Digital Initiatives in City Gas Distribution: GAIL Gas's Perspective

HC Pant
GM (CGD)
GAIL Gas

SCALE OF CITY GAS DISTRIBUTION IN INDIA

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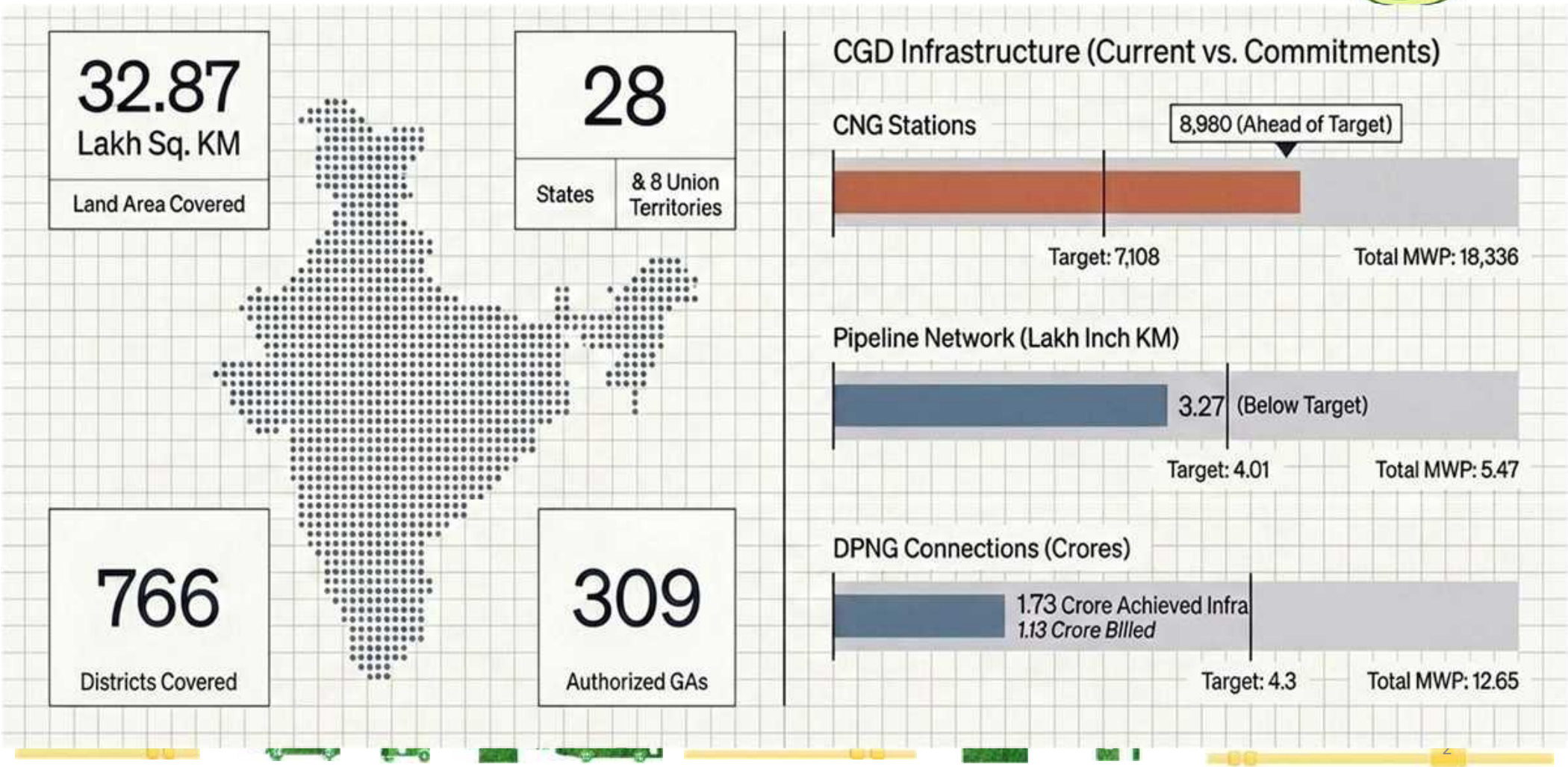

INFRASTRUCTURE SPREAD

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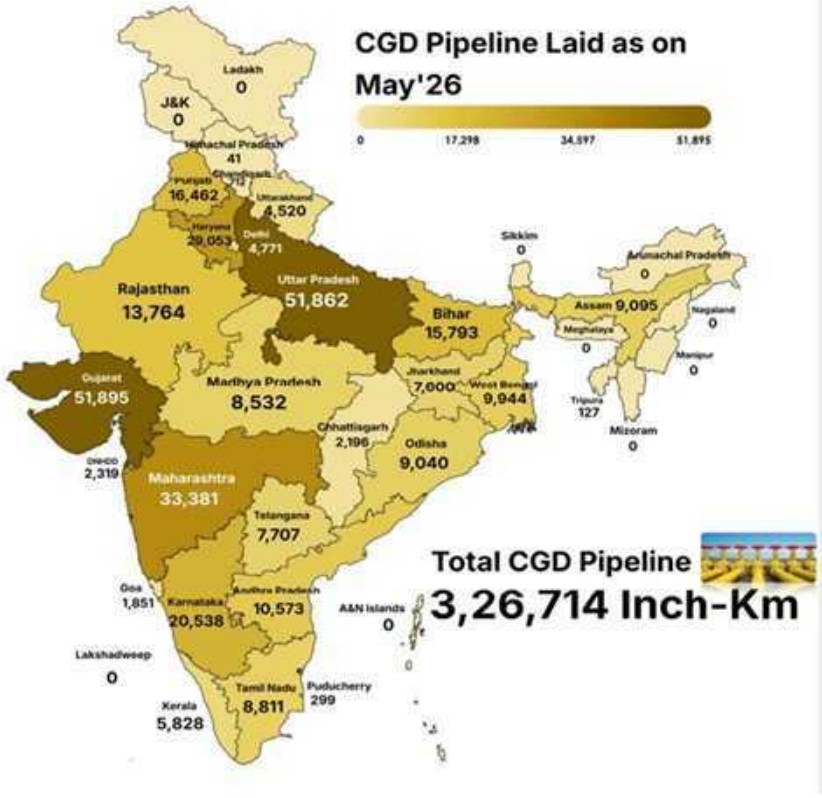

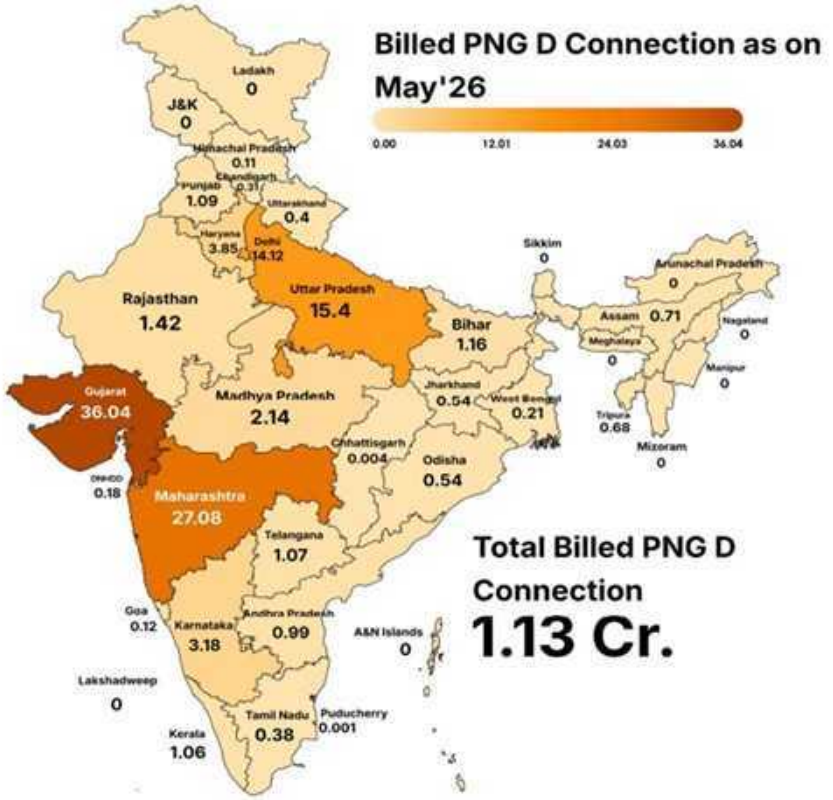

CURRENT GAS VOLUME FOR CGD CONSUMERS

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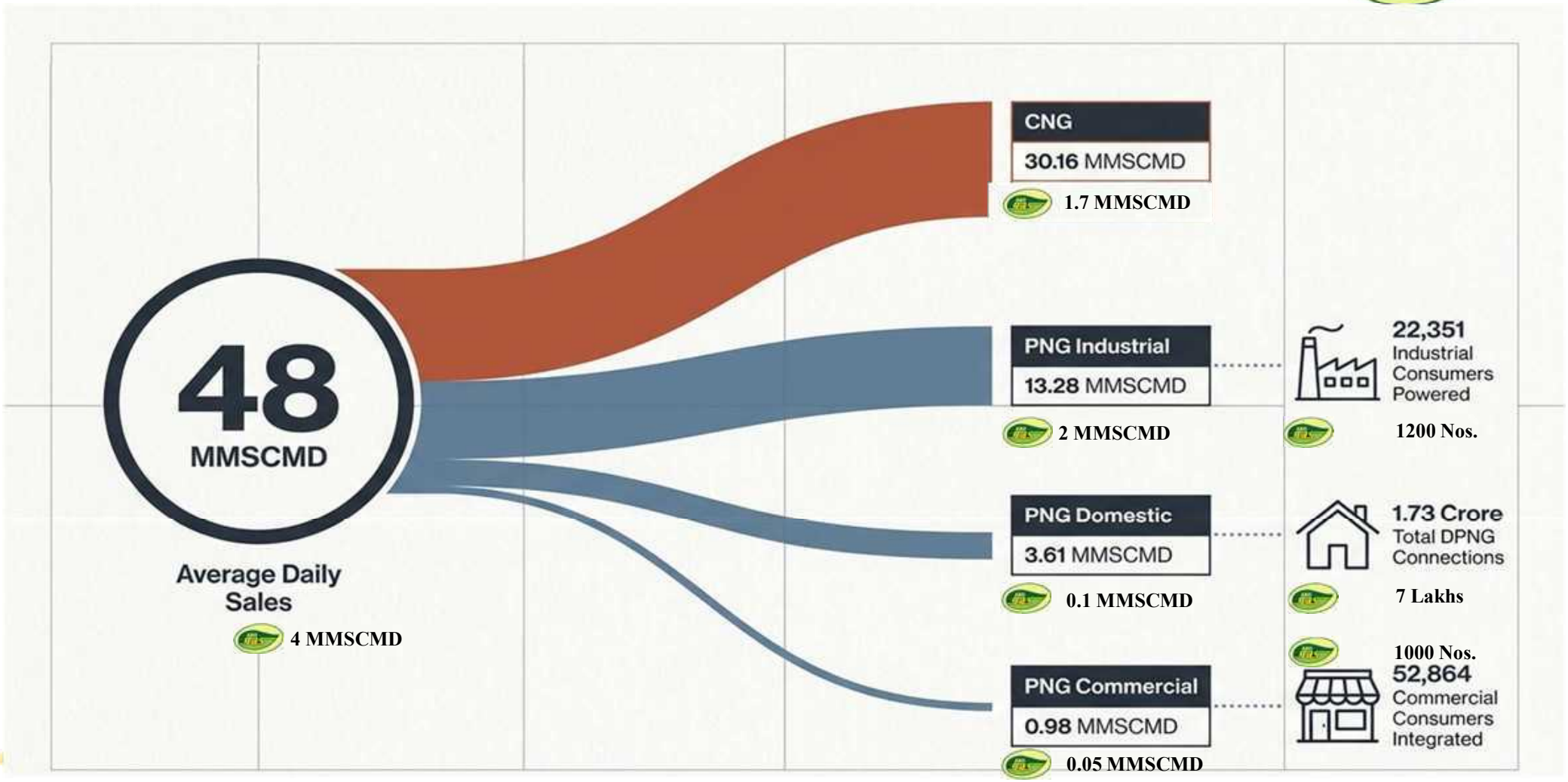

