



Exemplarity of the State for the Energy Efficiency of Buildings Institutional - Case of Morocco

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ABSTRACT

Engaged for many years in a strategy to control climate change, Morocco is committed to leverage on sustainable development as a new development model and as a true project for society. This commitment resulted in implementing several reforms targeting the consolidation of a developed economy, improving social conditions, and accelerating positive environmental changes. The public administration developed the Administration Exemplarity Pact (AEP) as a concrete action to lead by example in implementing the National Strategy for Sustainable Development. Developed in accordance with the main stake of the National Strategy of Sustainable Development, its goal is to promote sustainable development governance in our country through several strategic focus areas. This document presents the experience of a Moroccan administration that has implemented the guidelines described in the AEP. The approach and results are detailed and could be used as an example for other Moroccan companies. The first step of the methodology consists of a diagnostic phase to establish the current situation. The second step is related to the strategy to define the approach's main orientations and the action plan. These key steps allow us to identify areas of improvement and build a roadmap adapted to the current context and constraints. One of the best practices for this approach is to define the main orientations to act by positive contagion on the ecosystem. In conclusion, the AEP axes deployed in a dynamic improvement logic give convincing results. By acting with partners (subcontractors and suppliers), the Moroccan administration can act on the whole value chain and induce an essential change in the Moroccan economic fabric.

INTRODUCTION

After the Club of Rome warning in 1975 (Idowu et al. 2013), it is mandatory today to manage natural resources well. Since the oil shocks of 1973 to 1979, developed countries have realized that their financial sustainability was based on the intensive use of limited natural resources. Nevertheless, one important aspect has been neglected, i.e. the environment (Ahmad et al. 2022).

The Sustainable Development Goals (SDGs) were defined as the seventeen goals established by the United

Nations member states. They are assembled in the 2030 Agenda (Idowu et al. 2013). The Organization of the United Nations adopted this agenda in September 2015 after two years of negotiations, including governments and civil society. It defines targets to be achieved by 2030. The implementation of the SDGs within a State requires the active commitment of governments and all stakeholders, such as companies, communities, associations, and researchers.

Morocco has minimal energy resources and imports more than 95% of its need (Bouyghrissi et al. 2021). In this context, the Moroccan government gives primary importance to the energy sector as the main driver of economic development and social progress. Several strategic actions have been developed (Choukri et al. 2017):

- The Constitution of Morocco recognizes sustainable development as a right for all citizens to achieve better democratic governance.
- A national charter for the environment and sustainable development was deployed.

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- Law No. 99-12 was adopted and required the government to develop and implement a national strategy for sustainable development.
- Morocco is committed to international environmental and sustainable development conventions (The Kingdom of Morocco Ministry of Energy Transition and Sustainable Development 2017).

The adoption of the National Strategy for Sustainable Development by the Council of Ministers under the presidency of His Majesty King Mohammed VI (Kingdom of Morocco Ministry of Energy Transition and Sustainable Development 2017) was a crucial step in the process of consecrating sustainable development at the national level.

The first axis of this strategy aims to make the exemplarity of the administration a lever for implementing sustainable development. Thus, the public administration has developed the Administration Exemplarity Pact (AEP) as a concrete action to set an example for implementing the National Strategy of Sustainable Development (Kingdom of Morocco Ministry of Energy Transition and Sustainable Development 2019b).

This paper presents the experience of a Moroccan administration that implemented the guidelines described in the AEP. The approach and results are detailed and could be used as an example for other Moroccan companies.

EXEMPLARITY OF THE ADMINISTRATION - THE CASE OF MOROCCO

In the frame of the Administration Exemplarity Pact (AEP), the public administration has the challenge of leading by

example in the implementation of national sustainable development strategies (The Kingdom of Morocco Ministry of Energy Transition and Sustainable Development 2019b).

Adopted by the National Committee for Sustainable Development in February 2019, the Administration Exemplarity Pact (AEP) reflects the commitment of the Moroccan administration to sustainable development.

For the effective implementation of the AEP, a circular from the Head of Government has been sent to all public administrations concerned.

