UNIVERSITY OF HULL

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BRANDFIXX

European Union
European Regional Development Fund

CARBON FOOTPRINT CALCULATION
A CASE OF BRANDFIXX

REPORT BY
HULL UNIVERSITY BUSINESS SCHOOL

EXECUTIVE SUMMARY

Brandfixx is a revolutionary decal company that delivers modular vehicle branding. Its approach promises to be more versatile, easier to install, and inexpensive. Brandfixx's modular process streamlines design, production, and application by reducing cost and downtime per vehicle compared to the conventional process. Using 3D scanning, it creates a modular kit that fits almost all vehicles. Fitting, replacing/repairing, and removing modular branding is simple and straightforward.

In order to undertake this study, both the conventional wrapping process and Brandfixx's modular process are considered, and their respective carbon emissions are calculated. The calculation is done following the DEFRA's guidance on measuring and reporting Greenhouse Gas (GHG) emissions. In addition, the resource used in both processes is calculated and compared alongside the waste produced.

While comparing the results from the calculation the key findings are as follows.

1. Brandfixx's modular process generate up to 70% less CO2 than the conventional wrapping process.
2. Brandfixx's modular process generates up to 40% less waste than the conventional wrapping process.
3. Brandfixx's modular process does up to 55% of resource savings than the conventional wrapping process.

The results and findings indicate that Brandfixx has taken the correct course of action by adopting their modular process. This has provided them with a competitive advantage in terms of client satisfaction, while also enhancing their profitability & furthering progress to net zero.

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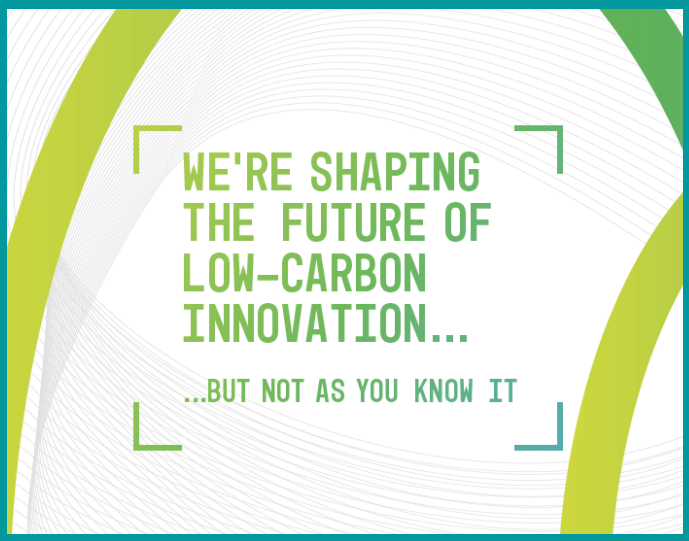
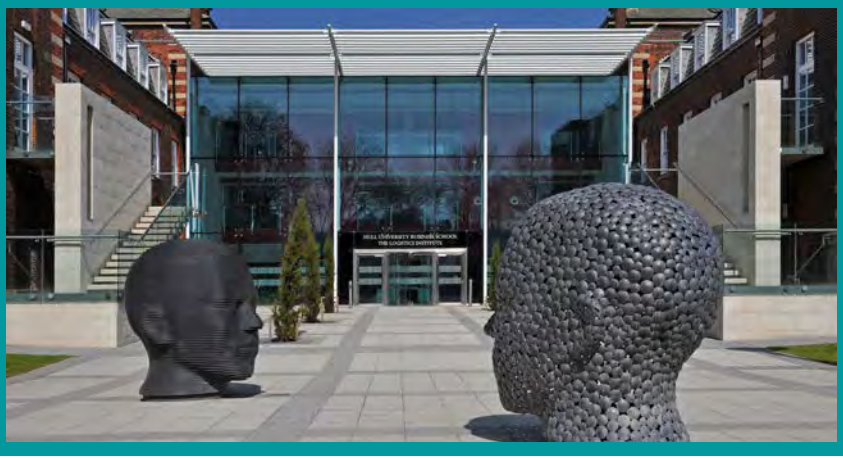
ABOUT PROJECT



Aura Innovation Centre (AIC): is one of the great initiatives of The University of Hull's commitment towards combating climate change Since early 2020, the Aura Innovation Centre at Bridgehead Business Park, Hessle, has provided several innovative low-carbon projects, as well as new ideas by bringing together specialists from the University of Hull and businesses in the Humber region and beyond. This £12 million innovation centre serves as a "front door" for the University of Hull, providing businesses with easy access to cutting-edge facilities, specialist-funded support, and a space to innovate and collaborate with academic and industry experts. Hence, promoting the growth of clean businesses.

In April 2018, the university obtained £4 million from the European Regional Development Fund (ERDF) for the construction of the Aura Innovation Centre (AIC) and a programme of innovation assistance for small and medium-sized enterprises (SMEs) in the offshore wind and low carbon sectors in the Humber region.

In this project, a team from Hull University Business School (HUBS) academics were involved in collaborating with one of the SMEs in the Humber region in order to increase their competitiveness through low carbon research, development, and innovation. The HUBS team worked with Brandfixx, a vehicle branding-decal firm, to explore its unique modular vehicle branding process being more efficient and less carbon-intensive compared to its competitors.



The HUBS team included the following members:

Principal Investigator (PI): **Dr Md Mamoon Al Bashir**
Co-Principal Investigator (Co-PI): **Dr Sushma Kumari**
Research Assistants (RAs): **Mahmudul Hasan**
Oladipupo Ogundolapo
Ryan Fuad Hibaturrahman

This study followed the UK Government's Department for Environment, Food and Rural Affairs (DEFRA)'s guidance for the measurement and reporting of local businesses' CO2 footprints. DEFRA's guidance includes comprehensive advice for measuring and reporting Greenhouse Gas (GHG) emissions. It is based on the GHG Protocol, the globally recognised standard for the accounting and reporting of GHG emissions by corporations. This implies that it conforms to a number of widely used national and worldwide voluntary measuring and reporting methods, such as ISO 14064-1 and the Carbon Trust Standard.

