Capgemini invent

HOW TO MAKE PHARMA MANUFACTURING MORE ENERGY EFFICIENT

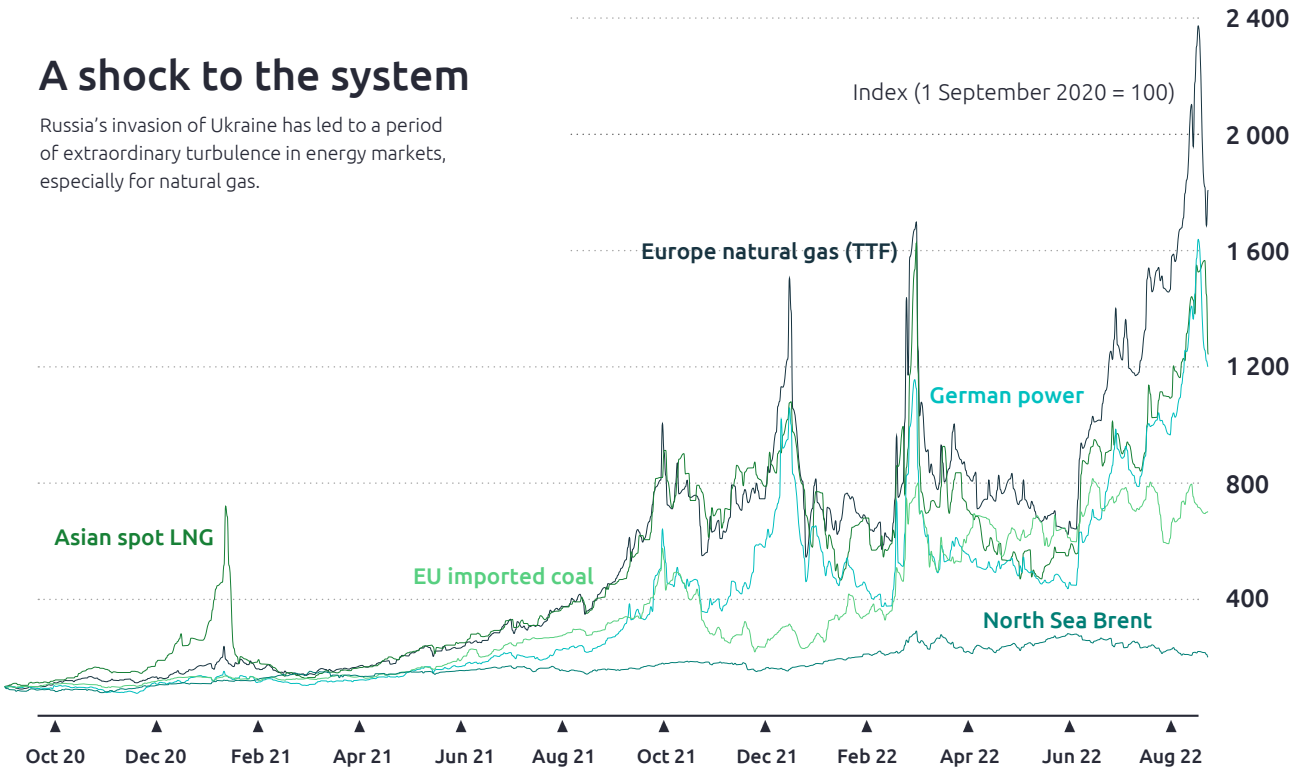
And why does it really matter

1 ENERGY IS BECOMING A KEY PILLAR OF BIG PHARMA'S INDUSTRIAL SUSTAINABILITY STRATEGY.

TO TAKE THIS TREND IN ITS STRIDE, THE INDUSTRY MUST EMBRACE THE DEVELOPMENT OF RENEWABLES AND ENERGY EFFICIENCY.

Europe is currently facing high volatility regarding energy supply and price, and this challenging context should be considered as the new normal in the coming years. In 2022 alone, average power generation costs increased by over 40% in the European Union.[1] Moreover, the International Energy Agency (IEA) states that we are now in "a period of extraordinary turbulence in energy markets, especially for natural gas" (see Figure 1).

Figure 1: Illustration of extreme energy markets volatility since September 2020 (source: IEA)[2]



Companies that are now reaching the term of their previous energy contracts are facing immediate difficulties in supply and massive price increases.

Estimating that 30%[3] of energy in buildings is inefficiently used or unnecessary, investigations and actions need to be quickly launched.