Since its launch, the deployment of the AEP has aimed to encourage and promote best practices of sustainable development among all economic and social stakeholders at the national level. The main objectives of the Administration Exemplarity Pact (Kingdom of Morocco Ministry of Energy Transition and Sustainable Development 2019a) can be summarized in 6 items, as described in Fig. 1:

To support the ministerial departments in the process of preparing their Exemplarity Pact, the Environment Department within the Ministry of Energy, Mines, and the Environment has carried out several actions. These actions include:

- The development and dissemination of a methodological guide on the Exemplarity of the Administration,
- Orientation sheets by the domain (water, waste, mobility, energy efficiency),
- and standardized terms of reference on environmental auditing in public buildings (Kingdom of Morocco Ministry of Energy Transition and Sustainable Development 2019a).

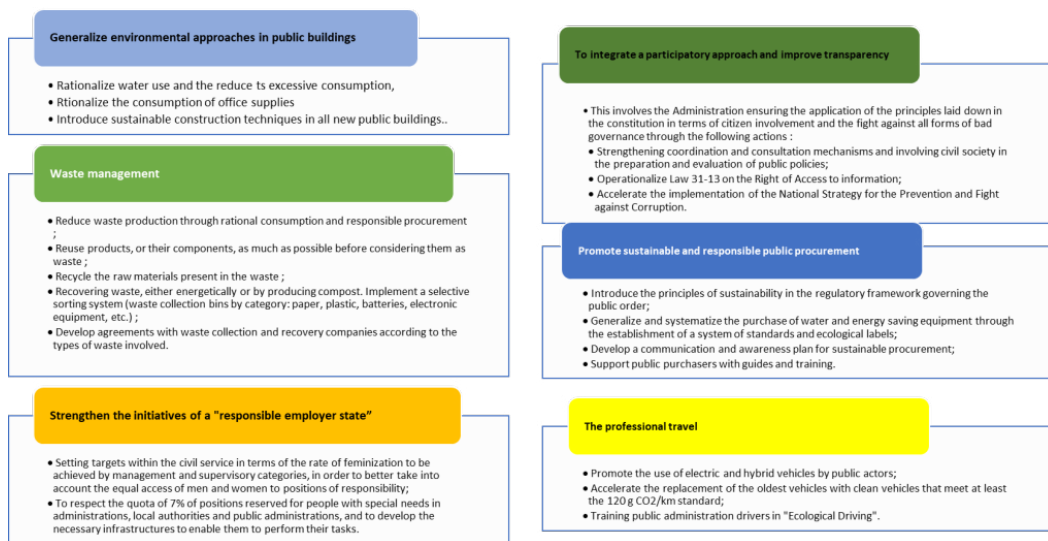


Fig. 1: AEP objectives.

In addition, technical assistance has been made available to ministerial departments within the framework of international cooperation to accelerate the pace of implementation and generalize these measures to public entities and local authorities.

The exemplarity of the administration concerns several domains: energy (mainly electricity), water, waste, public procurement, mobility, and Office consumables.

MATERIALS AND METHODS

The Moroccan authorities are convinced that the state, in the broadest sense, and the public administration in particular, have a decisive role to play in the process of the Kingdom's energy transition (Kingdom of Morocco Ministry of Energy Transition and Sustainable Development 2017). The AEP is a disposition by the Moroccan government to encourage the exemplarity of administrations in terms of sustainable development.

The purpose of this study is to present the methodology and results of a Moroccan administration that has implemented the AEP guidelines. This study aims to provide a methodology for implementing PEA tested in a public administration in Morocco. The article focuses on two components of this study: the results of the diagnosis and the actions implemented.

The study also demonstrates the need to involve stakeholders as early as possible in the process to ensure the wide dissemination of these principles.

This study could be extended to other administrations and companies to address the challenges of climate change,

economic development, and energy security.

To carry out this mission, a methodology in 3 steps was developed. As explained in Fig. 2, an initial phase related to the diagnosis and inventory of the equipment, analysis, and treatment of the preliminary data by carrying out field visits and working meetings with the concerned. The second phase is devoted to the realization of the field audit and synthesizing it to propose improvement tracks. The third phase was devoted to studying the technical and economic feasibility of the recommendations and implementing an action plan. This was an essential phase of the mission, which allowed the definition of the strategy and monitoring framework (analysis of operational objectives, monitoring indicators, etc.) and the definition of an action plan.

According to the AEP requirements, the audit (Boharb et al. 2016) covered: energy, water, waste, and paper use. During these audits, the following elements were analyzed: Energy contracts, use of renewable energy, lighting, office equipment, heating/ventilation/air conditioning, kitchen equipment, and hot water. The water consumption, the quantities of water discharged, the characteristics of the installed facilities, and the wastewater collection were examined for the water audit. It was also a question of evaluating the quantity of waste produced and making a point on the use of paper.