ABOUT BRANDFIXX

Brandfixx, a subsidiary of Vehicle Livery Solutions (VLS) was founded in the year 2020 by father-and-son team David and Greg Saunderson to solve the industry's problems associated with the conventional method of branding a vehicle.

Brandfixx is a revolutionary vehicle branding decal company that provides modular vehicle branding services. Its approach aims to be more adaptable, easier to install, and cheaper than the conventional approach. Since it has been developed to be a quicker and more economical technique for vehicle branding, Brandfixx's modular process streamlines the design, production, and application processes, resulting in significant cost savings as well as downtime per vehicle as compared to the conventional process.

Using state-of-the-art 3D scanning technology, it produces a modular kit that precisely fits each panel of the car. As a result, wrapping, replacing/repairing and removing its modular branding becomes simple and effortless.

BRANDFIXX AT A GLANCE.

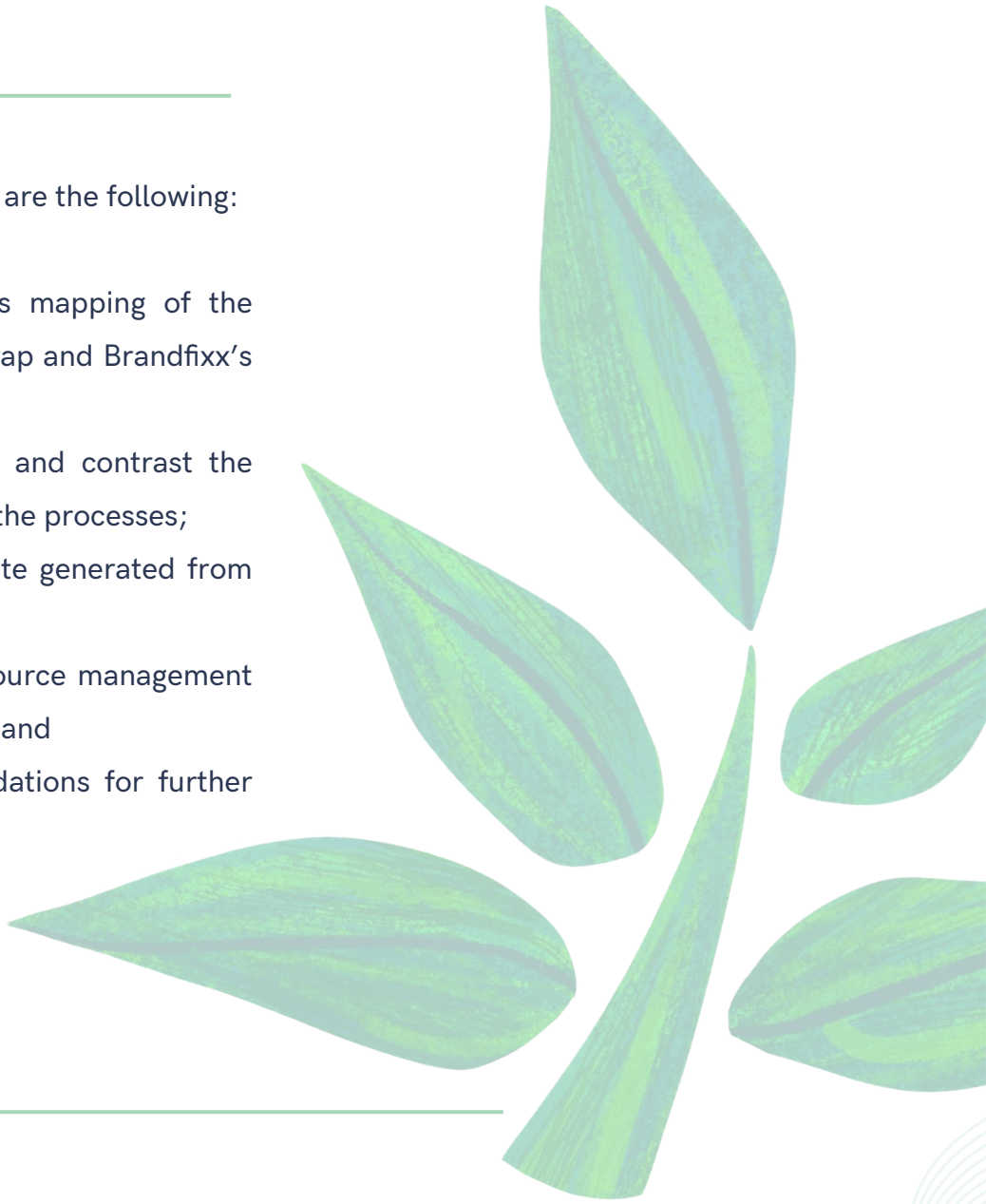
Fast, affordable, high-impact branding for any vehicle

- 99% less use of heatgun
- Half the labour and time
- Less waste of materials
- Repairs can be swapped in minutes
- Any vehicle, from Cars to HGVs

OBJECTIVES OF THE STUDY

The objectives of this study are the following:

1. To outline the process mapping of the conventional vehicle wrap and Brandfixx's modular process;
2. To calculate, compare and contrast the CO2 emission for both the processes;
3. To understand the waste generated from both the processes;
4. To understand the resource management for both the processes; and
5. To suggest recommendations for further improvement.



RESEARCH METHOD

In this section, the research method of this study has been briefly explained. At first, the sources of the emissions are investigated in order to sketch the carbon footprint. As we know, there are two different categories of carbon sources: direct and indirect.

