WHITE PAPER

Data centers

Energy efficiency and management

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1. Introduction

Building a highly efficient data center is demanding. It's also difficult to get the information the operator needs to make decisions.

Data centers consume a lot of energy - some 3.5 to 4% of total global energy use [1] - and the number of data centers is growing [2].

That means reducing the carbon footprint of data centers is vital.

Green and efficient data centers are vital if this growth is to be permitted without the CO_2 emissions increasing to a great extent.

The most important parameter of data center energy efficiency is power usage effectiveness (PUE) [3]. This metric, developed by ASHRAE and the Green Grid, is calculated like this:

Data Center PUE
(Power Usage Effectiveness)

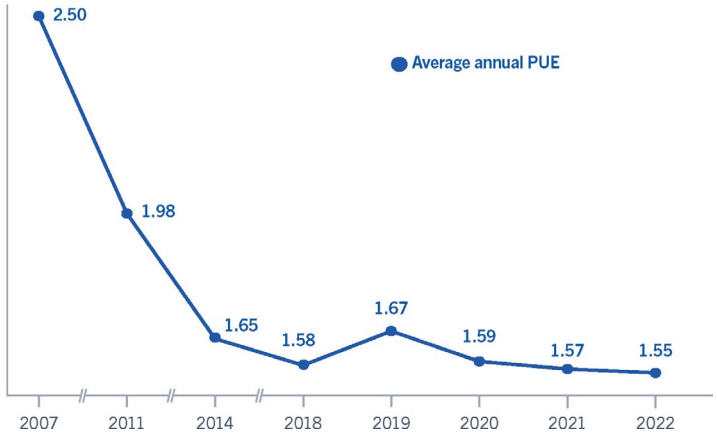
$$PUE = \frac{\text{Total facility energy}}{\text{IT energy}}$$

Total facility power

Power losses	**Cooling**	+	**IT equipment**
- batteries	- chillers		- servers
- transfer switch	- chilled water pump		- storage
- UPS	- cooling towers		- telco
- PDUs	- condenser pumps		- etc
- transformers	- dry coolers		
- rack distribution units	- CRACs & CRAHs		
- breaker panels	- fans		
- distributed wiring	- humidifiers		
- lighting	- in-row coolers		
- generators	- in-rack coolers		
- etc	- in chassis cooling		
	- etc		

According to a study by the Uptime Institute [4], the PUE levels of data centers have been decreasing.
That means actions must be taken to increase the efficiency of data centers during their operating life.

PUE values

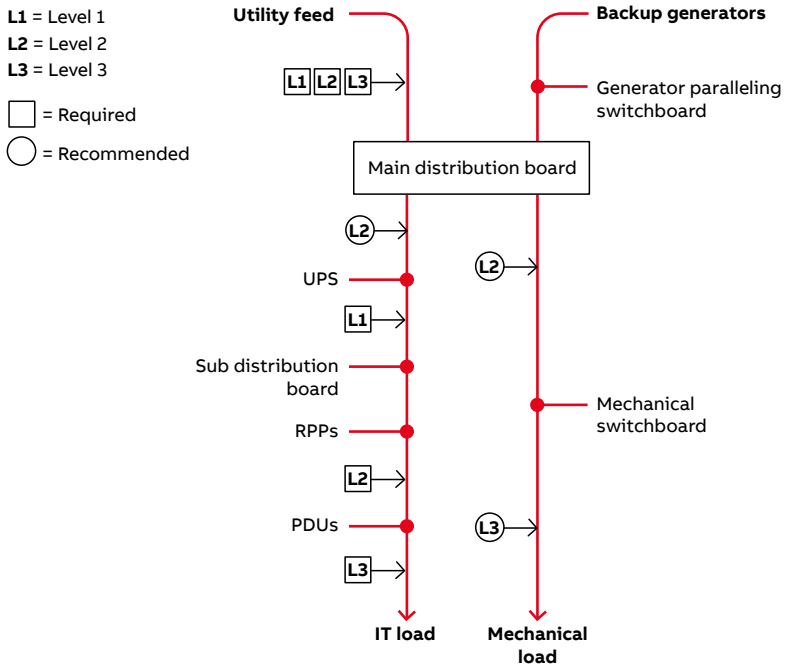


Another important parameter to consider is the measurement level, which depends on where measurement devices are located [5].

PUE is measured at three levels:

Measurement		Total facility energy	IT equipment energy	Measurement interval
Level 1 (L1) Basic	Required	Utility input	UPS output	Monthly
	Recommended	Utility input	UPS output	Weekly
Level 2 (L2) Intermediate	Required	Utility input	PDU outputs	Daily
	Recommended	Utility input UPS input/output Mechanical inputs	PDU outputs	Hourly
Level 3 (L3) Advanced	Required	Utility input	IT equipment input	Every 15 minutes
	Recommended	PDU outputs	IT equipment input	Every 15 minutes or less

Location of the measurement equipment



Standard EN 50600-2-2 for data centers requires measurement of voltage, current, power, energy and power factor to 1% accuracy.

In addition, it recommends measuring total harmonic current distortion and total harmonic voltage distortion (THCD and THVD) [5].

Energy efficiency is not easy to achieve and having the right measurements is of paramount importance. The requirements include:

- Measuring devices in the right positions
- High-precision measurement
- Fast and simultaneous data acquisition

Last but not least, the data must be analyzed and represented in the right way. The more accurately these requirements are fulfilled, the more the owner of the data center can be sure that the PUE value corresponds to reality.

The tiniest variation in the PUE value, risks several inconvenient consequences, including

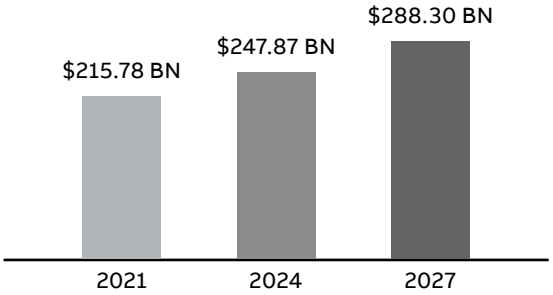
- The impossibility of measuring the energy efficiency of the data center. Difficulty in allocating power to the IT loads.
- The impossibility of planning installation upgrades promptly and effectively

ABB offers a flexible and unique solution that meets all customer measurement requirements while ensuring, accurate readings.

With the right information, it is easy to achieve correct power monitoring and capacity planning to improve the energy efficiency of a data center.

2. Sustainability

2.1.1 Sustainability in data centers



2021-2027 CAGR 4.95%

The need for sustainable data centers is vital owing to the unprecedented increase in data. Society demands computation of a vast amount of information, which grows every year. This growth leads to the expansion of data centers. According to recent research, such as Arizton's global data center market forecast [2], this trend does not appear to be slowing, but increasing exponentially

Sustainability embraces different aspects of a data center, including:

- economic aspects: demands for less usage of resources
- environmental aspects: the need for less environmental impact
- technical aspects: growing usage of long-lasting systems.

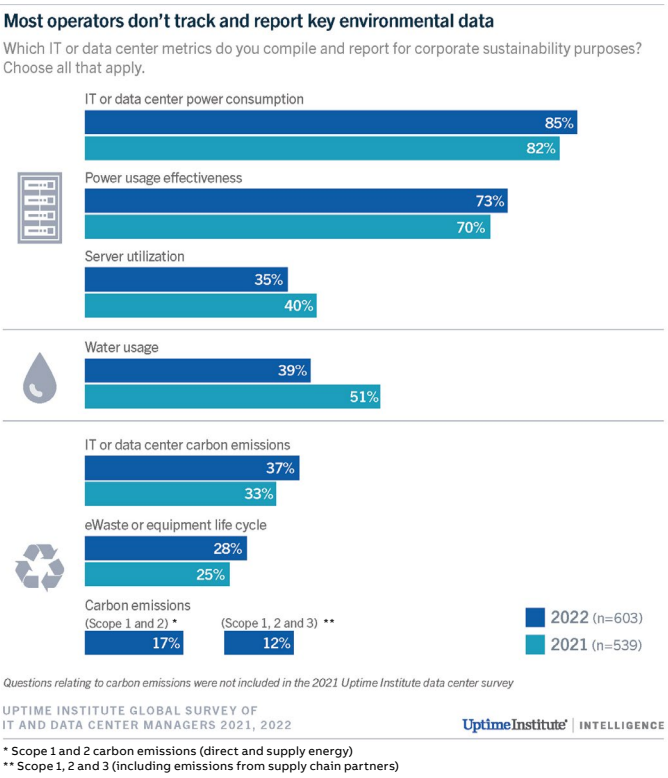
Many studies underline that the right approach is holistic. Resources cannot be considered independently because they are strictly connected. For example, an increase in productivity requires less energy consumption, heat dissipation and space occupancy, as well as less hardware, which has an impact on the environment.

The first step is to understand the sustainability level of the data center, for which a set of measurements is required. As indicated in the Uptime [4] survey, most data center operators collect power data for energy-efficiency purposes with the aim of reducing operating costs while as yet, few data center operators collect data that can be used for calculating carbon emissions.

Another important issue championed by governments is water consumption, even when the data center is not located in a place subject to drought. As the trend is a continuous increase in power density hardware, cooling systems will have to become more efficient. There are already 15MW data centers where water consumption equals that of 3 medium-size hospitals [6]. While air-cooling systems have reached their limit, water-cooling systems offer better heat transportation as well as better quality heat for reuse, which improves the sustainability of the data center.

Another important issue to monitor is the creation of waste, since most of the components of a data center become rapidly outdated and must be replaced if that data center is to continue to function efficiently. Microsoft stated in 2020 that the average life-cycle of the components used in data centers was about 5 years. Two techniques could improve this issue: designing long-lasting systems and implementation of a circular economy with increased recycling of materials. Sustainability studies should also involve the supply chain because the pollution generated during data center operation may be negligible compared to the pollution generated by suppliers during the production of components. It is therefore clear that the selection of suppliers is of fundamental importance if the sustainability of data centers is to be increased.

Monitoring and reporting of key environmental data by operators



* Scope 1 and 2 carbon emissions (direct and supply energy)
** Scope 1, 2 and 3 (including emissions from supply chain partners)

ABB is the right partner for sustainable data centers and can support data center tenants in many ways.

- ABB provides solutions compliant with ISO 50001 for monitoring all the parameters required for sustainability assessment, such as energy and water consumption, estimation of CO_2 emissions, etc.
- ABB provides components designed for long life. For example, ABB protection devices can be upgraded over time. This means that the electrical distribution system will continue to be enriched by new functionalities for increased efficiency of the installation.
- ABB invests in sustainability and works towards the implementation of sustainable practices across the whole value chain and life-cycle of products and solutions.

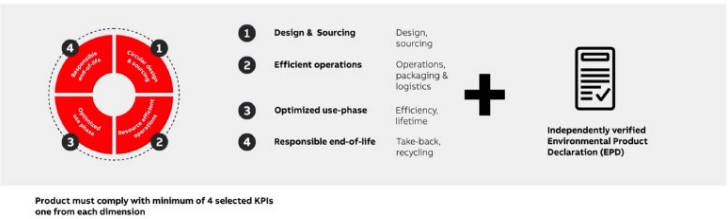
ABB sustainability

ABB EcoSolutions

ABB applies life-cycle assessment to ascertain the environmental impact associated with all stages of the life cycle of a product:
1. Manufacture
2. Distribution
3. Installation
4. Usage
5. End-of-life.

ABB products are packaged in recyclable materials to promote the reduction of waste sent to landfill. e.g. wood and cardboard.
The environmental product declaration is available for all ABB products, including product carbon footprints and a section dedicated to end-of-life, thereby contributing to credits for sustainability protocols such as LEED.
Moreover, to support our customers' circularity pathways, we have created a new product label, ABB EcoSolutions, which provides full transparency on the circularity value and environmental impact of our products. ABB EcoSolutions products comply with a minimum set of key performance indicators defined in ABB's circularity framework and carry either an environmental product declaration (ISO 14025) or an independently verified product-lifecycle assessment (ISO 14040).

