Enhance Energy Efficiency and Saving Through Automation Solutions

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ABSTRACT

Enhancing energy efficiency and achieving energy savings through automation solutions is a transformative approach for both residential and industrial sectors. Automation solutions, such as Variable Frequency Drive (VFD), Power Management System (PMS), Energy Management Systems (EMS), and Building Management System (BMS), enable real-time monitoring and adjustment of energy usage, optimizing the consumption.

By integrating with sensors, actuators, logic controllers, and IoT/Edge Computing, the automation solutions can identify inefficiencies of machines and recommend corrective actions, leading to improve machine efficiency and cost savings.

The potential of automation to streamline operations and lower energy costs is increasingly evident across buildings, factories, and infrastructure. As such, the adoption of automated systems represents a significant opportunity for businesses and consumers to reduce their environmental impact while benefiting from long-term financial savings.

This abstract explores the key energy efficiency & saving technologies, benefits, and future implications of automation in enhancing energy efficiency and reducing energy consumption across various sectors.

AGENDA (PART - ONE)

01 Introduction to Energy, Energy Efficiency & Automation

- Brief explanation about Energy, Energy Conservation, Energy Efficiency & Energy Saving.
- Introduction to Automation & Automation Solutions.

02 Variable Frequency Drive

- Fundamental of Variable Frequency Drive
- How VFD can improved energy saving
- Dynamic Braking & Power Regeneration

03 Power Management System

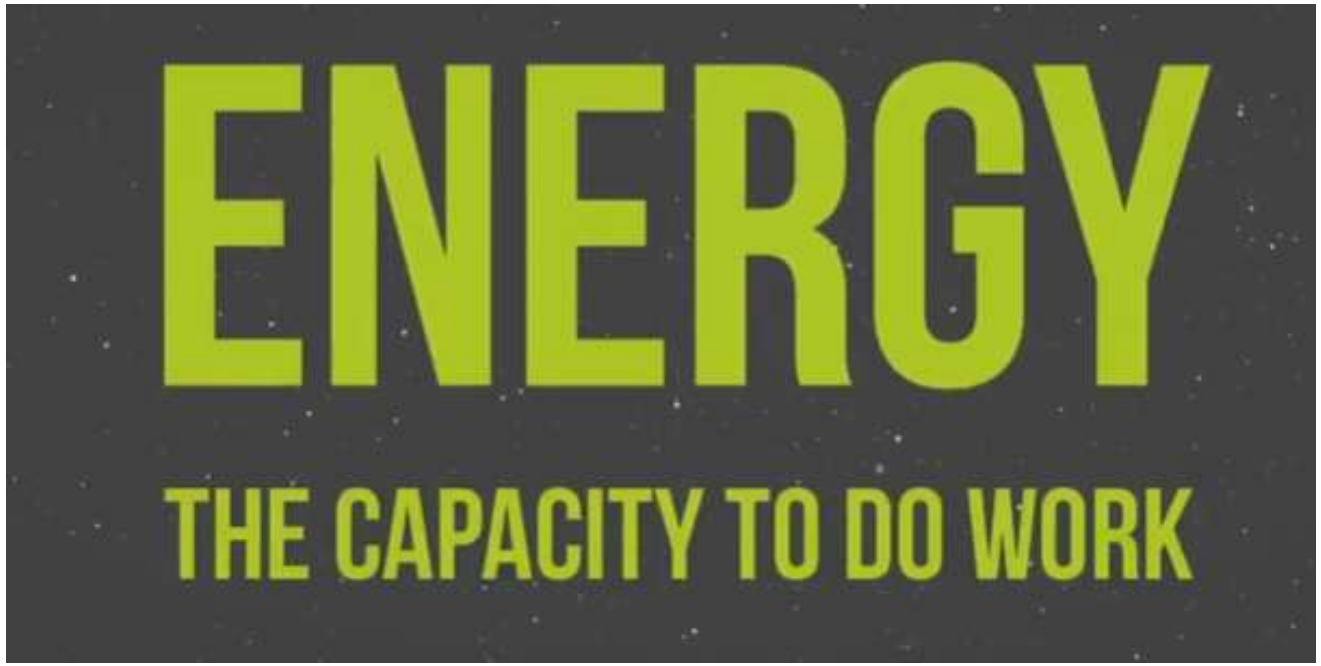
- What is PMS and What are its features?
- Generator PMS functions

INTRODUCTION TO ENERGY, ENERGY EFFICIENCY & AUTOMATION

ASTRO Automation

What is Energy?

Energy is the capacity to do work or cause change. It exists in various forms and is essential for powering everything around us, from natural processes to human-made activities. Energy can’t be created or destroyed, only transformed from one form to another, according to the **law of conservation of energy**.

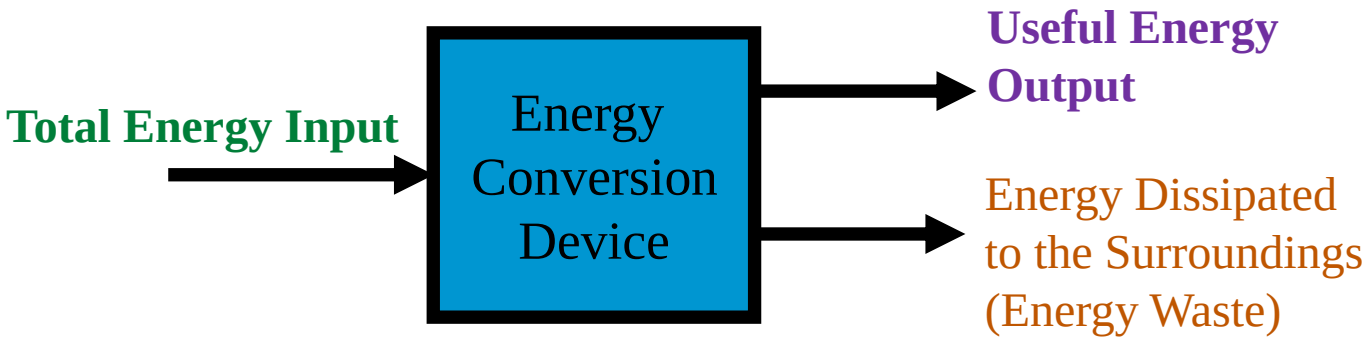


What is Energy Conservation?

Energy conservation is the decision and practice of using less energy. Turning off the light when you leave the room, unplugging appliances when they're not in use and walking instead of driving are all examples of energy conservation.

What is Energy Efficiency?

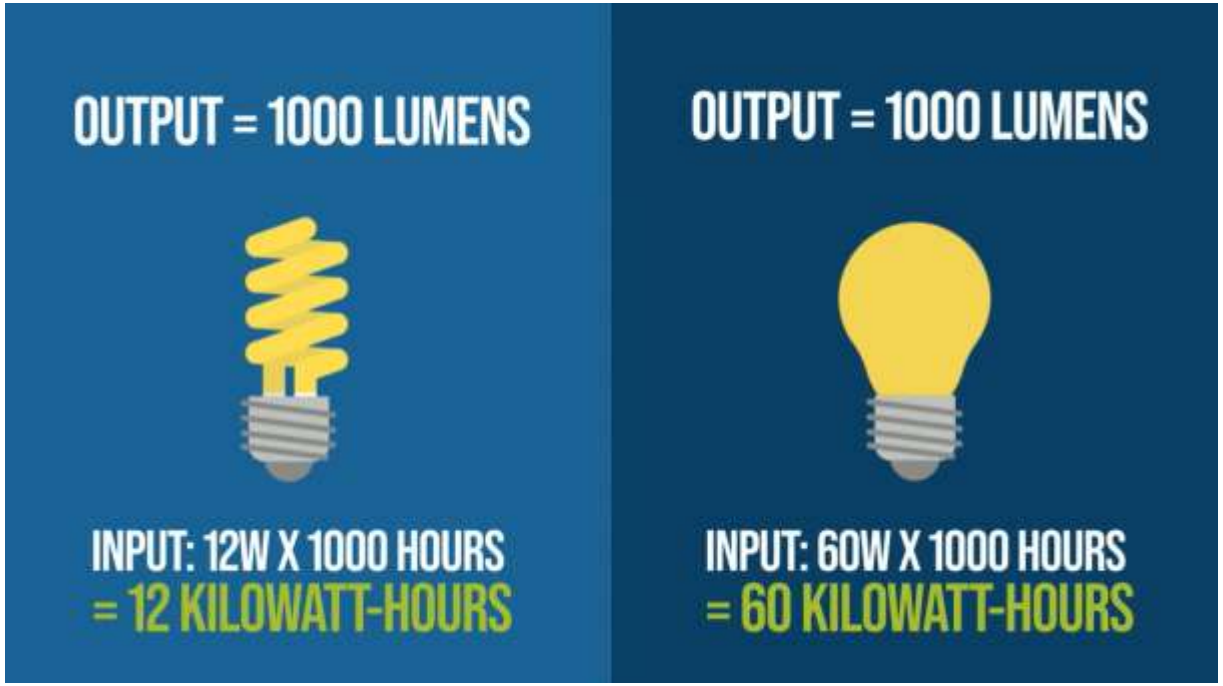
Energy efficiency simply means using less energy to perform the same task – that is, eliminating or reducing the energy waste.



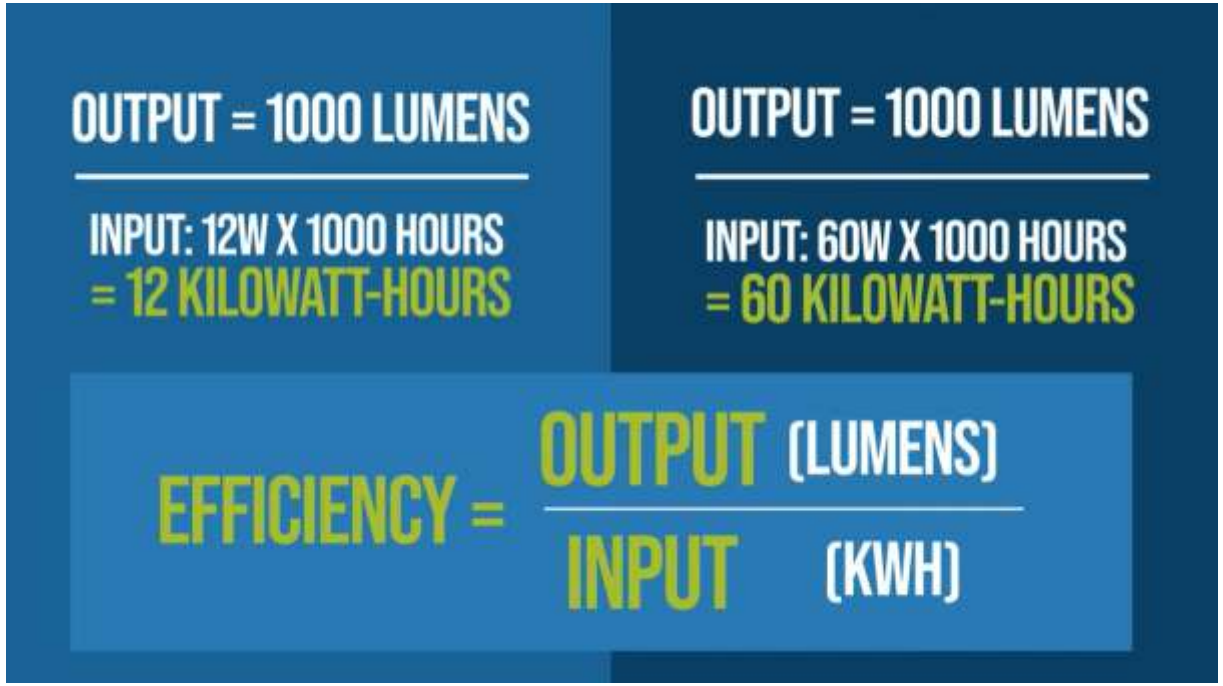
$$Efficiency = \frac{Useful\ Energy\ Output}{Total\ Energy\ Input}$$

Difference Energy Efficiency

Fluorescent

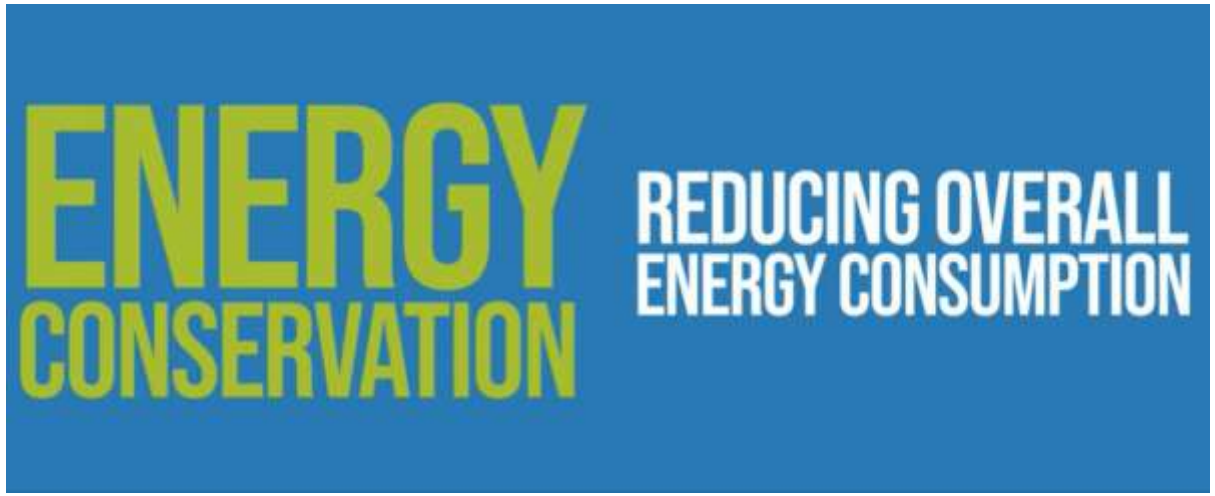


Incandescent



Efficiency Today, Savings Tomorrow

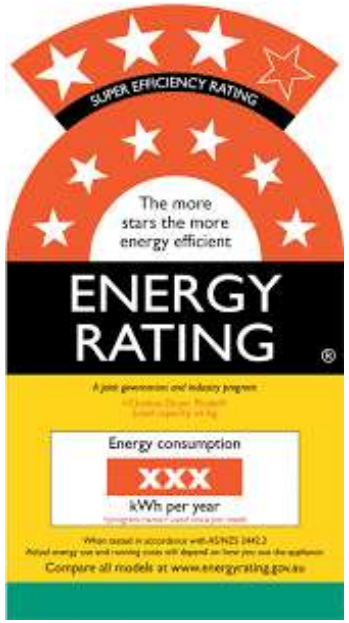
Summary : Energy Efficiency & Energy Conservation



Energy Efficiency

Energy efficiency is not a single technology but a **characteristic of every technology and process**, such as:

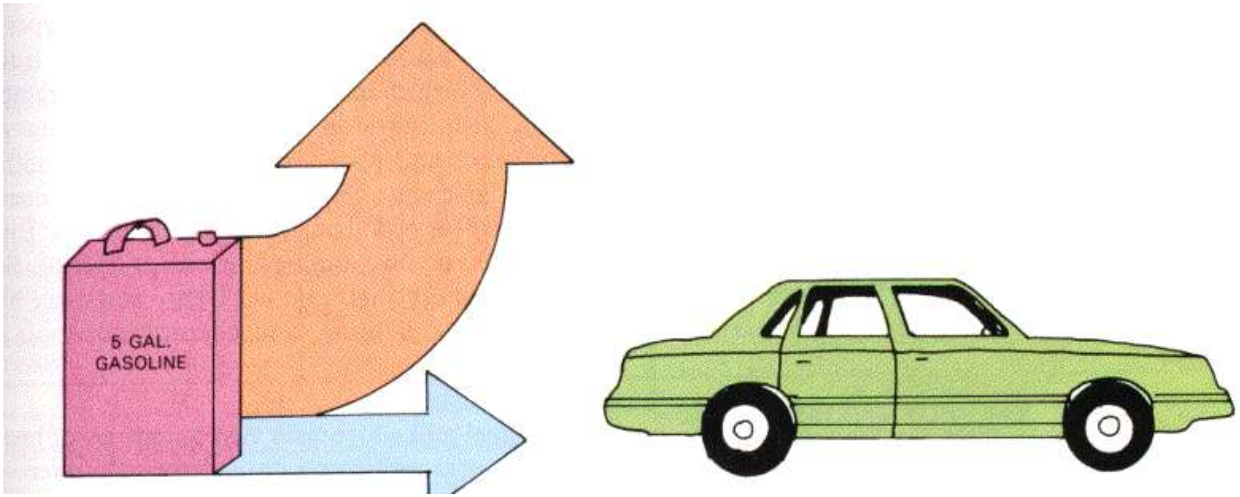
- Household appliances (energy start certified)
- Industrial and commercial processes
- Built environment
- Transport
- Digital technologies



Efficiency of Some Common Devices

Devices	Efficiency
Electric Motor	90
Home Coal Furnace	65
Steam Boiler (Power Plant)	89
Power Plant (Thermal)	36
Automobile Engine	25
Light Bulb-Fluorescent	20
Light Bulb -Incandescent	5