For the purpose of this study, only the direct sources (those are based on the quantity of electrical energy consumed) have been taken under consideration. Electrical energy consumption of the equipment used in both conventional process and Brandfixx's modular process are calculated. For this purpose, we have looked at the equipment of both the processes involved. The conventional process employs a desktop computer, a printer, a single hot laminator, and a Heat Gun, whereas the Brandfixx modular process employs a 3D laser scanner, a laptop, a desktop computer, a printer, a single hot laminator, and a cutting machine.

In order to achieve an unbiased and uniform result, Brandfixx demonstrated both processes at AIC's premise and provided videographic evidence detailing the overall process.

HUBS team worked on the following three factors to calculate the carbon output of these types of equipment:

1. The wattage consumed by the equipment;
2. The operating time for the equipment; and
3. The carbon constant equivalent as determined by DEFRA.

DEFRA has equivalent constants for each class and type of carbon source. Since all equipment mentioned above uses the same electrical source (UK Electricity), only one constant equivalent which is 0.19338 KgCO2e [1] is used. Furthermore, the following formula has been applied to calculate the CO2 emission of both processes:

Carbon Footprint = Σ (Activity data) X (Activity emission factor) [2] .....equation (i)

[1] GOV.UK, 2022. Greenhouse gas reporting: conversion factors 2022. [online] Available at: <https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2022> [Accessed 9 August 2022].

[2] GHGPROTOCOL.ORG, 2022. [online] Available at: <https://ghgprotocol.org/sites/default/files/standards_supporting/AppendixD.pdf> [Accessed 9 August 2022].

DATA COLLECTION

To facilitate this study, Brandfixx has carried out an experiment demonstrating both conventional and modular processes (including the decommissioning process) using one of their most worked-on vans; the Ford Transit Custom Van. As a result, we can affirm that all estimations of time, material, and energy required within each process remained accurate.

The HUBS team gathered data on the electricity requirements for the equipment needed for both processes from three sources. These include:

1. Extracting the electrical requirements of the equipment, provided online by the manufacturer;
2. Direct inquiries to the manufacturers of the equipment via emails and phone calls, requesting information about the equipment's electrical requirements; and
3. Information of equipment provided by Brandfixx.

Furthermore, three data collection methods were applied to estimate the time needed for both the vehicle wrapping processes. These include:

1. Information received from the Brandfixx team during interviews on the time estimates of each stage of their specific processes;
2. Visit Brandfixx to determine the lengths of each procedure and watch the operations in action; and
3. Time estimates derived from real-time videos provided by Brandfixx and AIC, showing the entire vehicle wrapping operation for both processes.

Finally, data on waste for both processes were collected with the help of the Brandfixx team.

PROCESS MAPPING

Process mapping is a technique for visualising a process and its associated processes. Effective mapping from beginning to end facilitates the organization's understanding of the entire process from beginning to end. This strategy may also aid in process improvement and process integration to increase the efficiency and effectiveness of an operation.

CONVENTIONAL PROCESS

Almost all the companies around the world still utilise the conventional approach to carry out their vehicle wrapping activities, costing them and thier client a lot in terms of time, resources and investment.

As mentioned earlier, we received video-graphic evidence of the conventional process from Brandfixx which was conducted at AIC's premises. The process involved a Ford Tran-sit Custom Van wrapping (the same vehicle has been used for the modular process in the later part, to correctly compare). The entire procedure has been described in detail below:

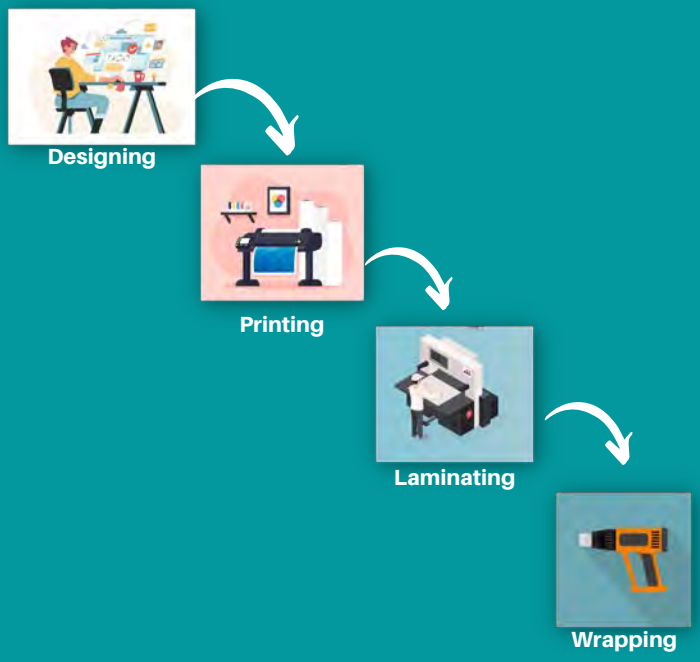
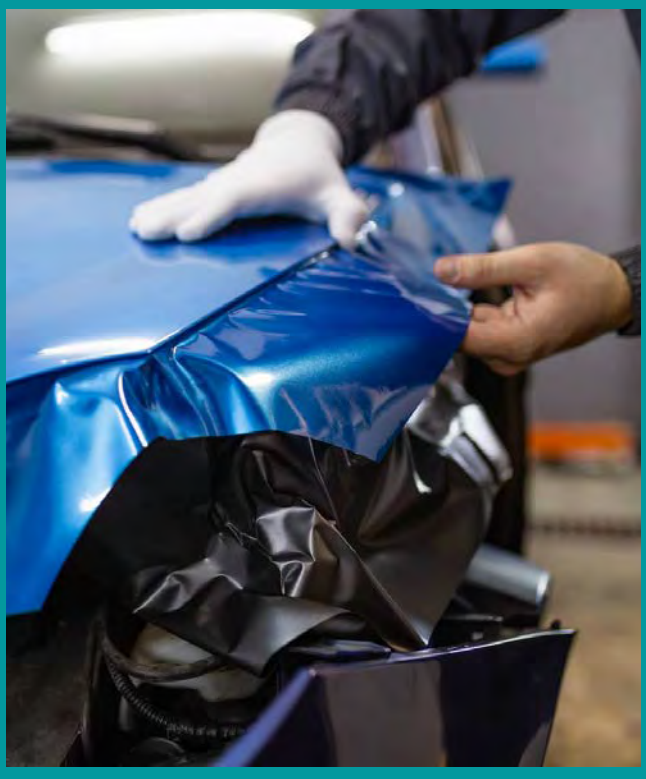


