pumps + electric heat

HVAC Tasting & Production
27 Hp - 20.1 kW & 21 HP - 15.7 KW
Tasting 18 tons + Production 12 tons

Mash & Lauter Tuns
11 HP 8.2 kW
Agitators, rake drive, pumps

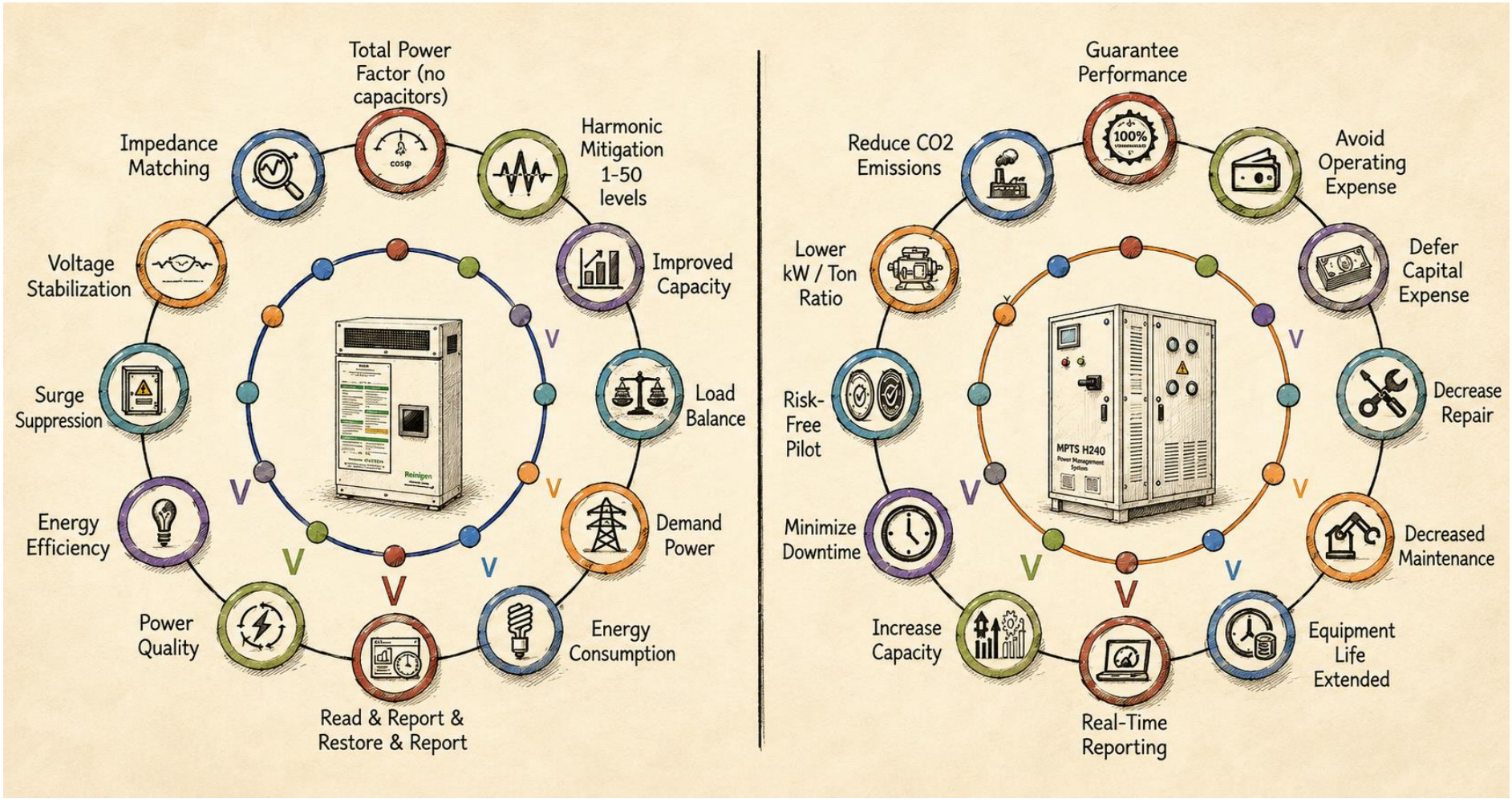
Centrifuge
20 HP - 14.9 kW
VFD high harmonic risk

Compressed Air
10 HP - 7.5 kW
Add refrigerated dryer

Controls & Lighting
1 HP - 0.8 kW
PLC, HMI, LED, receptacles

Total facility peak demand can exceed 120 kW | Multiple voltage classes: 120 V 1Ø / 208–240 V 3Ø / 460–480 V 3Ø

The Power Management Control System (PMCS) is a Computer



Multi-Function Integration

Guaranteed Performance Benefits

PMCS difference: read → report → then … restore → report

1 READ

Continuously measures voltage, current, power factor, THD, kW, kVA kVAR, phase balance; across 3-phases in real time

2 REPORT

Documents baseline electrical conditions: demand peaks, reactive power, harmonic spectrum, voltage events, energy intensity

3 RESTORE

Actively corrects power factor, suppresses harmonics, stabilizes voltage during transients; immediately and dynamically

4 REPORT

Confirms post-correction improvements with verified before/after data: kVAR reduced, THD lowered, voltage stabilized

CAPABILITY	EMS / BMS	PMCS (REINIGEN / MPTS)
Monitor & log power data	✓ Yes	✓ Yes
Alerts on threshold breaches	✓ Yes	✓ Yes
Correct power factor (dynamic loads)	✗ No	✓ Yes
Suppress harmonic displacement / distortion	✗ No	✓ Yes
Stabilize voltage during transients	✗ No	✓ Yes
Verify & report restoration	✗ No	✓ Yes

An Energy/Building Management System (EMS/BMS) tells you what happened.
It cannot prevent, correct, or restore your electrical system's power quality or energy efficiency.

Grain preparation and mashing create repeated motor events

18-22 HP

POWER QUALITY EXPOSURE	Motor starts, VFD Harmonics, voltage drop and phase imbalance can disturb controls.
PMCS RESPONSE	Improve PF and current quality; stabilize the bus during starts; reduce avoidable RMS current.
ENERGY EFFICIENCY VALUE	Lower distribution losses & verify kWh per batch at comparable recipes and throughput.

