

Welcome

to

AustraliaCDRhelp.Com

Career Episode 1

a) Introduction:

CE 1.1

This career episode is the illustration of my Research Project on Energy Efficiency in Building. The project is titled as 'An Internet of Things based Energy Monitoring System for a Mining Hut' and it was meant to be submitted in Month/Year and started in Month/Year. The whole project duration was Month/Year to Month/Year. I completed my master's degree from College of SHEEMurdoch University, Western Australia

b) Background:

CE 1.2

Nowadays, the only solution towards sustainable future is the efficient use of energy resources which makes it necessary to improve the energy efficiency in the workforce sector which will drop significantly not only the emission of greenhouse gases but will also offer comfort to many people. That's why, this project was developed to provide an optimum solution for improving thermal performance of a Mining Hut. In this research, both the heating and cooling energy were optimized intending to maintain the thermal comfort of the occupants.

The core objective of this research project is the energy optimization of HVAC system of Mining Hut with the help of Internet of Things based energy monitoring system by installing smart sensors and energy meters. During the tenure of this project, the Mining Hut was monitored for more than three months for get full understanding regarding the variation in temperature and energy load of Mining Hut. The monitoring phase provided the extensive knowledge on the building's thermal energy requirements by evaluating time lag, heat losses, energy load, and decrement factor of the building to recommend the required changes to enhance energy efficiency of a workforce building.

CE 1.3

I was accountable for the following tasks:

- Conducted an extensive literature survey on the given research topic.
- Prepared the work methodology, selected the equipment for monitoring, performed mapping of the monitoring points, and analyzed the monitored data.

1

Name: PROFESSIONAL CIVIL ENGINEER - QUANTITY SURVEYOR



AustraliaCDRHelp.Com
Competency Report Writing Helper

- Discussed the analysis results with the supervisor and calculated heat losses inside the mining hut building.
- Arranged frequent meetings and developed the weekly progress reports
- Abided the international standards and developed the final thesis document.

CE 1.4

Project Hierarchy:

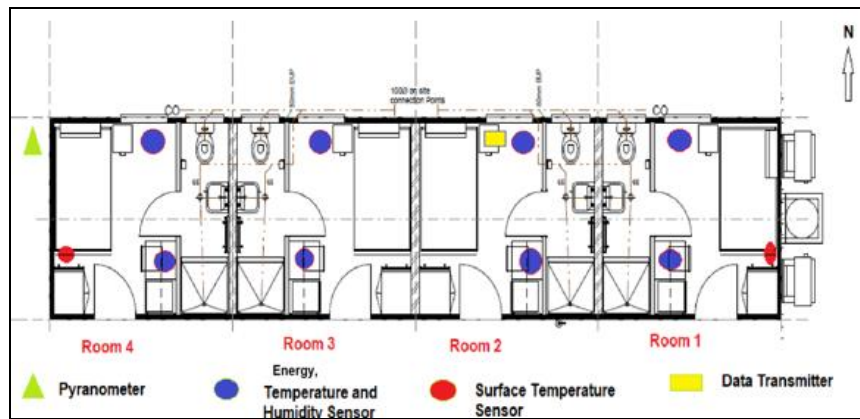
c) **Personal Engineering Activities:**

CE 1.5

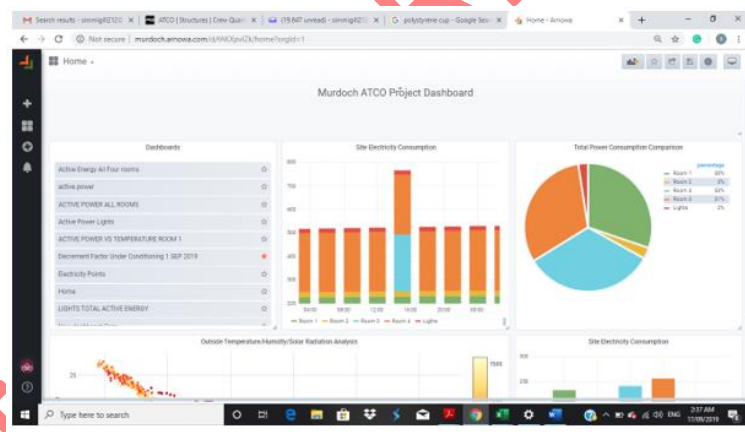
I underwent a deep literature review to understand the significance of IOT based energy monitoring and application of passive solar design principles in the building envelope followed by evidence-based research. Afterward, I prepared the research methodology for thermally monitoring the mining hut from ATCO logistics who provided crew quarters to the workforce sector throughout Australia at the Murdoch University premises for a time period of 3 Months that lasts from July to September 2019. I explained the basic layout of the methodology by developing the flow chart. For the building monitoring process, I worked with the Climate Change Response Pvt Ltd who helped me in the installation phase of monitoring devices at the monitored site. This study aims to monitor the thermal energy requirements and the electrical energy performance of a mining hut.

CE 1.6

My main task was to monitor the mining hut. For this purpose, I installed various sensors inside in all the four rooms to gather indoor data as well outside at the rooftop to collect daily weather information. Now, to record the data, I used the following type of devices and sensors such as pyranometer, infrared temperature sensor, transmitter, thermocouple socket sensor, and energy meters. I installed the pyranometer at the roof top for measuring planar surface's solar irradiance and I decided to install solar radiation flux density with the sensor to measure wind speed, noise level, humidity and temperature of outside environment. Further, I selected infrared temperature sensor and thermocouple socket sensor for accurately measuring the wall's surface temperature and humidity inside the mining hut rooms respectively. Also, I used energy meter to measure the active power and total consumption of energy by the electrical appliances. After the selection process, the mapping of the monitoring points was carried out. I mapped the temperature and humidity sensors which were installed inside all the four rooms of Mining Hut. The following figure explain the mapping process perfectly.