RESULTS AND DISCUSSION

Results of Diagnosis

At the current stage of diagnosis, it was essential to analyze the data to understand the energy situation at the site. It

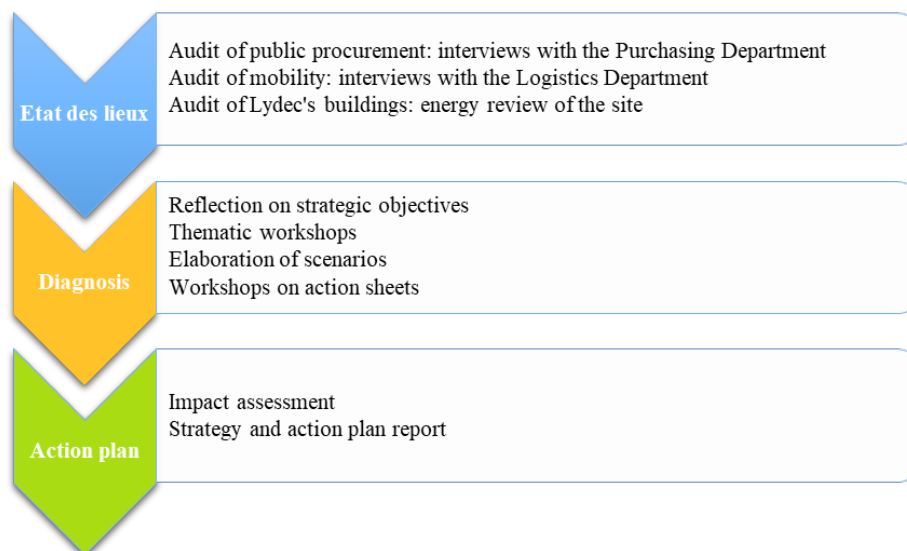


Fig. 2: The methodology of the study.

is often useful to graph the consumption data to visualize the changes in consumption. Establishing relationships between energy consumption and influencing factors provides a clear understanding of what is happening at the site.

Electricity Consumption

Electricity consumption varied from 2,090,678 kWh

in 2018 to 1,766,671 kWh in 2019 and 1,526,111 in 2020, a change of -15% and -14%, respectively (Fig. 3).

Water Consumption

Water consumption varied from 4,950 m³ in 2018 to 2,207 m³ in 2019 and 2,080 m³ in 2020, i.e., a change of -55% and -6%, respectively (Fig. 4).

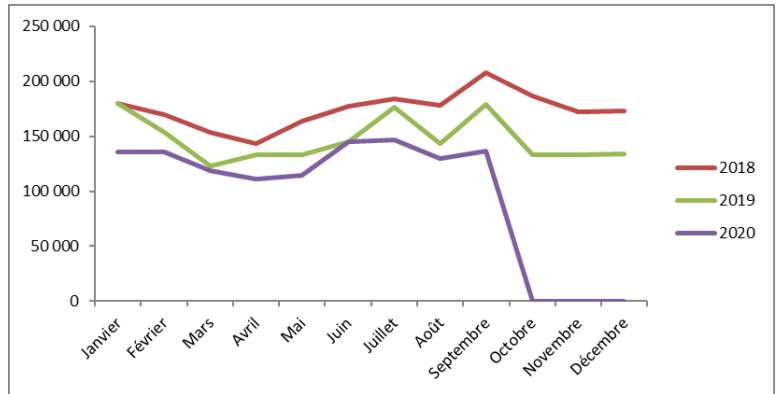


Fig. 3: Evolution of electricity consumption 2018, 2019, 2020.

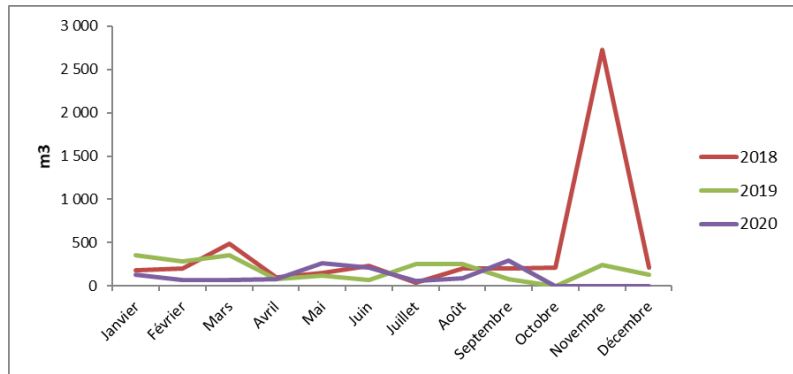


Fig. 4: Evolution of water consumption, 2018, 2019, 2020.