Result: repeatable conversion without wasting electrical capacity.

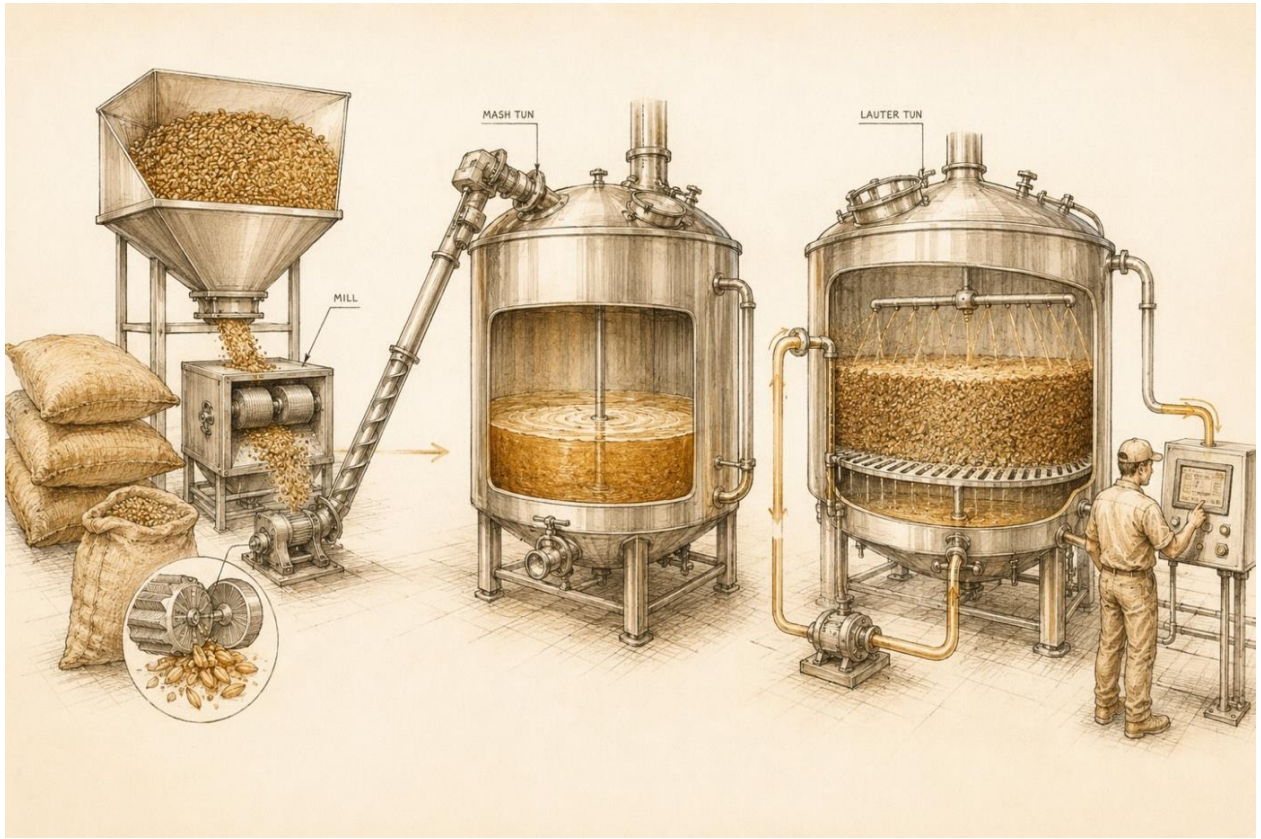


FIGURE 1 • GRAIN / MASH / LAUTER

Boiling is thermal; cooling becomes the dominant electrical duty

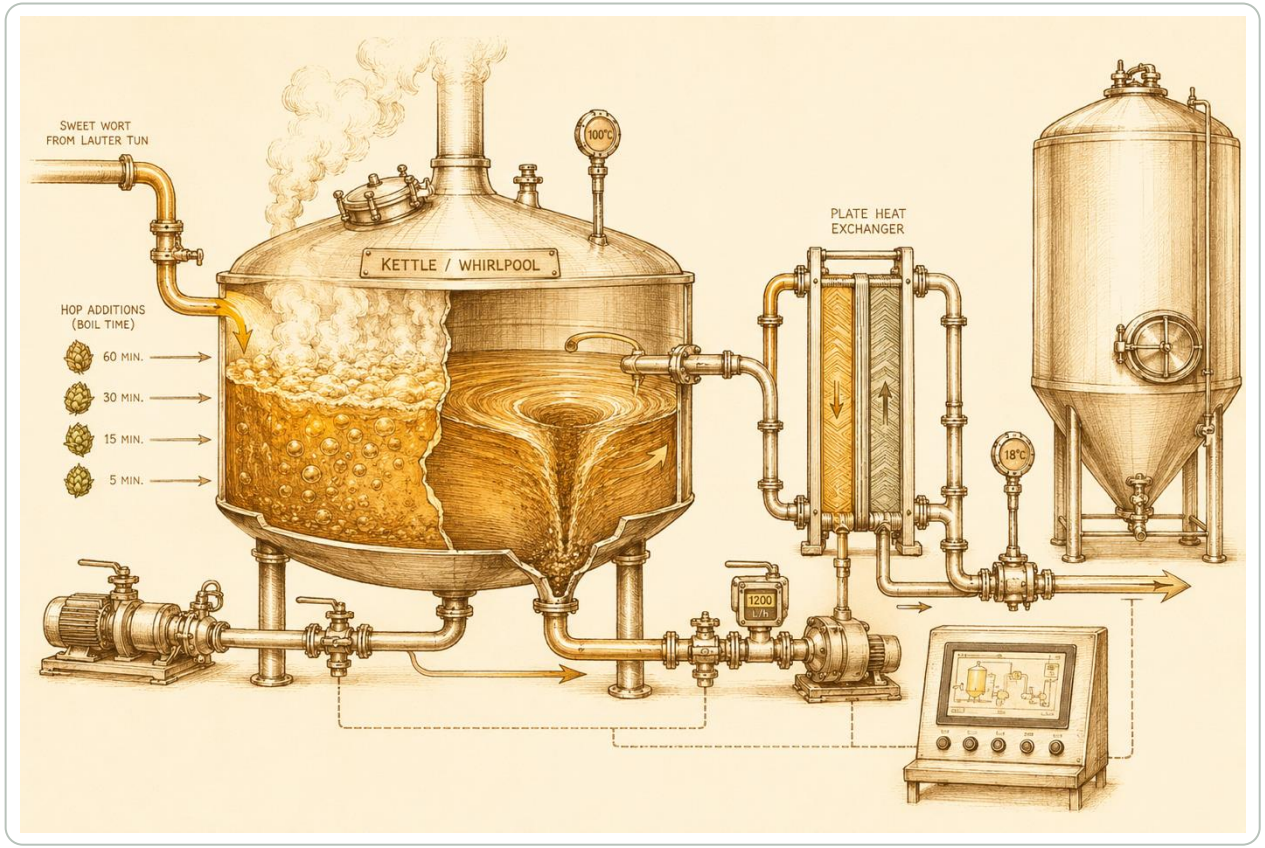


FIGURE 2 • KETTLE / WHIRLPOOL / COOLING

25-30 HP

EXPOSURE	Compressor starts, cycling kVA, reactive demand, voltage dip and simultaneous crash cooling.