I installed the surface temperature sensors at a height of 1.5 meter from the floor and were covered with polystyrene cups to avoid direct contact with conditioned air. Afterward, I worked together with the Climate Change Response Pvt Ltd on the software ‘Arnova’ consists of sensors and energy meters that are installed at the mining site to record per second data which was transmitted with the help of a transmitter installed in Room 2 to the cloud computing database. Then, I fetched the recorded data in the form of graphs and tables on a web server that can be accessed on various smart devices which is shown in the below figure:



CE 1.7

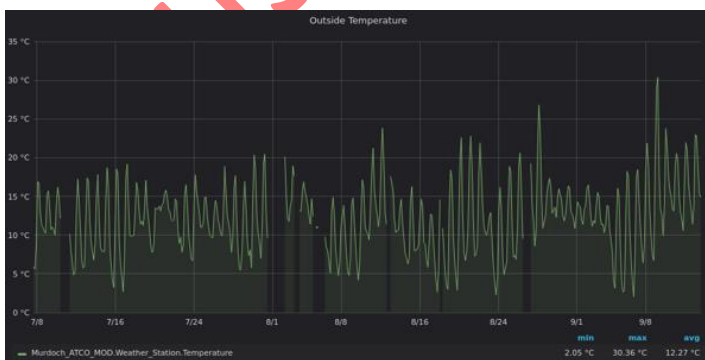
Then, I analyzed the data. For this, I first evaluated the temperature range of thermal comfort inside the mining hut by creating the bioclimatic chart using monitored average temperature and humidity value with the help of Olgyay’s bioclimatic chart which only considers outdoor temperature and humidity values. After this, I calculated the heating and cooling degree days in order to estimate the average energy cost according to ASHRAE fundamentals. I measured heating degree by observing how much in days and degrees the air temperature (outside) was under the certain level that the building requires heating. On the other hand, for measuring cooling degree, I checked how much in days and degrees the air temperature (outside) was more than the certain level that the building requires cooling. This degree days for the Mining Hut will be useful to eliminate outside temperature variable in₃

Name: PROFESSIONAL CIVIL ENGINEER - QUANTITY SURVEYOR

comparing the amount of energy consumed by electrical appliances. Next, I evaluated the thermal performance of walls by calculating the thermal decremental factor and time lag through walls of Mining Hut. For this measurement, I observed the heat wave which propagates from external to internal area of the building as well as wave's amplitude represents the temperature, while wavelength is a measure of time. During the heat wave's propagation through the walls, its amplitude changes based upon wall's thickness. Therefore, I named the time taken by the temperature wave to circulate from an exterior surface to an internal surface as time lag (ϕ) while I named the temperature amplitude's decreasing ratio as a decrement factor (f). Afterward, I evaluated the heat losses inside the Mining Hut. I used the recorded inside and outside temperature of Mining Hut to calculate the areas that contributes to maximum amount of heat losses. Here, I noticed that the heat from inside rooms is lost through walls, roof, floor, doors and windows in the form of conduction that is heat transferred from one molecule of a substance to another and infiltration that is leakage of energy through doors, windows etc. that corresponds to increase in energy load. Thus, I performed analysis to evaluate the heat loss will help to recommend changes for improving the building's thermal performance. Next, I evaluated the heating and cooling energy load under design conditions as per ASHRAE fundamentals. In this, I used the Mining Hut data to calculate heating and cooling load and then estimated the average annual energy load which could be helpful to determine the time- period when energy required will be maximum during the summer and winter season as well as it is helpful in energy efficient equipment selection. Lastly, the building was rated using available construction data to incorporate sustainability and energy savings features using Accurate Sustainability Software. Through this software, I assessed a thermal performance of the design and compared the building performance by changing design values.

CE 1.8

In this section, I will explain the results of the data analysis. First of all, I noticed the evaluation results to calculate heating and cooling degree days required for mining hut. For this case, I developed the graph which depicted the change in outside temperature of Mining Hut during day and night-time in the winter season. Many days during the entire monitored interval had a temperature below 10 degree Celsius which ultimately require building heating that leads to significant energy costs. Therefore, I found that degree days were increasingly useful as time goes on as a means of securing efficient operation of heating and cooling appliances along with estimating the energy load to avoid power cuts at mining sites.

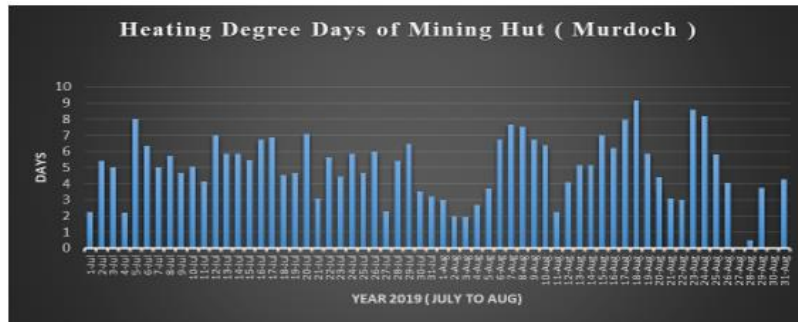


From the above graph, I obtained the maximum and minimum daily outside temperature in⁴

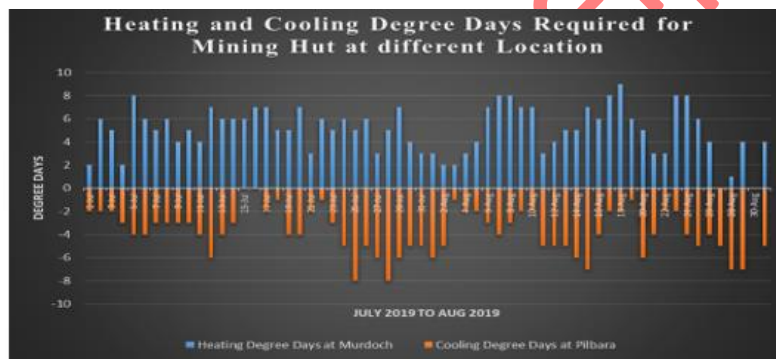
Name: PROFESSIONAL CIVIL ENGINEER - QUANTITY SURVEYOR



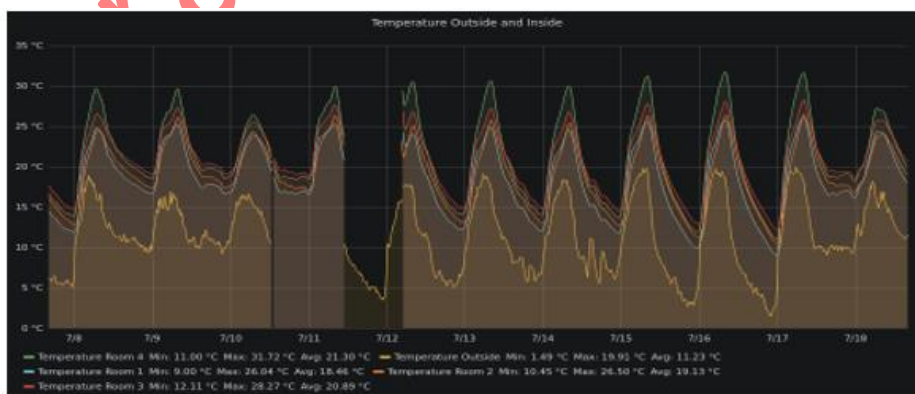
degree Celsius and calculated the average daily temperature of a day [Maximum daily temperature + Minimum daily temperature]/ 2 and also calculating difference between the reference temperature and the 24-hour average temperature. Further to this, I obtained the following results of heating and cooling degree days of mining hut from July 2019 to August 2019.



