WHITE PAPER

Ekip UP$^+$

The simple way to monitor energy and reduce food-growing costs

ABB
Ekip UP+
In=400A

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Applications

Energy needs for the food and beverage industry are increasing because of higher global demand, but with the Ekip UP⁺ upgrade unit, producers can monitor electricity in greenhouses and processing facilities to help lower those costs.

The food and beverage industry is one of the world's **biggest energy consumers**.

This distinction is mainly attributable to agriculture in greenhouses and processing factories that prepare food and water for the retail market.

Greenhouses

Key figures:
- Agri-food demand: +48% by 2050.
- China: 43% of projected increase.
- Greenhouses around large cities and vertical farming in large cities.
- High energy costs: energy expenditures account for up to 30% of the production cost of a greenhouse; expected to be 40% in the near future.
- Labor cost, shortage of labor and technology developments are drivers for robotized harvesting and grading.

The traditional way of growing fresh produce, like grain, potatoes, corn, beans and apples, is on outdoor farms in the countryside, far away from the cities where most consumers are located. This way of farming involves a lot of water consumption and extensive use of herbicides and pesticides. The energy requirement is low, but even though open agriculture is industrialized, the potential to improve yield is relatively low.

Around 1850, the Dutch started to grow grapes against a brick wall. The plants were protected by glass that was simply placed against the wall. Fifty years later, around 1900, the first heated greenhouses were built completely of glass. At that time, these structures still were about growing grapes, but we discovered that it was also possible to grow other food in heated glass greenhouses.

In today's greenhouses, we grow many different foods, like tomatoes, peppers, cucumbers, eggplants and strawberries, as well as non-food items, like flowers and tropical plants for decoration. Greenhouses enable us to grow food close to cities.
Today, **greenhouses are becoming more sustainable** as we have developed biological alternatives for pesticides and herbicides to better protect plants and crops.

- Grain, potato, corn, beans, apples
- Farm from cities
- Pesticides usage very high > trend to low
- Water consumption very high
- Energy requirement very low
- Industrialization level hight
- Yield optimization potential low

- Tomato, cucumber, peppers, melons
- Close to cities
- Pesticides usage high > trend to minimal
- Water consumption high > trend to circular
- Energy requirement high
- Industrialization level low > trend to high
- Yield optimization potential high

- Young plants, lettuce, herbs, berries
- Iside cities
- Closed hygienic box: low to no diseases
- Circular water system (aqua-/aeroponics)
- Energy requirement very high (lighting)
- Industrialization level very ligh
- Full control: yield potentially very high

Water is being re-used after treatment; however, energy consumption in greenhouses is growing because of the application of intelligent technology. In parallel, global greenhouse surface is growing as a result of the growing population and increasing demand for fresh food.

The greenhouse industry has provided the technology that enables farming inside buildings. This phenomenon, also known as urban farming or city farming, already has reached the point where it is possible to grow young plants, lettuce, herbs and berries without daylight. By applying grow systems in vertical layers, we can produce fresh fruit and vegetables inside cities; and since this is done in controlled indoor environments, we have considerable control over such important parameters as indoor climate, light spectrum and the circular use of water.

This way of growing food is energy intensive, but it offers the opportunity to constantly grow tasteful and nutritious fresh produce as close to the consumer as possible. Moreover, water scarcity, low yield and disease issues related to open field production are enforcing a transition toward controlled production.

Process industries

After agriculture, food and beverage completes the process-industry market segment. Within this segment, one major trend is a focus on ecological issues to develop greener, more sustainable production techniques, incorporating renewables and biodiversity.
The biggest food and beverage manufacturers are revamping their facilities and processes to be ready for **industry 4.0**. Meanwhile, they are examining ways to improve production with robots, automated guided vehicles and augmented reality. These technologies demand that producers take special care in considering energy consumption, which affects their profitability KPIs.

Considering highly globalized competition and material costs, energy expenditures erase margins on goods delivered to distributors.

Energy costs also impact penalties based on country regulations, which are becoming increasingly restrictive in relation to energy-intensive processes and require **CO2 savings** with efficiency-driven actions for this kind of production activity. Sometimes these actions are also prompted by incentives for a healthier planet.

