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Energy Performance Management in an Industrial Site: Definition and Application of a Specific Methodology for Carbon Emissions Reduction

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Abstract

Global warming continues to accelerate. It is essential that we all (individuals, government, organizations, etc.) make sustainable action for reducing carbon emissions for the future of the planet and for the next generation. The global decarbonization is now on the top list for every government, public institution, and private company. This article contains a strategy to manage energy performance in an industrial site based on the research in an industrial pharmaceutical company in France. Most of the principles also apply to non-industrial sites (e.g., administrative buildings). Several linked thematic are developed such as organization, culture, communication, partnership, audits, project management, cost control, metering, targeting, and monitoring. The concept of sobriety is also studied in this article. The implementation and the adaptation of an energy performance management through the years has led to divide by 2 the carbon emissions (and costs) of the site in this study.

Keywords

Energy Performance Management, Sobriety, Culture

1. Introduction

Greenhouse gas emissions, which are produced by fossil fuels, industry, transport, and other sectors, continuously increase and cause climate change (Kalaitzidakis et al., 2018; Grubb, 2000). This has led to a climate crisis. The crisis now threatens the world's peoples, nature, and ecosystems.

Faced with this challenge, the states of the world are mobilizing together to

combine their efforts for a common objective which is to try to stem climate change.

Industry and building represent 18% of world emission carbon (International Energy Agency, 2022). It is the third sector after electricity production and transport. A lot of industrial companies are engaged in carbon emission reduction but don't have a clear and robust energy performance management.

Performance management is a system to develop people's capability, to reveal and solve the appropriate problems and to improve business performance.

A substantial benefit can be gained by implementing a good energy performance management. However, it is important to recognize that the use of performance management elements, especially metering, monitoring and adequate resources, is always difficult. It is critical that implementation is phased appropriately so that the benefit of each step can be obtained.

This article is about a successful energy performance management. It is based on five years experimentation in the pharmaceutical industry. A review of past results over a representative period on the reduction of the carbon footprint and energy costs was first carried out. The energy saving actions already carried out were also reviewed (with a permanent critical eye) as well as the steps defined and followed to achieve the targeted objectives. The second main step is to look for all themes linked to energy performance and to make the link between them to establish a powerful energy performance management. At the end, the efficiency of the strategy has been verified through key performance indicators.

2. Past Performance Review Methodology

The first step is to analyze the past results performance on carbon emissions reduction. All relevant energy Key Performance Indicators (KPI) are gathered. Then, those relevant KPI are deeply analyzed. In this article, the period taken into consideration is the period corresponding to the beginning of the monitoring and the implementation of energy key performance indicators.

The next step is to compare the past energy reduction actions realized and their impacts on those KPI. In addition to KPI already in place, some efficient correlations are defined for the analysis of past results such as CO_2 tons emissions per unit of production (specific consumption). This deep and clear analysis permits to look back deeply on past performance and is helpful to define the strategy.

3. Set a Strategy

The strategy is the following key element in this journey to zero carbon emissions. It is set by a multidisciplinary team. For defining a non-complex and strong strategy, several studies and debates are conducted by the team. The strategy has also been adapted during the journey following results. It is also very important that the strategy is driven by the site leadership team (direction). Each member of the direction engages member of their service in this strategy.

The strategy includes a series of interlinking themes:

- Human resources and organization;

- Communication;
- Cost;
- CAPEX (Capital expenditure);
- Change Control;
- Engineering aspects;
- Energy sobriety;
- Continuous improvement tools.

3.1. Human Resources and Organization

Human resources and organization are dimensioned to site's size. There are also aligned with site's ambitions in carbon emissions reduction. The resources are dedicated to energy performance, and it is clearly describing in their job description. It is crucial to maintain these resources during all the journey and to adapt them based on change in the strategy or/and site organization.

The energy performance management structure first adopts sponsorship from a member of the site's direction. For a successful carbon footprint reduction, the sponsor is fully involved. A site energy manager has been also appointed. In this case study, based on the size of the site, it is a combined function (with maintenance of utilities). On larger site, it is ideal to have a dedicated role.

Ownership of site energy across the main users is essential to drive down consumption and improve usage efficiency. Operations managers are accountable for energy performance in their areas. Moreover, they assist with implementation of saving opportunities and coordinate savings initiatives in their area.

An energy representative has been appointed for each service. His missions are to influence and train peers in good energy awareness and practices. He also organizes and monitors Gemba and standards check. A regular interaction between services is the key also for a successful journey. For example, this has been done across brainstorming, visits, missions etc. To promote and facilitate interactions, a Sustainability Enterprise Resources Group (SERG) is created. This group includes people coming from different departement/services. They meet regularly, define, and implement actions. The group also make a focus on communication for inlvoving and motivating each user.