CHALLENGES WITH VAST CGD INFRASTRUCUTRE

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Operational Blind Spots

Manually checking DRS/MRS/Steel Network across distributed locations creates dangerous visibility gaps in flow and pressure control.

The Revenue Trap

Out of 1.73 Crore achieved connections, only 1.13 Crore are billed. Manual reading and estimated billing create a massive scalability ceiling.

Unaccounted Gas (UAG)

Monthly manual reconciliations of vast daily throughputs fail to detect real-time micro-leaks and volume losses.

Reactive Safety

Reliance on manpower-intensive, human reporting means delayed response times to third-party pipeline damages.

IMPACT ON MWP ACHIEVEMENT

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Area of Operation	Traditional Model	Digitally Enabled Future
Consumer Billing	Estimated bills, delayed cycles, trapped at 1.13 Cr billed	100% accurate AMR, infinitely scalable to 12.65 Cr MWP target
Network Monitoring	Periodic Manual Checks in MRS /DRS/ Steel Network, massive blind spots	Real-time telemetry across 5.47 Lakh Inch-KM
Gas Accounting	Monthly manual reconciliation, delayed UAG detection	Daily automated mass balancing of 48 MMSCMD
Safety & Emergency	Reactive dispatch reliant on human reporting	Prompt automated shut-offs and precise GIS routing

THE DIGITAL IMPERATIVE: CHALLENGES TO OPPORTUNITIES

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Vast Geography & Infrastructure

Challenge: Managing a sprawling network of City Gate Stations (CGS), Regulator Stations, and pipelines.

Requirement: Need centralized SCADA monitoring.

Outcome: One Control Center. Entire Network Under Watch.

Large Consumer Base

Challenge: Residential, Commercial, and Industrial consumers requiring accurate, automated billing and theft prevention.

Requirement: Need comprehensive Smart Metering.

Outcome: Automated reading, reduced losses, and transparent billing.

Operational Excellence

Challenge: High O&M costs, reactive maintenance, and paper-based workflows.

Requirement: Need data analytics and workflow automation.

Outcome: Predictive maintenance and optimized resource deployment. Do more with less.

Safety & Business Continuity

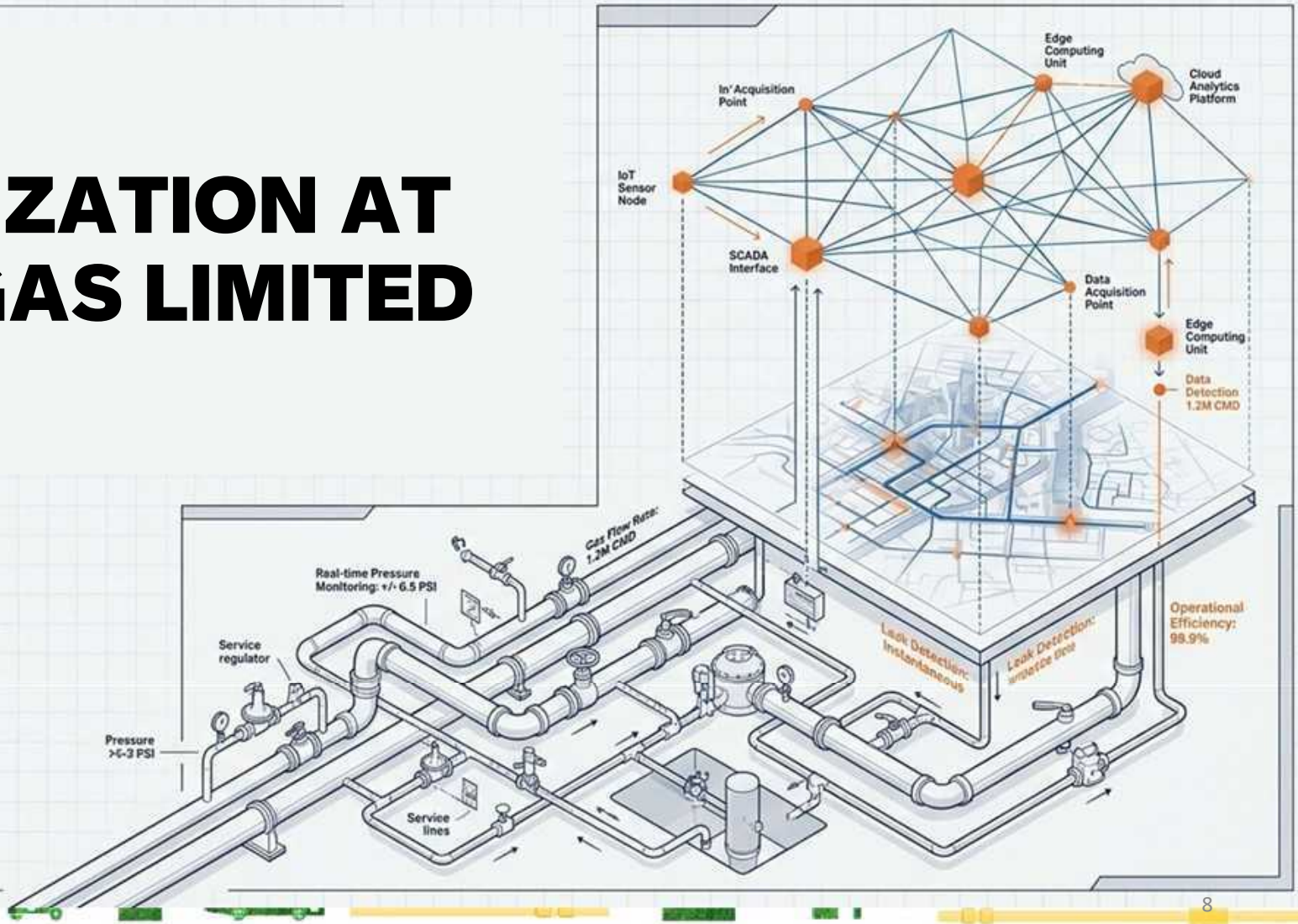
Challenge: Leak risks, asset integrity, and strict regulatory compliance.

Requirement: Need real-time visibility and early anomaly detection.

Outcome: Enhanced safety for people and assets. Quicker emergency response.

Digitization transforms vast physical networks into a smarter, safer, and sustainable energy ecosystem.

DIGITIZATION AT GAIL GAS LIMITED



GAIL GAS's SHARE IN CITY GAS LANDSCAPE

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GAIL Gas has been authorized in 16 GAs (standalone) and 25 GAs (including JVs) across **49 districts** in **13 states** ~7 lakh PNG customers (4% of Total 1.7 Cr) and ~600 CNG stations (7% of Total 9K) across the country.

1.7 Lakh Sq.KMs Area

MWP Target

- 21 Lakhs +
- 449 CNG Stations

Infrastructure

- 7 Lakhs DPNG
- 600 CNG Stations
- 1350 KM Steel Network
- 9000 KM MDPE Network

NEED FOR DIGITZATION AT GAIL GAS

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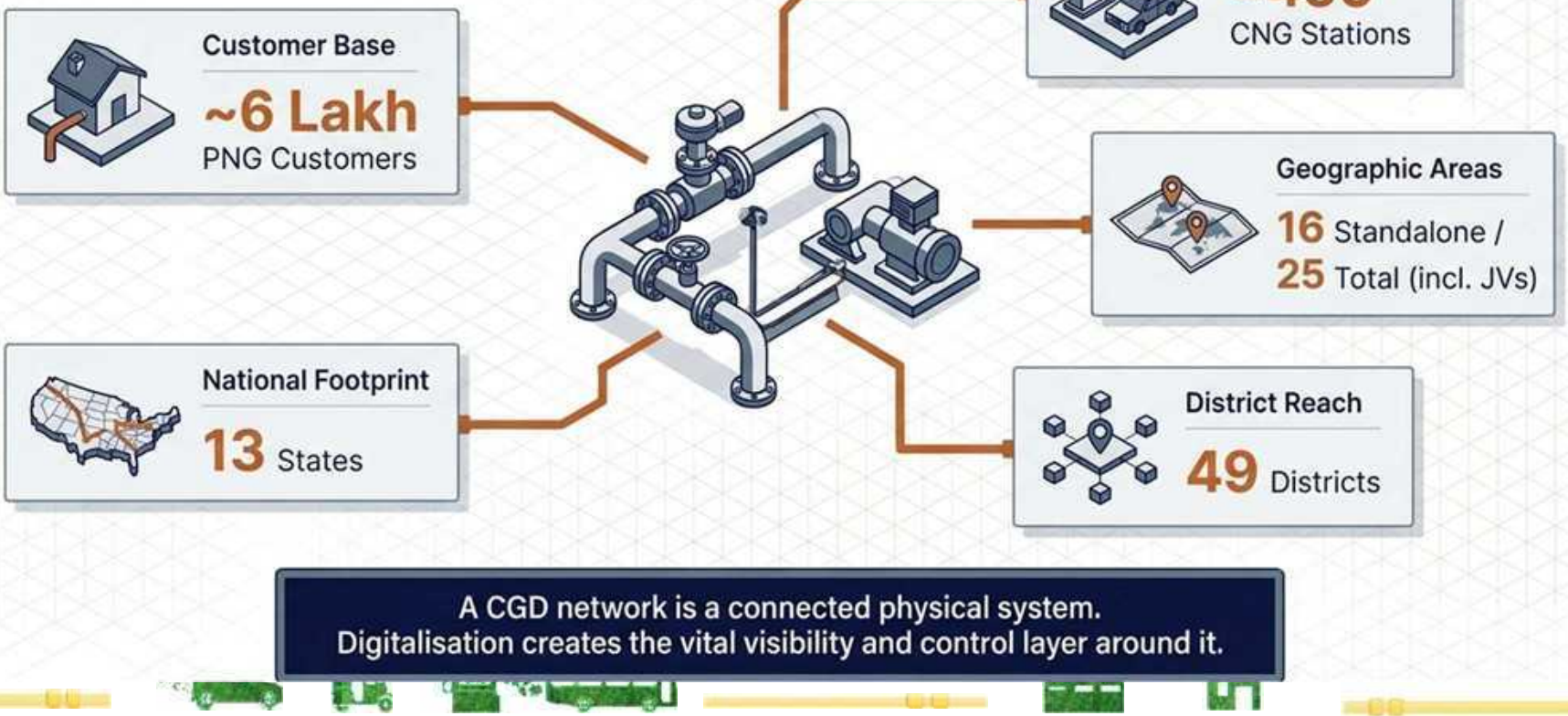
A Connected Physical System Requires a Unified Digital Brain