* Ref: Wikipedia

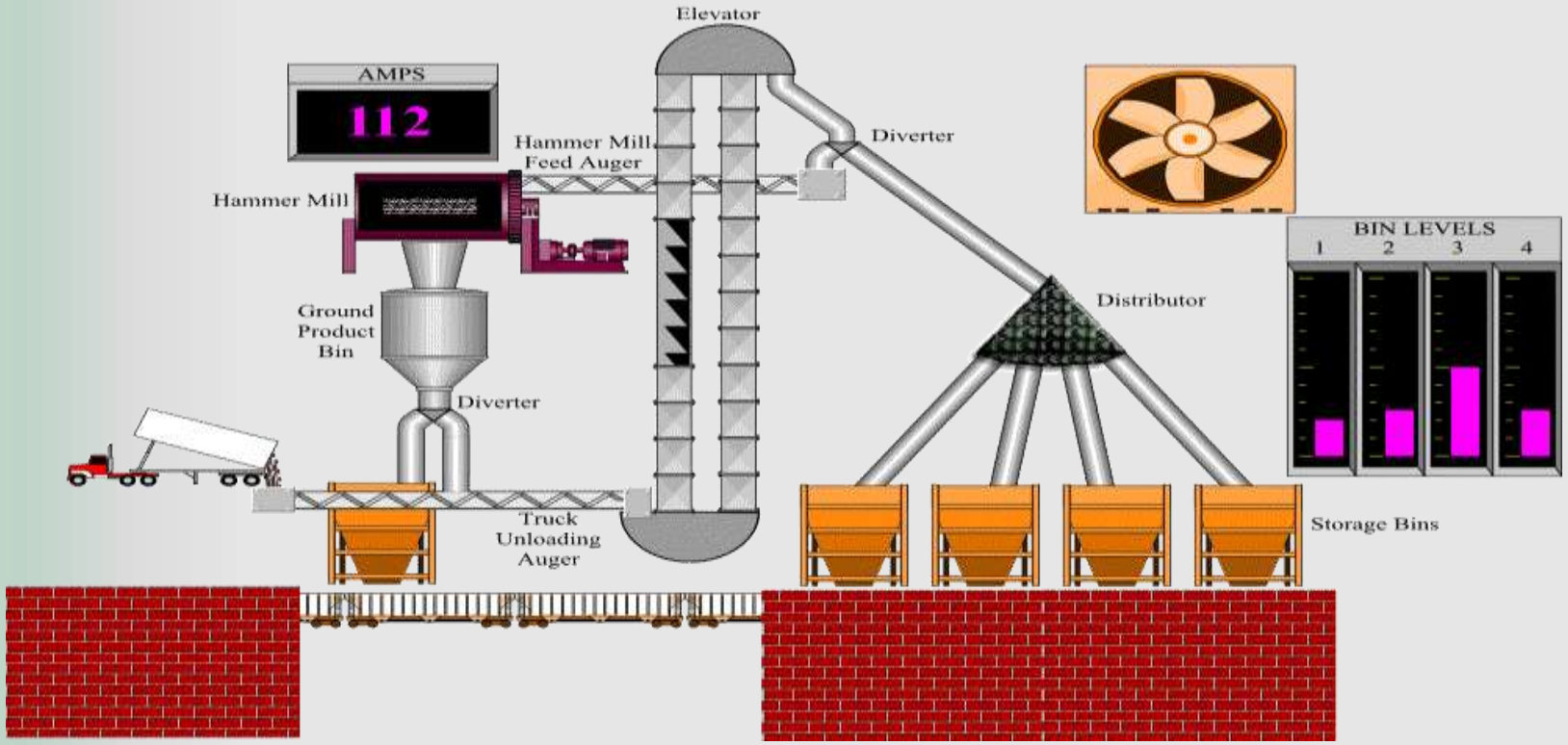


25% Of the gasoline is used to propel a car, the rest is “lost” as heat. i.e an efficiency of 0.25 (25%).

What is Automation & Automation Solutions?

Automation is the use of technology to perform tasks without human intervention, aiming to improve efficiency, consistency, and productivity.

Automation Solution is a set of tools, software, or systems designed to implement automation in a specific area, whether it's manufacturing, business, IT, or other fields. These solutions typically aim to improve efficiency, reduce errors, and lower operational costs.

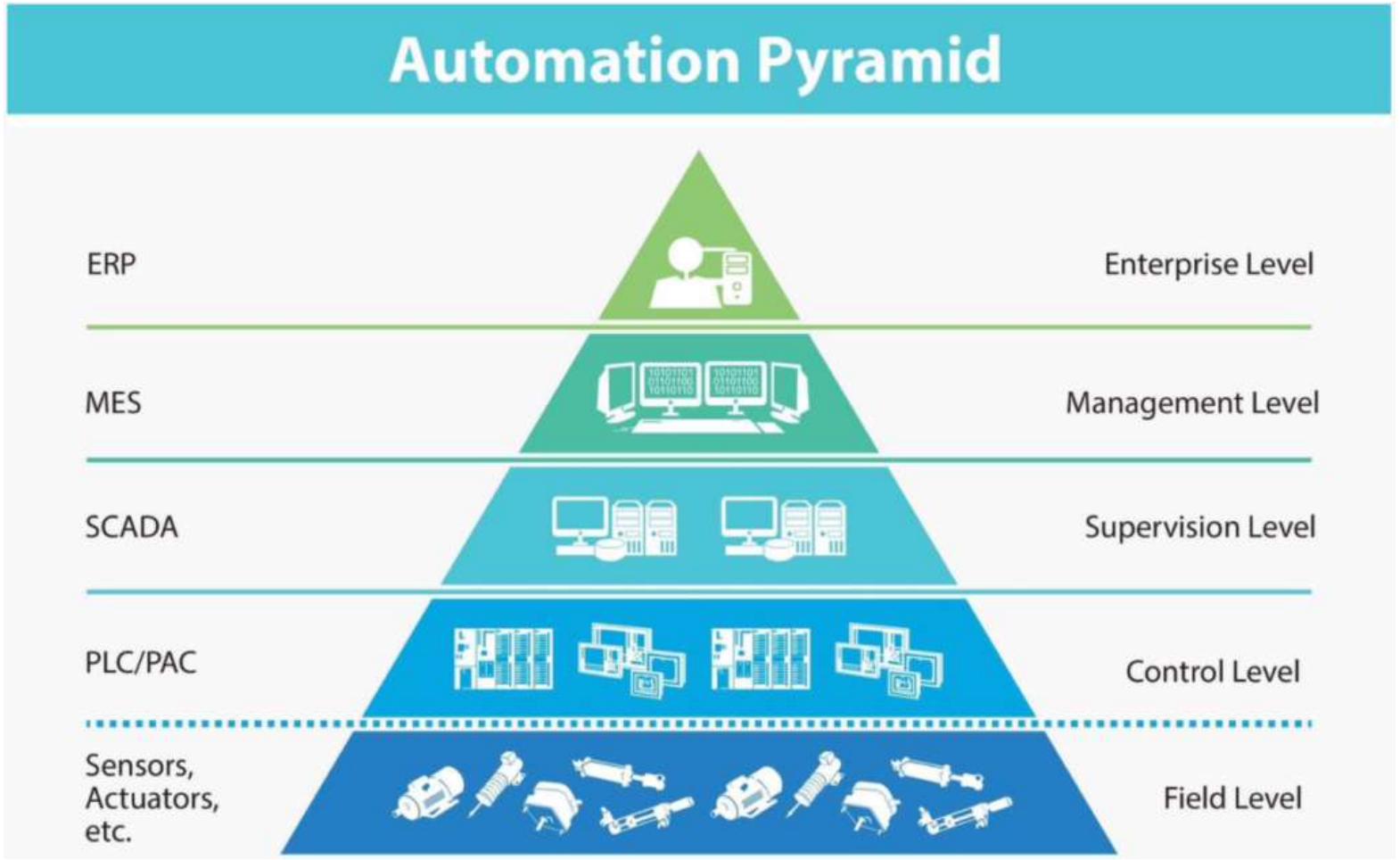


Applied Fields of Automation Solutions

Levels of Automation

The hierarchy of an industrial automation system, often visualized as a "pyramid," typically consists of five levels:

- Field Level (sensors and actuators)
- Control Level (PLCs and DCS)
- Supervisory Level (SCADA)
- Execution/Planning Level (MES)
- Enterprise Level (ERP), with the field level at the bottom directly interacting with machinery and the enterprise level at the top managing overall business functions.



Key Components of Industrial Automation Systems

Data Analytics and Machine Learning
Predictive Maintenance

Sensors and Actuators
The Nervous System of Automation

Safety Systems
Protecting People and Assets

Programmable Logic Controllers /(PLCs/)
The Brain Behind Automation

Communication Networks
Enabling Collaboration

Human-Machine Interface /(HMI/)
Bridging the Gap

Some Automation Solutions Examples to enhance energy efficiency

Here are some Automation Solutions to enhance energy efficiency and achieve energy savings:

A. **Variable Frequency Drive**: Automated systems can monitor and adjust energy consumption in real-time, ensuring that machines, lighting, HVAC, and other equipment only use energy when needed, preventing waste.

B. **Power Management System**: Automation in power generation & distribution allows for better management of electricity distribution. It helps in balancing supply and demand, ensuring that energy is used efficiently, and reduces the likelihood of overproduction or wastage.

C. **Energy Management Systems**: These systems are used to monitor, control, and optimize energy use in large facilities such as commercial buildings, factories, and campuses. Automated EMS can track real-time energy consumption data, providing insights into where energy is being used inefficiently and enabling adjustments to be made automatically to reduce consumption.

D. **Building Automation Systems**: These systems can control lighting, temperature, ventilation, and other building systems. They optimize the operation of these systems based on occupancy or time of day, reducing unnecessary energy usage.

VARIABLE FREQUENCY DRIVE (VFD)

What is VFD?

A variable frequency drive (VFD) is a type of motor controller that drives an electric motor by varying the frequency and voltage of its power supply.

The VFD also has the capacity to control ramp-up and ramp-down of the motor during start or stop, respectively.

Variable Frequency Drives it has different names such as :

- Variable speed drives.
- Adjustable speed drives
- Adjustable frequency drives
- Frequency converter
- Inverter

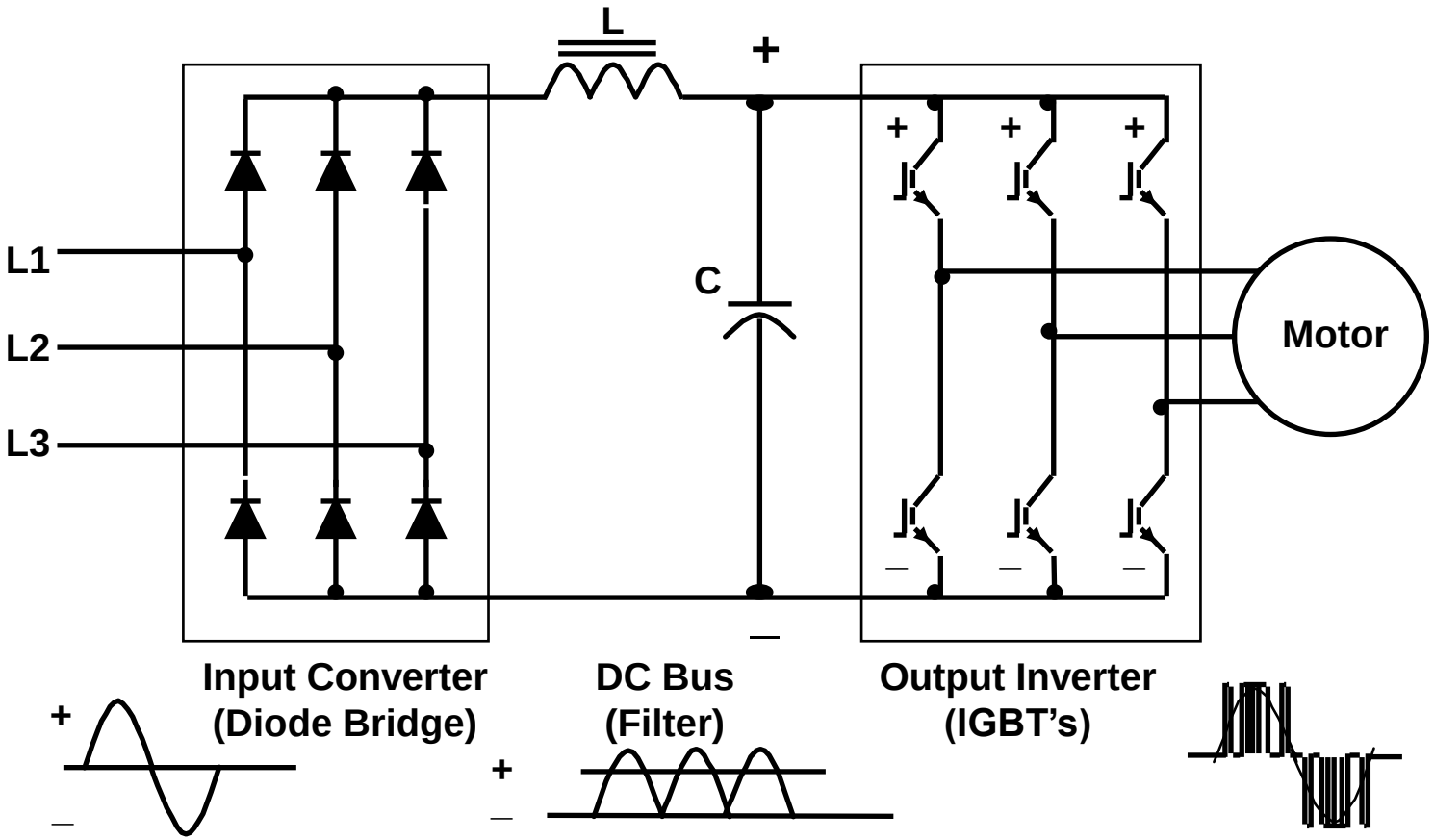
Why VFDs are needed?

The VFDs are necessary for precise and continuous control of speed, position, or torque of different loads. Along with this major function, there are many reasons to use VFDs.

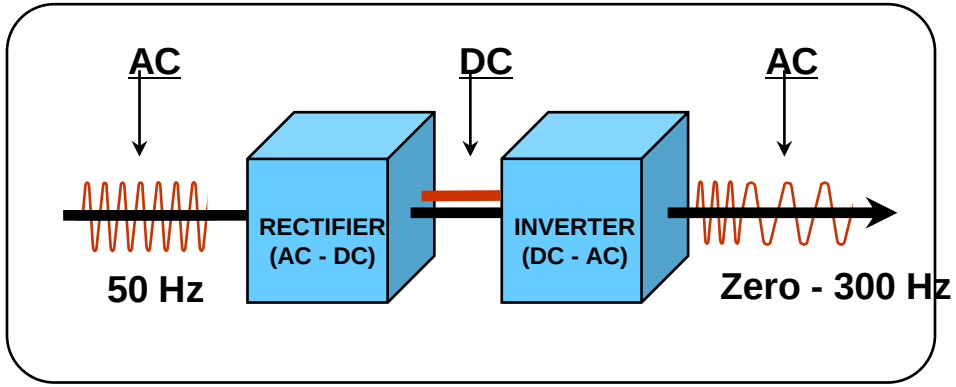
Some of these include

- ✓ To achieve high efficiency & energy saving
- ✓ To increase the speed of accuracy of stopping or reversing operations of motor
- ✓ To control/reduce the starting current
- ✓ To improve power factor
- ✓ To provide the protection
- ✓ To establish advanced control with variation of parameters like temperature, pressure, level, etc.

Typical Working Principle of VFDs



A variable frequency drive converts incoming 50 Hz utility power into DC, then converts to a simulated variable voltage, variable frequency output.

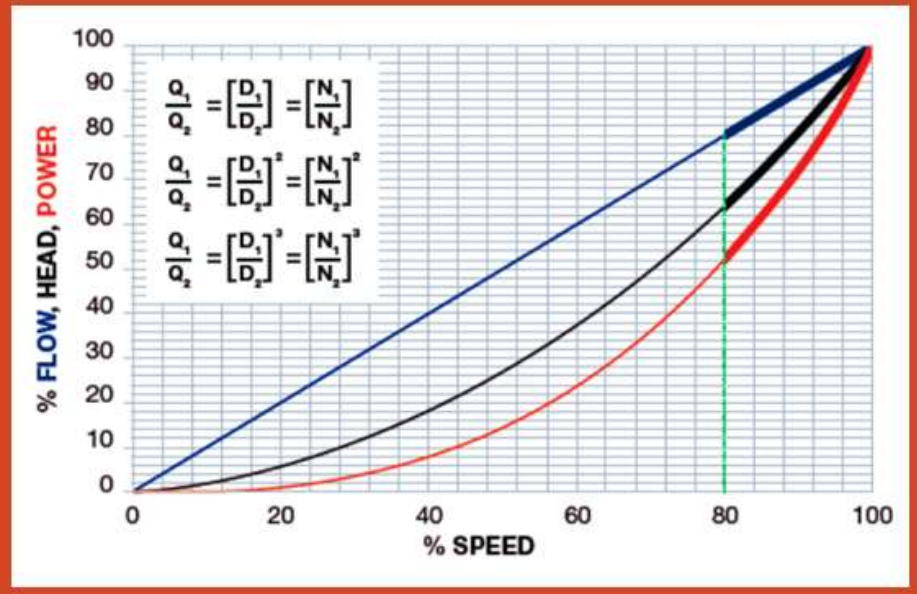


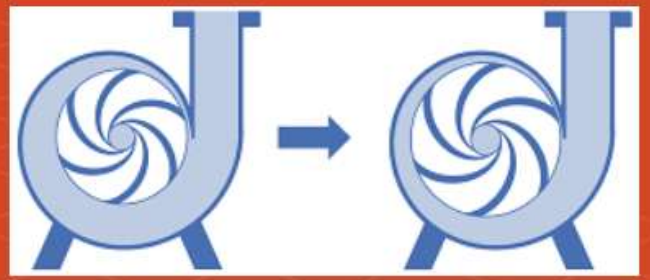
Affinity Laws

AFFINITY LAWS

PUMPS, FANS, TURBINES AND COMPRESSORS

- Flow varies with rotational speed.
- Head varies with square of rotational speed.
- Required power varies with cube of rotational speed.