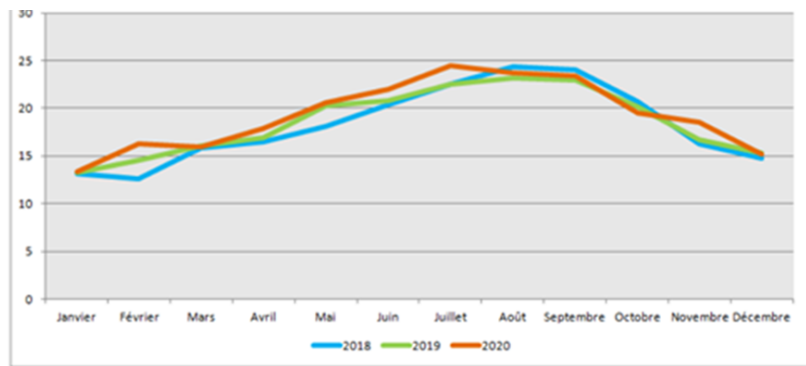


Fig. 5: Average temperatures in Casablanca (2018, 2019 and 2020). (Source: www.infoclimat.fr)

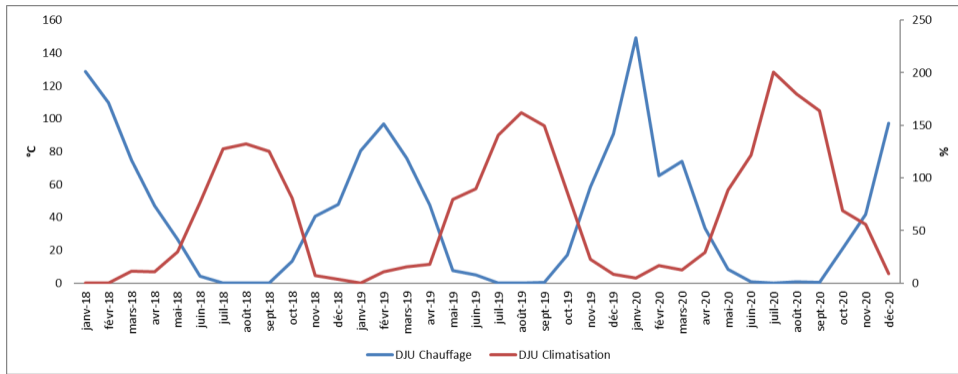


Fig. 6: Degree days in Casablanca (2018, 2019, 2020). (Source: www.infoclimat.fr)

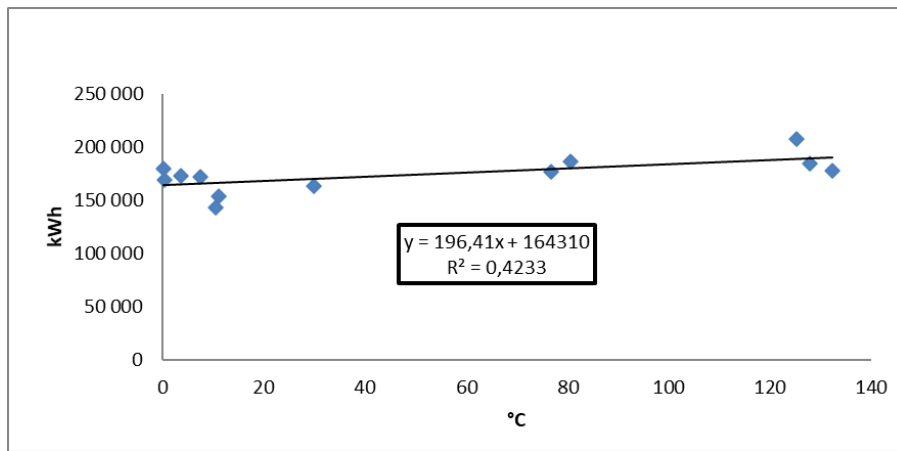


Fig. 7: Electricity consumption VS DJU Air conditioning.