[1] World Energy Outlook 2022, IEA, Nov. 2022

[2] World Energy Outlook 2022, IEA, Nov. 2022

[3] Siemens

In France, an “energy sobriety” plan was coordinated by the Government in October 2022. It has since gathered a hundred large companies, including Capgemini and industrial players in all sectors, such as Sanofi in Pharma.[4] All industrial companies and big energy users now face this new challenge. In some energy-intensive sectors with low margins, such as metallurgy, pulp and paper, and fertilizers, stopping (or not re-starting) production is now even considered the best option. For example, Duralex stopped producing tempered glass tableware in France five months ago,[5] and Norsk Hydro has ceased producing aluminum in Slovakia due to high energy prices.[6]

The Pharma sector is not yet at that level of criticality; however, an increase of 15-20% of the energy bill would mean higher medicines prices for patients and health insurance systems (even if prices are regulated and do not increase overnight). In some cases, interrupted production is also a risk, with many European Pharma companies reviewing their business continuity plans (potentially with backup production sites in other geographies). Mitigation plans include additional **alternative energies** (wind, solar, et cetera), mobilization of backup equipment, such as fuel turbines to produce electricity during shortage, or even production de-prioritization of some products. Following alerts, the first specific recommendations are starting to be shared within the European Pharma industry. For example, France has issued recommendations through the LEEM association[7] and the French Health Agency.[8]

Therefore, Pharma companies must consider energy supply and efficiency as the fourth pillar of their industrial strategy, on top of EHS (Environment , Health and Safety), quality and production volumes monitoring. Securing energy supply and prices through a shift to Renewables is currently a major move (more local than oil and gas by nature). This is achieved through on-site energy production and massive corporate PPAs (Power Purchase Agreements). For example, in 2021, Merck MSD signed a PPA with TotalEnergies in Spain for 90 GWh per year,[9] Sanofi announced a 4 MW Solar PV project in its industrial site of Aramon in France by 2023,[10] and Zentiva now sources its European manufacturing sites from **100% renewable electrical energy**.[11]

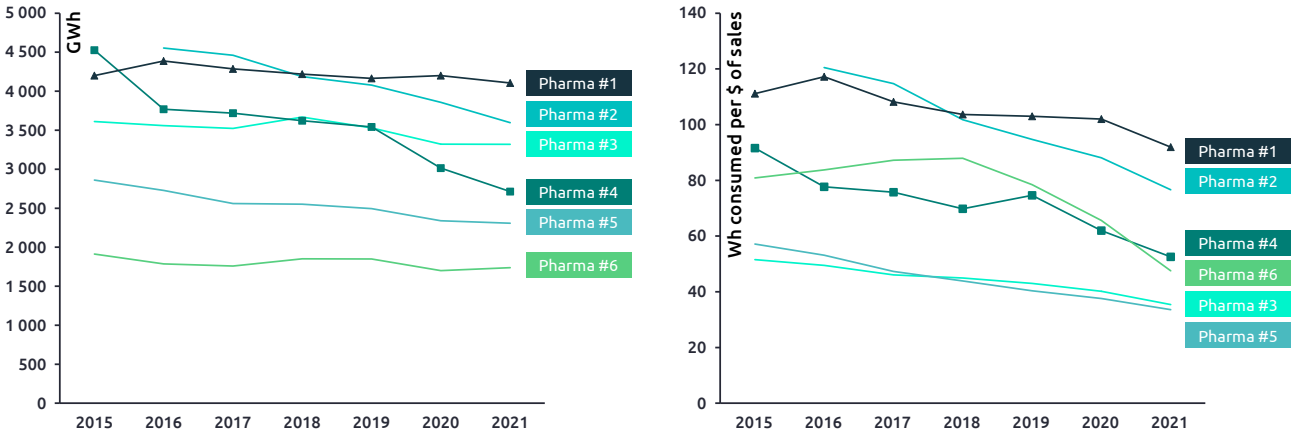
[4] Plan de sobriété énergétique, 6.10.2022
[5] Le Monde, 19.9.2022
[6] L’Usine Nouvelle, 26.8.2022
[7] LEEM, 7.11.2022
[8] ANSM, 26.10.2022
[9] PV-magazine, 20.5.2021
[10] EnergyNews, 21.4.2022
[11] Zentiva Sustainability report 2021

2 PHARMA INDUSTRIAL PROCESSES ARE RELATIVELY ENERGY-INTENSIVE, WITH HIGH USAGE OF SYSTEMS, SUCH AS HVAC.[12]

As a patient, when we take medicine, we can hardly imagine the large amount of energy it required during only its manufacturing process. The energy consumption of Big Pharma companies, such as Sanofi, GSK, or Johnson & Johnson, exceed 3 terawatt-hours per year (with a ratio of 0.7-1.0 kilowatt-hour per $10 of sales on average)[13] (see Figure 2). Comparisons of Big Pharma companies are still too complex to establish, due to various levels of manufacturing outsourcing and various product mixes.