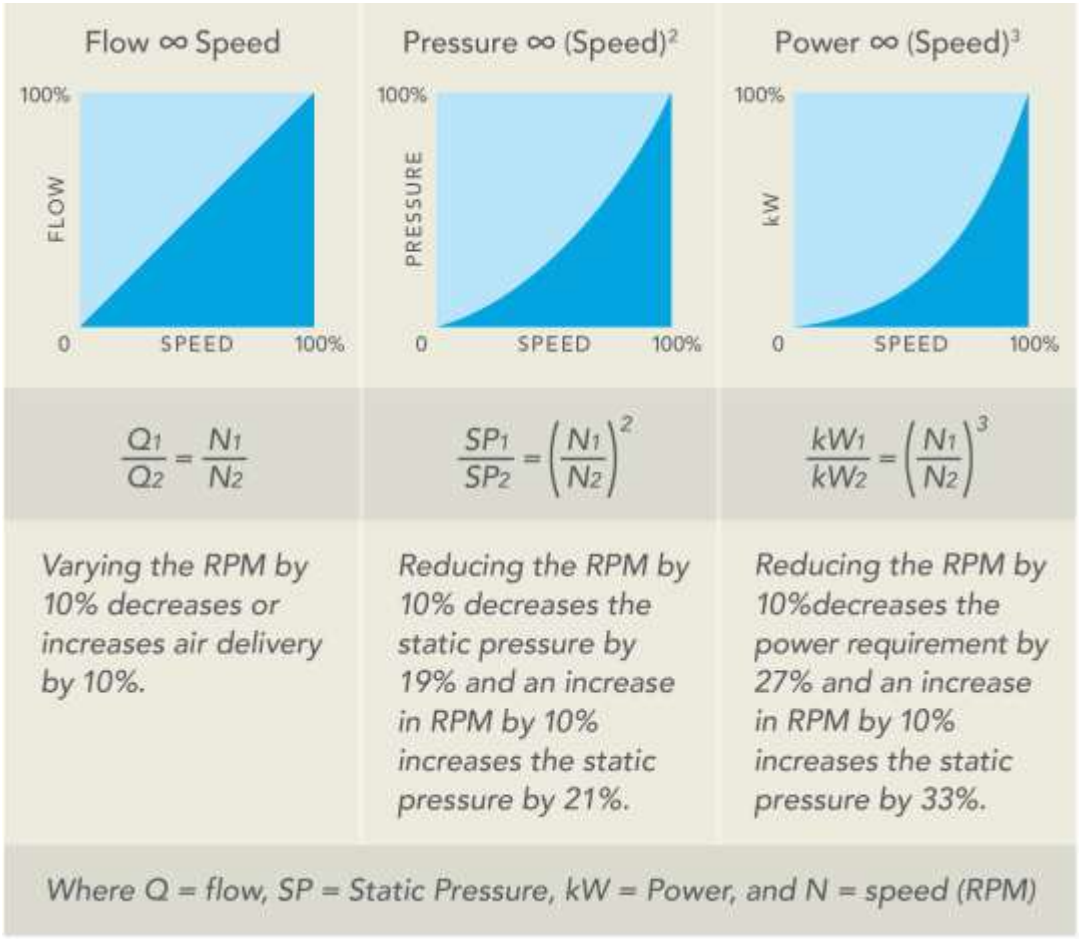


Energy savings with VFDs by Affinity Law

One of the main advantages of using VFDs is that they can reduce the energy consumption and savings.

By adjusting the motor speed to match the load requirements, VFDs can avoid wasting energy and improve the power factor of the system. When a motor is running at full speed, it consumes the most energy. By reducing the speed of the motor, the energy consumption is reduced proportionally, leading to significant energy savings.

For example, a fan running at 50% speed consumes only 12.5% of the power required. This is due to the affinity laws that govern the relationship between speed, flow, and power.



Cost Savings Calculation Example

Let's say we have a fan with a 60-horsepower (hp) motor that supplies air for 15 hours a day, 300 days a year, and the energy cost is 250 MMK per kilowatt-hour.

The operational cost is calculated with the following formula:

Cost = Power (kW) × Running Time × Cost/kWh

So, the cost of operation for running a motor at different speeds for different durations with VFD and without VFD is shown in below table.

Control	Speed (%)	Power (hp)	Duration in hours	Duration (%)	Cost (MMK) per year
Without VFD (A)	100	60	4500	100%	50,287,500.00
With VFD (B)	100	60	1350	30%	15,086,250.00
	75	25.3125	2475	55%	11,668,271.48
	50	7.5	675	15%	942,890.63
Annual savings per year by using VFD					**22,590,087.89**

cost of operation for running a motor with VFD and without VFD

Payback

To calculate the payback period of investing in an AC Drive, we can use the following formula:

$$\frac{\text{(Cost of drive)}}{\text{(annual savings)}} \times 12$$

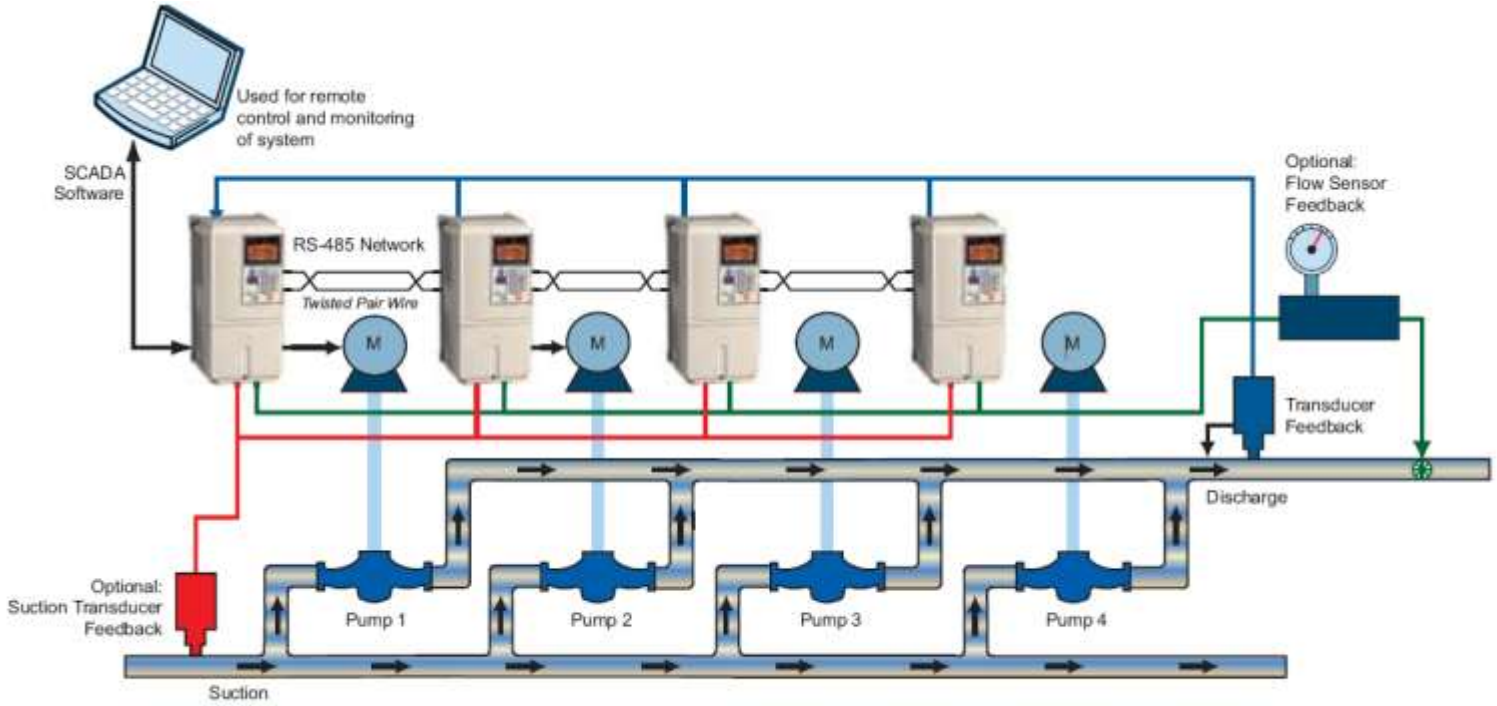
So, if our 60 HP Drive costs 12,000,000 MMK (assumed), the payback period would be around 7 months.

(i.e., less than one years!)

How Automation System apply VFD application

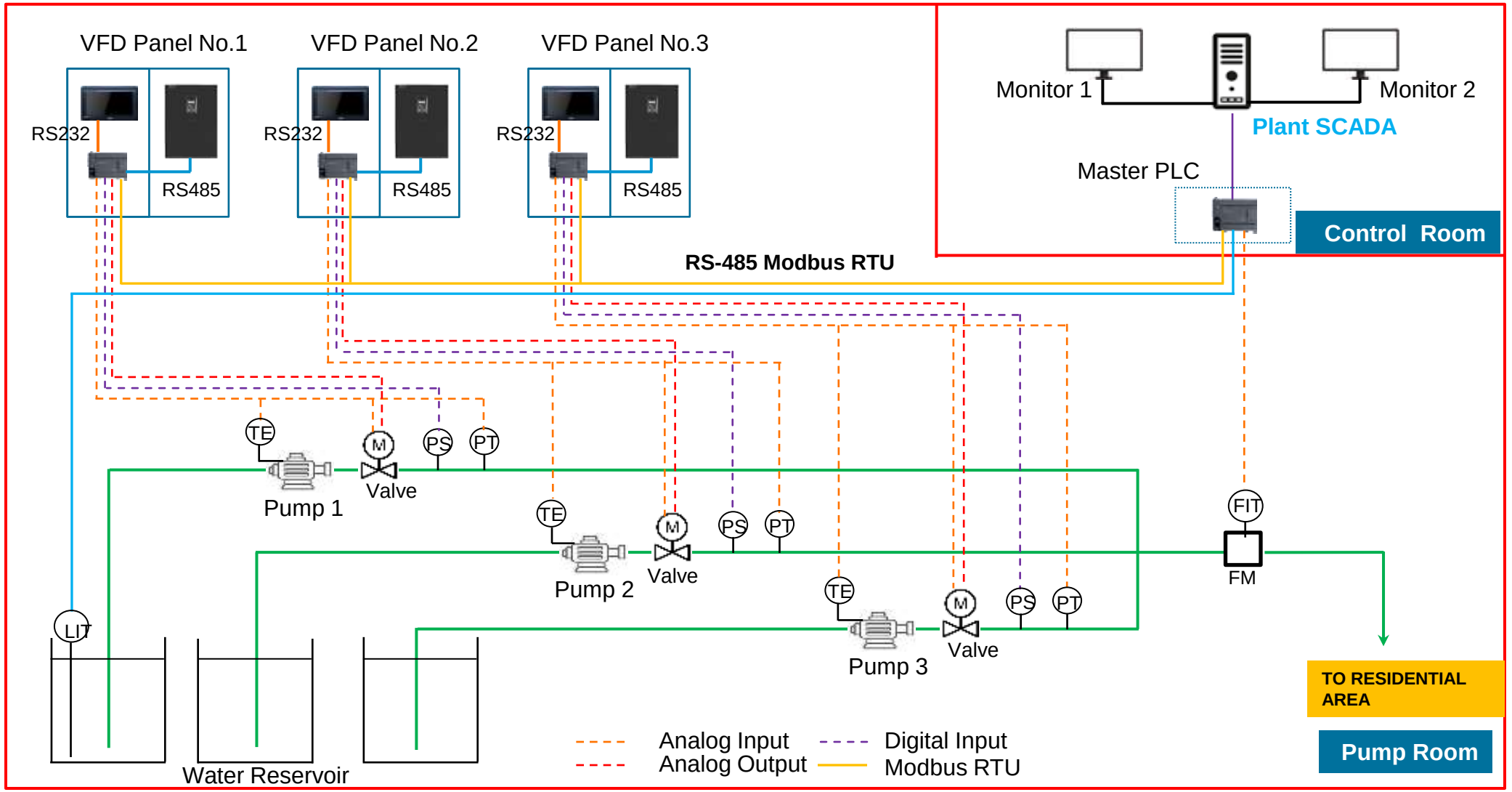
VFDs can be used in conjunction with other Automation control systems and devices, such as PLCs, HMIs, and sensors. PLCs perform control duties using a programmable logic program, whereas VFDs vary the frequency of the motor to adjust speed and torque.

Based on process conditions monitored by the PLC, PLC primarily controls the speed of a motor connected to VFD by sending digital/analog signals that command to start, stop, change rotation direction, and precise speed setpoints, essentially allowing for dynamic control of the motor's operation.

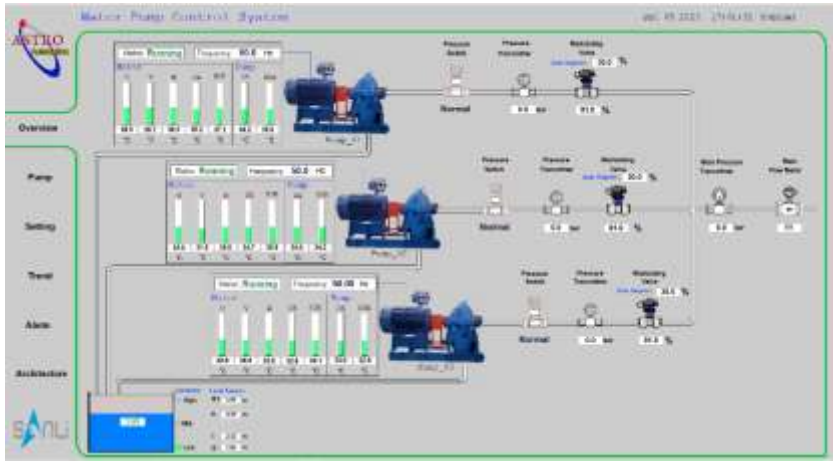


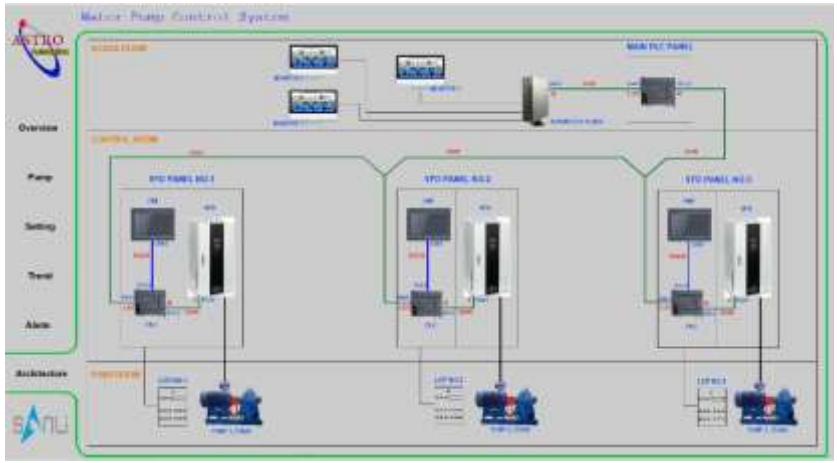
Systems can be configured for use with multiple feedback transducers for redundant backup.
A minimum of one feedback transducer is required for system operation.

Automatic Water Pump Control System integrated by VFD/PLC/SCADA (System Architecture)



Automatic Water Pump Control System integrated by VFD/PLC/SCADA





Others Application of VFDs through Automation Solutions

Electric Propulsion Motor

MOGAS Transfer Pump

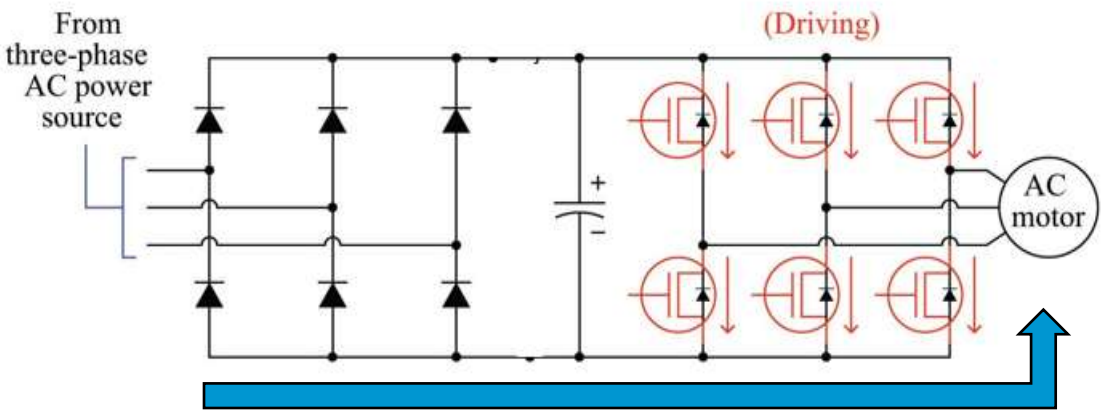
Chiller

Centrifuge Motor @

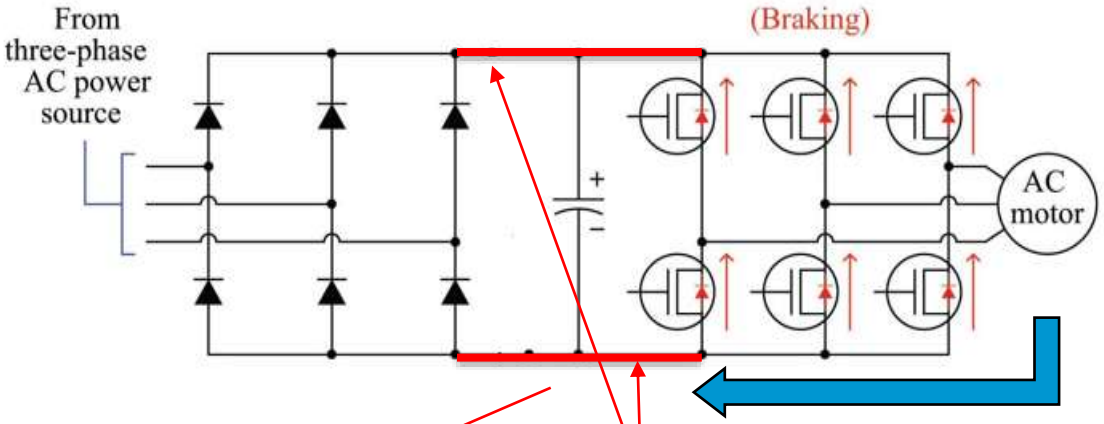
Motor Control Center @

Energy Waste by VFD Dynamic Braking

Dynamic braking in a **Variable Frequency Drive (VFD)** is a method used to rapidly decelerate a motor by converting the motor's kinetic energy into heat through resistive elements. It can produce a "negative torque," meaning the motor acts like a brake, generating power back into the system instead of drawing power to rotate. While this method is useful for stopping a motor quickly, it can result in **energy waste**.