MPTS ACTION	Dynamic reactive support, improved voltage stability and lower avoidable current.
PROOF	Compare kW, kVA, kVAR, PF, start current, minimum voltage and fault history.

Protect the cold side: refrigeration continuity safeguards fermentation, product and schedule.

Centrifuge loads concentrate harmonics and starting demand

15-20 HP

ELECTRICAL EXPOSURE	High-speed VFD load, harmonic spectrum, acceleration current and voltage sensitivity.
PMCS RESPONSE	Reduce harmful harmonic distortion at the treated bus and support voltage during acceleration.
VERFICATION	Measure THDi, THDv, individual harmonics, PF, kVA and drive faults at equal speed and load.

Cleaner power supports operations, and fewer process interruptions.

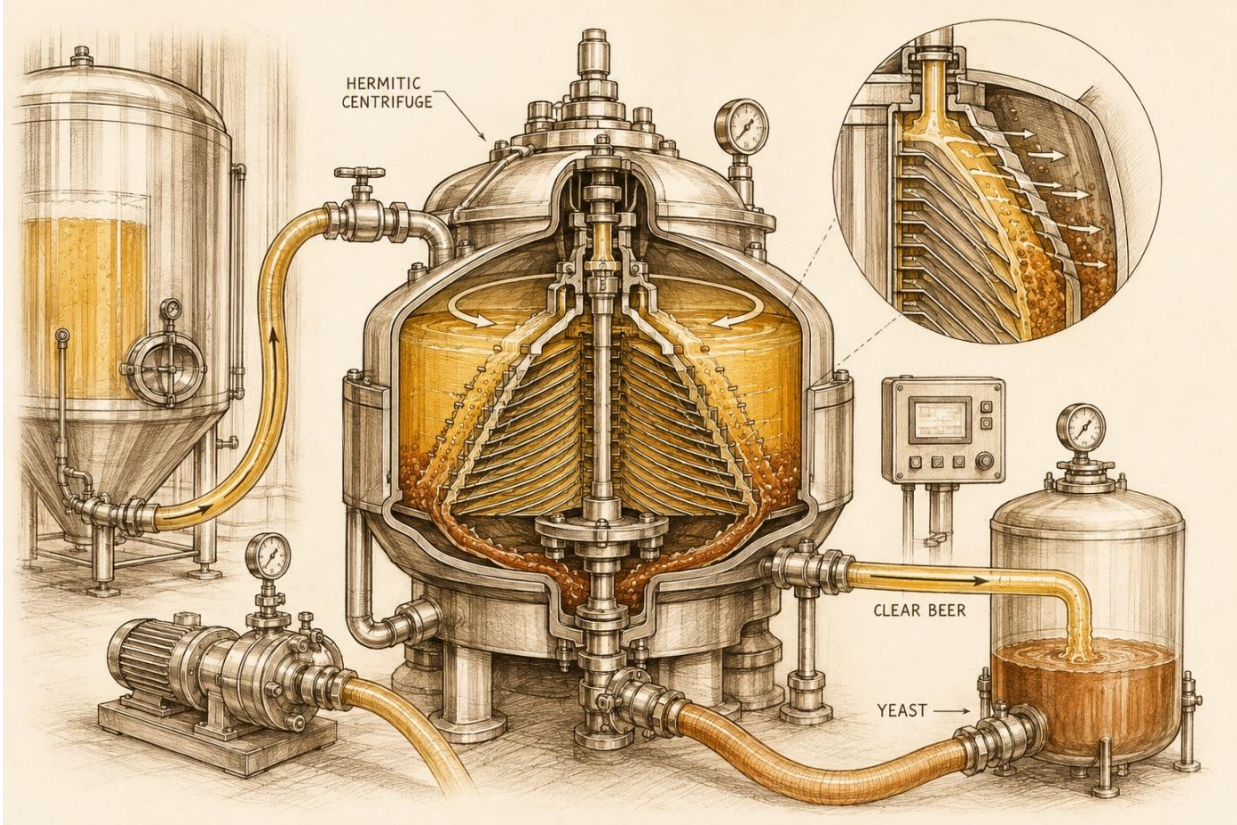
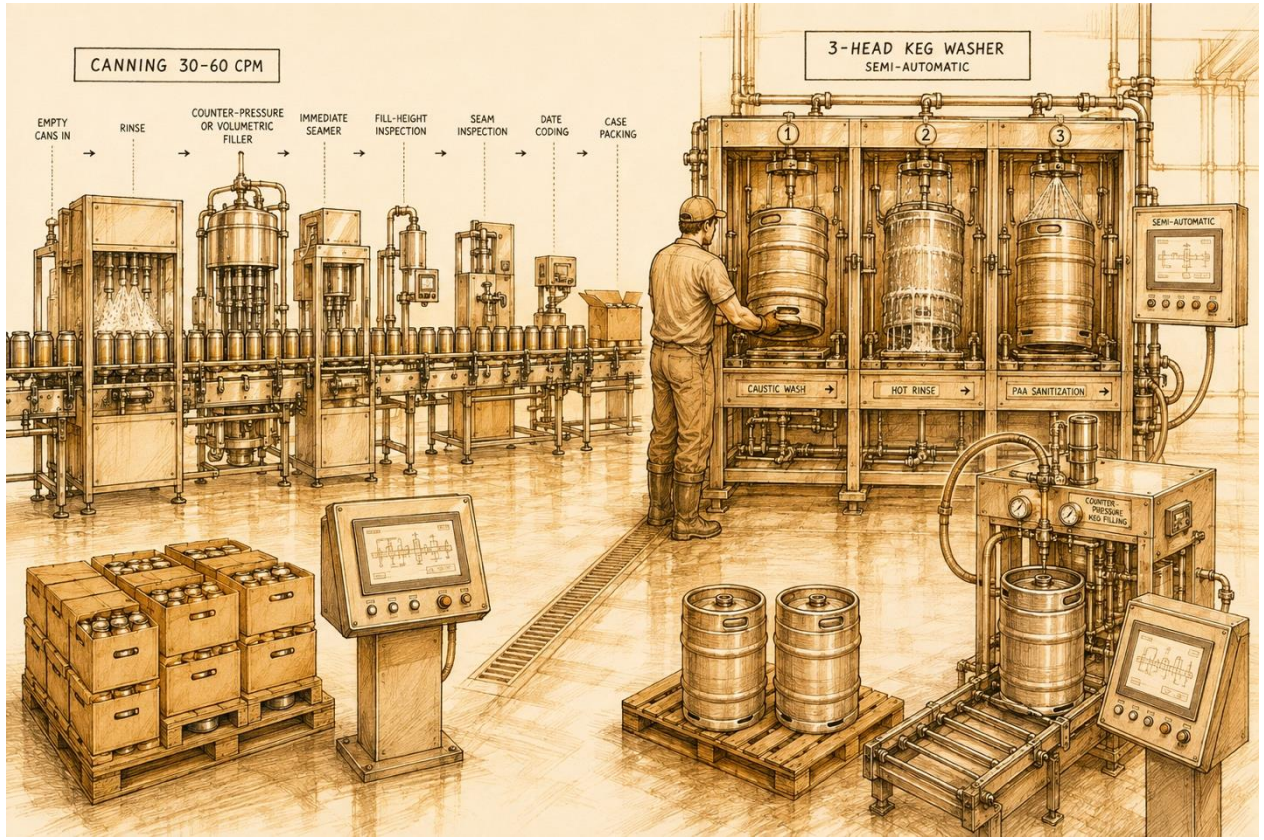