A CGD network is a connected physical system.
Digitalisation creates the vital visibility and control layer around it.

THE DIGITAL ROADMAP: CONNECTING ASSETS TO ACTIONS

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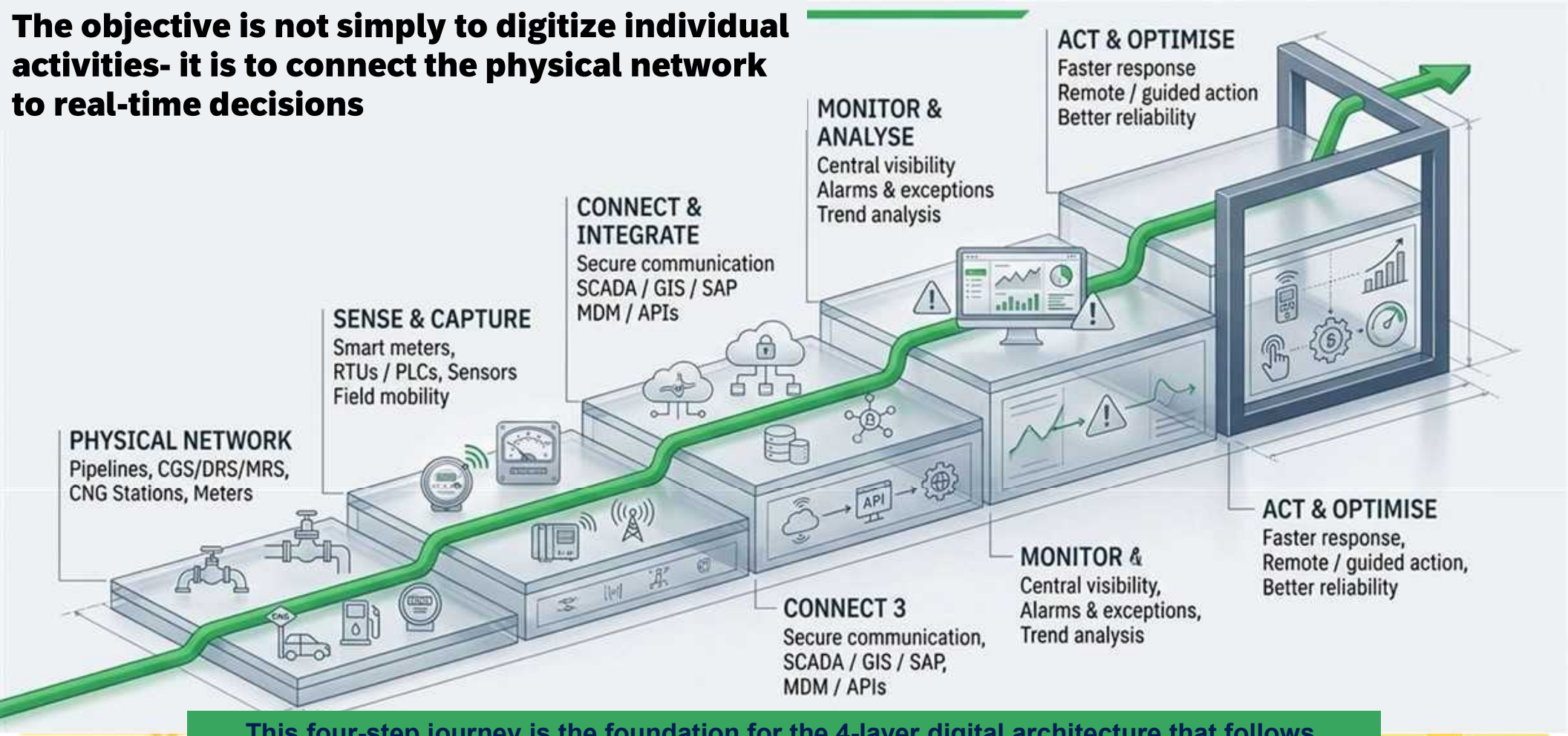
The objective is not simply to digitize individual activities- it is to connect the physical network to real-time decisions



This four-step journey is the foundation for the 4-layer digital architecture that follows.

DIGITAL ARCHITECHTURE: 4 LAYER STRUCTURE

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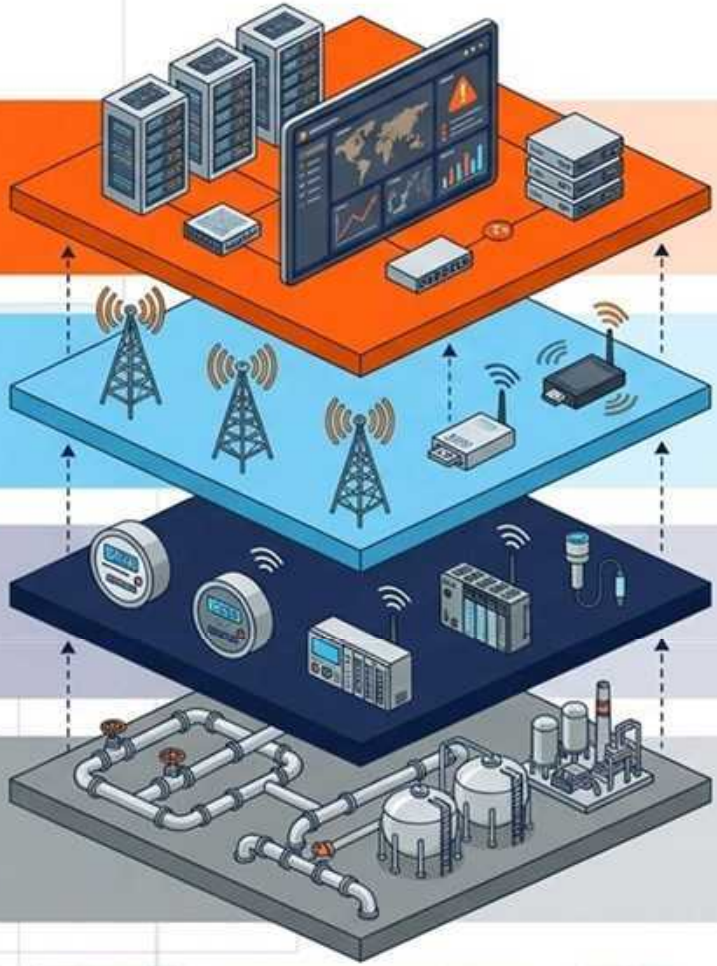

LAYER 4:
DIGITAL CORE & APPLICATIONS

SCADA, Automated Smart Billing, Emergency Control, Gas Reconciliation. Orchestrating millions of edge endpoints.

LAYER 3:
CONNECTIVITY ECOSYSTEM

LoRaWAN, Secure Cellular Networks, GPRS, Telematics.
The device-agnostic transmission pipeline.

LAYER 2:
IoT & EDGE SENSORS

Smart Meters, Remote Terminal Units (RTUs), PLCs, Cathodic Protection Sensors.
Digitizing physical states into telemetry.