Criteria for ABB EcoSolutions™ label



2.2.2 Energy efficiency direc - tives for data centers

Governments and organizations are concerned about the increasing demand for energy from data centers. They have implemented energy efficiency directives aimed at reducing the energy consumption of data centers while maintaining their performance. Some of the key directives include the European Commission Directive 2023/1791, US programs, and Chinese regulations on power usage effectiveness (PUE).

Article 12 of the European directive 2023/1791[1] focuses on reducing the carbon footprint of data centers in the European Union. It requires owners and operators of data centers within member states with a power demand of at least 500kW to publicly disclose information relevant to the energy performance and water footprint. They have to report their data center's energy performance for the previous year into a European database, starting May 15th, 2024. Member states encourage data centers with a power demand of 1 MW or more to adhere to the most recent version of the European Code of Conduct on Data Centre Energy Efficiency best practices.
The collected data and the sustainability indicators should give confidence about actual improvements following efforts to increase sustainability of new or existing data centres.

The most important measures suggested by the European Code of Conduct on Data Center Energy Efficiency[2] are:

- Monitoring and management of data center energy and environmental factors.
- Using efficient cooling systems to optimize cooling.
- Using of energy-efficient IT hardware and equipment.
- Virtualization and consolidation of servers to reduce energy use and improve IT utilization rates.
- Effective measurement and management of power loads to reduce waste and improve efficiency.
- Regular maintenance and optimization of critical infrastructure equipment like backup generators, power distribution units, and batteries.
- Implementation of efficient power distribution systems and use of renewable energy sources.
- Implementation of energy-efficient infrastructure design and layout to maximize cooling and reduce energy consumption.
- Collaboration and engagement with vendors, clients, and partners to promote energy efficiency and sustainability.
- Utilizing energy-efficient lighting systems and optimizing automation systems to reduce unnecessary energy consumption.

In the United States, several programs and initiatives have been implemented to promote energy efficiency in data centers. One such example is the Energy Star program, launched by the Environmental Protection Agency (EPA), which provides a benchmarking tool and provides guidelines to help data center owners measure and improve their energy efficiency[3]. Another initiative is the Data Center Optimization Initiative (DCOI)[4], which requires federal data centers to implement measures to improve energy efficiency and reduce costs.

Finally, the Green Grid[5], a non-profit consortium of technology companies, promotes energy-efficient and sustainable computing through development of open standards and metrics for data center efficiency. All of these programs and initiatives are contributing to significant improvements in data center energy efficiency in the US.

In China, the government launched in January 2024 a three-year action plan to promote the use of data usage in 12 sectors[6], part of the wider 'Digital China' plan. Together with this there is a great attention to creation of green high-quality "new infrastructure", a term that refers to digital-age assets like data centers and 5G networks[7]. Chinese government has implemented regulations that set strict energy efficiency standards for data centers. These standards include a PUE of 1.3 or less in 2023 for large data centers and the use of energy-efficient technologies such as virtualization and cloud computing. Additionally, the Chinese government provides financial incentives to promote the adoption of energy-efficient practices by data center operators. Overall, these energy efficiency directives demonstrate a global commitment towards reducing the energy consumption of data centers. By encouraging the adoption of energy-efficient technologies and practices, data centers can minimize their carbon footprint while maintaining high levels of performance and reliability.

Sources:
1. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:JOL_2023_231_R_0001
2. https://e3p.jrc.ec.europa.eu/sites/default/files/documents/publications/jrc132576_jrc132576_jrc_2023_best_practice_guidelines_v14.1.0final_gt1.pdf
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4. https://www.cio.gov/policies-and-priorities/DCOI/
5. https://www.thegreengrid.org/
6. https://english.www.gov.cn/news/202401/05/content_WS65973ab3c6d0868f4e8e2c44.html
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3. Energy efficient data centers with ABB

Highly efficient ABB devices ensure the highest efficiency for power distribution, including transformers, UPS systems, cables, and protection and switching devices. Thanks to 97.4% UPS efficiency, highly efficient power supply products and the right power supply design, usual **20% power distribution losses can be cut to just 5%.**

In addition, ABB offers measurement, monitoring and control solutions for further efficiency increases.
Protection devices with embedded metering are capable of measuring and controlling all electrical parameters on all distribution levels, with high flexibility and class 1 accuracy according to standard IEC 61557-12. Having embedded functionalities provides the following advantages:

- No need for additional relays and measurement devices, for simplicity and saving time
- High-level flexibility thanks to 7 embedded communication protocols
- Simple and effective cloud connectivity
- Increased reliability thanks to fewer devices and connections
- Rapid design, installation and integration.

The most important information from the devices can be easily viewed and monitored 7 native communication protocols to ensure easy integration in any supervision system.

ABB has tailored solutions for any PUE level defined by the data center standards, enabling data centers to be managed correctly and overall energy efficiency to be increased.

Intelligent distribution offering for data centers

ABB components are modular, thus it is easy to create scalable solutions for intelligent distribution in data centers.
To support customers, ABB has already pre-defined offering bundles. Customers can choose from Essential, Enhanced, and Advanced packages, depending on their preferences and the type of data center.
Offering levels will be differentiated according to monitored load types, devices, and their measuring and communication capabilities. Local or cloud interface systems for monitoring and control will be described separately and are left as optional at each offering level.

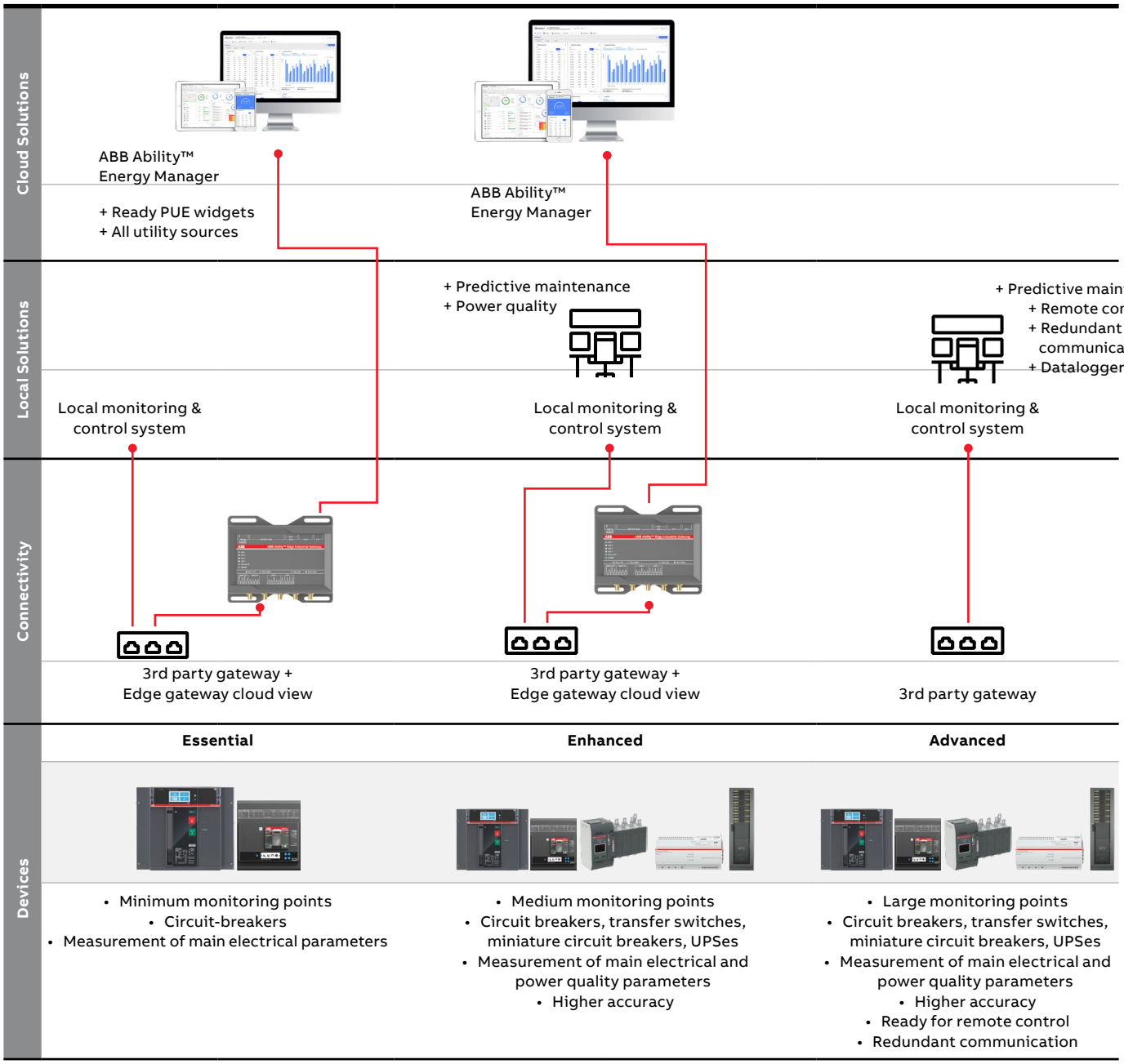
- **The Essential offering** | Provides metering for Incoming and IT loads. The ability to monitor PUE is provided with this solution. It could be the perfect choice for small installations like the private server rooms of industrial plants. This creates awareness about the energy efficiency status of the data center.
- **The Enhanced offering** | Enables metering and power quality monitoring of usage by zone. It provides a broader view of power consumption and power quality issues for a larger number of measuring points. This helps to attain energy efficiency goals and optimize maintenance.
- **The Advanced offering** | Provides complete monitoring and control functions. It consists of a complete package for metering consumption and ready-made infrastructure for remote control with redundancy in communication. This helps to maximize energy efficiency with up to capillary monitoring.

For Application packages we choose as default communication protocol Modbus TCP. It provides optimal communication performance and is simple, open and interoperable with the different vendors' devices thanks to use of a standard Ethernet basis. Its client-server architecture enables it to communicate with multiple supervisory systems at the same time. The other communication options will be discussed on page 21.

ABB pre-designed packages provide lots of advantages:

- Project design time reduced by up to 80%. The package is already defined and can be easily customized if necessary.
- Reduced project risk as digital connectivity is tested by ABB.
- Scalability. Thanks to their modular design, ABB components ensure adaptability to different projects.
- Upgradability. All packages can be upgraded at any time without the need to change hardware, but by adding advanced functionalities available from the ABB marketplace. This can result in up to 70% reduction in maintenance costs for upgrading the electrical system.

The table below contains an outlineof all the available pre-defined packages for intelligent distribution in data centers.



—
Communication with SACE Emax 2 air circuit breakers

—
Ekip G

3.1. The Essential data center monitoring solution

To obtain the basic level of measurements, which is the minimum required for assessing PUE, the main incoming breakers and downstream breakers of UPSes equipped with measuring capabilities can be used without any additional measuring device. This reduces the number of components in the system and simplifies the wiring. Emax 2 and Tmax XT circuit breakers, which must be chosen according to electrical characteristic requirements, should be equipped as indicated in Table 1. This enables the breakers to measure current, voltage, frequency, power, energy, power factor and peak factor with the precision indicated below and to connect, via the Modbus TCP protocol, to any monitoring system.

Thanks to special trip unit Ekip G Touch, the circuit breakers can provide special protection for generators such as loss of excitation (ANSI 40) or active overpower protection (ANSI 32OF). In addition to the protection provided by generator suppliers, this enables redundancy and a more reliable system.

