

## Chapter 14

# Obtaining Green Warehouse From the Movement of Trucks Through Piezoelectric Tiles: Case Study (Kinda Foods Warehouse)

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### EXECUTIVE SUMMARY

*The use of clean and renewable sources of energy is a global trend in preserving the environment. In addition, in the long run, the cost of renewable energy is lower than the energy generated by fuels. By extension, if clean energy is used in industry, it will have a very strong impact on all supply chains, both service and productivity. This case study highlighted the technical potential and economic feasibility of the activation the transformation of kinetic energy of trucks to electrical power using piezo-electric tiles, its effect in Kinda Food's warehouse, its impact on the supply chain, and the economic feasibility of its long-term application. This case explained how to convert regular warehouses into green warehouses, explained the usage of alternative energy in warehouses, explained the difference in cost of using renewable energy and fuel energy in warehouses, and obtained the benefits.*

### ORGANIZATION BACKGROUND

Kinda Foods Factory is a local factory in Alexandria located in the Apis Industrial Zone. Mr. Mohamed Kabbary is the owner of this factory. Kinda Foods Factory started in 2017 as a local factory. This factory produces different types of juices distributed and sold in the Egyptian countryside. The juice industry is one of the important industries that face many competitors due to its spread and the spread demand for ready-made juices, whether in the sectors of schools, hospitals, and various establishments (Yiqun Huang

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et, al.,2009). (This factory is not one of the huge factories with a huge administrative, and organizational structure, it consists of the chairman of the board of directors and the production department and quality, packing and warehouse management, as many small business owners start by structuring the business by trial and error, or haphazardly, therefore, the organizational structure of the factory is simple because the factory is based on local trade and a small regional scale. The culture of this institution is based on the idea of reducing the cost of juice because it targets villages and Upper Egypt to sell it in large quantities, but at a price lower than the market price, as it is common knowledge that regions and rural areas can market products of medium quality, not very high due to the different cultures of customers, for example, customers do not care The material of the packed carton or in the form of bottles that are packaged as a design, but they care about the taste, whether it is good or not, and equivalent to its cost or not. Therefore, Kinda Foods focused on the regional market and Upper Egypt due to its low costs compared to capital markets such as Cairo and Alexandria were targeted due to the lack of competition in Upper Egypt. And its ferocity in the capital. The company's situation is like most of the industrial sector, which is the high electricity costs, as any industry consumes a lot of electricity. The government also holds the commercial segment at a price per watt higher than the natural consumption, as it reaches that the price of a kilowatt reaches one pound and 60 piasters. The company faces the problem of electricity in the warehouse explicitly because it consumes electricity in a large volume due to the use of refrigerators to maintain the appropriate temperature for juices so that they do not spoil (EEHC, 2019). So, the main problem in the factory is the warehouse because the warehouse, as monthly electricity cost of the warehouse is very high and reaches 17,000 pounds per month, which reduces the factory's profits and also it raises the inventory price, therefore, the price of juice relatively compared to what the company wants to achieve the lowest price available in the market (personal communication, May 3, 2019).

## **SETTING THE STAGE**

In this case study, the piezoelectric technique was used, which is a technique that relies on converting kinetic energy into electrical energy through a specific type of crystal that converts kinetic energy into electrical energy. Those crystals were discovered in France in 1880 by two brothers, Pierre, and Paul (Hari Anand et al., 2019), and crystals work by converting Vibrations resulting from feet or moving anything on them to electricity, as shown in Figure 1. Piezoelectric tiles are made using special materials, such as crystals and ceramics, in which electric charge builds up when mechanical stress is applied" such as a foot pressing down (Zack Mester et al., 2012). The piezoelectric effect is very useful in many applications involving the production and detection of sound, generation of high voltages, electronic frequency generation, microbalances, and ultra-fine focusing of optical assemblies (Yanfang Meng et al., 2022). It is also the basis of several scientific instrumental techniques with atomic resolution, such as scanning probe microscopes (STM, AFM, etc.) (Zinc-Based Nanostructures for Environmental and Agricultural Applications, 2021). The piezoelectric effect also has its use in more mundane applications as well, such as acting as the ignition source for cigarette lighters (TK Basu, 2010). Due to the intrinsic characteristics of piezoelectric materials, numerous applications benefit from their use: High Voltage and Power Sources; an example of applications in this area is the electric cigarette lighter, where pressing a button causes a spring-loaded hammer to hit a piezoelectric crystal, thereby producing a sufficiently high voltage that electric current flows across a small spark gap, heating and igniting the gas. Most types of gas burners and ranges have a built-in piezo-based injection system. Sensors, the principle of operation

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