Product Carbon Footprint Report

Product Name: Air Cooler (Residential & Commercial)

Product Model: Product A: Winter+ & Product B: Venticool 20

Report Version: 2

Symphony Limited.

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General information	
Report Number	Version 2
Date of Issue	2022-05-05
Report Traceability	First report
Company Name	Symphony Limited.
Address	Symphony House, FP12-TP50, Sarkhej - Gandhinagar Hwy, Bodakdev, Ahmedabad, Gujarat 380059.
Standard	ISO 14040 Life Cycle Assessment (LCA) –Principle and Framework ISO 14044 Life Cycle Assessment (LCA) –Requirements and Guidelines PAS 2050 Specification for The Assessment of the Life Cycle Green House Gas Emissions of Goods and Services
Software tool used	openLCA 1.11.0
Product Description	Air Cooler
Product Model	Winter+ & Venticool 20
Weight	15.015 KG & 55.15 KG
Functional Unit	5 years (lifetime of use)
Boundary	Cradle to grave

INFINITE SOLUTIONS

RESULT AND INTERPRETATION		
GHG Emission	Winter +: 1.21 t CO_2e & Venticool 20: 3.54 t CO_2e.	
Identify Hot Spot	For Winter + & Venticool 20, the Use phase is the Hotspot	
Conclusion	Use Phase is 95.92% of CC for **Winter +** & 94.87% for **Venticool 20**. Use the more efficient motor in the air cooler while manufacturing i.e. BLDC motor. Because there are no brushes rubbing against anything, no energy is lost due to friction. That means brushless motors are more energy-efficient than brushed drills.	
Winter + & Venticool 20 picture		

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1 GOAL AND SCOPE DEFINITION

1.1 Goal definition

Symphony aimed to carry out a Carbon Footprint assessment for the air cooler products Winter + and Venticool 20. Through this Carbon Footprint assessment, Symphony can use the results to findout what the most important contributors are within the upstreaming, manufacturing, and downstream process chain of the air cooler.

Furthermore, elements of the process chain that can potentially be improved in the future can be identified through this investigation.

The goal of this report is to estimate an indicator for the Climate Change (CC) impact category of the air cooler during its lifetime.

1.2 Scope definition

1.2.1 Function Unit

The applicable functional unit is the product's lifetime of use. All results below will therefore be expressed per 5 years of use. The reference flow is 5 years of usage.

1.2.2 System Boundary

The studied product system is one air cooler used to cool the space area. To evaluate the life cycle of greenhouse gas (GHG) emissions in tons of carbon dioxide equivalents (t CO_2e) of both Winter+ & Venticool 20. The lifetime of the product is 5 years. The product is transported from OEM, various locations in India to various CFA in India.

The system boundary of this evaluation is set to include the following life cycle stages:

– Raw Materials
– Product Manufacturing
– Distribution
– Use
– End of Life

The system boundary can be shown in the following Figure 1 Life Cycle Process Map of the air cooler.