Several committees and governance are in place. An Environmental, Health and Safety (EHS) committee is held every month. The goal during this committee is to review performance and overall plans/progress, establish priority in site context and ensure sufficient resources and funds are available to deliver the improvement program.

A one-hour weekly energy meeting between the member of energy steering team (energy manager, energy pilot and energy apprentice), whose purpose is to own targets and budgets, review performance against these, call for support when required, seek savings, and update the energy pipelines, monitor, and check progress through audits and ensuring Gemba and standard implementation are effective. A daily energy user meeting (per area) is in place for reviewing metering data for the past week and compare to expected, highlight unexpected high usage,

check utility generation efficiency, identify remedial action and review Just Do It (JDI) action plan. A weekly CAPEX meeting is in place between the energy manager and the capital & projects manager with review of energy projects.

3.2. Communication

Communication is regular, adapted, and precise. The aim is to fully engage energy users. Thanks to a powerful communication, awareness is heightened, and cross site commitment is improved (Kalogiannidis, 2020). The communication is done through traditional ways of communication and new ways of communication such as professional social network. **Figure 1** represents an example of internal communication done in Workplace® (Facebook® for enterprise) for the implementation of solar panels.

Communication is also done through workshop, specific sustainability week, community of practices etc. To resume, communication helps to drive further improvement in performance.

Site steer team and if possible, board members or members of energy group participate to several energy events during all year long. Moreover, site members must do several benchmarks during the whole year. The sharing must be in two ways for being efficient.

The use of new digital communication tools such as Workplace®, or LinkedIn® is encouraged. Nowadays, those tools of communication are very efficient.

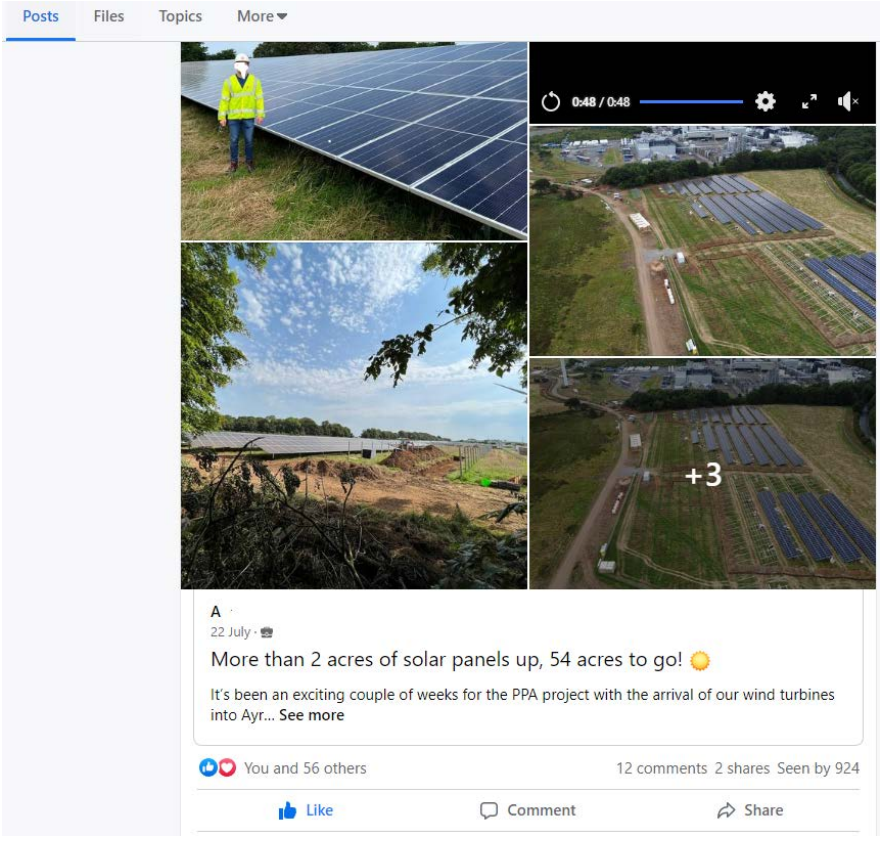


Figure 1. Workplace post on solar panels.

Partnership with company specialized in energy is also developed and maintained. Some of them have put in place sharing place like university, training etc. The site in this article participates regularly to the energy community of practices that the headquarter has put in place.