Today, these sites may have just basic supervision systems, and in large part they have not focused on energy management, especially on electrical distribution.

This **gap in energy control** must be closed through additional optimization steps, because it has become a consistent part of the overall energy bill. Especially on existing sites, investments are available that offer a short payback time without compromising 24/7 processing operations.

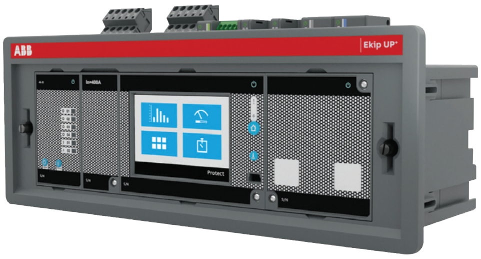
Solutions

—
Ekip UP$^+$

—
ABB Ability™ EAM

Ekip UP$^+$ digital units simplify the digitalization of existing greenhouses and automation factories. Thanks to plug-in sensors, the upgrade of a small-to-midsize food and beverage facility takes less than one day, leveraging existing electrical assets and connecting them **directly** to the ABB Ability™ EAM (Energy and Asset Manager).

Through this architecture, more than **1,000 energy-based data points** become immediately available from Ekip UP$^+$, viewable anytime and anywhere on tablets or smartphones, monitoring energy consumption and alerting events on low power quality. These are critical capabilities for managing site productivity and utility fees.



This digital ecosystem supplies better insights into the agriculture and manufacturing process, with data employed to better understand how different factors influence productivity results.
It is easy to identify where to take actions—for example which air conditioning assets should be retrofitted because of low-performance, enabling up to **30% savings in operational costs**. This architecture also grants immediate support for local energy audits required by country regulations.

With Ekip UP$^+$, a higher range of decision-making becomes possible at the level of the cultivation and production specialist, who uses this data to substantiate choices in process policy. For instance, power peaks are tracked so that related shaving logics embedded in Ekip UP$^+$ can be planned, **reducing electric bills by up to 20%**.

At the same time, asset management encourages efficient working at the company level—for example, by preventing unnecessary maintenance of installations or treatment of plants. Indeed, an additional 35% reduction in operating expenses is enabled by Ekip UP$^+$'s **predictive maintenance** feature applied to existing switchgear assets, scheduling maintenance activities based on forecasted device conditions.

Ekip Up$^+$ Monitor

- **Measure:** current, voltage, power, energy
- **Network analyzer:** power quality
- **Datalogger:** event analysis
- **Connectivity:** Modbus TCP, Modbus RTU, IEC 61850, Profibus, Profinet, EtherNet/IP™, DeviceNet™, ABB protocol, cloud-platform Ability™ EAM

Ekip Up$^+$ Protect

- Ekip Up$^+$ Monitor functions
- **Basic protection:** based on current, voltage, power, frequency

Software Packages

- Monitor to protect
- **Advanced protections:** Generator Protections, Motor Protections, Adaptive protections
- **Advance functions:** Power Controller, Adaptive Load Shedding, IPS (CEI 0-16)

Accessories

- Sensors
- Signalling modules
- Communication modules
- Synchrocheck modules
- Rating Plugs