I noticed that the average outside temperature of Mining Hut at the monitored location (Murdoch University from July 2019 to August 2019) lies below the reference temperature (18 degree Celsius) therefore for each day, heating degree days are required which is represented below:



Next, I checked the thermal evaluation of mining hut using time lag and decrement factor which is given in the below graph.



From the table, I noticed the change in outside air temperature significantly affects the indoor air temperature in all the rooms of Mining Hut. The data monitored in the month of July clearly showed that the indoor air temperature rises above 25 degree Celsius in all the rooms when the outside air temperature is around 20 degree Celsius. Moreover, I further examined the indoor air

Name: PROFESSIONAL CIVIL ENGINEER - QUANTITY SURVEYOR

temperature of Room 1 and Room 4 that were oriented towards west and east respectively, reached till 30 degree Celsius during peak sun hours due to wall's thermal properties that includes the effect of wall thickness on the heat flux time lag as well as decrement factor that needs to be investigated. While monitoring the Mining Hut rooms, I observed that because of heat flux through all the walls, variation in the indoor air temperature affects heating and cooling load due to which wall's thermal performance was assessed by calculating decrement factor and time lag of the walls below

$$\text{Time Lag} = T_{i \max} - T_{o \max}$$

Where $T_{i \max}$ = Time when inside temperature of Mining Hut room is maximum and $T_{o \max}$ = Time when outside air temperature of Mining Hut is maximum = 2:05 PM. I get the following results for time lag of four rooms

Location	Maximum Temperature of day (Degree Celsius)	$T_{i \max}$ (Time)	$T_{o \max}$ (Time)	Time Lag $T_{i \max} - T_{o \max}$ (Hours)
Room 1	24.6	4:05 PM	2:05 PM	2 hours
Room 2	25.4	4:30 PM	2:05 PM	2.25 Hours
Room 3	26.82	4:10 PM	2:05 PM	2.05 Hours
Room 4	30	4:00 PM	2:05 PM	1.55 Hours

Now to calculate decrement factor, I used the following equation:

$$\text{Decrement Factor} = f = \frac{A_i}{A_o}$$

where, $A_o = T_{o \max} - T_{o \min} = 13.82$ degree Celsius, $T_{o \max}$ = Maximum outside air temperature = 19.10-degree Celsius, $T_{o \min}$ = Minimum outside air temperature = 5.28-degree Celsius, $A_i = T_{i \max} - T_{i \min}$, and $T_{i \max}$ = Maximum temperature inside room, $T_{i \min}$ = Minimum temperature inside room.

Zone	$T_{i \max}$ (Degree Celsius)	$T_{i \min}$ (Degree Celsius)	A_i (Degree Celsius)	A_o (Degree Celsius)	Decrement Factor
Room 1	24.6	12	12.6	13.82	0.91
Room 2	25.4	12.98	12.42	13.82	0.89
Room 3	26.82	14.8	12.02	13.82	0.86
Room 4	30	14	16	13.82	1.15

CE 1.9

While working on the research project, I organized a proper meeting schedule to remain in-contact with the supervisor and I always updated him about the progress of every task. Moreover, I decided to explain the status of my tasks by preparing the progress report according to the university standards and also discussed these reports with my supervisor. He reviewed my weekly reports

Name: PROFESSIONAL CIVIL ENGINEER - QUANTITY SURVEYOR



and often instructed me to change the procedure or calculations work and I always listen to his advice. These reports were used to make the research thesis document. I presented my research work in the final presentation and explained every design work in-detail. I used MS-Word to develop all project documents. Further, I conducted all the work according to the international standards.

d) Summary:

CE 1.10

The research has helped me to understand the significance of IOT-based energy monitoring in the workforce sector and how monitoring the temperature variation and energy use can help to enhance energy savings by implementing solar design principles as well as reducing the thermal energy load of the buildings without compromising the thermal comfort level of occupants.

Career Episode 2

a) Introduction:

CE 2.1

The aforementioned career episode is the illustration of the main project to obtain the degree of Master in Renewable and Sustainable Energy. The project is named Analysis of an Existing House in Terms of Passive Solar Design and Energy Rating with Potential Improvements for Energy Efficiency. **It was started in Month/Year and Completed in Month/Year.**

b) Background:

CE 2.2

Nowadays, it is become significant to improve the residential sector's energy efficiency to reduce energy usage within the built environment and to enhance thermal comfort by reducing heating and cooling energy loads in the residential sector. Improving energy efficiency primarily in the residential sector is of utmost important to reduce the energy consumption as well as maintaining the thermal comfort inside the building, it is important to study and examine an existing residential building to analyze the potential improvements that can be made both in terms of minor changes in the building design as well as the amount of retrofitting that will be required. Therefore, in this project, an

Name: PROFESSIONAL CIVIL ENGINEER - QUANTITY SURVEYOR



AustraliaCDRHelp.Com
Competency Report Writing Helper

existing residential house was analyzed in terms of orientation, zoning, and required thermal mass requirements based on its climatic information and the type of material that was being used to build the house to improve the passive solar design. To improve its energy efficiency, the electrical appliances being used in the house were audited to perform the energy rating of the building using NABERS energy rating tool to examine the devices that consume a high amount of electricity. In this project, the residential house that was studied in terms to improve energy efficiency and passive solar design was 11 Bungaree Road, Wilson and **it comprises 3 bedrooms, a living room, kitchen, laundry, and washroom. The house has underground power and sewage system**

