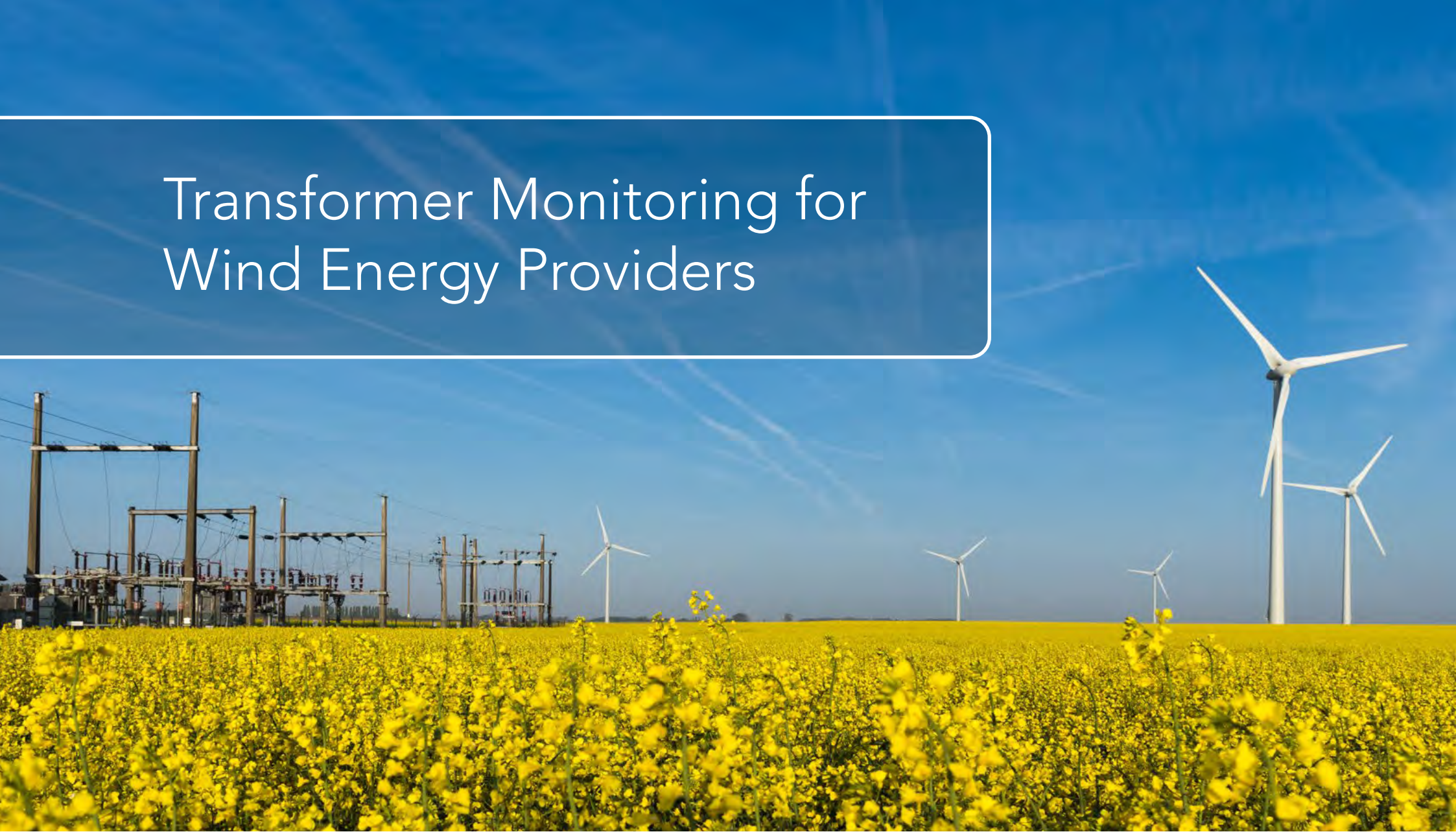
# Transformer Monitoring for Wind Energy Providers



kelvatek
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Reducing risk and maximising availability for wind power generation

# Safeguarding your connection to the electricity grid

With production of wind energy set to grow exponentially in the UK to meet net-zero targets by 2050, availability and uptime of assets are of key importance to wind farm owners and operators. And with many onshore and offshore sites located remotely, it is essential to understand how assets are performing and be aware of potential issues before they impact operations.