3.3. Costs

Energy costs are increasing every year. Therefore, a lot of industrial have added energy cost reduction in their objectives. The zero-emission carbon target is linked to energy cost reduction. In fact, cost savings are reinvested for doing expensive project buts with high CO_2 savings such as energy renewable project. Finance, procurement, and engineering services work closely together and deploy specific strategy for cost reduction. There is also a continuous and tough monitoring. It is very essential to consider cost reduction as one of the drivers. The most difficult is to find the right balance between energy emission reduction and energy cost reduction. This last diver should be taken as an ally in the long journey to zero-emission carbon

3.4. Capital Expenditure

Every year a capital expenditure (CAPEX) envelop is dedicated to carbon emission reduction. This amount is enough for doing major energy savings action. This envelop is also a minimum and if an opportunity is identified during the year the envelop can be increased. The energy steer team works closely with site CAPEX manager.

3.5. Change Control

In pharmaceutical industry, all changes with environmental impact must be done under a change control process (Stasis et al., 2013; Revenio, 2016). Therefore, all energy changes must be done through this process. The change control process contains a committee evaluation from experts and leaders coming from different services. Thanks to this process, energy impact will be taken into consideration. It is a very good practice.

3.6. Engineering Aspects

Engineering choices is a lever for reaching zero carbon emissions. For example, at the design stage an efficient design approach is utilized. Moreover, all energy-consuming equipment are identified and modified as much as possible. Renewable energy solutions are also studied and updated regularly to see if they can be put in place if it was not the case after the 1st study (new technology, cost reduction etc.).

A full assessment for all major energy projects is also done (i.e., equipment/process with high energy consumption). The project team uses for that assessment all relevant energy scientific studies, local regulation, and guidelines.

3.7. Energy Sobriety

Energy sobriety is embedded in behaviors (Lopes et al., 2012; Sweeney et al., 2013). The energy sobriety can be defined as the following "The easiest energy to make clean is the energy we don't consume". Each user adapts his daily behavior, knows his consumption, and propose reduction ideas, integrates energy optimization into installation management etc.

3.8. Continuous Improvement Tools

They are widely and wisely used (Kovach et al., 2011). The tools used in this case research are the following:

- Root causes analysis/Problem solving/Quick response action plan: Identify the root cause of a problem and establish a mitigation plan (corrective action and preventive action) for solving the problem. The different resolution problem methods contain several steps: 5 Why, Ishikawa diagrams etc.
- Continuous improvement framework: It consists of defining and implementing an improvement cycle. It can be a short, mid-term or long-term cycle. It contains the following step as a minimum: Objective; Current state; Next Target Condition and Problem to solve.
- GEMBA "the real place" (Suárez-Barraza et al., 2012): It is used to check energy efficient practices and procedures are in place (i.e., checking equipment is only enabled when required and that equipment is running within normal parameters; no leaks; no passing valves etc.).
- Performance management: Manage performance through a specific methodology: Lag; Lead; Analysis and Top 3 actions. **Figure 2** shows how it has been applied (energy performance dashboard).
- Leader Standard Work: It is a scripted agenda with key subjects. The goal is to measure and follow the adherence of the agenda. Each member of the energy steer team has a Leader Standard Work. This tool helps to make sure to spend enough time on key subjects for reaching the target.

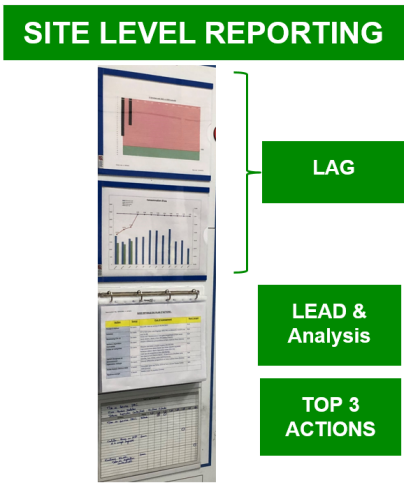


Figure 2. Energy performance dashboard with Lag, Lead, Analysis and Top 3 actions.

- Standard Work: Standard routines have been developed for switching off equipment and services when not required (line not running, breaks, shutdown periods etc.) and for modifying equipment and process parameters. This help to ensure that each area performance is maintained. Energy users play a leading role in delivering this initiative. That's why the use of the standard is mandatory.

Figure 3 represents an example of standard work. It is more precisely a Shutdown Weekly and Evening Equipment Plan (SWEEP) standard. It is used to standardize the shutdown procedure for all areas of the site including manufacturing areas, laboratories, and office areas. It is also developed for extended shutdowns and changeovers. Start-up procedures for each case are also developed. SWEEP standard is equivalent to 5S standards in production areas.