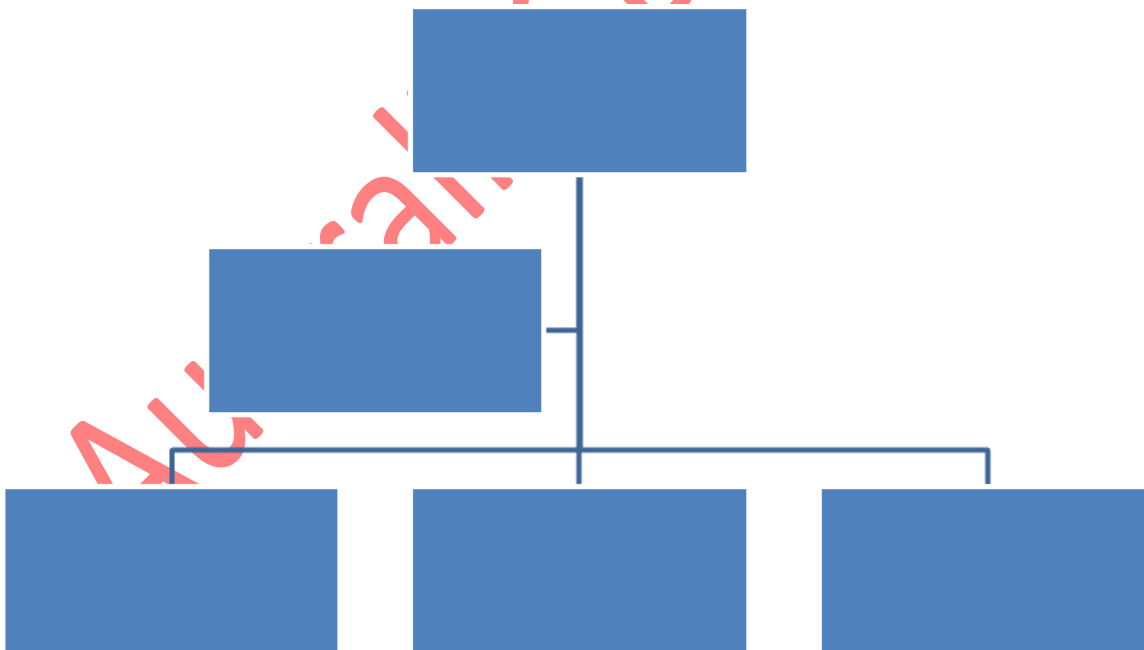
CE 2.3

I performed the following major tasks:

- Studied the residential house background, floor plan, and described the existing design of the house in terms of passive design principles of location.
- Analyzed different characteristics of the existing house i.e. zoning, window, shading, etc.
- Conducted **analysis to improve the energy-efficient house.**
- Developed the project documents and the project flowchart.

CE 2.4

Project hierarchy:



c) Personal Engineering Activities:

Name: PROFESSIONAL CIVIL ENGINEER - QUANTITY SURVEYOR



CE 2.5

In this project, I studied the project background and checked the building's geographic coordinates. I also studied thoroughly the floor plan of the existing house and I noticed that the house is having a rectangular shape with the entrance facing North. From this data, I explained to the supervisor in the meeting that the rectangular shape of the house is exposed to direct sunlight in the east where the living area, kitchen, and laundry receives sunlight during the sunrise that warms the inner temperature of the house at the beginning of the day. Also, the windows in the living area and kitchen allow the sun's radiation to directly enter in the inner space of the house thus affecting the thermal comfort and also described the orientation of the house in terms of its location which showed that the existing house orientation requires several major and minor changes to have an ideal passive solar design for winter and summer. Afterward, I move forward with the examination of different characteristics of the existing house.

CE 2.6

I checked the window characteristics of the existing house because, in terms of energy efficiency, windows play a critical role in transferring radiant and conducted heat. As per the floor plan, I found out that the existing house is having windows in all three bedrooms as well as in the living area and kitchen area. Now, I am going to explain the description of glazing in the existing house i.e. there were a total of 6 windows (window 1 to window 6) having a frame type of aluminum 3mm single glass. All the six windows have different sizes such as 1.3 m * 1.2m, 2m * 1m, 1.3 m * 1.2meter, 2 meter * 1.2 meter, 0.5 meter * 0.5 meter, and 1.2 m * 1 m respectively as well as also have different U-value (5.5, 6.9, 5.5, 6.9, 5.5, 5.5 respectively) and coefficient of solar heat gain. By using the U value, I measured the active conductance of heat by calculating non-solar heat gain or loss through it. Next, I examined the shading characteristics because shading of house and outdoor spaces will reduce the summer temperature rise inside the house that can improve comfort and saves energy. However, I observed that the existing house did not have any eaves, window awnings, shutters on any of the windows. The only shading that the house receives is from a tree which is planted right before the entrance in the northern side of the house whose description is given in the below table:

Landscape of tree	Height of tree [A]	Distance from left or right [B]	Tree location front [D]
In front of Room 1	4 m	3.5 m	9 m

Here, I supposed the radius of tree (C) as 0.5 m and used the following formula to calculated the tree distance: $E = \text{SQRT} \{[B]^2 + [D]^2\} = 9.65 \text{ m}$ and also determined the compass bearing with the help the equation: $H = \tan \text{ inverse } \{D/ B\} = 68.74 \text{ degrees}$. Lastly, I computed the tree radius canopy = $\tan \text{ inverse } \{C/E\} = 2.9 \text{ degrees}$. The tree as it was landscaped towards the northern side did not act as a light filtering agent during the sunrise and sunset time as trees with highest

canopies are beneficial to provide shading for roofs. So, I performed the below calculations to determine the sun angle for the house:

As the latitude of Perth was 32-degree South and according to this value, I determined the Equinox by subtracting the 90 degrees from Latitude (90 degree – 32 degrees). It was obtained as 58 and then, I computed the summer solstice by adding equinox with 23.5 degrees which were equal to 81.5. Lastly, I calculated the winter solstice by subtracting the equinox from 23.5 degrees. Based on the Summer Solstice and Winter Solstice, I found out that the existing design of the house did not incorporate any shading, therefore major changes need to be made to enhance thermal comfort inside the house. Apart from that, I also observed that the existing house had draughts at the edges of the doors and windows. As the house is an older brick home, the vent covers were absent in the living area. Moreover, other common spots that require draught-proofing is the place where plumbing pipes and electricity cables are connected as the air leaking area was not insulated. Furthermore, I noticed that the house had a moderate ventilation design which did not involve any major changes. However, the house lacks attic ventilation to extract the heat through mechanical ventilation or clerestory. Apart from the attic, I found out that the washroom was also not equipped with the right level of ventilation. The direction of the wind in the region was mainly the southwest direction therefore, window's airflow pattern of various opening height helps to fluctuate ventilation paths as well as control airspeed. Therefore, I suggested the installation of ventilation as it can reduce the temperature differential across the ceiling and walls by 50 %.