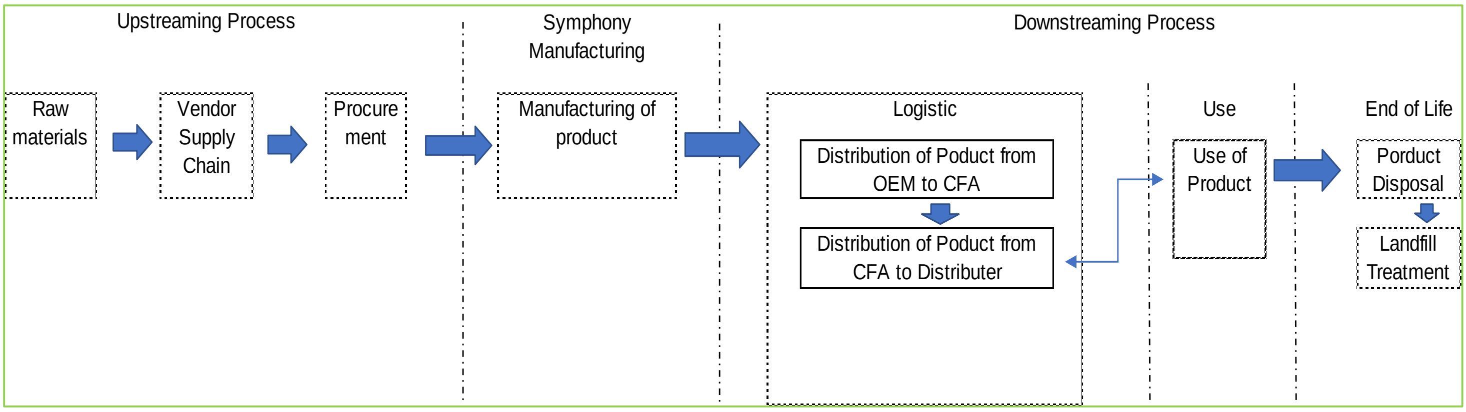


Figure 1 The Life Cycle Process Map

This air cooler system boundary includes all of the life cycle stages of the product, including raw material, product sub-part manufacturing and transportation, the air cooler assembling and packaging, main distribution steps, use phase, and end of life (disposal) phase.
The capital goods (e.g. subsidiaries, buildings, etc.) that are not directly associated with the production of this product are excluded.

2 LIFE-CYCLE INVENTORY

2.1 Data collection

2.1.1 Raw material acquisition and Production

The raw materials phase includes:
- Raw Material extraction such as plastics, metals, etc.
- Production/generation of energy used for raw material manufacturing.
- Production of water used for manufacturing.
The packaging material of raw material/components is not included in the system boundary.

The manufacturing of product sub-parts includes:
- Transportation of raw materials to product main components manufacturing;
- Manufacturing of product sub-parts and the generation of associated process waste andits treatment;

2.1.2 Distribution

The distribution phase includes:

- The transportation process from the manufacturing factory i.e OEM to the various CFA's in India.
- The transportation process from the various CFA's to the various distributer available in India.

The transportation distance from the manufacturing factory i.e OEM to various CFA's is about 2763375 km by truck, and the transportation distance from various CFA's to distributer is about 4697604 km by truck.
Data on the distance from the manufacturing factory to the various CFA and CFA to various distributer are provided by the symphony.

2.1.3 Consumer use

The function of an air cooler is to cool the area.
For the use phase, the assumptions were taken from the consumer view for how many times consumers use the air cooler and for how many days in a year they use the air cooler.

Assumptions:

Sr. No.	WINTER +	VENTICOOL 20
1	Cooler runs in a year for 6 months	Cooler runs in a year for 6 months
2	Cooler run in a day for 8 hrs.	Cooler run in a day for 8 hrs.
3	The electricity required for the cooler per hour is 0.2 kWh. So for a year, the electricity requirement is 292.8 kWh.	The electricity required for the cooler per hour is 0.58 kWh. So for a year, the electricity required is 849.12 kWh.
4	The water consumption per hour is 9L.	The water consumption per hour is 37L.
5	****Note: Life of the product is 5 years, so electricity & water amount will be required for 5 years in-use phase.**	

Table 1 Use phase assumptions for a cooler

2.1.4 End-of-life

The GHG calculation is based on databases, and the assumed waste treatment mode is assumed that after the product life ends the waste will go to the landfill and not for recycling.

3 Product Carbon Footprint Data Calculation

3.1 Raw Material Phase

The following picture shows the tCO_2e emission of different components for the raw material phase. We can see that the highest emission is from the PP for the whole raw material phase for Winter + & Venticool 20.