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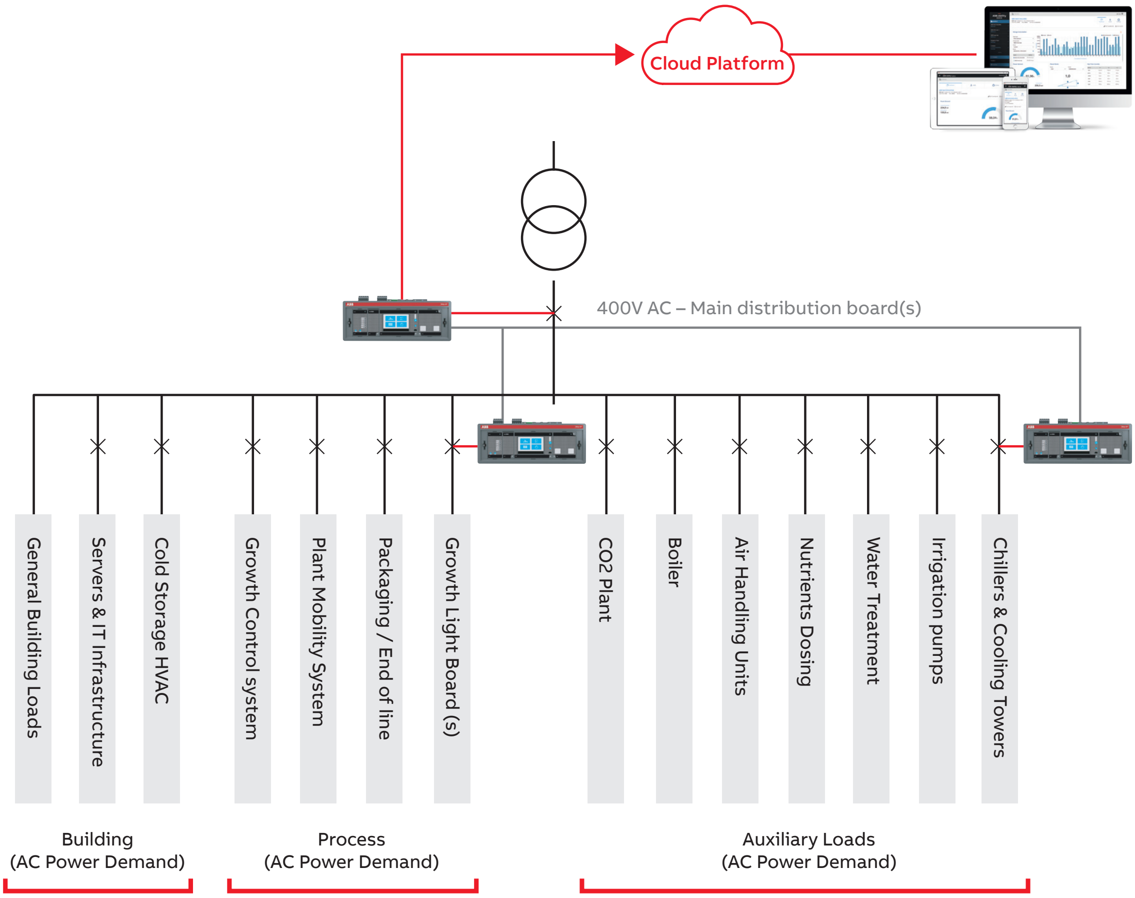
Ekip UP⁺ product catalog

Entering an existing greenhouse, we immediately can find the relevant electrical assets that are energy-consumption sensitive in a food and beverage plant, such as:

- Incoming power distribution
- Chillers
- Lighting feeders

The relevant equipment, whether manufactured by ABB or not, is ready for upgrade with Ekip UP⁺ digital units.

All the details for ordering codes are available in the product catalog.


Cloud Platform
400V AC – Main distribution board(s)
General Building Loads
Servers & IT Infrastructure
Cold Storage HVAC
Growth Control system
Plant Mobility System
Packaging / End of line
Growth Light Board (s)
CO2 Plant
Boiler
Air Handling Units
Nutrients Dosing
Water Treatment
Irrigation pumps
Chillers & Cooling Towers
Building
(AC Power Demand)
Process
(AC Power Demand)
Auxiliary Loads
(AC Power Demand)

Solutions

—
Network analyzer

—
ABB Ability™ EAM

—
Ekip Com
connectivity modules

Power quality

The main low-voltage switchboard protects the entire electrical system. It is powered by the transformer and, sometimes, a backup generator. Particularly where sodium or LED lamps are used for lighting, the harmonics content can be very high and cause conflicts inside the food and beverage site power grid and in the connection with the utility electrical distribution.

With its embedded network analyzer, the Ekip UP$^+$ Monitor version, located near the incoming circuit breaker, manages electrical systems according to IEC 61000-4-30 standards and IEEE's 1250 Guide for Identifying and Improving Voltage Quality in Power Systems.

