ASSIGNMENT 1 FRONT SHEET

Qualification	**BTEC Level 5 HND Diploma in Computing**		
Unit number and title	Unit 13:Computing Research Project		
Submission date	10/12/2022	**Date Received 1st submission**	
Re-submission Date		**Date Received 2nd submission**	
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Class	GCC0901	**Assessor name**	Cu Vinh Loc
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	Phi

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	Do Tien Thanh		
Issue date	03 August 2022	**Submission date**	03 August 2022
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.

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:

Introduction to theme

The environmental impact of digital transformation

The amount of data created and stored globally is expected to reach 175 Zettabytes by 2025, a six-fold increase from 2018. This will demand additional hardware and power consumption, which; in turn, will increase the environmental impact of the digital sector and there is already increasing attention on the environmental footprint of ICT equipment and services as they become more widespread in all aspects of human life.

It is the responsibility of everyone to take action in addressing the challenges of climate change, as professionals we must also seek ways that the digital sector can play its part. While digital technologies are one of the sectors that has achieved greater efficiency; achieving about 100 times more computation power from the same amount of energy per decade, it remains unsustainable. The sector must continue to seek ways in which it can continue to support and drive innovation, while addressing the global climate emergency for a greener and fairer future.

Choosing a research objective/question

Students are to choose their own research topic for this unit. Strong research projects are those with clear, well focused and defined objectives. A central skill in selecting a research objective is the ability to select a suitable and focused research objective. One of the best ways to do this is to put it in the form of a question. Students should be encouraged by tutors to discuss a variety of topics related to the theme to generate ideas for a good research objective.

The range of topics discussed could cover the following:

- The use of modern methods to reduce carbon emissions in IT network systems.
- The impact of cloud data centres on the environment.
- The environmental implications of e-waste and ways to reduce it.

The research objective should allow students to broaden their understanding and widen their erspective of being able to explore, argue, prove, and/or disprove a particular objective. The research objective should be feasible, novel, ethical, relevant and ultimately of interest to the student

You have to set you own research question in the research proposal base on the previous range of topic, and the research question must be specific enough.

<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>
</table>

I. Introduction

Title: Electric Consumption and Carbon Footprint of Cloud data Centers to the environment

1. Introduction the purpose of the research

Currently, with the strong development of cloud computing, many aspects of everyday life have been transformed by the omnipresence of software that runs on cloud networks. Startups and companies can save costs and expand their offerings without having to buy and maintain the gear and software themselves by utilizing cloud computing. Independent developers have the authority to release internet services and programs that are accessible to everyone. Data sharing and analysis are now possible at scales previously only available to well sponsored projects. Additionally, internet users can easily access programs and storage to create, share, and save digital media in quantities that extend far beyond the computing capacity of their personal devices. However, that's why Cloud Data Centers consume a lot of electricity, this increases the cost of operation and adds to the environment carbon footprint. Therefore, it can be seen that managing electricity consumption and decrease Carbon Footprint in light of the world's changing climate and energy shortages are important.

I will investigate the following topic in this study: “Electric Consumption and Carbon Footprint of Cloud data Centers to the environment”. This will help people get an overview about the impact of Cloud Data Centers to the environment.

2. Project research objective

The dynamic field of information and communication technology includes cloud computing. It is an affordable, reliable, scalable, and distributed parallel computing method with excellent performance. Therefore, With the growth and widespread use of cloud computing. The Amount of electricity consumption and carbon emissions is increasing and influencing the environment, it becomes one of the inevitable problems. Therefore, the goal of the research I will indicate electricity consumption and carbon emissions of Cloud Data Centers, besides, I also provide some solutions reduce environmental impact.

3. Project research scope

The project's study focuses on the impact of Cloud Data Centers on the environment (Specifically, Electric Consumption and Carbon Footprint). Therefore, I will conduct secondary research and discuss about the impact of Cloud Data Centers. After that, primary research by conducting a survey to collect data from my friends in Greenwich University with the purpose is to indicate some main causes that Cloud Data Center affect to the environment. From there, I will provide some solutions to reduce environmental impact.