FIGURE 3 HERMETIC DISK-STACK CENTRIFUGE

Packaging combines nonlinear loads, pumps and compressed air

30-60 CPM



12-16 HP

POWER-QUALITY RISK	Mixed-voltage electronics, VFDs, rapid transitions and compressor overlap.
PMCS RESPONSE	Improve current quality, PF, bus stability across the packaging operating state.
ENERGY TEST	Normalize kWh by packaging hour, cans filled and keg-washer cycles.

Business effect

Fewer stops, rejects, resets, peak-demand surprises.

FIGURE 4 • CANNING / KEG WASHING

Cold storage converts power reliability into product protection

8-12 HP

Continuous duty: Compressors and evaporator fans operate long after the brew day ends.

PEAK EXPOSURE	Coincident starts, defrost, HVAC and packaging can raise kVA and depress voltage.
PMCS RESPONSE	Improve PF, voltage stability and current quality while reducing avoidable distribution losses.
OPERATIONAL VALUE	Protect finished inventory, shipping schedules and future refrigeration expansion.

Measure daily kWh, starts/hour, peak kVA, cabinet temperature and alarms.



FIGURE 5 • COLD STORAGE / DISTRIBUTION

Ventilation and CO_2 safety remain independently protected

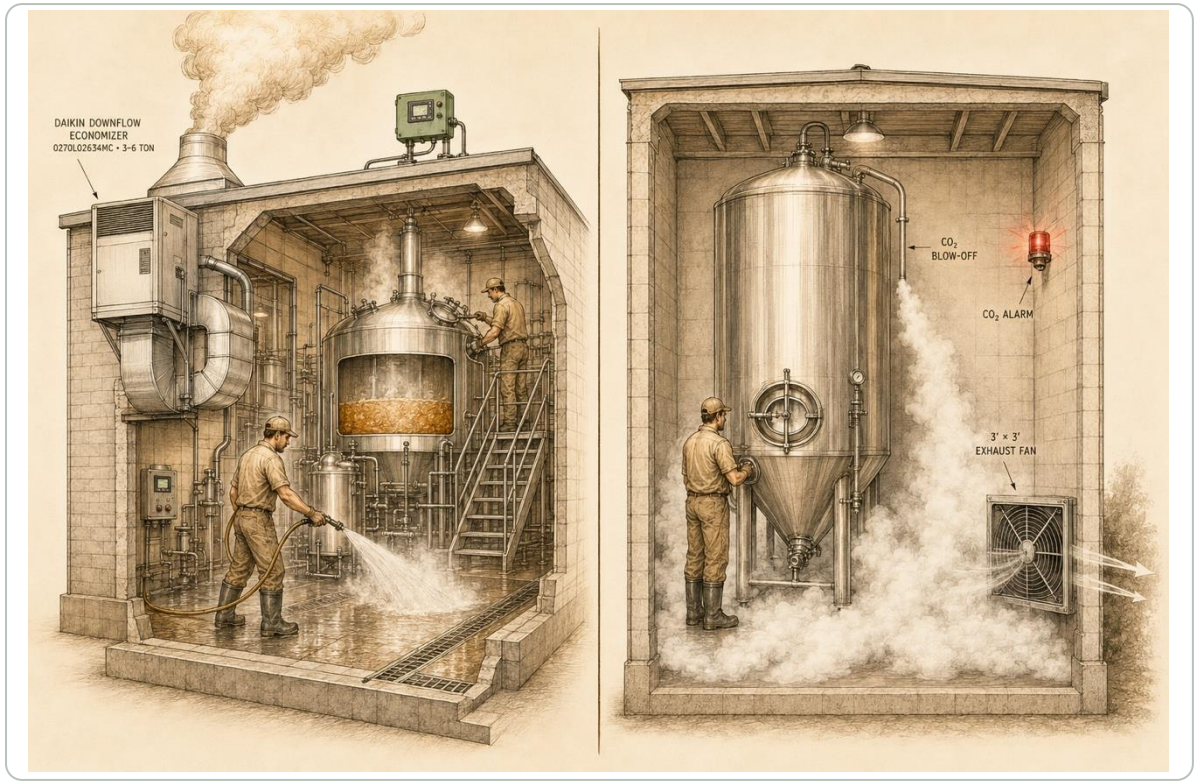


FIGURE 6 • ECONOMIZER / CO_2 EXHAUST

0.5-1.0 HP

ELECTRICAL LOAD	HVAC compressors, economizer dampers, exhaust fans, controls and alarms.
PMCS ROLE	Reduce peak interaction with refrigeration and improve power serving controls.
BOUNDARY	PMCS does not replace CO_2 detection, emergency exhaust or code compliance.

Vital distinction
Power quality strengthens operation; life-safety systems remain independently engineered and protected.

Summary: One PMCS coordinates problems across the brewery

The integrated PMCS systems work in unison; whereas standalones adversely affect each other

BREWHOUSE UNIT	ELECTRICAL PROBLEM	PMCS RESPONSE
Mill, augers, pumps	Starts • reactive current • imbalance	PF support • voltage stability • current quality
Glycol + cold rooms	Cycling kVA • voltage dip • long runtime	Dynamic support • lower avoidable RMS current
Centrifuge	VFD harmonics • acceleration demand	Harmonic response • stabilized bus
Canning + keg wash	Mixed nonlinear loads • heater/pump duty	PF + THD + voltage managed together
Compressed air	Motor demand • load/unload cycling	Reduce electrical losses; expose mechanical waste
HVAC + exhaust	Coincidence with process refrigeration	Control peak interaction and power quality
PLCs, HMIs, controls	Dips • distortion • nuisance resets	Cleaner, more stable supply environment

Integrated management reduces device sprawl and produces one verified facility-level result.

OPEX reduction, CAPEX avoidance & ROI framework

OPEX OPPORTUNITIES

- Reduce billed kVA demand where tariff includes demand or PF penalty
- Lower verified distribution losses and avoidable reactive energy
- Reduce downtime from nuisance trips, PLC resets, drive faults
- Reduce heat stress on transformers, motors, conductors, switchgear
- Protect refrigerated product and production schedules
- Normalize savings as kWh/barrel brewed or kWh/barrel packaged

CAPEX AVOIDANCE

- Release transformer, switchboard, and feeder capacity by reducing kVA
- Defer service upgrades for tank additions or packaging expansion
- Avoid oversizing PMCS; Reinigen pilot defines the actual need
- Prevent unnecessary VFD harmonic filters where facility correction suffices
- Document evidence before a commit to transformer or service upgrades

ROI MEASUREMENT

- Before/after 15-min interval data: kW, kVA, kVAR, PF, THDi, THDv
- Align with production records: barrels brewed, packaged, canning hours
- Normalize for weather, occupancy, and production volume changes
- Document drive fault reduction, trip frequency, maintenance cost
- Sign a performance guarantee report: specific, auditable improvement data
- Utility bill comparison after 3–6 billing cycles post-installation

Commercial case leads with four outcomes: reduced apparent/reactive demand | improved power quality | verified energy-loss reduction | avoided or deferred capacity expenditure (OPEX avoidance/CAPEX reduction)

True Power Factor = Displacement PF x Distortion PF

Lagging displacement PF from motor loads: Mash tuns, lauter pumps, wort chillers, and refrigeration compressors are all inductive. PMCS's capacitive reactive compensation shifts the current waveform back toward unity, raising displacement PF directly.