LAYER 1:
PHYSICAL ASSETS

5.47 Lakh Inch-KM Pipeline, 18,336 CNG Stations, City Gate Stations.
The physical foundation of gas movement.

THE TRANSFORMATION

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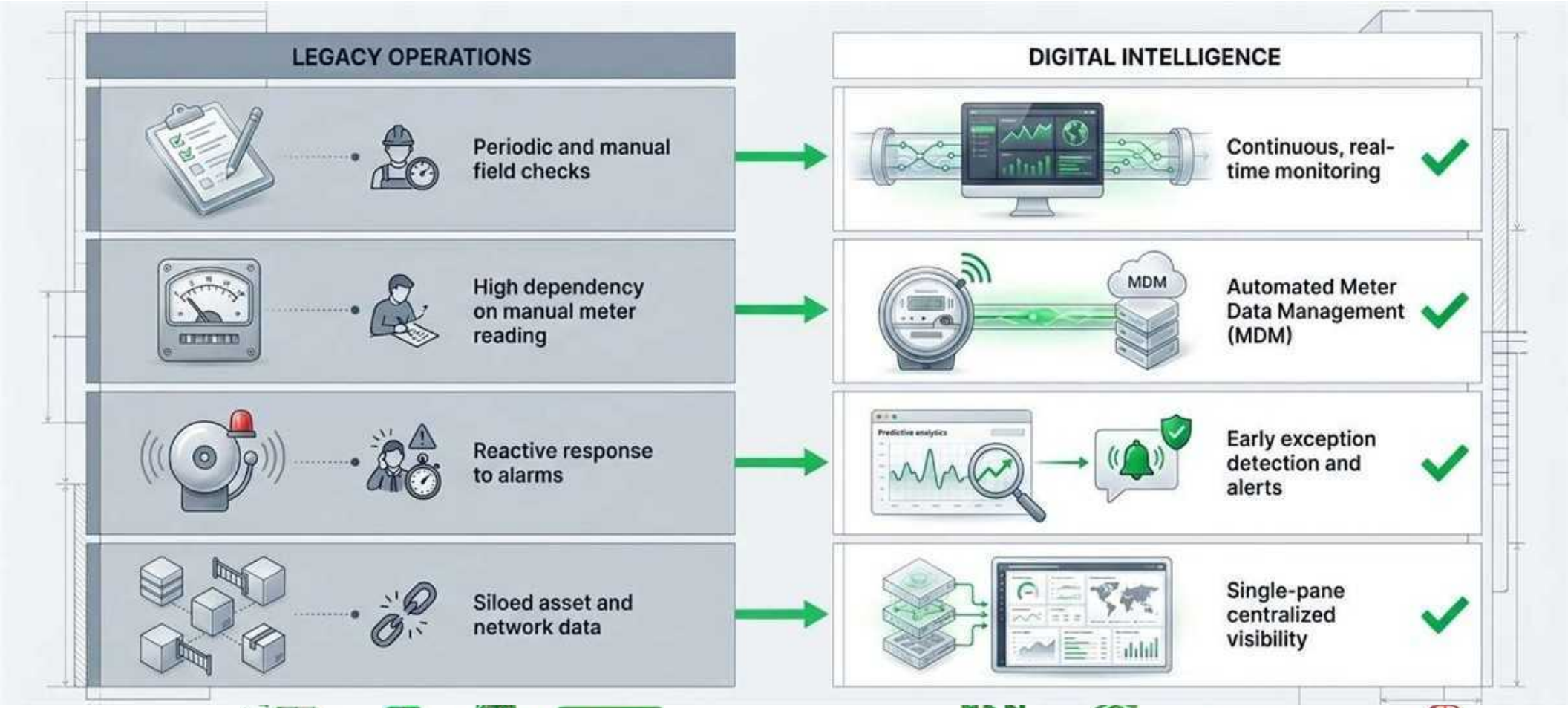

THE IMPACT

REAL-TIME MONITORING

Centralized Visibility & Insights

Continuous pressure, flow, and asset status for proactive management.

FASTER FIELD RESPONSE

Optimized Interventions

Right team and asset information dispatch for quicker problem resolution.

CUSTOMER BILLING & TRANSPARENCY

Accurate & Clear Invoicing

Automated data for precise bills and enhanced customer visibility.

GAS ACCOUNTING

Reliable Reconciliation

Traceable data flow for accurate measurement and reduced losses.

IMPROVED SAFETY

Continuous Risk Mitigation

Shift from periodic checks to continuous monitoring for hazard prevention.

CURRENT DIGITAL INITIATIVES ACROSS SEGMENTS

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3 Pillars of Digital Transformation

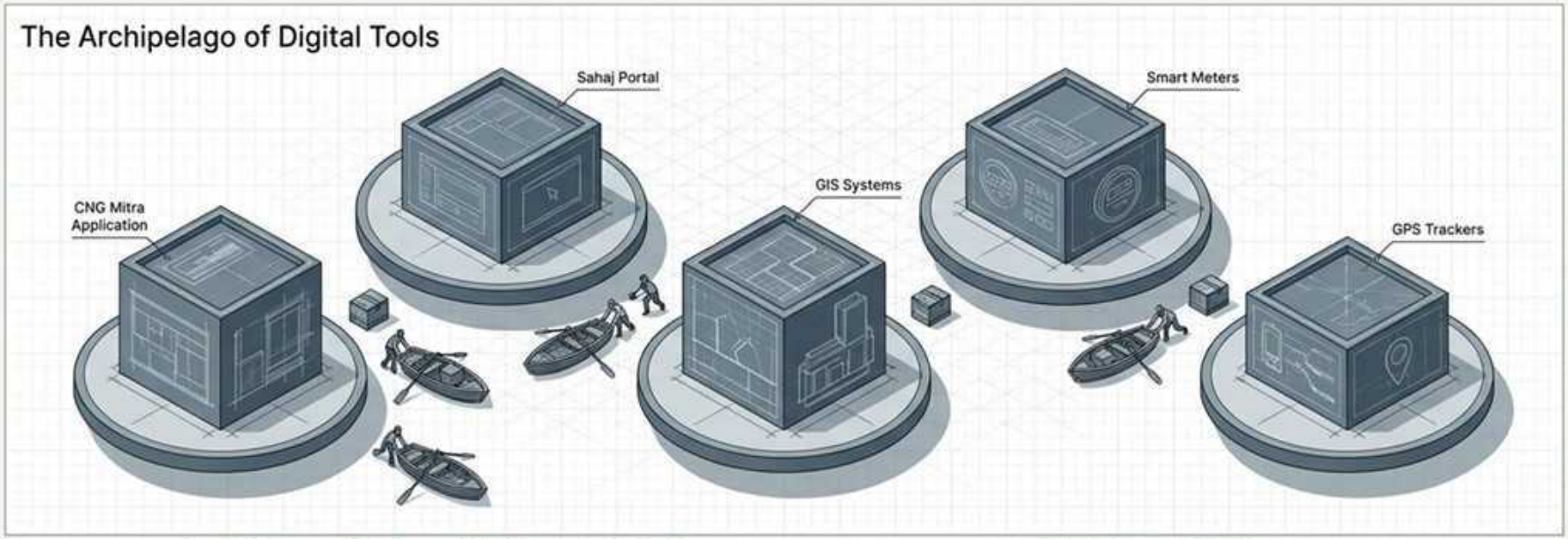
Intelligent Networks & Assets | **Agile Field Operations** | **Empowered Customers**

The current portfolio successfully covers the customer, field, asset, safety, and enterprise layers—**establishing a highly robust** foundation for the next phase.

The Illusion of Progress: We Have the Tools, But Lack the Intelligence

STATUS: HARDWARE DEPLOYED.
ANALYTICS OFFLINE.

Our initial phase of digital transformation successfully deployed cutting-edge hardware and software across the operational footprint. However, these solutions operate in strict silos.

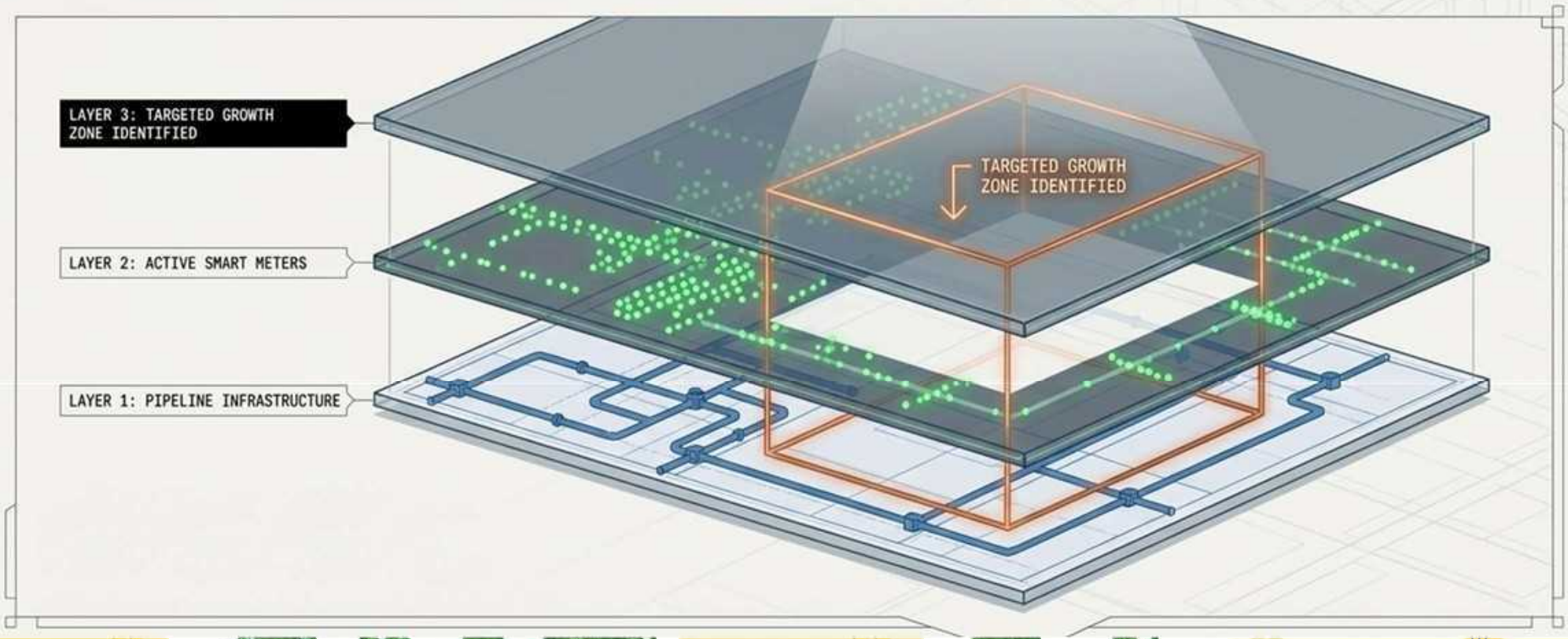


ANALYTICS AND INNOVATION GAP

Digital Asset	Current Isolated State	Missing Analytics	Unlocked Business Value
GIS Mapping	Static infrastructure visualization	Outage analysis during shutdown/breakdown	Precision outage management and rapid response.
Smart Meters	Automated billing	Analyzing granular consumption patterns	Demand forecasting and load balancing.
LCV GPS Tracking	Real-time vehicle location	Route and deployment optimization	Maximized LCV utilization and reduced fuel costs.
Patroller GPS	Route logging	Correlation with external excavation data	Narrowing down and preventing third-party damages.