CE 2.7

Next, I performed an analysis for the improvement of energy-efficient houses. In terms of orientation, major changes were required to alter the orientation of the existing house design to achieve maximum thermal comfort, for instance, I recommended designing the house that can allow daytime living areas to face 25 degrees west of North and 30 degrees east of Northside. Many home project corporations will flip or mirror a house design to suit according to thermal comfort at a minor cost. This will maximize late after solar gain and morning sun in winter by excluding summer sun from the west. Also, I suggested that the windows on the eastern and western side of the house should be removed to limit the direct heat gain at sunrise and sunset and the vacant space at the north side of the house where the entrance lies, a veranda must be constructed that will provide shade and shelter from high solar gain. Furthermore, I also provided recommended improvements for the windows. We used glazing which is a critical element for building the house energy envelope. It is also necessary to balance heat gain during daytime against heat loss during night timethrough windows by choosing appropriate glass and frame for the windows for the existing house design. I suggested to replace the window glass with U-value or low conductivity for example Double Glazing with a significant solar heat gain coefficient and also replaced the timber frames currently used in the house with PVC or composite frames that conduct less heat as timber frames result in air gaps that allow air infiltration and absorbs carbon dioxide. Moreover, I also recommended installing window films to decrease gain in solar heat through a thin polymer film comprising¹⁰

Name: PROFESSIONAL CIVIL ENGINEER - QUANTITY SURVEYOR



AustraliaCDRHelp.Com
Competency Report Writing Helper

reflective layer of metal or absorbing dye with a backing (adhesive). Many types of glass and frames for glazing are available in the market which can be replaced with the existing ones in the house to have better U-value and SHGC. Further to this, I found out that the existing house lacks roof ventilation, minor changes, so, I recommended to install air vents particularly in the kitchen and washroom to allow built-up heat to dissipate with the help of exhaust fans and also install supply ventilation system with the help of fan can pressurize home to force outside air to flow inside to enhance ventilation which are cheap as well.

CE 2.8

I managed the entire work of the project by creating the flowchart in which I explained all tasks which were needed to be carried out. This flowchart helped me to remain focus and to complete every task on-time. Furthermore, I organized meetings for discussing the tasks related issues and always considered his opinion to make my project work flawless. I continuously researched online and studied guide manuals for Australia to develop environmentally sustainable houses and research papers to select the best recommendations for the arose problem and also obeyed safety standards to perform every task safely. Also, I developed the thesis document to fulfill the degree requirement and explained every part of the project in detail.

d) Summary:

CE 2.9

In this project, I successfully analyzed the residential house and provided recommendations by using my knowledge, and from the analysis of this project, I found out that the existing passive solar design principles require major retrofitting as well as minor behavioral changes to increase thermal comfort and high energy performance of the house.

Career Episode 3

a) Introduction:

CE 3.1

In this third career episode, I am going to explain the project 'Energy Audit and Potential Ways of Energy Reduction in a Domestic House'. It was commenced by me during the final year of my master's degree in Renewable and Sustainable Development. The total project duration was 11

Name: PROFESSIONAL CIVIL ENGINEER - QUANTITY SURVEYOR



AustraliaCDRHelp.Com
Competency Report Writing Helper

Month/Year to Month/Year.

b) Background:

CE 3.2

This project will analyze the amount of energy that is being consumed by a domestic house in order to reduce the energy usage by 10% and 40% through an energy audit program that will calculate the consumption of electricity, fuel and gas over a period of one year by focusing on the monthly consumption through representing the data in the form of tables and charts to undergo Pareto analysis. Energy Audit through Pareto analysis was performed to provide a clear picture of the highest energy consuming appliances that are being used in the domestic house. As the energy supply includes Tariffs for gas and electricity, the conduction of energy audit program will help to find the impact of these tariffs for the cost analysis of energy consumption.

This project's core objective was to focus on highest energy consuming devices in order to adopt energy efficiency measures using modern or existing technology in a domestic house to help in achieving energy efficiency target of a nation. The data collection is limited to average use of an appliance including the peak load usage of electricity. This project primarily focuses on energy usage reduction rather than analyzing cost reduction level for the prices for which energy usage is being charged.