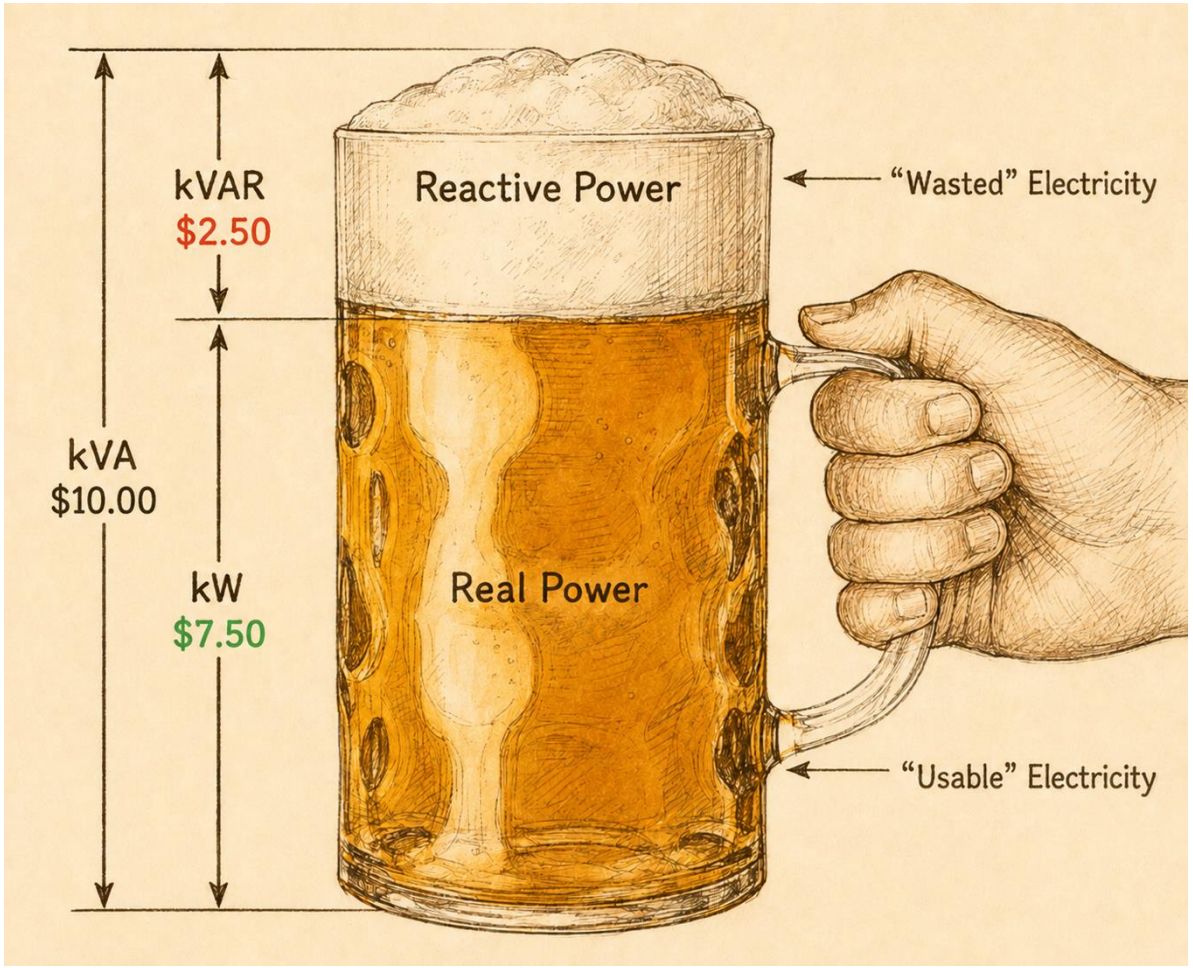
Harmonic distortion from VFDs: Variable frequency drives on pumps and conveyors generate 5th, 7th, and 11th harmonics, collapsing distortion PF. PMCS's active filtering suppresses these harmonics, restoring the sinusoidal waveform.

TPF is the product, so both factors must be corrected: Fixing displacement PF alone while ignoring THD still leaves TPF depressed. PMCS addresses both multiplicands simultaneously, which no single EMS/BMS can do.

Cold storage compressor cycling: Rapid load swings cause both reactive spikes (displacement PF) and transient harmonic injections (distortion PF). The PMCS reads, responds, and restores within milliseconds rather than just logging the event.

Canning/kegging line rectifiers: DC drives and rectified power supplies are classic distortion PF killers. PMCS's harmonic mitigation keeps distortion PF high while the line is running.

CO_2 recovery and HVAC compressors: These run near-continuously and are large inductive loads. PMCS holds displacement PF correction steady across load cycles rather than drifting as EMS systems do.



Displacement PF x Distortion PF = True PF

Neutral conductor overloading from 3rd harmonics: Triple harmonics (3rd, 9th) sum in the neutral, worsening distortion PF system-wide. PMCS eliminates this, protecting the neutral and the distortion PF factor across all three phases.

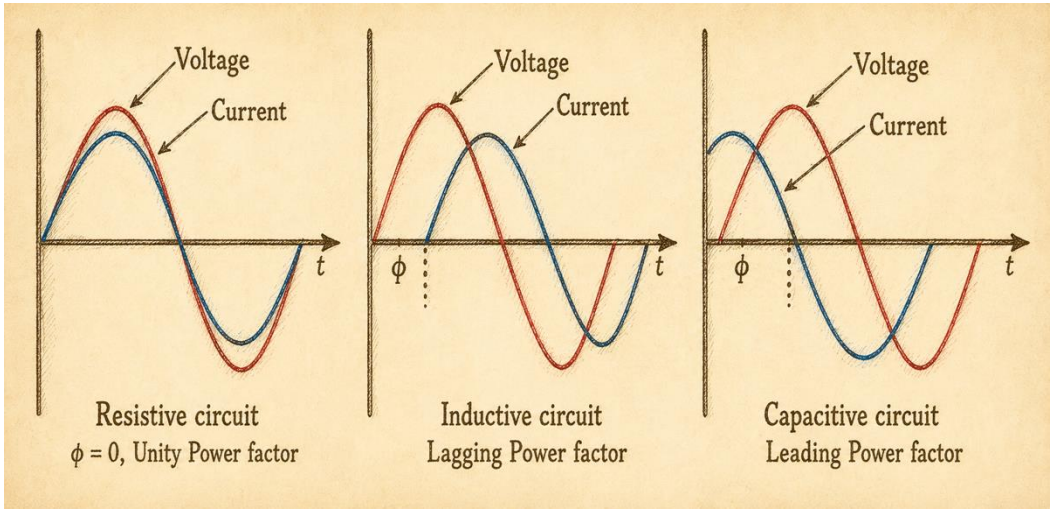
Utility penalty elimination: Utilities penalize on true PF below 0.90–0.95, which requires both displacement and distortion correction. PMCS bring TPF to 0.95–0.99, removing demand charges that target the combined shortfall.

Real-time restore, not just reporting: The PMCS "read → report → restore → report" loop means when a displacement or distortion event degrades TPF mid-brew, correction is applied before the utility meter records a penalty, not after.

Distributed correction at each load: A PMCS unit deployed for equipment (boiler, centrifuge, cold room) corrects displacement and distortion PF at the source, preventing harmonic propagation back onto the shared bus where it would degrade other loads' distortion PF.

