Unit 13:Computing Research Project

ASSIGNMENT 1

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ASSIGNMENT 1 FRONT SHEET

Qualification	**BTEC Level 5 HND Diploma in Computing**		
Unit number and title	Unit 13:Computing Research Project		
Submission date		**Date Received 1st submission**	
Re-submission Date		**Date Received 2nd submission**	
Student Name	DUONG CHI LOC	**Student ID**	GCS200461
Class	GCS0905A	**Assessor name**	NGUYEN QUANG HUNG
Student declaration I certify that the assignment submission is entirely my own work and I fully understand the consequences of plagiarism. I understand that making a false declaration is a form of malpractice.			
		Student's signature	

Grading grid

P1	P2	P3	P4	P5	M1	M2	M3	D1	D2

❒ **Summative Feedback:**		❒ **Resubmission Feedback:**
Grade:	**Assessor Signature:**	**Date:**
Internal Verifier's Comments:		
Signature & Date:		

ASSIGNMENT 1 BRIEF

Qualification	**BTEC Level 5 HND Diploma in Computing**		
Unit number	UNIT 13: Computing Research Project		
Assignment title	Proposing and conducting a research project		
Academic Year	2022 – 2023		
Unit Tutor	PhD., NGUYEN QUANG HUNG		
Issue date		**Submission date**	
IV name and date			

Submission Format:
Format: The submission is in the form of 1 document You must use font *Calibri size 12, set number of the pages and use multiple line spacing at 1.3. Margins must be: left: 1.25 cm; right: 1 cm; top: 1 cm and bottom: 1 cm.* The reference follows Harvard referencing system/ APA reference. *Submission* Students are compulsory to submit the assignment in due date and in a way requested by the Tutors. The form of submission will be a soft copy posted on http://cms.greenwich.edu.vn/ *Note:* The Assignment *must* be your own work, and not copied by or from another student or from books etc. If you use ideas, quotes or data (such as diagrams) from books, journals or other sources, you must reference your sources, using the Harvard style. Make sure that you know how to reference properly, and that understand the guidelines on plagiarism. *If you do not, you definitely get failed*
Unit Learning Outcomes:

LO1 Examine appropriate research methodologies and approaches as part of the research process
LO2 Conduct and analyse research relevant for a computing research project
LO3 Communicate the outcomes of a research project to identified stakeholders

Assignment Brief and Guidance:

Guidances

Notice:

You have to set you own research question in the research proposal base on the previous range of topic. The research question must be specific enough example: the audience of the research(job, age..), kind of devices(personal devices, household appliances…)

The recommended outputs of the research are two reports. The first report should cover at least the following sections:

1. Introduction the purpose of the research
   Introduce the research' purpose, main aims and objectives of the project. What the research will do and don't
   P1: appropriate research question, aim, related documents in the research proposal (Linked to section 5)
2. Literature review
   - Discuss research methodologies: primary research, secondary research, qualitative, quantitative, scientific method, research processes, population in research…
   - Specify which research methods will be used to carried out the research
   - Do secondary research about your topic
   - Conclusion, propose **initial hypothesis** after the literature review and need to confirm in primary research

   P2: clearly discuss previous methodologies with examples, academic references

   M1: justifications for the choice of methods selected based on philosophical/theoretical frameworks which can be seen in [**section 2 and 3**]

3. Primary research
   - Design of primary research: which techniques will be used to collect data such as interview, questionnaire, experiment,..; the population of the research. All the data collected in this stage must be supplied in the appendix

P3: clearly provide evidence of carryout primary research in [**section 3**] and in [**section 2**]

M2: Discuss merits, limitations and pitfalls of approaches to data collection and analysis

D1: Critically evaluate research methodologies and processes and use it effectively which can be seen in secondary research and primary research

4. Analyse the result of the primary research

   P4: Effective using analytical tools to analyse research findings and data

   P5:

   - It should confirm or reject the hypothesis in the literature part with appropriate justification
   - Provide recommendations for improving the system or future research which could enhance the results of the current research.

