



[Applying Energy Efficient measures for metal and metalworking SMEs and industry \(EE-METAL\)](#)

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Energy savings provided by the use of Energy Monitoring Systems in SMEs

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Abstract	This document aims to promote the use of Energy Monitoring Systems (EMS/SCADA) taking into account the experimentation carried out in 4 European SMEs of the targeted MMA subsectors.



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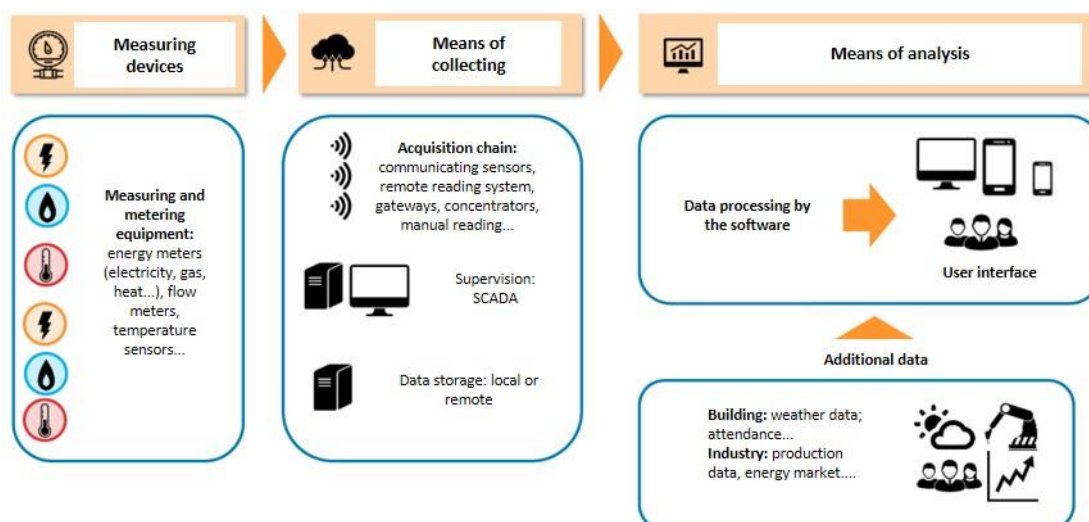
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1. Energy Monitoring Systems: definition

An energy monitoring system includes all devices for measuring, identifying and analyzing the energy performance of the company. Any energy monitoring system is composed of three elementary blocks:

- **Measuring devices:** they are composed of devices intended to be used to make measurements (voltage, electric power, flow, temperature, humidity ...)
- **The means of collecting:** they make it possible to collect and centralize the data coming from the measuring device with an acquisition chain
- **The means of analysis:** they correspond to the tools allowing to exploit the data recorded

The concept of energy monitoring system therefore includes metering instruments, the energy data acquisition chain and the means for analyzing energy data.



Schematic representation of the 3 building blocks of an energy monitoring system (Source ATEE)

2. Opportunities for MMA SMEs through the energy monitoring system

The implementation of an energy monitoring solution makes it possible to:

- **monitor** in real time the energy consumption of the company
- **drive** energy performance in relation to the optimization objectives selected
- **detect** as quickly as possible consumption drifts
- **identify** levers for improving energy efficiency
- **be responsive** in setting up corrective actions

In addition to all these advantages, energy monitoring solutions also offer interesting visibility into the state of equipment and installations, which makes it possible to anticipate and facilitate maintenance operations. This translates into productivity gains (increase in operating time and maintenance of equipment in operational conditions).



3. European Benchmark on energy monitoring system solution offerings

A European benchmark has identified the suppliers of energy monitoring solutions. There is a great disparity between each country in the panel of suppliers of energy monitoring solutions.

Country	Number of suppliers	TOTAL
Poland	8	136
Spain	24	
Italy	30	
France	74	

In order to facilitate and accelerate the networking between SMEs and suppliers, Workshops devoted to the promotion of energy monitoring solutions have been set up. During these events, meetings between SMEs and suppliers were organized.

Suppliers are also regularly informed about EE-METAL actions and the potential for energy savings represented by MMA SMEs. They receive a newsletter and the summary of the results of the energy audits conducted in 80 European SMEs thanks to EE-METAL.

4. Methodology for the implementation of an energy monitoring system in 4 MMA SMEs

A common methodology has been defined to achieve a similar implementation of a monitoring solution in SMEs:

1) Selection of SMEs

The 4 SMEs selected for the implementation of an energy monitoring system were selected on the basis of the following criteria:

- Significant energy consumption
- Potential for saving energy (economic interest)
- Prior completion of an energy audit
- Experience in a Management System (ISO 9001, 14001 or 50001 certifications acquired or in progress)
- Motivation and enthusiasm

Country	NACE Code	Activity	Number of employees	Annual energy consumption 2016	Share of energy in the turnover 2016
Poland	25	Surface treatment and production of steel constructions	239	> 5 GWh	6%
Spain	25	Surface treatment	16	1- 5 GWh	4 %
Italy	25	Metal framing and production of industrial plants	67	1- 5 GWh	1 %
France	25	Surface Treatment and Painting	31	1- 5 GWh	6 %



2) Drafting specifications

Each SME has been accompanied by the definition of its needs in order to define specifications to consult suppliers on the same basis.

