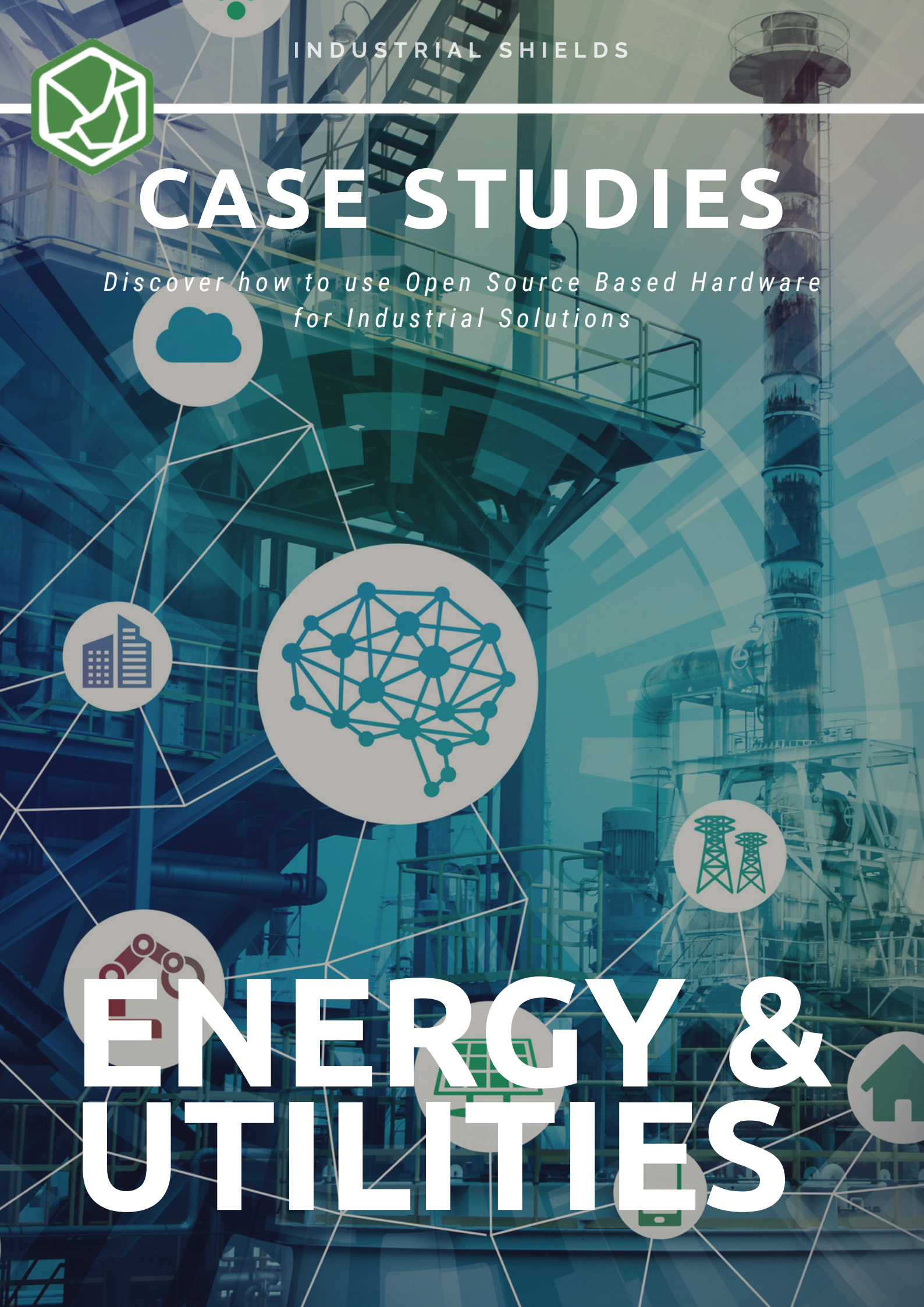
INDUSTRIAL SHIELDS

CASE STUDIES

Discover how to use Open Source Based Hardware for Industrial Solutions



ENERGY & UTILITIES

CASE STUDY

INDUSTRIAL SHIELDS

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Through real-world case studies, this document highlights how Industrial Shields open source based PLCs, Panel PCs and Gateways deliver measurable value in energy, water, and industrial sectors.

🔧 Operational Efficiency

Reduction of manual errors through automation
Real-time data acquisition for faster decision-making
Increased system uptime and productivity

⚡ Energy Optimization

Up to 30% more energy generated from solar panels
Improved control of biomass combustion, reducing fuel consumption
15% reduction in power usage in tidal energy systems

🌍 Sustainability & Compliance

Lower emissions and improved environmental impact
Smart dosing in water treatment to avoid overuse of chemicals
Full compliance with environmental and safety regulations

📡 Remote Monitoring & Control

VPN and MQTT integration for anywhere-access
Remote anomaly detection and automatic response
Centralized dashboards for multiple plants

💰 Cost Savings

No license fees thanks to open source platforms
Fewer breakdowns due to predictive maintenance
Efficient chemical use, lower energy waste, and reduced staff intervention

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CASE STUDY

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MONITORING THE EFFECTS OF CLIMATE CHANGE

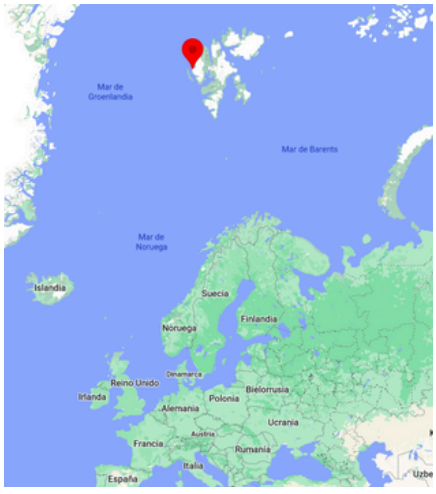
The study of polar ecosystems helps to understand alterations in climate change. One of the ways to analyse the environment under controlled conditions is through mesocosms or outdoor **experimental systems**.

