



IN-LINE

ENERGY EFFICIENCY

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objectives

FOCUS

ON THE ROLE OF INDUSTRIAL PRODUCTION
IN TERMS OF ENERGY CONSUMPTION

ILLUSTRATE

HOW DIGITALIZATION AND TECHNOLOGICAL
INNOVATION CAN MAKE THE INDUSTRY
MORE SUSTAINABLE

INTRODUCE

THE ROLE OF THE SMART PACKAGING HUB
IN THE FIELD OF ENERGY EFFICIENCY

GIVE VOICE

DIRECTLY TO THE FIVE COMPANIES WITHIN
THE HUB IN ORDER TO UNDERSTAND HOW
THEY ARE GETTING AROUND IN THIS FIELD

summary

The Smart Packaging Hub was conceived by the initiative of five companies, Baumer, Cama, Cleverttech, Tosa and ZACMI. They wanted to build a virtual meeting point for end users of automatic packaging machines or lines to discuss with manufacturers and find the best solutions in terms of production efficiency, product safety and quality, traceability and energy saving.

Hereinafter, the topics of production and energy consumption will be covered, showing some case studies introduced by Smart Packaging Hub companies, including some helpful guidelines on the best practices to promote sustainability.

Finally we shall discuss short- and medium-term trends to reduce consumption in the packaging industry according to suggestions made by the Hub companies. ●

introduction

In the industrial sector, reaching energy efficiency means improving the production to energy input ratio, reducing energy consumption in order to obtain the same production rate or increase the output with the same energy consumption. The EU aims at reducing the final energy consumption by 32.5% within 2030, compared to energy consumption planned within that time with reference to a 2007 scenario. Most recently, the EU Commission proposed a 36% reduction within 2030. ●

Industrial Production and Energy Consumption

Industry, in all its forms, is responsible for 37% of global energy consumption and 24% of global carbon dioxide emissions.

A higher energy consumption is mainly due to an increase in energy production for intensive industrial sub-sectors (that is: chemicals, iron and steel, concrete, cellulose and paper, aluminium), whilst much of the consumption today is associated with electric motors (approximately 70%).

In its 2020 annual report, the International Energy Agency pointed out the need for government intervention to impose targets on energy consumption and CO₂ emissions.

A close cooperation between government and enterprises should also favour the transition to secondary production methods, based on the recycling of raw materials.

EUROPEAN AND ITALIAN INDUSTRY DATA

According to the Eurostat Report, published in May 2023, the industrial sector was the third largest energy consumer in the EU in 2021, after transport and households, with consumption at 25.6%.

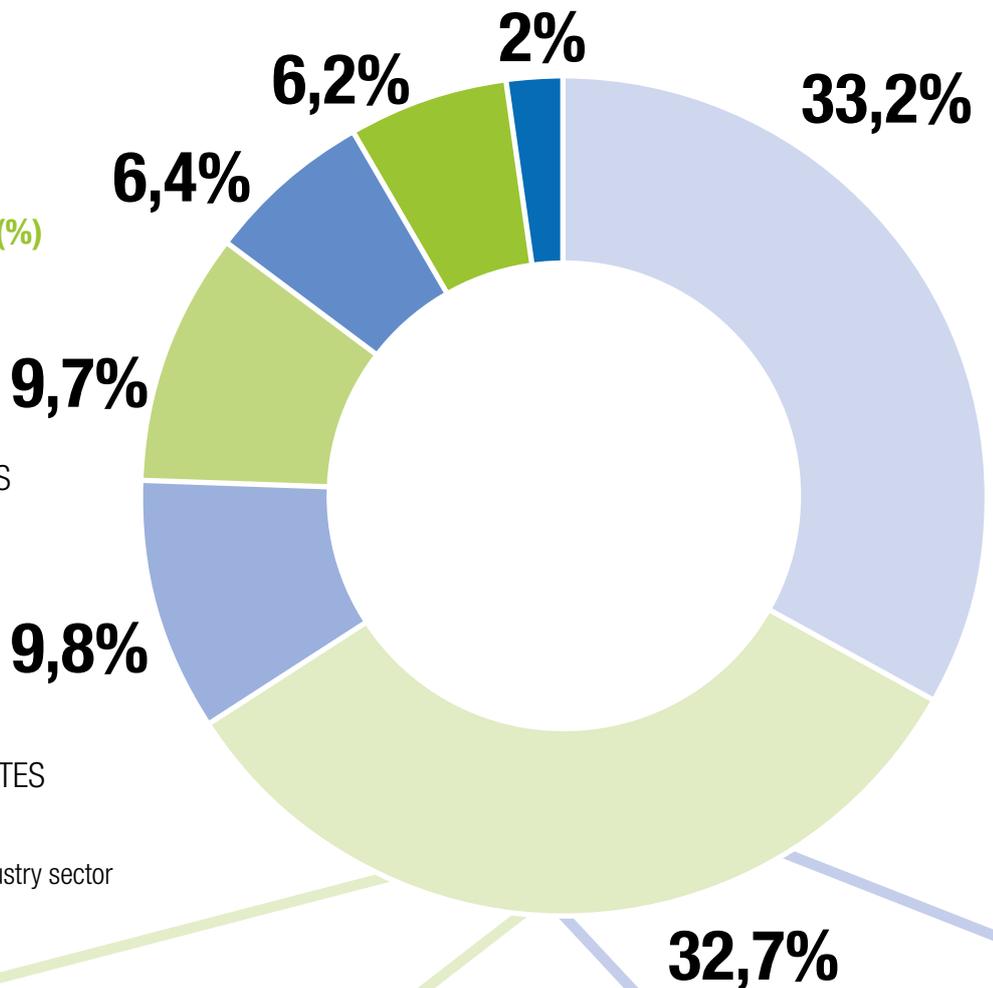
Natural gas, oil and oil by-products, solid fossil fuels and non-renewable waste, accounted for more than half (50.9%) of final energy consumption in industry during 2021. In absolute terms, more than one third of electricity and more than half of the heat produced in the EU during 2021 derived from fossil fuels.