4. Develop a Strong Energy Culture: Hummingbird Legend (Colibris & Le Mouvement, 2022)

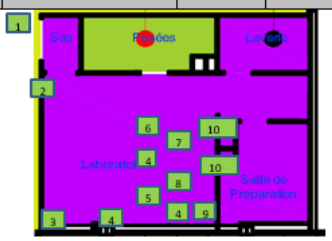
One day, as the legend goes, there was a huge forest fire. Frightened and overwhelmed, the animals were helplessly watching the disaster. Only the little hummingbird was struggling, fetching a few drops with its beak to throw them on the fire.

After a while, the armadillo, annoyed by this derisory agitation, said: "Hummingbird! Are you crazy? Those drops of water will not suffice to put out the fire!".

Switch it Off and Save Energy

Reducing our carbon footprint

Site Weekend and Evening Shutdown Plan (SWEEP)	Useful Contacts				Runs 24/5	Saving Potential
	Area Owner	Energy Champion	Energy Manager			- Lights - %
Area Name:						- Equipment - %
						- Comp air - %



No	Check Items	How	Where	Who	When Stop (Day/time)	When Start (Day/time)
1	Switch off Lights	By Switching Black Switch	Entrance to laboratory	Last Person Out	When Leaving	When Entering
2	Power off Printer	By Switching Black Switch	Right side of printer	Last User	After Printing	Before printing required
3	Power off Dryer Oven	By Switching Green Switch	Front Left of Unit	Last User	After test	Before test
4	Power off Computer	By Shutting Down Windows and switching off monitor	At Computer	User	After test	Before test
5	Power off HPLC	By Pressing 6 x Grey Buttons	Front of unit	User	After test	Before test
6	Power off HPLC	By Pressing 5 x Grey Buttons	Front of unit	User	After test	Before test
7	Power off Sampler Unit	By Switching Black Switch	Back left of unit	User	After test	Before test
8	Power off Printer	By Pressing on/off buttom	Front of unit	User	After Printing	Before printing required
9	Power off Spectrometer	By Switching Black Switch	Left side of unit	User	After test	Before test
10	Power off Fume Cupboard	By closing sash & switching off fan (if no product) + Pressing off button	ON digital panel side of cupbaord	User	After test	Before test
Actions completed by						
Time						
Date						
Signature						

Figure 3. Exemple of energy standard (SWEEP).

And the hummingbird replied,

"I know that, but I'm doing my part".

This legend means that everyone has a role for reaching a target and is also accountable. The most important is to act and contribute depending on his capacities. It is together that we succeed. Everyone is an actor of the energy performance starting from the operator on production line to the site director.

5. Carry out Kaizen & Audits

One other key element is the creation, filling and updating of an energy savings ideas pipeline. This pipeline is regularly updated and filled with new ideas. For example, output of an energy kaizen or audit are used for filling this pipeline (Cwikla et al., 2018; Dongellini et al., 2014). Kaizens permit to make a deep review and analysis of current consumption, identify, and quantify new opportunities for reducing site's carbon footprint (renewable energy etc.).

Figure 4 comes from an audit done by a specialized company on energy audit, and it represents the actual electricity consumption (green curve) and electrical reference consumption by considering different factors such as production volume and climate (red curve). It permits to identify when electrical consumption has improved and on the other hand when it degrades.

Ideas are also identified across benchmark and energy events. Site continuously looks for new technology and innovation. The energy savings ideas pipeline is essential for establishing yearly energy action plan. In fact, thanks to that we can quickly identify the action to do. Each idea is analysed through some key elements such as: realisation time, cost, CO_2 savings, payback, and complexity level.

In this pipeline, ideas are divided in 4 sections:

1) Ideas to implement ideas studied deeply and considered applicable by the Energy Team;