Although this solution is simple and has a low initial cost, very little information about the energy consumption of the data center is available since only two measurement points are installed. Consequently, there is little room for improving the overall efficiency and reliability of the data center.

Table 1. Package Accuracy

Current (RMS)	1%	Frequency	0.2%	Power factor	2%
Earth fault current (RMS)	2%	Active power	2%	Active energy	2%
Phase-phase voltage (RMS)	0.5%	Reactive power	2%	Reactive energy	2%
Phase-neutral voltage (RMS)	0.5%	Apparent power	2%	Apparent energy	2%

Table 2. Essential level

Product family	ABB product	Trip Unit	Measuring	Communication	Accessories
Air Circuit Breaker	Emax 2 - E1.2...E6.2	Ekip Touch	Measuring Package	Ekip Com Modbus TCP	Ekip Supply
Air Circuit Breaker	Emax 2 - E1.2...E6.2	Ekip G Touch (1)	Available	Ekip Com Modbus TCP	Ekip Supply
Moulded Case Circuit Breaker	Tmax XT - XT7/ XT7M	Ekip Touch Measuring (1)	Available	Ekip Com Modbus TCP	Ekip Supply
Moulded Case Circuit Breaker	Tmax XT - XT2, XT4, XT5	Ekip Touch Measuring	Available	Ekip Com Modbus TCP INT (2)	-
Moulded Case Circuit Breaker	Tmax XT - XT2, XT4, XT5, XT7/XT7M	Ekip Touch	-	-	-

(1) Ekip G-Touch and Ekip Touch Measuring already include the Measuring Package.
(2) At this offering level and since there is no need for any other cartridge modules, Ekip Com Modbus TCP for XT2, XT4, XT5 frames has been chosen as the internal version. This internal module is mounted inside the breaker and needs an external 24 VDC supply.

The Essential data-center monitoring solution

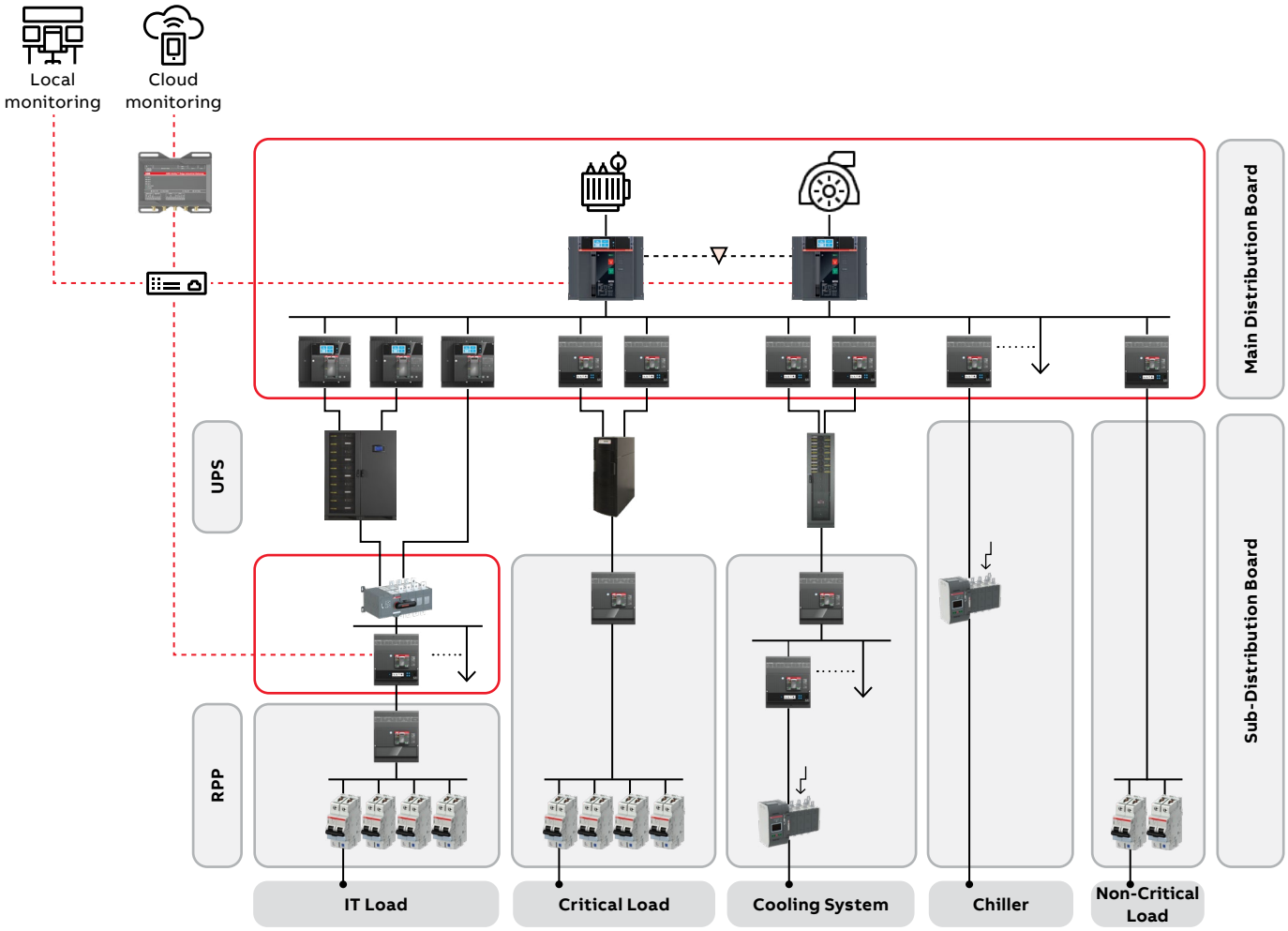


ABB Ability™ Energy Manager

3.1.1 ABB Ability™ Energy Manager

ABB Ability™ Energy Manager is a digital solution for monitoring and optimizing your energy consumption and CO2 footprint. It enables you to make faster and better decisions based on data insights. It is a ready-to-use solution based on the Software-as-a-Service business model and features pre-engineered functionalities.

Devices can be connected to the platform so as to share data with products (equipped with Ekip Com Hub) or with ABB Ability™ Edge Industrial Gateway via Modbus RS-485 and Modbus TCP/IP. If there is already a local monitoring and control system (BMS, Scada, EPMS, etc.) in the data center site, thanks to ABB Ability™ Edge Industrial Gateway and the Modbus TCP communication protocol, ABB Ability™ Energy Manager can be used simultaneously for the additional functions it provides.

Edge Industrial Cloud View

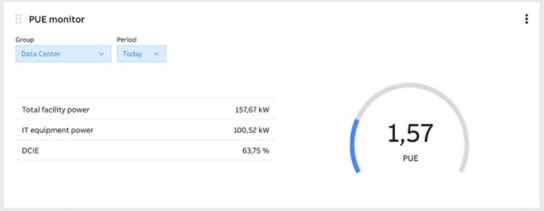
By connecting to the cloud you can unlock data and obtain insights about the energy consumption of the site and health of assets.
Key features:

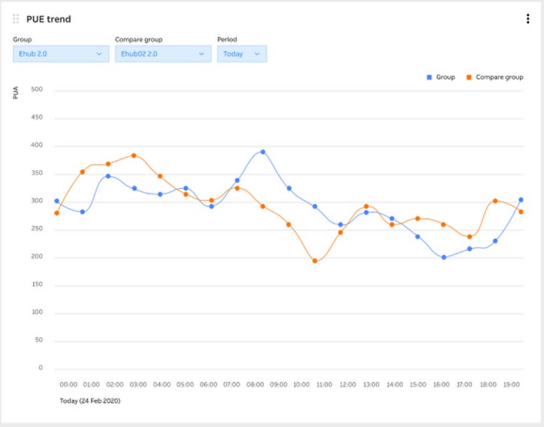
- Access to the data anywhere, anytime
- Live predictive maintenance curve.
- Benefits from the highest security standards and comprehensive services.
- Flexible and scalable user and subscription management.
- Alerts and alarms, feedback via email or SMS
- Scheduled and more detailed reports.
- Scalable, from a single site to a multi-facility system and more.

Both digital and analog sensors for measuring environmental parameters (temperature, humidity) and meters for other utility consumptions (water, gas) can be connected via the gateway. This function becomes very important considering the criticality of water consumption in the sustainability plans of a data center.

A data center-specific pre-configured dashboard is also available. Users can view all the information about their data center, such as input and output power, energy trends, peak power and more. It can also be upgraded with specific widgets to monitor PUE thanks to the **data center energy package add-on.**

PUE monitoring through data center energy package add-on

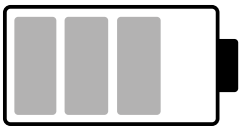




The load grouping feature enables the plant overview to be customized in a fast and flexible manner. For example, all the cooling load protection devices can be grouped together to enable the cooling load consumption values to be viewed while maintaining visibility of individual values.

Using the **power protection insight add-on**, the user can also monitor the main UPS parameters, such as real time current/voltage/power, battery status and the UPS status/alarm panel. Continuous monitoring of the UPS parameters helps to prevent damage to servers and other electronic equipment susceptible to voltage and frequency anomalies. In addition, keeping a check on the battery status can help to detect failures.

Monitoring of UPS parameters and battery status through our power protection insight add-on



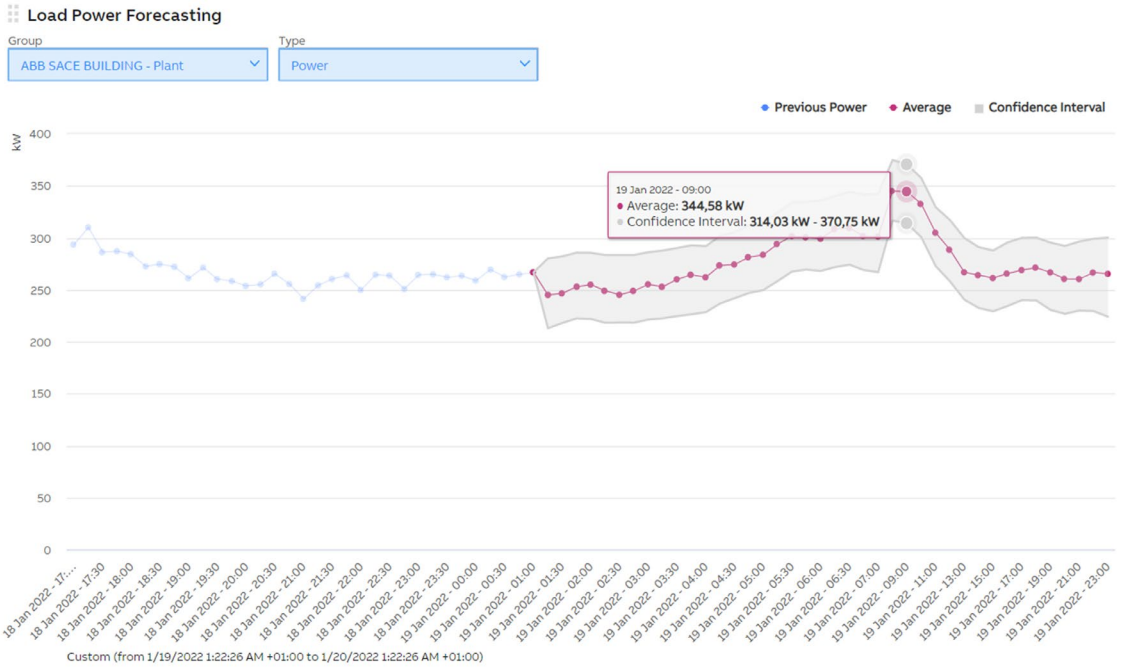
Battery Level
63%

UPS Temperature
27°C

UPS Battery Status

Phase	Input Voltage [V]	Input Current [A]	Input Power [%]
L1	194 / 132 / 100 / 260 — **399 V**	2400 / 800 / 0 / 4000 — **0 A**	No data
L1	194 / 132 / 100 / 260 — **400 V**	2400 / 800 / 0 / 4000 — **0 A**	No data
L1	194 / 132 / 100 / 260 — **401 V**	2400 / 800 / 0 / 4000 — **0 A**	No data

Load power forecasting add-on for learning energy consumption patterns



To improve energy management decisions and achieve energy cost savings, our platform not only supports you with historical data but also with a **load power forecasting add-on** that provides an advanced forecasting algorithm capable of learning the energy consumption patterns of a whole plant or defined consumption areas.