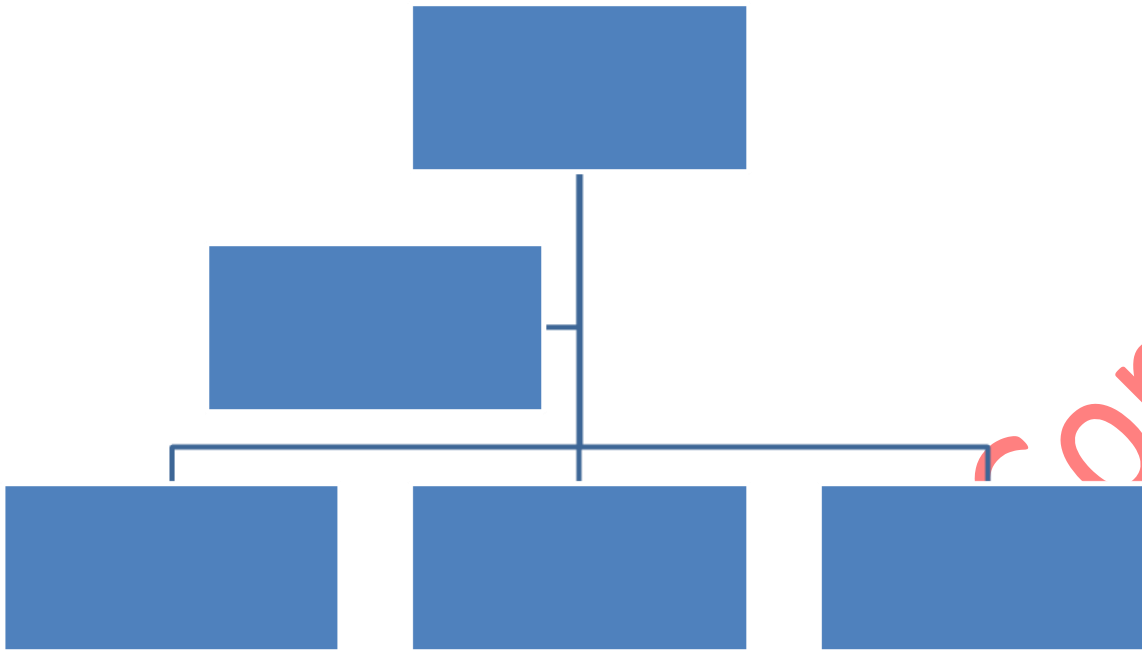
CE 3.3

The following tasks were conducted by be:

- Calculated the total amount of consumption of energy in domestic house.
- Performed Pareto Analysis and developed the energy mass balance diagram
- Provided the ways to reduce the Energy Consumption.
- Involved in the documentation process.
- Organized meetings with the supervisor.

CE 3.4

Project Hierarchy



c) Personal Engineering Activities:

CE 3.5

First of all, I developed the best methodology to perform an energy audit program at a personal domestic home by categorizing energy usage among different sectors to calculate the average annual consumption followed by recommendations to achieve the desired energy reduction target to build an energy saving house. Moreover, I also studied few manuals to know about main purpose of energy audit program to and gain knowledge how much energy is consumed at a particular site by analyzing the energy appliances for longer time. Afterward, I collected historical data of the chosen site by conducting site assessment to inspect the site visually and to measure energy use.

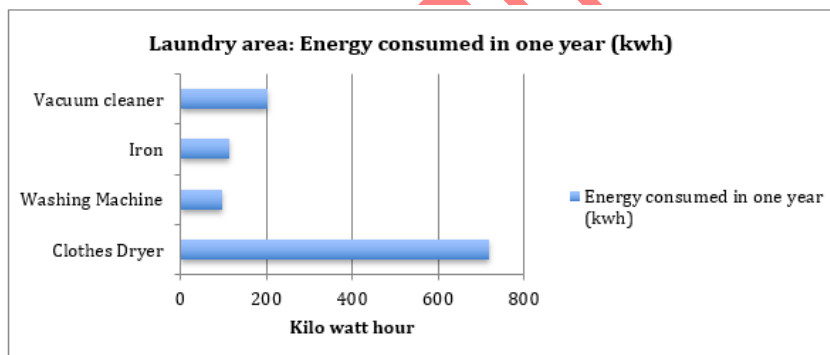
CE 3.6

I performed my first task of measurement of energy consumption in the domestic house. I measured the consumption of electricity in different areas of the house on the basis of rating of electrical appliances and number of hours of operation on a particular day. Also, I read the energy bills from the year 2017 and listed down the average monthly and annual consumption of electricity. I noticed that the device that consumes the highest amount of electricity in kitchen area was the Frost-free Refrigerator with a power rating of 200Watt and annual average energy consumption is 1752 Kwh due to continuous 24*7 operation while all other appliances such as dishwasher, coffee machine microwave etc. I calculated the total energy consumption in one year from the formula:

Energy Consumed in A Year= Power Rating (Watt)* Number of Hours of operation * 365 days

Appliance	Power rating (Watt)	Duration of use per day	Average energy consumed per day (kwh)	Average energy consumed per month (kwh)	Average Energy consumed in one year (kwh)
Refrigerator frost free	200	24 hours	4.8	144	1752
Dishwasher	1000	2 hours	3.6	108	1314
Coffee Machine	100	15 minutes	0.025	0.75	9.125
Microwave oven	1200	30 minutes	0.6	18	219
Electric oven	1200	30 minutes	0.6	18	219
Blender	500	5 minutes	0.041	1.23	14.965
Total energy					3528

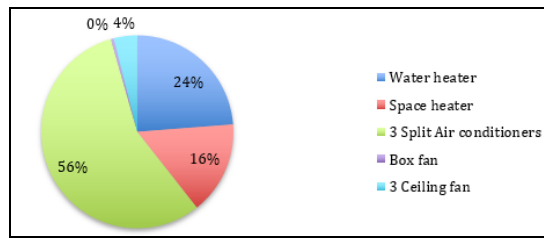
Similarly, I measured consumption of energy in the living area. I checked the appliances that were using in living area which were TV, dish, printer, router and charging point out of which, I noticed that the LCD consumed the highest energy as the number of hours it is used are more than 4 hours per day with a consumption of 18 Kwh of energy per month and the printer and mobile recharging consumes the least energy. Next, I calculated the energy consumption in the laundry area. The appliances that were present in laundry area were clothes dryer, washing machine, iron and vacuum cleaner out of which clothes dryer consumed a lot of energy for the given house and the vacuum cleaner as well with a total of average annual consumption of 720 Kwh and 201 Kwh respectively. Also, I developed the bar graph to represent the minimum energy consumed by washing machine, as the power rating of machine is quite efficient.



After this, I checked the amount of energy consumed in heating and cooling purposes. We used many heating devices only in season. In Perth the winter season mainly last from May till August in which high heating demand arises for space and water heating. At this time, appliances that are used in the domestic house is Water heater with a power rating of 4000 Watt and Space heater with a rating of 1500 Watt. High electricity bill is charged due to high consumption of hot water for washing, bathing etc. with an annual consumption of almost 30% of total electricity whereas, the cooling appliances are used in the summer season mostly that lasts from October till February in which the air-conditioning consumes highest share of electricity. I examined that the chosen house was using three Split air conditioners that run for 9 hours each day on an average day of summer and consume 27 kWh of energy on a particular day along with box and ceiling fans that are energy efficient and consumed less energy comparatively. Therefore, from the calculations, I obtained the average energy consumed per day, per month, and per year for heating appliance (kwh) for water heater as 16, 480, and 2400 respectively, while for space heater it was 10.5, 315, and 1575 respectively. But, for cooling appliances, I get the following results for 3 Split Air conditioners 27, 810, and 5670 respectively, for box fan 14