3) Selection of 3 or 4 suppliers

Depending on the needs identified, 3 to 4 suppliers could be selected on the basis of the following criteria:

- Response to needs
- Experience in the metal industry and SMEs
- Intuitive solution (ease of appropriation)
- Availability

Country	Supplier (name)	Measuring device (number of sensors)	Means of collecting (acquisition chain)	Means of analysis (software)	Follow-up equipments
Poland	REBUD Sp. z o.o.	Three-phase network analyzers POZYTON sEAB (3 electrical energy sensors)	RS-485/LAN Nport MOXA	Data visualizing software	W1 department (benders, welders, cutting equipment), Galvanizing furnace, Office building (lighting)
	CONCEPT Wojciech Małmyga	Three-phase network analyzers POZYTON sEAB (3 electrical energy sensors)	RS-485/LAN Nport MOXA	Data visualizing software	W1 department (benders, welders, cutting equipment), Galvanizing furnace, Office building (lighting)
	FreeEn Sp. z o.o.	Three-phase network analyzers POZYTON sEAB (3 electrical energy sensors)	RS-485/LAN Nport MOXA	Data visualizing software	W1 department (benders, welders, cutting equipment), Galvanizing furnace, Office building (lighting)
Spain	David Amigot (Circutor)	Three-phase and single-phase network analyzers (16 electrical energy sensors)	Modbus RS-485/Ethernet	Power Studio Scada (Real time monitoring)	- Total consumption (1 equipment) - Second electrical panel (1 equipment) - Electrical resistors (2 equipment) - Rectifiers (5 equipment)
	Humen (Circutor)	Three-phase and single-phase network analyzers (16 electrical energy sensors)	Modbus RS-485/Ethernet	Power Studio Scada (Real time monitoring)	- Extractor fan (1 equipment) - Depressor (1 equipment) - Electrical panel for sealing (1 equipment) - Lighting (2 equipment)
	EDS (Circutor)	Three-phase and single-phase network analyzers (16 electrical energy sensors)	Modbus RS-485/Ethernet	Power Studio Scada (Real time monitoring)	- Water treatment plant (1 equipment) - Electrical panel 1 (1 equipment) - Compressed air system (1 equipment)
	David Amigot (Schneider)	Three-phase and single-phase network analyzers, Three-phase and single-phase energy meter. (16 electrical energy sensors)	Modbus RS-485/Ethernet	Power Monitoring Expert 8 (Real time monitoring)	
	Humen (Schneider)	Three-phase and single-phase network analyzers, Three-phase and single-phase energy meter. (16 electrical energy sensors)	Modbus RS-485/Ethernet	Power Monitoring Expert 8 (Real time monitoring)	
	EDS (Schneider)	Three-phase and single-phase network analyzers, Three-phase and single-phase energy meter. (16 electrical energy sensors)	Modbus RS-485/Ethernet	Power Monitoring Expert 8 (Real time monitoring)	
	David Amigot (Carlo Gavazzi)	Three-phase and single-phase energy analyzers, (16 electrical energy sensors)	Modbus RS-485/Ethernet	Web server	



	Humen (Carlo Gavazzi)	Three-phase and single-phase energy analyzers, (16 electrical energy sensors)	Modbus RS-485/Ethernet	Web server	
	EDS (Carlo Gavazzi)	Three-phase and single-phase energy analyzers, (16 electrical energy sensors)	Modbus RS-485/Ethernet	Web server	
Italy	RTE - Rappresentanze Tecno Elettriche Snc	Lovato Electric (13 electrical energy meters)	Lovato Electric (RS485 + ethernet)	Lovato Electric (Software Sinergy)	<ul style="list-style-type: none"> Compressors (3 instruments); Office building (1 instrument); Painting * (1 instrument); Sandblasting * (1 instrument); Plasma cutting (1 instrument); Boring machine (1 instrument); Department internal supply lines (2 instruments) ** General supply line for all departments (3 instruments)
	EZ - Elettroimpianti	Lovato Electric (13 electrical energy meters)	Lovato Electric (RS485 + ethernet)	Lovato Electric (Software Sinergy)	
	Electro IB	Lovato Electric (13 electrical energy meters)	Lovato Electric (RS485 + ethernet)	Lovato Electric (Software Sinergy)	
France	GulPlug	E-Cube (10 electrical energy estimators)	E-Case XS (radio protocol)	XSave-It-Yourself (internet plateforme)	<p>Electricity:</p> <ol style="list-style-type: none"> General arrival of the automatic painting line Suction/Ventilation manual cabin line ventilation Suction/Ventilation automatic cabin line ventilation Suction sandblasting cabin Suction metallisation Long-length powder-coated cabin suction Air compressor 1 Air compressor 2 SFCME furnace General arrival of the shot blasting machine <p>Gas:</p> <ol style="list-style-type: none"> Degreasing bath 1 Degreasing bath 2 Dryer Automatic line polymerization furnace 1 Automatic line 2 polymerization furnace Long-length line polymerization furnace
	Energency	/	/	Energency (internet plateforme)	
	Astree Software	/	Module E/S (4E/4S Ethernet protocol)	AQUIWEB®- Aquienergie (software)	
	Socomec	10 electricity meters	DIRIS Digiware (Modbus RTU protocol)	WEBVIEW-M (software)	
	Clauger	6 gas meters + 10 electricity meters with wireless connectivity	ClaugerBOX (GSM protocol)	myclauger.com (internet plateforme)	
	Flamtech	6 gas meters QA25 (with electric pulses)	/	/	

4) Choice of the supplier by the SME

Once the different solutions are presented, the company selects the one that best meets its expectations:

- Poland: FreeEn Sp. z o.o. – this company was chosen for installation of the monitoring system because of the lowest purchase price
- Spain: DAVID AMIGOT – CIRCUTOR. They have been chosen because they are cheaper than other technology providers.
- Italy: After comparison of final purchase price, Electro IB has been chosen as best supplier for SCADA system because it is cheaper than other competitors
- France: The solution proposed by GULPLUG has been recognized as the simplest and most adapted to the company's needs. However, as it only allows the monitoring of electrical energy, it has been completed by a coupling with gas meters offered by the company Flamtech.