4. Project research schedule

4.1 Work breakdown structure

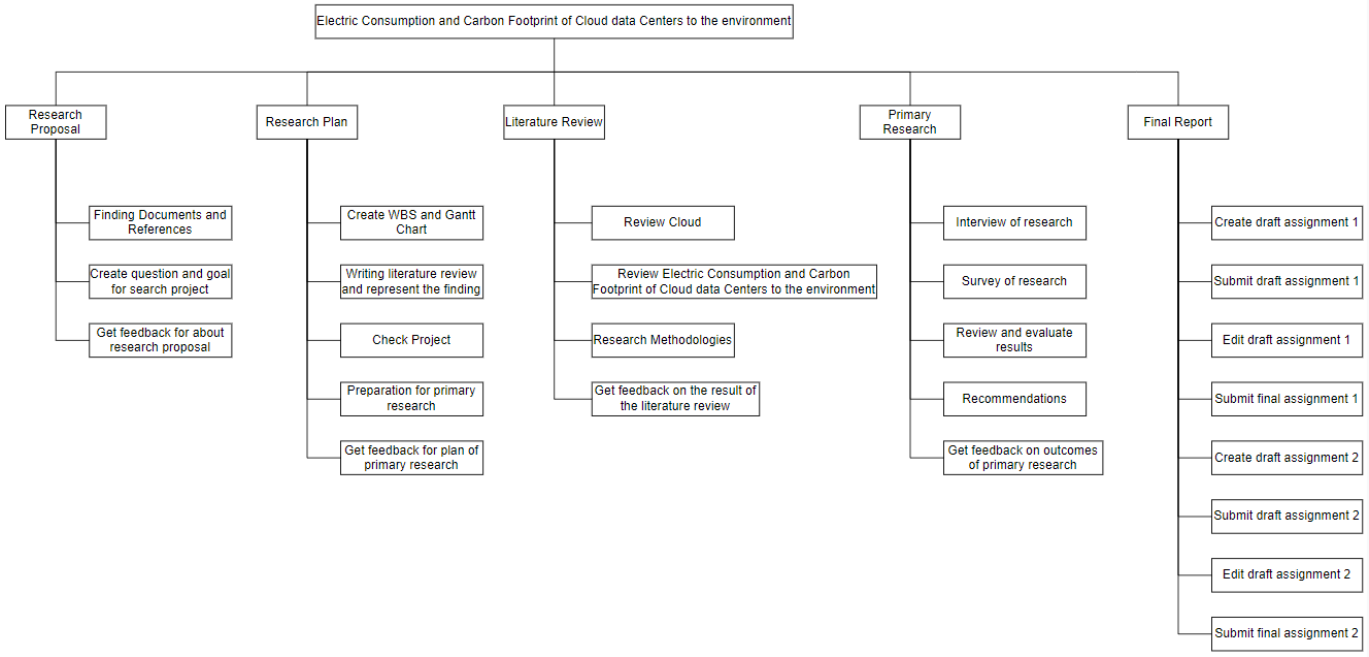

Figure 1 Work breakdown structure

4.2 Gantt chart

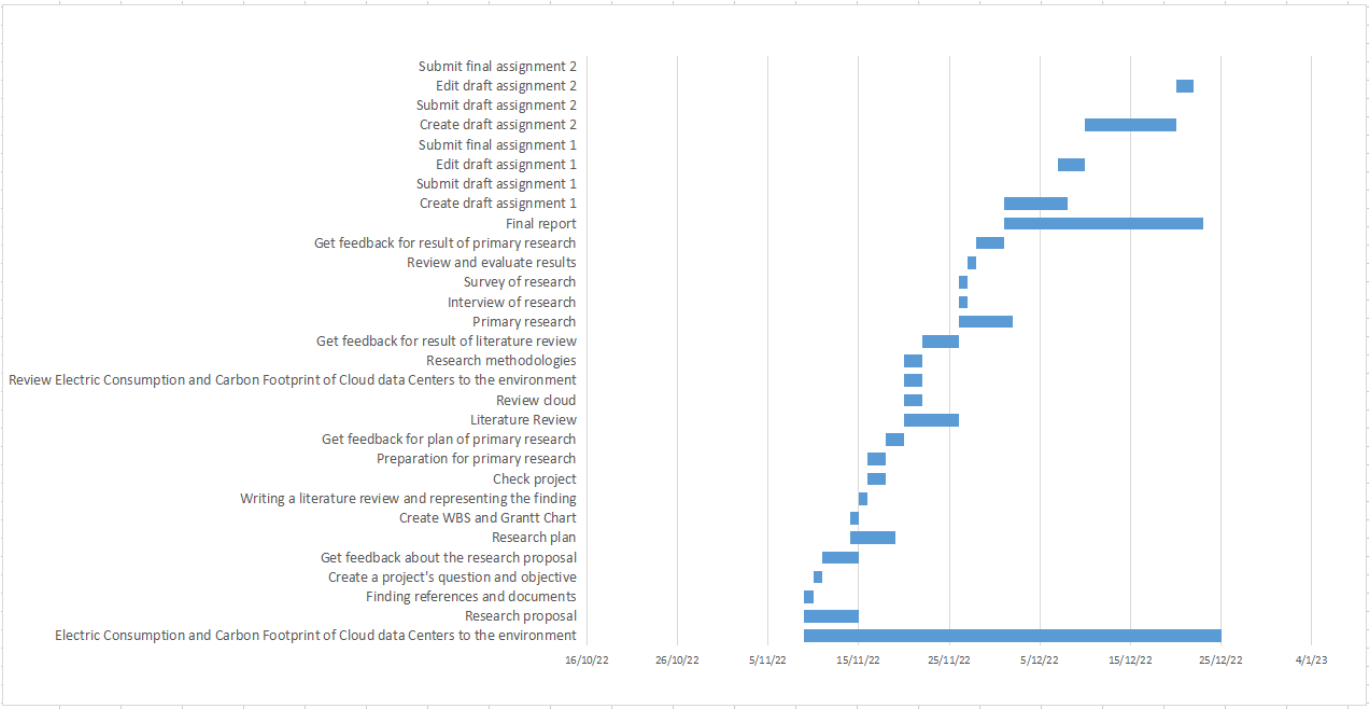

Figure 2 Gantt chart

II. Literature Review

1. Research methodologies

1.1 What is Research?

Research can be summed up as the process of learning new information. There may be a new understanding that was previously unknown as a result of the development of new ideas or of previously accepted theories and information. In addition, the following has been taken as a formal definition of research from the Code of Federal Regulations: “Research is a systematic investigation designed to develop or contribute to generalisable knowledge”.

Research is defined as the creation of new knowledge and/or the creative use of previously acquired knowledge to produce new concepts, theories, and understandings. This could entail combining and analyzing past studies in a way that results in new and creative ideas.

1.2 Primary Research

Primary research typically rests on the principles of the scientific method, a system of inquiry initially introduced by John Stuart Mill in his book Philosophy of the Scientific Method in the nineteenth century. Though their application varies from field to field, the broad principles of the scientific method allow researchers to understand more about the cosmos and observable phenomena. The scientific method is used by researchers to formulate study questions or hypotheses and collect quantitative, observable, and repeatable data on objects, individuals, or events. The ultimate purpose of primary research is to dispel our own biases while discovering something new that can be independently validated by others.

The essay's beginning provides a general overview of the ethical considerations that should be made when conducting primary research. The steps involved in conducting your preliminary research planning, gathering, analyzing, and writing are next discussed. The four steps are followed by a description of three standard techniques for conducting primary research in first-year writing programs:

- Observations: Paying close attention to and taking note of everything that is going on around you, including other people and tangible things.

- Interviews: One-on-one or small-group interrogations of individuals.

