**SCENARIOS**

**Aim-**

Our goal is to run a classroom and keep its occupants satisfied. We will calculate the energy consumption of each device and look for ways through which we can save energy and reduce the harmful GHG emissions in the process.

**Research-**

Location- **Classroom**

Ideal temperature **20-24 degrees**

**Thermal Comfort for occupants is in cooler conditions**

Increase in number of occupants = increase in humidity

How to tackle humidity = decrease air conditioner temperature

Decrease in air conditioner temperature = increase in energy consumption and energy cost.

**HVAC system** is the most essential feature in any university because of its multiple benefits such as providing Air Conditioning, Heating and Ventilation.

Research in the field of indoor comfort is showing that lower winter temperatures (20°C) and higher summer temperatures (up to 25°C) can maintain comfort levels acceptable to most occupants, depending on other aspects of the building, relative humidity and the occupants’ tolerance levels.

Our goal is to keep the occupant satisfied in their thermal comfort level. The occupant thermal comfort level is in cooler conditions and not in hot and humid ones.

if number of people increase --> temperature increase ---> energy consumption increase

**Some extra points (not included in our calculations)-**

Classroom size, the larger the area and student population, the higher the air conditioner capacity required. Insulation, the better the insulation in the walls and ceiling of the room, the lower the air conditioner capacity required. Window size, having larger windows in a room may mean a larger capacity system due to the higher solar gains into the space.

**Features provided by Amir-**

Environmental conditions like room temperature, relative humidity, transmitted solar radiation, indoor illuminance.

Occupant-related factors such as presence/absence in the space, skin temperature, heart rate.

Building-related factors such as supplied air temperature by HVAC system, lighting switch (on/off), shading position.

**Inputs for our scenario-**

* **Number of students**- 10, 20, 50, 100.
* **Class Duration**- 2 hours, 120 minutes
* **Classroom size-** 2000 sq feet
* **HVAC system (Duct System)-** 8kW consumption per hour, Electricity usage rate of 35c per KWH, Used 24 Hours a day. Our classroom has a total of 2 Ducted AC’s.

Thus, Total Energy cost for running 2 hours of Duct Air Conditioner is =

8 \* $0.35 \* 2 = **$5.60.**

* **Indoor Illuminance-** 12 \* 50W fittings = 600W = 0.6 kWh energy used for an hour and Cost of 1kWh is 34.41 cents.

Thus, Total Energy cost for running 2 hours of light is = 0.6 \* $0.3441 \* 2 = **$0.41292**.

* Small LED Lamp at the lecturer table- 15W and its consumption is 0.015 kWh.
* Window Shades
* Cost of Air Conditioner at different temperatures-



* **Student Laptop Charger-** Ideal consumption is 60W and costs 2 cents an hour.

Total Energy Cost for charging a Laptop is = 0.06 kWh \* $0.02 \* 2 hours = $0.0024.

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* **Mobile Chargers-** Ideal consumption is around 20W and costs 0.5 cents an hour.

Total Energy Cost for charging a Mobile is = 0.02 kWh \* $0.0005 \* 2 hours = $0.00002.

* **Lecturer Desktop-** Power Consumption is around 150W and costs 10 cents an hour.

Total Energy Cost for charging a Desktop is = 0.150 kWh \* $0.1 \* 2 hours = $0.03.

* **Projector-** We are using an LED Projector that consumes 90W an hour and costs 7 cents an hour.

Total Energy Cost for charging a Mobile is = 0.09 kWh \* $0.007 \* 2 hours = $0.00126.

**Scenario 1-**

Number of students = 10.

It’s a Sunny Day and the outside temperature is 29 degrees, the solar irradiance is high i.e., the intensity of the sun is at a high level. Inside the classroom, the window shades are down because of the sunlight and the Room Temperature is about 26 degrees.

The class is 2 hours long.  
The air conditioner is set at 24 degrees.

The window shades are down so all light tubes are switched on.

Number of students charging their laptops = 4.

Number of students charging their mobile phones = 2.

The lecturer desktop is switched on but isn’t being used.

The projector is also switched on but isn’t being used.

