Energy, Sustainability & AI in Modern Data Centres

Chapter 1: A Practical Guide from Cypernex EMS/ESG Platform

Executive Summary

As data centres become increasingly energy-intensive, sustainability goals and regulatory compliance demands are rising. Traditional EMS systems provide partial visibility, focusing mostly on physical assets like HVAC, lighting, and UPS systems. But in today's landscape, that's no longer enough.

Digital workloads - AI models, containers, virtual machines all consume significant energy and are often untracked in standard energy reporting tools.

Cypernex EMS/ESG software introduces a new approach: unifying **IoT sensor data, virtual system telemetry, AI-driven diagnostics**, and **actionable sustainability workflows** into one intelligent platform. This guide explores how our system helps operators reduce energy, improve reporting, and support sustainability across the entire stack from hardware to software, from site engineers to ESG teams.

1. Problems to address

1.1 Infrastructure-Level Gaps

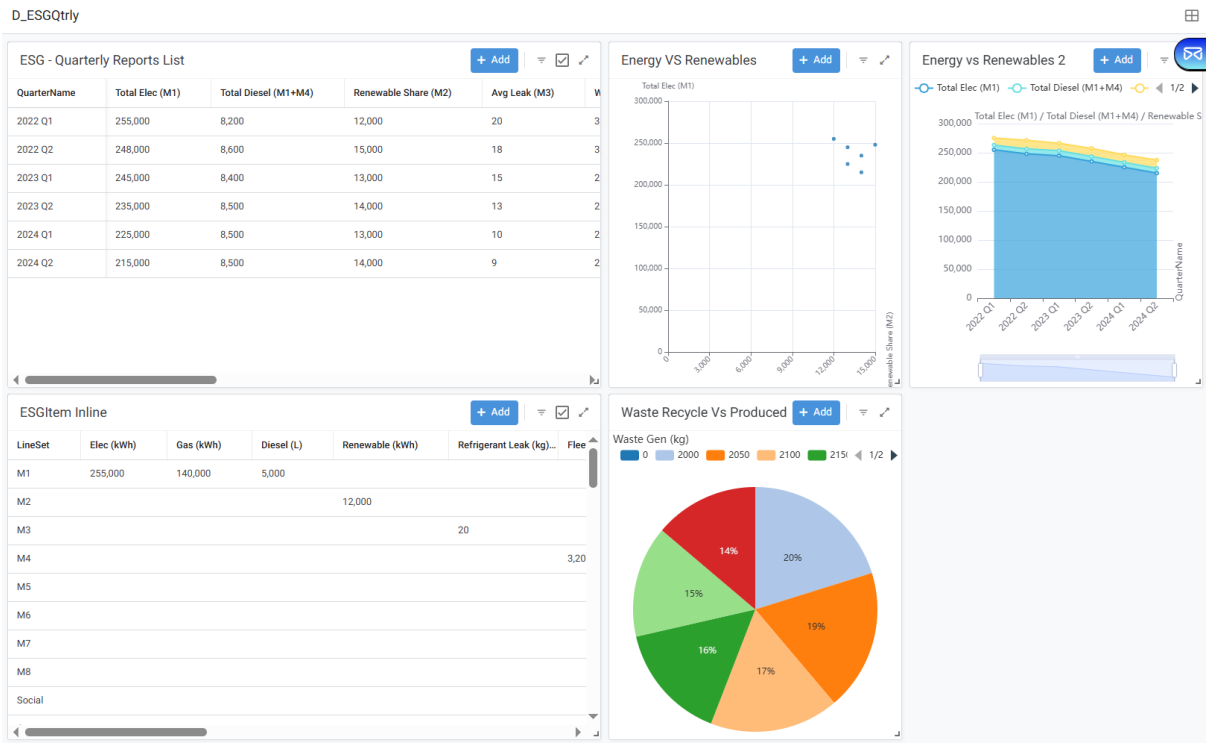
- Incomplete visibility across HVAC, CRAC, UPS, and power systems
- Lack of predictive maintenance and early fault detection
- Isolated monitoring systems with no unified ESG insight

1.2 Digital Workload Blind Spots

- No energy attribution to compute, AI, or container workloads
- Over-provisioned or idle systems running 24/7
- No automation linking workload scheduling to energy policies

1.3 Compliance & ESG Pressure

- Emerging reporting frameworks (SECR, CSRD, ESOS, GRI)
- Growing scrutiny from stakeholders, auditors, and regulators
- Difficulty linking operational data to ESG metrics and reports



