



TECHNICAL WHITEPAPER

The Payment Illusion

Why Prepaid Metering and Customer Self-Read Programmes Leave Non-Technical Losses Unaddressed

THE CASE FOR INDEPENDENT, CONTINUOUS CONSUMPTION MEASUREMENT

A meter that has been paid for is not the same as a meter that has been measured. Payment and self-reported figures are both proxies for consumption, and neither one closes the gap in which non-technical loss survives.

EXECUTIVE SUMMARY

Two metering strategies are common across the markets Priimal serves: prepaid metering, which shifts payment risk onto the consumer, and customer self-read billing, which shifts data collection onto the consumer. Both are often treated, formally or informally, as evidence that a utility has addressed its revenue exposure. Neither one measures anything independently of the person paying the bill.

Prepaid metering solves a real problem. It removes credit risk and end-of-period billing disputes, and it gives consumers control over their own spending. What it does not do is verify that all of the electricity consumed at a property actually passes through the metered circuit in the first place. The token security standard that protects prepaid transactions, STS, is genuinely robust. It is also solving a different problem to the one that drives non-technical loss.

Self-read billing solves a different problem again. It removes the field cost of sending someone to read a meter. What it does not do is provide a figure that has not passed through the hands of the person with the clearest incentive to understate it, and it removes the last incidental human check a utility had on the physical condition of the meter itself.

This whitepaper goes into more detail than Priimal's earlier coverage of this topic. It sets out where each of these two approaches stops working, what specifically goes undetected as a result, and what that means for how Priimal prioritises deployment in markets where either or both are already in place.

1. PREPAID METERING: WHAT IT SOLVES AND WHAT IT LEAVES EXPOSED

1.1 What prepaid metering actually changes

Prepaid metering is a payment mechanism, not a measurement mechanism. When a utility moves a customer from post-paid to prepaid billing, four things typically improve. Credit risk transfers to the consumer, since supply is withdrawn once credit is exhausted rather than accumulating as a receivable. End-of-period billing disputes fall away, because there is no reconciliation between an estimate and an actual reading. Collection efficiency improves, since payment happens before consumption rather than after it. And consumers gain a degree of budget control that post-paid billing does not offer.

These are genuine, well-documented benefits, and they explain why prepaid metering has been adopted so widely across Priimal's target markets. None of them, however, touch the physical question of whether the electricity a household draws from the grid is passing through the meter at all.

1.2 The token security standard is not the weak point

It is worth being precise about where prepaid metering's strength actually lies, because the honest answer matters more to a utility executive than a vague warning. The Standard Transfer Specification, published as IEC 62055, governs how prepayment tokens are generated, encoded, and validated. It was purpose-built to prevent exactly the failure modes people tend to assume are the risk. Tokens cannot practically be reverse-engineered from repeated entry attempts, a stolen vending station cannot generate valid tokens for meters outside its own authorised range, and a token that has already been redeemed cannot be redeemed a second time. Three decades of deployment across dozens of countries have not meaningfully compromised this layer.

That is precisely why the exposure that matters sits somewhere else entirely.

1.3 Where the exposure actually sits

- **Illegal connections upstream of the meter:** a connection made between the service drop and the meter enclosure draws power that never reaches the metering circuit at all. No token, however secure, can account for consumption the meter is never asked to register.
- **Physical tampering with the meter or its enclosure:** interference with the metering mechanism, whether through the enclosure, the current path, or the connection terminals, can cause a meter to under-register consumption while continuing to accept and validate tokens normally. The payment layer and the measurement layer operate independently of each other, so a compromised measurement layer produces no signal at the payment layer.
- **Vendor and agent-side leakage:** in markets where token sales run through a network of local agents, the exposure is sometimes commercial rather than technical. Informal credit extensions, account manipulation at the point of sale, and collusion between an agent and a customer all sit entirely outside the token validation process.
- **The retrospective recovery gap:** when a bypassed or tampered meter is eventually identified and corrected, the utility is left trying to establish how much unbilled consumption occurred during the intervening period. Because there was never an independent record of actual consumption during that window, only the resumed reading afterward, that recovery is usually an estimate rather than a defensible figure, and it is rarely pursued with confidence.

1.4 Why payment consistency is not proof of complete measurement

A household that tops up its prepaid meter reliably, month after month, looks like a well-behaved account in every utility system that measures behaviour by payment history. That behaviour is real,

but it only describes what happened to the portion of consumption that reached the metering circuit. It says nothing about whether that circuit was carrying all of the household's actual draw. Consistent payment is consistent evidence of one thing, that whatever the meter registered got paid for. It is not evidence that the meter registered everything.

2. SELF-READ PROGRAMMES: A DIFFERENT MECHANISM, THE SAME BLIND SPOT

2.1 Why utilities adopt self-read billing

Self-read programmes ask the customer to submit their own meter reading, typically through an app, SMS, an online portal, or a paper card, in place of a scheduled visit by a meter reader. The appeal to a utility is straightforward. It removes the cost of a field workforce, avoids repeated failed visits to properties with restricted access, and gives customers a convenient alternative to waiting in for a reader. In markets with dispersed rural connections or difficult access conditions, self-read is often adopted specifically because it is cheaper than the alternative, not because it is more accurate.

2.2 A structural conflict of interest, not just a data quality issue

Prepaid metering's exposure is a coverage problem: something happens physically that the meter, and therefore the payment system, never sees. Self-read introduces a different and in some ways more direct problem. The person submitting the reading is the same person who benefits financially from understating it. This is not a data entry error to be corrected with clearer forms or better instructions. It is an incentive built into the design of the collection method itself.