—
Network Analyzer

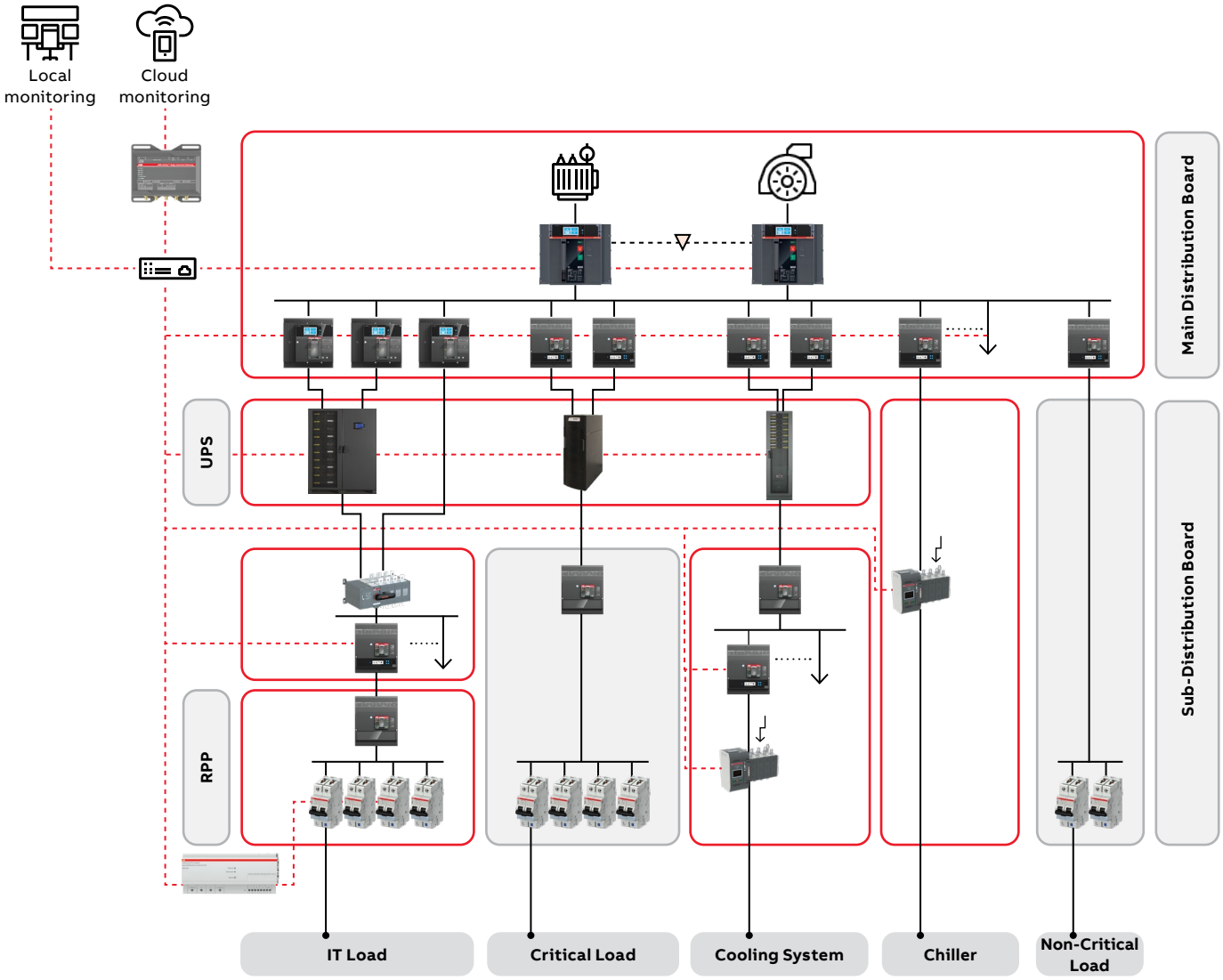
3.2. The Enhanced data-center monitoring solution

To get a clear picture of the overall operations performed by a data center and obtain the right basis for starting to improve its energy efficiency and reliability, the right number and level of measuring devices must be applied.

This task is easy thanks to the broad range of ABB devices capable of recording measurements, monitoring and communication. The devices communicate with each other as well as with any external device, thereby providing the data center operator with unique information.

Measurements are taken and communication is performed by almost all protection devices, transfer switches, UPSes and miniature circuit breakers for issues relating to incoming supplies, IT loads, and mechanical loads.

The Enhanced data center monitoring solution



Circuit breakers are equipped with Ekip Hi-Touch trip units for the purpose of acquiring more measurements with higher precision, as described below and in compliance with standard IEC 61557-12. They also have comprehensive data for root cause analysis and maintenance, providing full diagnostics of the system and guaranteeing complete control of the plant status.
Thanks to Ekip G Hi-Touch, the circuit breakers can provide advanced protection for generators such as rate of change of frequency (ROCOF – ANSI 81R) or Reactive overpower (ANSI OF).

In addition, the embedded Network Analyzer package of Ekip Hi-Touch trip units enables users to detect power quality issues and set controls on the voltage for analyzing the operation of the system: an alarm is generated whenever a control parameter exceeds a preset threshold. This function complies with IEC 61000-4-30 and IEEE 1250.
All the following parameters are continuously monitored:

- Hourly average voltage value.
- Short voltage interruption.
- Short voltage spikes.
- Slow voltage sags and swells.
- Voltage unbalance.
- Harmonic analysis.

Current (RMS)	0.5%
Earth fault current (RMS)	2%
Phase-phase voltage (RMS)	0.5%
Phase-neutral voltage (RMS)	0.5%

Frequency	0.1%
Active power	1%
Reactive power	2%
Apparent power	1%

Power factor	2%
Active energy	1%
Reactive energy	2%
Apparent energy	1%

Table 2. Enhanced level

Product family	ABB product	Trip Unit	Measuring	Communication	Accessories
Air Circuit Breaker	Emax 2 - E1.2...E6.2	Ekip Hi-Touch (1)	Available	Ekip Com Modbus TCP	Ekip Supply
Air Circuit Breaker	Emax 2 - E1.2...E6.2	Ekip G Hi-Touch	Available	Ekip Com Modbus TCP	Ekip Supply
Moulded Case Circuit Breaker	Tmax XT - XT7/ XT7M	Ekip Hi-Touch	Available	Ekip Com Modbus TCP	Ekip Supply
Moulded Case Circuit Breaker	Tmax XT - XT2, XT4, XT5	Ekip Hi-Touch	Available	Ekip Com Modbus TCP	Ekip Supply Ekip Cartridge 4 slots (2)
Moulded Case Circuit Breaker	Tmax XT - XT2, XT4, XT5, XT7/XT7M	Ekip Touch	-	-	-
Miniature Circuit Breaker	S200, S300, S800, S400 (3)	SCU100 Control Unit	Current Sensors	InSite Flat Cable	Connector Set
Transfer Switch	TruONE	Level 4	Available	Ekip Com Modbus TCP	OXEA1 Power Supply
UPS (4)	-	-	Available	ABB ANC Network Card	-

(1) Ekip Hi-Touch trip units already include measuring, network quality and class 1 packages.
(2) At this offering level, the external communication modules have been chosen so that additional cartridge modules can be added if needed in the future.
(3) The S400 miniature circuit breaker series for the SMISSLINE TP line provides a unique protection solution that ensures the highest possible reliability levels for remote power panels (RPP) and IT loads. The S200 and S800 series are typically used in the Tap-off Boxes of Busway systems. For detailed information on how to select the right circuit breakers and measurement system for RPP sub-distribution applications, please consult configurator website.
(4) UPS types can be chosen according to size, modularity requirements, tier level and data center design.

Another very important advantage is that IT loads can be easily monitored up to the capillary through System pro M compact® InSite devices (comprising an SCU100 control unit and sensors) retrofitted to remote power panels (RPP), and Busway solutions. They measure current, voltage, power factor, THVD, THCD, energy and power with an accuracy of 1-2%. The current sensors can be easily fitted into the RPP in any location up to 160A so as to measure the power consumption of each server rack. This is an important measurement that provides a precise picture of the PUE level as well as the status of each cabinet.

UPSes guarantee power supply to IT loads, critical loads and the cooling system, which are vital for a data center. Great attention should be paid to them since they are the most frequently serviced parts of the site and the most frequent cause of power distribution failure. Through communication, current, voltage, power, temperature and the battery charge status can be monitored in real time, as can all the alarms and events. This continuous monitoring of UPS parameters helps to prevent damage to servers and other electronic equipment susceptible to voltage and frequency anomalies. In addition, battery status monitoring can enable failures to be detected.

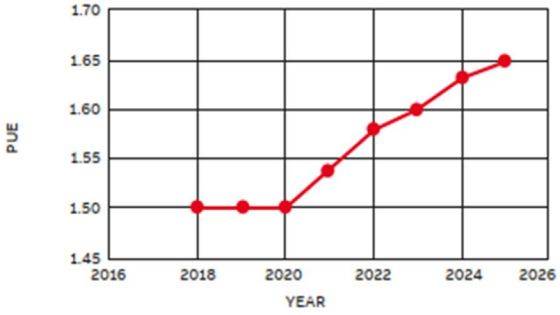
The TruONE® automatic transfer switch with level 4 controller is capable of measuring currents, voltages, active, reactive and apparent power, energy, THVD and THCD. It is also equipped with temperature sensors on the load-side terminals, which are used for indicating a possible loose contact with the switch terminal and cable/bar connection. If there is a loose contact on the source-side connections, the temperature rise will eventually lead to the load-side measuring point as well, so TruONE can also detect these sorts of faults and enable action to be taken before it is too late. 24/7/365 continuous monitoring is certainly much better than thermal imaging performed once a year.

Checking whether the load is connected to Source 1 or Source 2 is possible, as is monitoring the following data in real time: how many times TruONE has been operated, as well as the source statistics, including how long the load has been supplied by the sources and how long the sources have been available. The last generator start and how long this took is known at all times and remotely. It is often the case, that generators are not tested periodically and thanks to this information, the facility manager knows if this is the case. Thus, the generator starting time gives very valuable data if the generator equipment is not working properly since, if the starting time increases during the lifetime of the installation, the situation can be monitored, detected and action can be taken if required.

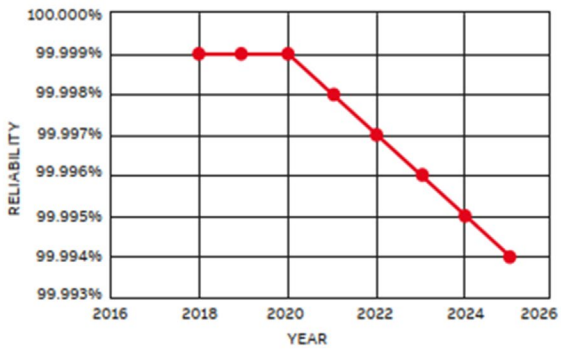
Lastly, TruONE always knows what the conditions were when the generator was operated and can calculate contact wear and estimate the expected lifetime of the device.