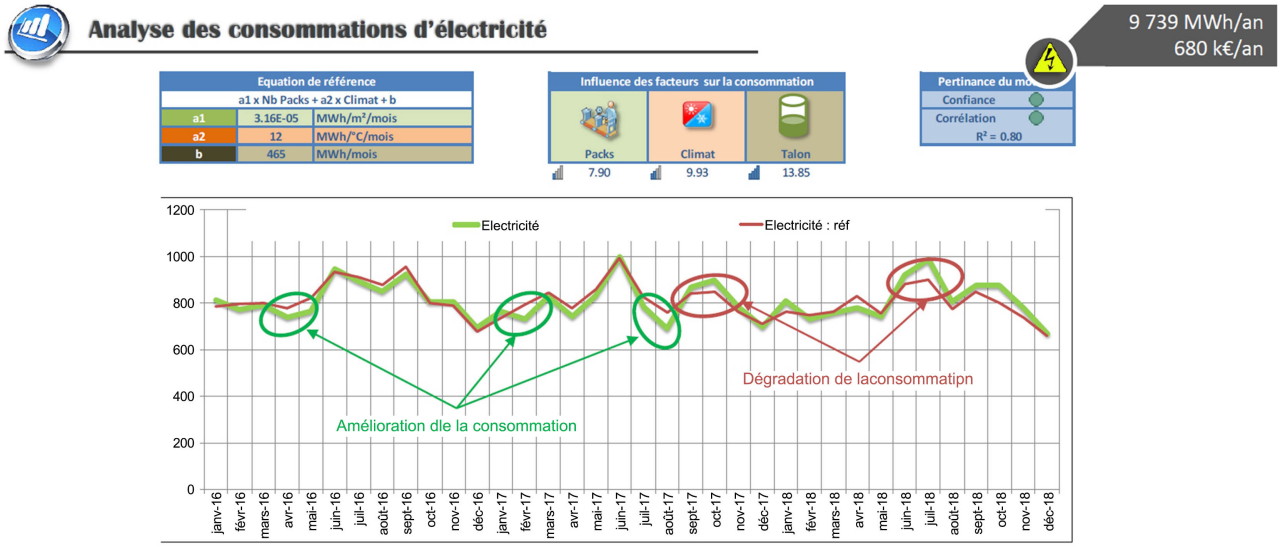


Figure 4. Analysis of electricity consumption during an energy audit (Unit of Y-axis = MWh ; Unit of X-axis = Months).

2) Ideas rejected: ideas not applicable at that time for specific reasons (i.e., cost expensive);

3) Ideas to develop not ready to be implemented because feasibility need more investigation;

4) Ideas implemented.

6. Some Major Projects Done Per Family/Technology

This section explains briefly some major actions defined and implemented for reducing sites carbon footprint. Sites have different Energy: Electricity; Gas etc. and secondary utilities Hot Water; Compressed air etc. The utilities represent nearly 75% of the site energy consumption. Therefore, the main actions are focused on utilities.

List of some projects done in last 3 years:

- Heat pump (heat recovery);
- Variable speed drive;
- High motor efficiency;
- HVAC (high efficiency filters etc.);
- Building isolation;
- Thermal survey and repairs;
- Compressed air leaks.

Figure 5 represents an aerial view of the production building with some details of the main projects done.

The site currently is exploring renewable energy solution: Solar panels; Wind turbines; Geothermal etc.

7. Key Performance Indicators and Monitoring

7.1. How to Build and Manage Key Performance Indicators

The important principles adopted for the Key Performance Indicators (KPI) are as follows (Andersson & Thollander, 2019):

- Easy to update and use;
- Heighten awareness;
- Trends easily visible;
- Deviations and anomalies reported;
- Show progress on projects contributing to the energy reduction target.

The relevant KPI for each tier of management are determined. The following 3 tiers are in place: Site's direction, utilities team, and production operations team. It is important to start with something simple which will work and can be implemented easily, rather than design a complex tiered system for which the required metering is not in place. 5 WH (Who, When, Where, What and Why) technique is used:

- Who? e.g. Direction board;
- When? e.g. Monthly;
- Where? e.g. Conference room;