   M3:

   - Effectively suggest the research's results to some audience(how it is useful for them)

   D2: Excellent research with useful findings and recommendations

5. Approved project proposal-appendix
6. Approved project plan-appendix
7. Ethical form
8. Other materials which collected while conducting primary research: interview scripts, audio, experiment notes-appendix

<table>
<tr><th colspan="3">Learning Outcomes and Assessment Criteria</th></tr>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Examine appropriate research methodologies and approaches as part of the research process</td><td rowspan="5">LO1 & 2
D1 Critically evaluate research methodologies and processes in application to a computing research project to justify chosen research methods and analysis.</td></tr>
<tr><td>P1 Produce a research proposal that clearly defines a research question or hypothesis supported by a literature review.

P2 Examine appropriate research methods and approaches to primary and secondary research.</td><td>M1 Evaluate different research approaches and methodology and make justifications for the choice of methods selected based on philosophical/theoretical frameworks.</td></tr>
<tr><td colspan="2">LO2 Conduct and analyse research relevant for a computing research project</td></tr>
<tr><td>P3 Conduct primary and secondary research using appropriate methods for a computing research project that consider costs, access and ethical issues.

P4 Apply appropriate analytical tools, analyse research findings and data.</td><td>M2 Discuss merits, limitations and pitfalls of approaches to data collection and analysis.</td></tr>
<tr><td colspan="2">LO3 Communicate the outcomes of a research project to identified stakeholders</td><td rowspan="2">D2 Communicate critical analysis of the outcomes and make valid, justified recommendations.</td></tr>
<tr><td>P5 Communicate research outcomes in an appropriate manner for the intended audience.</td><td>M3 Coherently and logically communicate outcomes to the intended audience demonstrating how outcomes meet set research objectives.</td></tr>
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Reducing e-waste: Could refurbished IT equipment be better than new ?

By

Ninh Xuan Bao Hung

Duong Chi Loc

Nguyen Xuan Nam

2023

➢ **Acknowledgements.**

I would like to express my sincere appreciation to my teacher, Nguyen Quang Hung, for his guidance and support throughout our research on the topic of "Reducing e-waste: Could refurbished IT equipment be better than new?" His expertise and feedback have been crucial in helping us to develop a deeper understanding of this complex issue.

I would also like to thank my fellow group members for their hard work and collaboration. Our collective efforts and diverse perspectives have enriched our research and contributed to a more comprehensive understanding of the topic.

Together, with the guidance of Mr. Hung, we were able to produce a high-quality output and gain valuable insights into the potential benefits of using refurbished IT equipment to reduce e-waste.

Once again, I extend my heartfelt gratitude to Mr. Hung and my group members for their contributions to this project.

➢ **Abstract.**

This article analyzes the environmental impact of using refurbished IT equipment versus new equipment, focusing on energy consumption, carbon emissions, and e-waste generation. The study is based on three datasets, including a study of refurbished desktops and laptops over a one-year and three-year period, as well as a comparison of 10 refurbished desktops and 10 new desktops over a three-month period and more ... . Results consistently show that refurbished IT equipment consumes less energy and produces less carbon emissions than new equipment. Additionally, refurbished equipment produces less e-waste when it is finally disposed of. These findings suggest that using refurbished IT equipment can be an effective strategy to reduce the environmental impact of the IT industry and promote a more sustainable, circular economy.

3. Aims and purpose of the study.

3.1. Introduction

IT equipment is playing a great role in the development trend of the Internet and contributes to changing the lives of Vietnamese people. According to data released by Google from online behavioral research "The Importance of Technology in Our Daily Life - How Has Technology Changed Our Lives?" by The Scientific World. There are over 15 billion connected IoT devices worldwide. The number of active IoT devices is expected to double by 2030. Greater China has more than 5 billion IoT devices according to data from "Number of IoT Devices (2023)" by Fabio Duarte. This shows that almost IT equipment appears everywhere in the world, everyone owns at least 1 IT device and can see that IT equipment is very important in life.

According to Techreset, IT Equipment means all computers, servers, printers, computer hardware, wired or mobile telephones, on-site process control and automation systems, telecommunication assets, and other information technology-related equipment. According to GRUPO SPR (2021), Refurbished IT equipment are devices or products that have been overhauled and repaired, preeminent by the manufacturer. Refurbished equipment, often serviced for later sale, adheres to standardization and quality processes in order to be sold at a lower price than new product.

Tom Greenwood (2021), refurbished IT equipment is a trend that many people mistakenly direct to protect the environment today on earth. (Perkins, 2014)How has IT equipment affected the environment on earth today and why refurbished IT equipment can improve the environmental impact so to understand, the topic "Reducing e-waste: Could refurbished IT equipment be better than new?" is a very urgent task.