Although data centers are built for the highest energy efficiency, this value can decrease over the years (PUE increases) due to aging of both equipment and facility, as well as non-optimal operation. The correct action should be taken to avoid this and cope with the decreasing PUE value trend.

Yearly data center PUE value without actions taken



Reliability



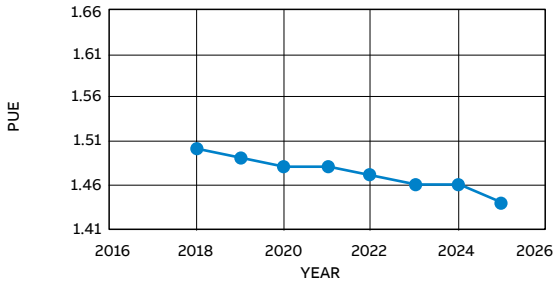
—
ABB Ability™
Smart Tracker

With higher precision, more measurement points and information about the equipment status, devices that consume the most energy can be easily identified and the correct action can be taken. It then becomes easy to make cost-effective changes that improve the overall efficiency of the data center.

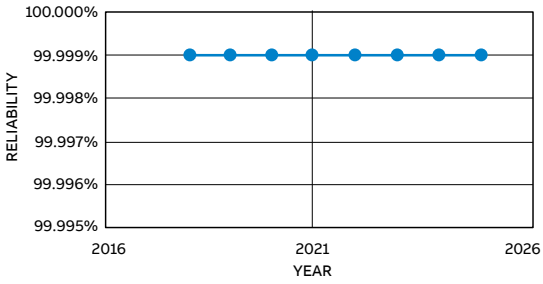
In addition, with information about the performance of each device in the data center, it is easy to chooset equipment when updating an existing data center in true compliance with the concept of modularity.

—
LV Predictive Maintenance

Yearly data center PUE value with actions taken based on measurements and monitoring



Reliability

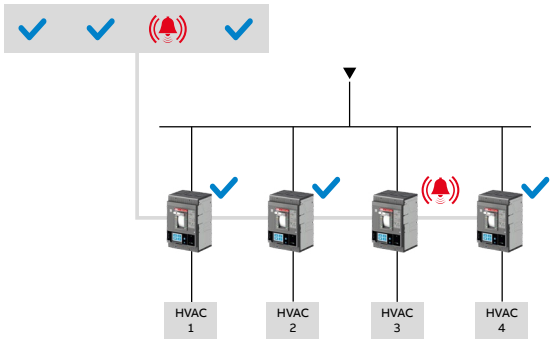


Since measurements are taken from most of the equipment, it becomes very simple to track the energy consumption of any part of the data center. By merely looking at the measurement information, you can see whether some part of the data center is consuming more energy than usual. This enables any equipment that is not functioning properly to be immediately repaired or replaced, thereby retaining high efficiency.

For example, if there is a hotspot in the data center, the cooling equipment responsible for this part will automatically increase its energy consumption to maintain a stable temperature.

The only way to recognize this kind of issue is by measuring the consumption of every cooling device. Thanks to the precision measurement capabilities of all ABB protection devices, from 1 A to 6,300 A, there is no need for special equipment or installations in order to meet the previously mentioned requirements.

Further, all devices continuously perform self-checks. If a device detects any abnormal conditions, it issues an alarm to ensure continuity of the operation and increase reliability.



In a data center it is not only important to supervise protection devices, but also the monitoring of UPS is essential to guarantee the continuity of service of a data center. The continuous check of UPS parameters helps to prevents damages to servers and other electronic equipment susceptible to voltage and frequency anomalies. The check of battery status might reveal failure. Thanks to UPS Insight it is possible to monitor
main UPS parameters such as real-time current and voltage, temperature and battery charge status, as well as see all alarms and all events.

Thanks to the unique predictive maintenance feature available on air circuit breakers, it is possible to plan maintenance in advance. If we assume that the maintenance work takes 2 hours and, and that the circuit breakers have a lifetime of 25 years, in traditional case, the maintenance on ACBs is required each year (25 times during the ACB lifecycle), while, using the predictive maintenance feature, this number becomes 9.

Based on previous information and taking the typical maintenance costs, our calculations show that we can easily save up to 43 % on the maintenance costs for each device. This represents only one example of the savings that can be made thanks to the predictive maintenance feature. The previously mentioned values can vary depending on many factors, such as environmental conditions, number of operations and number of short circuit interruptions. Additionally, with precise details about the health of each device and regular maintenance, the reliability of the whole plant increases dramatically, thus avoiding the extremely high costs of a data center outage, which can cost as much as $2.4 million.

Predictive maintenance is based on the information from the devices (environmental condition, operating conditions, events and effect of performed maintenance) and a complex algorithm develop by ABB. Additionally, all the devices continuously perform self-checks. If they detect any abnormal conditions, the device issues an alarm, to ensure the continuity of the operation and increase reliability. Finally, the customer can set upper and/or lower thresholds for any parameter (e.g. current, voltage, or power) of any device (e.g. circuit breaker or automatic transfer switch (atS) device), that will automatically trigger alarms.

—
ABB Ability™
Energy Manager

—
Predictive Maintenance

3.2.1 Upgrade to ABB Ability™ Energy

ABB Ability™ Energy Manager sets a new benchmark for simplicity and flexibility in asset-performance management. It enables you to view and optimize the behavior of your site equipment anytime, anywhere, thanks to an an intuitive graphic interface, thereby providing greater reliability and availability while minimizing unplanned maintenance. The predictive maintenance package can be ordered as an additional package of ABB Ability™ Energy Manager.

Predictive maintenance is very important, especially owing to the critical reliability needs of data centers. Using the **low-voltage CB health analysis add-on**, maintenance can be planned in efficient ways thanks to the field device data analysis feature provided, which delivers granular visibility of your asset behavior in real time. Predictive maintenance is based on information from the devices (environmental conditions, operating conditions, events, the effects of the maintenance performed) and a complex algorithm that runs in the cloud through ABB Ability™ Energy Manager.

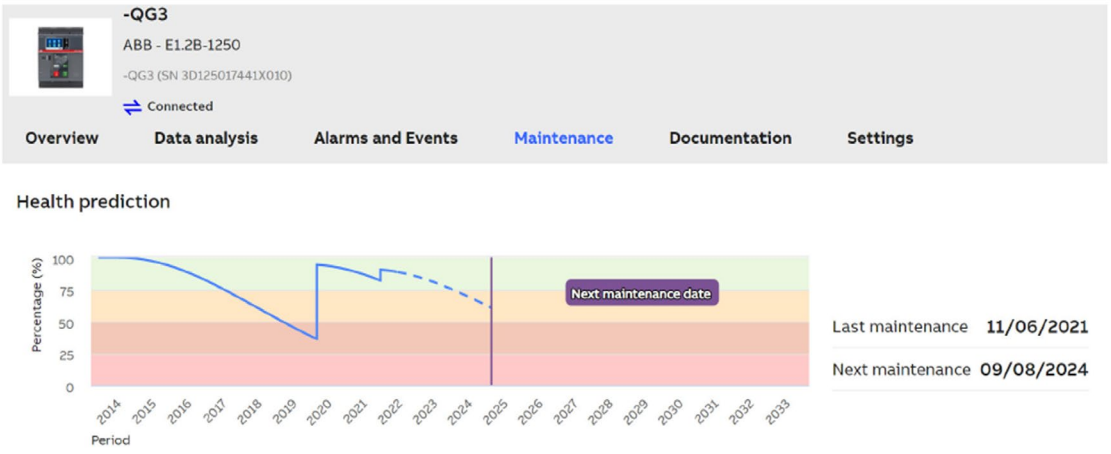
With precise details about the health of each device and regular maintenance, the reliability of the whole plant increases dramatically, thus avoiding the extremely high cost of data center outage, which can amount to more than 1 million [4]. According to the latest report from the Uptime Institute [4], the PUE levels of data centers are decreasing, but there is also a reduction in overall reliability. The solutions outlined here can only increase the reliability of data centers, overcoming the issues reported in the study.

ABB Ability™ Energy Manger can be further customized according to customer needs and available add-ons. As an example, ABB Ability Scanning is a powerful tool available as an add-on to ABB Ability Energy Manager, aimed at helping customers quickly identify energy consumption patterns and potential areas of inefficiency. This add-on provides an energy analysis report that includes deviations from expected energy usage and potential inefficiencies.
Furthermore, the energy analysis report contains graphical representation and statistical information on power-quality events such as voltage sags, spike, swell, and harmonics.

Another add-on is the Energy Simulator which is a powerful tool that allows users to simulate different energy consumption scenarios based on historical data and energy usage patterns. It is possible to include simulation with distributed energy sources like solar, hydro and storage to design a microgrid system with the highest return on investment. This feature helps users to predict energy consumption and optimize energy-saving measures before they are actually implemented. With this add-on, users can reduce energy waste, optimize performance, reduce costs and improve sustainability by making informed decisions based on accurate predictions and simulations.

For small data centers which may not have dedicated energy management teams, ABB Ability Energy Manager can help to make energy management more accessible, easier, and more cost-effective. The tool is designed to help users make informed decisions about energy consumption and reducing energy costs while improving sustainability.

Predictive maintenance through low-voltage CB health analysis add-on



3.3. The Advanced data center monitoring solution

A much more advanced monitoring system can also be obtained with capillary metering architecture, not limited to IT loads alone, but also including other types of loads in the installation. This advanced solution can be applied to any type of data center, regardless of its size.

It is easy to understand how capillary monitoring is more important the larger the data center is. That's because, for large and complex data centers, it is important to reduce costs without compromising energy efficiency and reliability of the installation.

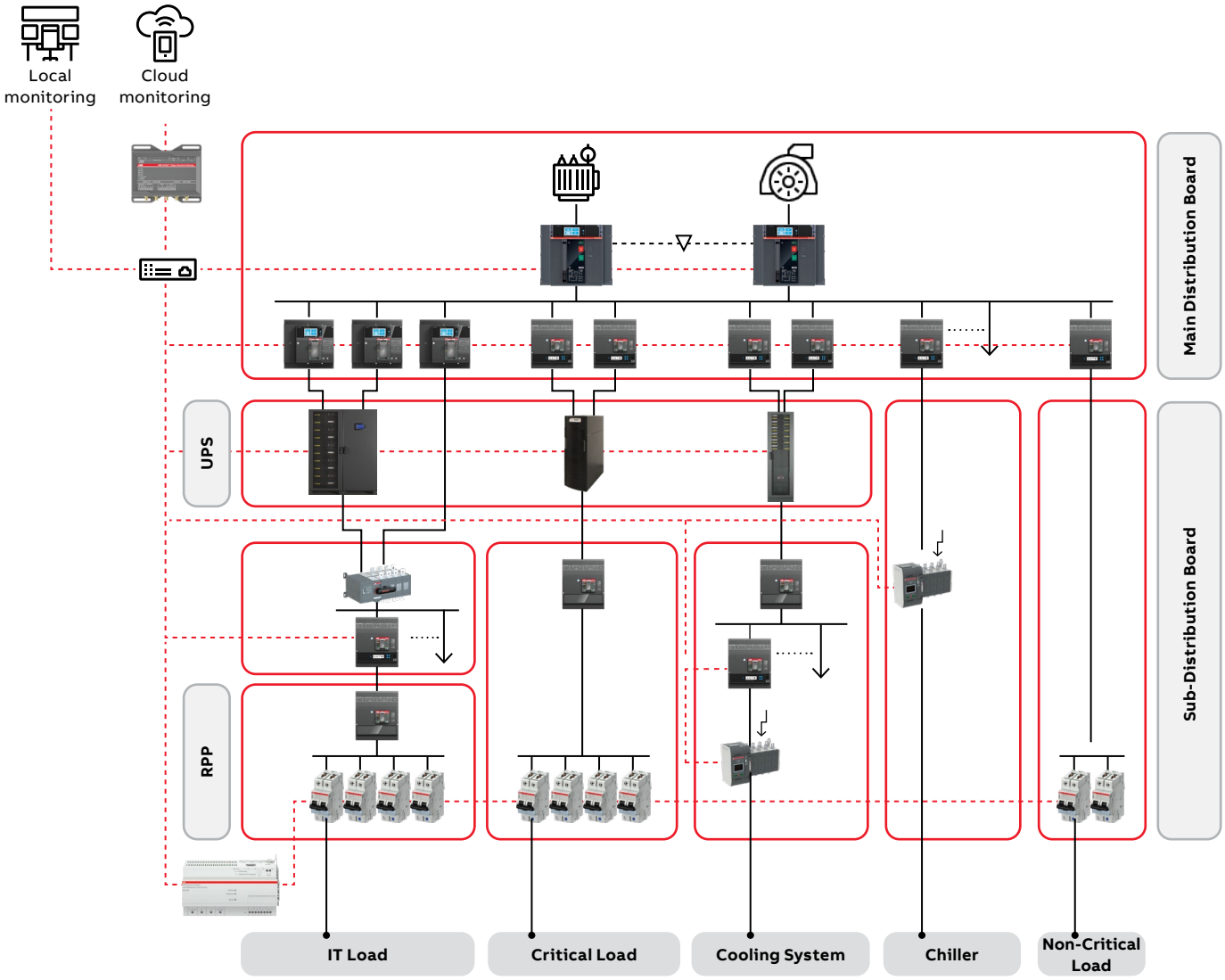
In addition, at this offering level, redundancy in communication for critical circuit breakers is required to supply a greater flow of reliable data without requiring any extra space.