Figure 1: Step-by-step conventional process

The usual operating procedure starts with accepting an order from the customer and follows by a discussion on the desired design. The design is done by the design team and afterwards sent for printing once the design is ready. After the design has been printed, it moves on to the lamination process. Finally, the production process is completed after a thorough quality check, and the product gets ready for wrapping

In the demonstration, it took the Brandfixx designing team around 5 hours to complete the design on a desktop computer. Once the design was completed, it was printed using the Digital Print Media (1520mm width) paper and Digital Printer. This pro-cess took about 322.8 minutes (approxi-mately 5.38 hours) to print a 32.5-metre-long material.

Followed by this, the lamination process was done using lamination material and Laminator for about 20.58 minutes (approximately 0.34 hours). In the final and the most time-consuming step, vehicle wrapping was completed by using the Electric Heat Gun, this took roughly 850 minutes (approximately 14.17 hours) to complete. During this wrapping process, in order to assure appropriate positioning of the material, workers disassembled a few car parts. These included such as headlights, taillights, bumpers, etc. Additionally, it was calculated that this operation produced 4.06 Kgs of waste.



The decommissioning process involves the removal of previous stickers (i.e. wrapper) from a vehicle. This process does not happen every time, but occasionally some vehicles come in with stickers already placed on them. This operation needs to be considered in the calculation not just because of the time required to remove the old stickers, but also because doing so typically necessitates the use of a heat gun, which uses energy.

CONVENTIONAL PROCESS OF DECOMMISSIONING

In this particular case, a Electric heat gun was used throughout the decommissioning procedure, which took around 90 minutes (approximately 1.5 hours) to be completed.

PROCESS MAPPING

BRANDFIXX MODULAR PROCESS

Brandfixx follows a totally different process of vehicle branding. For an accurate comparison, the same vehicle has been used in the modular vehicle wrapping process.

The operating procedure starts with accepting an order from the customer and follows by a discussion on the desired design. However, in this stage, compared to the conventional process, the modular process needs a 3D scanning of the vehicle. This process is used to obtain the vehicle's geometric data and is only employed when the company lacks precise data of the vehicle's geometry. The process proceeds with the designing and nesting of the graphic using the geometric data.

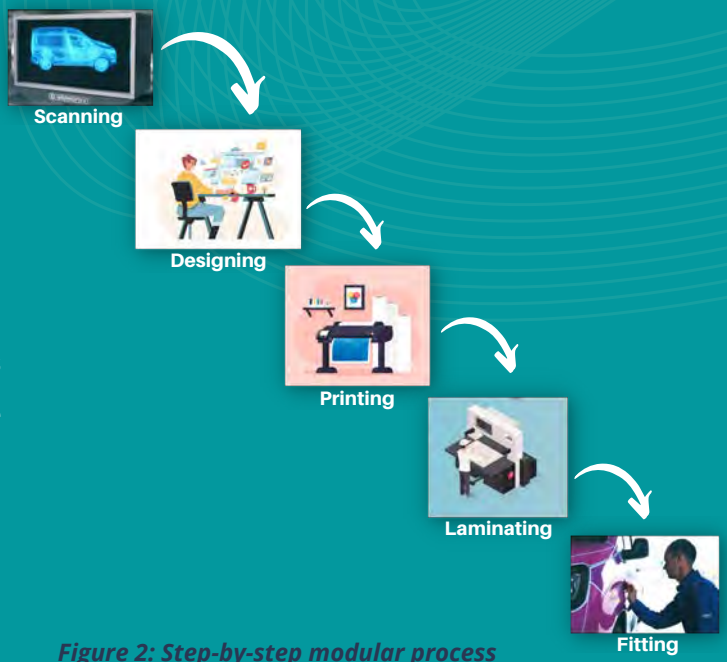


Figure 2: Step-by-step modular process

The design is done by the designing team and afterwards sent for printing once the design is ready. After the design is printed, it moves on to the lamination process which is followed by cutting. Finally, the production process is completed after a thorough quality check. The final product can be wrapped on the vehicle by Brandfixx or delivered to the customer as a DIY product to wrap themselves.

In the demonstration, Brandfixx used the 3D Laser Scanner and a laptop for about 210 minutes (approximately 3.5 hours) during the scanning process. After the scan was completed, the designing team took around 390 minutes (approximately 6.5 hours) to design and nest the graphic in the 3D scanned geometry. Once the design was completed, it was printed using Digital Print Media (1520mm width) and Digital Printer.

This process took approximately 150 minutes (approximately 2.5 hours) to print a 14.5-metre-long material. Followed by this, the lamination process was done using Laminator for around 8.37 minutes (approximately 0.14 hours). The last stage of production was cutting and trimming. Which was done using the Cutting Machine for about 17.87 minutes (approximately 0.3 hours). The finished product goes through a total quality check before it was sent for wrapping.

In the final step, vehicle wrapping was completed manually for about 255 minutes (approximately 4.25 hours) without the use of any Electric Heat Gun. Additionally, it was calculated that this operation produced 2 Kgs of waste.

MODULAR PROCESS OF DECOMMISSIONING

The decommissioning procedure took about 30 minutes (approximately 0.5 hours) without the need of any equipment. This is because the design was broken down into manageable pieces, which made it simple to decommission the vehicle without removing its individual parts. It doesn't need any equipment; thus, it doesn't contribute to CO_2 emissions.