Among the most critical of these assets are transformers which connect renewable generation facilities to the electricity grid - if a transformer suffers an outage, this can result in partial or even complete loss of generation for a prolonged period, significantly impacting revenues. The intermittent nature of wind energy generation places increased stress on these transformers.

By partnering with Kelvatek, wind farm owners and operators can gain a deeper understanding of the risk, health and performance of their transformers through our online monitoring solution TOTUS.

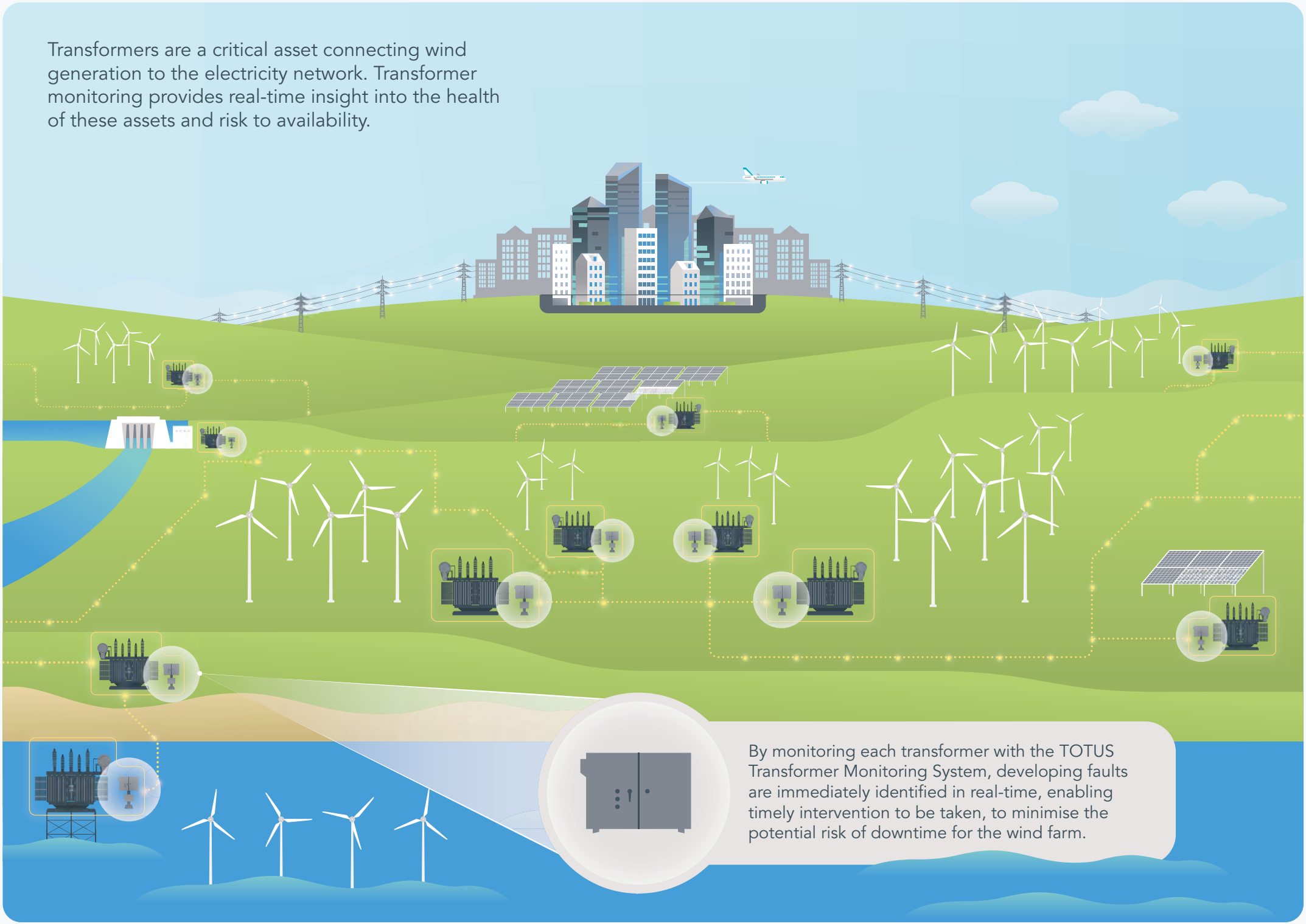
TOTUS monitors the most critical components of a transformer and is the only modular solution which encompasses Dissolved Gas Analysis (DGA), Partial Discharge (PD), Bushing Monitoring (BM), Through Fault Currents (TFC) and Transformer Analytics.