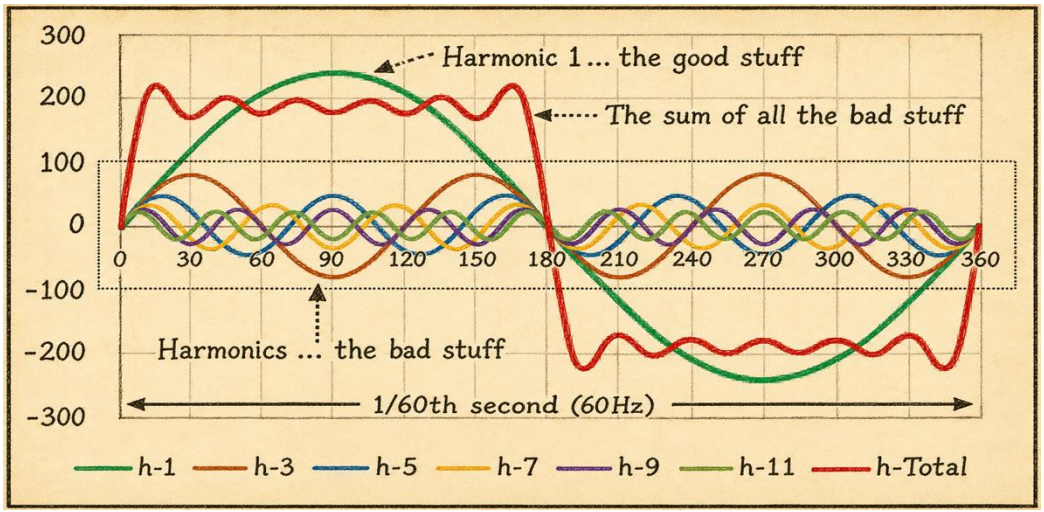
Power factor × distortion factor = kWh billed correctly: True PF determines how much apparent power (kVA) the utility bills versus real power (kW) you use. At TPF = 0.75, you're paying for 33% more apparent power than you consume. PMCS closes that gap at both the displacement and harmonic level.

Continuous adaptive correction across a full brew cycle: Displacement PF and THD shift from mashing through fermentation to cold storage as loads change. The PMCS monitors and adjusts both PF components continuously, keeping TPF optimized across the entire production cycle rather than only at the snapshot moment an EMS takes its reading.



No capacitor banks

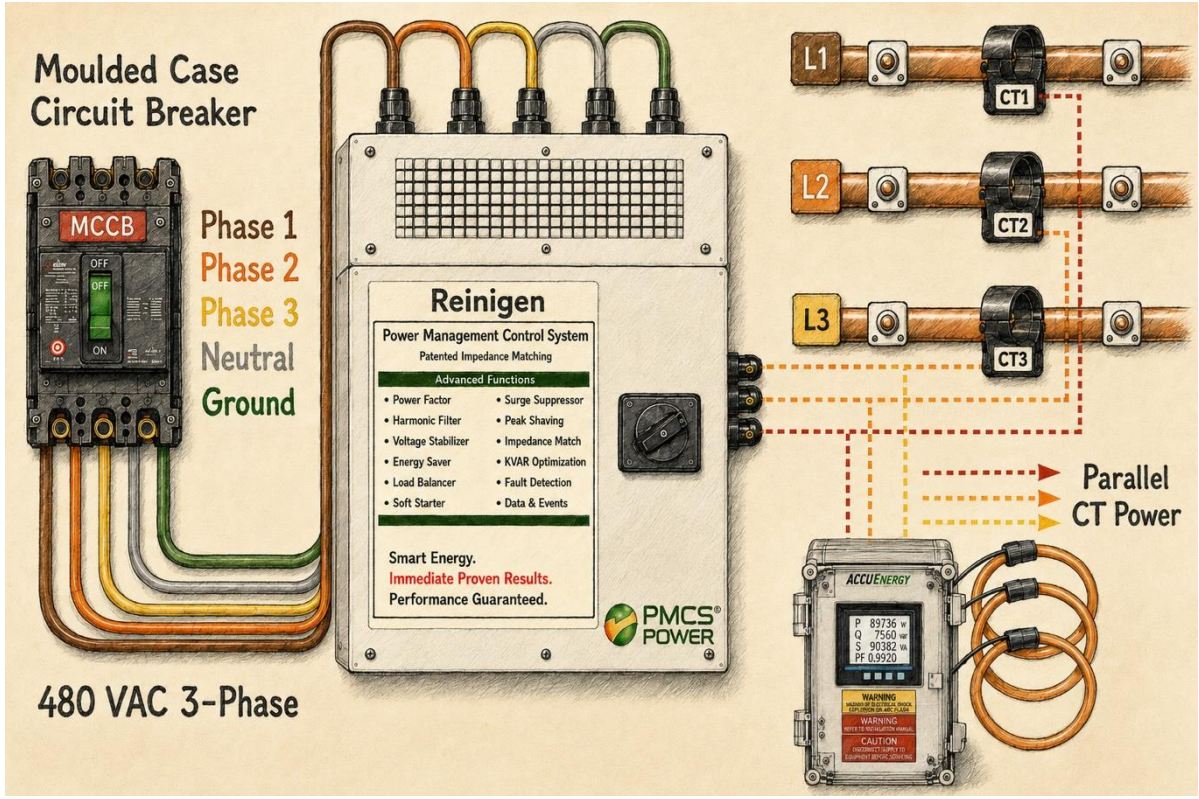
No harmonic filters



Validate with a Reinigen. Scale with an MPTS. Verify the result.

Performance guaranteed savings and ROI follow the verified operating data.

1. **BASELINE**
   Bills • single-line • nameplates • 3-phase interval data
2. **REINIGEN PILOT**
   Matched brew, packaging, cooling and sanitation cycles
3. **VERIFY**
   kW • kWh • kVA • kVAR • PF • THDv • THDi • Events
4. **MPTS DEPLOYMENT**
   Size and place the permanent facility-level solution
5. **PERSISTENCE**
   Monthly performance/quarterly production normalized



30 Watts Burden
ZERO Maintenance

The goal is not more monitoring ... It's restored, measurable performance.