Raw Material, Unit kg CO_2eq		
Indicators	**Product A Winter +**	**Product B Venticool 20**
PP	7.08	56.54
Plastic – ABS	3.56	-
Aluminum Sheet	-	16.74
Steel	2.78	-
Nylon 6	-	16.56
Paper & Cardboard	1.34	7.15
Others	4.67	24.58
Total (kgCO_2 eq)	**19.43**	**121.57**
tCO_2 eq	**0.019**	**0.12**

Table 2 Product Carbon footprint analysis by a Raw Material process

3.2 Product Manufacturing Phase

Here, we can see that the highest emission is from the electricity which is required to manufacture a product. For both product A & Product B, more impact is of electricity.

Product Manufacturing, Unit kg CO_2eq		
Indicators	**Product A Winter +**	**Product B Venticool 20**
Electricity	12.99	42.45
Water	0.031	0.031
Total (kgCO_2 eq)	**13.02**	**42.48**
tCO_2 eq	**0.0130**	**0.04**

Table 3 Product Carbon footprint analysis by a Manufacturing process

3.3 Distribution Phase

In the distribution phase, the electricity is having more impact on GHG emission. Because, after a product is ready at OEM then the product is transported to CFA and from CFA the product is transported to distributer. After an electricity, the transport is having the second most impact on GHG emission.

Distribution Phase, Unit kg CO_2eq	
Indicators	**Unit kg CO_2eq**
Electricity	16.59
Transport	0.0035
Total (kgCO_2 eq)	**16.59**
tCO_2 eq	**0.017**

Table 4: Carbon footprint analysis for the Distribution phase

3.4 Consumer use phase

For the use phase, electricity has a higher impact on GHG emissions. The assumptions were made according to the average household use of a cooler. The detailed assumptions are given in section 2.1.3.

Consumer use phase, GHG Emission calculations for both products are as below:

Consumer Use , Unit kg CO_2eq		
Indicators	**Winter +**	**Venticool 20**
Electricity	1156.56	3354.02
Water	0.023	0.023
Total (kgCO_2 eq)	**1156.58**	**3354.05**
tCO_2 eq	**1.16**	**3.35**

Table 5 Product Carbon Footprint analysis for the use phase

3.5 End of Life Phase

In the end of life, the product's life ends after 5 years. After the life ends the product will go to a landfill and for this, the impact analysis was done.

GHG Emission calculations for the End of life phase for both products are as below:

End of life, Unit kg CO2eq		
Indicators	**Product A**	**Product B**
Air cooler	0.133	0.356
Total (kgCO_2 eq)	**0.133**	**0.356**
tCO_2 eq	**0.00013**	**0.00036**

Table 6 Product Carbon Footprint analysis for the End of Life

The collected primary data of the raw material and manufacturing of Winter+, and VENTICOOL 20 product includes process energy consumption, transportation information, use phase power consumption, and total processes output flows. Most of the process data were collected in the FY 2021-22.

The generic data (secondary data) used in the OpenLCA 1.11.0 software for the GHG emission calculation is from the databases elcd 3.2_greendelta_v2.18. The used datasets were selected close to the year 2020 and reflect also state-of-the-art production data.