In 2021, in the EU these industrial sectors accounted for the highest shares of final energy consumption: chemical and petrochemical industry, with more than

one fifth (2,159 petajoules or 21.5%), non-metallic mineral products (1,420 PJ or 14.1%), paper, cellulose and printing (1,361 PJ or 13.6%), food, beverage and tobacco (1,168 PJ or 11.6%) and iron & steelmaking (1,027 PJ or 10.2%). The smallest share of final energy consumption concerns the textile and leather industry, with 1.3% (129 PJ).

Final energy consumption in the industry sector by energy product, EU, 2021 (%)

- 33,2%** ELECTRICITY
- 32,7%** NATURAL GAS
- 9,8%** OIL AND PETROLEUM PRODUCTS
- 9,7%** RENEWABLES AND BIOFUELS
- 6,4%** SOLID FOSSIL FUELS
- 6,2%** HEAT
- 2%** NON-RENEWABLE WASTES



Types of energy consumed by the industry sector (Source: Eurostat 2021)

In the wake of the Russian invasion of Ukraine and soaring energy prices, the demand of natural gas in the European Union in 2022 fell by 55 billion cubic metres, or 13%, the steepest decline in history. Gas consumption, in the industry sector, fell by 25 billion cubic metres or approximately 25%. However, electricity was the only sector in which a growing gas demand increased over 2021 levels.

As regards Italy, according to Confindustria data, in 2012 the energy intensity of the Italian industry sector was 101 tons of oil equivalent per million Euro of added value with a decreasing trend, that was, however, partially interrupted in 2020 and 2021 due to the pandemic.

In 2022, the ratio decreased again to 79.9, or approximately 10% less than in 2021.

Overall, in Italy, gas consumption decreased by 6.7% in 2022 against the 2019-2021 average. The steepest decline concerns industrial enterprises alone, with a consumption decline by 13.2% (-14.9% against 2021). Even electricity consumption in the industry sector decreased by 5.6% in 2022 against 2021. ●

THE DROP IN ENERGY INTENSITY IN THE ITALIAN INDUSTRY SECTOR

(Tons of oil/million Euros summed with other related values in 2015 = 100*)

*Ratio between gas energy, oil and electricity consumptions in the industry on added value.



Ratio between gas energy, oil and electricity consumptions in the industry on added value
(Source: document by Centro Studi Confindustria based on ENEA, Eurostat and ISTAT data)

ACTION AREAS TO PROMOTE ENERGY SAVING IN A FACTORY

AUDIT AND ENERGY ASSESSMENT

The first step is to carry out a full energy audit of the production line, assessing the consumption models, identifying energy-intensive processes and designating improvement areas. In this way, one can set realistic objectives and establish priorities for action.

PROCESS OPTIMISATION

This step includes analysing each single process to simplify it, by removing inefficiencies and minimising energy waste. Some examples for improvement include optimizing equipment settings, reducing downtime, implementing an efficient planning and bettering material flow to minimise energy intensive movements.