**Over 1,700 TOTUS monitoring solutions installed at world leading energy utilities, data centres and renewable generation plants**

This enhanced level of monitoring and insight enables Asset and Operations managers to develop and optimise proactive maintenance strategies which

- Significantly reduce the risk of sudden transformer failure and associated costs and lost revenues
- Improved availability and uptime for wind energy generation
- Allow staff to focus resources on optimising the wind plant's energy generation

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



By monitoring each transformer with the TOTUS Transformer Monitoring System, developing faults are immediately identified in real-time, enabling timely intervention to be taken, to minimise the potential risk of downtime for the wind farm.

## The Challenge:
Reduce risk of unplanned downtime

- Understand the health and risk of transformer assets
- Managing multiple transformers often in remote locations
- Avoiding unnecessary intervention and servicing
- Knowing the correct action to take and when to take it
- Managing insurance and associated costs
- Shortage of transformer experts and dedicated resources

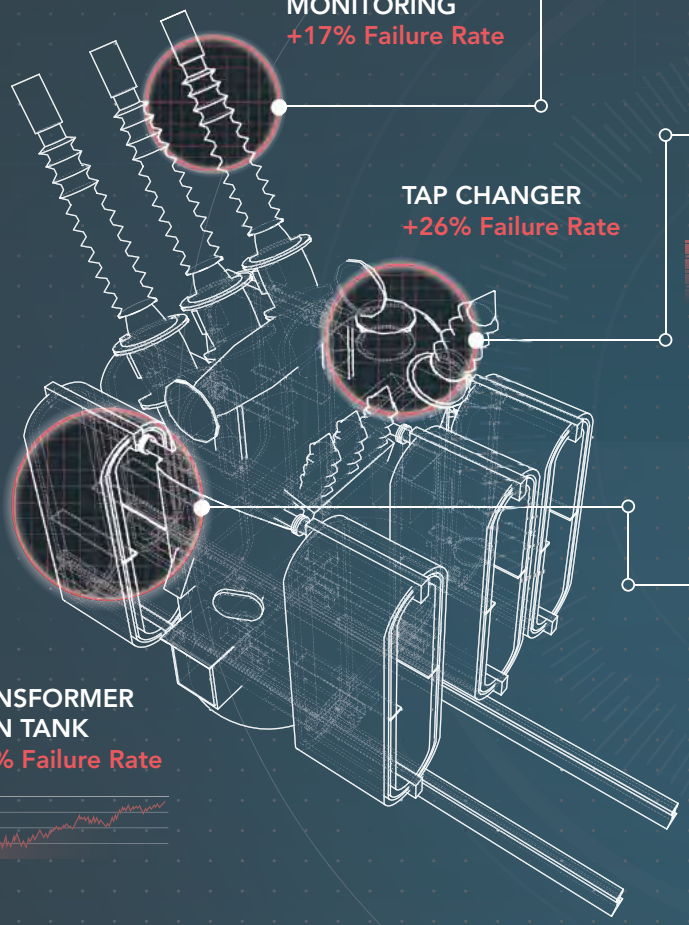
## The Solution:
Total transformer monitoring

