

Transformer monitoring for renewable energy providers



Reducing risk and maximising availability
for renewable power generation



Maximise Uptime and Availability

If you are involved in power generation from renewable sources, availability and uptime are top priorities and you will know how important it is to understand how assets are performing. With many sites often in remote locations, it is important to be aware of potential faults before they become serious, maximising revenues and saving both time and costs.

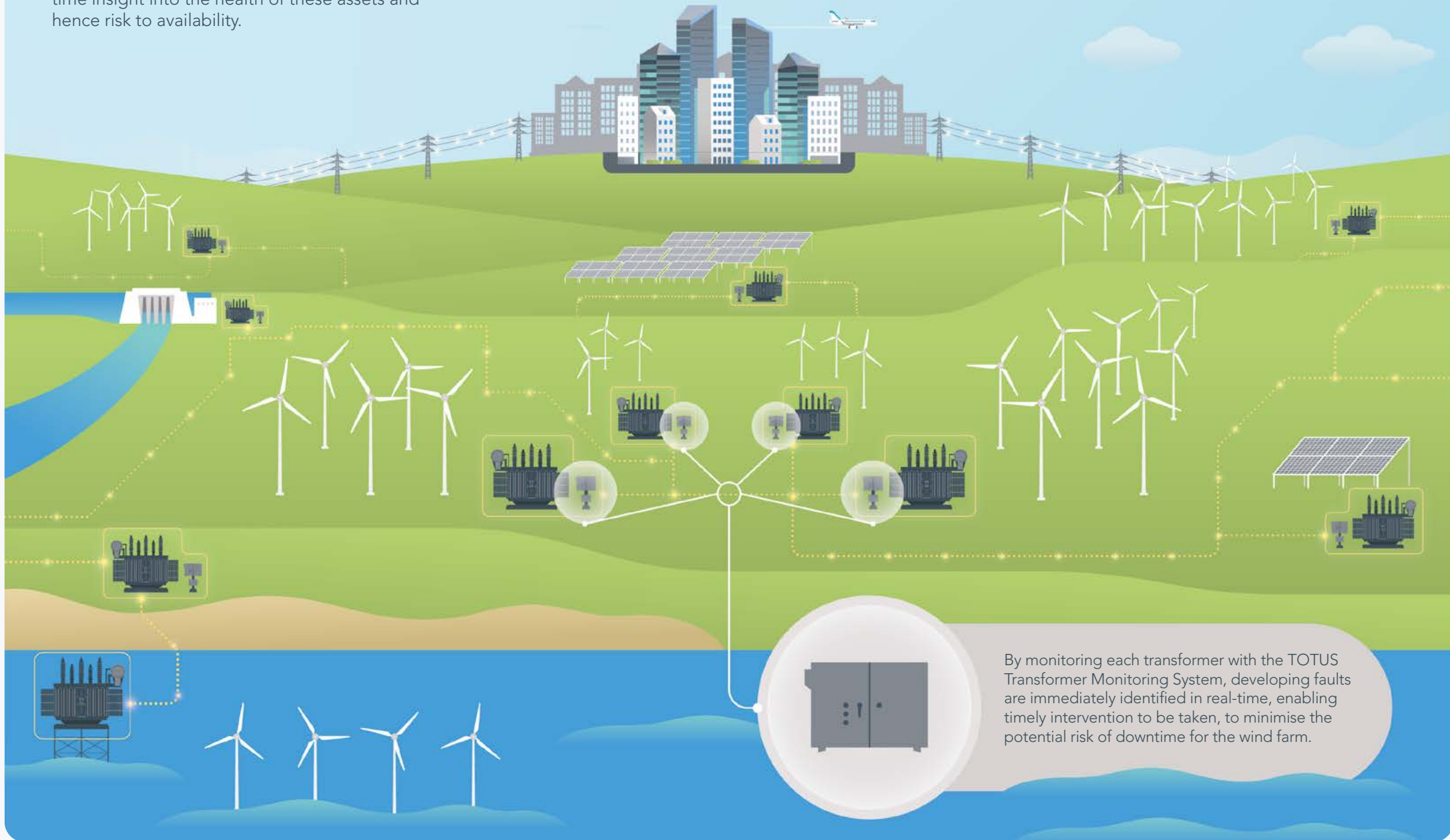
Among the most critical assets are transformers connecting renewable generation facilities to the grid: if a transformer suffers an outage, this can mean partial or even complete loss of generation for a prolonged period (weeks or even months!). And lost revenues can far exceed the cost of the transformer.