2. Cypernex Platform Capabilities

2.1 Overview

The **Cypernex EMS/ESG Platform** provides a unified digital and physical infrastructure monitoring solution:

- **IoT Sensor Integration** (HVAC, UPS, environmental)
- **Virtual Sensors** (API-derived telemetry from Prometheus, Kubernetes, etc.)
- **Digital Twin & AI Engines** (thermal modelling, asset simulation, predictive analytics)
- **Actionable Notes** (consultant collaboration, diagnostics, task tracking)
- **Service Ticketing + SLA Tracking**
- **Automated ESG Reporting** (aligned with SECR, CSRD, GRI, TCFD, ESOS)

2.2 Key Differentiators

Feature	Description
Virtual Sensors	Treat APIs as sensors and monitor workloads, fan speed, load
Actionable Notes	Consultant or AI-created issues/tasks for ESG/ops follow-up
AI Engines	On-demand or automated modules for diagnostics and modelling
Integrated SLA Module	Track equipment downtime, service tickets, and response KPIs
ESG Automation	Seamless regulatory and stakeholder report generation

3. Functional Roles & Responsibilities

The roles and responsibilities of sustainability and engineering professionals remain unchanged, but the way they carry out these responsibilities changes significantly.

3.1 Sustainability Roles

Title	Responsibilities	Platform Benefits
ESG Officer	ESG data reporting, compliance	Prebuilt reports, emissions breakdown
Head of Sustainability	Strategy, KPI oversight	Real-time dashboards, AI insights
ESG Analyst	Scope 1/2/3 data tracking	Virtual sensors, workload insights

3.2 Facilities & Engineering

Title	Responsibilities	Platform Benefits
Site Manager	Facility uptime, energy targets	Alerts, automation, SLA insights
Facilities Engineer	HVAC, CRAC, UPS systems	Asset tracking, predictive maintenance
DevOps / Systems Lead	Compute workloads, container orchestration	Idle load detection, AI-linked triggers

3.3 External Stakeholders

Title	Responsibilities	Platform Benefits
Consultant / Auditor	Energy audits, ESG support	Action Notes, live metrics, remote tools

4. Digital Workload Monitoring with Virtual Sensors

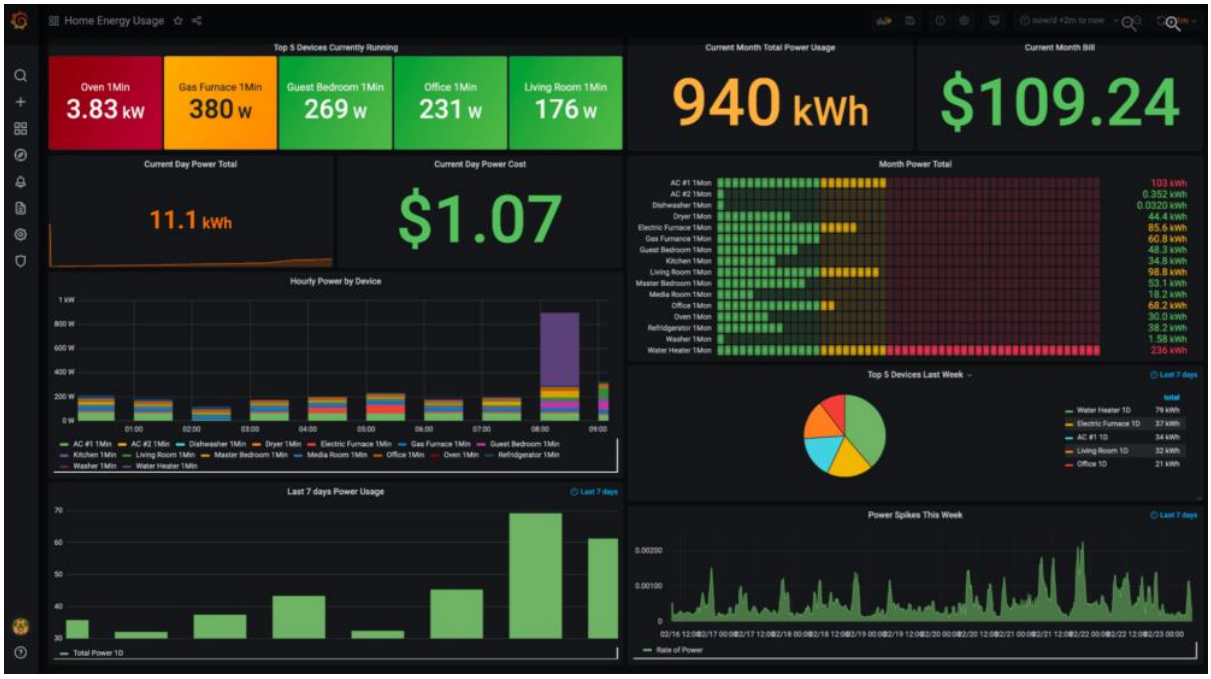
Cypernex Virtual Sensors enable visibility into server and software metrics via APIs (e.g. Prometheus), turning usage data into trackable environmental impact.