- 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 prescribed – reduced need for in-house transformer experts
- Sophisticated data analysis tools and transformer models that cut through data noise to the real issues
- 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 parameters to give the most complete picture of transformer health in a single integrated solution (DGA, PD, Bushings, and Through Fault Current)

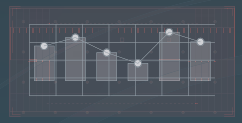
## The Result:
Optimal transformer uptime

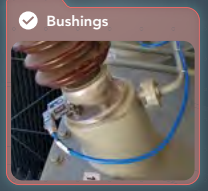
- The risk of sudden transformer failure is significantly reduced, protecting availability KPIs
- Resources are focused only on those transformers which represent a risk and preventative maintenance resolves faults before they become serious issues
- Condition-based maintenance avoids unnecessary intervention and servicing of healthy assets reducing operational expenditure
- Asset Managers receive the relevant information to make immediate decisions, reducing the volume of data that needs to be interpreted
- Risk is understood for insurance purposes, potentially creating savings
- Staff can focus on maximising energy generation, safe in the knowledge that critical transformer assets will be available to deliver renewable energy to the grid

# TOTUS
# MONITORING CAPABILITIES



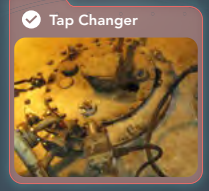
## BUSHING MONITORING
+17% Failure Rate





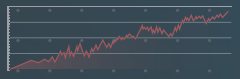

- Partial Discharges
  - Dedicated trend for Partial Discharges in bushings
  - Arcing events
- Leakage Current
  - Currents amplitude and phase
  - Current polar plot
- C1/PF
  - Tandelta/PF variations
  - C1 and C2 variations
- Others
  - Temperature
  - Load
  - Humidity

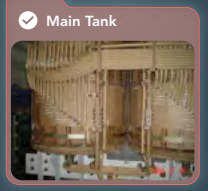
## TAP CHANGER
+26% Failure Rate




- 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

## TRANSFORMER MAIN TANK
+40% Failure Rate






- 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

# Technology spotlights

## Dissolved Gas Analysis

Providing a DGA profile of 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 an embedded and 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

TOTUS is the only system in the market 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 interface uses the innovative 'PD Triangle' for a 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 electrodynamic 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/arcing) enables Asset Managers to detect a fault in its inception. This allows an action to be taken before reaching a critical and irreversible condition. TOTUS monitors the following parameters in 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. This helps identify 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 developing fault.

## 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 can 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.

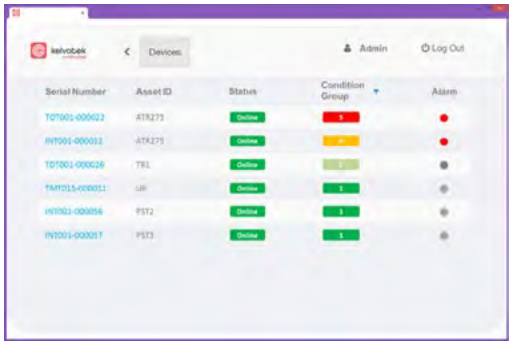
# Actionable information at your fingertips

### A modular approach to software

Customers have the option to expand software options depending on maintenance strategies. The TOTUSPRO Desktop is an optional expert tool with the ability to import offline data for deeper investigation into failure modes, while TOTUSPRO Access provides asset managers with a full fleet view.

Our TOTUSPRO Software Suite consolidates data from our hardware devices to provide a clear picture of asset health and fleet health, reducing unplanned outages, boosting production, and increasing operational efficiency.

## TOTUSPRO ACCESS

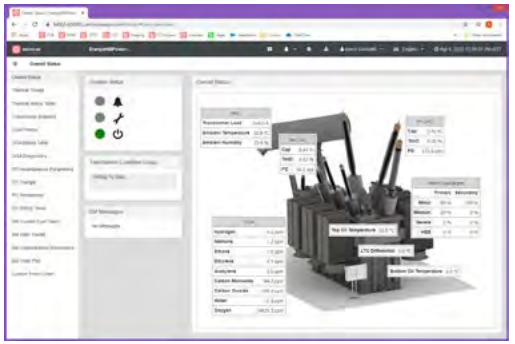



The TOTUSPRO ACCESS module immediately highlights which transformers are the greatest risk, sends email notifications, allowing Asset Managers to make decisions across the entire transformer fleet.