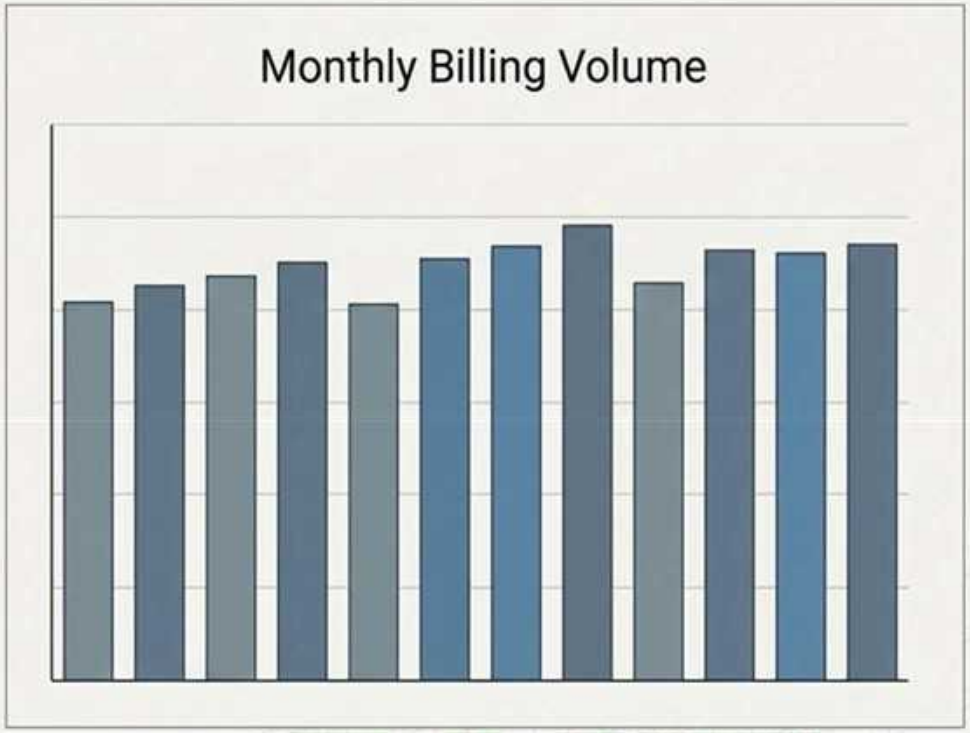
LACK OF INTEGRATION IN GIS AND CUSTOMER DATABASE

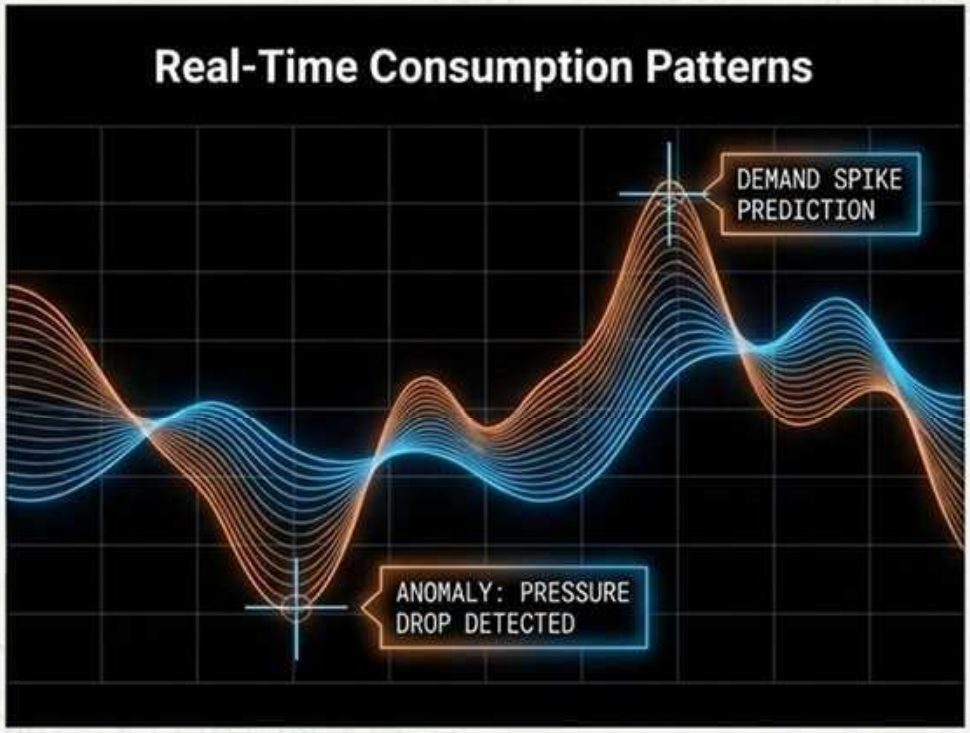
GIS mapping holds untapped potential for targeted growth. By overlaying active customer data onto our infrastructure maps, we instantly identify high-capital deployment zones that lack corresponding consumer activation—transforming a static map into a targeted sales diagnostic.



LIMITED USAGE OF SMART METERING

The digital solution is in place, but the right analytics are not being derived. Moving beyond monthly readouts to analyze **granular consumption patterns** allows us to predict demand spikes, balance network loads, and identify anomalies indicative of theft or leakage.





NEED FOR INTEGRATION : MULTIPLIER EFFECT

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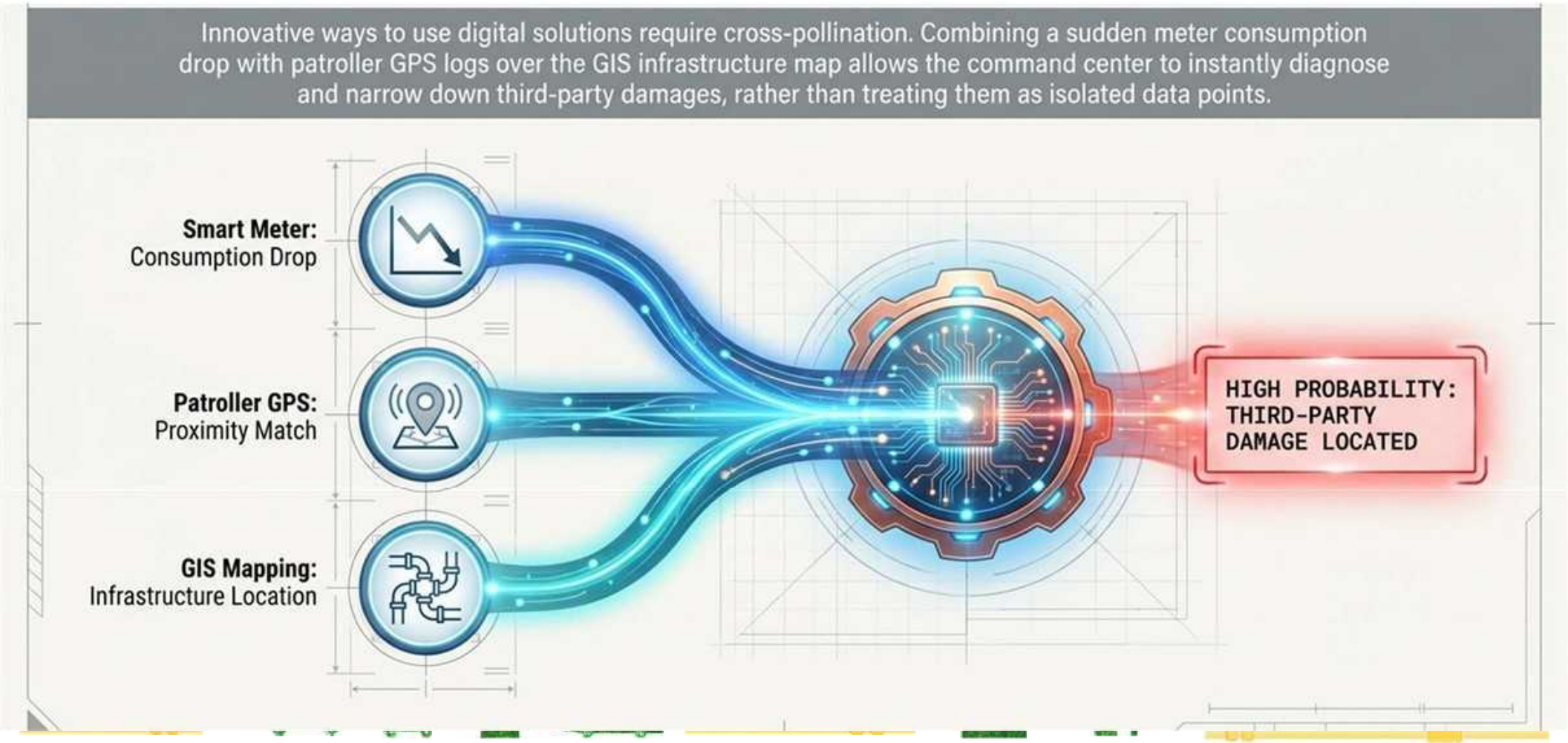

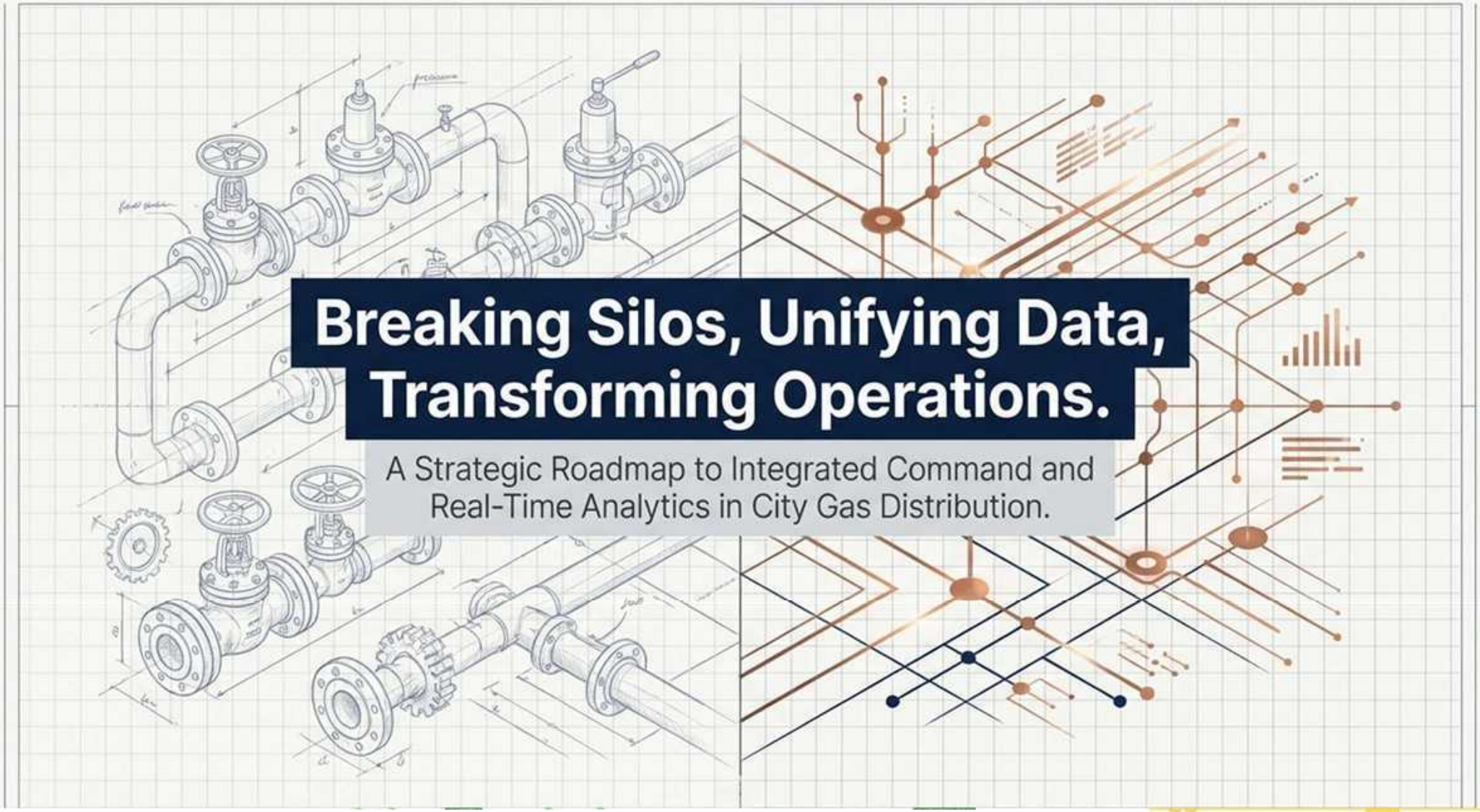
Breaking Silos, Unifying Data, Transforming Operations.
A Strategic Roadmap to Integrated Command and Real-Time Analytics in City Gas Distribution.