Examples:

Metric Type	API Query (PromQL)	EMS Usage
GPU Load	avg_over_time(node_gpu_utilization[5m])	AI energy tracking
Fan Speed	node_hwmon_fan_rpm	Thermal performance analysis
CPU Usage	avg(node_cpu_seconds_total{mode!="idle"})	Load optimization
Container Status	kube_pod_container_status_running == 1	Detect idle or zombie containers
Temperature	node_thermal_zone_temp	Cooling system correlation

Virtual sensors can be used to:

- Trigger AI engines based on thresholds
- Auto-generate Action Notes or Tickets
- Assign carbon impact to compute activities



5. Action Notes & AI Modules

Actionable Notes are live diagnostics or opportunities created by:

- Internal teams
- External consultants
- AI Modules

Each note includes:

- Description & evidence (sensors, reports)
- Assigned stakeholders (ESG, engineering, 3rd parties)
- Priority, deadlines, attachments
- Integration with SLA/Ticketing system

AI Modules can be triggered manually or via sensor rules and perform:

- Workload analysis
- Thermal efficiency modeling
- Fault detection or prediction

6. Use Cases: “Day in the Life”

ESG Officer

Task: Monthly ESG reporting
Flow: Dashboard > Auto-report export > Review flagged anomalies
Value: Saves 3–5 days of data prep; more accurate audit trail

Facilities Manager

Task: Monitor energy and critical assets
Flow: View alerts > Action Note issued > Resolve + close ticket
Value: Prevents downtime, improves SLA performance

Consultant

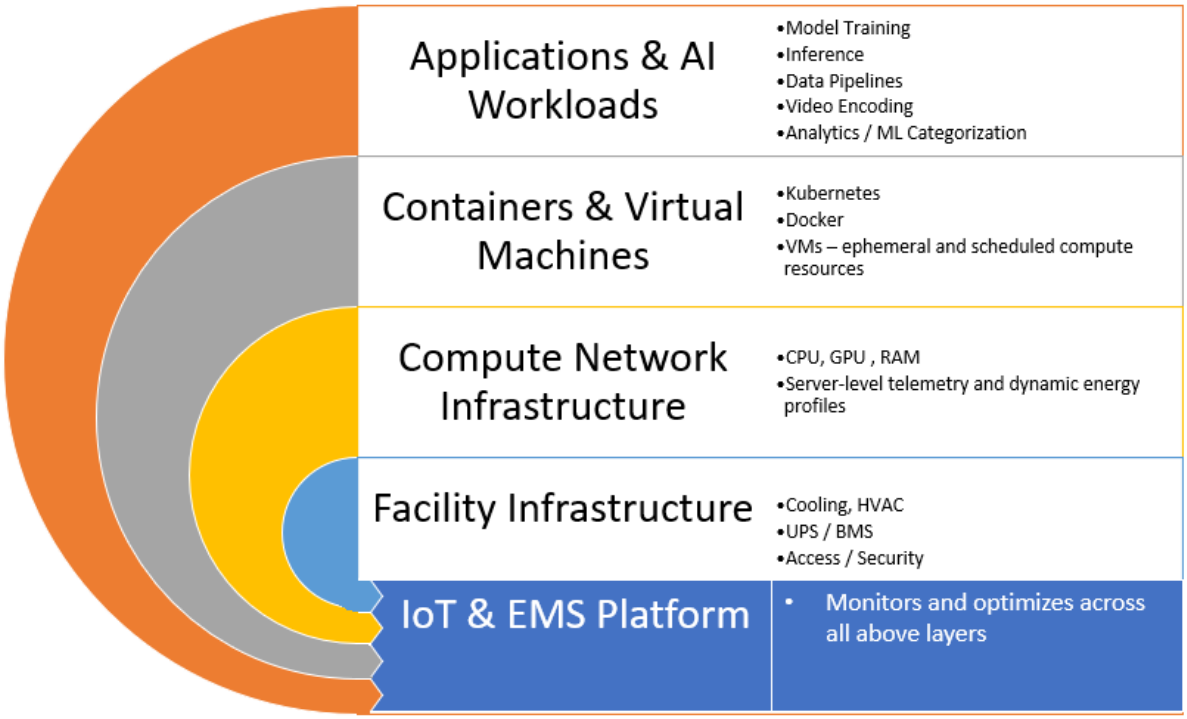
Task: Deliver energy audit across 3 sites
Flow: Access virtual sensors > Run AI Module > Assign opportunities
Value: Data-driven insights, faster recommendations, client visibility