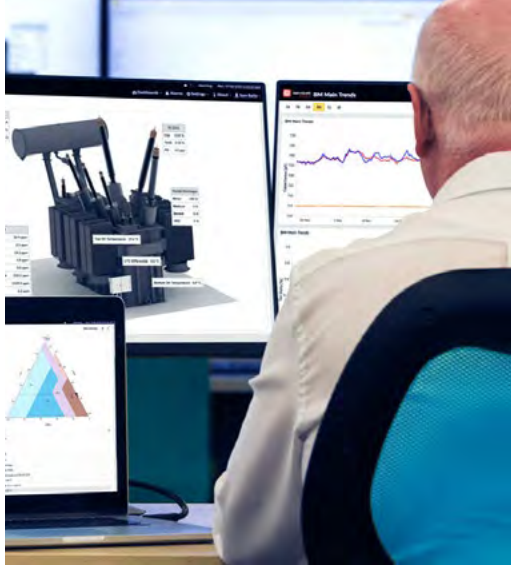
## TOTUSPRO DESKTOP

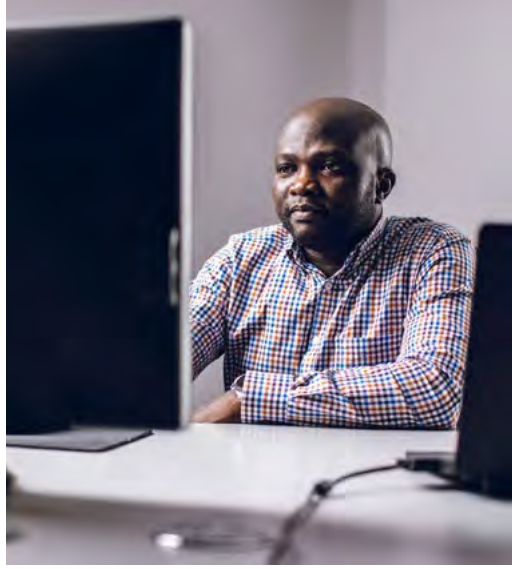
TOTUSPRO Desktop, an optional expert tool for deeper investigation on failure modes, providing customisable widgets and the ability to import offline data archives.

## TOTUSPRO WEB



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





## Independent expertise

Our transformer experts are on hand to support you throughout your transformer asset management journey. Our in-depth reporting and expert advice provide an independent assessment of transformer.

## Expert consultancy

Pre-procurement design review for a new transformer to ensure requirements and planned performance is clearly understood by both parties (customer & transformer OEM).

Independent technical support for factory acceptance tests of new transformers at the transformer OEM facility.

On-site asset inspection (e.g., for investigation of issues, or for potential improvements to operation).

Forensic investigations following a serious or catastrophic transformer failure.

## Condition assessments

The automated monitoring service available through the 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 full asset history that enables the earliest detection of any defects. Event diagnostics allow a rapid in-depth assessment following a significant alarm or detection of a defect and determines whether the continued operation is safe as well as recommending any interventions.

## Knowledge sharing

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

Performing the correct action based on the monitored data is often the most difficult step, even for experienced Asset Managers. Whilst our experts are on hand to support decision making, through our academic seminar programme you can access exclusive content to advance knowledge and expertise which enables better decision making.