In the following Success Story, you will see how our customer installed **12 mesocosms** in the town of New Ålesund —in the island of Svalbard (Norway)— to monitor changes at the North Pole.

CUSTOMER

The rapid disappearance of sea ice is a clear indicator of the global climate crisis. Glacial fronts and sea-ice systems are hotspots of biodiversity. Their evaporation will threaten Arctic coastal ecosystem function and ultimately local livelihoods.

The overall objective of **FACE-IT** is to enable adaptive co-management of **social-ecological fjord systems** in the Arctic in the face of rapid changes in the cryosphere and biodiversity.



CHALLENGE

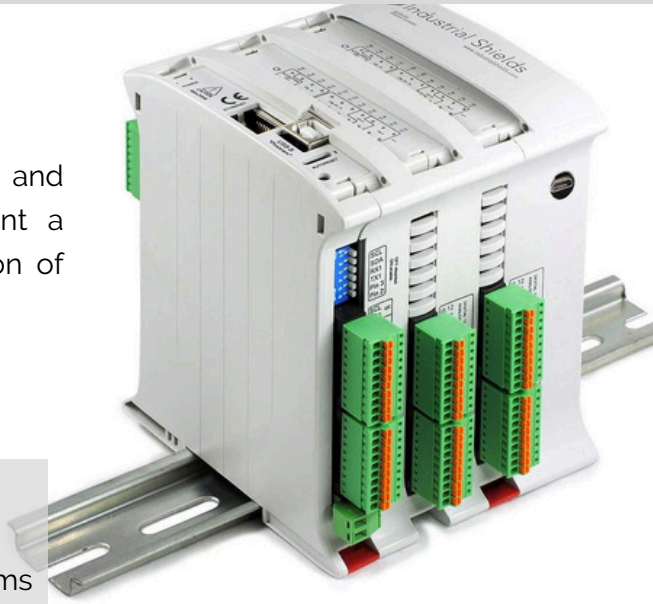
FACE-IT Arctic Biodiversity & Livelihoods

Our customer's goal is to study the effects of global warming, such as:

- increase in water **temperature**
- decrease in **salinity**
- **turbidity**

CASE STUDY

SOLUTION



FACE-IT was looking for a PLC solution easy to program and integrate with sensors. In order to manage and implement a monitoring system, Industrial Shields proposed the installation of several **M-Duino42+ PLCs**.

IMPLEMENTATION

The implemented solution consists of locating 12 mesocosms:

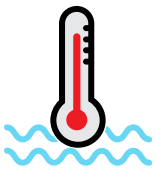
- 3 of them will be control mesocosms
- the experiment will be applied in the remaining 9 mesocosms

Each mesocosm has its own 3-way temperature control valve and 2-way fresh water control valve, connected to the analogue signal in the PLCs.

Multiple **sensors** connected to an **RS-485** bus are used to measure multiple parameters such as:

salinity

turbidity



temperature

Each PLC is responsible for the regulation of 3 mesocosms. The master PLC is responsible for data logging, via a **µSD card** and communication with a control computer.

The connection between the PLCs and the computer is made through **RJ45** ports, via **websocket** protocol.

Finally, a C# programming language interface is developed on the computer to **monitor** and **control** the experiment.

CASE STUDY

INDUSTRIAL SHIELDS

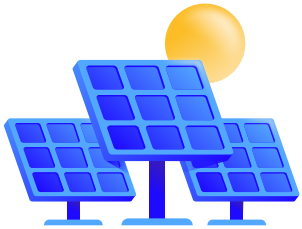
How to Monitor Autonomous Solar Panels

The use of renewable energy is increasing at cruising speed every passing day.

Solar energy is the most popular and has a huge range of possible applications in our daily lifes. It also offers many natural and environment advantages.

SUMMARY

In a world where most energy production comes from non-renewable resources, people are trying to find **efficient and price-effective** ways to use renewable energy.

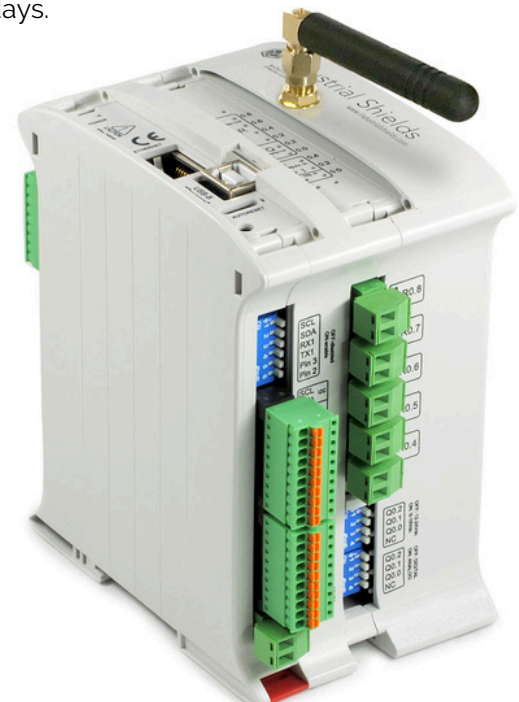


One of the great leaps forward in renewable technology has been the solar panel, which is composed of several solar cells that convert light into electricity.

Knowing the growing need of energy, the solar one is more efficient if the panels are controlled by two linear motors each. One for the x-axis and the other one for the y-axis, so they can take advantage from the weather conditions and all sunshine hours during the days.