- Surveys: Asking participants' thoughts and behaviors with a quick questionnaire

Table 1 Advantages and disadvantages of primary research

Advantages	Disadvantages
Allows for dealing with a certain issue	Can be expensive and takes a lot of time.
More control over the research process is possible	Low response rate risk, which could have an impact on the results

1.3 Secondary Research

The term "secondary data" refers to information that is already available and has previously been obtained and analyzed by another entity. When using secondary data, a researcher needs seek through a range of sources to find them. In this situation, he is obviously not dealing with the problems that are frequently associated with gathering original data. Secondary data may be public or unpublished and both are appropriate.

As a result, different methods for acquiring data exist. Consequently, the researcher must carefully select the method(s) for his individual study while taking the following into account:

- Nature, scope, and object of the inquiry: This is the most significant variable influencing the method of choice. The approach employed should be suitable for the kind of research the researcher wishes to carry out. This factor is essential in deciding whether to seek primary data that are still being gathered or to use secondary data that are already accessible.

- Funding: The amount of funding allocated for the study project largely determines the approach to be used for data collection. When a researcher doesn't have much money, he must choose a relatively less expensive approach, which could not be as effective and efficient as some other more expensive ones. Money is actually a significant practical constraint, and the researcher must operate within this bound.

- Time considerations: Time availability needs to be taken into account when selecting a particular data collection method. While certain methods can be used to collect data more rapidly than others, other methods take a comparable amount of time. As a result, the researcher's time constraints affect the approach that will be employed to gather the data.

- Precision required: This is yet another important consideration when deciding on the data collection method.

Table 2 The advantages and disadvantages of Secondary Research

Advantages	Disadvantages
Since a case study approach involves a detailed analysis of a social unit, it enables us to fully comprehend the behavior pattern of the unit in question. According to Charles Horton Cooley, "Case study expands our viewpoint and gives us a broader understanding into life." It addresses behavior directly, rather than in an oblique or abstract way.	Why Since case settings are rarely comparable, case study information is typically not comparable. Since the case study's subject narrates history in his own words, the investigator must infer or deduce logical concepts and scientific classification schemes from it.
A researcher can gain an authentic and insightful description of personal experiences through case studies, which would reveal man's inner strivings, tensions, and motivations—as well as the forces that drive him to act in a certain way.	Read Bain does not consider the case data to be important scientific evidence since they do not provide information about the "impersonal, universal, non-ethical, non-practical, repetitive features of events." Because case study information

	gathering requires the researcher's perspective, accurate information is frequently not acquired.
The researcher can learn about the social group's natural history and the interactions between them and the forces in their environment by employing this method.	Since only a few units are examined and no set procedures are followed in the information gathering process, there is always a chance of drawing the wrong conclusions.
It helps create relevant hypotheses and the data required to test them. Thus, case studies enable the improvement of general knowledge.	It takes a great deal of time and money. Using the case study approach takes more time since one must analyze the natural history cycles of social units in great detail.
When employing the observation method or the way of acquiring data through scheduling, it is often not practical to investigate social units in depth. This explains why case study methodology, particularly in social research, is so well-liked.	The case data are usually polluted, according to Read Bain, because the subject may write what he thinks the investigator wants; the deeper the relationship, the more subjective the entire process is.

Table 3 Distinguish between primary data and secondary data

Basis for comparison	Primary data	Secondary data
Meaning	Primary data are facts discovered firsthand by the researcher.	Data collected by someone else earlier is referred to as secondary data.
Data	Real time data	Past data
Process	Very engaged	Simple and quick
Source	Observations, experiments, questionnaires, in-person interviews, surveys, etc.	Publications, websites, books, journal articles, internal records, etc. From the government.
Cost effectiveness	Expensive	Economical
Collection time	Long	Short
Specific	Always tailored to the needs of the researcher	May or may not be tailored to the needs of the researcher.
Available	Available	Available
Accuracy and reliability	More	Relatively less

How to Use Primary and Secondary Sources of Information:

A researcher may choose to use one, both, or neither primary and secondary research approaches, depending on their objectives. For example, primary research is helpful if a researcher wishes to make unique findings or go into uncharted territory in their field of study. Primary research can also be used to provide trustworthy, reliable evidence regarding a topic.