5) Acquisition and installation of the energy monitoring solution

- Poland: FreeEn Sp. z o.o. was also responsible for installation of the monitoring system. This company has great experience in implementation of EMS/SCADA in industrial plants.
- Spain: David Amigot is the one designated for the installation of the equipments, since in addition to being the cheapest, he is the supplier of equipment and usual maintenance of the company. The integration of the monitoring equipment is carried out by specialized personnel in Circutor.
- Italy: For system installation, EZ – Elettroimpianti has been appointed because it is the regular installation company of the SME. This should simplify all operations because EZ – Elettroimpianti knows electrical architecture of production site and manages maintenance operations. Installation cost includes also current transformers supply.
- France: The installation of gas meters is entrusted to the company's plumber. The gas meters are then coupled to the electrical energy monitoring solution installed by GULPLUG.

6) Use and satisfaction of the Energy Monitoring Systems

In each country, the energy monitoring system implemented meets the expectations specified by the companies in the specifications and the measurements made during the energy audit (consumption breakdown).

The architecture of the monitoring solutions deployed in each country is detailed in the appendix (1 sheet per company, which details: the company's activity, the distribution of its consumption, the measurement systems implemented and a notion of cost).

Concerning the results obtained following the installation of monitoring systems, it should be underlined that a monitoring campaign needs quite long observation time to provide data that can be meaningful, comparable and that provide useful information to identify necessary interventions. These times are not coherent with the closure of the EE-METAL program and for this reason the data measured with the systems implemented in the companies are not reported in the deliverable.

However, until at this stage it is still a little early to present reliable figures, the first results are encouraging as they confirm the measurements made during the energy audits. In the long term, the sensors will make it possible to refine these measurements (with continuous measurement) and make them more reliable.

On some equipment, continuous measurement of consumption makes it possible to detect peaks in consumption and to alert on equipment malfunctions (breakdowns, adjustment problems, misuse...). This type of alert should enable companies to react more quickly, improve the operation of their equipment and thus save money.

Finally, energy monitoring solutions are beginning to be used in some companies as a means of improving production ranges. By monitoring the energy consumption of production lines, they can optimize the organization of production (delayed machine start-up, optimization of furnace heating times, equipment shutdown in the event of non-use, etc.).



Regarding company satisfaction, a survey of managers shows that it is very good, that they all perceive a strong interest in monitoring solutions and that they are ready to recommend them to other SME managers:

Country	Global satisfaction	Relevance	Ergonomics Simplicity	Flexibility Adaptability	Maintenance	Value for money	Comments*
Poland	10/10	10/10	8/10	9/10	9/10	10/10	See below
Spain	7/10	7/10	8/10	9/10	9/10	8/10	See below
Italy	9/10	8/10	8/10	9/10	9/10	9/10	See below
France	9/10	8/10	10/10	9/10	8/10	9/10	See below

** What advice would you give to an SME manager who wants to install an energy monitoring system?*

Poland: Energy monitoring system is useful for cost analysis with monitoring for individual production segments. It allows a full analysis of the company's costs.

Spain: After a brief experience with the energy monitoring system, it can be noted that if energy consumption is important and it is not possible to know exactly how much, when and where it is consumed, the energy control system provides valuable information to know about which areas or equipment is possible to act and be more efficient. It also allows to detect anomalies in equipment operation (changes in energy consumption).

Italy: Measures of energy monitoring system helps to develop a real energy efficiency awareness because results of a certain improvement action can be clearly verified and observed.

France: Non-intrusive solution for measuring consumption that facilitates integration in SMEs (simplicity, flexibility, reduced costs).

5. Recommendations for a wider deployment in MMA SMEs

- **Clearly define your needs:** identify the equipment and data already available, be clear on the expected, draft specifications...
- **Do not be too ambitious:** it is better to opt for a simple but scalable solution...
- **Have internal resources:** designate and train an energy referent...
- **Integrate this monitoring as part of a more global approach to improving performance:** improving productivity, facilitating maintenance...