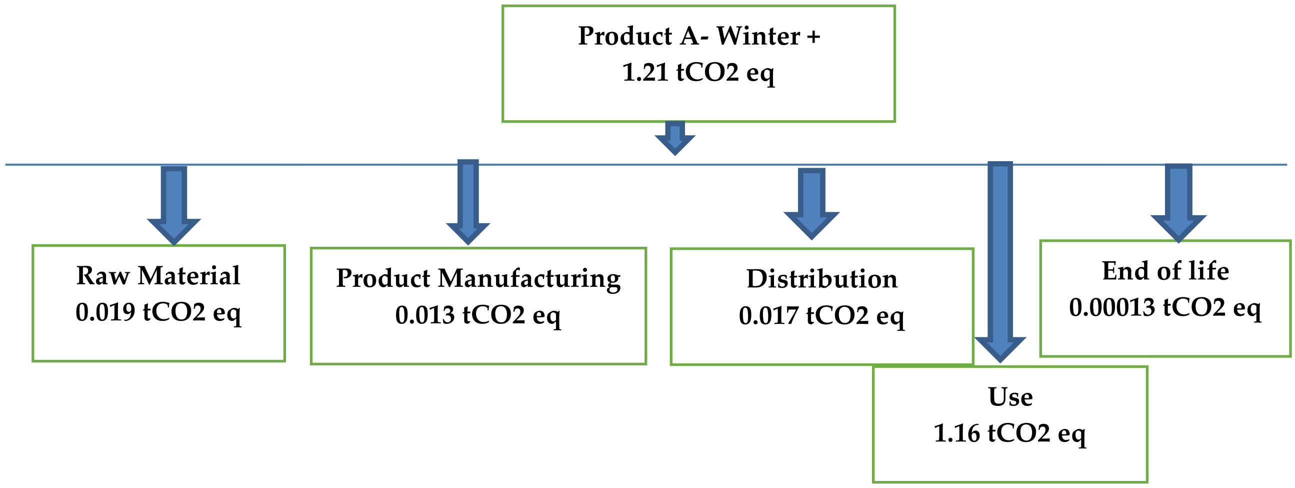


Figure 2 Life cycle model of the GHG emission calculation for product A in openLCA

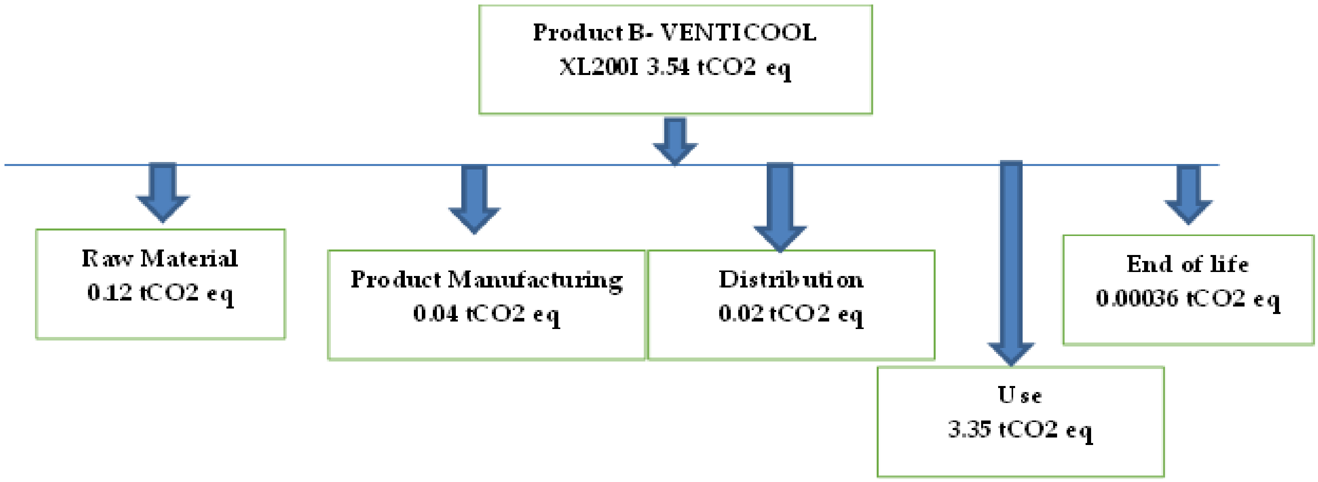


Figure 3 Life cycle model of the GHG emission calculation for product B in openLCA