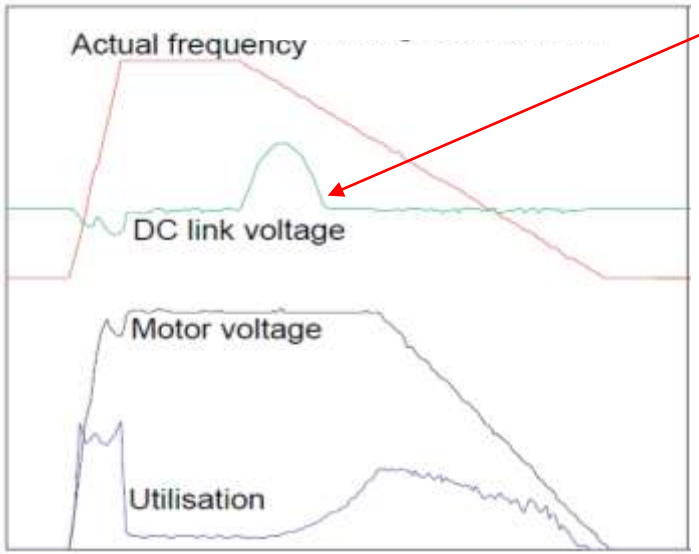


Power Flow to Motor

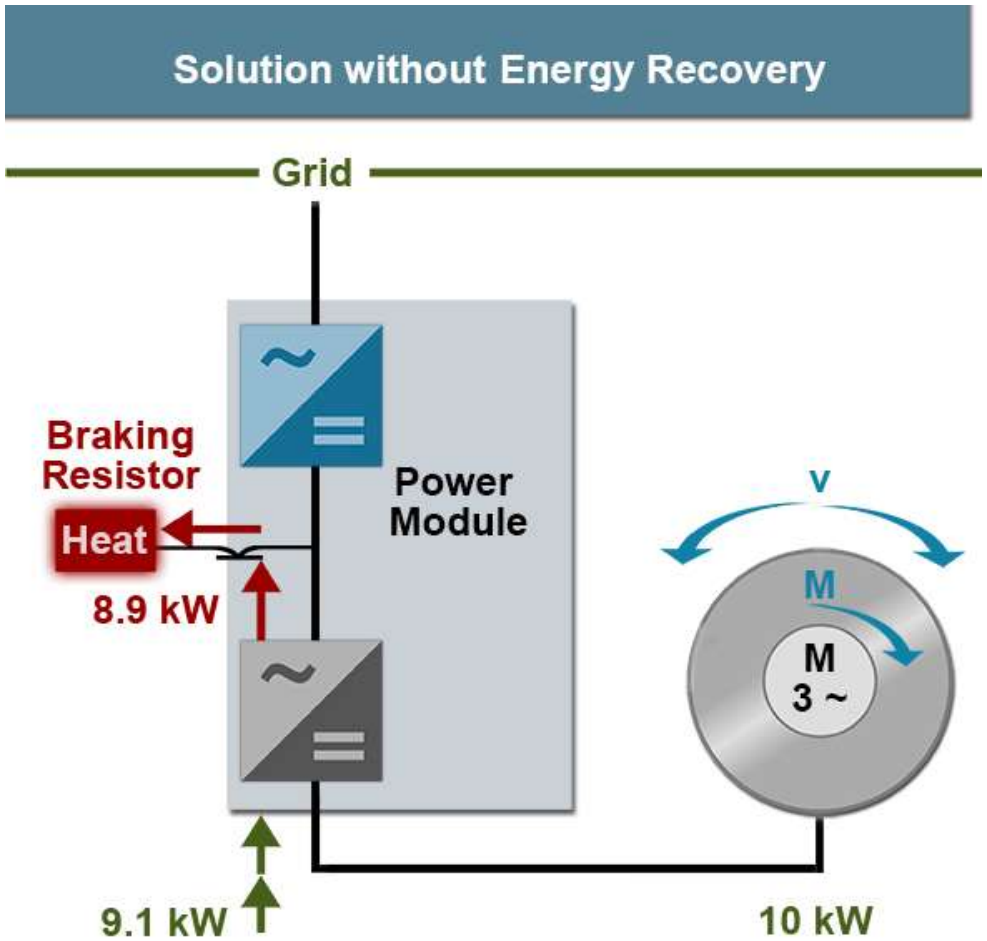


Power Flow from Motor

DC-Link Over Voltage,
lead to Excessive Heat



Energy Dissipation as Heat

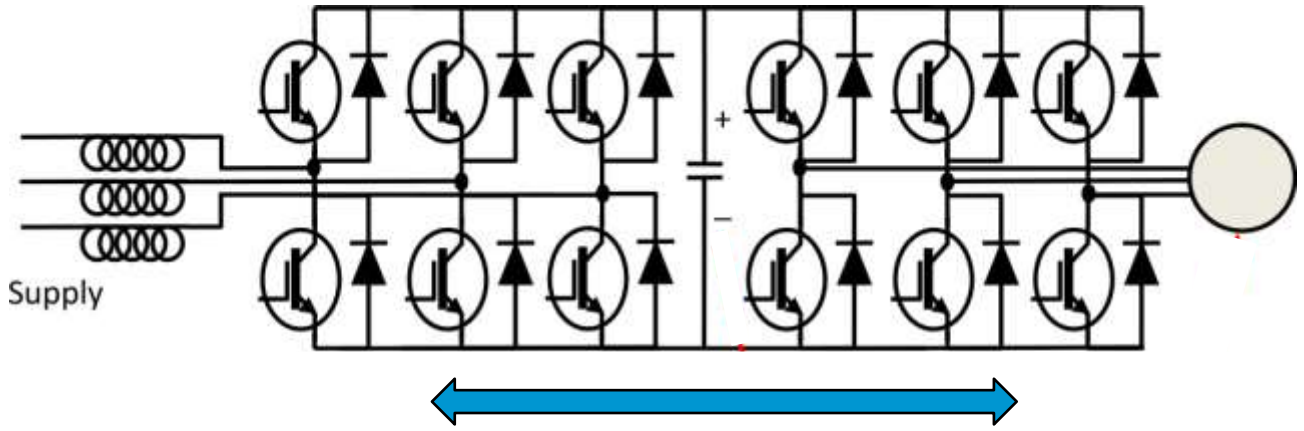


In dynamic braking, the motor’s kinetic energy is fed back into the VFD and converted into electrical energy, which is then dissipated through resistors as heat.

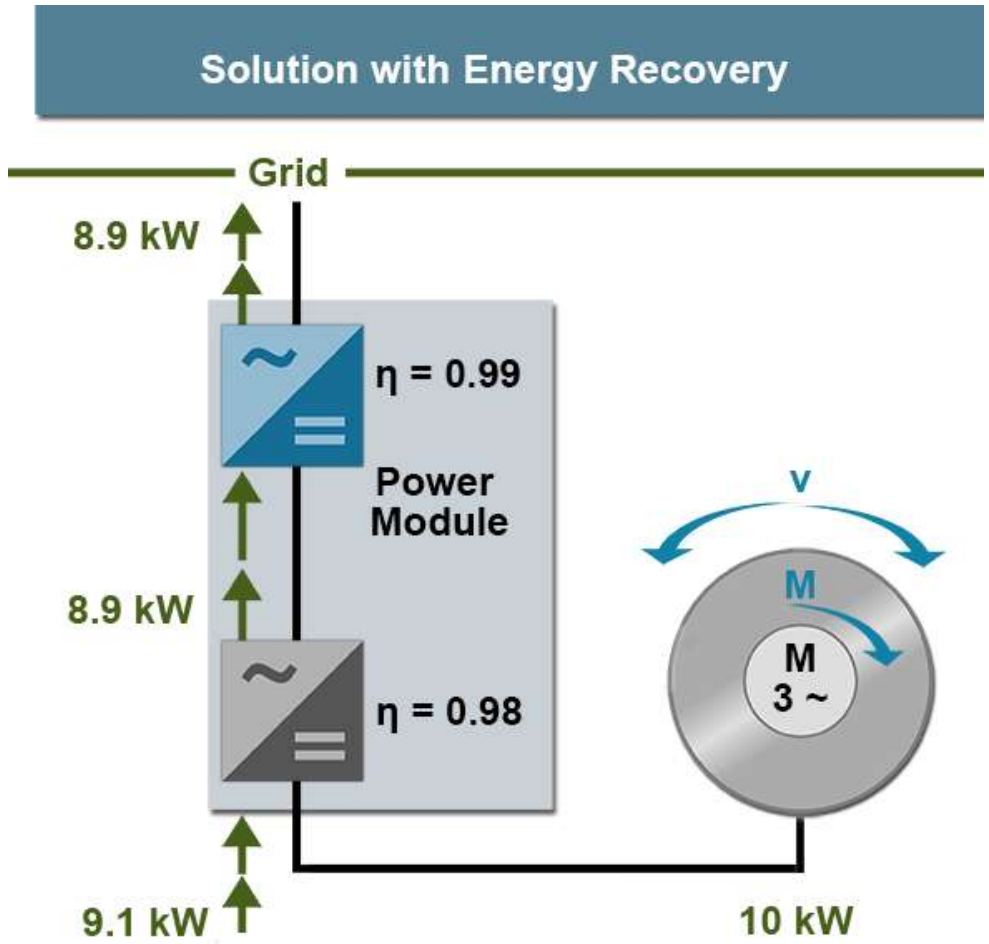
This conversion process doesn't recover the energy for use elsewhere in the system. Instead, the energy is simply lost as heat, which is why it's considered "waste" energy.

Capturing Wasted Energy with a Regenerative Drive

Capturing wasted energy with a **Regenerative VFD** is a more efficient alternative to traditional dynamic braking systems, which dissipate energy as heat. A regenerative drive captures the energy generated during braking and redirects it back into the grid power system.



Capturing Wasted Energy with a Regenerative Drive



“Regenerative" VFD not only controls speed but also captures energy generated during braking or deceleration and feeds it back into the power grid.

The motor’s kinetic energy is converted into electrical power. In a traditional drive, this energy would simply be lost as heat. However, in a regenerative drive, this energy is captured and stored or reused.

By returning energy to the grid or using it for other purposes within the system, energy costs can be reduced.

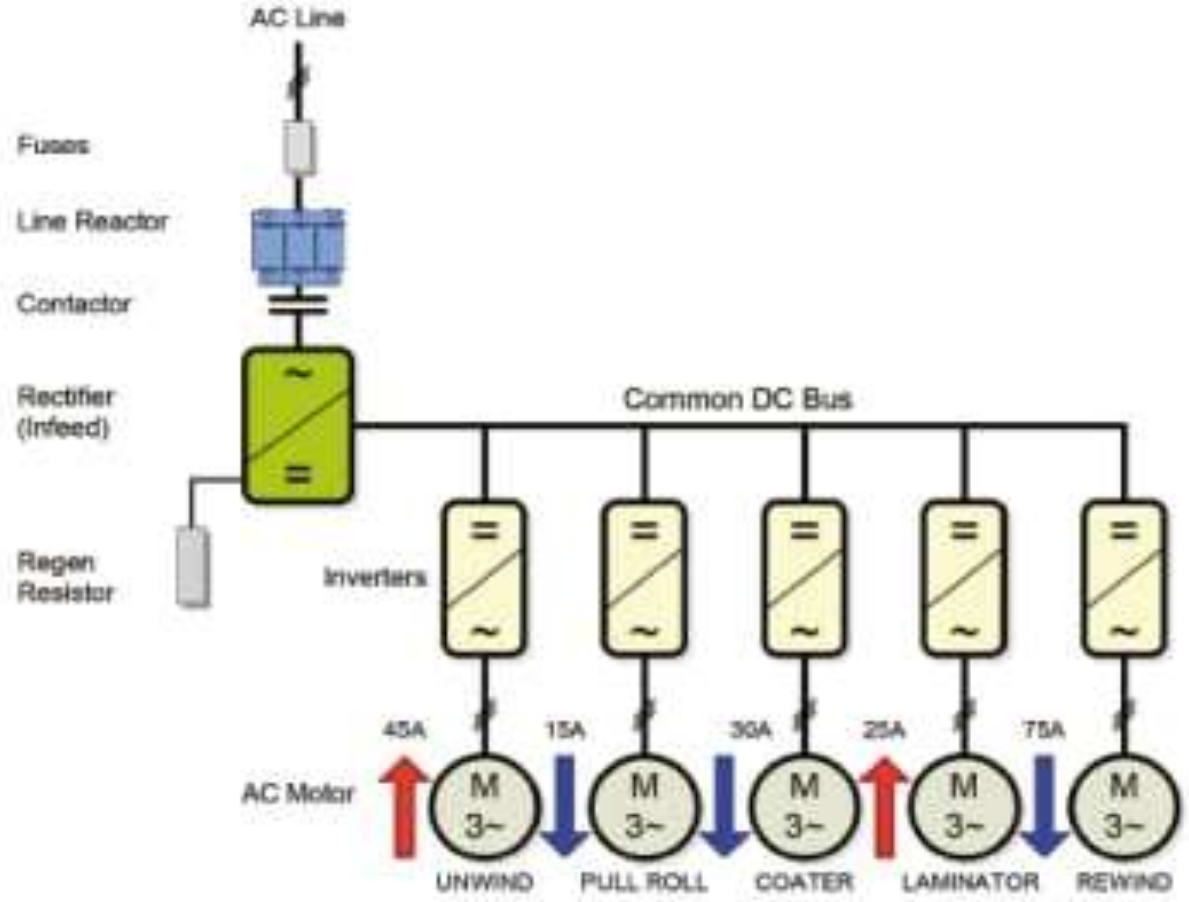
Regenerative Drive vs. Dynamic Braking

A **regenerative drive** offers significant advantages over traditional braking systems by capturing wasted energy and reusing it, which improves energy efficiency and reduces operational costs.

Feature	Regenerative Drive	Dynamic Braking
Energy Recovery	Yes, energy is returned to the grid or stored	No, energy is dissipated as heat
Heat Generation	Low, minimal heat output	High, heat generated in resistors
Energy Efficiency	Higher, as energy is reused or stored	Lower, due to energy waste
System Complexity	Higher, requires more components	Lower, simpler to implement
Cost	Higher upfront cost	Lower upfront cost, but higher operational costs due to wasted energy
Cooling Requirements	Lower, due to less heat generation	Higher, as resistors need cooling

Common DC Bus Drive System for Energy Savings

The common DC bus drive systems are far more efficient than the system composed of standalone AC/AC drives in several ways. When drive systems utilize a common DC bus design, a shared rectifier section is used to convert the AC power supply into a DC bus that is common to the parallel connected motor modules (inverters). With this technology, the drive system now uses less power from the rectifier as the generating drive sections can return their power to the DC bus to be shared by others.



CONCLUSION

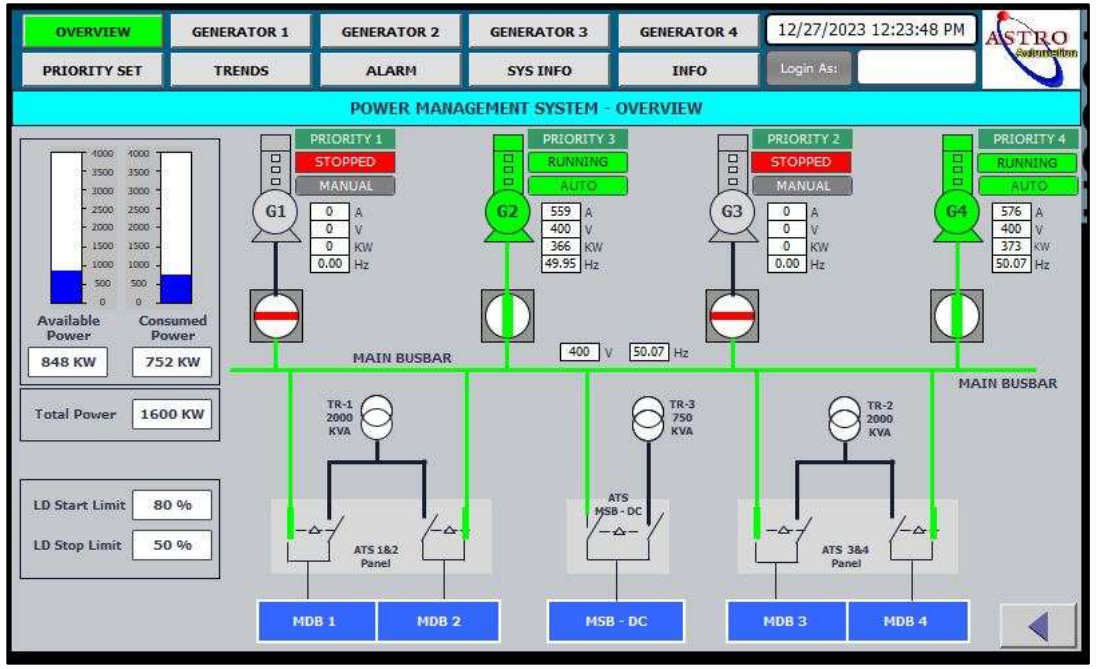
By implementing VFDs in your industrial and commercial facilities, you can enjoy several benefits for your business. These include lower energy bills and carbon footprint, as well as improved power quality of motor systems.