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Abbreviations

PMCS - Power Management Control System
MPTS - Maximum Power Transfer Solution

I - Amps
V - Volts
kW - kilowatts
kW-h - kilowatt-hours
kVA - kilovolt Amps
kVA-h - kilovolt Amps- hours
kVAR - kiloVoltAmpsReactive
kVAR-h - kiloVoltAmpsReactive-hours
FLA - Full-Load Amps
LED - Light-Emitting Diode

PF - Power Factor
$PF_{Displacement}$ - Power Factor Displacement
$PF_{Distortion}$ - Power Factor Distortion
PF_{True} - True Power Factor

THD - Total Harmonic Distortion
THDi - Total Harmonic Distortion Current
THDv - Total Harmonic Distortion Voltage

EMS - Energy Management System
BMS - Business Management System

HVAC - Heating, Ventilation, Air-Conditioning
CO2 - Carbon Dioxide

LRA - Locked Rotor Amps
MCA - Metal Chelating Activity

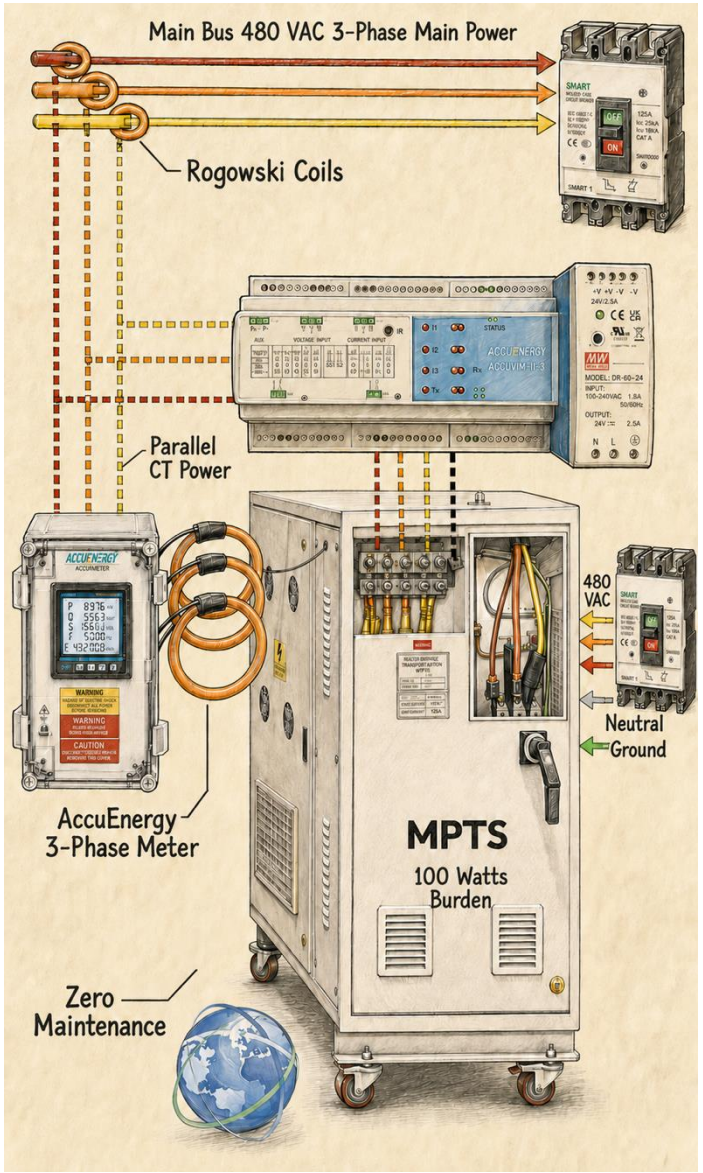
RMS - Root Mean Square
HP - Horsepower
VFD - Variable Frequency Drive
PFC - Power Factor Correction

CIP - Clean-in-Place
CPM - Cans Per Minute
HLT - Hot Liquor Tank
RO - Reverse Osmosis

ROI - Return-on-Investment
OPEX - Operation Expense
CAPEX - Capital Expense

HMI - Human-Machine Interface
PLC - Programmable Logic Controller

MOCP - Maximum Over-Current Protection
MOCP - Micro-Oxygenation Carbonization Process



100 Watts Burden
ZERO Maintenance

PMCS Pilot Process

Step 1: Value Assessment

- Select pilot location
- Electrical single-line drawings
- Most recent 12 months of utility bills (PDF)
- Most recent 12 months of utility interval data (CSV)
  - 15 min. kW / kVA / kVAR / Power Factor
- Most recent months of electromechanical cost center reports
  - maintenance, repair, operations (MRO), replacements

Step 2: High-Level Analysis (1-2 weeks)

- Project OPEX avoided and CAPEX deferred
- Determine PMCS locations and numbers
- Upgrade electrical single-line drawings
- Project Return-On-Investment (ROI)
- Provide performance guarantees
- Present analysis for review
- 1st Go / No-Go decision (post analysis)

Step 3: Go = Rent / Lease / Purchase Options

- Rent: 12 months
  - with a 1- to 30-day Go / No-Go option with a 100% full refund
- Lease: 2- 5 years,
  - with a 1- to 30-day Go / No-Go option with a 100% full refund
- Purchase: outright
  - with a 1- to 30-day Go / No-Go option with a 100% full refund
- Rent-to-Lease or Purchase options available
- Lease-to-Purchase option available

Step 4: Pilot Installation

- Client technician: trained to install meter(s)
- On-site Power/CTs connection: <4-hours
  - Install the AccuEnergy meter/integrator
  - Install the 3-phase Rogowski CTs
  - Install an internet/wireless connection

Step 4: Pilot Installation

- Pre-PMCS measurement (1-5 days)
- Post-PMCS measurement (1-5 days)
- Compare PMCS data with utility CSV data
- Prepare and present a formal pilot report
- Executive / Financial / Technical
- 2nd Go / No-Go decision post pilot (post pilot)
- If No-Go - remove technology; issue a 100% refund
- **Step 5: Post Measurement / Proof**
- Under full control of client technicians
- Run multiple circuits performance tests
- Check performance proof against guarantee
- 3rd Go / No-Go decision within 1-30 days
- If No-Go - remove technology; issue a 100% refund
- If Go - complete the contract term

3 x Go / No-Go decisions



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