By its nature most renewable generation is intermittent, which places increased stress on transformers. Understanding transformer risk, health and performance with real-time monitoring allows Asset and Operations Managers to develop and optimise proactive maintenance strategies for:

- Significantly reduced risk of sudden transformer failure and associated costs and lost revenues
- Improved availability and uptime for renewable energy generation
- Enhanced predictive maintenance to extend transformer life

Safeguard asset availability

Transformers are a critical asset connecting wind, solar and hydroelectric generation to the electricity network. Transformer monitoring provides real-time insight into the health of these assets and hence risk to availability.





The Challenge:

Reduce risk of unplanned downtime

Key challenges include:

- Mitigate against unplanned outages and plant downtime
- Understand the health and risk of transformer assets
- Managing multiple transformers often in remote locations
- Avoiding unnecessary intervention and servicing
- How to know the correct action to take and when to take it
- Managing insurance and associated insurance costs
- Shortage of transformer experts and dedicated resources



The Solution:

Total Transformer Monitoring

Our transformer monitoring products and services provide:

- Real-time assessment of the condition of the transformer enabling asset managers to react quickly to failure risks
- Easy to understand information with appropriate actions clearly proscribed – no need for in-house transformer experts
- Sophisticated data analysis tools and transformer models that cut through the data noise to see what is important
- Cutting edge sensor technology in a modular solution that can be tailored to the criticality and health of the transformer
- The ability to monitor all key components to give the most complete picture of transformer health in a single integrated solution (DGA, PD, Bushings, Through Fault Current etc)



The Result:

Generation availability maximised

Key benefits include:

- The risk of sudden transformer failure is significantly reduced, protecting availability KPIs
- Resources are focused only on those transformers which represent a risk and preventative maintenance resolves faults before they become more serious
- Condition-based maintenance avoids unnecessary intervention and servicing of healthy assets
- Asset Managers receive the relevant to make immediate decisions, not data which needs to be interpreted
- Transformers can be included in asset management digitisation projects
- Risk is understood for insurance purposes, potentially creating savings
- Staff can focus on maximizing energy generation, safe in the knowledge that critical transformer assets will be available to deliver renewable power to the grid



CAMLIN – your asset management partner

The TOTUS system is a lot more than state of the art sensors to monitor your transformer. TOTUS is a complete real-time monitoring solution that ensures actionable information is at your fingertips.

By partnering with Camlin, our solutions will enable you to implement a fully condition-based maintenance methodology for these critical assets, optimising your asset management strategy.

While the technology is fit-and-forget, we don't. CAMLIN's global service team and transformer experts are on hand to support you throughout. We ensure our customers can generate the maximum value and benefits from their TOTUS system for the entire life of the assets being monitored.





Actionable information at your fingertips

Our TOTUS total transformer monitoring solution consolidates and connects data from our monitoring equipment, together with other sources of offline data, to provide clear insights on asset health and health across the fleet of transformers.

With the TOTUSPRO software suite, actionable information is clearly and intuitively presented, and asset managers can make immediate decisions across their fleet and at the individual transformer level.