7. Environmental & Financial Impact

Impact Area	Typical Result with Cypernex
Energy Reduction	↓ 10–25% through efficiency workflows
Idle Load Elimination	Up to 30% workload removal
CO_2 Emissions Reduction	↓ 15–20% with workload transparency
ESG Report Time	↓ 60–70% faster with automation
Annual Savings (avg site)	£100k–£300k energy + ops optimization

8. Energy & Sustainability Stack

The technology stacks are interoperable, the EMS and NetZero agenda is not interrupted by day-to-day requirements of operations, instead it supports it.



Interdependancies such as idle workloads impacting case temperature and / or thermal radiation are identified and countermeasures can include the full range of environmental controls at the disposal of sustainability teams.

The use of familiar open-source technologies allows engineering and dev-ops teams to expand the scope of virtual sensors on the fly, making the teams more agile and independent.

Cypernex EMS/ESG Platform

Enabling Visibility, Efficiency, Flexibility, Agility, Transparency and Collaborative

9. Case Snapshot: UK Tier III Facility

Overview:

- 3 locations, high AI workload profile
- Legacy EMS covering only facility systems

Challenges:

- Ghost workloads consuming 20–30% energy
- Overcooling in multiple zones
- ESG reporting took 4–6 weeks to complete

With Cypernex:

- Virtual sensors via Prometheus
- ESG + Ops dashboard integration
- Action Notes to facility teams
- ESG report ready in under 2 days

Results:

- 18% energy saving
- 42 ghost workloads eliminated
- Compliance with SECR + CSRD

Conclusion

As sustainability and carbon accountability become essential, Cypernex EMS/ESG empowers teams to **act with intelligence**, **collaborate across silos**, and **translate operations into impact**, not just in facilities, but at the heart of compute and workloads.

Whether you're an ESG lead, consultant, or data centre manager, this platform equips you to move from compliance to leadership in the sustainability era.

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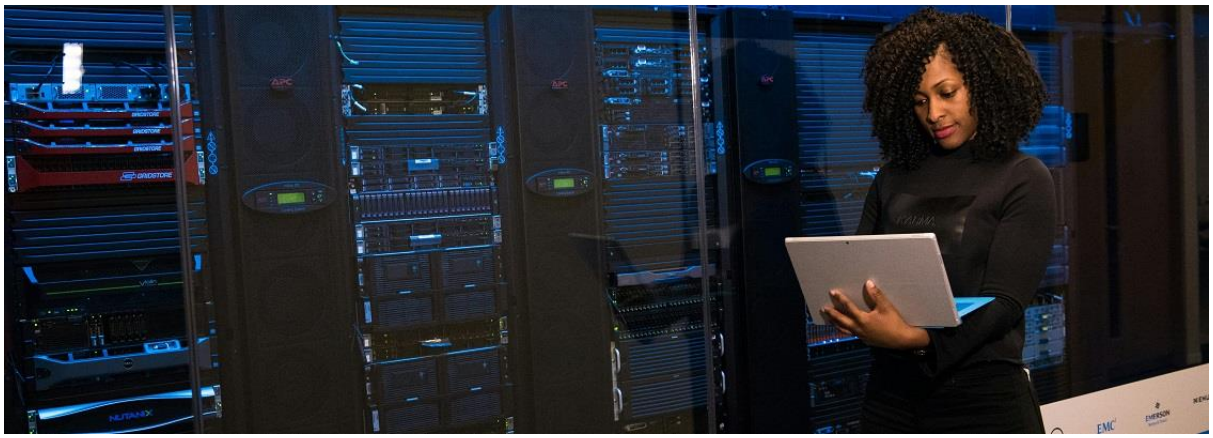
Chapter 2: Real-World Considerations for Cypernex EMS/ESG Integration



Executive Summary

Modern digital operations, from cloud computing to AI model deployment are placing unprecedented pressure on the energy footprint of data centres and critical IT infrastructure. While most EMS/ESG systems focus on facility-level energy tracking, they often miss the deeper, functional insights driven by virtual workloads, server behaviour, and automated systems.