Annex 1: Description of the energy monitoring system installed in Italy

Brief description of the company:

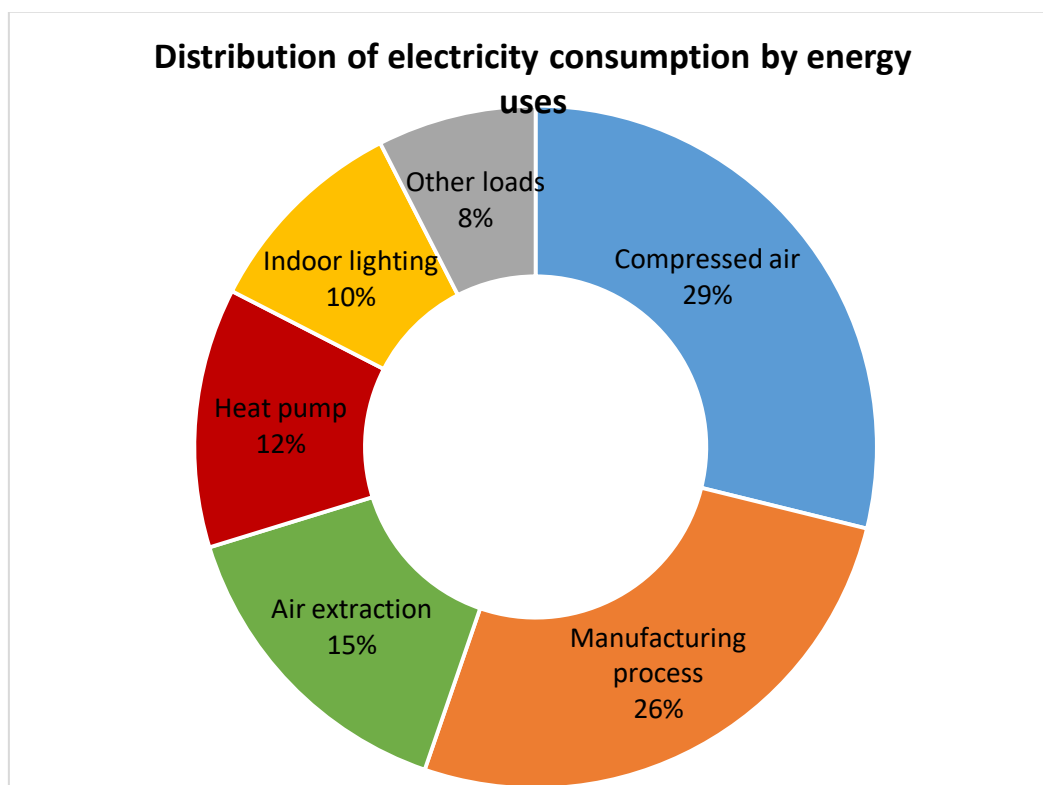
Installation of SCADA system (Supervisory Control And Data Acquisition) has been carried out in a metalworking SME that produces metal framing and industrial plants.

Different light, medium and heavy carpentry solutions are built, and equipment for metallurgical industry are realized. Crucibles for EAFs (electric arc furnace) and industrial furnaces, ladles, scrap baskets, steel pipes are just some examples of final products of this SME.

Distribution of the company's energy consumption:

Thanks to EE-Metal project, an energy audit in compliance with UNI EN 16247 technical standard has been achieved and significant energy usages of the manufacturing site have been identified. Results of the analysis have driven design phase of monitoring system, in order to measure and track more relevant and/or interesting company energy uses.

In the following chart distribution of electricity consumption for the manufacturing site is shown. On the other hand, natural gas request has not been included in monitoring system because it is negligible and limited to workspace heating.



Description of the installed energy monitoring system:

In this set of data, SCADA system has been designed on two different levels: the first includes a general meter for each company department, the latter focuses on specific measures of some relevant equipment or users that are selected through a significance and cost-effective analysis. Energy uses that affect no more than 5% of total site electricity consumption and with no improvement potential have been neglected. Some exclusions from the SCADA have been also applied for technical impediments due to framework of existing electrical plant.



Design activities have been supported by on-field inspection.

Final configuration of monitoring system includes 13 energy meters, each of them with an ID number, as it is described below.

1. Department 1
 - General meter → M1
 - Painting → M2
 - Sandblasting → M3
 - Compressor 1 → M4

2. Department 2
 - General meter → M5
 - Compressor 2 → M6
 - Office building → M7
 - Busway FM2 DX → M8
 - Plasma cutting → M9
 - Busway FM2 centro → M10

3. Department 3
 - General meter → M11
 - Compressor 3 → M12
 - Boring machine → M13

Under painting and sandblasting meters of department 1 also consumption of fans for air extraction is included; busway FM2 DX contains submerged arc welding 800, welding air extraction E3 and E4 and other less important loads. Meter of busway FM2 centro measures submerged arc welding 1000 and other less important loads.

Monitoring system does not cover:

1. Department 1
 - Building B
 - Cranes
 - Warehouse lighting
 - Indoor lighting
 - Outdoor lighting (load already measured)