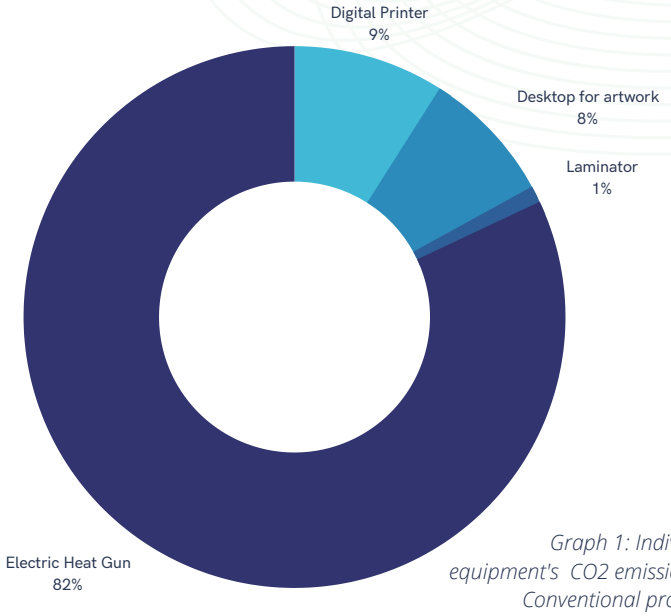
The process mapping section described above addresses objective 1 of the study.

RESULTS

In this section, we have calculated the CO2 emission of both conventional wrapping and Brandfixx's modular processes. Following equation (i), the carbon footprint of the activity (Individual equipment) is calculated by multiplying the activity data (for example, KWh electricity consumed) by the activity's emission factor (e.g., KgCO2e per KWh electricity). Finally, the total carbon footprint is calculated by adding the individual carbon footprints for each activity within the specified life cycle.

CONVENTIONAL PROCESS

From the equipment details described in conventional process mapping and using the DEFRA constant (0.19338 Kg CO2e), the total carbon footprint from the conventional process can be calculated using equation ...(i). Please see table 1



Graph 1: Individual equipment's CO2 emissions in Conventional process.

Equipment List	Time (Hrs)	Power (KWh)	Emission factor	KgCO2e
Digital Printer	5.38	3.50	0.19338	0.676
Laminator	0.34	0.51		0.100
Electric Heat Gun	14.17	31.17		6.027
Desktop for Artwork	5.00	3.00		0.580
Total	19.89	38.18		7.383

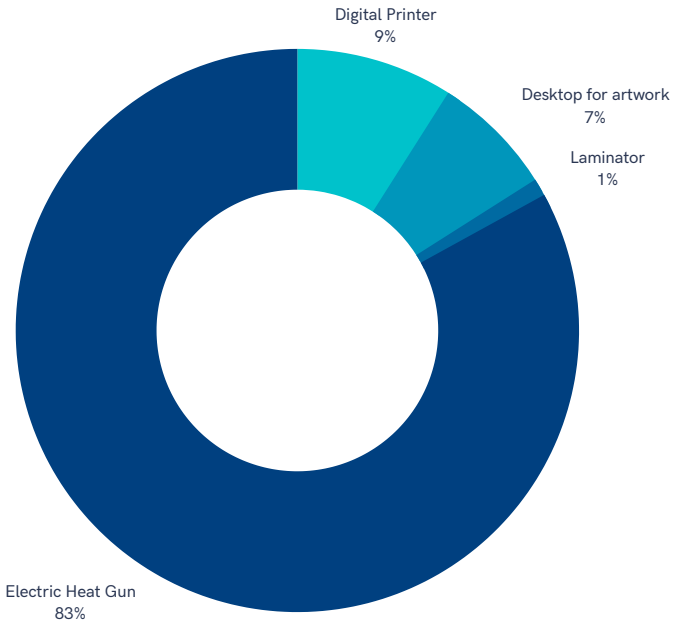
Table 1: Calculation of CO2 emission by the equipment in the conventional process

From Table 1 above, the total CO2 emission when engaging in the conventional process for the Ford Transit Custom Range Van can be summed up to be 7.383 Kg CO2e. The pie chart *(Graph 1)* shows the individual percentile of CO2 emission of each equipment used in the process.

From the calculation above (Table 1 and Graph 1), the highest contributor to the overall carbon footprint is the Electric heat gun contributing 82% (6.027 KgCO2e). This is due to the equipment's heavy wattage (Power KWh) as well as the duration for which it is used. Followed by this are the Digital Printer contributing 9% (0.676 KgCO2e) and Desktop for Artwork contributing 8% (0.580 KgCO2e). Finally, the lowest contributor (with the lowest wattage and duration of time) is the Laminator contributing 1% (0.1 KgCO2e) to the overall carbon footprint. Furthermore, it is essential to note that, this value remains within this range for every time this process is carried out.

CONVENTIONAL PROCESS WITH DECOMMISSIONING

A large number of times, cars come pre-wrapped from before. Those need to go through a decommissioning process. Decommissioning is a complex process for the customer to do by themselves. The decommissioning process uses the heat gun for a substantial amount of time. Table 2 below shows the calculation of CO2 emission with the decommissioning process included.



Graph 2: Individual equipment's CO2 emissions in Conventional process with decommissioning.