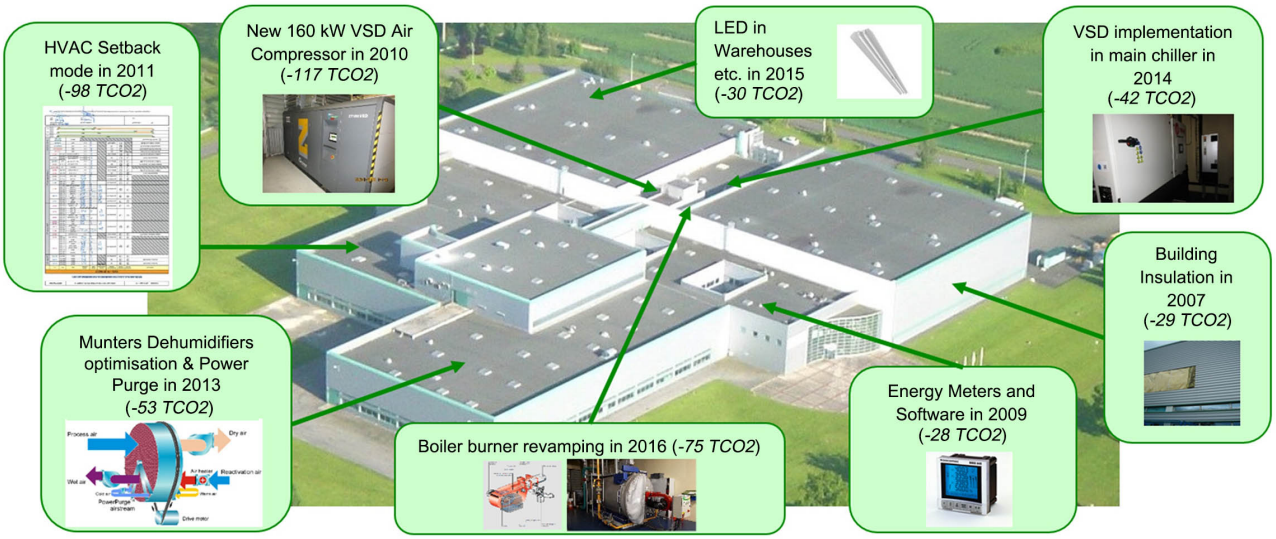


Figure 5. Some energy projects from 2007 to 2018.

- What (metrics)? e.g. CO_2 kg emissions;
- Why? e.g. Reduce site's environmental impact.

Lead metrics such as projects being completed have been included also, where possible.

Tiered metrics in the context of energy performance management are KPI with associated dashboards. The dashboard reports status against targets at various levels of detail depending on the tier. Appropriate metrics are devised for each level of the organization. This encourages ownership at each level within the organization.

For example, the direction board is mainly interested in high level performance KPI such as total site CO_2 emissions, total energy cost, total water consumption, whereas the utilities team is more attracted in boiler efficiency, compressed air generation efficiency and chiller performance (see example of tiered metrics below). Production operations are more interested in electricity consumption by area kWh, cost of electricity by area, specific energy consumption and JDI action update.

It is essential that the monitoring of the tiered metrics leads to corrective action where needed to maintain the established pattern of energy performance. The assignment of actions is in line with existing site processes for assigning actions or investigations. The metrics provides the information to identify and priorities these activities, but the responsibility is on the site's leadership team and managers to ensure actions are taken to prevent deterioration in energy efficiency performance.

7.2. Monitoring

When embarking on a metering project, it is critically important not to be overly ambitious in the first instance. The installation of meters by itself does not lead to immediate performance improvement. It is only by using the metering infor-

mation to identify and deliver savings, that the benefits will be observed. Many metering projects have been unsuccessful either because: the cost of the project was higher than what the business was willing to support (because there were so many costly meters in the scope) or the project was supported, and benefits weren't realised. In this case the business would lose confidence in the energy team's ability to deliver.

Therefore, the recommended approach is to implement meters in stages. The strategy applied is as follow:

STAGE 1—Main utility usage

- Electrical incomer, chilled water, compressed air, gas, hot water—minimum weekly readings.

STAGE 2—Check utility efficiencies

- Hot water boiler generation efficiency;
- Heat pump generation efficiency;
- Electricity meter for each chiller;
- Compressed air efficiency (electricity meter + compressed air flowmeter).

STAGE 3—Sub metering

- Measure building, business unit and equipment usage (for main utilities). As a good rule of thumb, at least 5% of the annual cost of the utility is to purchase and implement meters and to monitor them. Nevertheless, energy performance dashboards require sometimes a deeper level of detail and cost percentage is higher than 5%.

STAGE 4—Automated meter collection

- Meters fitted at least with pulse output capability.

Before metering data can be used effectively, it is important to ensure the quality of data (data cleansing). Metering data tables is checked for any data omissions or incorrect values. Checks are made for the following:

- Any zero values (data loss) returned when this is not to be expected;
- Negative values—this may be the case where meter values are derived from calculation (e.g., meter C = meter A – meter B);
- Values where the sum of submeters exceed the value of upstream meters – check for correct meter setup e.g., Current Transformer (CT) ratios, pulse count per kWh.

Once the data have been validated as above, effective monitoring and targeting can be implemented.

A good monitoring software package allows early warning of adverse trends for owners, prompting quick action to resolve and ensure best practice is maintained. It also allows for "forensic" detailed investigations to identify new energy projects by the site energy manager and expert team.

Figure 6 represents one of the energy software stations used in this research. The monitoring is done thanks to a software fully dedicated to energy and that permits to do:

- Dynamic and interactive dashboards;