Several parameters are monitored, with available thresholds for alerts.
All the power quality data is available on a color touch-screen display, made possible by nine embedded connectivity protocols and the ABB Ability^{T}M EAM cloud platform. This data includes:

- Deviations of the voltage average value from the rated value
- Short interruptions and spikes of power supply
- Short decreases (sags) or increases (swells) of voltage value
- Voltage unbalance, i.e. difference in voltage values between different phases
- Presence of current and voltage harmonics.

Energy management

A food and beverage site incorporates loads that absorb most of the power, like chillers and lighting feeders. These loads should be monitored to increase energy efficiency .

In new plants, automation systems are designed to improve energy consumption. For example, in a modern greenhouse, the various circulators, burner fans, CO2 circulation system fans and particularly cooling towers have variable-speed regulation, or water treatment is managed by decentralized PLCs that allow for the precise and optimized control of electricity.
These capabilities are not found in older plants. Because they do not have these technologies in place, energy efficiency gaps must be identified before their resolution.

For instance, all the energy consumed by air conditioning is very critical for current greenhouses in the Middle East and Africa, where hot environmental conditions increase electrical consumption by air conditioning systems.

Another big greenhouse load is produced by lights. In a North European greenhouse garden, 10MW is dedicated to lighting lamps with around 10 feeders of 1400-1600A at 400V-3ph that supply nine lighting panels, on average 100 lamps of 1kW. Indeed, for certain growing practices (between seasons with reduced sunlight conditions), natural light can be supplemented by artificial lighting, which provides the energy that is necessary for the vegetable plants.

Various technologies support this lighting, like sodium bulb lamps or LED for different light wavelengths required for the best photosynthetic activity. In every case, continuous operation is important, so it is not only a matter of energy savings needed but also of monitoring the continuity of electrical distribution service.

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ABB EQmatic

Both types of Ekip Up$^+$ (monitor and protect) units monitor the energy of these big loads, ensuring their connection at the same time to the automation SCADA, PLCs and ABB Ability™ EAM cloud-based monitoring platform.

Thanks to spread Ekip Com connectivity modules, there is no need for any protocol converter, but each one can be chosen according to the architecture needed onsite, with as many as four modules together providing redundancy .

Protocol	**Ekip Com Module**	**Ekip Com Redundant Module**
Modbus RTU	Ekip Com Module RS-485	Ekip Com R Module RS-485
Modbus TCP	Ekip Com Module TCP	Ekip Com R Module TCP
Profibus-DP	Ekip Com Profibus	Ekip Com R Profibus
Profinet	Ekip Com Profinet	Ekip Com R Profinet
EtherNet/IP™	Ekip Com EtherNet/IP™	Ekip Com R EtherNet/IP™
DeviceNet™	Ekip Com DeviceNet™	Ekip Com R DeviceNet™
IEC61850	Ekip Com IEC61850	Ekip Com R IEC61850
Open ADR	Ekip Com Open ADR	-
Cloud connectivity	Ekip Com Hub	-