Additionally, primary research can be used to produce data that is not only reliable but also specific and suited to the objectives of the researcher. Due to the individualized nature of research instruments like

surveys and interviews, primary research is suitable for researchers who need a high level of control over data gathering methods.

Despite their differences, both primary and secondary research will be helpful to the study process. According to Foley, integrating the two research methods produces the best outcomes. By examining published materials and existing literature, researchers can determine the breadth of current knowledge on a subject (secondary research). If there aren't enough data, researchers can spend time and energy performing primary research.

1.4 Qualitative research

The perspectives and understanding of the problem environment are provided by qualitative research. It is an unstructured, exploratory approach to research that looks at exceedingly complex phenomena that are challenging for quantitative analysis. But it stimulates thoughts or ideas for additional quantitative research. Qualitative research seeks to fully comprehend human behavior, experience, attitudes, intentions, and reasons through observation and interpretation. The researcher in this type of study gives more weight to the participant's comments. Case studies, grounded theory, ethnography, history, and phenomenology are examples of qualitative research methods.

Qualitative data collection methods:

- One-on-one interviews: which are among the most common qualitative data-collection techniques, are a great option when you need to collect highly customized data. It is best to utilize open-ended questions during informal, conversational interviews so that you can obtain rich, detailed context.

- Open-ended polls and forms of inquiry: Participants can freely and in-deathly answer to open-ended surveys and questionnaires rather than selecting from a predetermined list of possibilities.

- A focus group is: With the exception of the fact that they are conducted in a group environment, focus groups resemble interviews. Focus groups can be used as a substitute for one-on-one interviews if they are too difficult or time-consuming to schedule.

- Case studies: You mix and examine a variety of qualitative data sources using the case study method to draw conclusions.

Table 4 The advantages and disadvantages of Qualitative Research

Advantages	Disadvantages
It allows for the quick and inexpensive identification of places that pose a higher risk.	It forbids the estimation of probability and outcomes using numerical measures.
Analysis is reasonably easy and moderately priced.	Choosing safeguards presents more of a challenge for cost-benefit analysis.
	The results are approximate and of a broad nature.

1.5 Quantitative research

Quantitative research uses methods from the natural sciences to provide precise data and numerical results. By using computer, statistical, and mathematical approaches, it aims to prove a causal link between two variables. It is sometimes referred to as empirical research because the results of the study can be precisely and precisely measured. The data acquired by the researcher can be arranged into groups, given rankings, or quantified using different units of measurement. It is easier for the researcher to assess the results while doing quantitative research because it allows for the creation of graphs and tables of raw data.

Quantitative data collection methods:

- Surveys: The most common method for gathering quantitative data is through the use of surveys. Closed-ended survey questions, in contrast to open-ended qualitative survey questions, only allow respondents to select one or more answers. In open-ended qualitative survey questions, participants may provide as much or as little detail as they desire. These surveys can also gather demographic data like age, gender, income, or occupation.

- Interviews: Interviews can also be used to collect quantitative data. A quantitative interview is far more regimented than a qualitative interview since interviewers ask respondents a preset list of closed-ended questions that preclude responses with in-depth context.

- Observation is a simple method for gathering quantitative data when researchers monitor or count individuals as they take part in an event or utilize a service in a specific place. It's a method for gathering numerical data that places more emphasis on the "what" than the "why.

- Review of documents and secondary data collection: The process by which researchers study quantitative data they have found in already-existing primary documents, such as court records and private letters, is referred to as review of documents. Using the supplementary data in these publications, researchers can supplement and strengthen data from various quantitative data-collection methods.