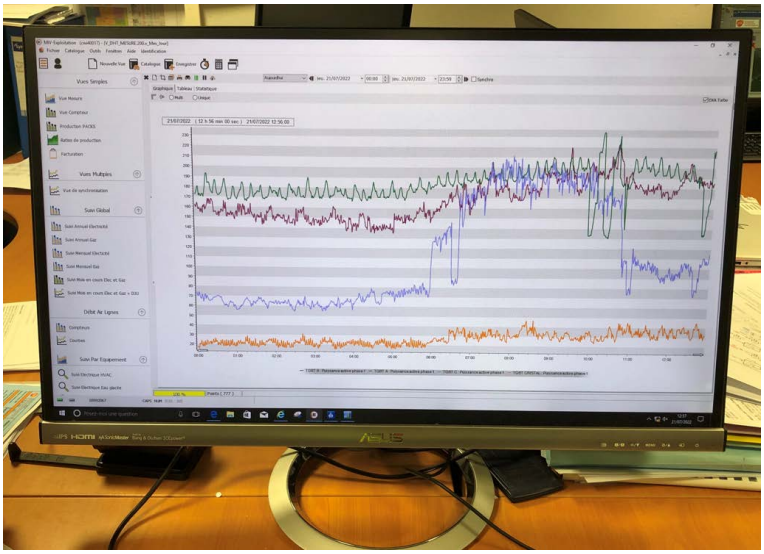


Figure 6. Energy software station.

- Comparison of differences in consumption and influencing factors;
- Analysis of consumption per minute, day, week etc;
- Live monitoring;
- Reporting.

Targets are set annually by the site and the headquarter (because site is inside an international group). Once the metering and collection of meter readings is reliable, the next step is to carry out analysis of the metering information, identify any areas of overuse, establish targets, and produce appropriate dashboards/reports based on tiered metrics.

There are 3 levels of reporting, each one increasing in complexity and usefulness to attain these aims:

1) Environmental, Health & Safety Management Software Solution—This is the standard basic energy and water reporting software used throughout the group to collect monthly energy usage and cost for all sites. It allows basic reports of monthly trends to be produced.

2) Basic analysis of trends—metering values can be analyzed for changes in trends. This is easily achieved in Microsoft Excel. It can also be done by using metering data collection software (e.g., IP21). This becomes even more powerful as representation of driving factors is also presented on the report. For example, if energy usage increases with production, plotting production as well as energy use on the same graph is helpful with analysis.

3) Regression Analysis & Overspend League Table—Spreadsheet Analysis and Dashboard. Building energy consumption modelling and forecasting is essential to address buildings energy efficiency problems and take up current challenges of human comfort, urbanization growth and the consequent energy consumption increase (Bourdeau et al., 2019).

The results are followed regularly (monthly basis) by the headquarter. All actions are also tracked for being sure that there is no problem. Site level reporting

is in place. To be more precise, each service has an energy target and follows energy performance. Once the appropriate tiered metrics have been identified for each area of the site, dashboards have been developed to display and promote the current performance. Whenever possible, the dashboards include an over-spend league table to engender a healthy competitive and sharing approach to good practice.

8. Energy Results after Deployment of This Energy Performance Management

Figure 7 indicates the progression of site carbon emission initiative from 2007 to 2019.

As represented in Figure 8, the site wins in 3 years what he has won in 12 years. This is due to the deployment of the methodology of this paper: key projects (such as heat pump), directions set by the board, involvement of the core team etc.

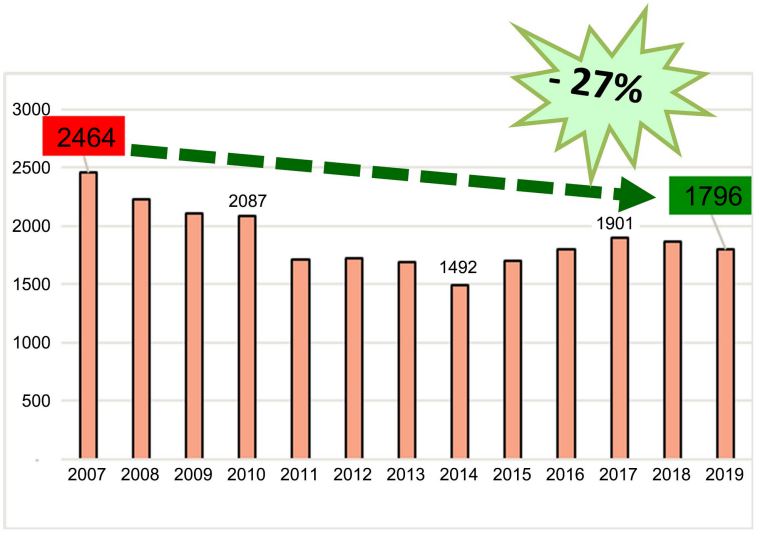


Figure 7. Site's CO2 tons emissions from 2007 to 2019 (Unit of Y-axis = CO_2 tons emissions ; Unit of X-axis = Year).