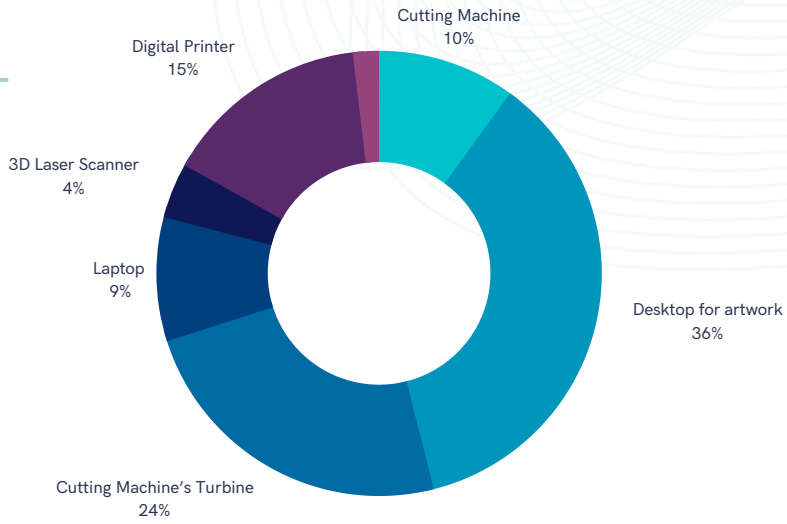
Equipment List	Time (Hrs)	Power (KWh)	Emission factor	KgCO2e
Digital Printer	5.38	3.50	0.19338	0.676
Laminator	0.34	0.51		0.100
Electric Heat Gun	15.67	34.47		6.665
Desktop for Artwork	5.00	3.00		0.580
Total	21.39	41.48		8.021

Table 2: Calculation of CO2 emission by the equipment in the conventional process including decommissioning.

From Table 2 above, the total CO2 emission when engaging in the conventional process (including decommissioning) for the Ford Transit Custom van can be summed up to be 8.021 KgCO2e. The pie chart (Graph 2) shows the individual percentile of CO2 emission of each equipment used in the process.

MODULAR PROCESS

From the equipment details described in Brandfixx modular process mapping and using the DEFRA (0.19338 Kg CO2e), the total carbon footprint from the modular process produced by Brandfixx can be calculated using the equation ….(i). Please see Table 3.



Graph 3: Individual equipment's CO2 emissions in Conventional process with decommissioning.

Equipment List	Time (Hrs)	Power (KWh)	Emission factor	KgCO2e
Digital Printer	2.50	1.63	0.19338	0.314
Laminator	0.14	0.21		0.040
3D Laser Scanner	3.50	0.49		0.095
Laptop used for scanning		0.95		0.183
Cutting Machine's Turbine	0.30	1.07		0.518
Cutting Machine		2.68		0.207
Desktop for Artwork	6.50	3.90		0.754
Total	12.94	10.92		2.112

Table 3: Calculation of CO2 emission by the equipment in the conventional process including decommissioning.

From Table 3 above, the total carbon footprint produced by Brandfixx when engaging the modular process for the Ford Transit Custom Range van can be summed up to be 2.112 Kg CO2e. The pie chart (Graph 3) shows the individual percentile of CO2 emission of each equipment used in the process.

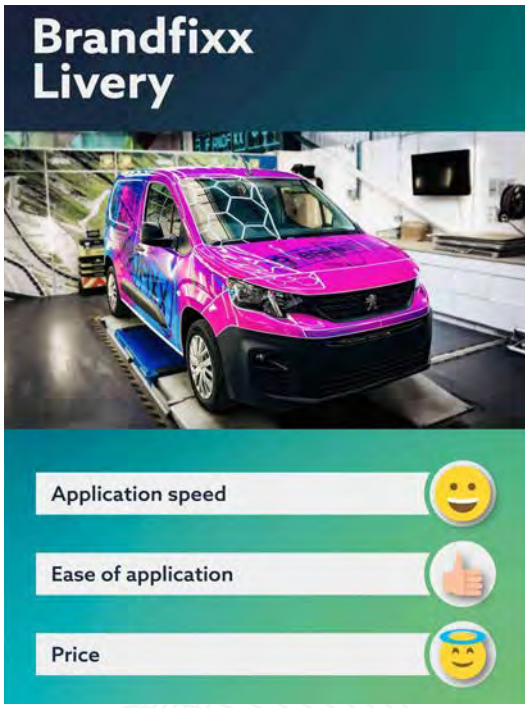
From the above calculation (Table 3 and Graph 3), the highest contributor to the overall carbon footprint is the desktop for designing artwork, which contributes 36% (0.754 Kg CO2e). This is as a result of having the highest power consumption value and running time. Followed by this are Cutting Machine's Turbine - 24% (0.518 KgCO2e), Digital printer - 15% (0.314 KgCO2e), Cutting Machine - 10% (0.207 KgCO2e), Laptop for scanning - 9% (0.183), and 3D Laser Scanner - 4% (0.095 KgCO2e) respectively. Finally, the lowest contributor (with the lowest wattage and duration of time) is the Laminator, contributing 2% (0.040 KgCO2e) to the overall carbon footprint.

However, this is not always the same case for every process being done. The total carbon footprint reduces substantially as the number of vehicles being worked on. This is due to energy savings from repeated processes such as 3D scanning and 3D modelling in the desktop computer. According to Brandfixx, the company worked on 3000 vehicles in 2021, and just 600 of them required scanning. This implies that the company had previously scanned the information of every 1 in 5 cars they worked on. As a result, the company saved energy from the 3D Laser Scanner, Laptop used for scanning and Desktop used for artwork which together accounts for approximately 25% of the overall carbon footprint.

MODULAR PROCESS WITH DECOMMISSIONING

The decommissioning process in the modular process is as easy as peeling it off and wiping it. Most of the customers can do it themselves as it doesn't require any professional tool or heat gun. As a result, Modular wrap decommissioning has no impact on the result analysis since it does not contribute to any direct CO2 emission.

The result section described above partially addresses objective 2 of the study.