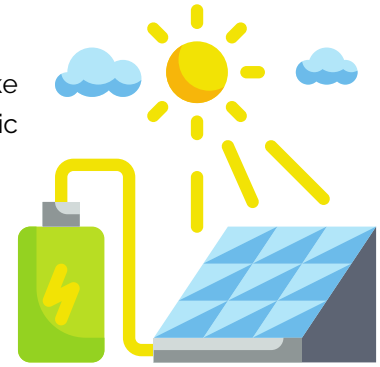
That said, monitoring your solar installation will allow you to:

- **Continuous monitoring** of weather conditions and panel position.
- **Optimal energy production** with surplus capacity.
- High system **reliability and durability**.
- **Remote access** to energy data in the cloud.
- **Reduced** maintenance **costs**.



CASE STUDY

GOAL



The objective is to chase the sun, which is a moving target, so that we can all take advantage of it and generate more solar energy. Solar panels operated by automatic control systems can generate up to **30 % more** energy than static panels.

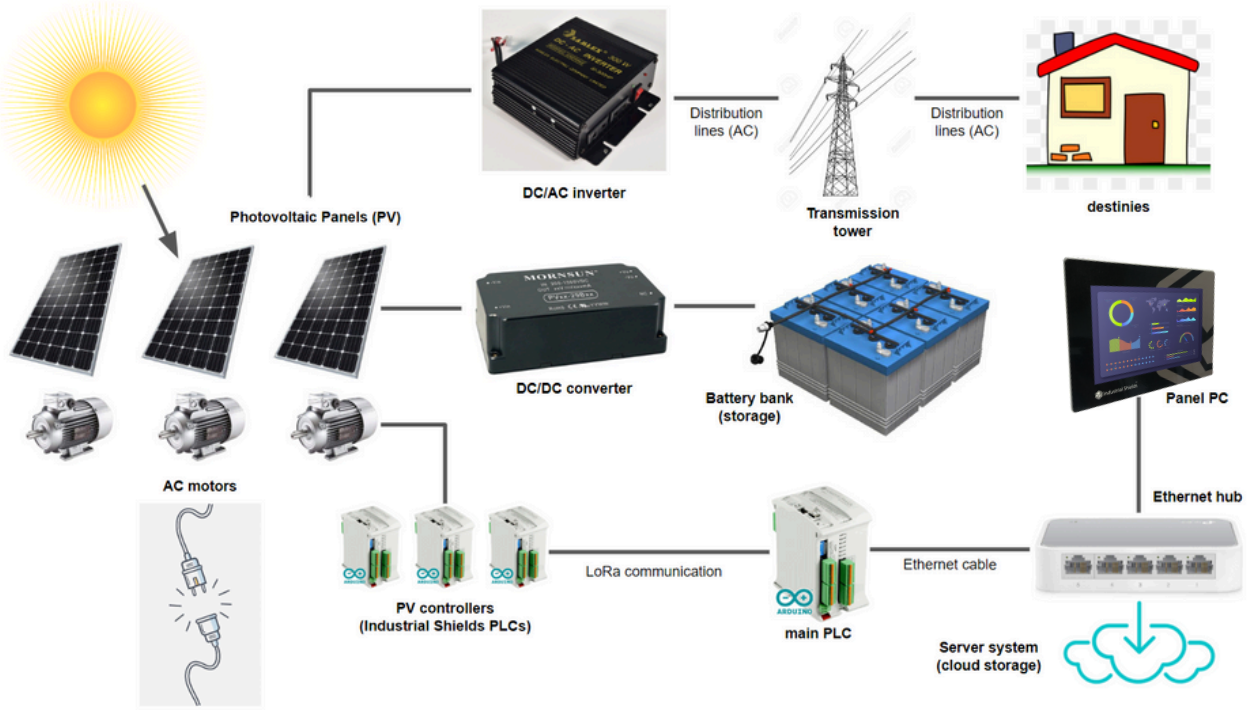
CONCLUSION

The **Industrial Shields equipment** is going to control the AC motors connected to the photovoltaic panels, so they can **take advantage** of the weather conditions and **produce** as much solar energy as possible. The control will be done with some previous calculations for the different positions of the sun as the hours go by and ans will be transferred to our PLCs by the Arduino IDE.

The main **PLC, an M-Duino 19R** will be the master, which will receive the data from the others (one for each PV group), and transfer them to the **Panel PC** (HMI), Human to Machine Interface, and upload it to the cloud. The cloud information will be useful to improve the PLC's Software in the long term.

The achieved energy will be distributed in two different ways:

- One will be converted with a DC/AC inverter, so it can pass trough the high voltage lines and reach the destinations where it is needed.
- The other distribution way will be made for extra power that has no destination. This will have its voltage adapted with a DC/DC converter, so it can be stored in the battery bank for a future use.



CASE STUDY

INDUSTRIAL SHIELDS

Electricity Grid Analysis

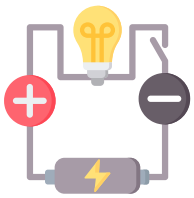
Nowadays, the use of electricity is so massive that it is practically unsustainable. It is therefore necessary to apply advanced tools and strategies to bring this situation under control.

In this case, a current analyser was used in conjunction with the Industrial Shields equipment to have real-time monitoring of the consumption on the street lighting poles.

SUMMARY

Having real-time knowledge of the current consumption of urban lighting can help us to have a better understanding of the current cost of the installation. Information is power.

With this information and the help of an Arduino-based PLC to manage all the data received, alarms can be set up when the current exceeds a set limit, as well as to process the data and display it in real time.



The possibilities offered by our equipment to communicate with the current analyser are:

To control the alarms, the digital inputs of the device can be used.
(These alarms will reach the server via the Ethernet port of the Arduino-based PLC).

Relay digital outputs
For use on the installation circuits.

RS485 port for peripherals..
(Normally, current analysers allow RS485 communication. Modbus RTU is a good protocol for such communication).

However, it is also possible to use **RS232 or SPI**, among others.

CASE STUDY

CONCLUSION

The hardware implementation of the system consists of receiving voltage and current data via the current analyser.