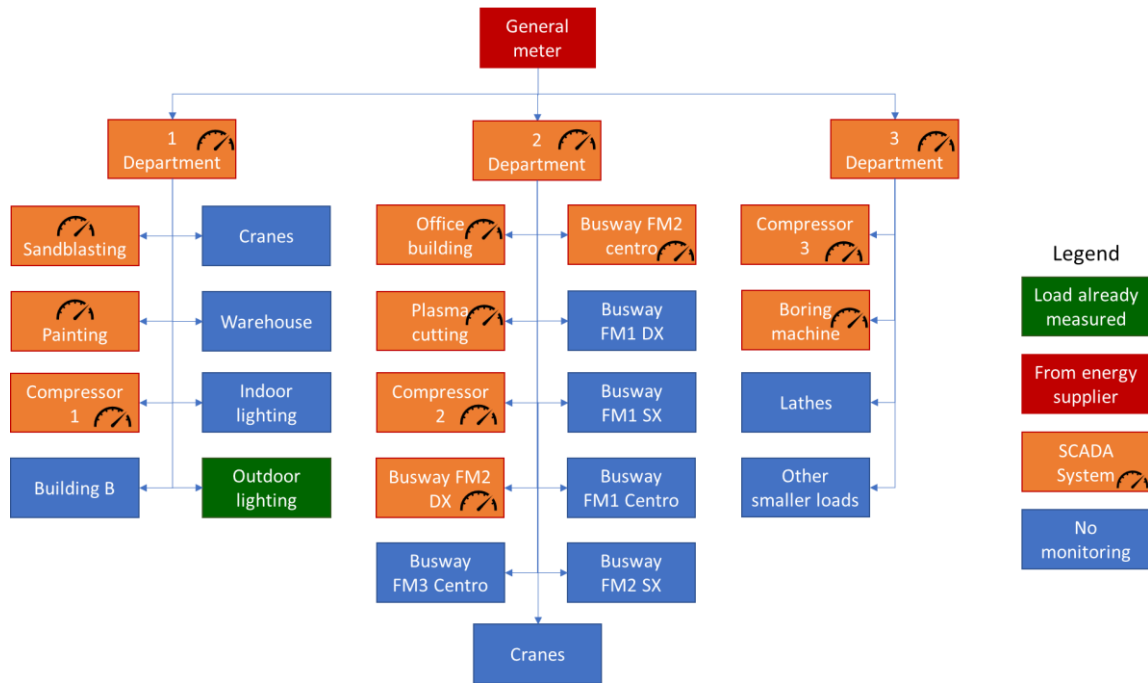
2. Department 2
 - Busway FM1 DX, SX and centro
 - Busway FM2 SX
 - Busway FM3 centro
 - Cranes

3. Department 3
 - Lathes and less important loads

According to results of energy audit, designed monitoring system should cover 75% of company electricity consumption with detailed measures (second level) but this percentage can be further raised in the future with additional meters for indoor lighting.



Thanks to specific energy meters, this SCADA will also provide a precise partition among company departments.



Cost indication:

The total price of the solution amount at about 10.000 €.

Annex 2: Description of the energy monitoring system installed in France

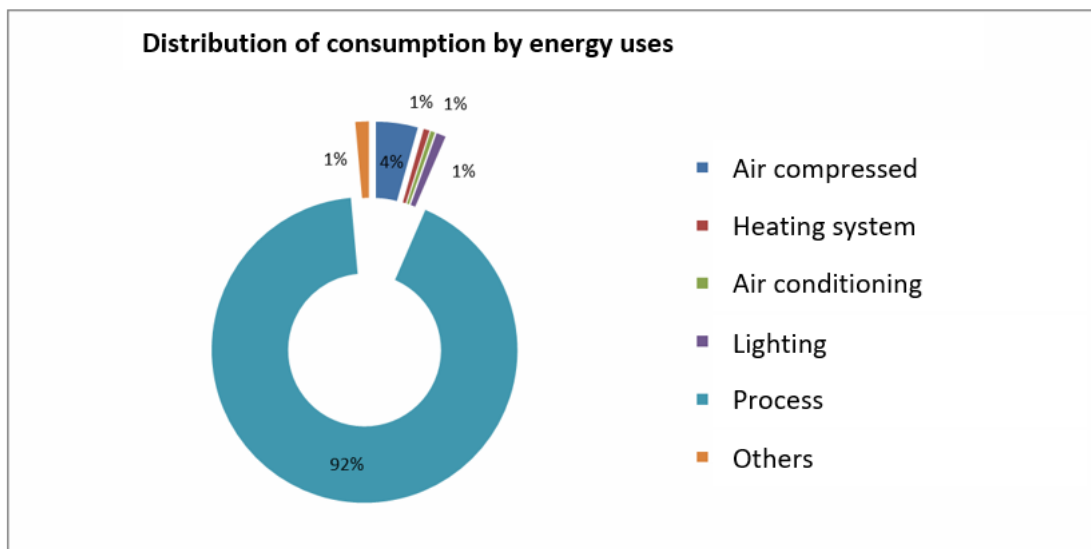
Brief description of the company:

Installation of SCADA system (Supervisory Control And Data Acquisition) has been carried out in an SME with 31 employees specialising in the treatment and coating of metals (chemical spraying, sandblasting, metallisation and painting).

Distribution of the company's energy consumption:

The distribution of the 2 energy sources used is as follows:

- 80% gas (heating of degreasing baths, paint polymerization furnaces, dryer)
- 20% electricity (furnace suction, powder coating booths, sandblasting and metallization booths, compressed air, lighting, office heating/air conditioning)



The distribution of consumption by energy use shows that 92% of the energy consumed by the company is process energy.