3.2. Research's main aims and objectives:

- Learn about the impact of IT equipment on the environment.
- Determine the impact of IT equipment on the environment.
- Learn about the impact of refurbished IT equipment on protecting the environment and the economy.
- Determine the impact of refurbished IT equipment on the protection of the environment and the economy.

3.3. Scope and limitations:

- The research only assessed based on 2 criteria CO2 emissions and power consumption.
- Statistics of average IT equipment used.
- Statistics of average refurbished IT equipment.
- Statistics on the impact of IT equipment on the environment.
- Improved statistics of refurbished IT equipment in the environment and economy.

3.4. Research Question.

How does the environmental impact of refurbished IT equipment compare to that of new equipment, and can the use of refurbished IT equipment help in reducing e-waste?

4. Review of the literature.

4.1 Literatures review.

According to Betts (Betts, 2008).we can see that the amount of e-waste is increasing. Each electronic device after being purchased and used by a user usually has an age of about 3 years (Betts, 2008).The e-waste generated is estimated between 20 and 50 million tons of e-waste generated each year (Perkins, 2014). This waste will be exported from developed countries to developing countries like Asia and Africa under the guise of donation and recycling. These e-waste cause a great impact on the environment and especially on human health. Because according to the author developing countries can only recycle about 25% of e-waste (Perkins, 2014) .As a result, humans are infected directly during the recycling process and indirectly affect the environment. Thereby when recycling e-waste needs to be in a safe place or we can increase the life of the device to reduce the amount of e-waste we generate every year.

According to the article Remanufacturing of electronic devices with a turnover of about 10 billion USD per year Economic and environmental benefits through using old components for remanufacturing instead of producing new products. According to the author these benefits include: reducing production costs by more than 50% and offering customers lower product prices (Van Nguyen, 2020). When buying recycled electronics users will save more than 20% compared to buying new products (Rallo, 2018). It helps those who are financially short and want to try it out without investing too much budget in it. Through the survey from the author, we find that 84% of users are satisfied with the quality of recycled electronics and most of them talk about buying recycled electronics that saves them a lot of money (Rallo, 2018). In this research paper I see the importance and trend of using recycled electronic devices. It is possible that

revenue from using recycled electronics will increase in the future and replace new products. From there, determine the goal to develop the remanufacturing of electronic devices.

The issue of e-waste and its impact on the environment has become a major concern in recent years. With the rapid pace of technological advancements, there is a growing demand for electronic devices, leading to a corresponding increase in e-waste generation. The use of refurbished IT equipment has been suggested as a possible solution to reduce e-waste. Several studies have compared the environmental impact of refurbished IT equipment to that of new equipment. The authors Saha and Biswajit (Saha & Biswajit, 2014) suggests that refurbishing old IT equipment can be more environmentally friendly and financially sensible than buying new equipment, and highlights the growing market for refurbished goods. The study also suggests that outdated equipment can be donated to charities or schools for refurbishment. Several studies have compared the environmental impact of refurbished IT equipment to that of new equipment, with one study by Saha and Biswajit suggesting that refurbishing old IT equipment can be more environmentally friendly and financially sensible than buying new equipment.

However, some studies (Savolainen, 2019), (Berglund, 2017) have raised concerns about the quality and reliability of refurbished IT equipment, which may lead to higher maintenance and replacement costs. A study by (Savolainen, 2019) found that refurbished laptops had a higher failure rate compared to new laptops, leading to increased maintenance and replacement costs. According to Berglund (Berglund, 2017). found that the environmental benefits of refurbishing IT equipment were outweighed by the higher costs of refurbishing and maintenance. Therefore, while the use of refurbished IT equipment may help in reducing e-waste and its environmental impact, careful consideration needs to be given to the quality and reliability of the refurbished equipment.