How to use qualitative vs. quantitative research:

Following these general rules can help you decide between qualitative and quantitative data:

- Test a hypothesis using quantitative research to support it (a theory or hypothesis)

- Use qualitative research to understand a topic better (concepts, thoughts, experiences)

For the majority of study concerns, you can choose a qualitative, quantitative, or combined approaches approach. Your research question(s), whether you are performing experimental, correlational, or descriptive research, and practical considerations like time, money, data availability, and access to respondents will all play a role in the approach you choose.

Table 5 the Advantages and disadvantages of Quantitative methods

Advantages	disadvantages
It enables the quantification of incident consequences.	The accuracy and dynamic range of the measuring scale must be the foundation for quantitative measurements.
The results of the costs and benefits analysis were considered for selecting safeguards.	The analysis's conclusions might not be precise or even understandable.
It creates a more accurate representation of risk.	A more qualitative description is required.
	Analysis performed using those techniques is often more expensive, necessitating higher levels of knowledge and specialized equipment.

Table 6 The difference between qualitative and quantitative research

Basis for Comparison	Qualitative Research	Quantitative Research
Meaning	A method of inquiry known as qualitative research seeks to understand the human and social sciences by discovering how people think and feel.	Quantitative research is a type of study that uses mathematical, logical, and statistical methods to produce hard data and numbers.
Nature	Holistic	Particularistic
Approach	Subjective	Objective
Research type	Exploratory	Conclusive
Reasoning	Inductive	Deductive
Sampling	Purposive	
Data	Verbal	Measurable
Inquiry	Process-oriented	Result-oriented
Hypothesis	Generated	Tested
Elements of analysis	Words, pictures and objects	Numerical data
Objective	To explore and discover ideas used in the ongoing processes.	To examine cause and effect relationship between variables.
Methods	Non-structured techniques like In-depth interviews, group discussions etc.	Structured techniques such as surveys, questionnaires and observations.
Result	Develops initial understanding	Recommends final course of action

1.6 Scientific method

The scientific method is a process that researchers employ to confirm findings or build reliable models of any natural event. They are carried out by creating an impartial framework for scientific investigation,

critically evaluating the results, and then coming to a conclusion that either supports or refutes the initial observation.

Analysis of the first observation is the common goal of all scientific procedures. Nevertheless, several actions are conducted as necessary for each unique observation. In addition, there is a well-known sequence of phases in scientific procedures. The following are the steps of the scientific method:

- Goal/Question: The first step in a scientific approach is to pose a question. Asking a yes-or-no question, one that requests a specific explanation, or an open-ended query are all options if you want to learn how to grow soy crops using less water, for instance. Your inquiry can be based on something you notice about the outer world. Questions like "how," "what," "when," "who," "which," "why," or "where" are typically the first words in these sentences. A excellent query seeks to get fresh knowledge. It can also be defined and tested.

- Research: Do background research. Note your sources in order to correctly cite your references. Today, a significant percentage of your study might be done online. Go to the article's bottom to verify the references. Even if you don't have access to the publication's whole text, you may usually scan the abstract to find a summary of related studies. Consult authorities on the topic. You will learn more about the problem the easier your inquiry is to conduct.

- Hypothesis: Present a theory. This is a hypothesis about what you think will happen. It is a prediction about the outcome of an experiment. A hypothesis is frequently presented as a cause-and-effect relationship. Alternately, it might describe how two phenomena are related. One type of hypothesis is the null hypothesis, also referred to as the no-difference hypothesis. Assuming that changing a variable won't have an effect on the outcome, this form of hypothesis is straightforward to test. Even though you know that reality will change, there are instances when it makes more sense to reject a theory than to accept it.

- Experiment: Create and run an experiment to verify your theory. In an experiment, there are independent and dependent variables. The independent variable is changed or managed, and the impact on the dependent variable is then noted. It is crucial to change only one component rather than attempting to combine the effects of numerous in an experiment. For instance, completing two separate studies is actually required when conducting an experiment to examine the effects of fertilizer content and light intensity on a plant's growth rate.