This guide introduces the **Cypernex EMS/ESG platform** and outlines its capabilities for **physical and virtual asset tracking**, **AI-powered analytics**, and **load-based operational insights**. It also addresses the practical **limitations**, **real-world objections**, and the rationale for when and how to pursue **load-aware ESG reporting** without overengineering or overextending.

Section 1: Context — Data Centres & the New Sustainability Challenge

Data centres now consume **2–3% of global electricity** — a number expected to rise sharply with the expansion of AI, IoT, and automation. Yet most ESG reporting and EMS platforms continue to monitor **space, not function**; **meters, not workloads**.

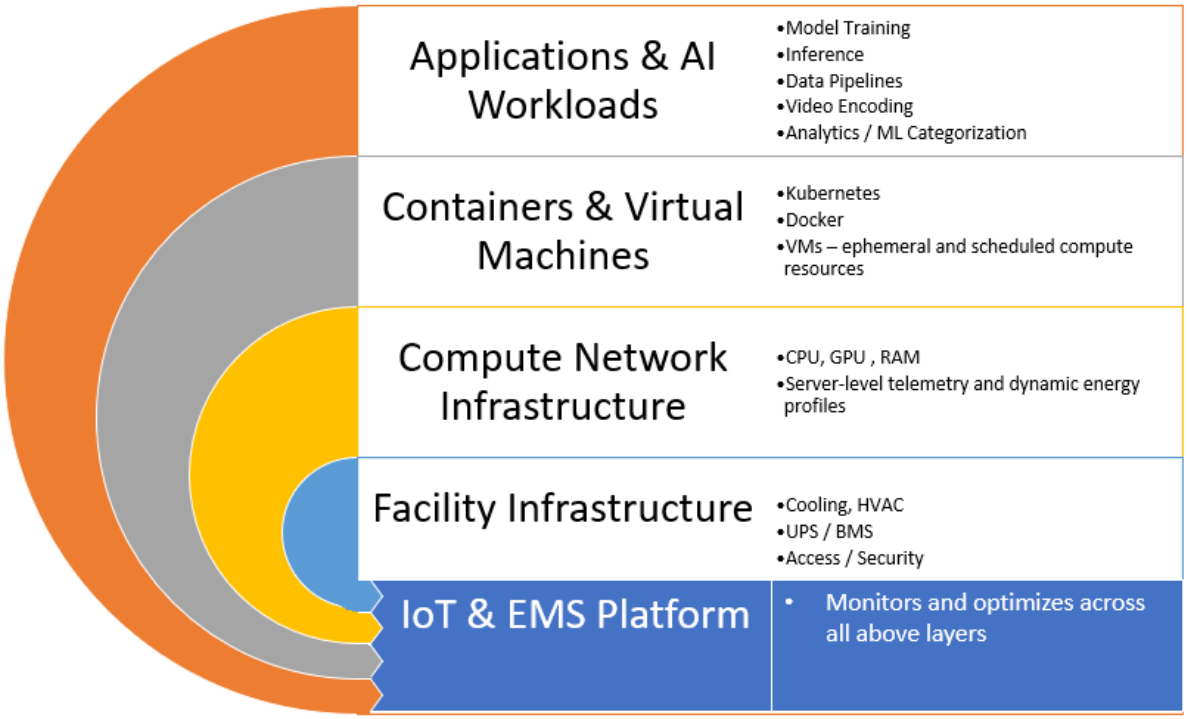
Modern sustainability teams face a dual mandate:

- Reduce carbon and energy intensity
- Increase operational insight and accountability

But **server loads**, **VMs**, **AI engines**, and **software containers** are dynamic, non-spatial entities — they don't fit easily into existing reporting frameworks that rely on **FTE** or **square footage**.

Section 2: Cypernex EMS/ESG – Capabilities Overview

Cypernex offers a full-stack infrastructure and software suite that extends traditional energy and sustainability monitoring into the virtual realm.