Historically, Pharma companies continuously improved energy efficiency and usage of their manufacturing process over time, but at a relatively limited scale and with a limited overall impact. In the new energy global context, and to reach their Sustainability commitments in the mid-term, they must review their approach in a more radical and disruptive way.

Figure 2: Energy consumption and energy intensity of six major global Pharma companies



To be compliant with regulations and totally safe for patients, Pharma production needs continuous, tight control and monitoring of air quality, temperature, and humidity levels at each step of the process.

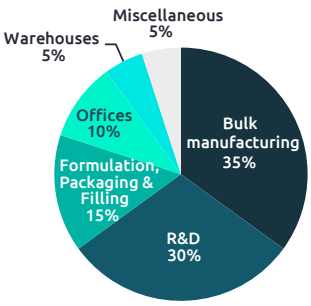
Therefore, heating, ventilation, and air conditioning (HVAC) is generally estimated at over 50% of total energy use.[14]

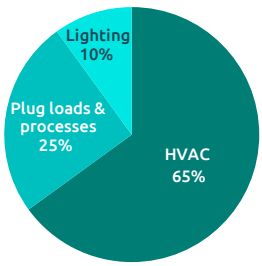
As a key part of the sterilization protocols, steam and water purification processes also require massive amount of energy (see Figure 3).

Figure 3: Energy consumption split of a US Pharma company by process and nature (by EPA Energy Star)

Energy consumption in the Pharma industry

(EPA estimate for a "typical" plant in the US)





HVAC
- *Ventilation for clean rooms and fume hoods*
- *Areas requiring 100% make-up air*
- *Chilled water*
- *Hot water and steam*
- *Particle control ventilation*
- *…*

Plug loads & processes
- *Centrifuges*
- *Sterilization processes*
- *Incubators*
- *Dryers*
- *Separation processes*
- *Mixers*
- *Motors*
- *Microscopes*
- *Analysis equipment*
- *…*

[12] HVAC: Heating, Ventilation and Air Conditioning

[13] Company websites and CSR reports

[14] Energy efficiency improvement & cost saving opportunities for the pharma industry, US EPA, March 2008

3 ENERGY EFFICIENCY IS THE PERFECT INTRODUCTION TO SUSTAINABILITY MATTERS AT SCALE IN THE PHARMA INDUSTRIAL CONTEXT.

IT REQUIRES THE EFFORT AND EMPOWERMENT OF THE WHOLE COMPANY.

Industrial energy efficiency assessment and improvement in the Pharma sector requires the **involvement and empowerment of the whole company**, from top management to site managers to employees.

At the top management level, energy efficiency necessitates decisions about the overall industrial strategy. It is also vital to apply appropriate targets and objectives in terms of greenhouse gas emissions, energy consumption, and energy mix. This is achieved by establishing adapted organization, implementing energy-efficient solutions, optimizing process design and operations, and using renewable energy sources including the recycling of wasted water and condensate.

A newly opened factory with brand-new industrial equipment will very often be more efficient. Making manufacturing sites more compact is also a major lever, such as reducing the surface area and the volumes of industrial facilities (e.g., lower ceiling heights) for the same production volumes. This is true for all sectors, and **Pharma companies are no exception**. For example, "Pfizer invests $25-40 million each year to reduce energy demand through asset replacement, efficiency improvements, and installation of renewable technologies."[15] But replacing old equipment is a significant investment that requires time and a high level of change management.

Indeed, in the Pharma sector, the HQSE (Health, Quality, Safety, and Environment) departments historically play a major role at a business unit and site levels for industrial operations. Most of the modification should be reviewed and approved by them as well as the regulatory affairs through a change control process. Until now, their focus has been mostly Patient, Product, Process quality, and manufacturing employees' safety. So far, the Energy and Utilities space was mostly considered an enabler, or entrant among others. Today, at least the HQSE departments must integrate close real-time monitoring and optimization into their objectives and day-to-day operations.