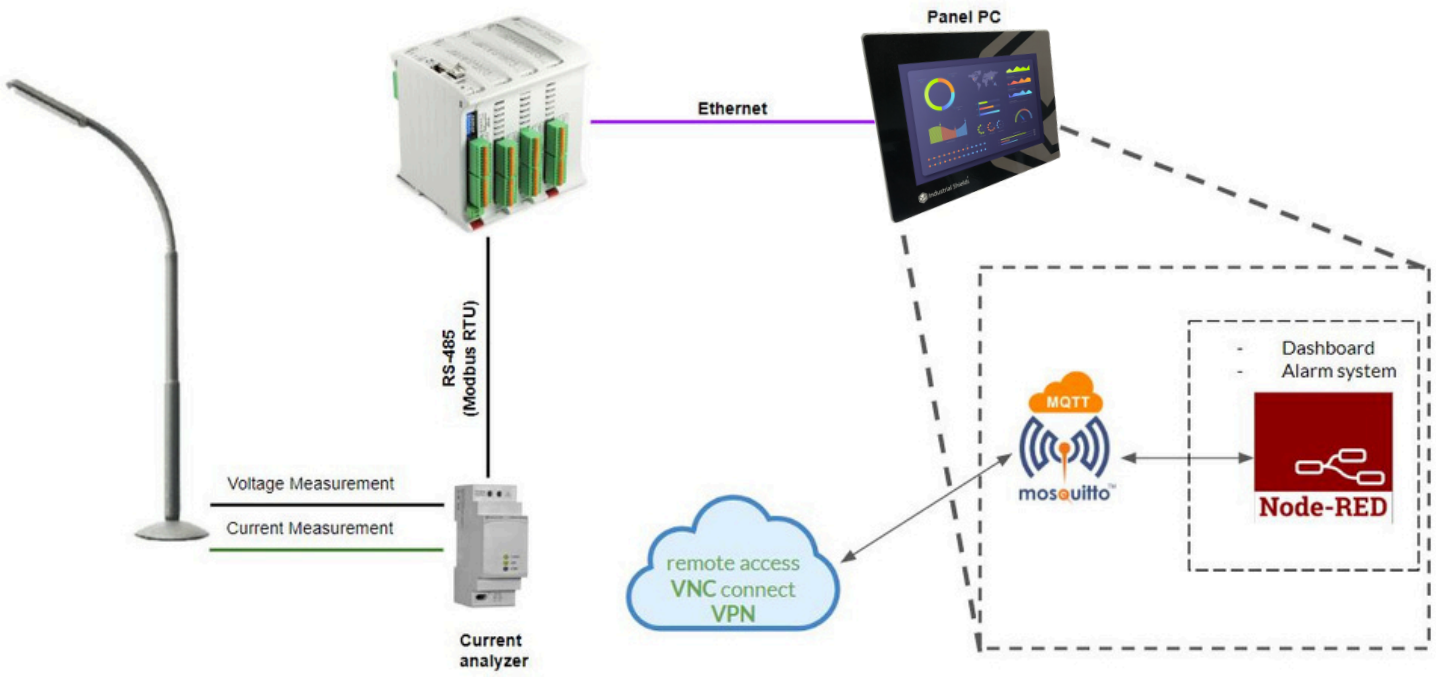
This information will be directed to the **Arduino PLC (M-Duino 19R +)**, which can optionally also have contactors connected to its relay outputs to act on the current flow in case of an alarm.

Once the information is managed, it is sent to the **Panel PC** which has an intermediary **MQTT** server to share the data on **Node-RED**.

Node-RED allows us to make a control panel to sample the data in real time and even warn in case of alarm status.

The Panel PC will also have connection via **VPN** to be able to share the data in a virtual private network and have access from any other point (PC, smartphone, ...).

To ensure time synchronisation, there is an internal clock with 3.3V lithium coin battery.



CASE STUDY

INDUSTRIAL SHIELDS

Smart Current Metering

This project is designed to measure the current consumption in a company using a current sensor. Through a database in the Arduino PLC itself, it is possible to know the consumption statistics for medium and long-term tracing and even stop the current in case they exceed the allowed limit.

The information can be accessed remotely, through a VPN connected to our MQTT server.
In the company, a Panel PC based on Raspberry Pi3 will monitor the results in graphic form.

SUMMARY

The current sensor is located at a strategic point of current flow.

The data is processed in the **PLC based on Arduino** and these are sent to the Panel PC, where the database is located. In the **Panel PC**, there is also a broker server (MQTT) that is responsible for receiving and sending data between the PLC and the Panel PC.

To monitor the data, **Node-RED** has been used.

OBJECTIVES

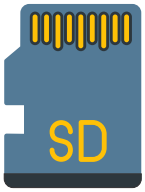
The main points to solve are the following:

- **Accurate and automated** metering, eliminating human error.
- Remote management of outages and pre-outages **without manual intervention**.
- Automatic logging of **data, events, and anomalies** such as lack of voltage and current, **proactively alerting** the control center without the need for consumer alerts.