- Data/Analysis: Record observations and explain the findings. You'll frequently use the data to make a table or graph. Don't ignore data points that you think are incorrect or that disagree with your projections. Some of science's most astounding discoveries have been made as a result of the data's strange appearance! To support or refute your theory, you might need to conduct a mathematical analysis, depending on the information you have.

- Conclusion: Determine whether your theory is true or false. Since there is no right or wrong response, either result of an experiment is valid. Of course, accepting a hypothesis does not make it

true! Sometimes, repeating an experiment yields surprising results. In other cases, a hypothesis could be able to predict an outcome, yet you might still draw the incorrect inference. Inform others about your discoveries. The results may be published in a paper or put into a lab report for official presentation. Whatever your opinion of the hypothesis, you almost certainly learnt something new. For a subsequent experiment, you could want to modify the original hypothesis or develop a new one.

1.7 Research processes

In order to focus on the pertinent topic and offer knowledge that will be valued by the project, a researcher must follow a number of systematic phases in the research process. For effective research, you must be aware of and follow the stages of the research process.

Figure 3 Research processes

There are a few steps in the research process:

Step 1: Recognize the Issue: Finding an issue to solve or coming up with a study topic is the first stage. A clearly stated problem will direct the researcher through each stage of the research process, from developing objectives to choosing a technique. There are several ways to gain understanding of a topic and insight into it. Examples include:

- A preliminary survey

- Case studies

- Interviews with a small group of people

- Observational survey

Step 2: Assess the Literature A thorough analysis of the relevant studies is necessary for the research process. It enables the researcher to identify the specific components of the problem. Once an issue has been found, the investigator or researcher needs to learn more about it. The issue area's context is provided at this

stage. It instructs the researcher on past research, its methodology, and its conclusions. The researcher can prove consistency between his work and other works through a literature review.

Step 3: Develop Original Hypotheses: After defining and distilling the study problem, it seems sense to go on to developing an original hypothesis. A belief resolves the connections between the variables that are logical. A hypothesis can only be developed by a researcher who is an authority in the subject. It is critical for researchers to keep in mind that a hypothesis must be based on the topic of their research. Researchers are better able to concentrate their efforts and stay committed to the goals when they develop theories to guide their work.

Step 4: Research Design Research design is a method for achieving objectives and answering research questions. It explains where to look for the relevant information. Planning studies to test hypotheses, address research problems, and provide decision-making support is its main goal. The goal of the research plan is to make gathering valuable data take less time, money, and effort. This tactic can be divided into four categories:

- Exploration and Surveys
- Experiment
- Data Analysis
- Observation

Step 5: Describe the Demographic: Studies of research usually concentrate on a certain population, a location, or the use of technology in the workplace. In research, this topic is referred to as the "population." The study group is selected in part depending on the topic and goals of the research. Let's say a researcher wants to look into a particular community's population. In that case, the study might focus on a certain age range, gender, locale, or ethnic group. The sample or population of a research study must be chosen as the last step in its design in order to allow generalization of the findings.

Step 6: Data Collection: Data collection is essential to obtaining the knowledge or information required to address the research topic. Every research endeavor gathered data, either from the sources or the subjects themselves. Researchers must give data from the two types, original data and secondary data.

Step 7: Data Analysis: Data analysis is planned by the researcher during research design. After collecting the data, the researcher evaluates it. The data is analyzed based on the technique employed at this stage. Reviewing and reporting the findings of the study. Data analysis involves a number of interconnected procedures, such as category creation, category application to raw data through coding and tabulation, and statistical inference generation. The researcher can examine the data they've gathered using a variety of statistical methods.

Step 8: Report-writing: After completing these steps, the researcher must produce a report detailing his findings. The following points must be carefully considered when composing the report:

- The Layout: The prologue, acknowledgements, and title of the report should all be on the first page. Tables, graphs, and charts, if any, should be listed after the table of contents.

- Introduction: the objectives and methods of the study should be described. This section should outline the parameters and scope of the investigation.