MACHINERY UPDATING AND RETROFITTING

This step might require replacing obsolete machines with energy efficient ones, installing variable speed devices (VSD) to adapt equipment speed to production requirements or integrating energy recovery systems like regenerative braking systems.

IMPLEMENTING ENERGY MANAGEMENT SYSTEMS

MS provide for centralised monitoring, control and optimisation. They allow for a real time energy consumption monitoring, promote the decision-making process based on data and offer detailed information on energy-saving opportunities.

INVOLVING AND TRAINING EMPLOYEES

Involving and training employees in energy-saving practices is fundamental to succeed in any energy-saving method.

CONTINUOUS MONITORING AND IMPROVEMENT

Implementing an efficient energy-saving method requires the continuous monitoring of energy consumption and performance indicators.

Energy Efficiency at the Workplace: the Role of the Smart Packaging Hub

Sustainability guides the evolution of packaging in the Food & Beverage industry, including primary, secondary and tertiary packaging. Today, digitalisation, automation, the Internet of Things and all other Industry 4.0 enabling technologies cooperate to build a virtuous path towards the smart factory, to guarantee sustainable production, in particular on the energy efficiency front.

With this in mind, Smart Packaging Hub proposes itself as reference point to face the challenge of digitalisation and technological innovation.

SOME PROJECTS FULFILLED

Cama Group, Cleverttech Group and Tosa worked together to implement a high efficiency line for their Customer Kraft Heinz.

Initially, the Customer wanted to palletize the product near the production-packaging line. A forklift truck was supposed to be available for each of at least two shifts 355 days a year for a minimum of 20 years. The forklift was supposed to take seven pallets every hour from the palletizer to the finished pallet storage site. Cleverttech Group supplied a palletising system fully integrated with logistics and storage, offering savings of management, vehicles, staff and energy costs compared to the initial project.

The motorisation of the product transport from the packaging to the final palletising area saw the use of the latest generation of electric motors, namely the SEW Mov-

igear series, offering a 93.9% efficiency, even 88.7% more than IE5 motor series with separate inverter, allowing an energy saving of 55% compared to normal motors with separate inverter.

The SEW Movigear series with its inverter on the field also makes it possible to reduce the size of the gearcase by at least 30% compared to a configuration with remotely controlled inverter on the gearcase. The fact of having the inverter on the field greatly simplifies wiring during installation, with a shorter automation start-up time compared to prior solutions.

The line fully meets Cama's design standards as regards the use of low consumption components: the trend goes towards the demand of motors that, though small, feature a high-energy class.

Tosa contributed with the use of IE3 electric motors instead of motors driven by pneumatic cylinders, wherever possible, as the latter use approximately six times



Integrated line details (Source: Clevertch Group)



Detail of the preparation and filling line built by ZACMI (Source: ZACMI)

more energy and their efficiency decreases in time, which is not the case with an electric motor. Furthermore, they eliminated the motor used to shrink the lower part of the film in order to stabilize the pallet and replaced it with a mechanical component.

A strict control of the line performance and a full and intelligent integration of various machines are for ZACMI a crucial point to obtain a very high efficiency level and a low environmental impact, mainly in flexible production environments.

In 2019, ZACMI won the project to implement a preparation and filling line of soups and ready-made dishes from the second most important canned food factory in Europe, based in the United Kingdom.

The line was supposed to manage more than 160 different recipes, eight different filling machines and six additional control and ancillary machines. The agreement provided for 85% desired OEE (Overall Equipment Efficiency) level and ZACMI succeeded in reaching 91.3%.

The new line made it possible for the Customer to increase its profitability whilst dramatically reducing its environmental impact. In fact, considering a production speed of 500 c.p.m., for 300 working days a year in two shifts, an additional 6.1% OEE enabled the Customer to produce 9 million cans more with the same re-