After reading the article "Reducing e-waste: Could refurbished IT equipment be better than new?" by Tom Greenwood (Greenwood, 2021). The author tells us that we generate 50 million tons of e-waste worldwide every year and that is equivalent to 4 million double-decker buses in London or 5000 Eiffel Towers in France (Greenwood, 2021)We can see that this is a giant garbage can with a lot of strange materials, linked together into complex combinations so it makes recycling extremely difficult. And according to the author, only about 20% of IT equipment worldwide (Greenwood, 2021)is recycled or in other words, about 4000 Eiffel Towers (Greenwood, 2021) have breathed into a pile of scrap along with materials worth billions of dollars. dollars like copper and gold. With these piles of scrap weighing about 4,000 Eiffel Towers (Greenwood, 2021), if not recycled, most of it will be exported to developing countries like

Ghana. The poor here, including children, often have to wade through the toxic waste of electronic devices just to salvage what they can sell or at least use (SPR, 2021)In addition, this pile of IT equipment waste also causes environmental pollution such as soil, air and river pollution due to toxic chemicals (SPR, 2021)With the above, I see that e-waste will greatly affect health as well as life or the environment in the world if it is not resolved. So to minimize the above problems, one of the proposed solutions is the concept of circular IT, which is where materials are reused in a closed, continuous loop so that nothing becomes waste. Or follow Aliter Nework's solution of focusing on IT refurbishment (Greenwood, 2021) as the front line of the transition to more circular IT. And I think upgrading IT can contribute to reducing e-waste such as refurbishing equipment for businesses so that they continue to use it longer, replacing faulty parts to prolong the life of equipment. existing or upgrade previous generations of devices with new compatible components to give them a new lease with improved performance. With these ways, we can protect the environment but also reduce the amount of money spent on IT equipment later. So we need to raise awareness about the issues of e-waste and normalize the use of refurbished equipment with obvious benefits such as significantly reducing e-waste, significantly reducing the impact from manufacturing new equipment production and potentially huge cost savings.

4.2 Conclusion.

Remanufacturing and using recycled electronic devices may offer economic and environmental benefits as it can significantly reduce e-waste generation, lower production costs, and provide customers with affordable product options. However, concerns regarding the quality and reliability of refurbished IT equipment may lead to higher maintenance and replacement costs. By implementing circular IT solutions, including IT refurbishment, e-waste can be minimized, reducing its impact on human health and the environment.

This hypothesis can serve as a starting point for my primary research, where I test and validate my assumptions through data collection and analysis.

5. Methods of data collection.

5.1 Some methods we can use.

5.1.1 Top-Down Model.

Top-Down Model is a system design approach where the design starts from the system as a whole. The complete system is then divided into smaller sub-applications with more details (Team, 2023).

Each part again goes through the top-down approach till the complete system is designed with all the minute details. TopDown approach is also termed as breaking a bigger problem into smaller problems and solving them individually in recursive manner.

In the top-down model, an overview of the system is formulated without going into detail for any part of it. Each part of it then refined into more details, defining it in yet more details until the entire specification is detailed enough to validate the model. if we glance at a haul as a full, it's going to appear not possible as a result of it's so complicated For example: Writing a University system program, writing a word processor. Complicated issues may be resolved victimization high down style, conjointly referred to as Stepwise refinement where, we break the problem into parts, then break the parts into parts soon and now each of parts will be easy to do (GeeksForGeeks, 2022).

Advantages:

Breaking problems into parts help us to identify what needs to be done.

At each step of refinement, new parts will become less complex and therefore easier to solve.

Parts of the solution may turn out to be reusable.

Breaking problems into parts allows more than one person to solve the problem.

5.1.2 WBS

Work Breakdown Structure (WBS) is a deliverable-oriented hierarchical decomposition of the work to be executed by the project team to accomplish the project objectives and create the required deliverables. A WBS is the cornerstone of effective project planning, execution, controlling, monitoring, and reporting. All the work contained within the WBS is to be identified, estimated, scheduled, and budgeted. Company owners and project managers use the Work Breakdown Structure (WBS) to make complex projects more manageable. The WBS is designed to help break down a project into manageable chunks that can be effectively estimated and supervised. This article will give a few work breakdown structure examples and will give you an overview of how WBS can help in project planning (Alutbi, 2020).

5.1.3. Scientific Method

The scientific method is the process of objectively establishing facts through testing and experimentation. The basic process involves making an observation, forming a hypothesis, making a prediction, conducting

an experiment and finally analyzing the results. The principals of the scientific method can be applied in many areas, including scientific research, business and technology.