Description of the installed energy monitoring system:

Considering the above energy data, the choice was made to concentrate the measuring equipment on the process. On the other hand, since gas consumption is very important in this company, the monitoring system includes both energy sources. The measurement points are distributed as follows:

GAS: 6 sensors that measure the instantaneous consumption and correlate it with the temperature inside the equipment:

1. Degreasing bath 1
2. Degreasing bath 2
3. Dryer
4. Automatic line polymerization furnace 1
5. Automatic line 2 polymerization furnace
6. Long-length line polymerization furnace



ELECTRICITY: 10 sensors that measure instantaneous consumption:

1. General arrival of the automatic painting line
2. Suction/Ventilation manual cabin line ventilation
3. Suction/Ventilation automatic cabin line ventilation
4. Suction sandblasting cabin
5. Suction metallisation
6. Long-length powder-coated cabin suction
7. Air compressor 1
8. Air compressor 2
9. SFCME furnace
10. General arrival of the shot blasting machine

In order to have a global supervision of consumption (all energy combined), the 2 types of sensors (gas and electricity) have been made compatible. The gas volumetric meters were thus made communicating and connected to electrical sensors ([non-intrusive](#)) whose technology already allowed data collection and analysis with a web platform (<https://save-it-yourself.com>).

Cost indication:

The total price of the solution amount at about 12.000 €.



Annex 3: Description of the energy monitoring system installed in Poland

Brief description of the company:

Installation of SCADA system (Supervisory Control And Data Acquisition) has been carried out in a metalworking SME that produces metal framing. The main area of the company's activity are steel structures of halls, fencing made of welded mesh, fencing for cattle and many others. The modern machine park also allows hot-dip galvanizing and high-temperature galvanizing with centrifugation.

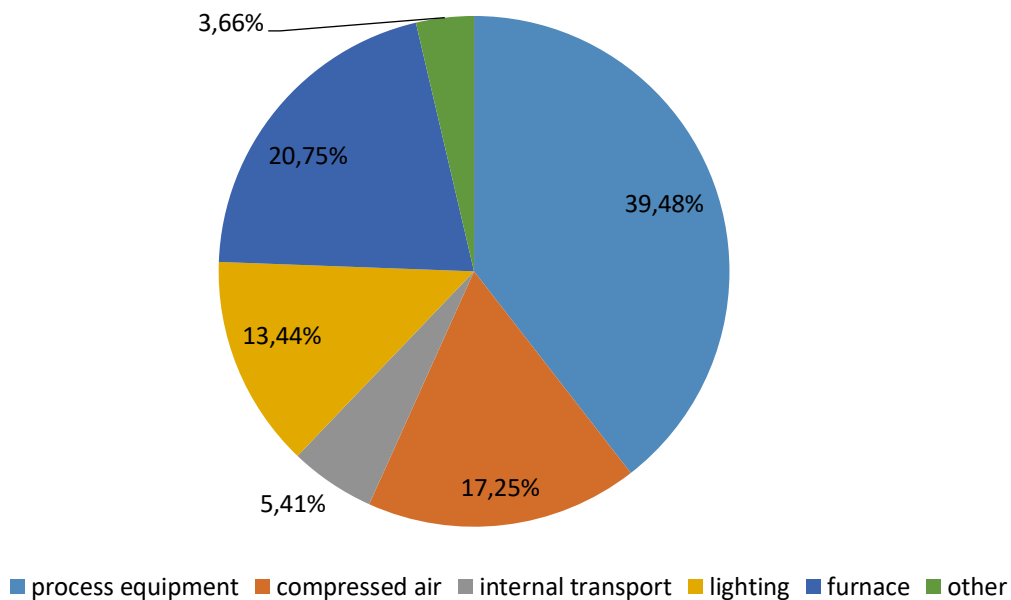
Distribution of the company's energy consumption:

Thanks to EE-Metal project, an energy audit in compliance with PN-EN 16247 Part 1: General requirements and Part 3: Processes technical standard has been achieved and significant energy usages of the manufacturing site have been identified.

Results of the analysis have driven design phase of monitoring system, in order to measure and track more relevant and/or interesting company energy uses.

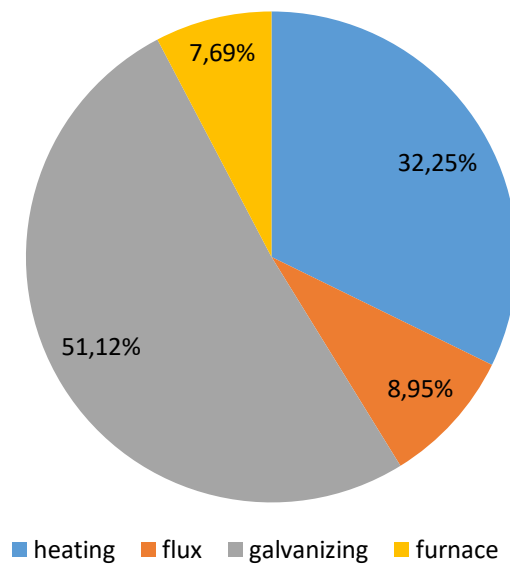
In the following charts distributions of electricity and natural gas consumption are shown:

