# An Investigation on the Impact of Occupancy Patterns On Energy Performance In Industrial Buildings

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## Aim of the Investigation

The aim of the investigation to gather information on **Energy Saving Strategies** that could be implemented into 'Smart Buildings' (**NZEB**) & also to investigate if Occupancy has a **major effect on Energy Performance in Industrial Buildings** of a selected typography

## Literature Review

**Energy Performance explained**

It is the sustainability of the energy efficiency of a building of any type, involving calculation of average energy consumption to determine its actual energy performance rating.

**Energy performance & Building Occupancy Correlation**

The relationship between Building occupancy and Energy performance is defined as Energy wastage due to employee interaction with energy consuming equipment. proper operation can lead to a decrease in energy wastage, in turn improving energy performance.

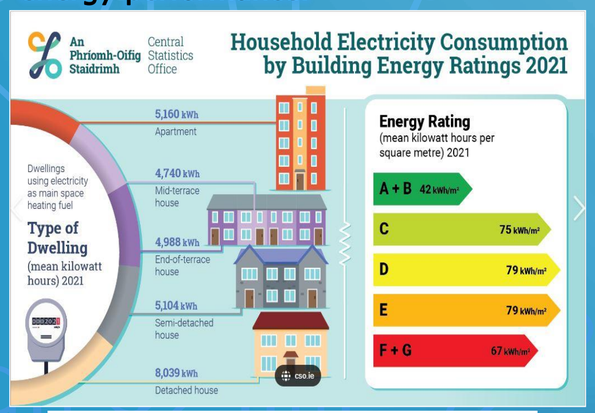



Figure 1 : Graph on Energy Consumption in different building typography's

## Methodology Research Results

Through Surveying it was found that :

- ✓ HVAC Systems was a main contributor to energy consumption
- ✓ **RFID** is the most popular methods of tracking occupancy

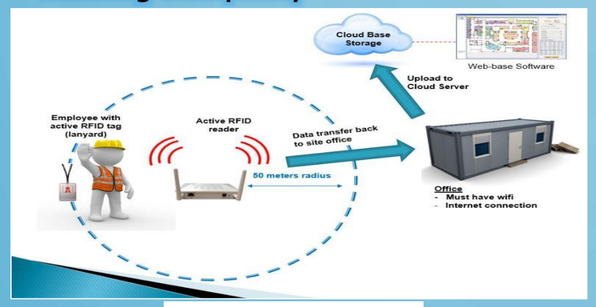



Figure 2 : How RFID Works in Industry

## Relevant Case Studies Findings

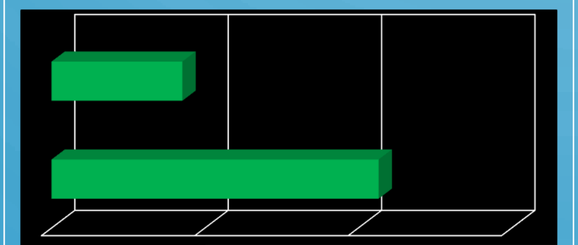
**From Case Study #1:**

- ✓ It is crucial to monitor the permittable Air-Change rates per hour, as it can have an optimistic effect on energy performance

**From Case Study #2:**

- ✓ Strong correlation between building occupancy and energy consumption in all building typography's (Strongest in Office spaces) involved in the study.

**Cost Reduction Figure (in €) After reducing ACH from 20 to 16**



| | Total Cost before ACH Reduction | Total Cost After ACH Reduction |
|---|---|---|
| Cost Reduction Figure (in €) After reducing ACH from 20 to 16 | €106,667 | €42,667 |

Chart 1 : Bar Chart Representing data from Case Study #1

## Investigation Insights & Guidelines

**Investigation Insights**

- ✓ Cleanrooms play a significant role in the overall energy consumption of pharmaceutical manufacturing facilities.
- ✓ Variable Refrigerant Flow Systems would be the most suited HVAC System for use in cleanrooms

Figure 4 : Typical Cleanroom in a pharmaceutical Industrial Factory

**Energy Efficiency Guidelines**

1. Installation of Presence sensors on to lighting devices.
2. Space Ventilation Conditions should be closely monitored in both low & high occupancy levels.
3. Energy management systems should be used in all industrial manufacturing buildings.

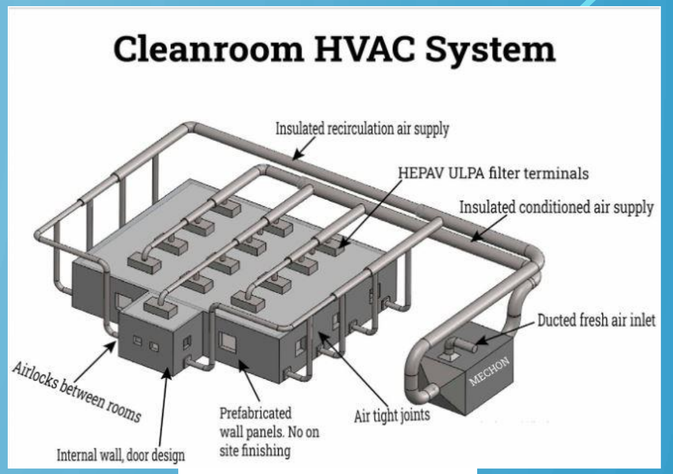



Figure 3 : Variable Refrigerant Flow System

| Lumens | Standard Incandescent | New Halogen Incandescent | CFLs | LEDs | |
|---|---|---|---|---|---|
| 450 lumens | 40 Watts $5.34/yr | 29 Watts $3.87/yr | 10 Watts $1.34/yr | 5 Watts $0.67/yr | energy use / energy cost per year |
| 800 lumens | 60 Watts $8.02/yr | 43 Watts $5.74/yr | 13 Watts $1.74/yr | 10 Watts $1.34/yr | energy use / energy cost per year |
| 1100 lumens | 75 Watts $10.02/yr | 53 Watts $7.08/yr | 16 Watts $2.14/yr | 15 Watts $2.00/yr | energy use / energy cost per year |
| 1600 lumens | 100 Watts $13.36 | 72 Watts $9.62/yr | 20 Watts $2.67/yr | 19 Watts $2.54/yr | energy use / energy cost per year |
| Typical Life Span based on 3 hours of use per day | 1 year | 1-2 years | 10 years | 15-25 years | |
| Average cost of light bulb | $2.00 | $7.00 | $11.00 | $20.00 | |

Table 1 : Average Cost of various lightbulbs

## References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