TRANSITION TO INTEGRATED DASHBOARD

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Phase 1:

Unified Platform

Consolidates siloed data: CNG Mitra, PNG Mitra, CP Monitoring, Sahaj.

Phase 2:

Proactive Capabilities

Real-time analytics and predictive outage management.

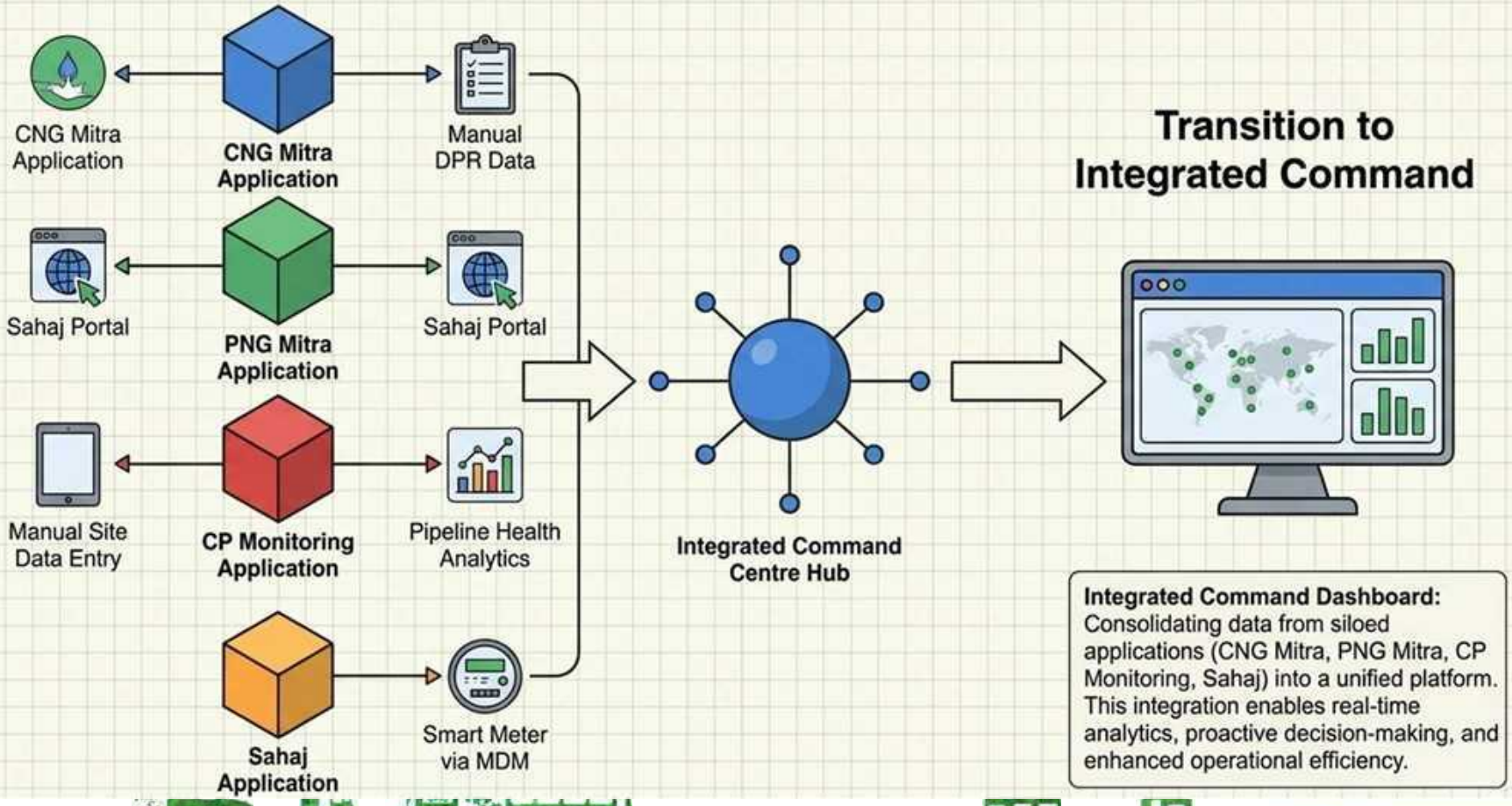
Phase 3:

Automated Reporting

Instantaneous Daily Progress Reports and Asset Summaries.

PHASE-1 : INTEGRATED DASHBOARD

Phase 1:



GAIL GAS INTEGRATED DASHBOARD

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The Single Source of Truth: Integrated Command Dashboards

Orchestrating millions of edge endpoints into unified executive visibility

Command Centre Needs

Centralized hub for real-time monitoring, cross-functional collaboration, and rapid incident response.

Roadmap to Full Integration

Phased implementation:
1. Automate Data
2. Integrate Platforms
3. Elevate to Predictive Operations.

Tooltip 1

Granular Sales Tracking: GA-wise and station-type daily volume metrics.

Predictive Prevention: Analytics applied to operational maps to predict and prevent station dry-outs before they occur.

GAIL GAS INTEGRATED DASHBOARD

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Highest Sales
Non-Performing Asset
Performing Asset

Asset Utilization
Unbilled Consumer
GA Wise Performance

INTEGRATED DASHBOARD- FUTURE OUTLOOK

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Phase 1:

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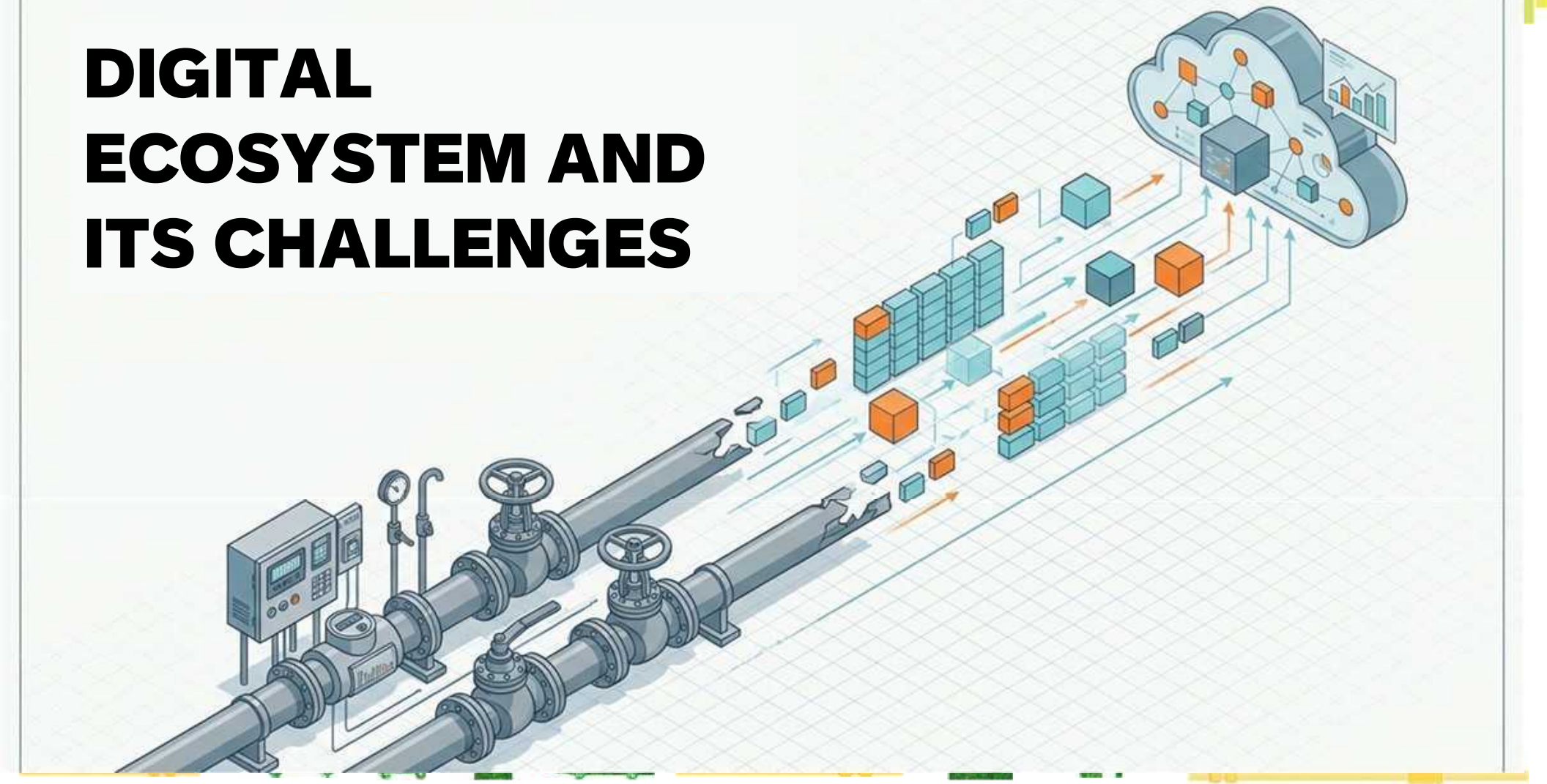
DIGITAL ECOSYSTEM AND ITS CHALLENGES