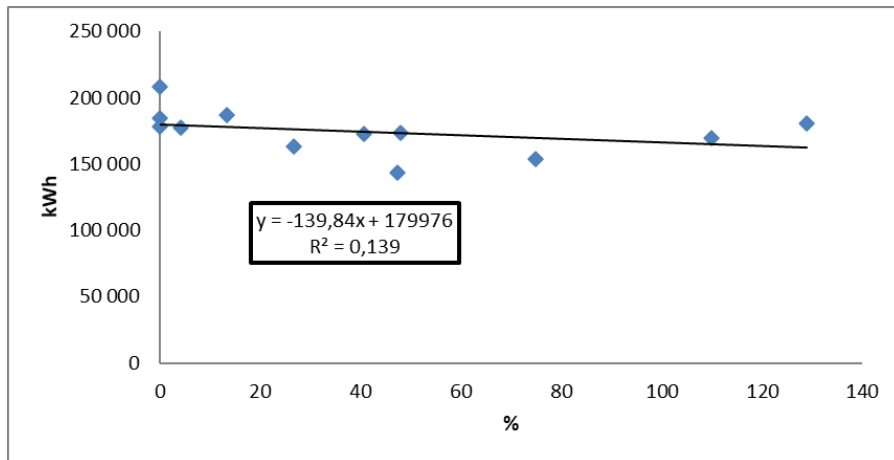


Fig. 8: Electricity consumption VS DJU heating.

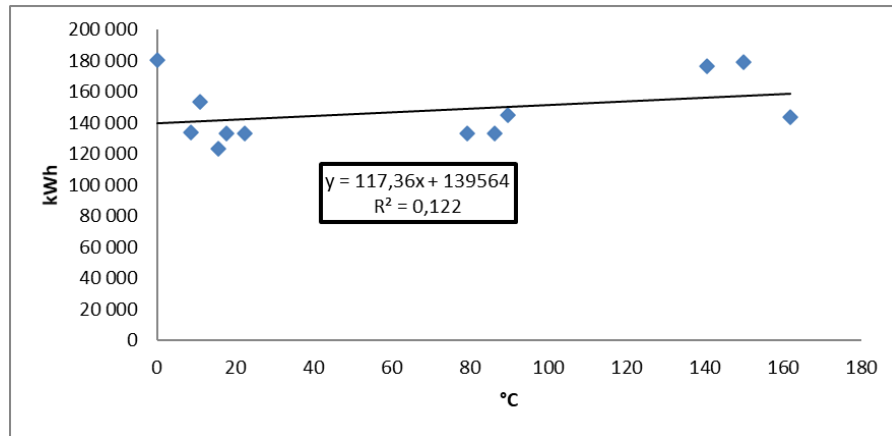


Fig. 9: Electricity consumption VS DJU air conditioning.

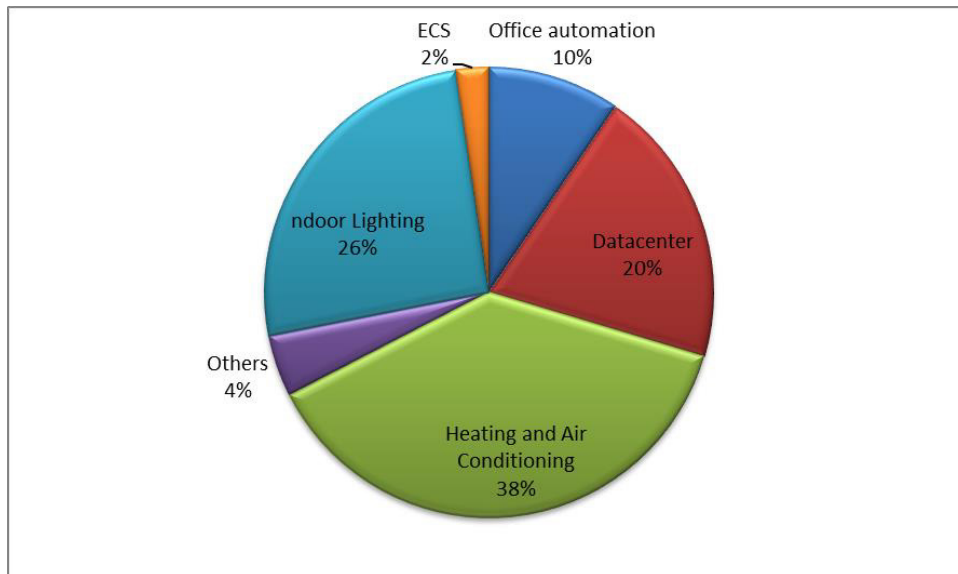


Fig. 10: Significant uses.