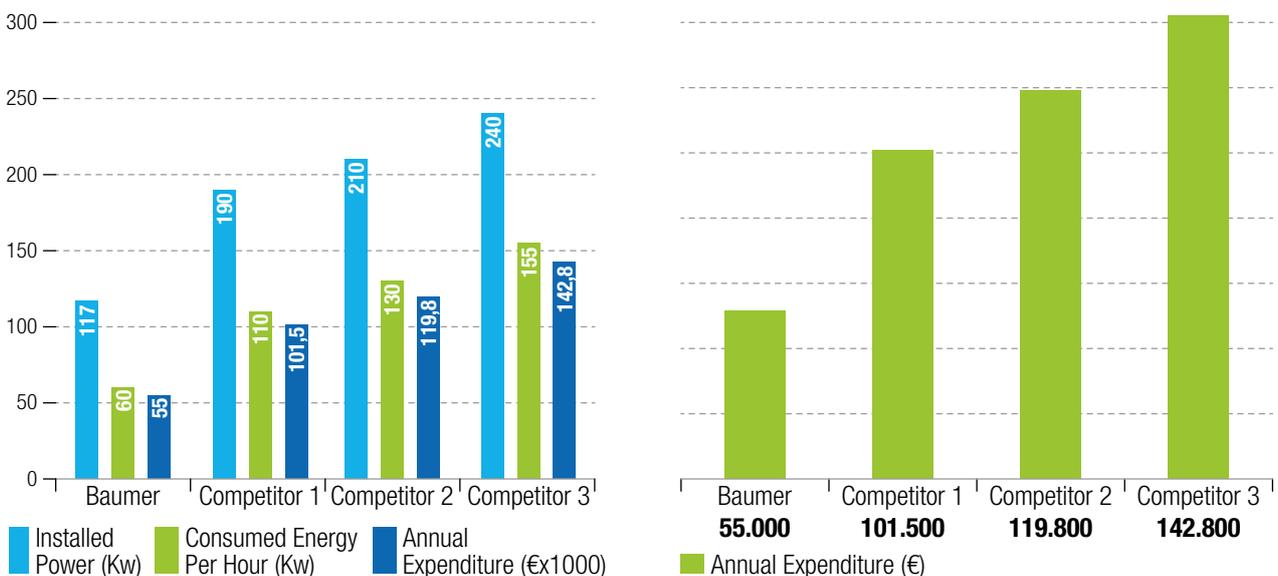
sources. The high efficiency level also drastically reduced the consumption of raw material, packaging material, steam, water and electricity.

In 2022, Baumer was commissioned by a Customer in the beverage industry to develop a high-speed shrink-wrapping line with a focus on energy efficiency, which was expected to save more than 20 per cent compared to standard solutions.

At the time, the aim was to redesign the thermo-shrinking tunnel, responsible for major consumption, to make it more efficient.

The Greentech Tunnel is the result of years of advanced engineering:

- The NiChrome 80/20 internal heating elements can reach the operating temperature in just 20 minutes, providing immediate power
- the implementation of a multilayer inside insulation allowed to reduce heat dispersion to the outside by more than 80%
- the installation of inlet, outlet and network airflow control ensured the total elimination of turbulence
- the addition of the tunnel temperature control from several sides allowed to obtain a homogeneous thermo-shrinking even with 30 to 80 micron extremely thin films, thus saving not only electricity but also plastic material.



Statistics of consumption and expenditure based on 0.25€/kWh per cycle, 16hrs/day, 220 days/year

Besides its Tunnel, Baumer also integrates two energy saving solutions on each line:

- High efficiency servomotors: allow a precise and quick control of movement (for example, during sealing and packaging operations), minimize energy dissipation, and maximise power output. Integration with the Software allows reduction in set-up time. Every Baumer motor is controlled by Nidec dedicated drives that control both acceleration and deceleration, airflow inside the tunnel and temperature control, in order to reduce energy consumption by approximately 20% compared to motors equipped with old generation drives.
- Integrated energy saving Software on every Baumer machine. The Software menu is dedicated to maximize energy saving by automatically putting the most energy-consuming components on standby (like tunnel and gluing unit) during production pauses.

FEATURES OF THE BAUMER GREENTECH TUNNEL



**NICHEL/CHROME
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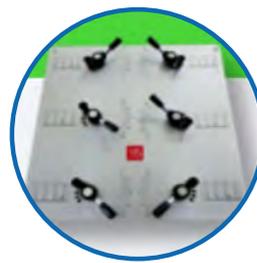
WORKING
TEMPERATURE
IN 20 MINUTES

IMMEDIATE POWER



**TUNNEL WITH
MULTILAYER
INSULATION**

REDUCTION
OF HEAT
DISPERSION



**AIR FLOW
CONTROL**

AIR CONTROL
FROM INLET,
OUTLET AND NETWORK

TOTAL ELIMINATION
OF TURBULENCE



**TEMPERATURE
CONTROL FROM
VARIOUS SIDES**

HOMOGENEOUS
THERMO-SHRINKING

30 TO 80 MICRON FILM

BEST PRACTICES FOR A SUSTAINABLE PRODUCTION

ZACMI emphasizes that continuous monitoring of the line's energy consumption and of efficiency calculation is crucial in order to detect waste and implement the necessary corrections. They also list three guidelines to obtain sustainable production lines:

- Use of IE3 electric motors even where not expressly required by the standards in force
- When lubricating machines, such as seamers, devote all energy to one circuit at a time, so that a small pump can be used
- Modulate the consumption of technical gas (nitrogen, carbon dioxide and water vapour) based upon the line speed.