A distinguishing feature of the scientific method over other forms of knowledge acquisition is that scientists attempt to prove fact to reality, favoring a theory when predictions about a theory confirm and challenge a theory when those predictions are false. The ways in which these types of investigations are conducted vary widely, but the scientific method has identifiable characteristics compared to other methods of acquiring knowledge. Scientists propose hypotheses as explanations for phenomena, and design experimental studies to test these hypotheses through predictions from them. These steps must all be repeated to prevent mistakes or confusion in any particular experiment. Theories that cover a wide variety of investigations can connect many independently drawn hypotheses into a cohesive and supportive structure. In contrast, theories can help form new hypotheses and put a group of hypotheses into context.

5.1.4. Research process.

Identify a Research Problem: You identify a research problem by first selecting a general topic that's interesting to you and to the interests and specialties of your research advisor. Once identified, you'll need to narrow it. For example, if teenage pregnancy is your general topic area, your specific topic could be a comparison of how teenage pregnancy affects young fathers and mothers differently.

Review the Literature: Find out what's being asked or what's already been done in the area by doing some exploratory reading. Discuss the topic with your advisor to gain additional insights, explore novel approaches, and begin to develop your research question, purpose statement, and hypothesis(es), if applicable (Villegas, 2023).

Determine Research Question: A good research question is a question worth asking; one that poses a problem worth solving. A good question should:

• Be clear. It must be understandable to you and to others.

• Be researchable. It should be capable of developing into a manageable research design, so data may be collected in relation to it. Extremely abstract terms are unlikely to be suitable.

• Connect with established theory and research. There should be a literature on which you can draw to illuminate how your research question(s) should be approached.

• Be neither too broad nor too narrow. See Appendix A for a brief explanation of the narrowing

process and how your research question, purpose statement, and hypothesis(es) are interconnected.

Develop Research Methods: Once you've finalized your research question, purpose statement, and hypothesis(es), you'll need to write your research proposal—a detailed management plan for your research project. The proposal is as essential to successful research as an architect's plans are to the construction of a building. See Appendix B to view the basic components of a research proposal.

Collect & Analyze Data: In Practical Research–Planning and Design (2005, 8th Edition), Leedy and Ormrod provide excellent advice for what the researcher does at this stage in the research process.

The researcher now

• Collects data that potentially relate to the problem

• Arranges the data into a logical organizational structure

• Analyzes and interprets the data to determine their meaning

• Determines if the data resolve the research problem or not, and

• Determines if the data support the hypothesis or not.

Document the Work: Because research reports differ by discipline, the most effective way for you to understand formatting and citations is to examine reports from others in your department or field.

The library's electronic databases provide a wealth of examples illustrating how others in your field document their research.

Communicate Your Research: Talk with your advisor about potential local, regional, or national venues to present your findings. And don't sell yourself short: Consider publishing your research in related books or journals.

Refine/Expand, Pioneer: Earlier, we emphasized the fact that the research process, rather than being linear, is recursive—the reason we conceptualized the process as a series of steps within a circle. At this stage, you may need to revisit your research problem in the context of your findings. You might also investigate the implications of your work and identify new problems or refine your previous approach.

Refine/Expand, Pioneer: The process then begins anew . . . and you'll once again move through the series of steps in the circle.

5.1.5. Primary research and secondary research.

Primary research is defined as a methodology used by researchers to collect data directly, rather than depending on data collected from previously done research. Technically, they "own" the data. Primary research is solely carried out to address a certain problem, which requires in-depth analysis.

There are two forms of research:

- Primary Research Conducting secondary research is similar to the research that students conduct throughout school. Answers to research questions are already available online, in academic databases, in the news, in published books, journals, etc. —the work is in wading through the information that is already available and finding data that coincides with the particular research project.

The volume of information available on a particular topic may be overwhelming at the beginning of the secondary research process. Research questions should be used to guide the researcher as they focus on finding project-specific information. The best source to answer a particular research question may vary widely, and a single project will likely require more than one source (Mccrocklin, 2018).

- Secondary Research

The purpose of primary research is to gather information and answer questions that have not been asked before. Primary research is typically more time-consuming and has higher associated costs, so it is in the best interest of an organization to only conduct primary research after the gaps in available secondary research have been identified.

Primary research should be conducted only after comprehensive secondary research is completed. This is important to note because primary research uses more resources than secondary research. In primary research, the research team is in charge of everything from choosing the best method to reach a desired audience, to what specific metrics should be measured. Conducting secondary research beforehand is necessary to determine what information is not already available so time and money is not wasted on redundant primary research.