Another important feature is that the critical products are ready for remote control. After the products have been equipped as indicated in the table below, this connection also enables circuit breakers and transfer switches to be controlled through the Modbus TCP communication protocol. In addition, miniature circuit breakers can also be controlled thanks to the I/O modules of System pro M compact® InSite.

Product family	ABB product	Trip Unit	Measuring	Communication	Accessories
Air Circuit Breaker	Emax 2 - E1.2...E6.2	Ekip Hi-Touch (1)	Available	Ekip Com Modbus TCP Ekip Com R Modbus TCP	Ekip Supply Ekip Com Actuator M, YO, YC (2)
Air Circuit Breaker	Emax 2 - E1.2...E6.2	Ekip G Hi-Touch	Available	Ekip Com Modbus TCP Ekip Com R Modbus TCP	Ekip Supply Ekip Com Actuator M, YO, YC
Moulded Case Circuit Breaker	Tmax XT - XT7M	Ekip Hi-Touch	Available	Ekip Com Modbus TCP Ekip Com R Modbus TCP	Ekip Supply Ekip Com Actuator M, YO, YC
Moulded Case Circuit Breaker	Tmax XT - XT2, XT4, XT5	Ekip Hi-Touch	Available	Ekip Com Modbus TCP Ekip Com R Modbus TCP	Ekip Supply Ekip Cartridge 4 slots MOE-E (3)
Miniature Circuit Breaker	S200, S300, S800, S400 (4)	SCU100 Control Unit	Current Sensors	InSite Flat Cable	Connector Set I/O Modules (5)
Transfer Switch	TruONE	Level 4	Available	Ekip Com Modbus TCP	OXEA1 Power Supply
UPS (6)	-	-	Available	ABB ANC Network Card	-

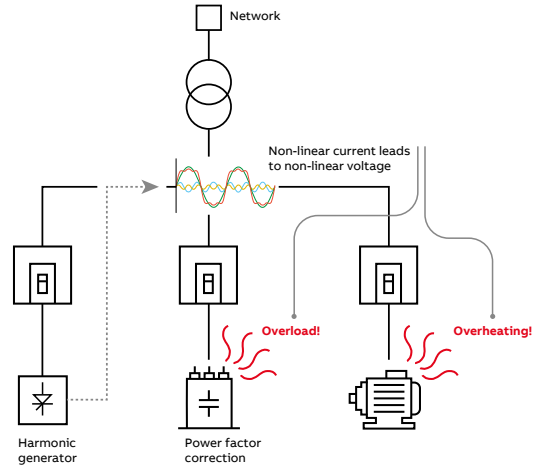
(1) Ekip Hi-Touch trip units already include measuring, network quality and class 1 packages.
(2) M = Spring charging motor, YO = Shunt opening release, YC = Shunt closing release.
(3) MOE-E = Electronic stored energy motor operator.
(4) The S400 miniature circuit breaker series for the SMISSLINE TP line provides a unique protection solution that ensures the highest possible reliability levels for remote power panels (RPP) and IT loads. The S200 and S800 series are typically used in the Tap-off Boxes of Busway systems. For detailed information on how to select the right circuit breakers and measurement system for RPP sub-distribution applications, please consult configurator website.
(5) Not compatible with the S400 miniature circuit breaker series.
(6) UPS types can be chosen according to size, modularity requirements, tier level and data center design.

The Advanced data center monitoring solution



—
Selectivity

Another way to improve the energy efficiency of a data center is to reduce distribution losses.



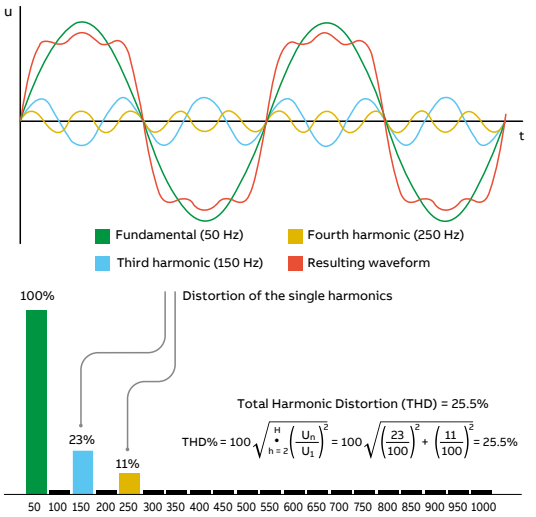


ABB offers equipment able to decrease power distribution losses down to 5% for all types of data centers. In addition, having a large number of measurement devices provides clear insights into the causes of distribution losses, enabling the distribution to be optimized for the purpose of increasing efficiency. Let's consider the example of measuring the losses from UPSes.
A DPA 250 S4 UPS has 97.4% efficiency. This means that the losses are 2.6%. Measuring this value with a low-accuracy device will not provide any useful data. The same UPS high efficiency level is available for different data center sizes. For example, MegaFlex DPA UPS can be relied on for larger data centers.
Accurate information about distribution losses can be obtained thanks to ABB's high-precision devices.

The IT equipment installed in data centers can produce power quality issues causing harmonic distortion in the network. Harmonics will lead to additional losses and reliability problems. This can be overcome by installing suitable filters inside the network. However, the right information about the source and level of the harmonic distortion must be available if the filters are to be correctly selected and located. ABB equipment can take measurements up to the 50th harmonic without additional devices, thereby providing the right information and enabling these improvements to be made. In addition, the same equipment can monitor other aspects of power quality, such as average voltage, voltage spikes or short interruptions, voltage imbalances between phases and other issues, thus increasing energy efficiency and reliability to an additional extent.

ABB devices feature embedded power quality meters and thanks to this, power quality measurements can be taken at any point of the data center power supply distribution network. Some of these measurement points could be:

- The utility entrance, to monitor overall power quality.
- The power distribution units (PDUs), to identify which group of IT cabinets is producing the power quality issues.

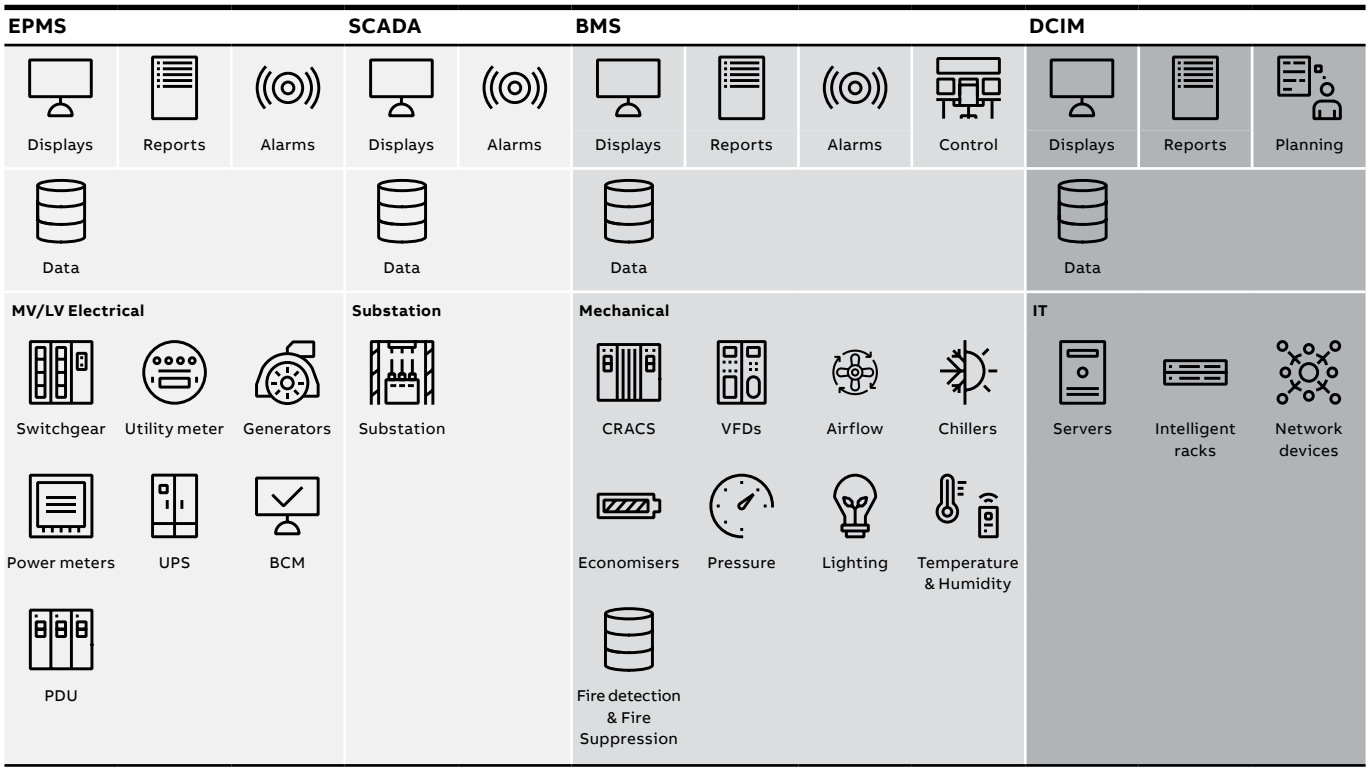
Power quality problems could be easily prevented in this way.

Mechanical loads can consist of power drives, which can also be the source of harmonics; thus, in order to be sure where the source of the problem lies, it is advisable to locate power quality measurement devices at mechanical level. Finally, power quality can also be measured at other data center levels, thereby providing a clear picture of any power quality issues.

In more complex systems, digitalization can significantly increase resilience and continuity of service. Digitalization applied to electrical distribution systems can actually be used to design logic selectivity. Thanks to intelligent relays integrated into protection devices, a faulty part of the system can be automatically isolated within the shortest possible time, while healthy parts of the data center continue to work.

For a complete example of standardized data center architecture that includes intelligent distribution solutions, take a look at 'White paper System plus system (2N) electrical distribution - Data Center Design IEC - 0.5 MW IT load design'.