Platform Capabilities:

- **IoT + Digital Twin Engine** – Physical sensors and digital twin mapping of all assets (machinery, HVAC, servers, racks, etc.)
- **Virtual Sensor Framework** – Turn API endpoints (e.g., Prometheus, Kubernetes) into telemetry sources
- **EMS Core** – Real-time energy tracking, alerts, optimisation
- **ESG Reporting Engine** – Automated emissions reporting aligned with Scope 1, 2 (and optionally, 3)
- **Service Ticketing + SLA Module** – Incident reporting, KPIs, performance benchmarks
- **AI Engine Library** – Prebuilt AI modules triggered by conditions or schedules
- **Action Notes** – Collaborative diagnostic and advisory tool for consultants and internal teams

Modelling Digital Twins – Building and/or the Business

Section 3: The Challenge with Traditional Metrics

Most-used Intensity Metrics:

Metric	Typical Use	Limitations
Energy per FTE	Office efficiency	Breaks down when compute loads aren't tied to staff size
Energy per m²	Building-level benchmarking	Misses back-end or virtual load not related to space use
PUE (Power Usage Effectiveness)	Data centre infrastructure efficiency	Doesn't reflect software/service-level consumption

Emerging Problems:

- Server-heavy teams are **misrepresented** in FTE-based metrics
- Remote workloads are **invisible** in building-based reporting
- Energy intensity reports may **under-represent real operational load**

Section 4: A More Practical Approach to Load-Based Reporting

When is load tracking worth the effort?

Use the following justification model:

1. Materiality Threshold

Is IT/server energy > 10–15% of total use?
If yes → start examining variance by workload or function.

2. Variance Across Teams

Do small teams consume vastly more energy than their size suggests?
If yes → existing FTE or area metrics may be misleading.

3. Operational Impact

Would refined metrics change decision-making, project prioritisation, or reporting clarity?
If yes → investing in this makes strategic sense.

4. Data Availability

Do you already track server logs, Prometheus metrics, or cloud usage by team or project?
If yes → Virtual Sensors can be implemented incrementally.

🧠 Section 5: Real-World Objections – And Practical Responses

Objection	Underlying Reason	Suggested Response
"We already report by area/FTE."	It aligns with physical meters.	Suggest segmenting reports: function + facility.
"It adds complexity."	Concern over year-on-year comparability.	Offer parallel metrics — keep existing but enhance insight.
"We don't have team-level usage data."	Infrastructure is centralised.	Start with estimates, VM-hour tracking or usage proxies.
"It's an IT issue, not ESG."	Organisational silo.	Highlight need for integrated digital + ESG strategy.
"It's not required by GHG Protocol."	Compliance-first mindset.	Emphasise clarity, leadership, and strategic foresight.

Section 6: Suggested Adoption Strategy

Phase 1: Assessment & Baseline

- Identify buildings/sites with >10% IT energy loads
- Map existing Prometheus/K8s metrics
- Introduce virtual sensors to track CPU/GPU load, VM time, fan speed, server heat

Phase 2: ESG Integration

- Match energy use to workloads
- Segment energy per function/team/project
- Use Action Notes to surface anomalies, inefficiencies, idle loads

Phase 3: Reporting & Optimisation

- Adjust ESG reports to include server-driven energy
- Trigger AI diagnostics on load spikes
- Begin load scheduling, automation for non-peak hours

Section 7: Benefits of Cypernex EMS/ESG Platform

Feature	Benefit
Unified IoT + Virtual Sensor Model	Combine physical + digital energy data
Action Notes	Simplifies collaboration across ops, engineering, consultants
Server Load Telemetry	Enables function-based energy optimisation
AI-Driven Analysis	Automated alerts, forecasting, impact scoring
SLA & KPI Modules	Track maintenance, uptime, sustainability targets

Section 8: Case Example — Energy Impact of Virtual Workloads

Scenario: A team of 8 researchers running large-scale AI models
Physical Location: Small satellite office
Server Usage: 3x GPU nodes on remote cluster

With no load attribution, their Scope 2 impact is absorbed by the data centre.
With Cypernex, telemetry from Prometheus is virtualised, integrated, and reported per team.
Action Note flags overnight idle load.
Outcome: Model scheduling adjusted, 22% energy reduction per week.

Final Thought

Cypernex doesn't just monitor buildings, it understands operations. As AI and automation scale, ignoring the energy and emissions of digital workloads will only widen the gap between **reported and actual impact**. By offering modular, practical tools that evolve with your infrastructure, Cypernex empowers sustainability teams to see clearly, act smartly, and report truthfully.