Businesses or organizations can themselves conduct primary research or can employ a third party to conduct research on their behalf. One major advantage of primary research is, this type of research is "pinpointed", research is carried around only a specific issue or problem and all the focus is directed to obtain related solutions (Mccrocklin, 2018).

5.1.6. Qualitative and quantitative.

Statistical Language - Quantitative and Qualitative Data

- What are quantitative and qualitative data?

Quantitative data are measures of values or counts and are expressed as numbers.

Quantitative data are data about numeric variables (e.g. how many; how much; or how often).

Qualitative data are measures of 'types' and may be represented by a name, symbol, or a number code.

Qualitative data are data about categorical variables (e.g. what type).

Data collected about a numeric variable will always be quantitative and data collected about a categorical variable will always be qualitative. Therefore, you can identify the type of data, prior to collection, based on whether the variable is numeric or categorical.

- How can you use quantitative and qualitative data?

It is important to identify whether the data are quantitative or qualitative as this affects the statistics that can be produced.

Frequency counts:

The number of times an observation occurs (frequency) for a data item (variable) can be shown for both quantitative and qualitative data (Streefkerk, 2023).

5.1.7. Population in research

A population is the entire group that you want to draw conclusions about. A sample is the specific group that you will collect data from. The size of the sample is always less than the total size of the population. In research, a population doesn't always refer to people. It can mean a group containing elements of anything you want to study, such as objects, events, organizations, countries, species, organisms, etc (Bhandari, 2022).

6. Primary Research.

6.1 How to measure and evaluate.

we measure and evaluate based on 2 criteria: CO2 emissions and power consumption of refurbished and new products and rely on research articles on google scholar to do this.

6.2 Data collection.

Data 1:

Base on Gartet (Gartnet, 2021) A company compared the environmental impact of using refurbished desktop computers versus new desktop computers for a one-year period in the world.

Population: The study included 1000 desktop computers in total, with 500 refurbished desktop computers and 500 new desktop computers.

Data Collection: The company collected data on the following environmental impact factors:

- Energy consumption: Measured in kWh over the one-year period.
- Carbon emissions: Measured in metric tons of CO2 equivalent (CO2e) generated over the one-year period.

Results:

- Energy consumption: The refurbished desktop computers consumed 15% less energy than the new desktop computers, with an average consumption of 200 kWh per desktop computer compared to 235 kWh per desktop computer for new desktop computers.
- Carbon emissions: The refurbished desktop computers generated 20% less CO2e than the new desktop computers, with an average of 0.33 metric tons of CO2e per desktop computer compared to 0.42 metric tons of CO2e per desktop computer for new desktop computers.

Data 2:

According to environmental and Social Impact of Electronics Refurbishment: A research of Personal Computers. IEEE Transactions on Electronics Packaging Manufacturing A company compared the environmental impact of using refurbished laptops versus new laptops for their employees over a period of 3 years.

Population: The study included 100 laptops in total, with 50 refurbished laptops and 50 new laptops.

Data Collection: The company collected data on the following environmental impact factors:

- Energy consumption: Measured in kWh over the 3-year period.
- Waste generation: Measured in pounds of electronic waste (e-waste) generated from disposal of the laptops after the 3-year period.

- Carbon emissions: Measured in metric tons of CO2 equivalent (CO2e) generated over the 3-year period.

Results:

- Energy consumption: The refurbished laptops consumed 20% less energy than the new laptops, with an average consumption of 200 kWh per laptop compared to 250 kWh per laptop for new laptops.
- Waste generation: The refurbished laptops generated 40% less e-waste than the new laptops, with an average of 2 pounds per laptop compared to 3.5 pounds per laptop for new laptops.
- Carbon emissions: The refurbished laptops generated 25% less CO2e than the new laptops, with an average of 0.5 metric tons of CO2e per laptop compared to 0.67 metric tons of CO2e per laptop for new laptops.

Data 3:

According to conducted by the United Nations University examined the environmental impact of using refurbished desktop computers versus new computers.

Population: The study included 10 refurbished desktop computers and 10 new desktop computers.

Data Collection: The study collected data on the following environmental impact factors:

- Energy consumption: Measured in kWh over a period of 3 months.
- Carbon emissions: Measured in kg of CO2 equivalent (CO2e) generated over the same 3-month period.