Tosa also emphasizes the use of IE3 motors. The company also underlines that each machine is equipped with a carbon footprint detector that can estimate the consumption per pallet, shift or pre-defined time unit. On the other hand, these machines, though being high performance units, shall not necessarily work at full capacity all the time. Consequently, their engines are less stressed, consume less and last longer. In the opinion of Cama Group, plants should be close to the utilities, avoiding as much as possible the use of compressed air consuming components (Venturi vacuum generators), with a continuous monitoring of electricity and compressed air consumption. Overall, at present, Customers require that we guarantee the highest possible energy saving even as regards compressed air, while they prefer centralized pneumatic systems (factory-level vacuum networks).

Clevertch Group emphasizes that, referring to the Kraft Heinz case history, in terms of efficiency and sustainability, one should prefer an installation in which pneumatic cylinders are replaced with an electric motor. In this case, one can save approximately 9,500 Euro per year. Moreover, electric motors improve the air quality and, as already mentioned, need much less maintenance. Furthermore, a good practice is energy recovery of braking motors in every installation: the energy recovered is

stored in the gearcases for re-use in the following cycle.

Shrinkwrappers are the most consuming machines of the Baumer line. Here, size and efficiency of the tunnel are essential: to be able to reduce consumption one shall implement a range of Hardware and Software updates to limit heat dispersion and optimize standby/operation times. Another important topic is the use of lighter and thinner materials to obtain the best shrinkwrapping with less energy and heat consumption.

FUTURE DEVELOPMENT PROSPECTS

Energy recovery during the passive stages of a machine is a crucial topic in a short and medium term, also according to Tosa. Technology is already in place, it is only a matter of implementing it on a large scale bearing in mind a basic requirement, that is the availability of high acceleration masses and high speeds. For accumulation, a new component will be used, the superconductor, able to release energy on demand.

Also in the area of sustainability, however in relation to consumables, Tosa aims at replacing oil derivatives with paper and using simulators of the transport conditions to optimize consumables in all applications.

Among trends emphasized by ZACMI, let us consider:

- Using high-performance filling valves to install smaller machines with a lower consumption per product item.
- Direct motor utility coupling to reduce the need for transmissions.
- Use of dedicated servomotors instead of large centralised asynchronous motors.

Cama too has been re-using braking energy for years; in fact, its portfolio includes intermittent operating machines. They consider optimising the size of motors an important topic to enhance plant design and installation upstream of the machines. Finally, they underline that today and in the near future, Customers pay more and more attention to sustainability.

The focus at Clevertech Group's is secondary packaging and, on in this field, they register three major trends:

- The demand for smaller packs, connected with a generally smaller households.
- The demand to reduce the use of plastics in secondary packaging, that drastically changes the design.
- The great influence of e-commerce in the Food & Beverage sector. While in 2017-18 it was practically non-existent, it is now as high as 30% in some countries. Actually, e-commerce requires minimum packaging for time, money and disposal reasons.

Every year, Baumer invests a big portion of its budget in R&D, its aim being to continue supporting Customers in cutting costs. For sure, in the next few years, suitable materials and the use of 4.0 sensors, will help optimize energy consumption even more. Furthermore, the use of thinner and thinner plastic films will minimise costs whilst maintaining top quality. ●

Final Key Points

- **Energy efficiency is a crucial topic for the industry.**
- **It is about reducing costs and promoting environmental sustainability.**
- **Sustainable production is supported by digitalisation and the shift to electricity.**
- **The Smart Packaging Hub is a reference for sustainability in the Food & Beverage industry.**

Conclusion

Energy efficiency is an important item of the European programme to reach carbon emissions neutrality within 2050. Furthermore, improving energy efficiency helps reduce energy intensity of the economy that is the gross domestic energy consumption to GDP ratio.

The contribution of this industry to sustainability is fundamental and we have considered, in particular, the Smart Packaging Hub and its companies, with their implemented projects and future development prospects, as having an important role in its success. ●



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