The Climate of Casablanca

The climate of the city of Casablanca is temperate, influenced by the Atlantic. The average temperatures do not vary much. The temperature profiles of the years 2018, 2019, and 2020 seem to be close (Fig. 5).

On the other hand, the heating and cooling degree days show that 2020 was warmer than 2019 and 2018 (Fig. 6).

Consumption Ratios

The variation of consumption in a building can be influenced by its surface, the number of occupants, and the climate when the building has an air conditioning system. In our case, we do not have information on the number of occupants and the

surface. Therefore, we will be satisfied to do the exercise with the meteorological data of Casablanca.

Electricity Consumption Ratio

A linear regression analysis of the available data showed a possible correlation with the air-conditioning degree days (Fig. 7, Fig. 8, Fig. 9). The correlation coefficients obtained for 2018, 2019, and 2020 are, respectively, $R^2 = 0.84$ and 0.78 and 0.74 . And the respective residual consumptions are 147 MWh, 117 MWh, and 104 MWh.

Significant Energy Uses

The selection of significant uses is made for any use whose share of consumption exceeds 10%. Hence the significant

uses for the company are air conditioning, lighting, the Datacenter, and office automation (Fig. 10).

Mobility Audit

The reduction of greenhouse gas emissions has become a critical global objective. Recent scientific studies estimating the socio-economic costs of the effects of global warming reinforce concerns about environmental and energy constraints and emphasize the nature and modalities of the policies to be put in place (Fouillé et al. 2012). Transport is now the leading sector in terms of greenhouse gas emissions and carbon dioxide emissions (Jia et al. 2009). The mobility audit carried out for the company in question highlighted the numerous measures already implemented for the management of its truck fleet, which has led to a reduction in fuel consumption in recent years. Optimizing the fleet and experimenting with new modes of transport through pilot projects (electric cars, electric mopeds, etc.) is an asset for finding solutions to reduce the environmental impact of mobility.

Recommendations

Various studies have shown that it is possible to reduce electricity costs without significantly reducing energy consumption when time-of-use electricity rates are applicable (Hu et al. 2020). These strategies typically require little or no capital outlay and use optimized control strategies to prioritize electrical energy use outside the more expensive periods of the day through time-shifting.

In general, it is claimed that buildings consume energy, even if the “building” is responsible for very low energy consumption during its operational life but much more during the design, construction, and deconstruction phases. Indeed, most of the energy is consumed by the occupants. However, they do not have direct contact with the energy carriers (fuel, gas, electricity), and more precisely, with the equipment and goods that provide them with services; therefore, the users do not feel directly responsible for the energy consumption, which is consumed by the equipment and, more generally, by the buildings. It is interesting to note that energy consumption is measured in kW h.m⁻² year and not in kW h.person-year⁻¹ (Delgoshaei et al. 2017).

Thus, actions related to user behavior have also been implemented to ensure compliance with good energy use practices, including turning on lighting only when necessary, turning off lighting when leaving the premises, using air conditioning only when necessary, appropriate adjustment of the air conditioning temperature (winter/summer), closing doors and windows when using air conditioning, limiting the use of table water in plastic bottles and favoring tap water.

The choice of low-consumption equipment is an important axis of the action plan.

The optimization of water consumption through the use of drip systems and programming of watering time (avoid watering in full sun), as well as the choice of plants with low water demand.

Other recommendations have been implemented to improve the building’s electrical energy performance: the generalization of the replacement of light points by LED lighting, the generalization of the choice of equipment with low power consumption, automatic control of lighting by presence detector, especially for sanitary facilities, adjustment of the automatic control of exterior lighting, and realization of programmed cut-off of lighting taking into account the working hours and functions of each room.