TOTUSPRO ACCESS

Serial Number	Asset ID	Status	Condition Group	Alarm
TOT001-000022	ATK271	Online	1	
INT001-000012	ATK271	Online	2	
12T001-000028	TR1	Online	1	
PMT015-000011	UR	Online	1	
INT001-000006	PST2	Online	1	
INT001-000017	PST3	Online	1	

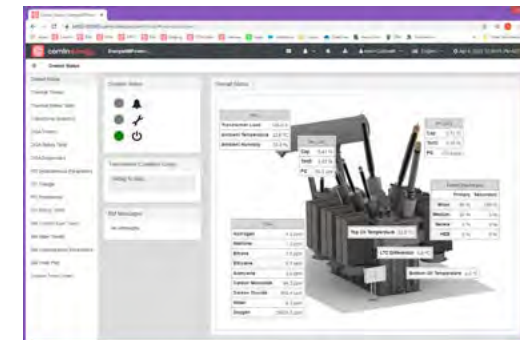
The TOTUSPRO ACCESS module immediately highlights which transformers are the greatest risk and allows asset managers to manage and make decisions across the entire transformer fleet.

TOTUSPRO DESKTOP



TOTUSPRO DESKTOP module provides subject matter experts with a deeper analysis on failure modes with the ability to easily import offline data archives.

TOTUSPRO WEB



Each TOTUS device comes embedded with TOTUSPRO Web, and online server which incorporates advanced diagnostics, providing key insights to asset condition in a graphical and easy to read display of information.

Our customisable hardware can be tailored to the criticality of your transformer.

TOTUS can be equipped with:



Dissolved Gas Analysis (DGA)



Partial Discharge (PD)



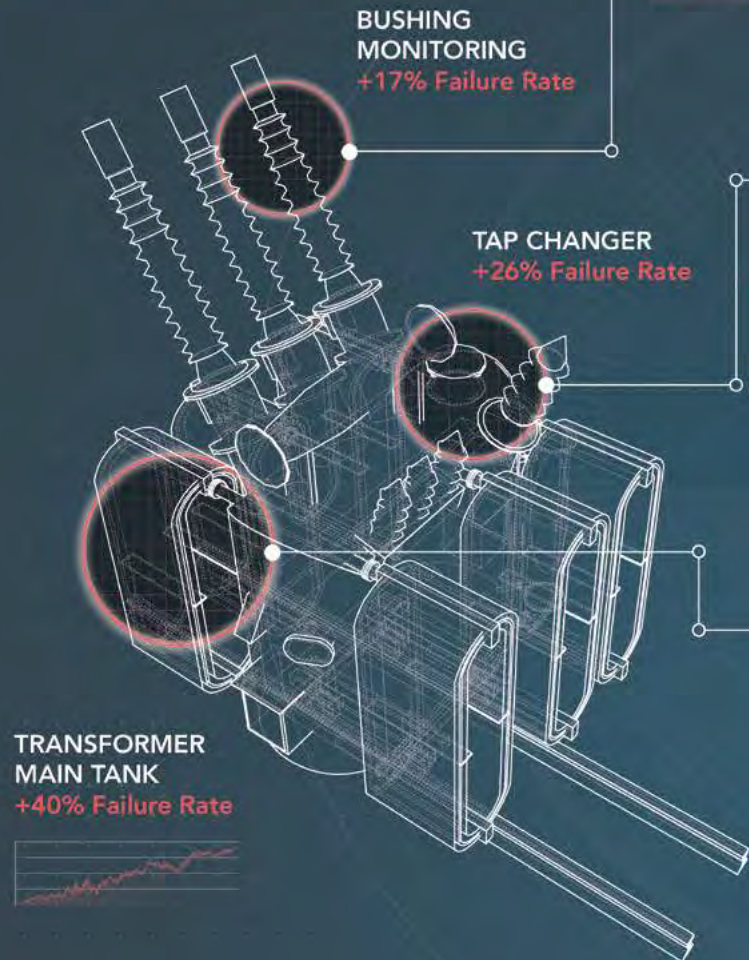
Bushing Monitoring (PD)



Through Fault Current (TFC)

Giving you a comprehensive picture of transformer health in a single system.