4 Life Cycle Impact Assessment

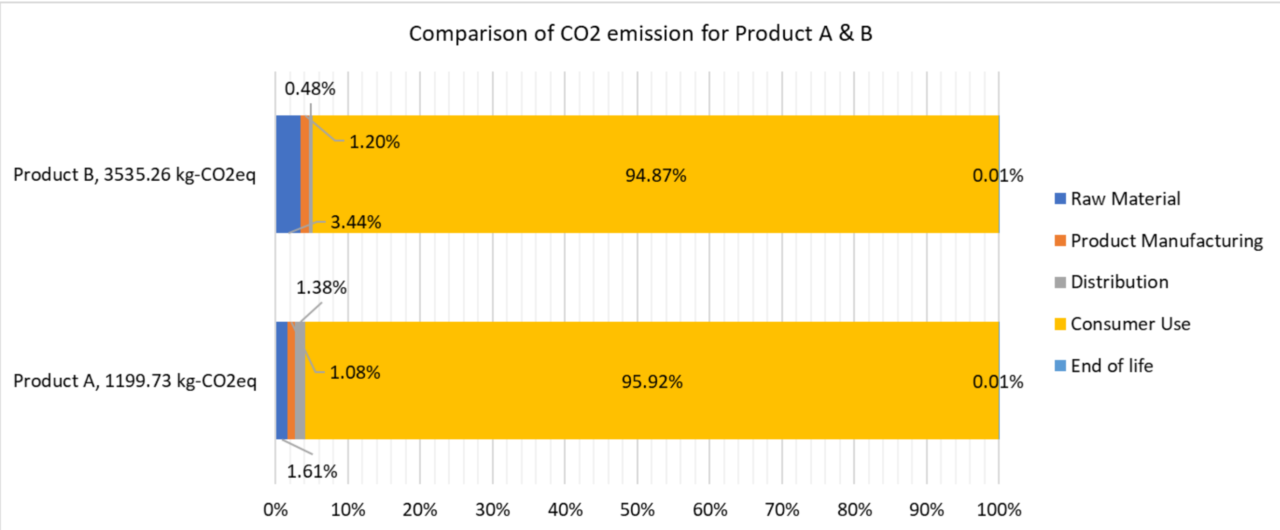
The growing concerns of global warming draw particular attention to Symphony to GHG (Greenhouse Gases) emission along the whole life cycle of Product A & product B i.e. Winter+ & Venticool 20.

Based on the methodology, assumptions, and modeling described in this report, the resulting greenhouse gas (GHG) emissions in relative scale to Global warming, in a ton of carbon dioxide equivalents (t CO2e) of the Winter+ is **1.21 t CO2eq**, and for Venticool 20 is **3.54 tCO_2eq**.

Impact Category, Unit (tCO_2eq)		
Phase	**Product A Winter+**	**Product B VENTICOOL 20**
Raw Material	19.43	121.57
Product Manufacturing	13.02	42.48
Distribution	16.59	16.82
Consumer Use	1156.58	3354.05
End of life	0.13	0.36
Total (kgCO_2 eq)	**1205.74**	**3535.26**
tCO_2 eq	**1.21**	**3.54**

Table 7 Product Carbon footprint analysis

In terms of life cycle phases, the result can be shown in Figure 5. It shows that the highest emission occurs in the consumer use phase, which is 95.92% for Product A & 94.87% for product B for the whole life cycle of GHG emissions.



In a complete life cycle of both products, the consumer use phase impacted more on GHG emission compared to other phases. The distribution phase and end of life phase have a negligible impact on GHG emissions for the complete life cycle for Winter + & Venticool 20.