Distribution of electricity consumption





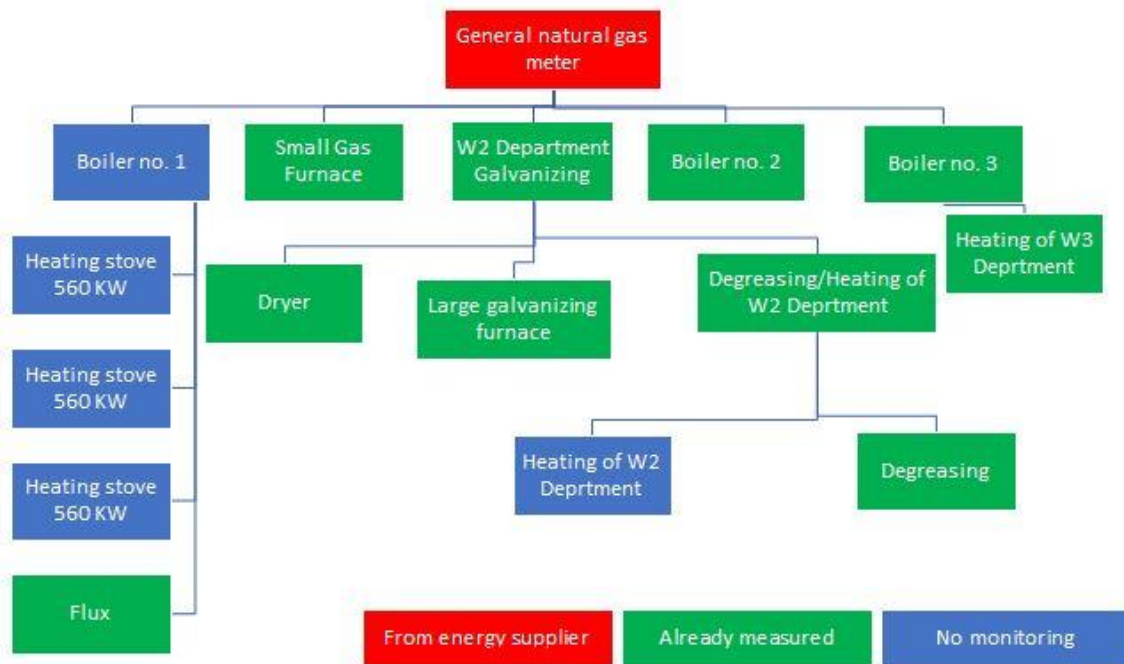
Distribution of natural gas consumption



Description of the installed energy monitoring system:

SCADA system for whole company includes two different levels: a general meters for electricity and natural gas and specific measures of some relevant equipment or users that are selected through a significance and cost-effective analysis.

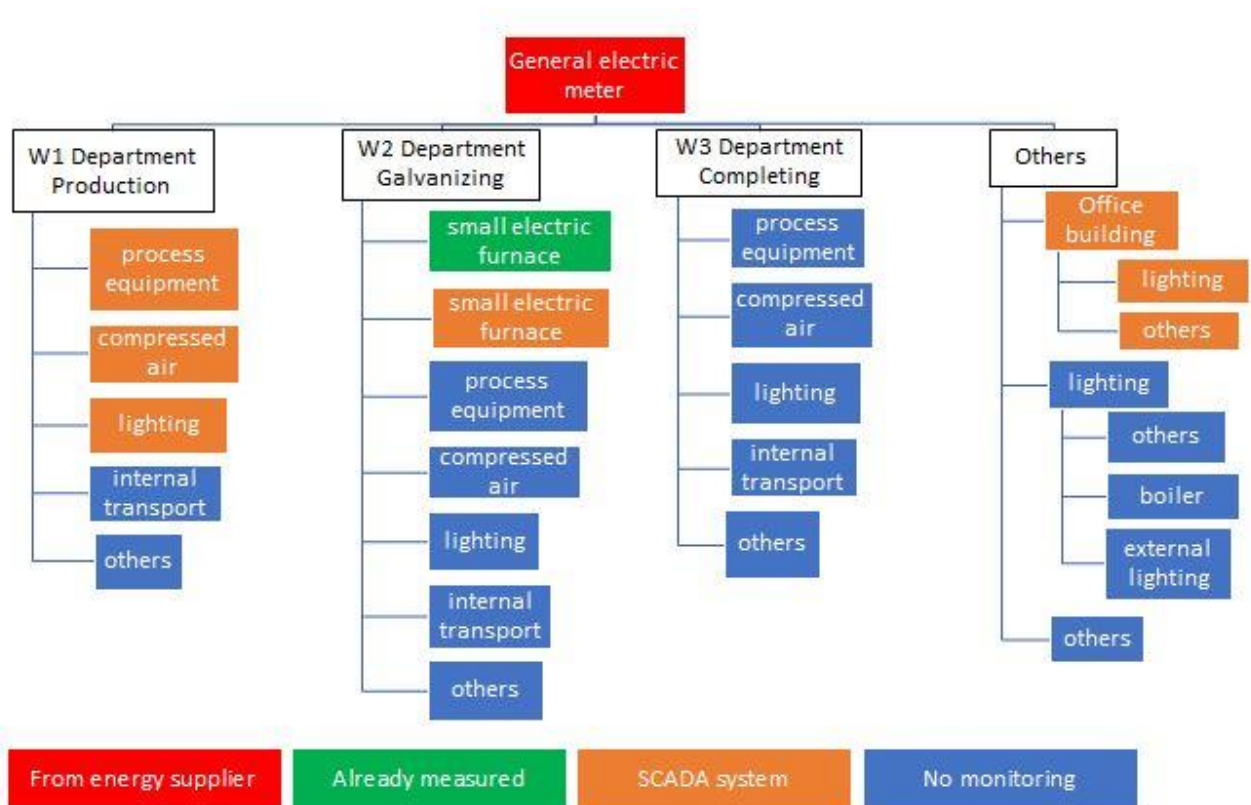
Natural gas measurement is included in the already existing monitoring system and was not a part of SCADA system development as part of the EE-METAL project.