TOTUS MONITORING CAPABILITIES



80%+ of transformer failures are due to failures in the Bushings, Windings and OLTC (CIGRE Working Group A2.37)

Partial Discharges	Dedicated trend for Partial Discharges in bushings Arcing events
Leakage Current	Currents amplitude and phase Current polar plot
C1/PF	Tandelta/PF variations C1 and C2 variations
Others	Temperature Load Humidity

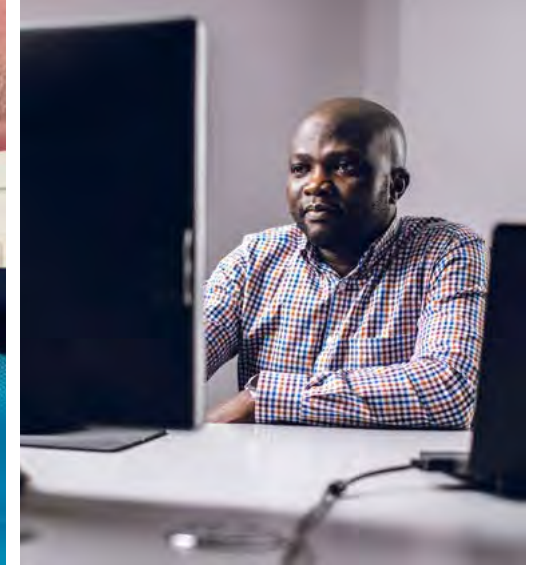
Temperatures	Main Tank Temperature OLTC Temperature Differential Temperature
Motor	Current Voltage Torque
DGA	7 Gas Moisture in Oil
Others	Tap Position Oil Level Load Status / Alarms

DGA	9 Gas 5 Gas Moisture in Oil	
Partial Discharges	Active PD's Arcing events	
Through Faults	Event Count Cumulative Effect	
Cooling Sytem	Pump / Fan Absorption Cooling Status Temperatures	
Models	Hot Spots Aging / Remaining Life Moisture in Paper	Bubbling Dynamic Loading Oil Breakdown Voltage
Others	Geomagnetic Induced Currents (GIC) Direct winding temperatures with fiber optics Analog and Digital Inputs Integration of any third party monitor/system	



Our expert support services gives you access to the many decades of collective transformer subject matter expertise in Camlin to support your decision making.





Independent expertise

Asset managers can often be reluctant to place reliance on the OEM providers of the transformers as they are often incentivised to sell additional transformer servicing works.

Our transformer experts are on hand to support you throughout your Transformer Asset Management journey. Our in-depth reporting and expert advice provides a wholly independent assessment of transformer health that you can really trust.

Expert consultancy

Consultancy Services include:

- Pre-procurement design review for a new transformer to ensure requirements and planned performance is clearly understood by both parties (customer & transformer OEM)
- Neutral technical support for Factory Acceptance Tests of the new transformer at the transformer OEM site
- On-site Asset Inspection (for example for investigation of issues, or for potential improvements to operation)
- Post-mortem examination following a serious or catastrophic transformer failure
- Other consultancy as required

Condition Assessments

The automated monitoring service available through TOTUS software can be further extended to the most holistic transformer condition assessment that considers the online data as well as any relevant historical and offline data of the transformer's entire lifecycle.

Initial Diagnostic Assessments benchmark the health of the transformer when online monitoring is first installed. Periodic Diagnosis Reports trend the condition of the asset and create a gapless asset history that enables the earliest detection of any defects. Event Diagnostics is a rapid in-depth of assessment following a significant alarm or detection of a defect and determines whether continued operation is safe as well as recommending the measures to take.

Knowledge sharing

Knowledge of the monitoring device ensures best usage of the system and its provided information, enabling maximum benefit to be derived from your investment. Through product trainings we cover not only normal operation, but also situations where alarms are reported and need investigated.

Performing the correct action based on the monitored data is very often the most difficult step, even for experienced asset managers. Whilst our experts are on hand to support in decision making, through our academic seminar programme you can access exclusive content to advance knowledge and expertise which enables better decision making and leads to more constructive discussions with transformer OEMs.