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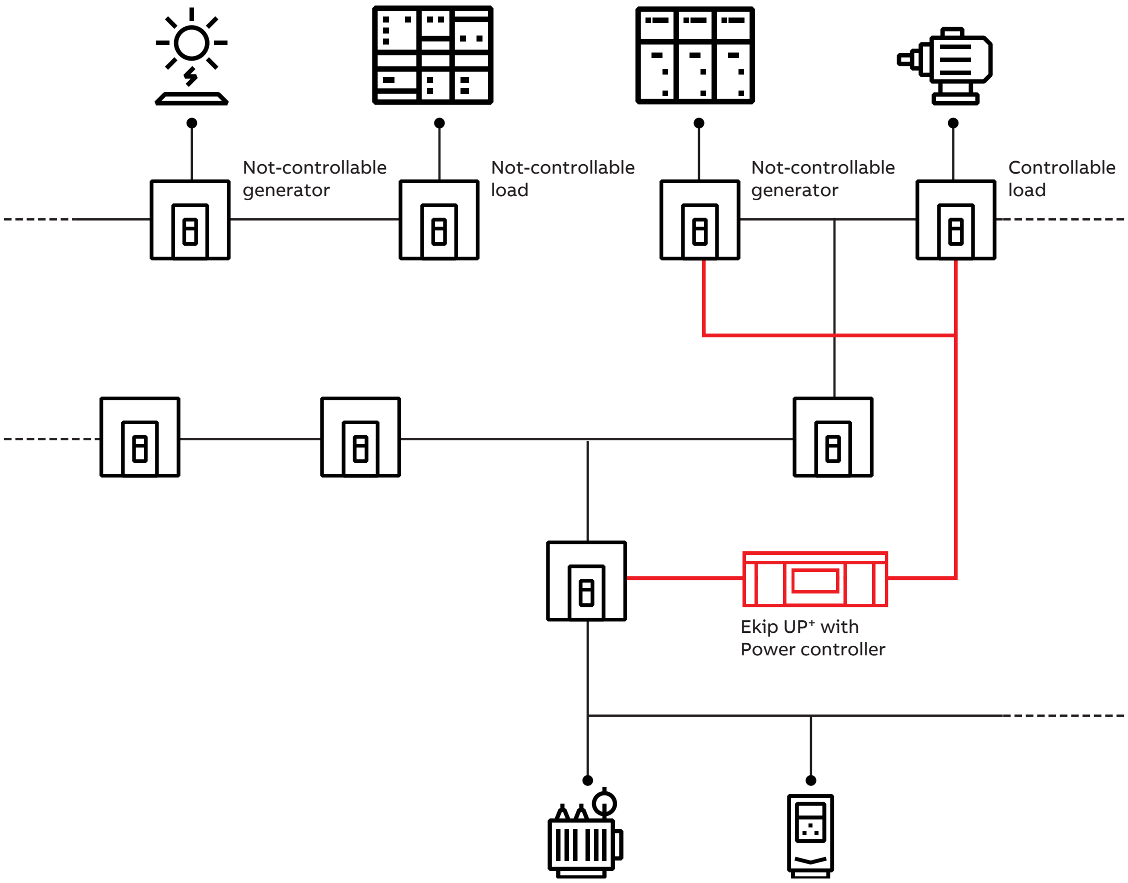
Ekip Power Controller

Remote supervision of energy KPIs on smartphones and tablets is granted by Ekip UP$^+$, which directly uploads chiller and lighting switchboard information to the cloud ABB Ability™ EAM. With the built-in Ekip Com Hub gateway, the digital unit sends upgraded circuit breaker information, including information from third-party breakers. The digital unit also can collect data from other existing meters, if any.
This is achieved with the unit's own measuring technology and Modbus-network connectivity pooling data for up to 200 devices per food and beverage plant. If installed meters are not from ABB, they can be added in the same architecture though the ABB EQmatic integration device.

Power management

The remote energy monitoring makes it possible to detect and implement improvement actions for power quality and consumption—for example planning peak shaving logics Ekip Up$^+$ with software package Power controller allows reduction of contractual power just for overloads, leading to lower bills and fewer penalties from utilities when a contractual threshold is exceeded. The algorithm does not require additional design on PLCs.

The Ekip Power Controller algorithm is based on a forecast average power absorption over a determined time interval and is set by the user. Whenever this value exceeds the fixed power, the Power Controller function intervenes to bring it back within the limits, sending On/Off commands to controllable loads, like pumps or auxiliary thermal units.



Solutions

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Ekip Signalling 3T

Asset management

If Ekip UP⁺, in its Protect version, is installed together with an ABB SACE Emax circuit breaker/ switch disconnector, GE Entelliguard G circuit breaker/switch disconnector (coming soon!) or ABB SACE Emax 2 switch disconnector at incoming or main loads (for example, chillers or lighting feeders), it enables the Predict function on ABB Ability™ EAM.

The predictive maintenance algorithm is based on utilization category, asset aging, switching operations, current flows and environmental conditions.