CASE STUDY

CONCLUSION

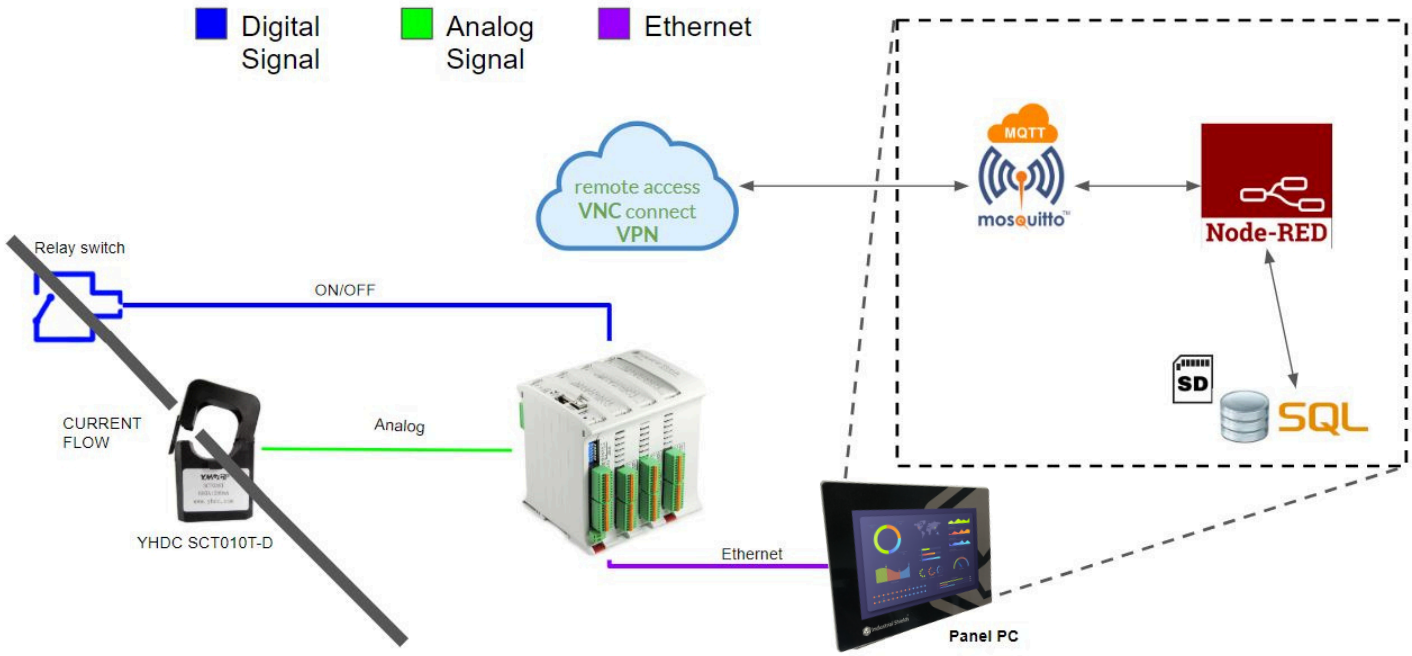
The **YHDC** current sensor **SCT010T-D** will be connected to the Ethernet PLC on an analog input. The data is received periodically and it will be sent to the **Panel PC** via ethernet using the MQTT protocol for sending and receiving data.



Once the data arrives at the Panel PC, these are stored in the SD memory. The database located inside the Panel PC will collect the data received from the PLC, and use the Node-Network tool to monitor all the data, in graphic format, to observe the results in the medium and long term.

The client also wanted to remotely access the information, for this reason, the system has been connected to a **VPN** so that a web client can access the server remotely as long as it has permissions.

If an anomaly is detected in the system, the PLC automatically cuts the electrical current with a relay output.



CASE STUDY

INDUSTRIAL SHIELDS

AUTOMATION AND MONITORING OF WATER TREATMENT

This project implements the automation and monitoring of a water treatment plant using Industrial Shields equipment.

The installation allows operators to remotely know the status of the plant and also to control all parameters: solenoid valves, chemical dosing, speed regulation of dosing pumps, measurement of pH, chlorine, turbidity, among others.

SUMMARY

This project focuses on automating a water treatment station using Industrial Shields equipment. The main purpose of the project is to visualise the data collected by the station's sensors on a **Touchberry Pi 10.1" Panel PC** and also to allow remote configuration of the system.

GOAL

The customer's objective is to create an autonomous water treatment station with remote data monitoring capability. The aim is also to ensure ease of replication in another nearby area and to allow remote configuration of the system.

PROPOSAL

As the customer requires an industrial controller that can be easily integrated, he opts for an **ESP32 PLC 42**. The fact that the programming platform is free of charge is a decisive incentive, along with the flexibility of the programming itself. Arduino IDE is used for the PLC and Node JS for the user interface and database.

CASE STUDY

IMPLEMENTATION

The control system for water treatment must be able to obtain the composition of the solution, specifically the:

pH **and chlorine levels.**

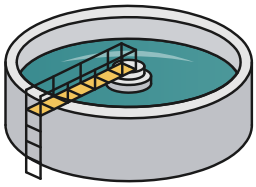
Analogue sensors read the pH and chlorine levels periodically. If the water quality properties are below the minimum value, the system activates the solenoid and valves to dose the necessary chemicals and bring the values within the allowed ranges. In addition, the system regulates the speed of the dosing pump to ensure proper dosing.

SOLUTION (HARDWARE)

The raw water tank has two sensors that check the chlorine and pH levels of the water.

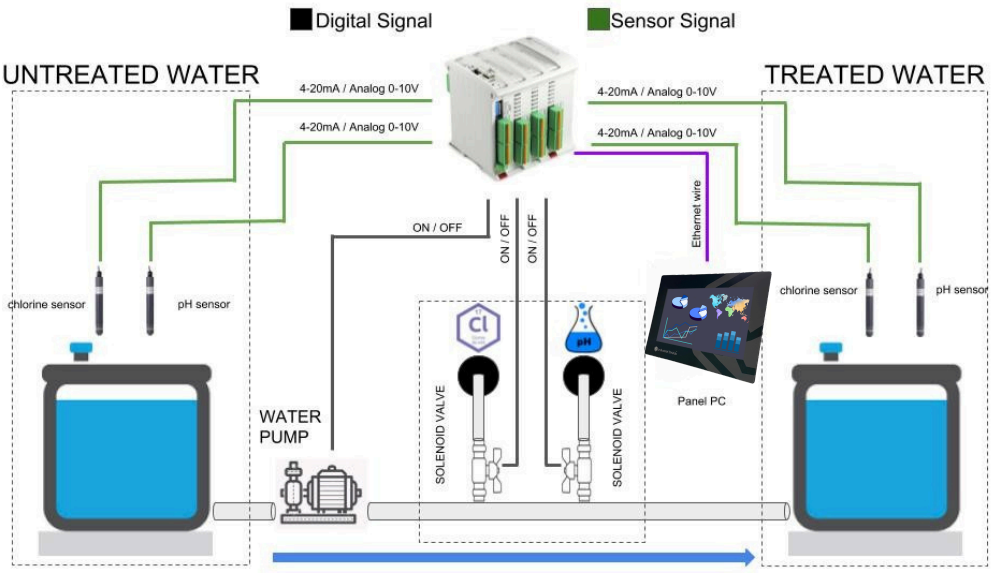
These levels can be shown on the **Industrial Shields Panel PC** in the plant using the MQTT protocol.