Technology Spotlights



Dissolved Gas Analysis

Providing a DGA profile of 1, 5 or 9 gases, TOTUS delivers cost-efficient condition-based maintenance with best-in-market accuracy without the need for any carrier gas consumable. Featuring embedded advanced alarm management, our dependable solutions enable more efficient maintenance scheduling for asset managers, with alerts only triggered when there is an issue with the transformer.



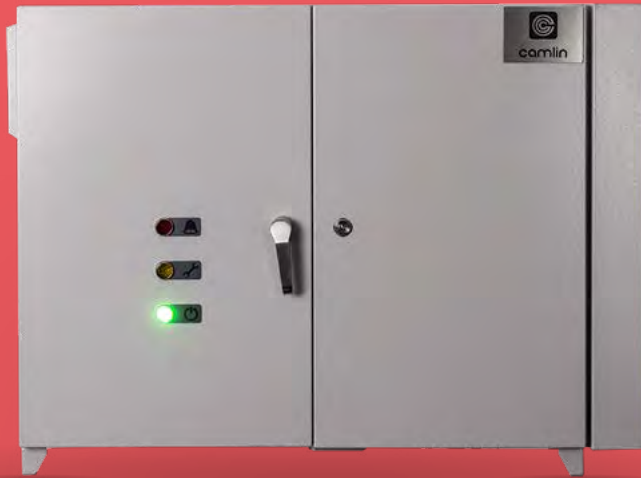
Partial Discharges

Camlin is the ONLY company that can separate the PD in bushings from the PD in the Main Tank. Early detection of PD can significantly improve risk diagnosis, driving quicker accurate decision making. With no need for expert interpretation, our user-friendly solution uses the innovative 'Camlin PD Triangle' for quick and easy understanding of data. This data can be graphed and correlated to other parameters such as temperature, humidity, load and DGA.



Through Fault Current

One of the largest causes of transformer faults is due to external events such as through faults. Understanding which transformer is impacted in the fleet, plus visibility of the integrity of the paper insulation can help assess the mechanical strength of the transformer and the risk for mechanical damages. TOTUS monitors the stress caused by through faults and cellulose ageing due to the combined action of temperature, moisture and oxygen.



Bushing Monitoring

Online monitoring of bushings, through monitoring of internal insulation (capacitance / Tan Delta or Power Factor) and the internal electrical activity (Partial discharges,) enables asset managers to detect a fault at its very preliminary stage, allowing action to be taken before reaching a critical and irreversible stage. TOTUS monitor the following on bushings: Partial Discharges, High Energy Events, Leakage Current Angles and Magnitude, Temperature, Load, Bushing Properties.



Arcing Events

Acetylene is the primary marker of a high-energy event. Whereas other monitors can provide basic information identifying acetylene in the transformer, TOTUS delves deeper into arcing activities, identifying the phase and winding, as well as visibility on the number of arcing events. The key benefit is the ability to correlate data and generate a deeper understanding of the transformer.



Transformer Analytics

The TOTUS Transformer Analytics module provides reliable diagnostic and prognostic guidance on transformers based on IEEE and IEC loading guides.

By combining data from sensors, nameplate details and factory test results, TOTUS is able to run thermal models to estimate transformer remaining life as well as assess overloading capabilities. A specific moisture-package provides bubbling temperature, online breakdown voltage and moisture in paper estimation by using the moisture in oil data.



With Camlin as your asset management partner, we support you on your entire asset management journey, from scoping out the ideal transformer monitoring solution for your assets, delivery and installation of the monitoring equipment, to long-term support to ensure you derive the maximum benefits from your investment.