For that, they can build on their long-lasting certification efforts for ISO 14001 (environment) and ISO 50001 (energy management) started a decade ago.

For example, Sanofi has 30 sites certified ISO 50001 (as of end 2021), including the French Aramon and Le Trait sites.

The HQSE departments and regulatory affairs must be involved at the very start of the energy efficiency initiatives to provide initial guidance on how to prioritize them, with the lens of regulatory compliance and risk management. **The HQSE departments and regulatory affairs are not in a go/no-go position at the end of the process, but they are a plain stakeholder** with an incentive to make these initiatives a success also in terms of overall CO2 emissions reduction.

On their side, Procurement departments must now include precise elements about energy characteristics in their request for information for information and proposals in a more systematic way, on top of the well-covered technical, functional, and capacity criteria. The Return on Investment (ROI) and the Total Cost of Ownership (TCO) analysis is to be reassessed to consider in a more accurate way the savings implied by a more energy-efficient equipment (but generally at a higher initial cost). **Setting an internal carbon price can be instrumental in this regard**.

[15] **Pfizer ESG Report 2021**

The case-by-case trade-off between maintenance and replacement is also at stake. What is the best option? Keeping and maintaining old equipment (less energy-efficient by nature) or replacing it with an upgrade (more energy-efficient but also generating CO2 emissions for its production)?

The make-or-buy trade-off is also to be reconsidered and requires the full transparency of the potential providers on their own energy efficiency: sometimes, a provider with a strong expertise in iits domain or with the right scale can be more effective.

Sustainability is more and more integrated in the procurement decision process, and energy efficiency must be part of that equation. Also, for new investment or when replacing equipment, it is important to consider **alternative technologies** available on the market that comply with regulatory and normative requirements. Savings can be significant. For example, for water-for-injection production, low energy consumption technology combining reverse osmosis and ultrafiltration instead of using distillation technology should be considered, especially when the temperature of use is low. For such a project, a global balance is needed, considering energy and water consumption.

Within the production department, having energy efficient equipment in good operating conditions is no longer enough. Moreover, sometimes the overall process might need to be streamlined or radically changed. To identify optimization areas, we should think of energy, cold and hot water as fluids that have their own patterns and flows. It is all about avoiding losses, maximizing closed loops, and seizing opportunities to make **heat recovery** and organize production planning. This should be done in a way that optimizes the perfect sequence from one sub-process to the next along all the work shifts considering energy price and consumption aspects. For example, in 2020, GSK France installed a new heat exchanger at its Mayenne site,[16] which transfers heat previously lost in chilling water and uses it **to provide 70% of hot water demand for the site**. Additionally, Ipsen is investing in "innovative heat-recovery technology."[17] Sanofi France has led two remarkable initiatives on two Active Pharmaceutical Ingredients (API) production sites that led to **energy savings of over 10%**. The Sisteron facility now incorporates high-capacity CO2 refrigerant fluid, **requiring 15% less energy than the standard refrigerant gases**. The Aramon site has led a project of heat recovery from its incinerator and the installation of a new dryer for its wastewater sewage sludge.

Maintenance activities are also very important and should involve the workers in direct contact with this equipment as much as possible, with a clearly established reporting and escalation process in place.

Finally, to make lasting progress over time, energy efficiency must be included in the operational routines of shopfloor workers on a day-to-day basis. This must be implemented under the directives of an overall energy governance in place at a site level, including HQSE and the Procurement departments. It can take multiple forms, such as "Energy Efficiency Stand Up meetings" or dedicated problem-solving groups.

Continuous training plans echoing an intensive awareness of communication with shared key indicators, as well as detailed and clear updated job descriptions, instructions, and ways of working, are the baseline of the effectiveness on this **energy governance**.