The chemical solution is adjusted by valves if the levels are out of range.



The water goes to the treated water tank after treatment, where two sensors confirm that the water is in good condition.

The Industrial Shields Panel PC can also automate the dosing of the chemicals based on preset values.



CASE STUDY

BENEFITS

Efficiency
Thanks to the automation of the water treatment process, the efficiency of the system is improved.

Quality
By having sensors that monitor chlorine and pH levels, the chemical solution can be corrected accurately and in a timely manner, ensuring optimal quality of the treated water.

Traceability and control
The solution allows recording and tracking of sensor data, which provides traceability and control over the water treatment process.

Fexibility
Accessing data and viewing it on the Panel PC remotely facilitates monitoring and decision making from any location. This provides flexibility and agility in system management.

Resource savings
By automating the process, the need for constant manual intervention is minimised. This saves time and resources that would otherwise be spent on manual monitoring and adjustment of chlorine and pH levels.

Cost savings
By having sensors that measure chlorine and pH levels accurately, over- or under-dosing of chemicals is avoided. This reduces chemical waste and ensures efficient dosing.

Early detection of problems
Continuous monitoring of chlorine and pH levels allows for early detection of any deviations or problems in the treatment process. Addressing irregularities in a timely manner avoids costly situations and major problems in the long run.

WHY INDUSTRIAL SHIELDS?

Industrial Shields has won the project and beaten its competitors thanks to the following points:

- **Open solution**, with no licence fees.
- **Modular solution**, with the possibility of future expansion.
- Team of **technical experts**, providing assistance and guidance from the project definition phase through to commissioning.
- Equipment designed and manufactured for **industrial use**, at **affordable prices**.

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CASE STUDY

INDUSTRIAL SHIELDS

EFFICIENCY IMPROVEMENT AND PREVENTIVE MAINTENANCE IN BIOMASS FACILITIES

The case study focuses on how these PLCs optimize the combustion of different types of biomass and analyzes the environmental and economic impacts of their use in biomass-based energy systems.

The objective is to provide a comprehensive overview on the efficient management of renewable energy resources, highlighting the advantages in flexibility and customization of open source PLCs in the context of climate change.

SUMMARY

The **variables** that we are going to take into account in the performance and maintenance of the combustion system are:

Fuel type, power plant location and generation capacity

Fuel type

It will depend on factors such as **local availability, energy value, and combustion characteristics**.
The following types are contemplated:

Energy crops

Woody origin

Agricultural residues

Geographical locations

The availability of available **resources** will be affected by the different locations.
For example:

Rural areas
Availability of agricultural residues

Forest areas
Access to woody biomass

Industrial Regions
Integrating biomass energy into existing processes

Scale of Operation

The PLC based on open source hardware is optimal for use in both installations, either:

- **Small scale**, such as local heating systems or small power generation plants.
- **Medium or large scale**, such as power plants with large generation capacity.

CASE STUDY

GOALS

- **Reduce maintenance costs, and know what and when to check or change.**
- **Monitor data for relevant information.**
- **Early detection of problems.**
- **Improve the safety of the biomass combustion system.**
- **Contribute to sustainability by reducing environmental impacts through more efficient systems.**

CONCLUSION

Thanks to the use of PLCs, **precise control of processes** such as:

- automatically regulate the biomass feed and biomass residue
- adjusting the combustion temperature to gain efficiency and save fuel consumption
- control fan speed to optimize combustion and heat delivery

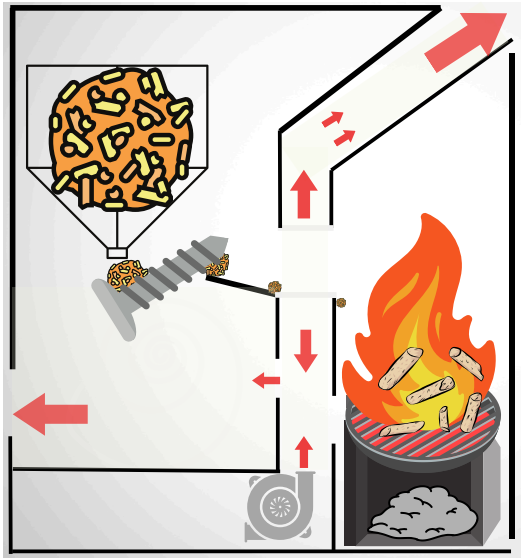
All of this allows for a significant **reduction in downtime and associated costs**, making the generation facility more **efficient, cost-effective and, in turn, sustainable**.

In addition, thanks to easy **connectivity and communication with data management systems**, it integrates with platforms where decisions are made based on established parameters or real-time readings.

A global system for **monitoring and control of biomass plants** with PLCs based on open source has been developed together with a company specialized in the renewable energy sector.

The implementation has maximized efficiency, minimized emissions and facilitated remote and automated management.

Notification and alarm systems have been added in some phases of the energy generation processes that allow to quickly evaluate the phase and status of the biomass system and inform the plant managers.



CASE STUDY

INDUSTRIAL SHIELDS

Why can PLCs be a breakthrough in geothermal energy?