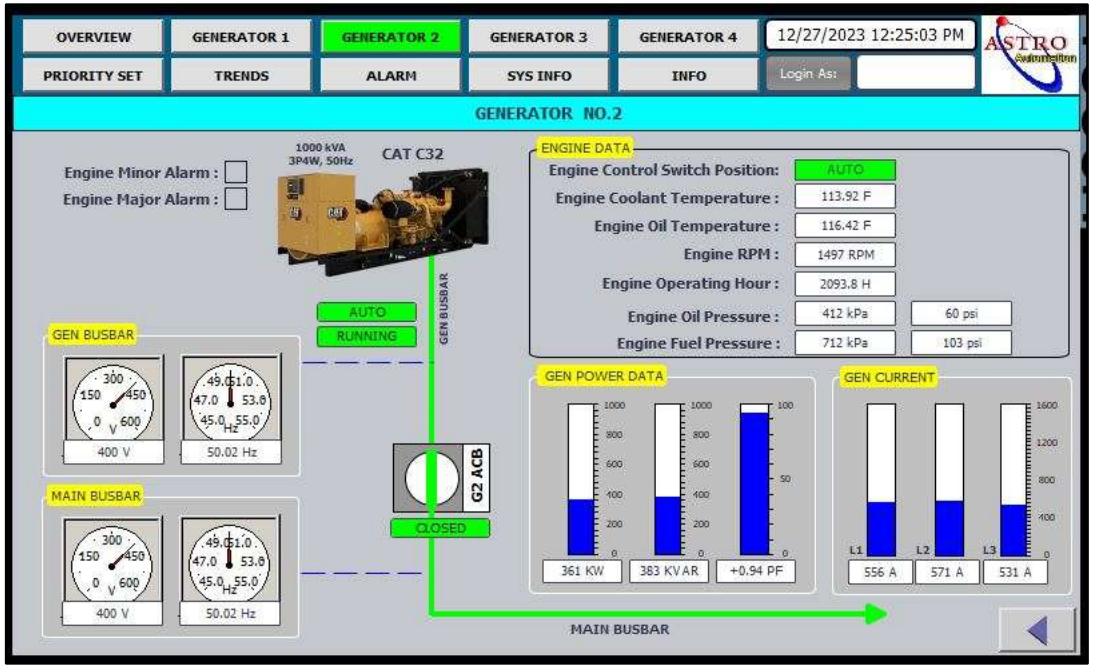
Additionally, VFDs can optimize motor speed and torque for different applications and conditions, resulting in higher performance and reliability. Furthermore, VFDs can enhance process control and automation, leading to greater operational efficiency and productivity.

POWER MANAGEMENT SYSTEM (PMS)

What is Power Management System (PMS)?

A **Power Management System (PMS)** is a comprehensive system designed to monitor, control, and optimize the generation, distribution, and consumption of electrical power in an organization or facility. The primary goal of a PMS is to ensure efficient and reliable energy use, reduce waste, and prevent system overloads, all while improving overall operational efficiency. These systems are commonly used in industries, large commercial buildings, and facilities where power management plays a crucial role.



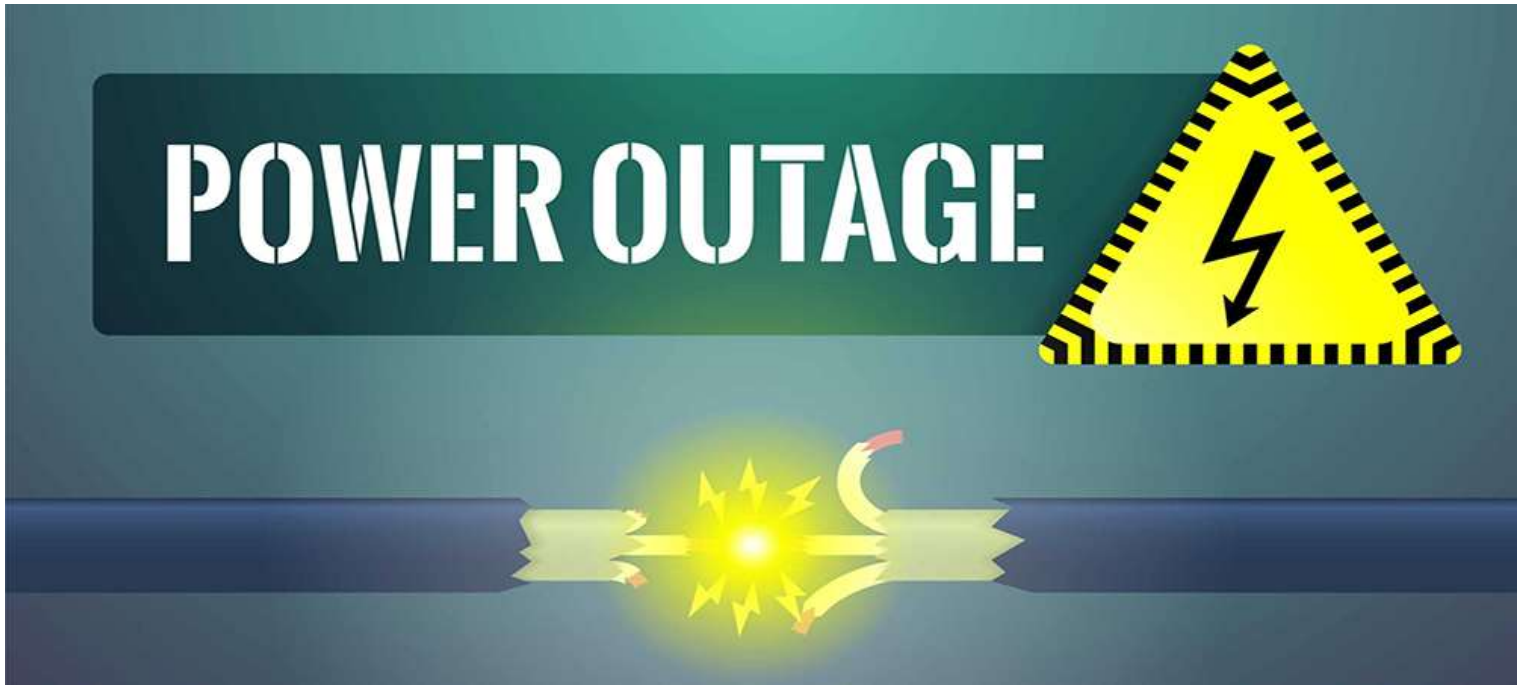


Why we need Power Management System (PMS)?

Power Management Systems increase electrical stability and reduce operational risk.

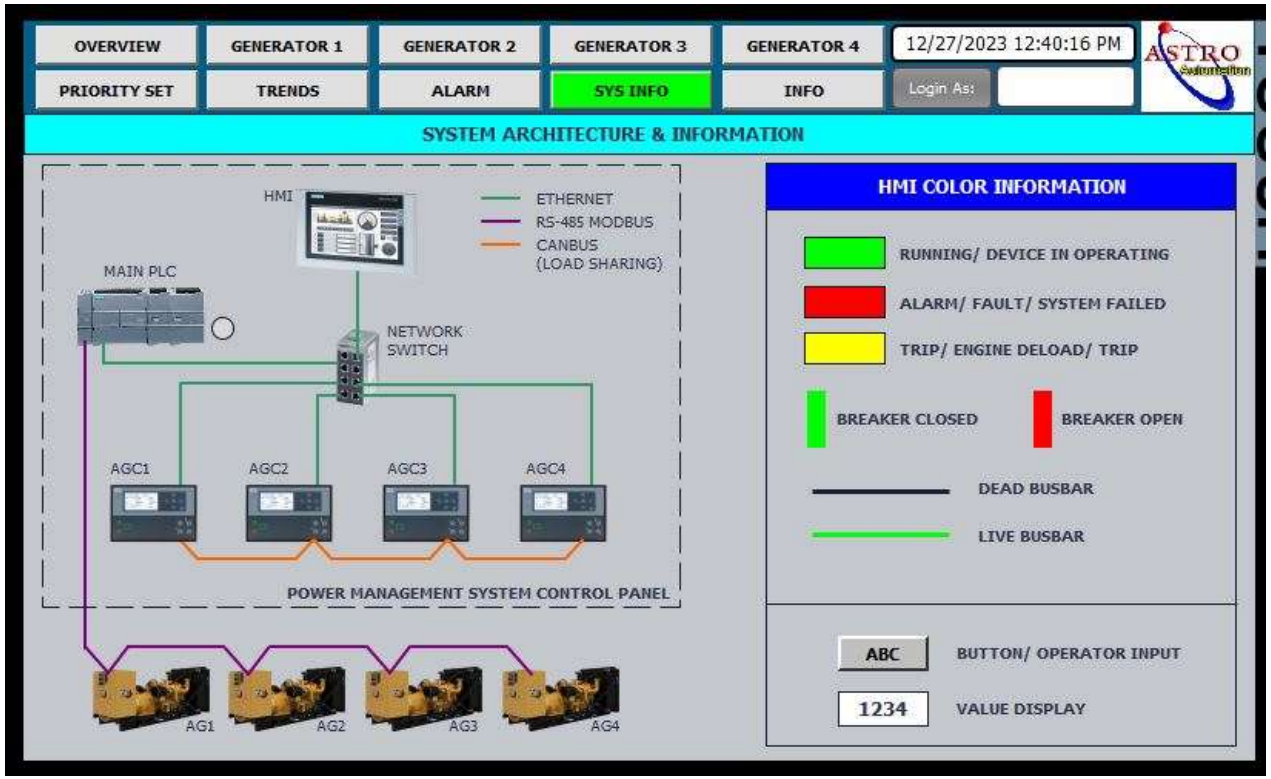
Imagine drill bits are not spinning in the search for oil. Cranes are not lifting cargo that needs immediate delivery or thrusters are not propelling your vessel away from a collision due to the insufficient power. If motors and drives fail to start, it can quickly lead to lost revenue, production shortages, damage and even serious injury.

A power management system operates to ensure that power is always available on demand, so that when you need to start a system, it starts on the first attempt.



Key Technologies Used in PMS:

1. **Advanced Generator Controller**: Devices for generator control, protection, measuring energy consumption, and other electrical parameters.
2. **Automation Controllers**: These devices control electrical loads and manage power distribution, optimizing usage.
3. **SCADA/HMI Systems**: To monitor and control remote equipment, allowing centralized control of power generation & distribution management.
4. **Cloud Computing & IoT**: For remote monitoring, real-time data analytics, and integration with smart devices.



Key Features of a Power Management System

1) **Real-Time Monitoring and Data Logging**: PMS continuously tracks the performance of electrical systems, including energy generation, consumption, and distribution. This data is logged and analyzed to help optimize energy usage patterns and identify potential inefficiencies.

2) **Load Shedding**: PMS can automatically reduce energy consumption during peak demand periods through load shedding, helping to avoid overloads.

3) **Power Quality Management**: It ensures the stability and quality of power supply by managing voltage fluctuations, harmonics, and other power disturbances, preventing damage to sensitive equipment.

Key Features of a Power Management System

4) **Energy Optimization**: PMS optimizes the energy flow across various units or systems, ensuring that electricity is distributed efficiently to meet real-time requirements, reducing waste and improving energy savings.

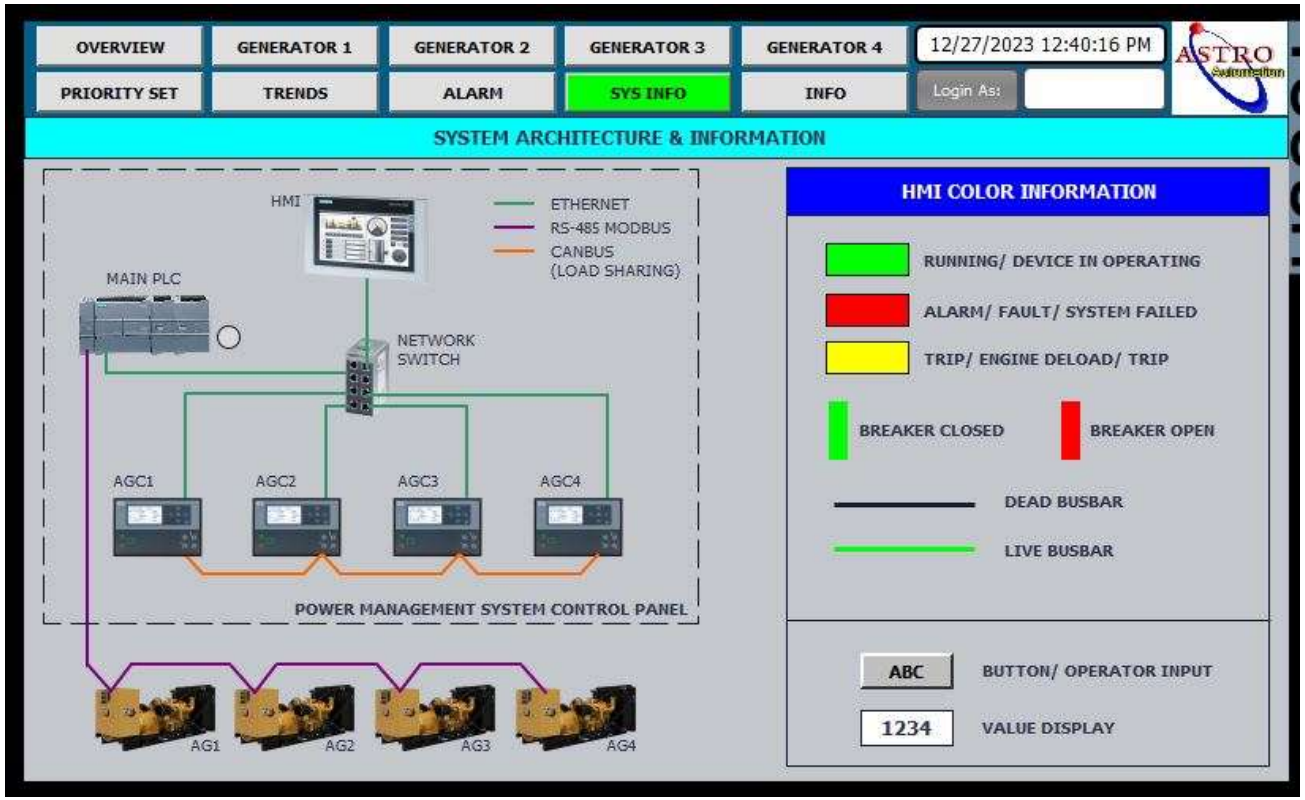
5) **Integration with Renewable Energy Sources**: Many modern PMS can integrate with renewable energy sources like solar or wind, enabling facilities to optimize the use of green energy and minimize reliance on conventional power.

6) **Reporting and Analytics**: The system provides detailed reports on energy consumption trends, efficiency improvements, cost savings, and system performance, allowing managers to make data-driven decisions for future energy management strategies.

Typical Features of PMS

Typically, PMS employs the following functions are included:

- Auto/Manual operation of breakers and diesel driven generators (DDG)
- Load dependent start and connection of DDG
- Load dependent disconnection and stop of DDG
- Automatic changeover of DDG when trip or load reduction request on a connected DDG
- Monitoring of critical parameters
- Load Control of “dynamic” consumers to prevent overload on generators. Power available to crane/winch
- Blackout restart and connection of DDG after failure.
- Heavy consumer request
- Load shedding / Preferential Trip

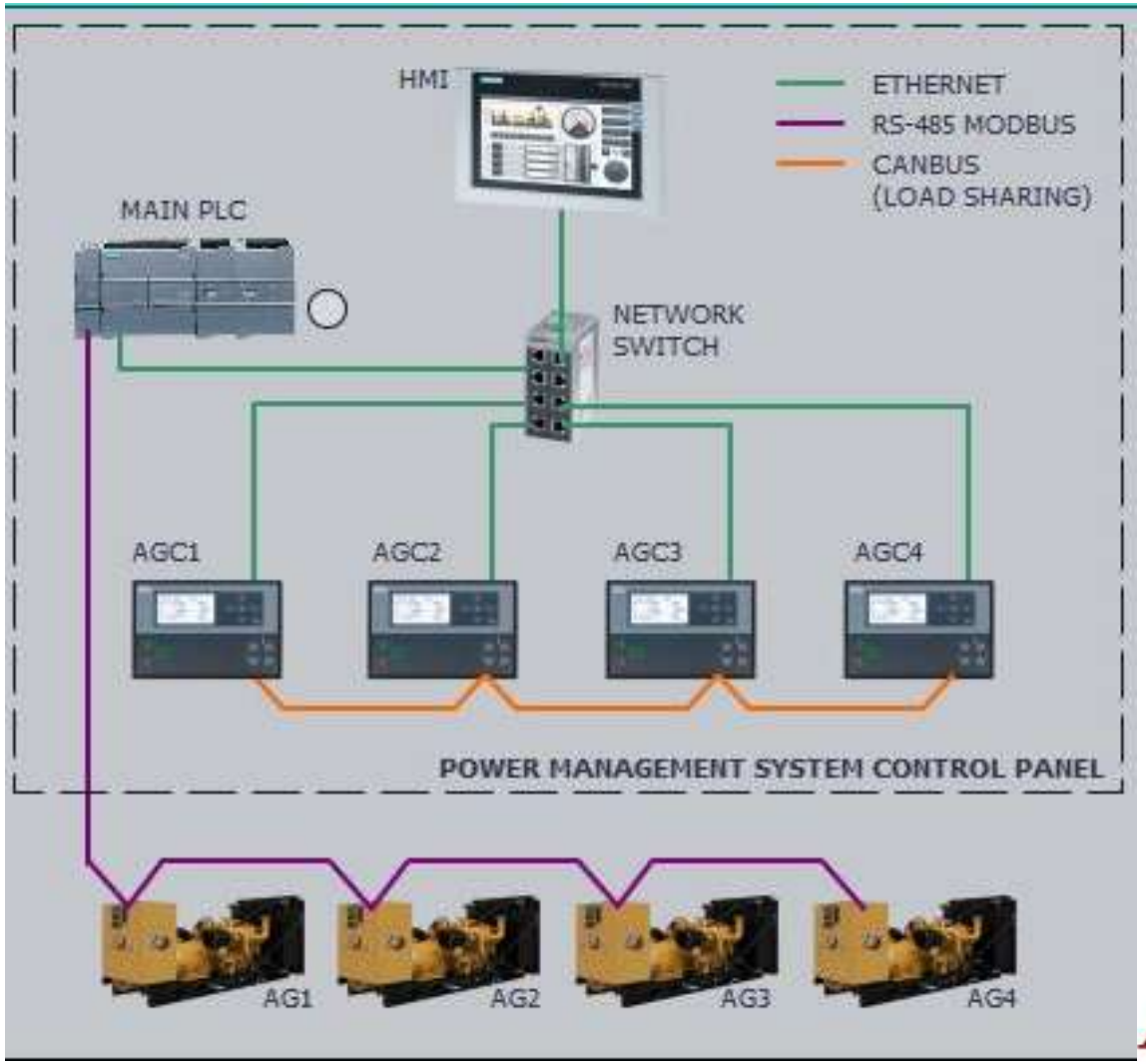


System Architecture

The Power Management System (PMS) can be functionally employed by combination of a PLC control system and Advanced Generator Controllers for load sharing, synchronizing & protection.

Engine operation & critical data can be collected from Engine local controller via communication interfaces.