5 Air Cooler Vs Air Conditioner

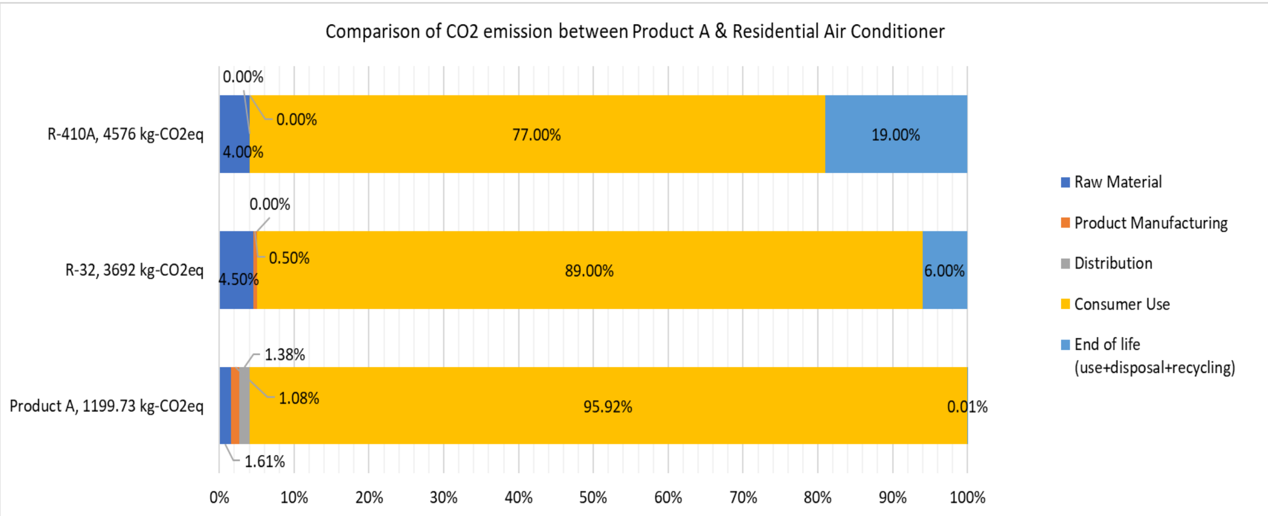
5.1 Residential air cooler Vs air conditioner

Here, the complete life cycle for product A and the residential air conditioner with a different type of refrigerant used i.e., R-32, and R-410A is shown below. The residential air conditioner is of 0.8 TR capacity and the air cooler Winter+ is of 3.5 TR and both product life is taken same i.e., 5 years.

As you can see below, the impact on GHG emission of life cycle phases for air conditioners is higher compared to air coolers. The different refrigerant types impacted differently GHG emissions, R-32 is environmentally friendly compared to R-410A hence its impact on GHG emission is less compared to other refrigerants i.e., R-410A.

Phases	Winter+	RAC, R-32	RAC, R-410A
Raw Material	19.43	166.14	183.04
Product Manufacturing	13.02	18.46	0.00
Distribution	16.59	0.00	0.00
Consumer Use	1156.58	3285.88	3523.52
End of life (use+disposal+recycling)	0.13	221.52	869.44
Total (kgCO_2eq)	**1205.74**	**3692.00**	**4576.00**
tCO_2 eq	**1.21**	**3.69**	**4.58**

Table 8 Carbon footprint analysis for Product A, RAC R-32, & RAC R-410A.