Geothermal energy, a renewable and sustainable energy source, is obtained from heat stored beneath the earth's surface. Despite its potential, it faces challenges such as temperature control and efficient monitoring, which are crucial for its viability and efficiency.

In this case study, we will introduce Industrial Shields technology in the geothermal energy sector. We will control and monitor the heat pumps with the help of a PLC.

SUMMARY

PLCs will play a key role in the automation and control of processes in geothermal plants. They offer innumerable advantages such as:

- **They are economical**
- **Highly customisable**
- **They support flexible and accessible programming.**
- **Faster implementation and easy maintenance.**

The variables that we are going to take into account in a geothermal energy extraction process are basically:

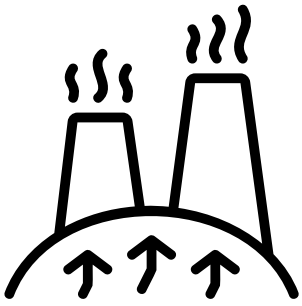
The temperature and flow of the water or steam.

Sustainable management of the reservoir to avoid degradation of its capacity over time.

Possible damage to the heat pump or the Plant.

OBJETIVES

- **Systems integration and communication.**
- **Maximising energy production.**
- **Monitor and communicate data.**
- **Perform preventive and predictive maintenance thanks to information forecasts in the cloud.**
- **Contribute to operational sustainability by reducing environmental impacts.**



CASE STUDY

CONCLUSION

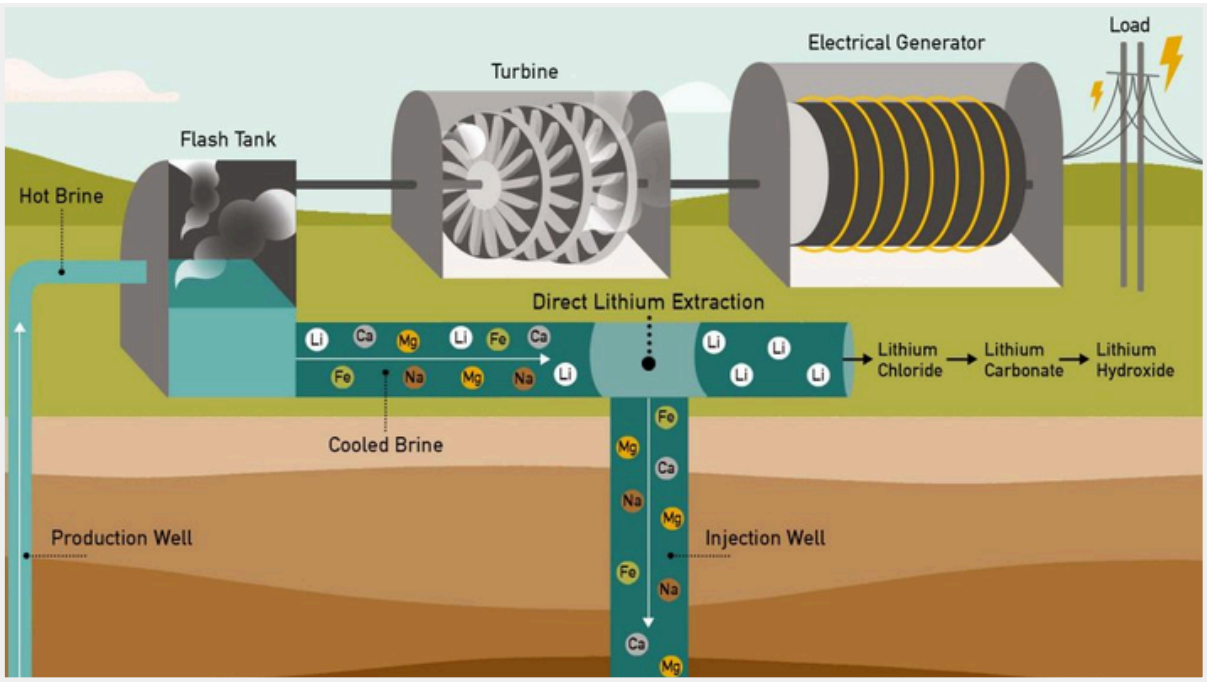
The PLC will control sensors installed on heat pump manifolds and other critical system components, such as **pressure**, **temperature** and **other abnormal or hazardous conditions**. It also controls actuators that regulate the operation of **pumps, valves,** and other mechanical equipment, adjusting them as necessary.

It runs control programs that determine how to respond to different sensor signals. These programs are essential to keep the system operating within the set parameters.

It also plays an important role in system security. It can **trigger alarms or emergency shutdown** procedures to prevent equipment damage or safety hazards.

The hardware collects and stores operational data that can be used for **historical analysis**, **performance optimisation** and **strategic decision-making**.

Following this model we could develop an integrated system for the management and optimisation of **multiple geothermal plants** using advanced PLC technology, focused on improving efficiency, production and environmental management through a **centralised and automated network**.



CASE STUDY

INDUSTRIAL SHIELDS

Powering tidal power generation with PLCs

Currently, power generation and desalination based on waves and ocean currents face critical challenges. Because manual management is inefficient and error-prone, it is necessary to automate these processes.

In this case study, we explore how the implementation of a PLC can improve the efficiency and reliability of operations.

SUMMARY

In this context, optimizing energy performance and efficient resource management are crucial challenges. It is essential to maximize the production of electricity and drinking water while minimizing the consumption of essential resources, such as fresh water and energy to supply the system.

For the automation of the system we implemented the **Raspberry PLC** industrial controller due to its features, such as:

- Diversity of **inputs and outputs**. The controller can be easily integrated into an existing system.
- It is a **scalable** system, which can be expanded without becoming obsolete.

This device offers a **flexible and powerful** solution for monitoring a wide range of critical parameters.

In addition, the PLC facilitates the integration of automated control systems and its **compact and versatile** design makes it ideal for industrial applications, even in harsh environments such as marine.