COMPONENTS OF DIGITAL ECOSYSTEM AND ITS CHALLENGES

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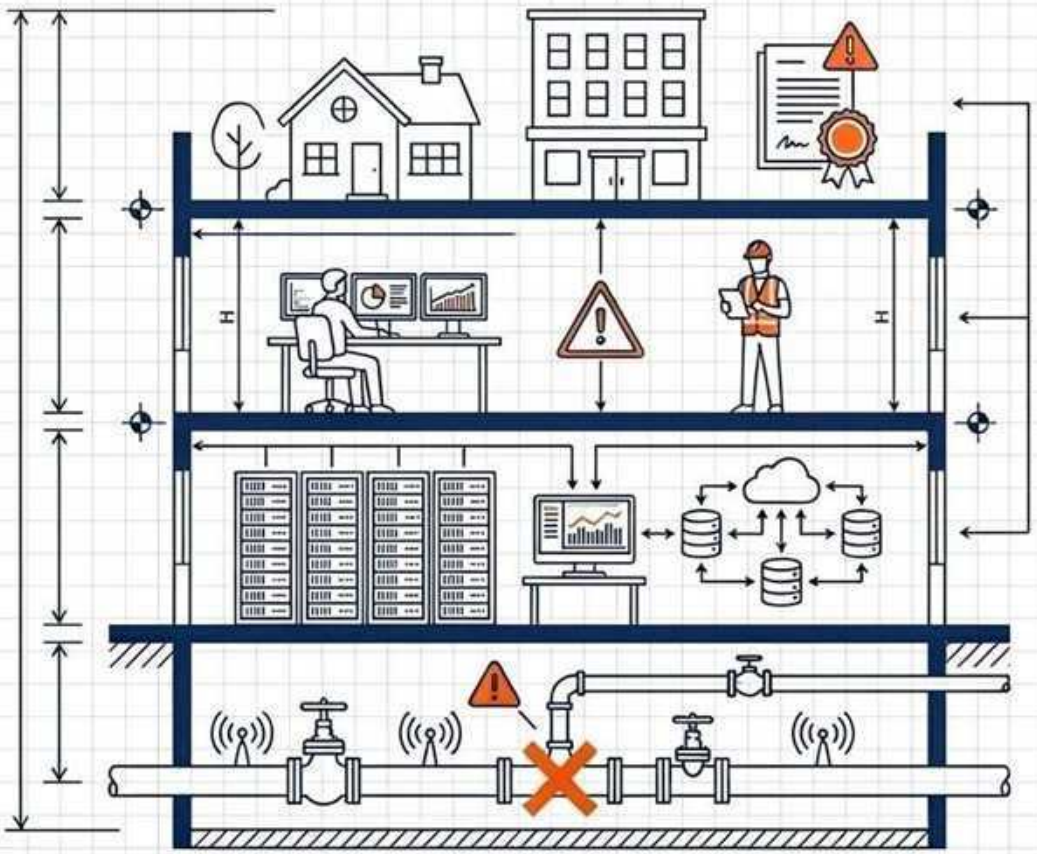


Customer & Regulatory Context

Challenges: External complexities blocking data monetization.

Human & Organizational Operations

Challenges: Operational silos blocking data utilization.

IT & Data Infrastructure

Challenges: Architectural legacy blocking data movement.

Field Asset & Data Generation

Challenges: Physical realities blocking data generation.

Friction in Field & Asset Component

Field & Asset Friction

The hazardous environments restrict data generation at the source.

Node A (Underground Attenuation): Signal Loss

Asset enclosures block cellular/LoRaWAN signals, necessitating costly repeaters.

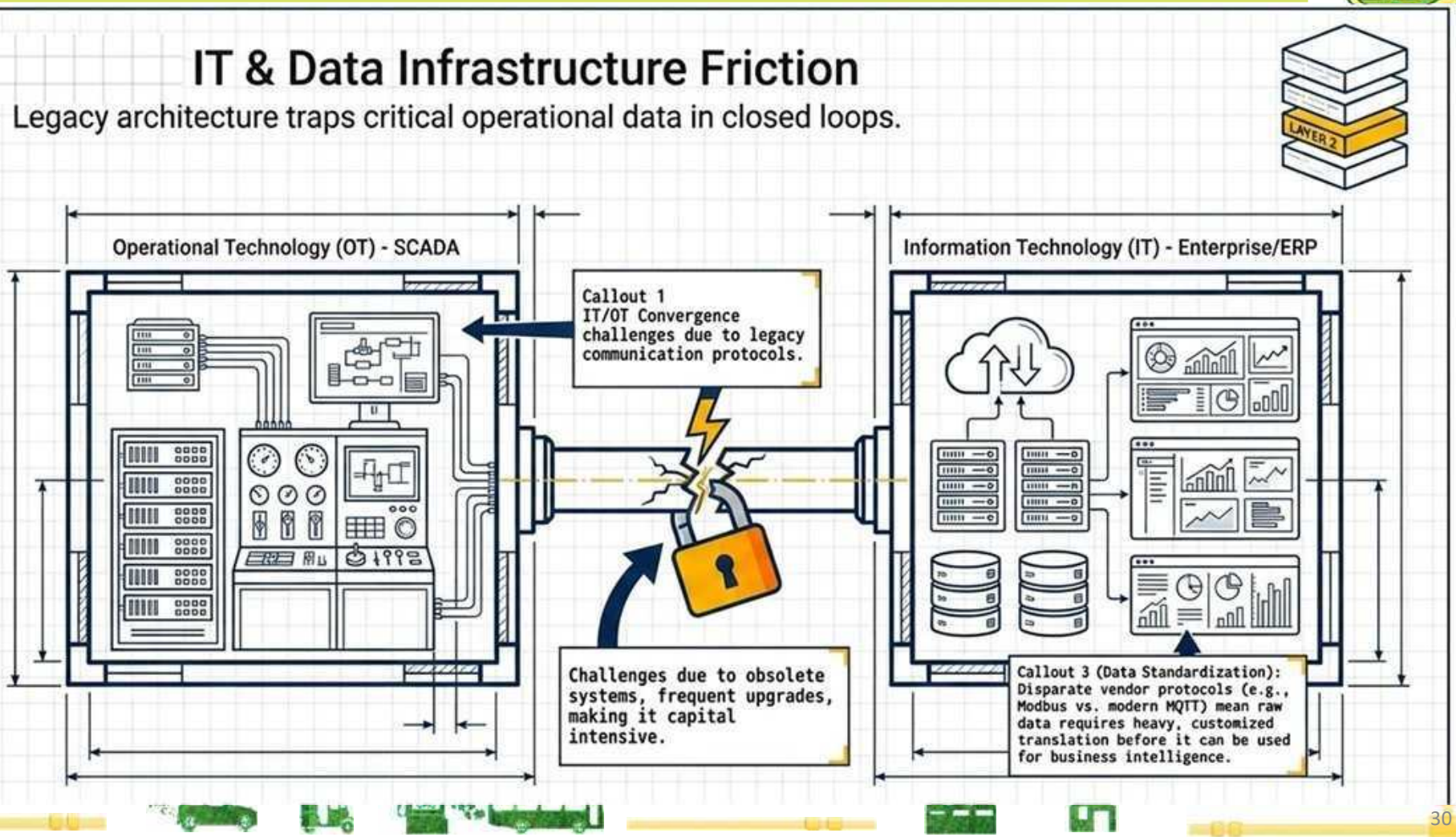
Node B (Hazardous Environments): ATEX Certification limits

Strict explosion-proof requirements drastically reduce the availability and increase the cost of viable IoT edge devices.

Node C (Power Constraints): Battery life vs. Data frequency

High-frequency data transmission drains remote sensor batteries in months, replacing digital efficiency with high manual maintenance costs.

Friction in IT & Data Infrastructure Component



CONSTRAINTS IN SMART METERING ADOPTION

Non-Uniform Protocol: Lack of standardized communication protocols across devices.

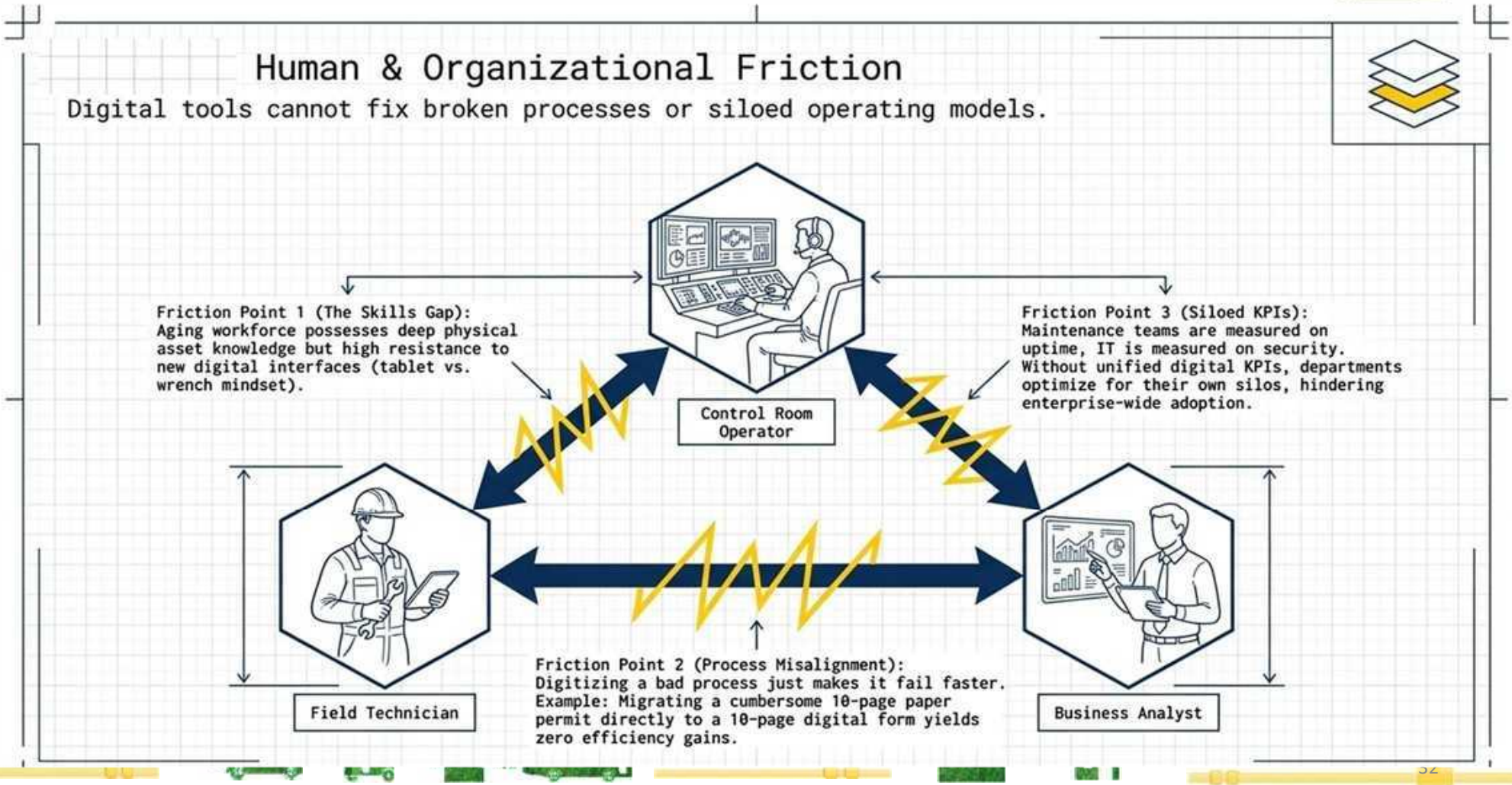
Multiple MDM for Different Meter Makes: Complexity in managing diverse Meter Data Management systems.