Either a SCADA or HMI can be used to visualized the overall operation & control of PMS.



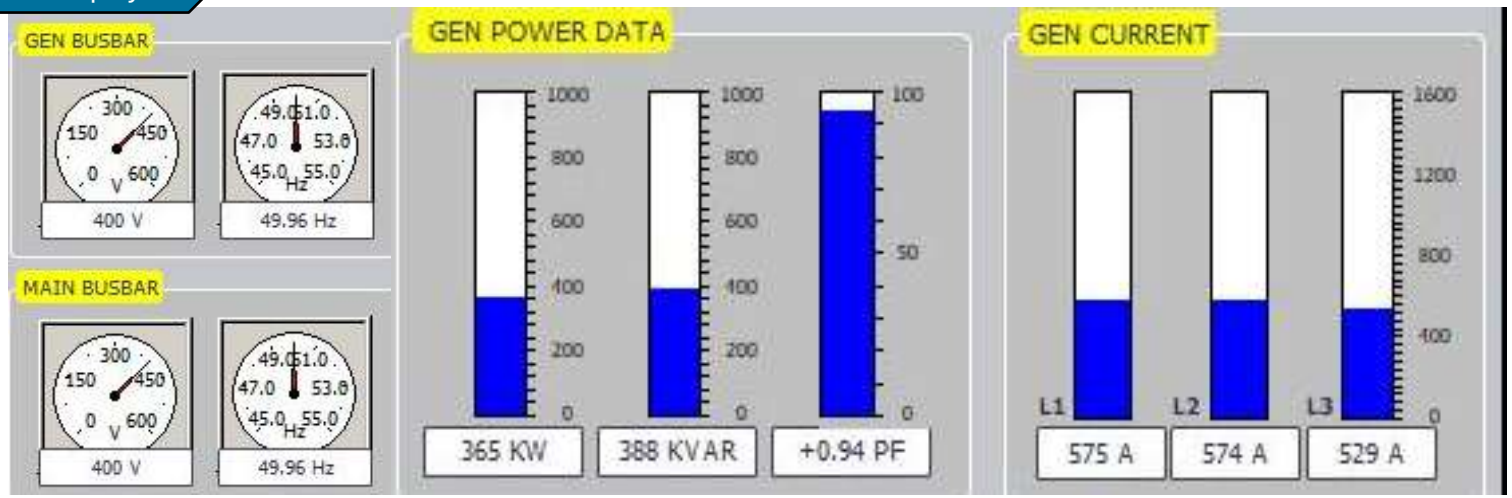
Generator Measurements

Following measured values for generators are connected to PMS::

- Active power P (kW)
- Reactive power Q (kVAR)
- Voltage U (V)
- Current I (A)
- Frequency f (Hz)
- Power factor (cos phi)

The values can be read both the display on Genset Controller and HMI.

HMI Display



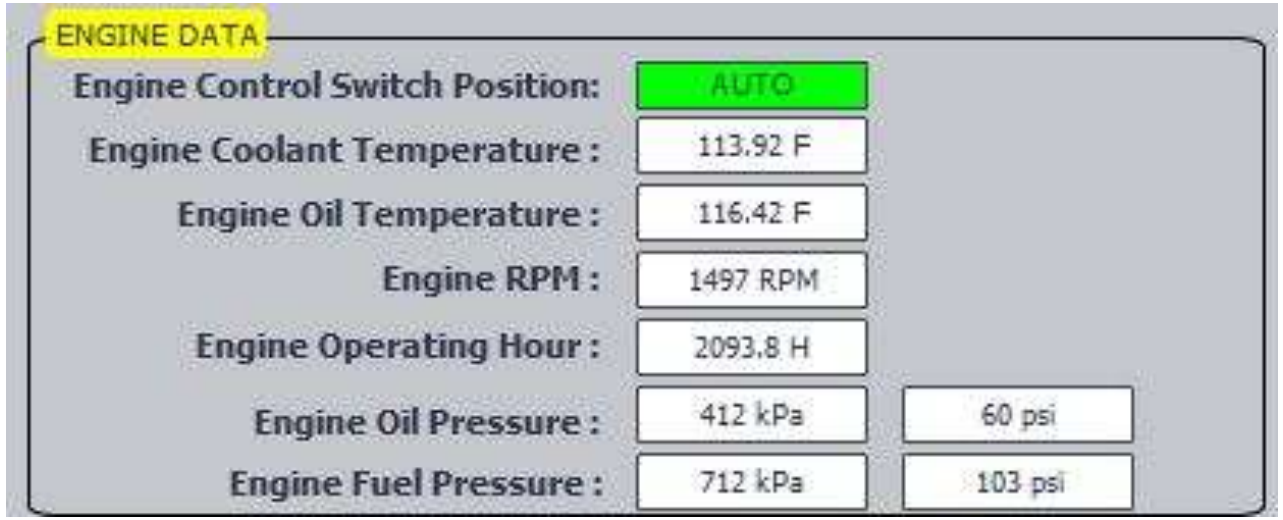
DEIF AGC Display

Engine Operation Status

The following critical parameters & alarms from generators can be visualized in SCADA/HMI.

- Control Switch Position (Note: Engine can be remotely started from PMS panel only at AUTO mode)
- Coolant Temperature
- Oil Temperature
- Engine Operating Speed
- Operating Hour
- Oil Pressure (kPa & psi)
- Fuel Pressure (kPa & psi)
- Engine Minor Alarm (Group Warning Alarm)
- Engine Major Alarm (Group Shutdown Alarm)

Detail alarms must be checked in respective engine local controller unit.



Mode Selections

TWO operation modes

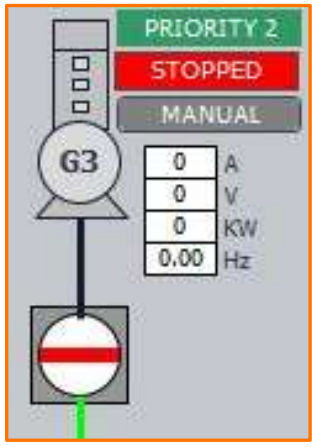
MANUAL & AUTO

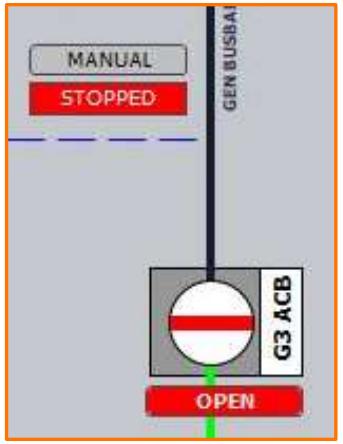
MANUAL MODE

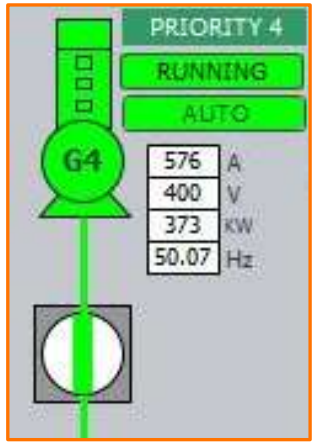
The generators start/stop and breakers open/close are to be operated manually by the operator.

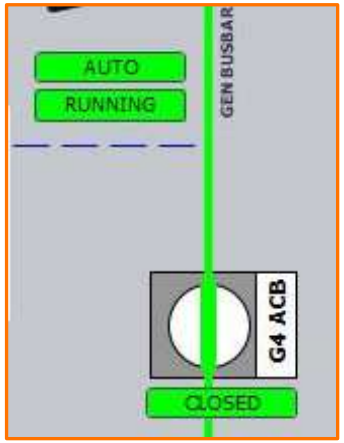
AUTO MODE

All available diesel generator units are controlled by the PMS, and are started and stopped according to the start priority. No operator actions are needed.







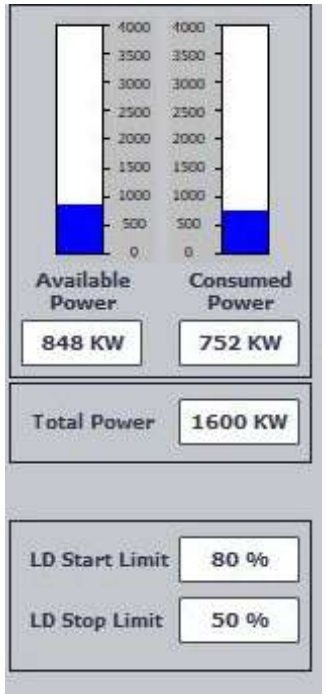


Load Dependent Start/Stop

This function ensures that sufficient power is always available on the power plant. Gensets are automatically started and stopped so that only the required number of gensets run.

The load-dependent start/stop function is active when the AUTO mode is selected. The starting and stopping of the gensets is done automatically according to the configured set points and priority selection.

The calculation of the load-depending PM start/stop command is based on the preset LD start/stop limit.



Load Calculation

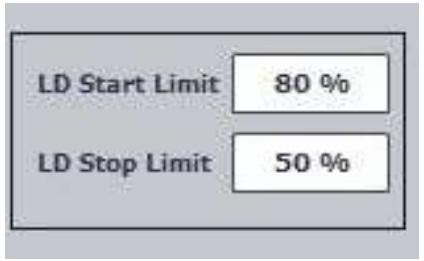
- Total PWR = Avail PWR + Cons PWR
- Avail PWR = Total PWR - Cons PWR

LD Limits

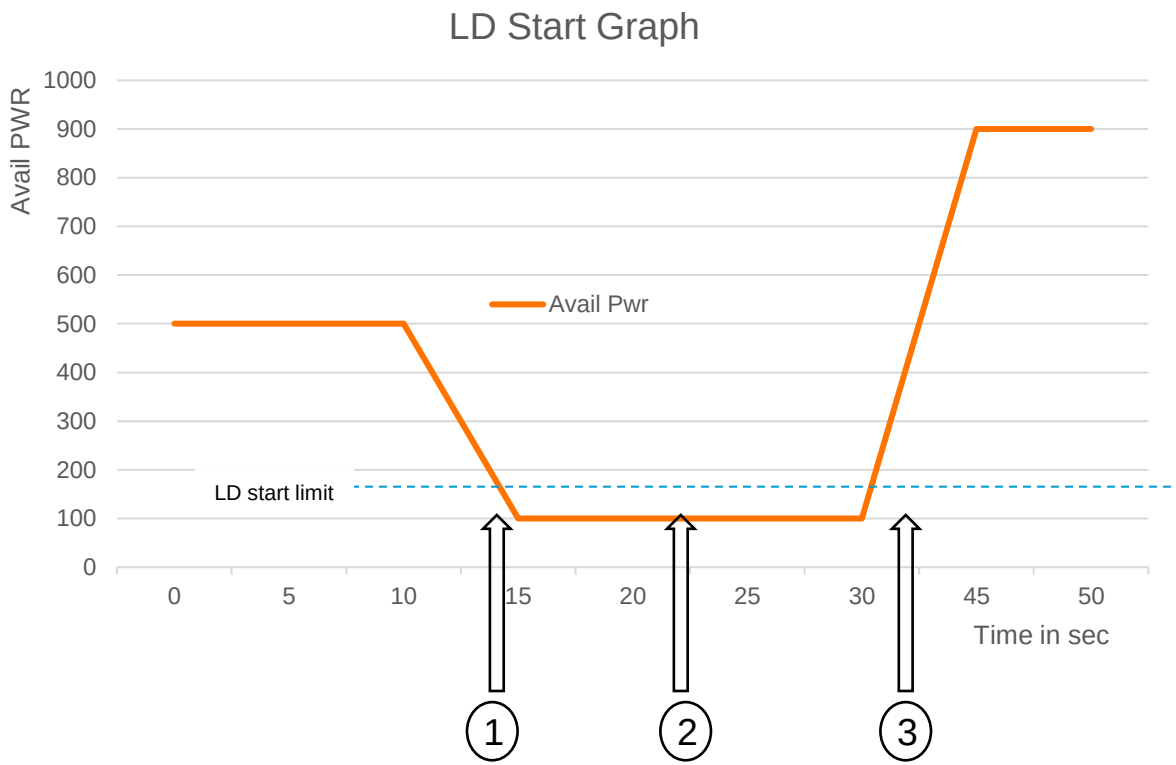
- LD Start Limit = Cons PWR > 80% x Total PWR
- LD Stop Limit = Cons PWR < 50% x Remaining PWR

Load Dependent Start

The available power is 500 kW. When the load increases, the available power drops until 100kW which is below the start limit (160kW). The stand-by genset will start when the start timer runs out, and after the synchronising the available power increases (in this example to 1500 kW).



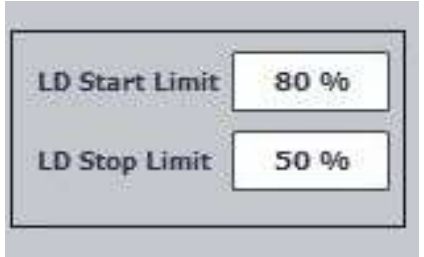
LD Start Limit = Cons PWR > 80% x Total PWR
= Avail PWR < 20% x Total PWR

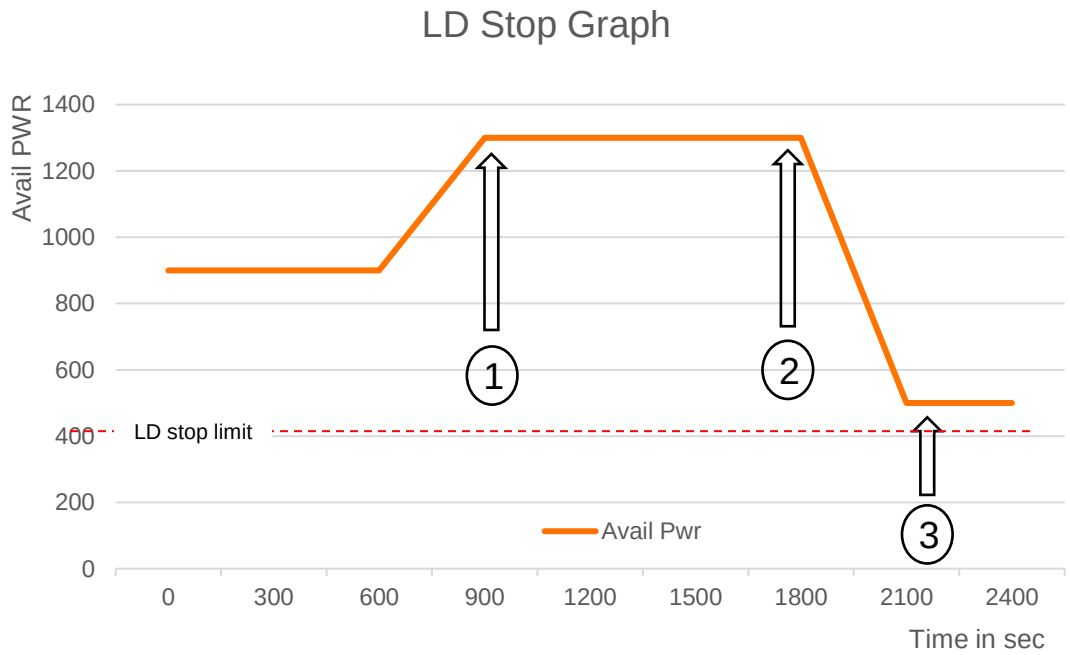


(1) Load increase
(2) “Load Start Delay” runs out, PMS start command.
(3) Stand by genset running and connecting to the busbar

Load Dependent Stop

The available power is 900 kW. When the load decreases, the available power increases to 1300 kW. The controller calculates what happens if the last priority genset is stopped. The last priority genset is 800 kW which means that it can be stopped, because the remaining available power will still be above the LD stop limit.





LD Stop Limit = Cons PWR < 50% x Remaining PWR
= Avail PWR > 50% x Remaining PWR

(1) Load decrease.
(2) “Load Stop Delay” runs out, PMS stop command.
(3) Last priority genset stopped.

Blackout Restart

Depend on the multi-start selection for maximum no. of generators to start in case of blackout, the generators will be started and connected to the deadbus while

- The remote start signal(s) is/are from any of ATS controllers, if ATS is applicable.
- The corresponding generator breaker is in OFF position.
- There is no other fault trip/ alarm activated in the generator.

Upon successful started up, the PMS will proceed the Load Dependent Start/Stop operation accordingly.

Benefits of a Power Management System:

I. **Cost Savings**: By reducing energy waste, optimizing consumption, and preventing equipment failure, a PMS can significantly lower operational costs.

II. **Enhanced Reliability**: By proactively managing energy distribution and preventing overloads or faults, PMS increases the reliability of power systems.

III. **Sustainability**: By integrating renewable energy and improving overall energy efficiency, a PMS contributes to reducing the environmental footprint of a facility.

IV. **Improved Control**: Operators gain better control over energy usage patterns, helping to make informed decisions on energy consumption and distribution.


Break
Time!

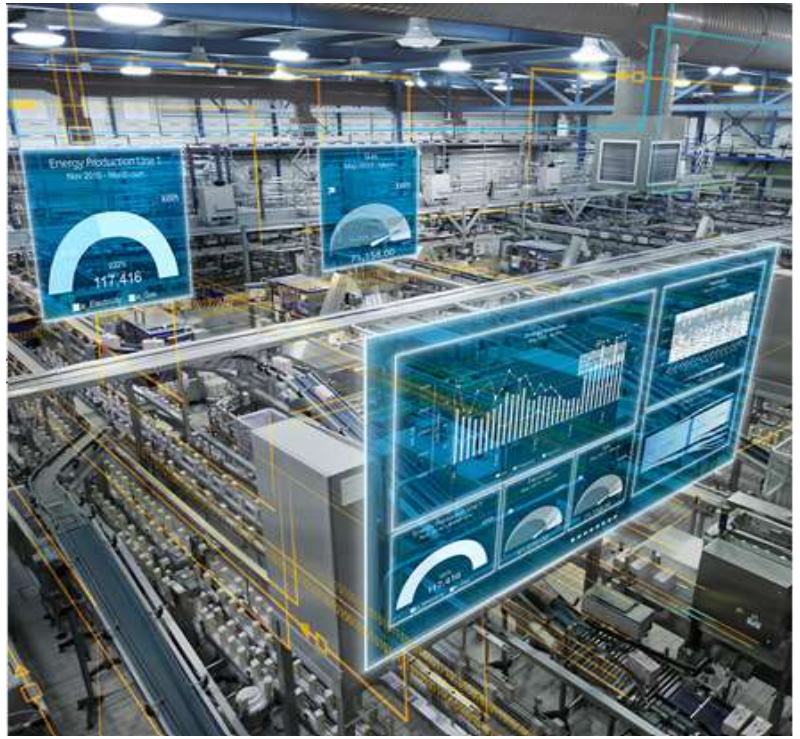
AGENDA (PART - TWO)

01 Energy Management System

- How EMS works.
- Understanding of Energy Management Cycle

02 Building Management System / Smart Home

- What is BMS & Smart Home?
- How they enhance the energy efficiency & saving.