In case of electricity measurement some exclusion from the SCADA has been applied for technical impediments due to framework of existing electrical plant and because of arrangements with the company management. Final configuration of electricity monitoring system includes 4 energy meters, 3 of them were installed as part of EE-METAL project:



1. General meter
2. WP1 Department – Production → **M1**
 - process equipment (benders, welders, cutting equipment)
 - compressed air
 - lighting
3. W2 Department Galvanizing → **M2**
 - small electric furnace
4. Others → **M3**
 - office building (lighting, others – office equipment, air conditioners)



All design activities have been supported by on-field inspection.

Monitoring system does not cover:

1. WP1 Department – Production
 - internal transport
 - others
2. W2 Department – Galvanizing
 - process equipment
 - compressed air
 - lighting
 - internal transport
 - others
3. W3 Department - Completing
 - process equipment
 - compressed air



- lighting
 - internal transport
 - others
4. Others
- lighting (boiler, external lighting, others)
 - others

Existing SCADA system should be raised in the future with additional meters for missing areas. Thanks to specific energy meters, SCADA will provide a precise partition among company departments.

Cost indication:

The total price of the solution amount at about 4.000 €.

Annex 4: Description of the energy monitoring system installed in Spain

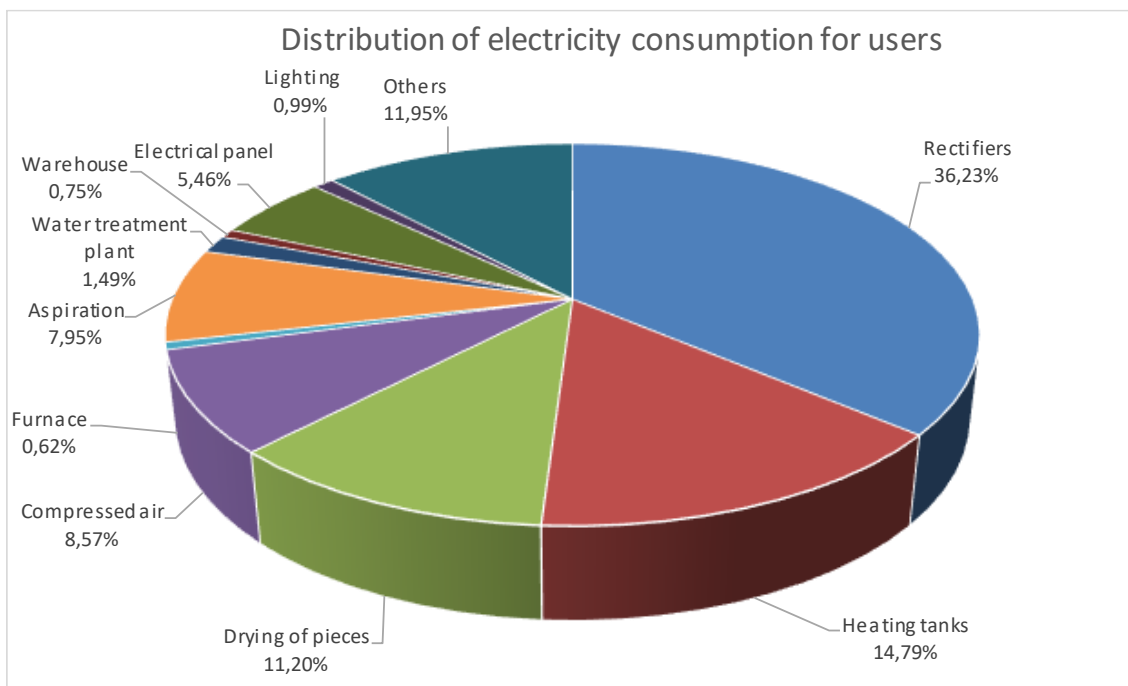
Brief description of the company:

After carrying out an energy audit and the implementation of ISO 50001 Energy Management, an energy monitoring system was installed in an SME with 16 employees and more than 20 years of experience dedicated to the treatment and coating of metals.

Distribution of the company's energy consumption:

The results of the energy audit have served as the basis for the design of the monitoring system. The significant uses obtained from the energy audit have been considered important and priority when it comes to measuring and controlling.

On the other hand, only electricity consumption has been included in the monitoring system since the consumption of diesel (another energy source) is insignificant and its use is limited to heating the production area.



Description of the installed energy monitoring system:

With the monitoring system installed, more than 85% of the company's energy consumption is covered and, given its modular nature, this percentage can be increased with the addition of new energy meters.

Taking into account the previous energy consumption data, the monitoring system includes 16 energy meters which are listed below:

- ✓ Total consumption (1 equipment)
- ✓ Second electrical panel (1 equipment)
- ✓ Electrical resistors (2 equipment)



- ✓ Rectifiers (5 equipment)
- ✓ Extractor fan (1 equipment)
- ✓ Depressor (1 equipment)
- ✓ Electrical panel for sealing (1 equipment)
- ✓ Lighting (2 equipment)
- ✓ Water treatment plant (1 equipment)
- ✓ Electrical panel 1 (1 equipment)
- ✓ Compressed air system (1 equipment)

Cost indication:

The total price of the solution amount at about 10.500 €.