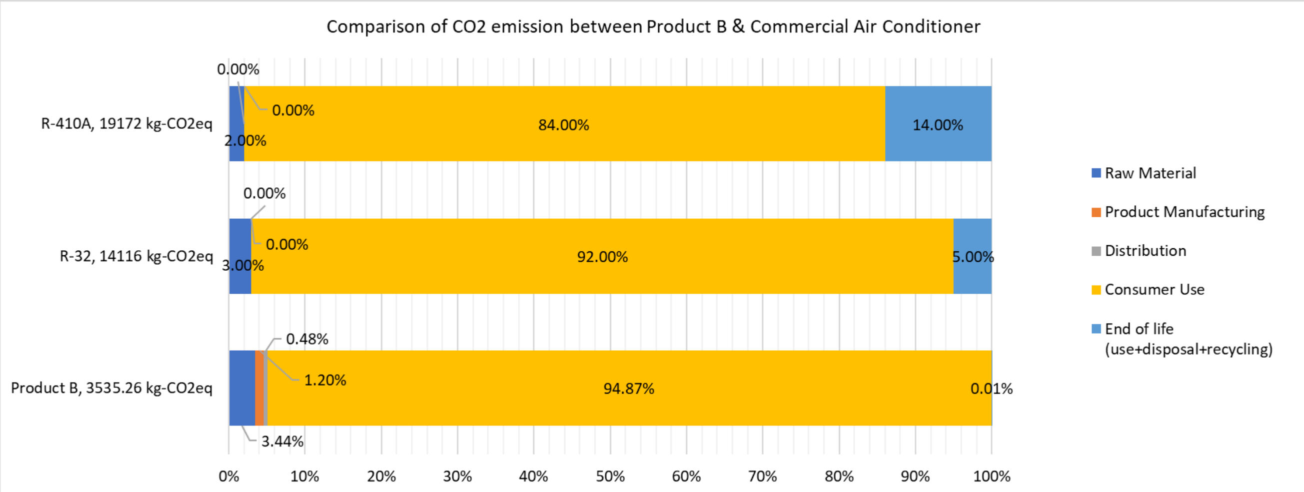
5.2 Commercial air cooler Vs Air conditioner

Here, the complete life cycle for product B and the commercial air conditioner with a different type of refrigerant used i.e., R-32, and R-410A is shown below. The commercial air conditioner is of 4.0 TR capacity and the air cooler Venticool 20 is of 14 TR and both product life is taken same i.e., 5 years.

As you can see below, the impact on GHG emission of life cycle phases for air conditioners is higher compared to air coolers. The different refrigerant types impacted differently GHG emissions, R-32 is environmentally friendly compared to R-410A hence its impact on GHG emission is less compared to other refrigerants i.e., R-410A.

Phases	Venticool 20	CAC, R-32	CAC, R-410A
Raw Material	121.57	423.48	383.44
Product Manufacturing	42.48	0.00	0.00
Distribution	16.82	0.00	0.00
Consumer Use	3354.08	12986.72	16104.48
End of life (use+disposal+recycling)	0.36	705.80	2684.08
Total (kgCO_2eq)	**3535.26**	**14116.00**	**19172.00**
tCO_2 eq	**3.54**	**14.12**	**19.17**

Table 9 Carbon footprint analysis for Product B, CAC R-32, & CAC R-410A.



5.3 PCF Comparison

Residential Category	Winter+	RAC, R-32	RAC, R-410A
tCO_2 eq/TR	**0.345**	**4.615**	**5.720**
Commercial Category	**Venticool 20**	**CAC, R-32**	**CAC, R-410A**
tCO_2 eq/TR	**0.252**	**3.529**	**4.793**

Table 10 PCF Comparison for Residential & Commercial category

From the above table, it is observed that the GHG emission of Symphony's air cooler is lower than the GHG emission for air conditioners for both categories, i.e., the residential & commercial.

6 Conclusions

The main interpretations and conclusions of this evaluation are described hereinafter:

- The results for different phases and manufacturing processes, please see section 3.
- The highest impact of the air cooler GHG (Greenhouse Gases) emission occurs from the use phase (95.92% of the resulting life cycle GHG emission) for Product A, and 94.87% of the use phase for Product B. The GHG emission of use phase occurs from the loss of electric power (details please see section 3), and water used. For air conditioners, the result is similar to an air cooler. The use phase has more impact on the GHG emission compared to the remaining phases in the life cycle of the product.
- The Symphony's air cooler GHG emission is lower than the GHG emission for an air conditioner for both the residential category as well as commercial category.
- The CO_2 emission for the use phase is more because of using the less efficient motor in the air cooler. It is suggested to use Brushless Direct Current Motor (BLDC) motor to reduce the CO_2 emission as a BLDC motor is more efficient. Because there are no brushes rubbing against anything, no energy is lost due to friction. That means brushless motors are more energy-efficient than brushed drills.