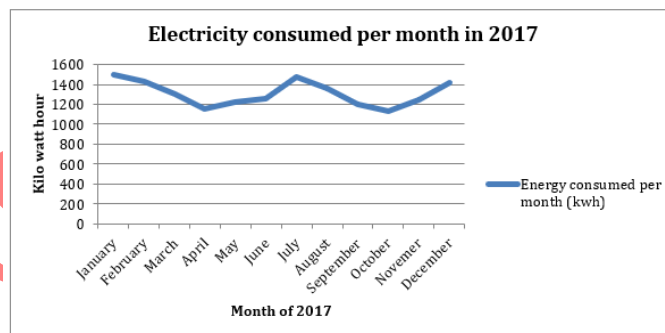
Name: PROFESSIONAL CIVIL ENGINEER - QUANTITY SURVEYOR

0.24, 7.2, and 50.4 respectively, and for three ceiling fan 1.9, 57, and 399 respectively. By representing the heating and cooling energy consumption throughout the year, I made it clear that 56% of electricity is used by air- conditioners followed by water heating that comprise of 24% of electricity consumption share in the below pie chart.



CE 3.7

I read the past year’s electricity bill provided by Synergy Energy to analyze the monthly electricity bill in order to understand the electricity tariff and seasonal effects of energy consumption. I noticed that the highest consumption of electricity was in the month January and July 2017 due to seasonal variation. In the month January, the temperature of the area was touching 40 degree Celsius due to summer weather. This directly increased the usage of air conditioners to cool down the inner space due to which maximum electricity units were consumed in January that was 1503 units and the electricity bill recorded as the maximum of \$426.72. Apart from that, the winter season demands water heating and space heating and the maximum usage was in the month of July where the temperature fallen below 12 degree Celsius and the consumption reached up to 1475 units in winter season. I also plotted the line graph to observe the minimum usage of electricity was in the month of April and October due to moderate temperature in which nor the excessive heating or cooling.



Also, I estimated the consumption of gas in the year of 2017 to 2018. As most of the cooking is done through electric oven and microwave, I noticed that the consumption of cooking gas was very low in the house. The supplier of natural gas in the area of Boora goon is Alinta Energy and the average daily energy consumed through gas was 4 units that correspond to 3.07 kWh. Thus, the average monthly and annually energy consumed was 92 and 1105 Kwh. Further, I also found out that the average annual gas consumption is around 1105 units with a monthly cost of \$25.05. Afterward, I estimated the fuel consumption. There were three vehicles used by the residents of the house namely Hyundai, Civic and Ford falcon. Out of three, Hyundai Getz was being used the most for the delivery purpose and having maximum fuel consumption of 6 liter per day and total energy of 20880 kwh consumed annually.15

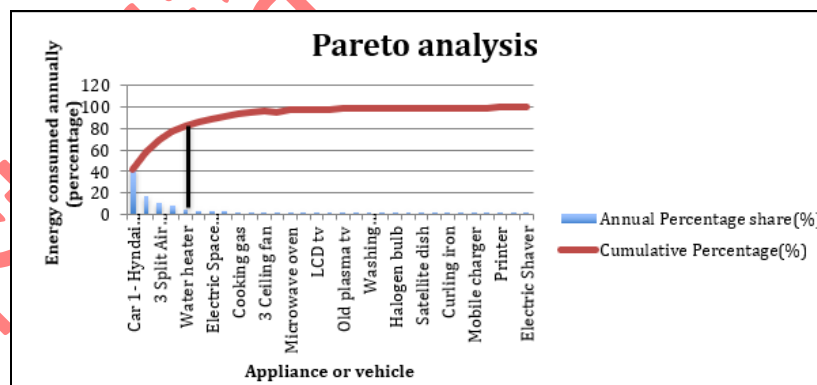
Name: PROFESSIONAL CIVIL ENGINEER - QUANTITY SURVEYOR

I combined the energy consumption of all three cars that are mostly used daily, thus the total fuel consumed an average of 33096 kWh of energy in the year 2017. I formulated this data with the help of fuel receipts and online transactions made at gas stations for unleaded 91 fuel that is being used in all the three cars. Lastly, I converted the total energy consumed through electricity, fuel and cooking gas to mega joule per annum, it was calculated that the average energy consumption of 58 Aldridge Boora goon, 6154 in the year 2017 was 49913.15 kwh that is equal to 179687 Mega joules.

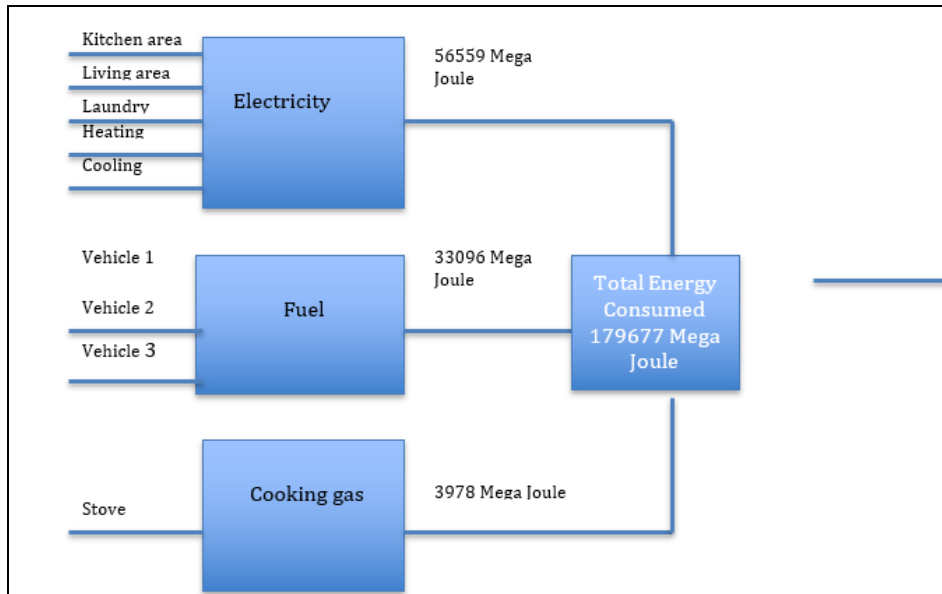
Energy consuming device	Average annual energy consumption (Kwh)	Average annual energy consumption (mega joule)
Motor Vehicles	33097	119149
Heating/ Cooling	10095	36342
Kitchen electric appliances	3528	12700
Laundry appliances	1132	4075
Natural cooking gas	1105	3978
Living room appliances	484.55	1744
Electric lightings	450	1620
Others	21.6	77.76
Total	49913.15	179687

CE 3.8

To determine the highest energy consuming device or sector, I performed Pareto analysis of the analyzed data by arranging the energy consuming devices in the descending order and I also determined the cumulative percentage share of each device. This includes all the vehicles, electric appliances and gas-consuming units of the house. Then, I developed the a multi graph that includes bar graph with the readings of individual device energy consumption and the line graph represents its cumulative percentage.