Total Energy Cost for each device mentioned above = Air Conditioner Consumption Cost + Mobile Phone Charger Consumption Cost + Laptop Charger Consumption Cost + Projector Consumption Cost + Desktop Consumption Cost + Light Tubes Consumption Cost

Total Energy Cost for each device mentioned above = ($5.60 +$5.60\*$0.40) + ($0.00002\*2) + ($0.0024\*4) + $0.00126 + $0.03 + $0.41292

Total Energy Cost for each device mentioned above = $7.84 + $0.00004 + $0.0096 + $0.44418

**Total Energy Cost for each device mentioned above = $8.29382.**

**Total Energy Consumption = (0.6 + 0.015 + 8 + (0.06\*4) + (0.02\*2) + 0.150 + 0.09) \* 2 = 18.27 \* (30/1000) = 0.5481 kWh.**

**Scenario 2-**

Number of students = 20.

The class is 2 hours long.  
The air conditioner is set at 23 degrees.

The window shades are down so all light tubes are switched on.

Number of students charging their laptops = 10.

Number of students charging their mobile phones = 10.

The lecturer desktop is switched on but isn’t being used.

The projector is also switched on but isn’t being used.

Total Energy Cost for each device mentioned above = Air Conditioner Consumption Cost + Mobile Phone Charger Consumption Cost + Laptop Charger Consumption Cost + Projector Consumption Cost + Desktop Consumption Cost + Light Tubes Consumption Cost

Total Energy Cost for each device mentioned above = ($5.60 +$5.60\*$0.44) + ($0.00002\*10) + ($0.0024\*10) + $0.00126 + $0.03 + $0.41292

Total Energy Cost for each device mentioned above = $8.064 + $0.0002 + $0.024 + $0.44418

**Total Energy Cost for each device mentioned above = $8.53418.**

**Total Energy Consumption = (0.6 + 0.015 + 8 + (0.06\*10) + (0.02\*10) + 0.150 + 0.09) \* 2 = 19.31 \* (30/1000) = 0.5793 kWh.**

**Scenario 3-**

Number of students = 50.

The class is 2 hours long.  
Two air conditioners are switched on and are set at 23 degrees.

The window shades are down so all light tubes are switched on.

Number of students charging their laptops = 30.

Number of students charging their mobile phones = 15.

The lecturer desktop is switched on but isn’t being used.

The projector is also switched on but isn’t being used.

Total Energy Cost for each device mentioned above = Air Conditioner Consumption Cost + Mobile Phone Charger Consumption Cost + Laptop Charger Consumption Cost + Projector Consumption Cost + Desktop Consumption Cost + Light Tubes Consumption Cost

Total Energy Cost for each device mentioned above = [($5.60 +$5.60\*$0.44)\*2] + ($0.00002\*15) + ($0.0024\*30) + $0.00126 + $0.03 + $0.41292

Total Energy Cost for each device mentioned above = $16.128 + $0.0003 + $0.072 + $0.44418

**Total Energy Cost for each device mentioned above = $17.06836.**

**Total Energy Consumption = (0.6 + 0.015 + (8\*2) + (0.06\*30) + (0.02\*15) + 0.150 + 0.09) \* 2 = 37.91 \* (30/1000) = 1.1373kWh.**

**Scenario 4-**

Number of students = 100.

The class is 2 hours long.  
Two air conditioners are switched on and are set at 22 degrees.

The window shades are down so all light tubes are switched on.

Number of students charging their laptops = 50.

Number of students charging their mobile phones = 40.

The lecturer desktop is switched on but isn’t being used.

The projector is also switched on but isn’t being used.

Total Energy Cost for each device mentioned above = Air Conditioner Consumption Cost + Mobile Phone Charger Consumption Cost + Laptop Charger Consumption Cost + Projector Consumption Cost + Desktop Consumption Cost + Light Tubes Consumption Cost

Total Energy Cost for each device mentioned above = [($5.60 +$5.60\*$0.56)\*2] + ($0.00002\*40) + ($0.0024\*50) + $0.00126 + $0.03 + $0.41292

Total Energy Cost for each device mentioned above = $17.472 + $0.0008 + $0.12 + $0.44418

**Total Energy Cost for each device mentioned above = $18.03698.**

**Total Energy Consumption = (0.6 + 0.015 + (8\*2) + (0.06\*50) + (0.02\*40) + 0.150 + 0.09) \* 2 = 41.31 \* (30/1000) = 1.2393 kWh.**