The following areas for improvement have been identified: Improve the management of document archiving, generalization of the digital archiving of documents, implementation of a charter for the use of paper in the offices with the aim of Optimize pagination, use of appropriate fonts, preventing on-screen correction, minimizing the number of printouts, using electronic forms instead of paper forms, using double-sided functionality whenever possible, reuse paper waste, generalization of the monitoring of paper consumption by site and by function.

In conclusion, the energy-water-waste-paper audit of administrative buildings also highlighted many actions already underway in buildings, including the deployment of low-energy LED lighting and the replacement of air conditioners with equipment that emits less greenhouse gas, the development of renewable energy production and the monitoring of electricity and water consumption. The deployment of digital technology to reduce paper consumption is also recommended.

Analysis of Public Procurement

Responsible public procurement can be understood as a new concept of public purchasing (El Asri et al. 2022), which could affirm the role of public actors in sustainable development.

This initiative also aims to professionalize the “purchasing” function by developing skills and improving decision-making tools (Gayot 2019). Therefore, the combination of efficiency and sustainable development objectives is at the heart of the new governance of purchasing (Cantillon 2010).

The analysis carried out as part of this study shows that a corporate social responsibility policy is already

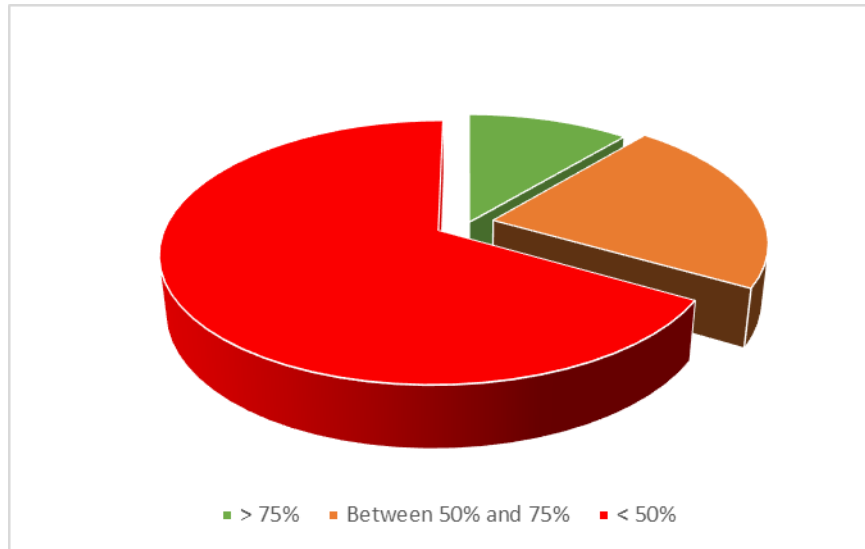


Fig. 11: Audit companies results.

in place for responsible purchasing management. The framework documents governing supplier contracts refer to environmental protection, and almost all contracts include clauses on services' social or environmental impacts.

To go further, an audit of the most significant subcontractors was carried out to evaluate their performance in terms of respect for the environment. The audit was carried out based on a grid integrating objective criteria linked to respect for the environment.

As shown in Fig. 11, only 2 companies have a high level of global maturity. This study shows that public administrations have an important role in supporting and engaging subcontractors in energy efficiency initiatives. Beyond the contractual obligations, a work of accompaniment of these companies must be carried out.

So it is very important to involve stakeholders as early as possible in the process to ensure wide dissemination of these principles.

CONCLUSION

In this paper, a common framework has been developed for the evaluation of an energy management system. The PEA is based on provides a framework for improving the energy performance of organizations. This document offers a methodological framework for deploying the principles of the AEP.

A Moroccan administration operating in the Casablanca area was chosen as a case study. In particular, its buildings were used to assess energy performance and serve as an

illustrative application to demonstrate the general validity of the method.

The application of all the steps of the method revealed to the energy manager the necessary actions to be implemented. In addition, monitoring and controlling performance proved to be a fundamental step in gaining efficiency.

In conclusion, the PEA axes deployed in a dynamic improvement logic give convincing results. By acting with partners (subcontractors and suppliers), the Moroccan administration can act on the whole value chain and induce an essential change in the Moroccan economic fabric.

This commitment has enabled several ministries to make real savings in terms of resources. For example, some departments have reduced their water consumption by 50% and produced 22% of their electricity needs from renewable energy. While others have been able to achieve 32% of their fleet of clean vehicles and achieve a rate of 1 waste of about 35% (Diao 2021).

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