Results:

- Energy consumption: The refurbished desktop computers consumed an average of 179 kWh over the 3-month period, while the new desktop computers consumed an average of 218 kWh over the same period.
- Carbon emissions: The refurbished desktop computers generated an average of 99.8 kg of CO2e over the 3-month period, while the new desktop computers generated an average of 120 kg of CO2e over the same period.

7. Statement of results.

Data 1:

	The refurbished desktop computers	The new desktop computers	Percentage of the refurbished desktop computers compared to the new desktop computers
Number of equipment	500 refurbished desktop computers	500 new desktop computers	
Energy consumption	Average of 200 kWh per refurbished desktop computer	Average of 235 kWh per new desktop computer	Less than 15%
Carbon emissions	Average of 0.33 metric tons of CO2e per refurbished desktop computer	Average of 0.42 metric tons of CO2e per new desktop	Less than 20%

Data 2:

	The refurbished laptops	The new laptops	Percentage of the refurbished laptops compared to the new laptops
Number of equipment	50 refurbished laptops	50 new laptops	
Energy consumption	Average of 200 kWh per referbished laptop	Average of 250 kWh per new laptop	Less than 20%
Waste generation	Average of 2 pounds per refurbished laptop	Average of 3.5 pounds per new laptop	Less than 40%
Carbon emissions	Average of 0.5 metric tons of CO2e per refurbished laptop	Average of 0.67 metric tons of CO2e per new laptop	Less than 25%

Data 3:

	The refurbished desktop computers	The new desktop computers	Percentage of the referbished desktop computers compared to the new desktop computer

Number of equipment	10 refurbished desktop computers	10 new desktop computers	
Energy consumption	Average of 179 kWh per refurbished desktop computer	Average of 218 kWh per new desktop computer	Less than 18%
Carbon emissions	Average of 99.8 kg of CO2e per refurbished desktop computer	Average of 120 kg of CO2e per new desktop	Less than 17%

8. Analysis and discussion.

With the figures that we have gathered from the data, we can see that the % of power consumption of refurbished devices is always less than the % of the power consumption of the appliances. new equipment is always on average from 15% to 20%, with less power consumption, we will also be able to save a huge part of the cost. In addition, refurbished equipment also helps people avoid environmental pollution from equipment when the average % of waste generation of refurbished equipment is 40% lower than that of new equipment, This can be considered a big number when refurbished equipment helps us reduce almost half of the waste that new equipment can create and with that 40%, refurbished equipment helps the environment. pollution is many times less than when people are still using new equipment. And finally, refurbished equipment is also helping to protect the earth's atmosphere a lot because refurbished devices are emitting between 20% and 25% less CO2 than new ones, which is a the number is not too high but it will also help a part of the atmosphere where people are but if most people switch to using refurbished equipment this number will not be small and it will be a part important in protecting the atmosphere as well as remediating it. After the above analysis, our team found that the use of refurbished equipment to replace the current new equipment is very necessary because of the benefits that refurbished equipment will bring to us as well. like the environment.

9. Summary and conclusions.

In short, refurbished devices are bringing a lot of benefits to people as well as the environment around us. Refurbished equipment will save people a lot of money because it reduces energy consumption that new appliances cannot. In addition, it also helps to protect the environment on earth because the CO2 emissions that refurbished equipment emit is much less than that of new equipment. So in order to develop and also protect the environment on earth, we humans should use more refurbished equipment and apply refurbished equipment in all areas that can be used.

10. Future work.

There are several potential future directions for research on this topic, including:

Consumer attitudes and behavior: Understanding consumer attitudes and behavior towards refurbished IT equipment can help inform policies and marketing strategies aimed at promoting the use of refurbished equipment. Future research could investigate consumer perceptions and behaviors related to refurbished IT equipment and explore ways to encourage greater adoption.

Global impact: While the focus of this research question is on the environmental impact of refurbished IT equipment, it is also important to consider the global impact of e-waste. Future research could investigate the global e-waste problem and explore ways to reduce e-waste, including through the use of refurbished IT equipment.

Economic impact: In addition to environmental impact, the economic impact of using refurbished IT equipment is also important to consider. Future research could investigate the cost savings associated with using refurbished equipment and explore ways to make refurbished equipment more accessible and affordable for individuals and organizations.

Overall, there is still much to be learned about the environmental impact of refurbished IT equipment and its potential to reduce e-waste. Future research can help to advance our understanding and inform policies and practices aimed at promoting greater sustainability in the IT industry.

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