# Your expert partner

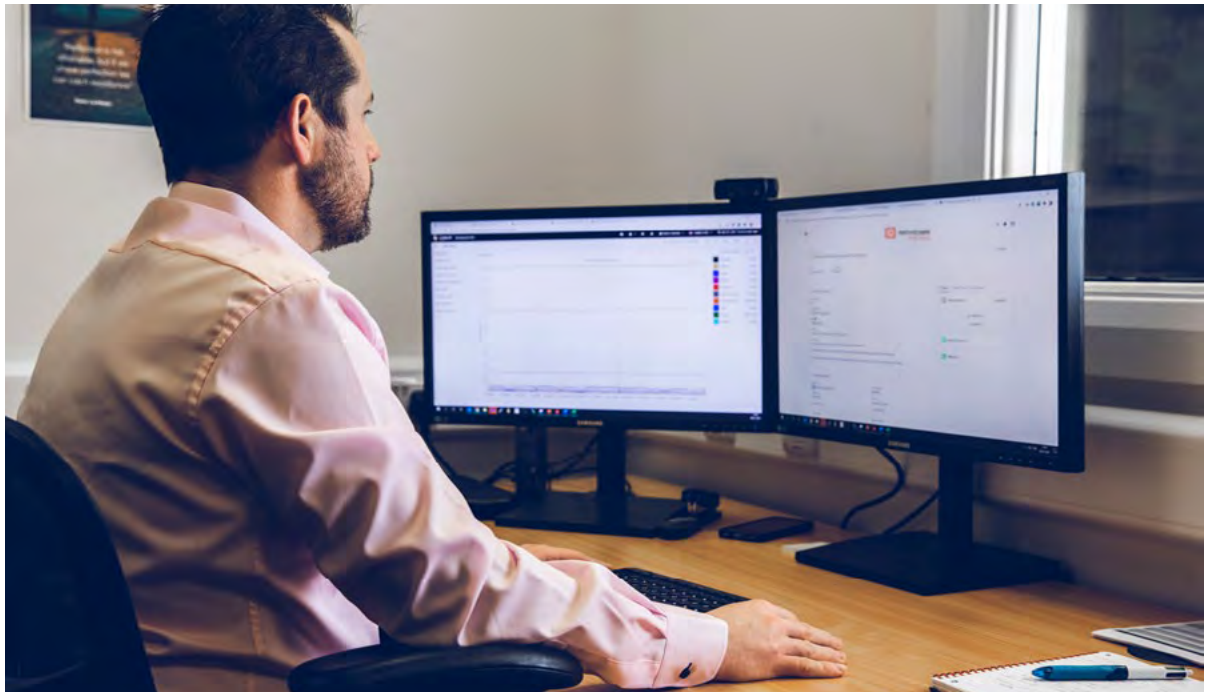
As a trusted partner, we support you on your entire asset management journey - from scoping out the ideal transformer monitoring solution for your assets, delivery and installation of the monitoring equipment, and long-term support to ensure you derive the maximum benefits from your investment.

We ensure that you always have access to the latest improvements in asset monitoring technology. Our goal is to provide you with the tools you need to solve problems and access knowledge in real-time about your assets.

You get access to decades of transformer expertise already built into our transformer analytics tools as well as one-on-one expert support through our customer support platform.

## Turnkey delivery

To ensure the success of your investment in online asset monitoring capability, 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 coordination 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 information covering assets, work orders and technical support cases.

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



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For over two decades, Kelvatek has been working collaboratively across the UK & Irish Energy industry. Our vision is to help build a smarter, more sustainable future through our highly accurate ability to target interventions and investment, all while minimising unplanned interruptions. Underpinning this is our industry-leading solutions and services for Fault & Load Management, Asset Monitoring and Biogas & Gas Monitoring.

Data – and the insight it provides – drives everything we do. The powerful insights we deliver from our clients' data allow them to maximise returns from current network investments, make strategic decisions, deliver improved customer outcomes, and embrace the opportunities of net-zero. The data we collect is transparent and open, putting Network Operators firmly in control of their networks.

We exist to engineer better futures. You'll see that commitment reflected in initiatives to make our operations more sustainable and to help our customers on their journey to net-zero.

Kelvatek is part of the Camlin Group which has a worldwide presence with facilities in 21 cities across 17 countries. Camlin's goal is to optimise the critical infrastructures that people, cities, and communities around the world depend on, all day and every day.

- Asset Monitoring
- Fault & Load Management
- Biogas & Gas Monitoring

# Contact Details

## Group Headquarters

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