WASTE MANAGEMENT

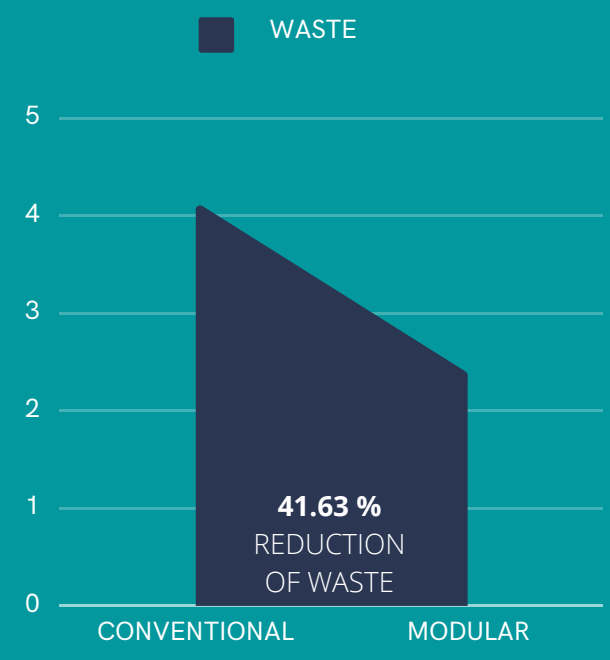
In this section, we are going to discuss the waste management issues related to both the conventional and modular processes and provide a comparative scenario in terms of the waste generated in both processes.

Materials that are undesired or unusable are considered waste. It can be characterised as any material that is thrown away after initial usage or unusable. Hence, waste management can be defined as the strategy an organisation uses to dispose, reduce, reuse, and prevent waste. It is the measure utilised to manage waste in its entire life cycle, from waste generation to disposal

WASTE ANALYSIS

In light of waste management, Brandfixx has been able to significantly reduce waste by implementing the modular process of wrapping, saving both time and materials. According to the data and our observation, the total wasted material generated by the conventional process for the Ford Transit Custom van was around 4.06 kgs, whereas the waste generated by the modular process is approximately 2.37 kgs. This amount represents a 41.63% reduction in material waste generation.

The waste management section described above addresses objective 3 of the study.



Graph 4: Comparing waste generation of both processes.

RESOURCE MANAGEMENT

In this section, we are going to discuss the resource management issues related to both processes and would provide a comparative scenario in terms of the resource required and saved in both processes.

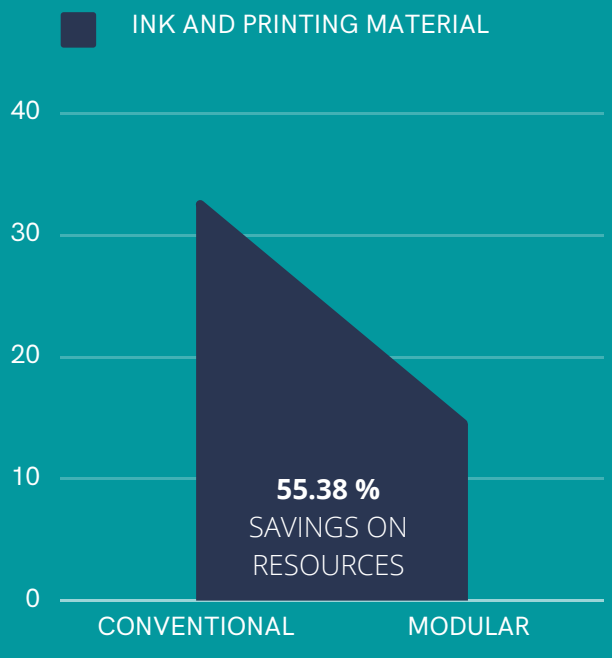
PRINTING MATERIAL

The total material used for the conventional printing process amounted to 32.5 meters, while that of modular was 14.5 meters. This means that Brandfixx's modular process, in this scenario, was able to save a total of 18 meters. This value represents a total 55.38% reduction from the conventional wrapping process.

The resource management section described above addresses objective 4 of the study.

INK

The amount of ink saved is directly proportional to the amount of printing material used. The ink consumption is measured in terms of its paper coverage. Therefore, the ink coverage for the conventional wrapping process amounted to 32.5 meters, while that of the modular process was 18 meters. This value represents a total reduction of 55.38% in ink consumption.



Graph 5: Comparing material consumption of both processes.

TIME

When compared to the conventional process, Brandfixx has been able to save a significant amount of time by using the modular process. Using the case study of the Ford Transit Custom van used for this project, Brandfixx was able to save a significant amount of time in the following areas:

- **PRINTING TIME**: The printing time in the conventional process took 322.8 minutes (approx. 5.38 hrs), while that of the modular took 150 minutes (approx. 2.5 hrs). Therefore, in printing time, Brandfixx was able to save a total of 172.80 (approx. 2.9 hrs.) minutes. This represents a 53.53% reduction.

- LAMINATION TIME: The lamination time in the conventional process took 20.58 minutes (approximately 0.34 hours) while that of the modular took about 8.37 minutes (approximately 0.14 hours). Therefore, in lamination time, Brandfixx was able to save a total of 12.21 minutes (approximately 0.20 hours). This represents a 59.34% reduction.

- DECOMMISSIONING TIME: While decommissioning the vehicle from the previous wraps, the conventional process took a total of 90 minutes (1.5 hrs), while the modular process took about 30 minutes (0.5 hrs). Saving Brandfixx another 60 minutes (1 hr) in time. This represents a 66.67% reduction.

Activity	Conventional Method (Minutes)	Modular Method (Minutes)	Resource savings
Printing time	322.8	150	172.8
Lamination time	20.58	8.37	12.21
Decommissioning time	90	30	60
Total	433.38	188.37	245.01

Table 4:Calculation of time saved in both processes

In total, Brandfixx saved a total of 245 minutes (approximately 4 hours), in the overall time spent by engaging in the modular wrapping process. Table 4 above shows the time breakdown.