ENERGY MANAGEMENT SYSTEM (EMS)

ASTRO Automation

What is Energy Management System?

"Energy Management" is a term that has a number of meanings, but we're mainly concerned with the one that relates to saving energy in businesses, public-sector/government organizations, and homes.

Combination of software and hardware that connect to energy resources to provide a define baseline of energy consumption.

It can also provide metering, sub metering, and monitoring functions.

Features:

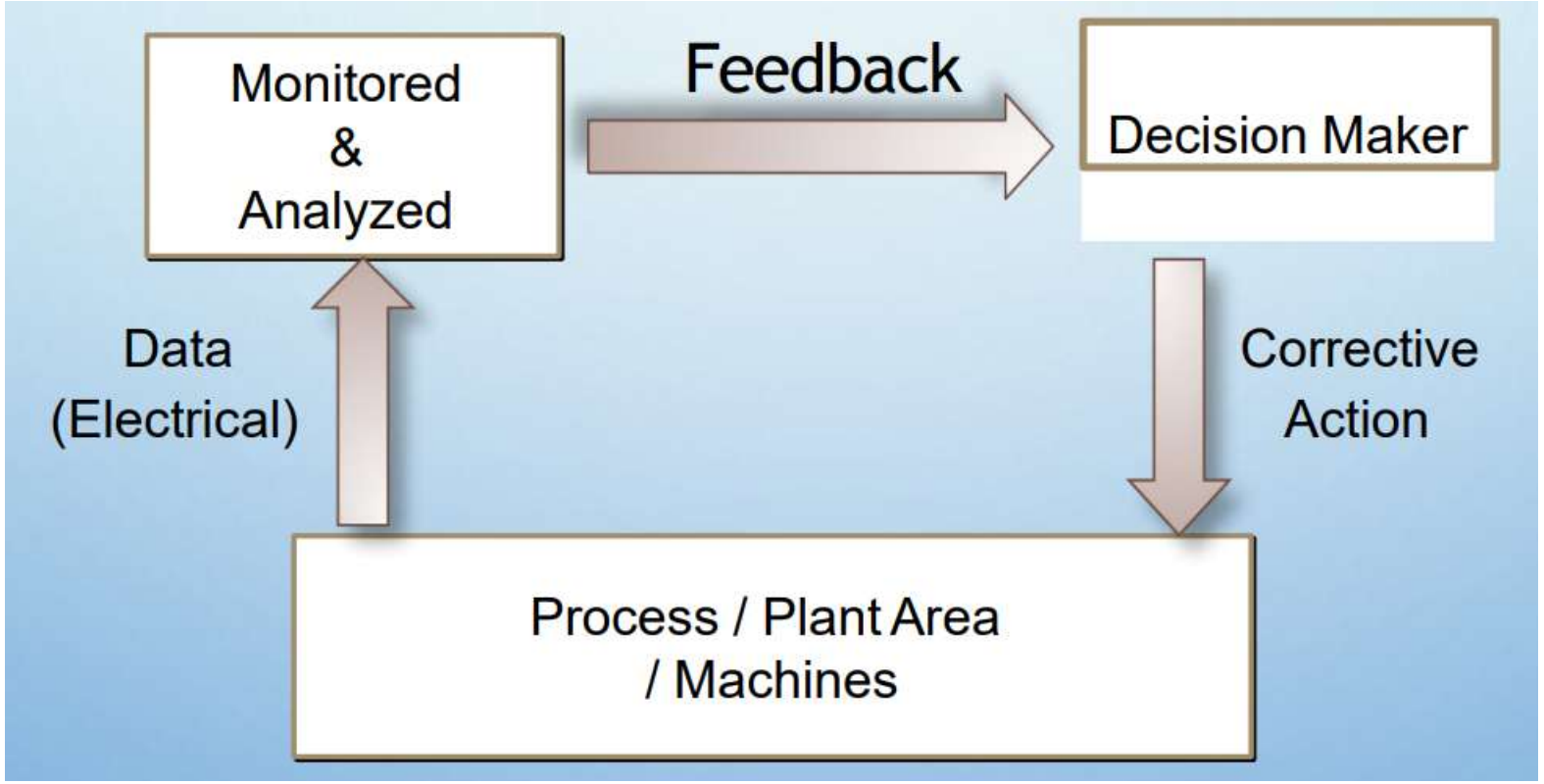
The EMS will be freely programmable and have the ability to perform all the following routines

- Reading electrical parameters and duel energy reading (utility & gensets)
- Generates alarms/events in the failure of monitoring devices
- Data logging and storage capabilities include
- Data logging period: configurable from every minute to once a week
- Data storage duration: up to 2 years, depending on quality of collected data.

How EMS Helps

- ❑ Gives information about electrical data and energy consumption for taking corrective actions.
- ❑ Gives a clear picture about energy costs involved into production lines & offices.
- ❑ Helps to optimize and monitor electrical parameters to achieve cost reduction.
- ❑ Helps future planning based on consumption patterns from the system. (eg. OEE)

How EMS Works



What do we analyze?

How much energy is consumed

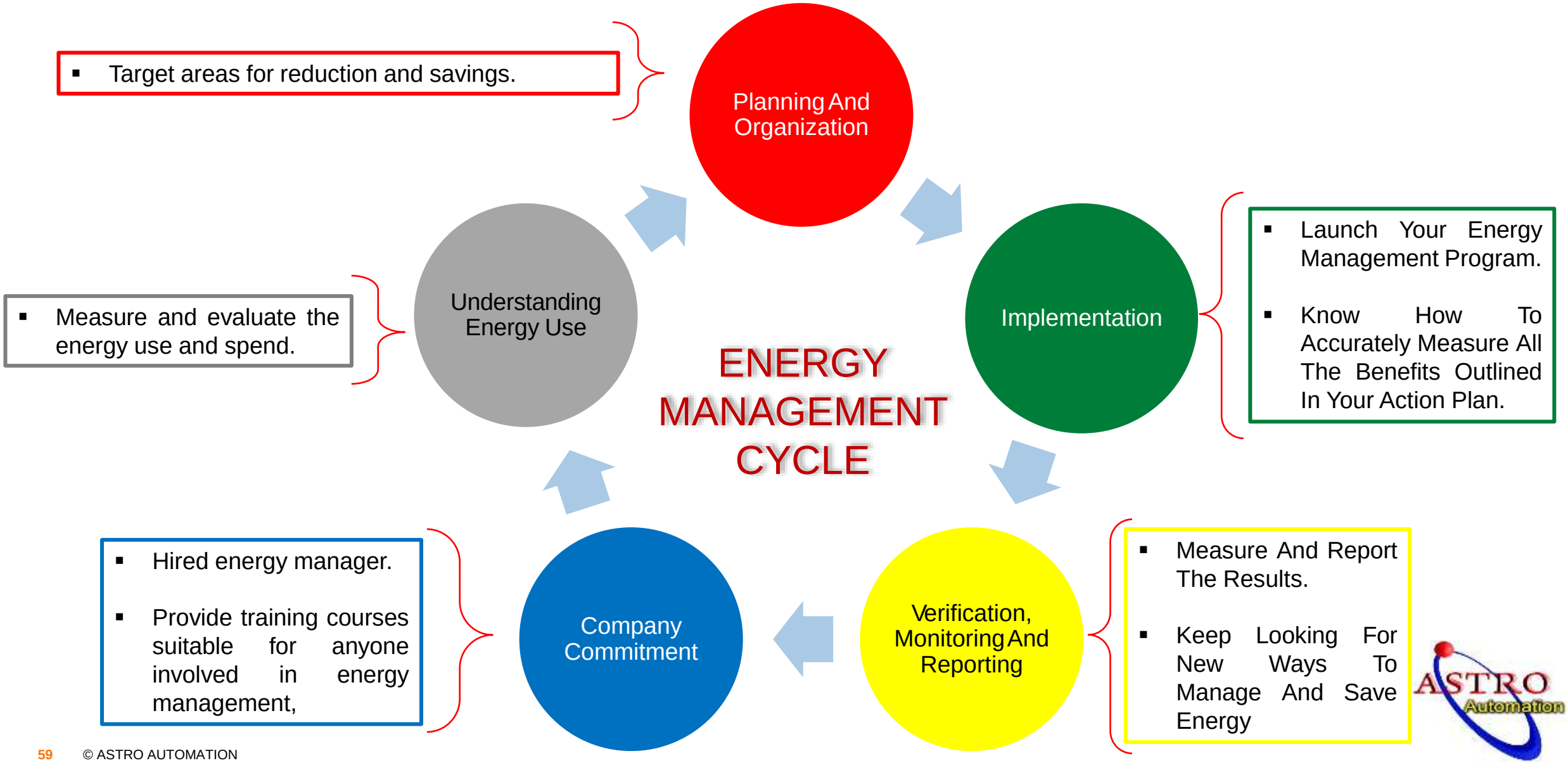
Where is energy is consumed

What is the quality energy is consumed

How is energy is consumed

When is energy is consumed

Energy Management Cycle



Technologies and Tools in EMS

a) **Energy Meters and Sensors**: These devices capture real-time data on electricity, water, and gas consumption. They provide detailed insight into energy usage at the equipment level or facility-wide.

b) **Data Acquisition**: Industrial gateways collect real-time data from various energy meters. They support protocols like **Modbus**, **BACnet**, **OPC**, and **M-Bus**, which are commonly used in industrial settings.

c) **Energy Management Software (EMS) :** It is a suite of tools designed to help organizations monitor, control, and optimize their energy use. This software typically integrates with various energy-consuming systems and devices in a facility or across multiple sites, providing detailed insights, reports, and analytics that guide decision-making aimed at reducing energy consumption, improving operational efficiency, and lowering costs.

d) **Cloud Platforms**: Many modern EMS solutions are cloud-based, offering real-time data access, centralized monitoring, and remote management, making them more flexible and scalable.

Energy Management System – Architecture

Data from…

- ❑ Energy Meters
- ❑ Water Meters
- ❑ Gas Meters
- ❑ Power Quality Analyzers
- ❑ Substation Automation Controllers

Over …

- ✓ Modbus
- ✓ OPC UA
- ✓ ASCII
- ✓ IEC 61850
- ✓ DNP3

Energy Management System

- Energy Monitoring
- Dashboards
- Reports

Metering

Current, voltage, active and reactive power, power factor and reference / output of active and reactive energy

Recording

of two energy registers to separately record consumption of any two power source

Reporting

Through prepared standard reports

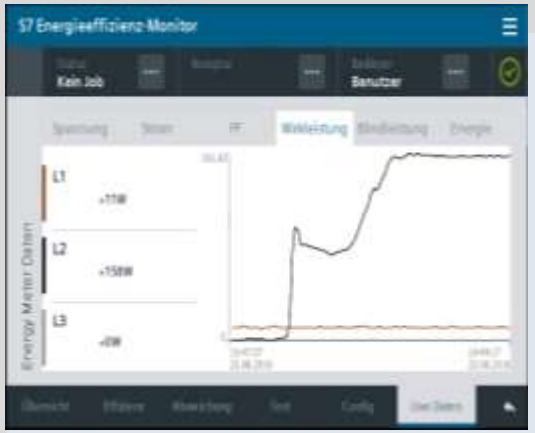
Energy Management System – Achievement

Visualize the realtime Metering data

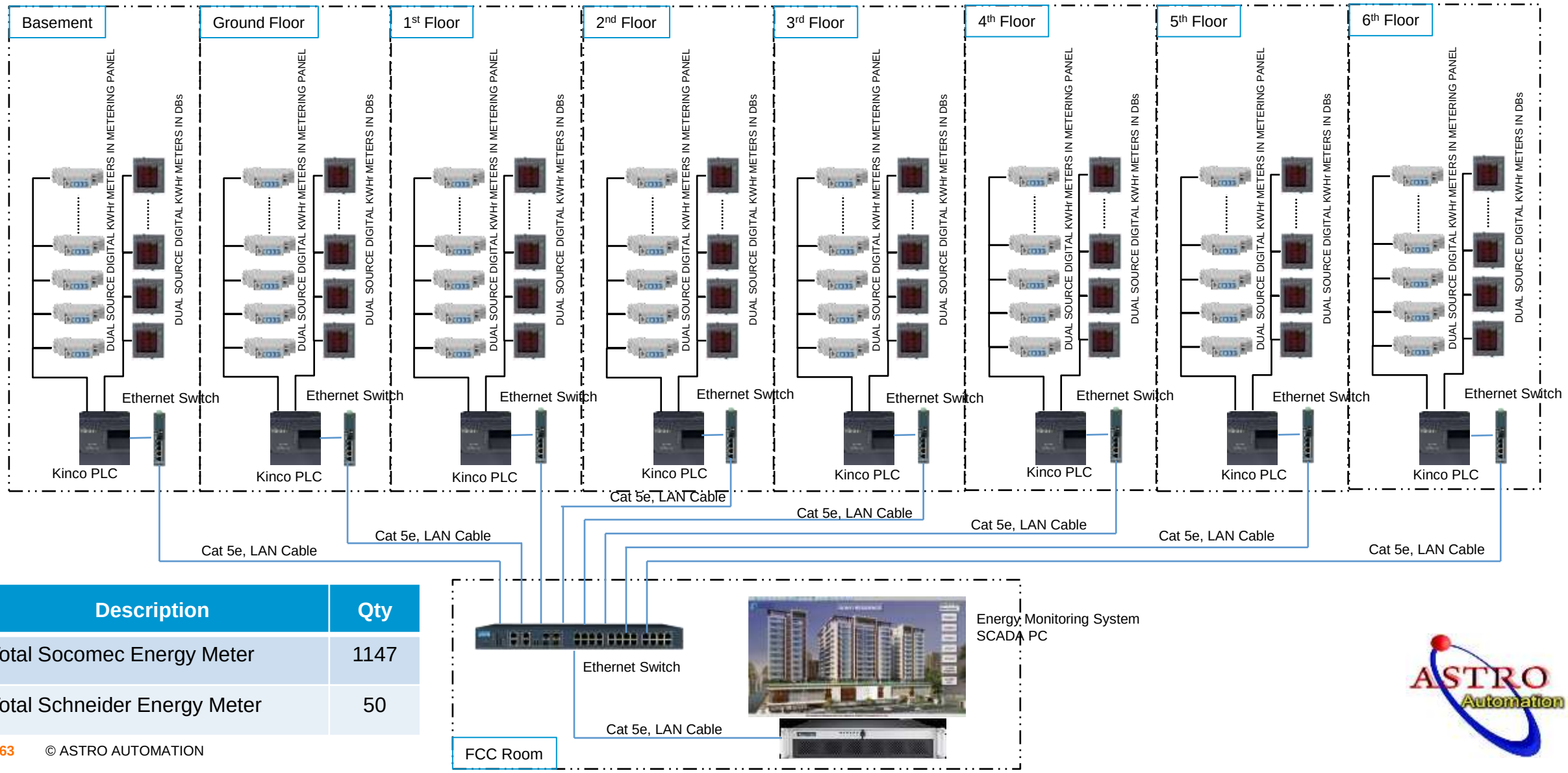
- **Device application,**
  Energy monitoring, Main or Backup power monitoring
- **TWO energy registers** to separately record consumption of any two power source combinations: i.e. utility/genset

Energy Management System SCADA visualization

- **Energy data profile as standard interface**
  (Modbus RS-485)
- **Standard visualization** for current, voltage, active and reactive power, power factor and reference / output of active and reactive energy
- **Status-related energy data analysis**



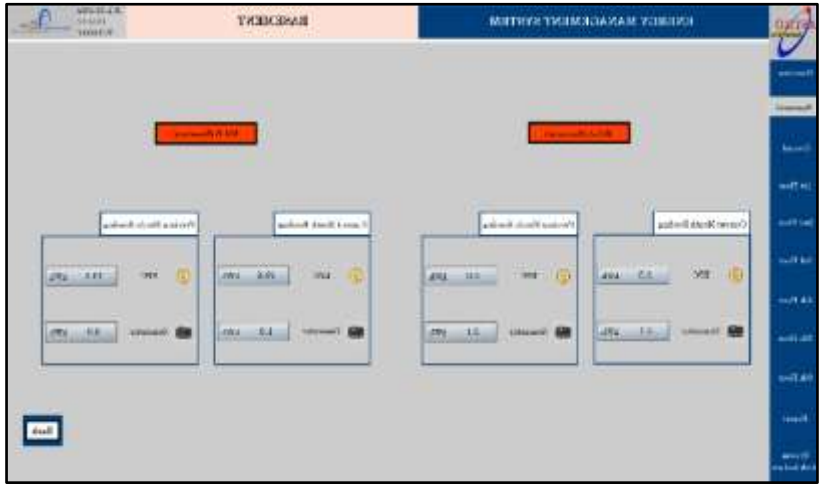
Energy Management System – Overview Architecture

