

# ***ENERGY METERING AND MANAGEMENT PRACTICES OF MANUFACTURING COMPANIES: A SYSTEMATIC LITERATURE REVIEW***

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## **Overview**

While metering and management of energy costs plays a significant role in energy intensive companies, the application of energy costs management in non-energy intensive companies is rarely addressed in the literature. Based on a systematic literature review, we investigate energy management practices in energy intensive vs. non-energy intensive companies. We also distinguish between differences in practices of small and medium enterprises (SME) vs. large companies. Specifically, we address how companies measure energy usage and costs, and use the data for energy management purposes, mainly for analyzing energy related investments. The literature review covers 19 journals in the fields of business, accounting, energy, and engineering, using keywords such as “energy management,” “energy metering,” or “energy measuring.” The final sample includes 45 papers for the analysis. The findings suggest that most literature concerns energy intensive and large companies.

The most important findings are based on the few studies that cover non-energy intensive companies. These use imprecise methods for measuring and allocating energy costs. The majority of companies do not allocate energy costs at all, a minority of companies uses sub-metering to track energy consumption within the company, and others allocate costs roughly, such as per square meter or per employee. There are almost no studies that provide a more nuanced description of measuring and allocating energy costs, for example by investigating specific cost allocation bases, the accuracy of cost allocations, and differentiating between first-stage and second stage allocation. Still, the overall impression is that many non-energy intensive companies may lack much of the information necessary for energy management, such as information needed for improving energy efficiency, evaluating the financial benefits and costs of energy efficiency improvement investments, and holding managers accountable for energy efficiency.

## **Methodology**

We conducted a systematic literature search that yielded 45 empirical papers in 19 journals in the field of management accounting and energy. We started the search process by scanning journals for topic-related keywords, followed by an extensive backward and forward citation analysis. This led to a final count of 45 relevant papers. We constructed an overview table to distinguish between specific characteristics of companies and methods observed in selected papers. This new perspective helped us in showing similarities and pointing out gaps in the literature.

## **Results**

First, 73.3% of the relevant papers mainly focus on metering and energy management practices in energy intensive companies, while only 17.8% of the papers focus on non-energy intensive companies.

Second, it is shown that non-energy intensive companies monitor and measure energy usage to a small extent, and even when the energy audits are made, they rarely lead to investments in energy conservations, because it is considered to be more profitable to do nothing.

Third, 13.3% of the papers reviewed address allocation of energy costs to departments, and only one paper address second stage allocation, i.e. the allocation of energy costs from departments to products or cost centers.

Fourth, far less non-energy intensive companies have clearly formulated and long term energy strategies than energy intensive companies.

## Conclusions

Companies benefit to a large extent from detailed measurements on energy consumption. The potential cost savings due to more accurate measurements are often underestimated and therefore just a small share of companies is measuring their energy consumption with high accuracy. This systematic review reveals that the implemented measurement methods vary from inefficient measurement methods to detailed sub-metering in real time. The implementation rate of detailed sub-metering is higher in large and energy intensive companies. Nonetheless even in these kinds of companies sub-metering is often lacking and cost saving potential is left unexploited. This points to an even larger unexploited cost saving potential in small and medium sized enterprises and non-energy intensive industries.