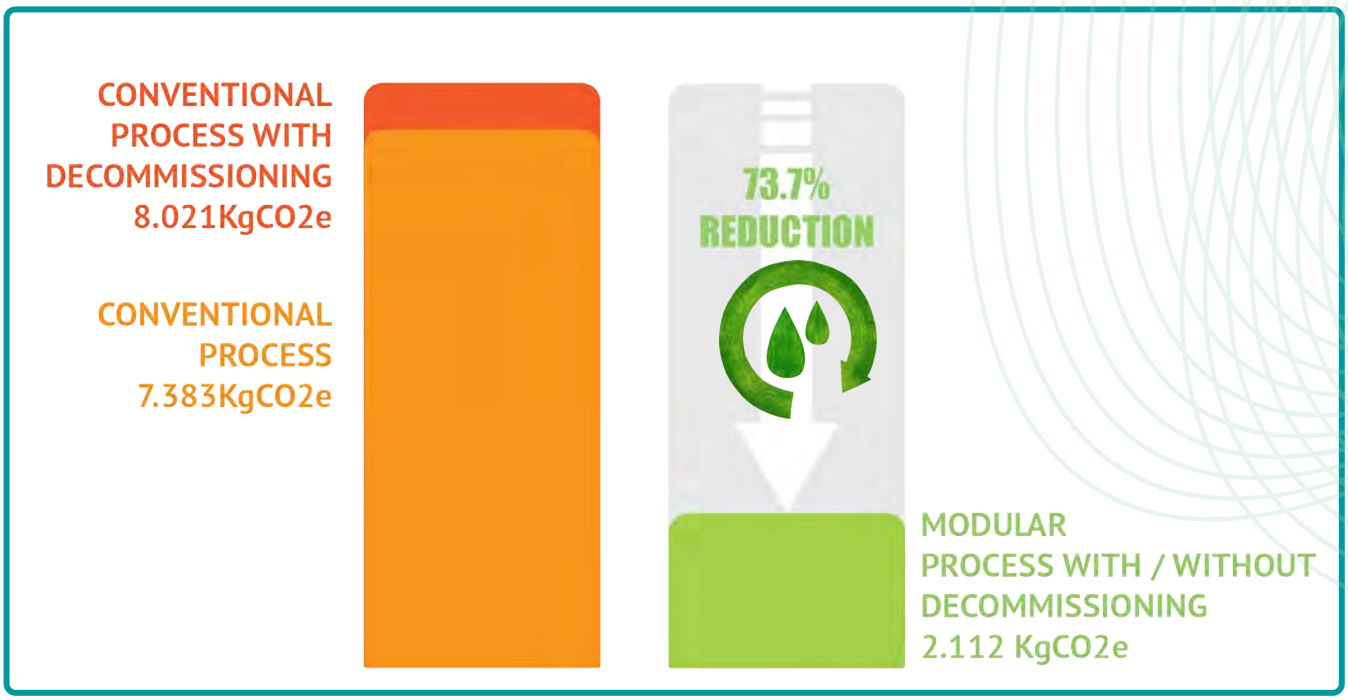
Graph 6: Amount of operation time saved in both processes

DISCUSSION

One of Brandfixx's most notable improvements is the switch from the conventional wrapping process to the modular wrapping process. This has boosted their profitability in terms of time and materials while also reducing the overall carbon footprint of their business. From the calculations, the total carbon footprint for the conventional process without decommissioning, conventional process with decommissioning and the modular process (with or without decommissioning) are 7.383KgCo2e, 8.021KgCo2e and 2.112 KgCo2e, respectively. These values show a total reduction of 71.4% (compared to conventional process) or 73.7% (compared to conventional process with decommissioning) of its carbon footprint by adopting the modular process.

Graph 7: Comparison of CO2 emission and waste

According to Brandfixx, 3000 cars were worked on in 2021. Following this estimation, the annual savings from carbon emission can be projected to be approximately 17,727 KgCO2e, making it a significant improvement. Also, by adopting the modular process, Brandfixx has significantly increased its financial gain in terms of time and resources. Calculations demonstrate that, on average, Brandfixx has been able to save at least 245 minutes (4.08 hrs) on each vehicle being wrapped as well as saving the customer on average 40% cost per vehicle.



Graph 8: Carbon footprint differentiation between both processes with or without decommissioning

This results in the members' staff working lesser hours and, in the end, savings on wage payments. Furthermore, compared to the conventional process, the cost of buying wrapping material has decreased dramatically. According to Brandfixx, the material expenses involved in covering the Ford Transit Custom van using the conventional process were significantly more than those associated with the modular process. They claimed that the value disparity resulted in an approximate 80% price reduction for all packaging materials. In addition, the conventional process's total ink cost was significantly higher than the modular process, saving Brandfixx approximately 60% of the ink that would have been consumed. The waste produced from the materials in the conventional approach was also estimated to be 4.06 kgs, while that of the modular process was 2.37 kgs, resulting in a 41.6% waste reduction and supporting a better waste management system. As a result, this can be claimed that Brandfixx has already contributed significantly to nature and would continue doing so in the future.

The discussion section described above fully addresses objective 2 of the study.□

RECOMMENDATION & CONCLUSION

Switching from the conventional process to the Brandfixx modular process has helped Brandfixx significantly in all areas. However, there is always room for improvement in terms of performance and environmental friendliness. Firstly, Brandfixx should try finding better ways to treat the waste produced. As previously mentioned, Brandfixx was able to reduce its waste output by up to 41%, however, it could be reduced further. Brandfixx's modular process which already produces lesser waste than the conventional process makes recycling much easier due to the reduced volume. By doing this, Brandfixx improves both its brand image and environmental sustainability. Furthermore, utilising renewable energy sources can also considerably minimise the carbon footprint generated by Brandfixx. In this case, electricity consumption is the sole source of carbon emission for both processes (conventional or modular). This number may be further reduced by using renewable energy sources like solar, wind, hydro, or even biomass energy.

It is clear that implementing the modular process can boost the livery industry's environmental friendliness, efficiency as well as profitability in the long run. Brandfixx has chosen the appropriate course of action by moving to the modular process. This has provided them with a competitive edge in terms of customer service while also strengthening their profitability and brand image with regard to being more "Green and Clean".

The recommendation and conclusion section described above addresses objective 5 of the study.

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