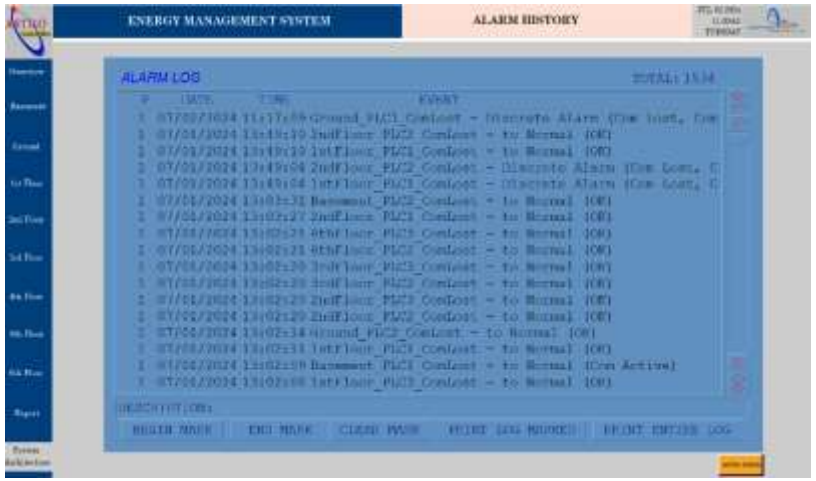


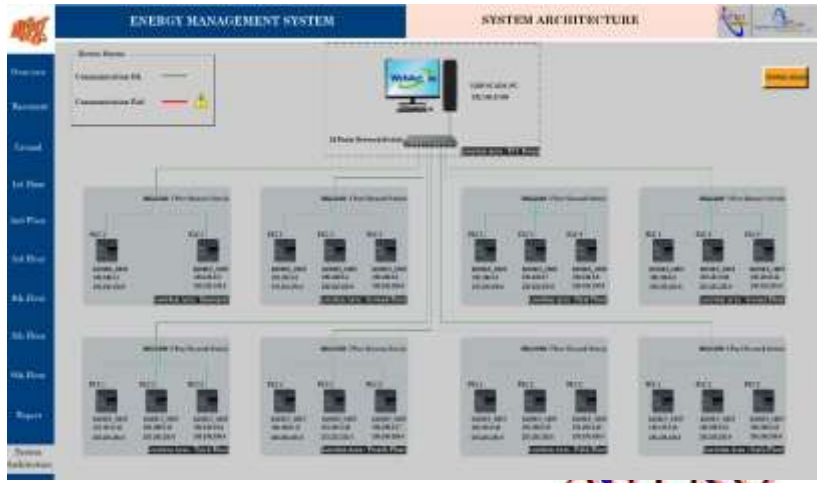
Description	Qty
Total Socomec Energy Meter	1147
Total Schneider Energy Meter	50

Energy Management System

EMS SCADA Graphics







Energy Management System

EMS Panel Fabrication, Production, On-Site Installation

System

Energy Monitoring System

Scope of Works

Design, Supply, Programming, Fabrication and Installation of EMS Panel, Integration of Plant SCADA, FAT,SAT,T&C

Year of Installation

2024

Energy Management System

Existing Metering Panel Integration








Benefits of an Energy Management System (EMS)

1. **Cost Savings**
   - By optimizing energy usage, an EMS can significantly reduce energy costs. The system helps identify inefficiencies and allows for better control over when and how energy is consumed, leading to more informed decisions that lower utility bills.
   - Automated load management and demand response can further reduce energy costs by minimizing peak load charges and reducing reliance on expensive grid electricity during high-demand periods.

2. **Operational Efficiency**
   - EMS ensures that all systems, from lighting to HVAC and machinery, are operating at peak efficiency. Through automation and real-time adjustments, energy waste is minimized, leading to smoother operations and lower maintenance costs.
   - The system also helps prevent downtime by enabling predictive maintenance, identifying equipment inefficiencies, and providing early warnings for necessary repairs or replacements.

BUILDING MANAGEMENT SYSTEM (BMS) /SMART HOME

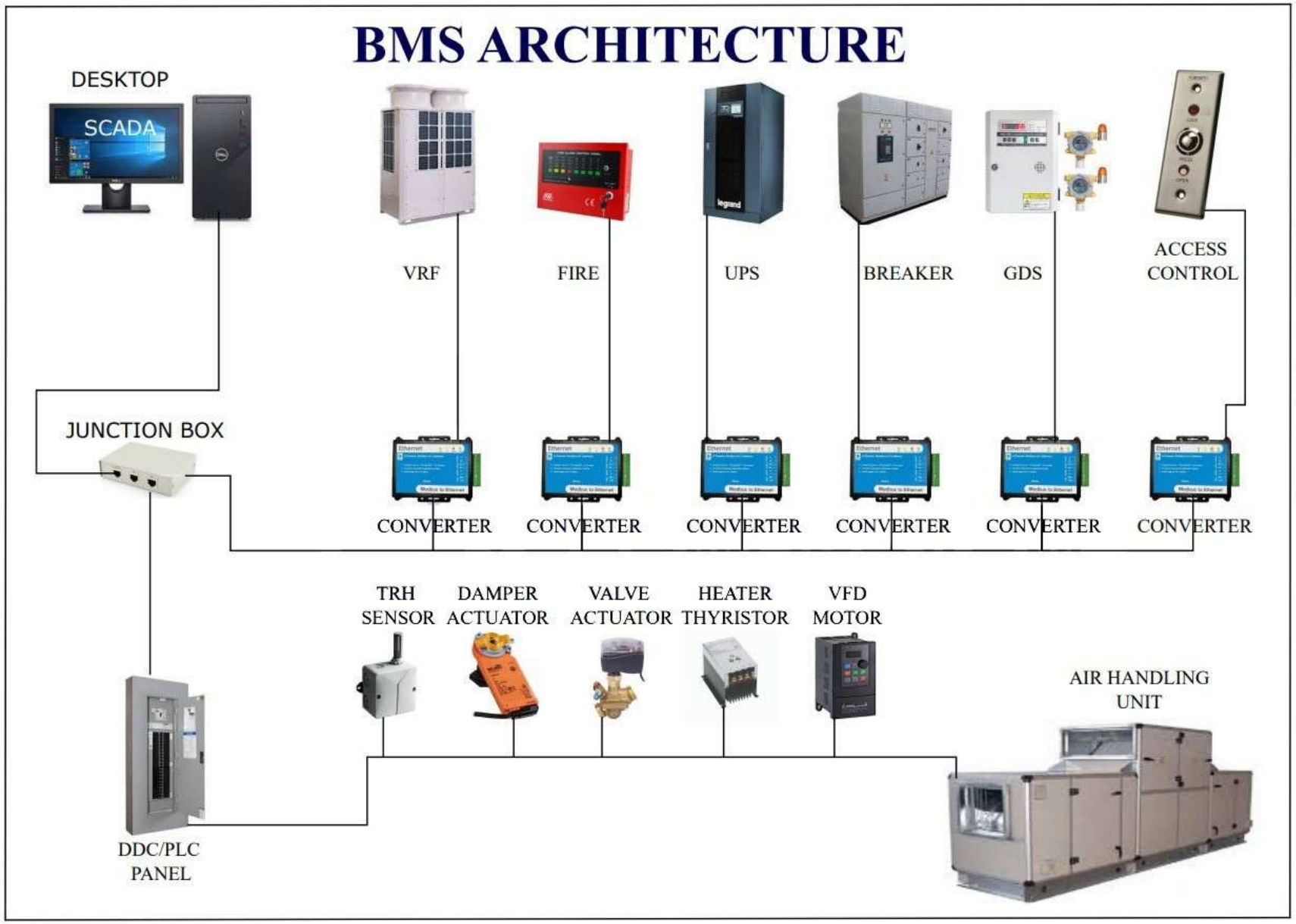
ASTRO Automation

What is BMS?

A **Building Management System (BMS)**, also known as a **Building Automation System (BAS)**, is a computer-based system that controls and monitors building mechanical and electrical equipment, such as HVAC, lighting, security systems, fire systems, and more. The primary goal of a BMS is to optimize building performance, enhance occupant comfort, and achieve energy savings through efficient management and automation of building operations.

Building management systems are most commonly implemented in large projects with extensive mechanical, and electrical systems. Systems linked to a BMS typically represent 40% of a building's energy usage; if lighting is included, this number approaches to 70%. BMS systems are a critical component to managing energy demand. Properly configured BMS systems are believed to reduce up to **15% - 20%** of the building energy usage.

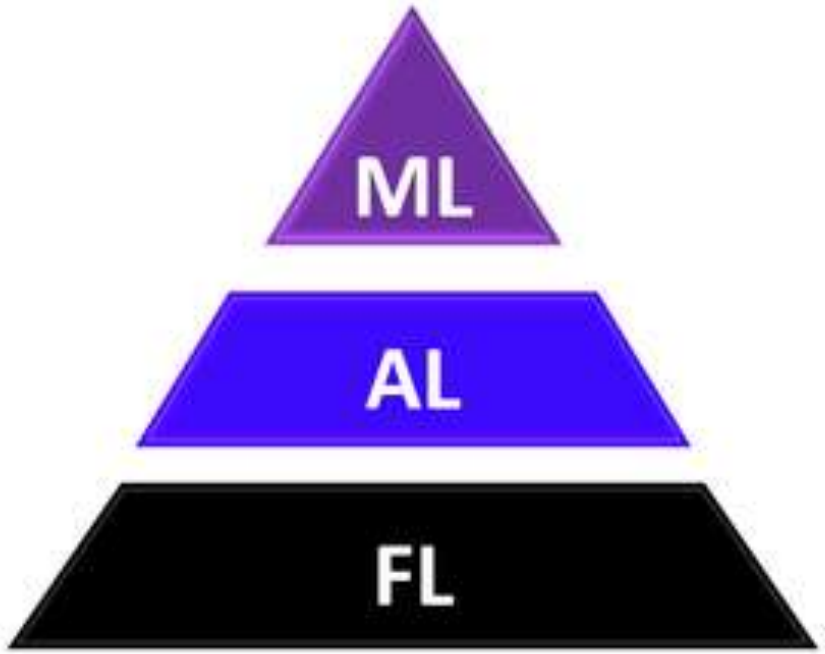
Typical BMS Architecture



Component of BMS

Generally, the BMS term covers all control elements, including hardware, software, controllers, any linking network and central controllers. A BMS consists of;

- Field layer level (field device),
- Automation layer level (DDC controller) and
- Management level (centralised workstation).



Component of BMS

Presentation Layer

Application Layer

Business Logic | Data Consolidation | Analytics | Workflows | Web Services | Data Sharing

Data Layer

Warehousing | Management | Integrity | Live Data

Communications Layer

BACnet | Modbus | SNMP | OPC | LonWorks | API | SQL | Web Services

Network Layer

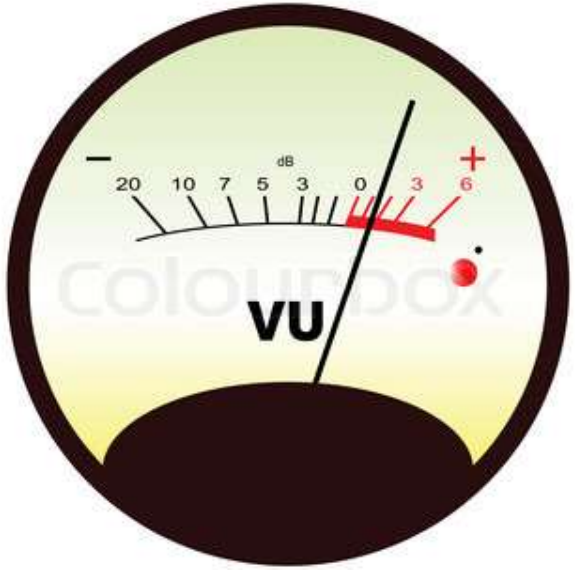
Process Layer

Electrical Meters	HVAC	Security	RTLS	Access Points	CCTV
Water Meters	Lifts	Plant & Equipment	Hydraulics	Smart Devices	People Counters
Gas Meters	Generators	Sensors	Electrical	BMS	Emergency Lighting
Thermal Meters	Movements	Occupancy	Lighting	Fire	Other...

Field layer level (field device),

- **Filed controllers** get a single or stimulus which collect the information from the environment with the device are and respond from sensors, meters, switches or valves and transfers it to the next stage which is the Automation layer (DDC controller).

Sensor



Meter

Switch

Automation layer level (DDC controller)

- **Automation Layer (DDC Controller)** is running and communication. When this layer gets data from filed layer, they transit them to an interface (Web Browser), which can display all information. This component are; Micro-processor based, Pre-configured / freely programmable and Controls the HVAC equipment of the building

HVAC control

Micro-processor based controller

Management level (centralised workstation)

- **Management Level** shall provide a uniform view to all systems through the open Building Operating System (BOS) platform. All the systems - controls of cooling, ventilation and lighting, consumption measurements, access controls, intruder alarms, fire alarms - shall be integrated with the BOS using device drivers.

Key Functions of a Building Management System (BMS)

1) **HVAC Control**: BMS controls heating, ventilation, and air conditioning (HVAC) systems to ensure a comfortable indoor climate while optimizing energy use.
2) **Lighting Control**: Controls lighting systems based on occupancy, time of day, or natural daylight availability.
3) **Energy Management**: Monitors and optimizes energy consumption within a building to reduce costs and improve efficiency.
4) **Security and Access Control**: Manages security systems such as alarms, surveillance cameras, access control systems, and sensors.
5) **Fire and Life Safety Systems**: Ensures the building's fire safety systems (fire alarms, sprinklers, emergency lighting, etc.) are working properly.
6) **Elevator and Lift Control**: Manages the operation of elevators or lifts within a building, optimizing their use to enhance flow and reduce energy consumption.
7) **Indoor Air Quality (IAQ) Monitoring**: Ensures good indoor air quality by controlling ventilation systems and filtering air.
8) **Water and Irrigation Systems**:Manages water usage and irrigation systems, ensuring that water consumption is optimized and waste is minimized.
9) **Building Maintenance and Diagnostics**:Monitors the performance of various building systems and equipment to detect faults or maintenance needs.

Benefits of a Building Management System (BMS)

1.Energy Efficiency:

Result: Reduced energy bills, better resource utilization, and a smaller carbon footprint.

2.Cost Savings:

Result: Savings on energy bills, maintenance costs, and system replacements.

3.Enhanced Comfort and Productivity:

Result: Improved occupant satisfaction, comfort, and even productivity, especially in office buildings.

4.Centralized Control:

Result: Easier management, quicker responses to problems, and more efficient building operation.

5.Improved Safety and Security:

Result: Enhanced safety for occupants and assets, as well as quicker response times in the event of a fire, break-in, or other security issues.

6.Data-Driven Insights:

Result: Better decision-making, predictive maintenance, and informed budgeting for future upgrades.

Features of (BMS)

Building Management System interact with the connected technical building equipment via HMI or SCADA. It is also designed to be user friendly for operators, engineers and building managers.

Building Management System (BMS) also prevent unauthorized uses and provide password protection to provide operator specific access or operator log summary.

Features of (BMS)

Building Management system gives automatic gathering and storage of data from the field equipment for later analysis and reporting in dynamically or historical form and in Customized charts and graphs form and also in Tabular reports

Building Management System (BMS) also prevent unauthorized uses and provide password protection to provide operator specific access or operator log summary.

What is SMART Home Automation?

SMART VILLA

SMART CONDO

SMART HOSPITAL

SMART HOTEL

SMART OFFICE

SMART BUILDING

Smart home automation, also known as home automation or smart home technology, is a system that allows you to control and monitor your home's devices remotely. It connects your home's devices to a central hub, which you can access from a mobile device, tablet, or computer. You can use smart home automation to create automatic functions for your home devices, such as turning on lights when someone enters a room.

Some examples of smart home automation include: Automatic lights, Automatic door locks, Smart security cameras, Automatic blinds, and Automatic heating and cooling.

Most common functions for Smart Home Control System

Services

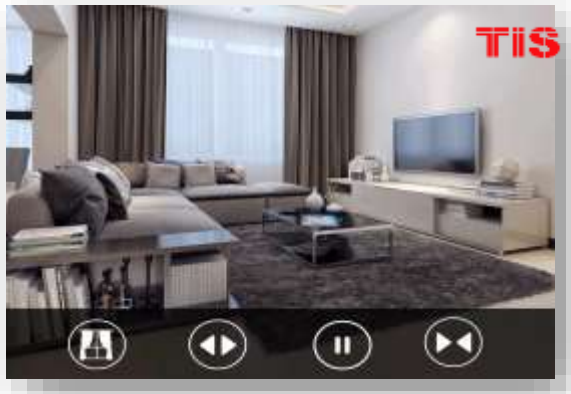
- Lighting Control
- Climate Control
- AV System Control
- Motorized Control
- Smart Lock & Access Control
- Energy Saving & Monitoring
- Environment Monitoring
- Security & Safety

Lighting Control

Climate Control

AV System Control

Environment Monitoring



Motorized Control

Energy Saving & Management

Security & Safety

SMART HOME CONTROL TECHNOLOGY

HVAC Control System Demonstration (Sample)

VRV / VRF CENTRAL TYPE

VRF GATEWAY

TIS
HVAC6-3A-T

FCU/ VAV

Ventilation System

TIS
ES-10F

Split Type

TIS-IRE-T.pdf

TIS
IP-PORT

TIS
AUT-TMR

LUNA TOUCH PANEL

Why should we use Smart Home Control System?

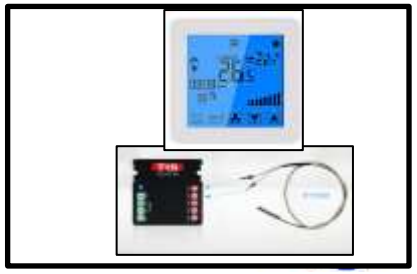
➡ **SAVE MONEY & ENERGY**

Automated Lighting

Automated Blinds

Automated appliances

Air-con , Heater, control by Smart thermostats



Why should we use Smart Home Control System?

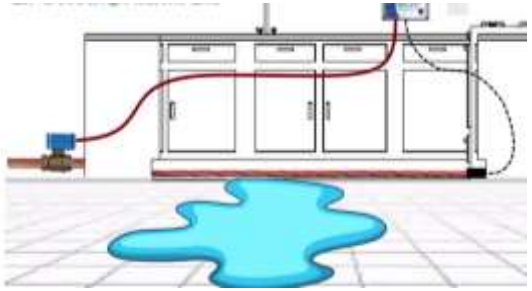
- **MORE SECURE**

“Install a smart security system and integrated with CCTV system , access control , smart sensor . Smart lock”

Why should we use Smart Home Control System?

Reduced utility costs

Increased Safety & Real-Time Surveillance



Leak Detection & Flood Sensors

Improved indoor environment

Reduced maintenance costs

Smart & convenient

Increased property value