3.5. Local Monitoring and Control System



The scope and functions of the monitoring, control and operation infrastructures that are frequently encountered in data centers can be outlined in a simple way, as illustrated below.

The devices described in the different offering levels can be connected to all these systems when required through use of the communication system interface documents of each device.

—
Emax2 - Communication System Interface

—
Tmax XT - Communication System Interface

—
Truone - Communication System Interface

—
Insite Pro M – Manual with Communication Interface

Table 4. Available communication protocols for related products

Communication protocols	Emax2	Tmax XT	TruOne	UPS	InSite Pro M
Modbus RS-485	●	●	●		●
Modbus TCP	●	●	●	●	●
IEC61850	●	●			
Profibus-DP	●	●	●		
Profinet	●	●	●		
Ethernet / IP	●	●	●		
DeviceNet	●	●	●		
Bluetooth (1)	●	●			
Ekip Link (2)	●	●			
SNMP V2 and V3, SMTP				●	

(1) Bluetooth is available for all Emax 2 and Tmax XT breakers with Touch and Hi-Touch trip units. Other protocols can be obtained by adding Ekip modules.
(2) Ekip Link is ABB's proprietary protocol

4. How to increase the efficiency of an existing data center

—
Retrofitting

—
Ekip UP*

According to one of the latest data center studies [7] the size of the data center renovation market is expected to grow to $60.91 billion in 2027 at 24.7% CAGR.

In addition to the previously explained trend towards increased data center efficiency, one of the main drivers for data center renovation is energy efficiency. An efficiency increase can justify high data center service costs, which represent around 15% of the total cost of ownership of data centers (TCO) [8].

All the solutions previously explained for increasing the efficiency of data centers are based on the design of a new data center. However, the same solutions are also applicable to existing data centers since the ABB Advanced package enables the existing installation to be upgraded. ABB has a broad portfolio of service solutions which can fit any type of installation by providing high-level flexibility and ensuring time and cost savings thanks to advanced technologies.

There are three main ways in which the existing installation can be adapted to receive the solutions suggested for new installations.
A high, medium or light impact on the installation can be achieved, depending on how the existing structure is built and the level of changes the data center owner is willing to apply.
The ABB offering for smart upgrades and updates comprises 3 packages:

- light upgrade
- medium upgrade
- high upgrade.

4.1. High upgrade: retrofitting of protection devices

In the retrofitting solution, the existing protection devices are completely replaced with new devices featuring measurement and connectivity capabilities.

Thanks to ABB's advanced retrofitting solutions, the time required for upgrading the installation is minimal, thus maximizing availability.

With the minimum possible impact on the installation, the data center can be equipped with the latest generation of circuit breakers, which feature the lowest losses, are able to take class 1 accuracy measurements, and provide connectivity to both the on-site monitoring system and ABB Ability™ Energy Manager. The highest level of data center efficiency is thus ensured.

4.2. Medium upgrade of the installation

The metering and connectivity capabilities of the protection devices can be 'unlocked', virtually without impact on the existing installation.

This is done by using the digital unit called Ekip UP⁺. Thanks to open-style current sensors, Ekip UP⁺ provides a plug and play solution for every low-voltage system. It can be connected to any protection device regardless of whether it uses an electronic or thermo-magnetic trip unit. Thus, everything previously explained for new installations also becomes applicable to existing ones thanks to connection of Ekip UP⁺ digital units.

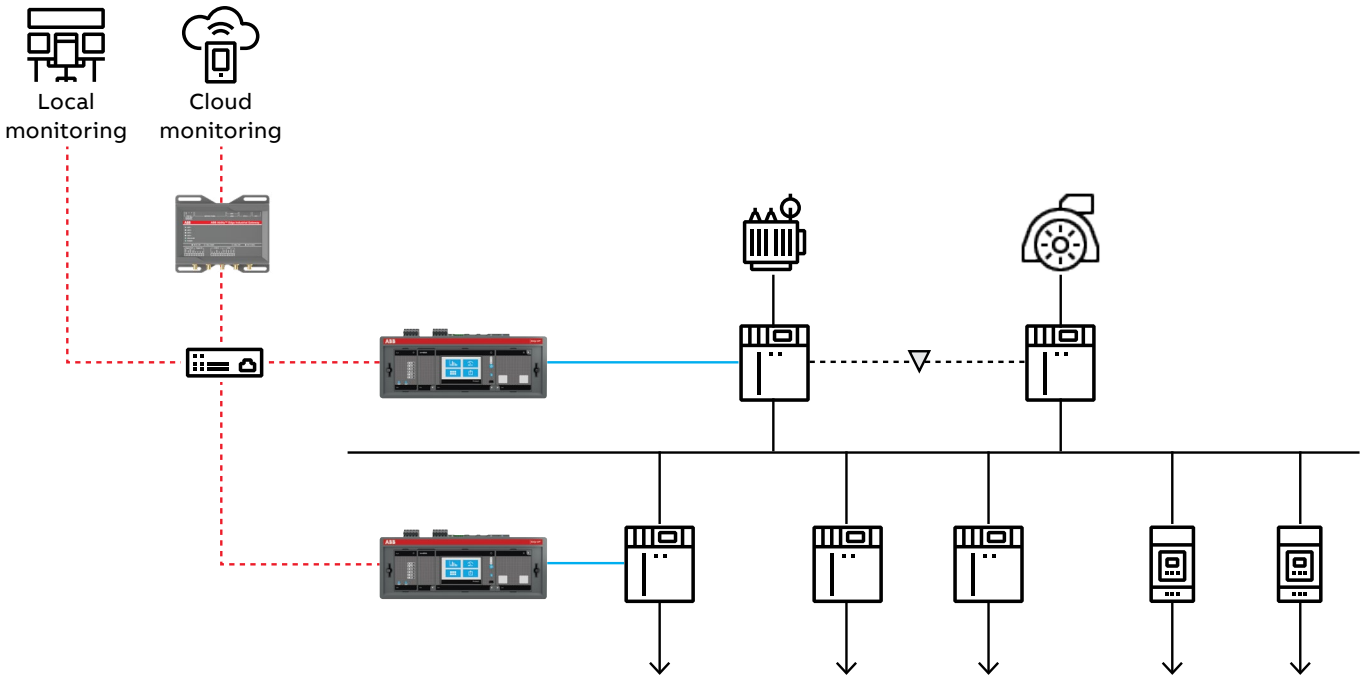
Connection of Ekip UP⁺ to the installation not only obtains monitoring functions and connectivity, but also provides the same advanced protection functionalities as the new protection devices.

4.3. Light upgrade: complete flexibility for new installations

If the installation already has the newest devices with measurement capabilities, it can be adjusted using device cartridge modules.
For example, the data center user can upload measuring and power quality packages and add or change cartridge modules without any impact on the installation.
In addition, the new features of ABB Ability™ Energy Manager (e.g. predictive maintenance) can be added at any time by the actual user. This provides the data center user with complete flexibility, since new functionalities can be changed or added whenever required and without impact.

Plug and play module

Medium upgrade of the installation



5. ABB devices for energy efficiency

Circuit breakers

This section presents an overview of the most important ABB devices for measuring and monitoring inside data centers.

5.1. Emax 2 and Tmax XT circuit breaker families and Ekip UP+

ABB Emax 2 and Tmax XT circuit breakers range from 160A to 6300A. As well as offering protection functionalities, they can also be used for measuring and monitoring.

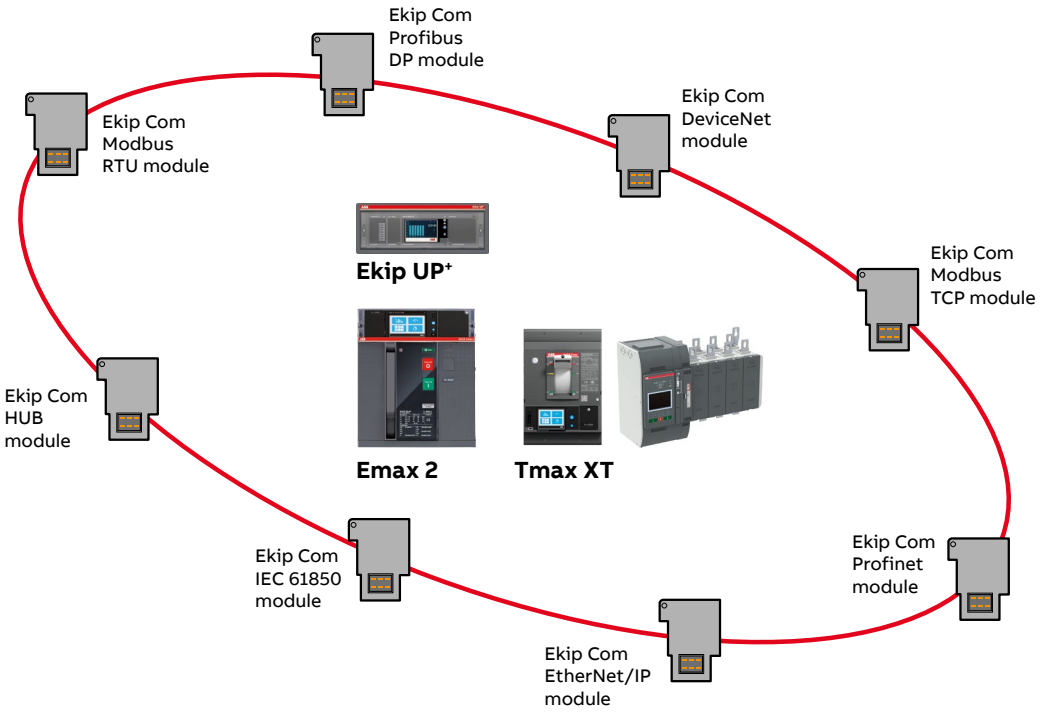
The Ekip Architecture of the full range of circuit breakers unlocks high accuracy measurements, embedded in devices, for all electrical parameters (current; voltage; frequency; active, reactive and apparent power and energy; power factor; peak factor; THVD; THCD) with up to 0.5% accuracy (currents, voltages) or 1% accuracy (power, energy).

This includes Class 1 accuracy for power and energy measurements, according to standard IEC 61557-12.

In addition, the Ekip UP+ digital unit is designed to upgrade existing installations so as to provide them with the same capabilities as the Ekip trip units in terms of metering, protection and control.

Thanks to open-style current sensors, Ekip UP+ ensures plug and play installation for every low-voltage system.

In order to acquire, transfer and monitor the parameters being measured, Emax 2, Tmax XT and Ekip UP+ can be equipped with seven different communication protocols.



—
UPSes

—
DPA 250 S4

—
MegaFlex DPA

Thanks to all these features, Emax 2, Tmax XT and Ekip UP+ devices are perfect for any type of data center and are capable of providing all the functionalities that the pertinent standards require.

5.2. DPA UPS product lines for data centers

The ABB DPA UPS product line is designed to serve the data centers of the future and all the models in the family are built with a focus on energy efficiency, reliability and modularity.

The most recent UPS units – DPA 250 S4 and MegaFlex DPA – feature 97.6% module efficiency and 97.4% system efficiency. This means that your UPS will use about 30% less power, thereby reducing energy losses and operational costs. The Xtra VFI feature maximizes efficiency under low loads by dynamically adjusting the number of active modules that your critical IT equipment requires.