Network Availability: Inconsistent connectivity, especially in remote or dense areas.

No Regulatory Mandate: Absence of government enforcement or incentives for adoption.

Commercial Viability for Adoption: High upfront costs and unclear ROI for widespread deployment.

Friction in Human & Organizational Component



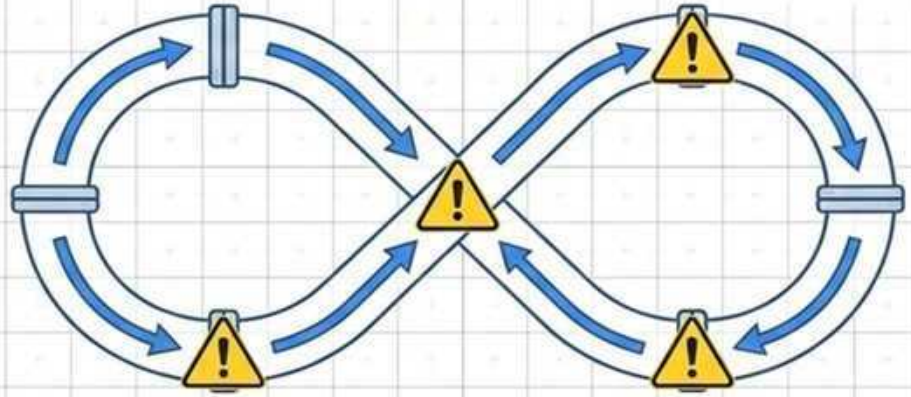
Friction in Customer & Regulatory Component

Customer & Regulatory Friction

LAYER 4

External interfaces present the final hurdle to realizing digital ROI.

Rollout Point 1 (Smart Meter Rollout Logistics):
Upgrading consumer endpoints requires physical access to millions of premises, leading to fragmented, multi-year, hybrid (manual/digital) operating periods.



Integration Point 2 (Legacy Billing Integzation):
High-frequency data from new smart meters overwhelms legacy CIS (Customer Information Systems) built for bi-monthly batch processing.

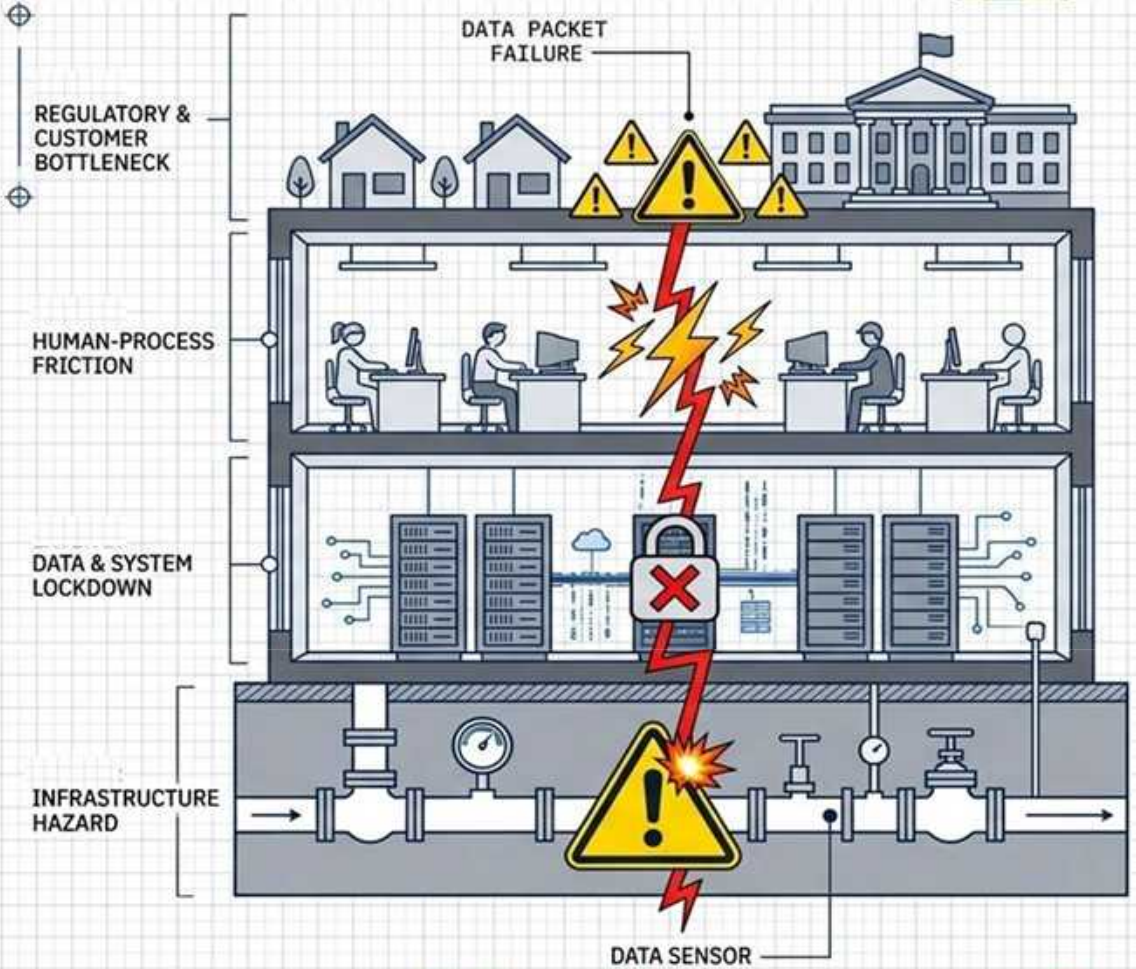
Lack of Regulatory Enablers acts as hindrance for adoption of Smart Meters

THE COMPOUNDING EFFECT:

Synthesis: The Compounding Friction Heatmap

Modernization in City Gas Distribution cannot be solved by a single software vendor or hardware upgrade; it requires a holistic, systemic architectural strategy.

Digital transformation fails because issues compound vertically.



ROAD MAP TO COMPLETE AUTOMATED AND INTEGRATED SYSTEM

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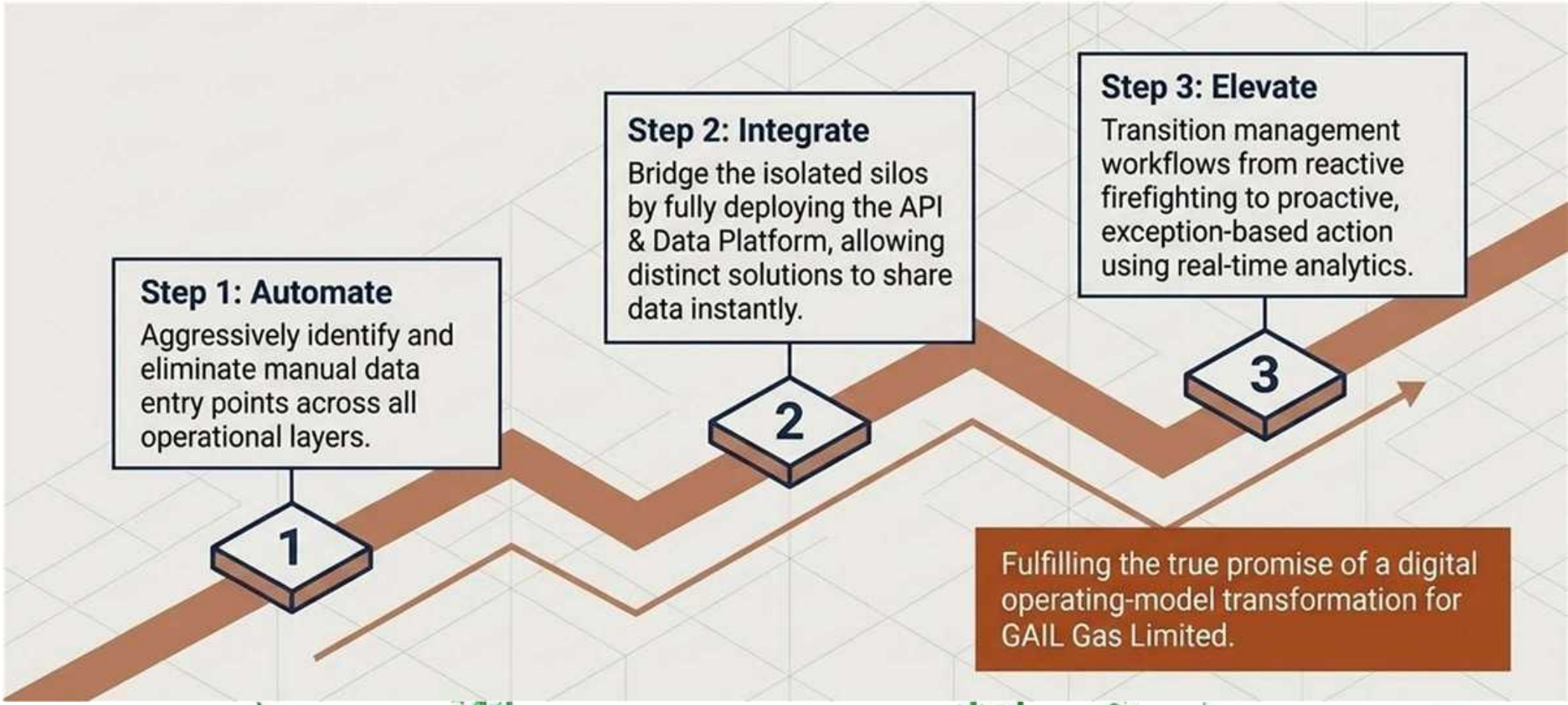

THANK YOU