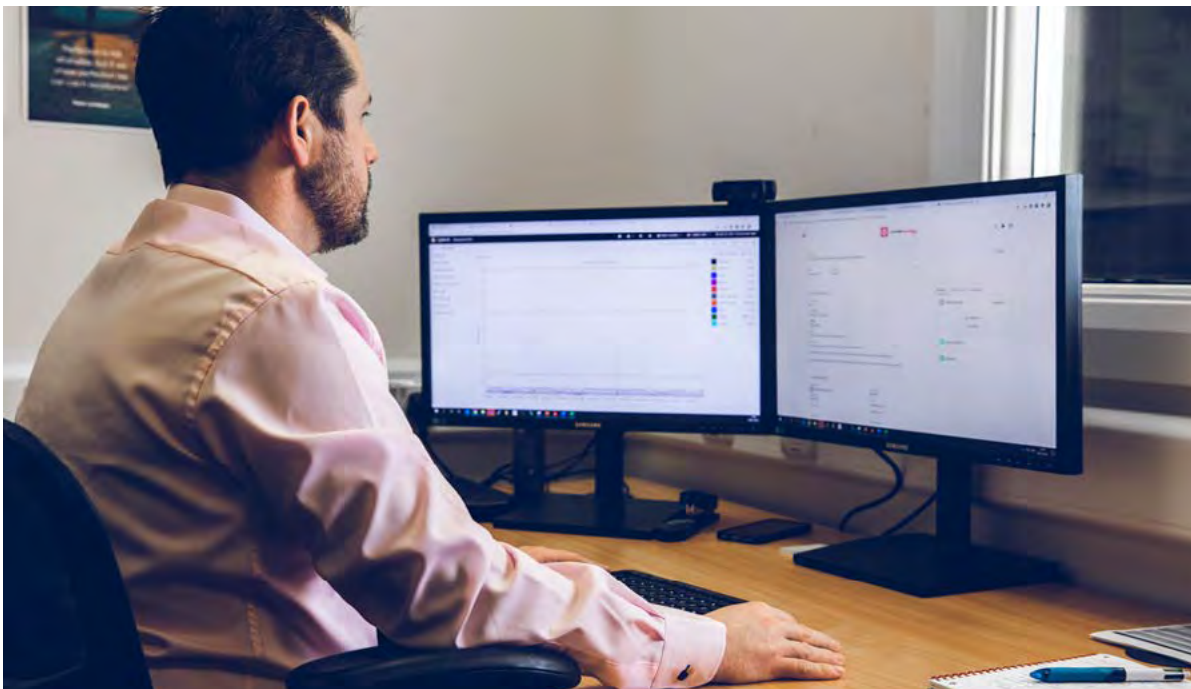




Turnkey delivery

To ensure the success of your investment in real-time asset monitoring capability, our we offer a focused service from procurement through to installation & commissioning.

Every customer has a dedicated project manager, whose role is to ensure all aspects of a project are aligned to our customers' core business needs. Our field co-ordination teams work with you to ensure all onsite requirements are met, including custom product configuration and detailed planning and scheduling.



Customer Support Portal

Developed in partnership with our customers, our Customer Support Portal hosts a wealth of real-time information covering assets, work orders and technical support cases.

Our customers can chat live with their dedicated Camlin Agent, get answers to questions in real time and access our knowledge centre for key learnings and information on best practice.



Optimising Critical Infrastructures

With a history stretching back over 30 years, the foundations of the Camlin business are built on a core belief that innovation is key to driving improvements in the energy industry. We have been at the forefront of key innovations that have changed the face of the industry – including digital fault recorders; digital circuit breaker analysers; advanced protection systems and network automation technologies. Camlin continues this track record of innovation, developing innovative and intelligent monitoring products and services that help make electricity networks safer, more efficient, resilient, and sustainable.

Key asset management products and services



Holistic Asset Monitoring

Transformer, circuit breakers and rotating machines



Digital Solutions

Advanced analytics providing prescriptive actions on asset health



Asset Condition Assessment

Building a full picture of asset health



Expert Services

Focused seminars and training aimed driving knowledge sharing

We believe in leveraging our partners existing platforms and technology, partnering this with new developments to provide expert analysis into asset condition and translating diagnostic data into prescriptive actions. With headquarters in the UK, Europe, US and China and facilities in 21 cities across 17 countries, we are set up to deliver globally.



We want to ensure our customers see real value from monitoring technology.



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