Through this line graph, I analyzed the 80/20 share of energy consumption in which Car 1- Hyundai Getz consumed 41.8% energy, Car 2- Honda Civic consumed 16.8% energy, 3 Split Air conditioners consumed 11.36% energy, Car 3- Ford Falcon consumed 7.6% energy, and water heater consumed 4.6% energy. These all were the highest energy consuming areas. Then, I developed the energy balance diagram which is shown below:



I divided the total energy consumed into three sectors namely electricity, fuel and cooking gas, which describe the flow of energy consumption in the domestic house through a mass balance diagram with a total of 179677 Mega Joule on an average in the year 2017.

CE 3.9

I developed the audit report in which I summarized all findings of energy consumption data and provided recommendations for energy efficiency. I discussed the details mentioned in the report with the supervisor in the project meetings and often made changes according to his recommendations. I suggested different modification in current energy consuming areas to reduce 10% of total energy to increase the vehicle engine efficiency, automated lightening system, etc. Moreover, during the project, I obeyed international standards to calculate the energy consumption accurately and implemented safety standards as well to keep the environment safe.

d) Summary:

CE 3.10

In this project, I determined the different energy consumption devices based on their power rating in a domestic house. On the basis of personal energy audit analysis and electricity bills and fuel transactions, it is clear that the air conditioning and water heating consumes the maximum amount of electricity and the vehicle with model year of 2004 is inefficient and consumes maximum energy. Based on the Pareto Analysis and Energy Mass Balance Diagram the highest consuming energy devices were required to be properly maintained to have a 10% and 40% energy reduction target.

PROFESSIONAL ENGINEER

Summary Statement

Competency Element	A brief summary of how you have applied the element	Paragraph in the career episode(s) where the element is addressed
PE1 KNOWLEDGE AND SKILL BASE		
PE1.1 Comprehensive, theory-based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	For this designing procedures in my project, I applied the basic engineering knowledge that I gained from the courses I studied during post-graduate study	CE 1.6, CE 1.7, CE 1.8, CE 2.6, CE 2.7, CE 3.6, CE 3.7, CE 3.8
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics and computer and information sciences which underpin the engineering discipline	Calculations and analysis are crucial to determine heat losses inside the mining hut building, to calculate rate of non-solar heat loss or gain, total amount of consumption of energy, etc.	CE 1.7, CE 1.8, CE 2.6, CE 3.6, CE 3.7, CE 3.8
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	I installed the Arnowa software record per second data related for energy measurement and also assessed the thermal performance of the building by using Accurate Sustainability Software	CE 1.6, CE 1.7
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	Throughout the research projects, I get myself in-touch with the latest technologies and studied many articles to get better understanding of IOT based energy monitoring	CE 1.5, CE 2.5, CE 2.8, , CE 3.5
PE1.5 Knowledge of contextual factors impacting the engineering discipline	I followed international standards construction to justify the design work	CE 1.9, CE 3.9



<p>PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the specific discipline</p>	<p>My designs were crafted after consulting different engineering standards and project requirements</p> <p>My designs conformed with engineering standards to display authenticity of my work</p> <p>I followed safety procedures set by university faculty and other additional safety processes</p>	<p>CE 1.6, CE 1.7, CE 1.8, CE 2.6, CE 2.7, CE 3.6, CE 3.7, CE 3.8</p> <p>CE 1.9, CE 3.9</p> <p>CE 2.8, CE 3.9</p>
<p>PE2 ENGINEERING APPLICATION ABILITY</p>		
<p>PE2.1 Application of established engineering methods to complex engineering problem solving</p>	<p>I faced all the challenging situation like a competent engineer and learned from my mistakes</p>	<p>CE 1.6, CE 1.7, CE 2.7, CE 3.6, CE 3.7,</p>
<p>PE2.2 Fluent application of engineering techniques, tools and resources</p>	<p>The use of various Software tools like Accurate Sustainability Software were crucial to carry out designing procedures</p>	<p>CE 1.6, CE 1.7</p>
<p>PE2.3 Application of systematic engineering synthesis and design processes</p>	<p>I applied engineering methods of to monitor the energy system of the mining hut, to improve the energy efficiency of the house, and to perform energy audits</p>	<p>CE 1.6, CE 1.7, CE 1.8, CE 2.6, CE 2.7, CE 3.6, CE 3.7, CE 3.8</p>



<p>PE2.4 Application of systematic approaches to the conduct and management of engineering projects</p>	<p>I got the chance to work with the Climate Change Response Pvt Ltd who helped me in the installation phase of monitoring devices at the monitored site</p>	<p>CE 1.5, CE 1.6</p>
<p>PE3 PROFESSIONAL AND PERSONAL ATTRIBUTES</p>		
<p>PE3.1 Ethical conduct and professional accountability</p>	<p>I incorporated different standards and engineering norms to justify my actions</p> <p>I displayed my competitive risk management skills and ensured the implementation of the safety standards</p>	<p>CE 1.9, CE 3.9</p> <p>CE 2.8, CE 3.9</p>
<p>PE3.2 Effective oral and written communication in professional and lay domains</p>	<p>I showcased my communication skills by properly making the meeting schedule and actively participating in group discussions</p>	<p>CE 1.9, CE 2.5, CE 2.8, CE 3.9</p>
<p>PE3.3 Creative innovative and proactive demeanour</p>	<p>These projects were great learning experiences for me as I interacted with my different engineers of the Climate Change Response Pvt Ltd</p>	<p>CE 1.5, CE 1.6</p>
<p>PE3.4 Professional use and management of information</p>	<p>I created the thesis document by using the MS-Word software to fulfill the research project requirement</p>	<p>CE 1.9, CE 2.8, CE 3.9</p>