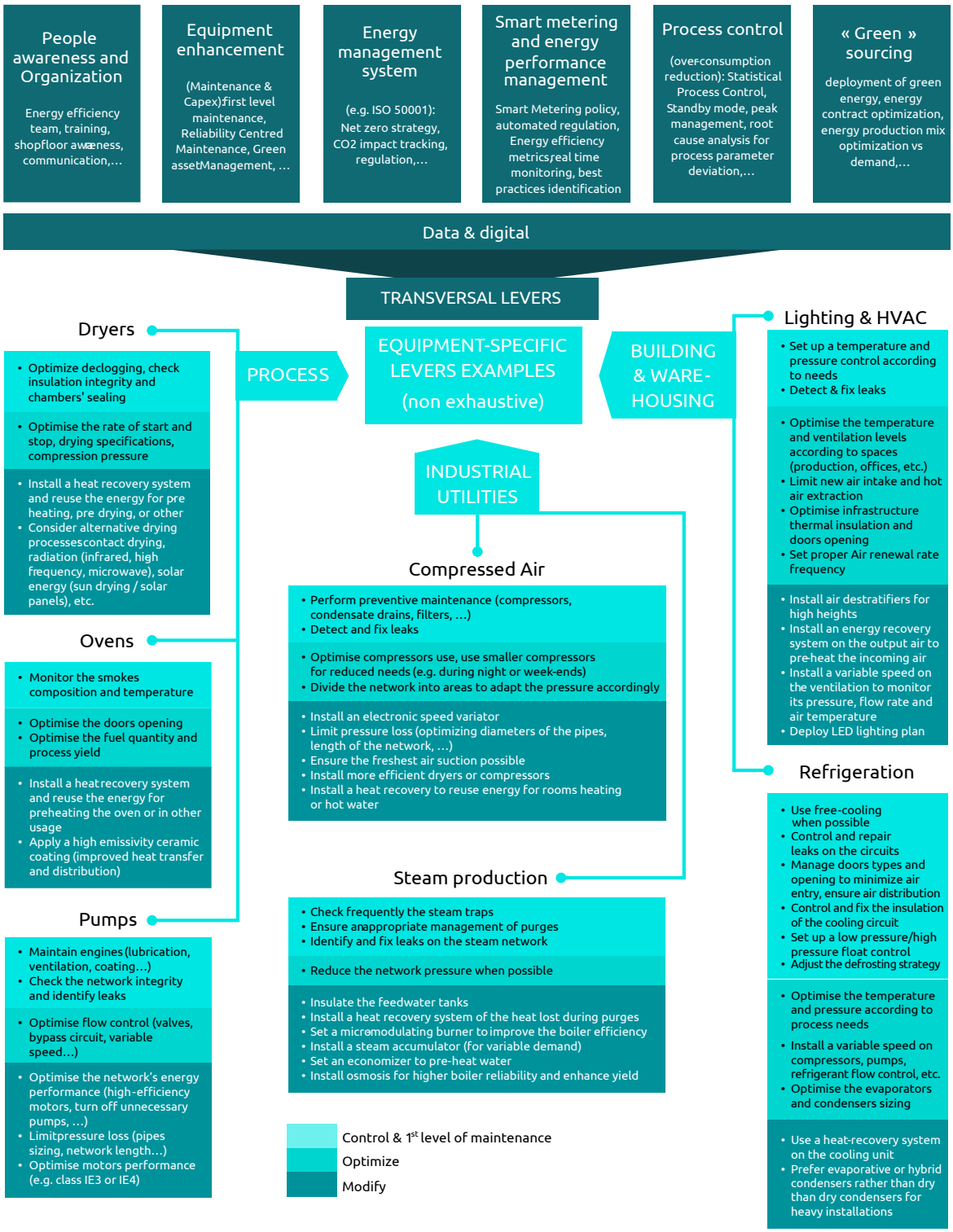
[16] **GSK annual report 2020**

[17] **Ipsen, 27.10.2021**

4 AT CAPGEMINI, WE BELIEVE ENERGY EFFICIENCY MUST BE ADDRESSED IN A HOLISTIC MANNER.

Our energy efficiency framework is composed of **seven key levers** (see Figure 4). We believe they must be activated in a holistic way to reach optimal results.

Figure 4: Capgemini's energy efficiency framework[18]



[18] **The No-Excuse framework to accelerate the path to Net-Zero manufacturing and value chains, World Economic Forum, Jan. 2023**

As a base for this framework, data and digital are key levers that play a transversal role in effective energy performance management, providing the necessary information and tools to improve energy efficiency and reduce costs. Some examples of how data and digital can be used in energy performance management include:

1 DATA COLLECTION AND MONITORING:

Digital sensors and devices can be used to collect data on energy consumption and production, which can then be analyzed to identify areas for improvement.

2 ENERGY MODELING AND SIMULATION:

Digital tools based on data science can be used to model and simulate energy systems, which can help to identify the most energy-efficient design and operating strategies.