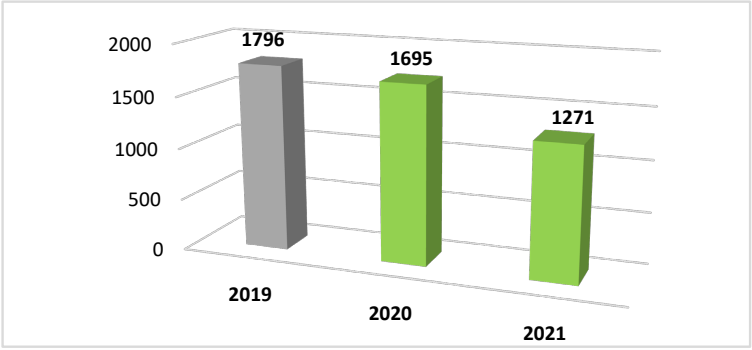


Figure 8. Sites's CO2 tons emissions from 2019 to 2021 (Unit of Y-axis = CO_2 tons emissions ; Unit of X-axis = Year).

9. Conclusion

This paper demonstrates that the robust and clear energy performance management contributes greatly to significantly reducing the carbon emissions of an industrial site. This management can be expanded to non-industrial sites. Energy performance doesn't include only technical aspects but other aspects such as culture.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

Andersson, E. & Thollander, P. (2019). Key Performance Indicators for Energy Management in the Swedish Pulp and Paper Industry. *Energy Strategy Reviews, 24,* 229-235. https://doi.org/10.1016/j.esr.2019.03.004

Bourdeau, M., Zhai, X., Nefzaoui, E., Guo, X., & Patrice Chatellier, P. (2019). Modeling and Forecasting Building Energy Consumption: A Review of Data-Driven Techniques. *Sustainable Cities and Society, 48,* Article ID: 101533. https://doi.org/10.1016/j.scs.2019.101533

Colibris & Le Mouvement (2022). https://www.colibris-lemouvement.org/mouvement/legende-colibri

Cwikla, G., et al. (2018). Assessment of the Efficiency of the Continuous Improvement System Based on Kaizen in an Example Company. *IOP Conference Series: Materials Science and Engineering, 400,* Article ID: 062008. https://doi.org/10.1088/1757-899X/400/6/062008

Dongellini, M., Marinosci, C., & Morini. G. (2014). Energy Audit of an Industrial Site: A Case Study. *Energy Procedia, 45,* 424-433. https://doi.org/10.1016/j.egypro.2014.01.046

Grubb, M. (2000). Greenhouse Emissions and the Changing Climate. *BMJ, 321,* 1169-1170. https://doi.org/10.1136/bmj.321.7270.1169

International Energy Agency (2022). https://www.iea.org/data-and-statistics/data-browser?country=WORLD&fuel=CO_2%20emissions&indicator=CO_2BySector

Kalaitzidakis, P., Mamuneas, T. P., & Stengos, T. (2018). Greenhouse Emissions and Productivity Growth. *Journal of Risk and Financial Management, 11,* Article 38. https://doi.org/10.3390/jrfm11030038

Kalogiannidis, S. (2020). Impact of Effective Business Communication on Employee Performance. *European Journal of Business and Management Research, 5,* Article No. 6. https://doi.org/10.24018/ejbmr.2020.5.6.631

Kovach, J., Cudney, E., & Elrod, C. (2011). The Use of Continuous Improvement Techniques: A Survey-Based Study of Current Practices. *International Journal of Engineering Science and Technology, 3,* 89-100. https://doi.org/10.4314/ijest.v3i7.7S

Lopes, M. A. R., Antunes, C. H., & Martins, N. (2012). Energy Behaviours as Promoters

of Energy Efficiency: A 21st Century Review. *Renewable and Sustainable Energy Reviews, 16,* 4095-4104. https://doi.org/10.1016/j.rser.2012.03.034

Revenio, J. (2016). The Impact of Change and Change Management in Achieving Corporate Goals and Objectives: Organizational Perspective. *International Journal of Science and Research, 5,* 1233-1239.

Stasis, A., Whyte, J., & Dentten, R. (2013). A Critical Examination of Change Control Processes. *Procedia CIRP, 11,* 177-182. https://doi.org/10.1016/j.procir.2013.07.053

Suárez-Barraza, M. F., Ramis-Pujol, J., & Estrada-Robles, M. (2012). Applying Gemba-Kaizen in a Multinational Food Company: A Process Innovation Framework. *International Journal of Quality and Service Sciences, 4,* 27-50. https://doi.org/10.1108/17566691211219715

Sweeney, J. C., Kresling, J., Webb, D., Soutar, G. N., & Mazzarol, T. (2013). Energy Saving Behaviours: Development of a Practice-Based Model. *Energy Policy, 61,* 371-381. https://doi.org/10.1016/j.enpol.2013.06.121