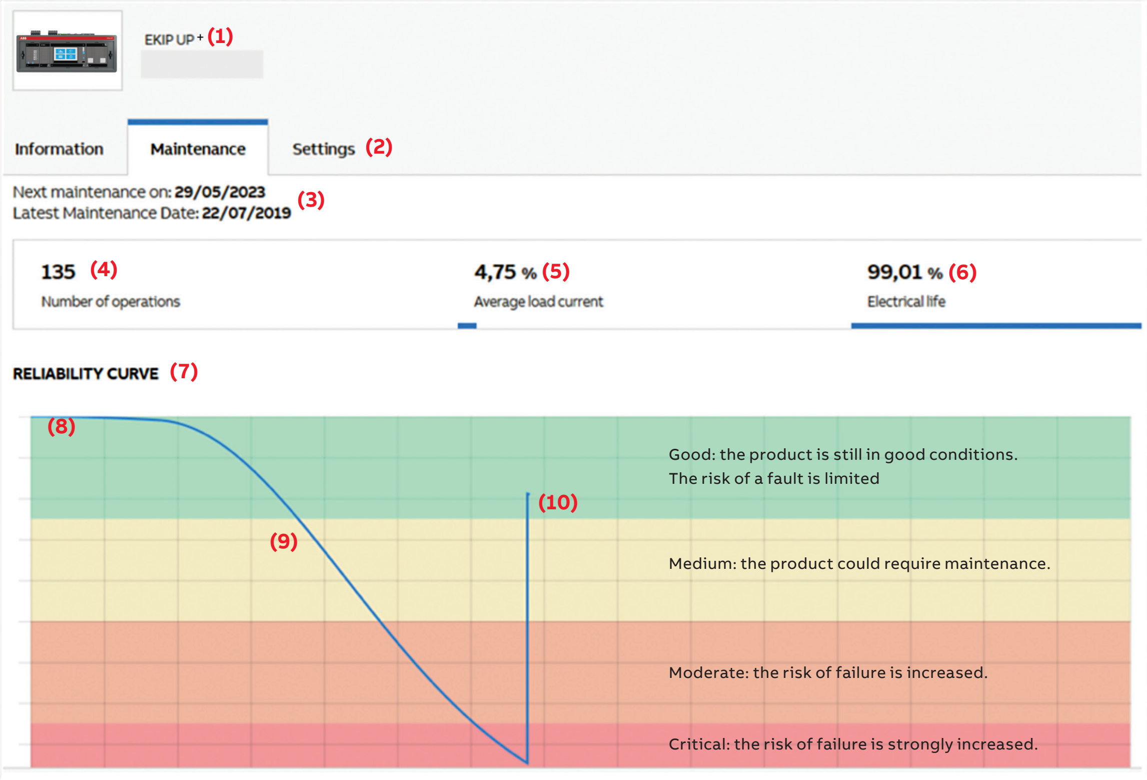
Of course, the design and testing know-how on asset performance makes the predictive algorithm consistent.

Temperature measurements or humidity inputs are available through an Ekip UP⁺ unit equipped with the Ekip 3T cartridge module.

This condition-based function reduces operational costs up to 35%, optimizing the maintenance scheduling that is fundamental for 24/7 food and beverage operations. It becomes easy to know which spare parts are needed and when maintenance must be planned.

These events can be shared to local SCADA through APIs.

Reliability curve on ABB Ability EAM



Next maintenance on: **29/05/2023**
Latest Maintenance Date: **22/07/2019** (3)

135 (4)
Number of operations

4,75 % (5)
Average load current

99,01 % (6)
Electrical life

RELIABILITY CURVE (7)

Good: the product is still in good conditions. The risk of a fault is limited

Medium: the product could require maintenance.

Moderate: the risk of failure is increased.

Critical: the risk of failure is strongly increased.

(1) Ekip UP⁺ tag name

(2) Here there are the settings related to circuit breaker or switch disconnector associated with Ekip UP⁺ and environmental installation conditions. For details, look at Predict technical documentation.

(3) Predictive maintenance scheduling (last and next). Next one is forecasted when reliability curve will change from Green to Yellow Zone during normal life. In case of fault, it will be speeded up and SMS/mail will notice maintenance manager.

(4) Opening/closing times counted

(5) Current utilization of the asset

(6) Real time residual life of switching asset

(7) Residual life expected during asset life

(8) Asset production and installation period

(9) Asset ageing curve without fault event

(10) Life expectancy restoration after asset maintenance by authorized personnel and Ekip UP⁺ installation

ABB S.p.A.
5, Via Pescaria
I-24123 Bergamo - Italy
Phone: +39 035 395.111
www.abb.com

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