3 ENERGY MANAGEMENT SYSTEMS:

Software platforms can be used to monitor and control energy use in real time, which can help to optimize energy consumption and identify inefficiencies. Capgemini has established its own Energy Command Centers, as presented **here**, to track and manage the performance of our energy assets and support our sustainability activities throughout our campuses in India.

4 PREDICTIVE MAINTENANCE:

Data analytics and machine learning algorithms can be used to predict equipment failures and schedule maintenance to minimize downtime and energy waste.

5 ENERGY AUDITING:

By using the data collected, energy auditing software can be used to identify and prioritize energy savings opportunities and track the progress of energy efficiency improvements over time.

By using data and digital technologies, energy performance management can be more accurate, efficient, and cost-effective. Moreover, a **control tower** enables companies to have a consolidated view of their energy consumption and allow site managers to deep dive at a site, equipment, and operator level.

5 MASSIVE REDUCTIONS CAN BE REACHED IN A TIMELY MANNER IN THE PHARMACEUTICAL SECTOR.

In the Pharma sector, analyzing levers for energy efficiency can reveal dozens of initiatives as part of an acceleration plan that contributes to reducing energy consumption (electricity, gas, and hot water) by over 20% of the total consumption. Table 1 below shows examples of initiatives with related benefits.

~65% of the identified initiatives require capital expenses while 35% of them are "low hanging fruits" or "Quick Wins" without significant capital expenditure with a deployment plan within one year.

REDUCE	REUSE	MAINTAIN OR REPLACE
OPTIMIZE ~20% in HVAC-related energy bill, thanks to optimized regulation and the resetting of the air supply required for each cleanroom	**MODIFY** Heat recovery: ~40% gas economy with the reuse of hot air of dryers, chillers, compressed air equipment	**MODIFY** Compressed air with a higher efficiency compressor can result in cost savings of up to 50% compared to old systems
OPTMIZE Quick win: harmonized room temperature and humidity setpoints with adapted range can reduce energy consumption by up to 10%	**MODIFY** Heat recovery: Up to 10% water & heating economy with reuse of final rinse water at pre-rinse step for cleaning (CIP)	**CONTROL** Quick win: savings of up to 10% on equipment energy consumption through steam traps monitoring (control and secure their efficiency)

This **energy efficiency** acceleration plan is based on:

- defining smart quantified objectives for each of the identified levers,
- linking these objectives to types of action to be implemented, as "Control and first-level maintenance," "Optimize," and "Modify,"
- and ranking these actions by technical feasibility, quick wins, and CAPEX related impact.

Quantified objectives start to be defined by the top management and are refined through a maturity assessment by site for each main function of the company. **Maturity assessment** is also a key step to achieve to clearly point out the level of energy efficiency management in the site governance and daily operations. This work enables to formalization and alignment of all stakeholders on their real status and the roadmap to undertake.

Energy efficiency analysis starts by identifying areas of **overconsumption** that need to be explored through a deep analysis of the consumption data during an extended period (3–5 years), by type of energy, building, production lines, products, and equipment. The exhaustivity and accuracy of the results depend on the metering policy and digitalization (including automated data collection) in place down to the equipment level.

Data provides real state consumption figures that then are explained and understood through technical review and challenge of existing practices and process parameters, all related to energy use considering the genuine business and quality requirements. The intent is to show and confirm the relevant actions to undertake. These actions related to each lever previously presented are ranked by type. This is done by evaluating their technical feasibility, quality, regulatory impacts, and savings potential in comparison to the required CAPEX with all technical stakeholders, including local suppliers.

A global implementation plan showing quick initiatives to be launched with significant savings (easily be between 5-10% over 1 year) will be the baseline for intensifying future investments with mid- to long-term initiatives to increase and sustain the savings.

With the involvement of top management as a key facilitator, the deployment plan of all the confirmed actions starts first with the **essential work of raising awareness and the implementation of energy management system** for the energy efficiency monitoring indicators (including energy efficiency benefit tracking). These indicators must be at the same level as other important productivity and quality key indicators. Therefore, this will initiate, by design, a related continuous improvement plan.

Finally, making pharma manufacturing more energy efficient is a fantastic opportunity that can:

- help in reducing the carbon footprint of the industry and contribute to meeting global emission reduction targets,
- increase the operational excellence level by better knowing, controlling, and improving the established operating model and industrial processes that will also help to mitigate the risk related to energy scarcity,
- and furthermore, fundamentally ensure the security of business continuity and medicine availability around the world.

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