2.3 What self-read cannot detect or prevent

- **No independent verification:** unless a utility schedules and actually carries out a periodic audit read, a self-submitted figure is accepted as it stands. There is no second data source to compare it against.
- **No tamper signal of any kind:** a modern metering device generates event data, cover-open flags, current imbalance alerts, and consumption anomalies, that gives a utility something to act on. Self-read generates none of this. A meter that has been bypassed produces no anomaly in a self-read system, because the customer is reporting a plausible number rather than a device reporting an actual one.
- **Estimation defaults that compound the gap:** when a customer does not submit a reading for a billing cycle, most systems fall back on a historical average or a flat estimate. This tends to systematically understate genuine consumption growth, such as a new appliance, an added occupant, or a home-based business, and it makes a developing bypass indistinguishable from an ordinary estimate. A suspiciously low self-read and a suspiciously low system-generated estimate look identical in the billing record.
- **Reconciliation cost when an audit eventually happens:** when a utility does carry out a physical audit read and finds it materially inconsistent with months of self-reported figures, the result is a retrospective billing dispute covering an extended period, usually contested by the customer, and resolved through individual case-by-case reconciliation rather than systematic monitoring. This consumes exactly the kind of skilled revenue protection time that should be directed at network-wide loss patterns instead.

2.4 The counterintuitive cost of removing the meter reader

It is easy to think of a meter reader visit as pure operational cost with no revenue protection value attached. In practice, even a meter reader whose only formal task is to record a number provides an incidental benefit. A person occasionally looks at the meter, its enclosure, and its immediate surroundings. That look is not systematic tamper detection, but it is a physical presence that a self-read programme removes entirely. A change intended purely to reduce field cost can therefore also remove the last non-technology check a utility had on the physical state of its metering infrastructure.

2.5 On reported accuracy

Industry commentary on manual and customer-submitted meter reading commonly cites error rates in the range of five to ten percent of readings, drawn from billing software and utility operations sources rather than a single authoritative study. Priimal treats this as directional rather than definitive, and it is worth separating from the tampering question entirely. Even an honestly submitted self-read is still an estimate of a number a person read off a display, not an independently verified figure. Accuracy and honesty are two different problems, and self-read billing leaves both unresolved.

3. TWO MECHANISMS, ONE COMMON FAILURE

Prepaid metering and self-read billing look like unrelated strategies. One is a payment method, the other is a data collection method. But they fail in the same structural way. Both leave the utility's data trail dependent on a point that a bypass, a tamper event, or a simple misreport can silently corrupt, with no independent mechanism to flag that this has happened. A utility relying on either approach typically only discovers the problem when an aggregate loss figure moves, or when a rare physical audit happens to catch it.

Table 1: Verification capability by metering and billing approach

Dimension	Prepaid Metering	Self-Read Billing	Full Retrofit AMI Coverage
Verifies payment against a declared reading	Yes	No, nothing to verify against	Not applicable, payment-independent
Detects physical bypass or tampering	No	No	Yes, tamper and anomaly alerts
Detects illegal upstream connection	No	No	Partial, via zone-level energy balance
Depends on customer honesty	No, post-payment	Yes, entirely	No
Provides continuous consumption data	No, transactional only	No, cyclical and often estimated	Yes, real-time interval data
Addresses credit and collection risk	Yes	No	Complementary, does not replace this

Dimension	Prepaid Metering	Self-Read Billing	Full Retrofit AMI Coverage
Relative field cost to utility	Low, vending infrastructure only	Very low	Low, retrofit with no meter replacement

4. WHAT THIS MEANS FOR DEPLOYMENT SEQUENCING

Some utilities operate prepaid metering and self-read billing together, typically in areas where both cost pressure and access constraints are highest. In visibility terms, this is the least favourable configuration a network can be in. Payment is disentangled from consumption measurement almost entirely, and the little physical presence a meter reader once provided has usually been removed as well.

This should not be read as a reason to deprioritise these markets. It should be read as the opposite. A market with heavy reliance on prepaid metering, self-read billing, or both is not a market with lower non-technical loss. It is a market where non-technical loss is currently being measured least well. The reported loss figure in these markets is more likely to be an underestimate than an accurate baseline.

Priimal's retrofit optical reader is designed to sit independently of whichever payment or billing mechanism a utility already has in place. It reads the meter's own consumption register directly, through the existing optical port, regardless of whether the customer is prepaid or post-paid, and regardless of whether billing has historically relied on self-read submissions. A utility does not need to change its payment model or its billing process to gain independent, continuous, tamper-aware visibility of consumption. The retrofit layer simply gives the utility a genuine measurement for the first time, sitting on top of whatever commercial arrangement is already serving its customers.

5. CONCLUSION

Payment collected and figures self-reported both function as proxies for consumption. Neither one is consumption, measured. A prepaid meter that accepts a token and a self-read app that accepts a submitted number are both, in the end, taking someone's word for it: the token issuer's in one case, the customer's in the other, rather than reading it directly from the point where electricity is actually consumed.

The gap this leaves is not a rounding error. It is the specific gap in which non-technical loss survives, because both approaches were designed to solve a payment or cost problem, not a measurement problem. Closing it requires a device that reads the meter's own register independently of how the customer pays or what the customer reports. That is precisely the retrofit capability Priimal deploys alongside prepaid infrastructure and self-read billing systems already in place, without requiring either to change.

About Priimal Technologies

Priimal Technologies AS is a Norwegian technology company. Its Vantage platform helps utilities, insurers and public bodies see where revenue may be lost and prioritise cases for review. Priimal works with local Market Partners, and also offers a retrofit optical reader that gives utilities independent meter readings without replacing meters.

connect@priimal.com | www.priimal.com | +47 911 98 971