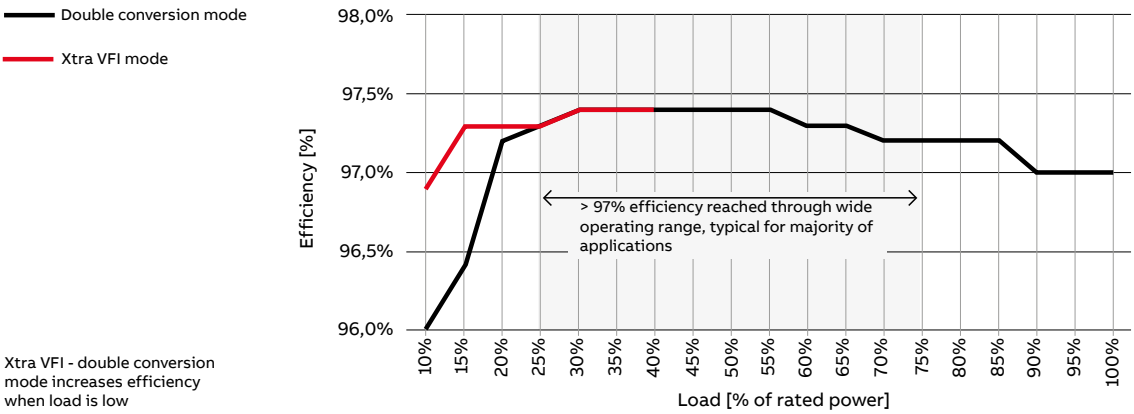
All DPA models are capable of measuring input voltage, input frequency, battery capacity and autonomy, as well as output voltage, power and current.

Based on these values, the UPS can also send alerts if any of the values are above or below the defined limits.

DPA 250 S4 **MegaFlex DPA**

All this information is available locally on the DPA display, as well as remotely using the Modbus communication protocol.

Finally, for DPA 250 S4 all those measurements are also available in the cloud through ABB Ability™ Energy Manager.



Xtra VFI - double conversion mode increases efficiency when load is low

EcoSolutions Label

The MegaFlex DPA™ Uninterruptible Power Supply (UPS) has become the first Smart Power product to earn ABB's new EcoSolutions label, reflecting the focus on circularity and sustainability that guides our product development process.
To earn an EcoSolution label, a product must first obtain an independently verified Type III ISO:14025 Environmental Product Declaration. It must then meet a minimum of four ABB sustainability targets, one from each of the key stages in its lifecycle. The MegaFlex DPA UPS was designed to close resource loops with a strong 75% recyclability rate and clear end-of-life instructions for the user. The Quartino production facility in Switzerland produces MegaFlex DPA with 'zero waste to landfill' and packaging that uses 80% recycled cardboard.
Use of MegaFlex DPA has been highly optimized, providing customers with 97.4% system level efficiency and 15-year extended lifetime, thanks to a modular design and services that prolong its working life. According to calculations, MegaFlex customers can save more than 400 tonnes of CO2 equivalent emissions over the lifetime of the UPS. Our MegaFlex DPA UPS solution combines the highest efficiency ratings available with our commitment to the circular economy.
This not only helps reduce energy losses and operating costs, but also provides a product that uses minimal resources and materials that can be easily recycled.
Learn more at MegaFlex DPA - UPS and power conditioning | ABB

Our circuit breakers and more will will be getting the EcoSolutions label very soon. Updated information is available at EcoSolutions website.

ABB EcoSolutions™
Coming full circle.

Together with customers and partners, ABB is innovating to make circular, increasingly sustainable solutions and operations a reality.
ABB's new EcoSolutions label provides full transparency to environmental impact across the entire product lifecycle. go.abb/EcoSolutions

ABB Eco Solutions™

—
System pro M compact® InSite

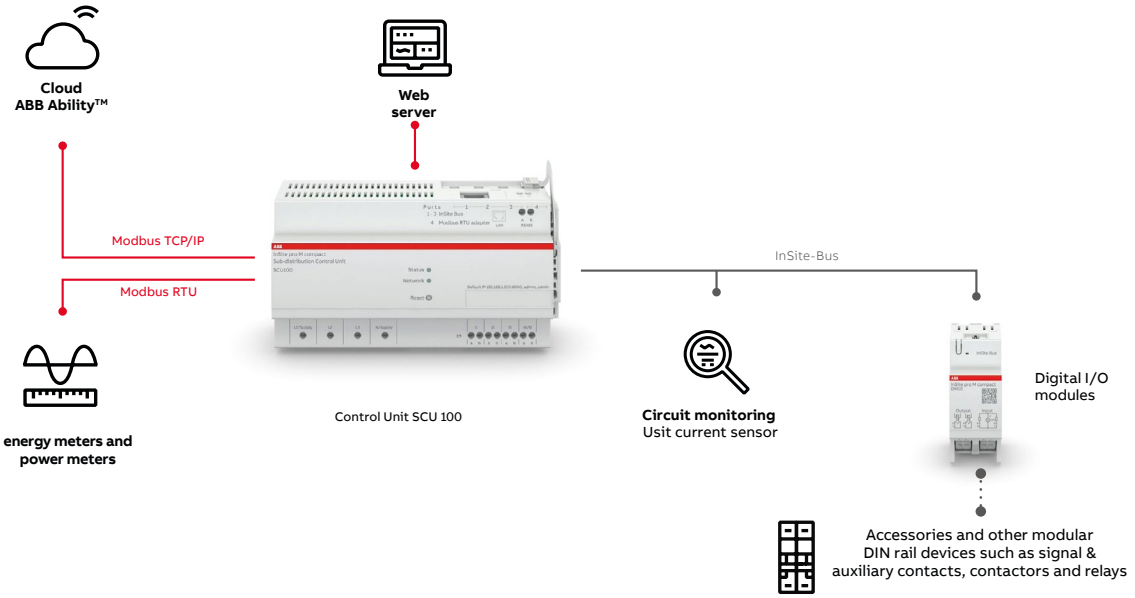
5.3. System pro M compact® InSite

System pro M compact® InSite enables currents up to 160 A to be measured.

It consists of a control unit and sensors allowing all data center distribution lines to be easily monitored. It measures current, voltage, power factor, THVD, THCD, energy and power with an accuracy of 1-2%.

The measurement devices can be easily fitted into the electrical circuit in any location where the measurement is to be taken.

The system uses an open-loop Hall-effect sensor or giant magneto resistance (GMR) effect sensor.



Three different devices can be used for these measurements:

Sub distribution control unit	Technical feature	Unit	Description
	Supply voltage	[VAC]	80-277 (L1-N, +5%)
	Frequency	[HZ]	50/60
	Power input (L1-N)	[W]	5...45 depending on number of sensors and I/O modules
	Power input , current transformer, secondary side	[VA]	Current circuit <2 (per phase)
	Voltage measurement range	[VAC]	80-277 (L1, L2, L3-N)
	Measurement range, current transformer, secondary side	[A]	nominal: 5 max: 6
	Harmonic component	[HZ]	up to 2000
	Data rate of Modbus RTU	[BAUD]	RS485 2- wire, 2400...115200
	Refresh time		1sec / 30 sec (depending on type of data)
	Data storage and export		Integrated 1-year data storage Automatic CSV data export

Any of these devices can easily be connected via the unique bus to SCU100, which can be installed on the DIN rail. This unit enables data to be stored and transferred through different protocols and/or to the ABB Ability™ Energy Manager using the Modbus TCP communication protocol.

Input and Output module	Technical feature	Unit	Input module DM11	Output module DM00	Input and Output module DM10
	Number of digital channels		4 Input	4 Output	2 Input + 2 Output
	Voltage (min-max)		active input: 22-26 VDC	relay output: 5VDC-240VAC	active input: 22-26VDC relay output: 5VDC-240VAC
	Current (min-max)		active input 4mA	relay output: 5mA-2.5A Max 4.5A (<5sec	active input: 4mA relay output: mA-2.5A Max 4.5A (<5sec)
	Pulse minimum duration	[MS]	5	n/a	5
	Pulse frequency	[Hz]	100	n/a	100
	Cross section of terminals	[MM2]	2.5	2.5	2.5

TruONE ATS

Ekip Signalling 3T

SlimLine XR Gold (XRG)

5.4. TruONE ATS

The new TruONE is the world's first true all-in-one automatic transfer switch, engineered to incorporate switch and controller in one seamless unit. It has a range between 200 A and 1600 A and can provide a variety of measurements.

With level 4 controls, TruONE is capable of measuring currents, voltages, active, reactive and apparent power and energy, THVD and THCD.
Similarly to Emax 2, Tmax XT and Ekip UP+, TruONE can be equipped with communication modules in order to send data to remote locations and the ABB Ability™ Energy Manager.

The available communication protocols are: Modbus RTU, Modbus TCP, PROFIBUS, PROFINET, EtherNet/IP, and DeviceNet.

5.5. Ekip 3T signalling measurement module

The Ekip Signalling 3T module allows environmental conditions to be measured and monitored.

The module can be installed directly on the circuit breaker and digital units (in the same way as the communication modules).

This module provides three analog inputs for PT100/PT1000 thermo-resistances and one 4-20mA analog input for external sensors. The information from those sensors provides precise environmental details for predictive maintenance purposes.

This information is also available remotely using one of the communication protocols above and/or through the ABB Ability™ Energy Manager computer software.

Possible locations for the temperature measurement sensors include the busbar system, distribution board and transformer; environmental measurements are also provided. For example, the analog input can be used for measuring humidity.

5.6. SlimLine XR Gold (XRG)

SlimLine XR Gold (XRG) switch disconnector fuses with ratings between 63 A and 630 A fulfil ever-increasing demands from the industry for safe energy distribution.

As with circuit breakers, SlimLine XR Gold (XRG) is capable of monitoring fuse status, voltages, currents, active and reactive power, power factor, energy, temperature, fuse status and switch position. It is equipped with the Modbus RTU communication protocol, which enables it to be easily integrated into monitoring systems and/or ABB Ability™ Energy Manager.

SlimLine XR Gold (XRG) also offers an integrated motor (as an option) for remote or local operation. The motor operator unit is fully integrated into SlimLine XR Gold (XRG).

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M4M

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ITS2

5.7. M4M network analyzer

The new M4M network analyzer range provides accurate real-time monitoring of the power quality KPIs to enhance reactivity to events in the electrical system, thereby helping to avoid operational impact and uncoordinated maintenance.

Available in two families, M4M 20 and M4M 30 ensure Class 0.5 accuracy compliant with IEC 61557-12 and IEC 62053-22 standards, and represent the perfect choice for sub-metering inside sub-distribution boards and power quality monitoring in main distribution boards and power centers.

In data centers, M4M allows power quality and power reliability to be fully monitored, easily detecting where harmonics are created and preventing damage to installed equipment.

5.8. EQ meter

ABB EQ meters are high-performance, modular DIN rail-mounted electricity meters that are safe, easy to install and can be integrated into existing and future electrical installations.

They are designed to fulfil any type of sub-metering requirement. MID-approved EQ meters are certified and have verified metering accuracy, which is a critical factor in establishing fairness in cost allocation.

The low rated or base currents of these products ensure high dynamic performance with superior accuracy even at low currents.

EQ Meters support broad voltage and temperature ranges. They can also be equipped with built-in serial communication interfaces for M-Bus or Modbus RTU (RS-485).

The range comprises up to 80A direct and indirect, one- and three-phase meters able to read a wide range of values such as active, reactive and apparent power, current, voltage, frequency, power factor and harmonics.

5.9. ITS2 intelligent monitoring unit

The ITS2 intelligent monitoring unit for switches and fusegear lets you optimize your network simply and safely.

Cloud-based connectivity with ABB Ability™ Energy Manager or local systems through Modbus RTU and Modbus TCP makes it easier to monitor key electrical parameters such as line and phase voltage, current, power, and energy consumption, but also temperature of 1 phase, which can indicate a temperature rise in the system, which might predict a fault or a loose connection. In addition to the measurements it is also possible to get the status of the fuse and position of the switch.

It can be integrated with InLineII and SlimLine XRG - 80% faster installation compared to using separate metering devices. Also it can be used for a standalone unit, compatible with OT switch-disconnectors and OS switch fuses.

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