CASE STUDY

GOALS

A series of landmarks were established to evaluate the success of the PLC implementation. These are:

Improved energy efficiency: Reduce consumption by 15% by optimizing generation processes through PLC implementation.

Improved system reliability: Reduce unplanned downtime by 25% by implementing automated PLC monitoring and control systems.

Improvement of water quality: Increase the quality of desalinated water by optimizing desalination processes and controlling critical parameters that ensure optimum water quality.

Compliance with regulatory standards: Ensure 100% compliance with environmental and safety regulations by implementing precise control and monitoring measures.

CONCLUSION

An industrial controller system has been developed in conjunction with a company specializing in this sector to improve operational efficiency and resource management.

With the implementation of the solution, the company now has the ability to accurately **monitor and control** a variety of critical aspects. This includes monitoring energy capture rate, desalination efficiency, water quality and temperature, all **in real time**.

The integration of automated control systems has made it possible to optimize the performance of the devices, thereby minimizing operating costs and improving the **reliability and safety** of the facilities. This advanced approach not only provides **greater efficiency** in the production of energy and drinking water, but also meets the most rigorous standards in terms of **quality and sustainability** in the industrial sector.

CASE STUDY

INDUSTRIAL SHIELDS

Transforming the oil industry with PLC

In the oil refining industry, worker safety and operational efficiency are critical to the success and sustainability of the business.

This case study examines the implementation of Open Source based PLCs as a viable alternative to improve both safety and efficiency in a refinery plant.

SUMMARY

Oil refineries face a variety of problems, from **occupational injuries** to **environmental impacts**, due to lack of safety training, poor regulatory compliance and inadequate equipment maintenance.

The implementation of **Raspberry Pi PLC** in these facilities improves the **monitoring, control** and data **acquisition** in critical processes such as pH control, water treatment and gas measurement.

These devices combine the versatility of an **Open Source** based system such as Raspberry Pi with the functionality of a traditional PLC, being more **accessible and customizable**.

Some advantages of its implementation include:

- Greater **flexibility and customization** in the design of control systems.
- **Very competitive** initial and maintenance costs and **even lower** software costs.
- Possibility of **integration** with new technologies, such as IoT, to optimize production and prevent failures.

It also includes process optimization through the use of **real-time** data, implementation of predictive maintenance practices and improved resource management.

CASE STUDY

GOALS

Thanks to the installation of PLCs that allow monitoring and control implementation, it was achieved:

Improve worker safety at the refinery by implementing reliable and effective control systems.

Increase the refinery's operational efficiency and production through process optimization and the use of appropriate control technology.

Comply with environmental regulations and promote sustainability in refinery operations.

CONCLUSION

A solution has been developed in which an oil refinery plant has successfully implemented an advanced PLC system to improve its **safety and operational efficiency**.
After facing a number of challenges, including labor incidents and environmental concerns, the plant decided to adopt this open source based solution.

Following the implementation of the automatons, the plant was able to significantly improve its ability to **monitor and control** the refinery's critical processes. This led to a notable reduction in the number of work incidents and an improvement in worker safety. In addition, process optimization led to an **increase in oil production** and **greater efficiency** in the use of resources.

As a result of these improvements, the plant not only achieved more effective compliance with environmental regulations, but also **increased its profitability** and contributed to the **economic development of the region**.

CASE STUDY

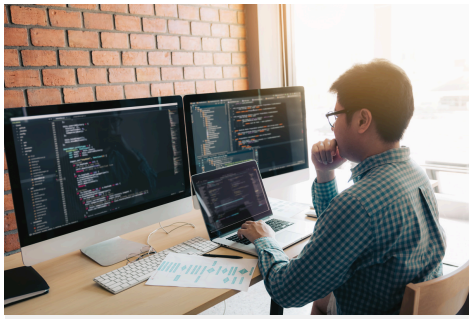
BENEFITS

Remote management

Thanks to the installation of programmable logic controllers, it is possible to control and supervise the system remotely.

Quality

Industrial Shields offers quality assurance through verification systems and internal audits.

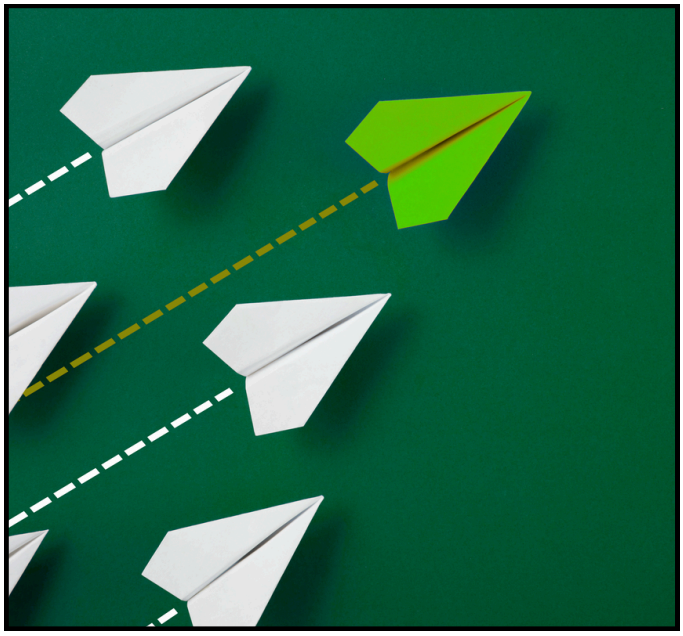


Easy programming

Industrial Shields PLC's can be programmed with the system that best suits the customer's needs.

WHY INDUSTRIAL SHIELDS?

Industrial Shields stands out from its main competitors thanks to the following points:



Open solution. No license fees.

Modular solution: Product specifications can be expanded in the future.

Technical support: Our team is available to help you from the first contact, during the installation phase and up to after-sales.

Equipment designed and manufactured for **industrial use** at a **competitive price**.

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