- Summary of Findings: Following the introduction, the conclusions and recommendations are succinctly stated. The findings should be shortened if they are lengthy.

- Principal Report: The report's main information should be logically organized and understandable.

- Conclusion: The researcher should restate his findings at the end of the main paragraph. It is the result.

1.8 Population in research

It can be seen that a research population is generally a large group of individuals or objects that serve as the main focus of a scientific inquiry. Research is carried out to benefit the general population. However, because population sizes are so large, it is occasionally time-consuming and expensive for researchers to investigate every individual in the community. Researchers use sampling techniques due to this. The phrase "research population" also refers to a well-defined collection of individuals or objects that are known to share common characteristics. Typically, every person or object within a population shares some sort of unifying quality **(Mohamed Adam, n.d.)**

Two Types of Population in Research:

- **Target Population:** The phrase "target population" refers to the entire group of individuals or objects that researchers are interested in extrapolating the findings from. The theoretical population, which is a different name for the target population, usually has a variety of characteristics.

- **Accessible Population:** The research population to which the researchers can apply their results is called as the accessible population. The study population is known as a different name for this population, which is a subset of the target population. Researcher took samples from the population that is easily accessible.

Relationship of Sample and Population in Research: Simply said, a sample is known as a subset of the population. The inability of the researchers to test every person of a given population gave rise to the idea of a sample. The sample must be enough in size to enable statistical analysis and representative of the population from which it was collected.

The primary purpose of the sample is to enable the researchers to perform their research on members of the population in order to draw generalizable conclusions from the study's findings. It is very similar to a give-and-take transaction. The sample is "given" by the population, which then "takes" inferences from the sample's results **(explorable, 2019)**

2. Secondary Research

2.1 Cloud Computing and their advantages and disadvantages

In order to provide quicker innovation, adaptable resources, and scale economies, cloud computing is the distribution of computer services over the Internet ("the cloud"), including servers, storage, databases, networking, software, analytics, and intelligence (Ranger, 2022)

Strategies for cloud deployment:

- **Public cloud** services are those that are made available to users by a third-party service provider over the Internet, to put it simply. The term "public" does not always imply unlimited access, even if it is free or only reasonably priced to use. Using a public cloud does not mean that a user's data is exposed to the broader public because public cloud companies frequently provide an access control strategy for their users. Systems can be deployed in a flexible, economical manner using public clouds.

The advantages and disadvantages of Public Cloud

Advantages	Disadvantages
Convenience: If you choose for a public cloud deployment option, the infrastructure setup and usage, as well as the vast majority of day-to-day administrative issues, may be handled by the service team.	Potential security issues: The most important issue with public cloud models is without a doubt the data security and privacy concerns that arise when a public third-party controls data storage. Users can easily access their own data, but there are still uncertainties regarding who else can access it and where it is kept.
Reliability: Unlike on-site equipment managed by a small company, third-party service providers frequently have a huge network of servers at your disposal, ensuring 24/7 operation and essentially eliminating downtime.	Simpleness: Many public cloud service providers rely on scalability and only offer the simplest service bundles. Many consumers benefit from simple service agreements, but if your business needs more sophisticated service plans, it could be challenging to locate one that matches your needs.
Scalability: Most public cloud service providers allow you to easily increase or decrease your consumption based on your needs.	Even though a public cloud model's dependability is frequently seen as one of its strengths, there is still a chance for disconnections given the strength of the networks.

- **Private Cloud:** It can be seen that a private cloud provides many of the advantages of a public cloud computing environment, including elasticity and service-based architecture. A private cloud-based service allows data and processes to be handled within the business without the network bandwidth restrictions, security threats, or legal duties that using public cloud services could entail. This is the difference between a private cloud and a public cloud. Due to restricted user access and

designated networks, private cloud services also allow the customer and provider more control over the cloud infrastructure, boosting security and resilience.

The advantages and disadvantages of Private Cloud

Advantages	Disadvantages
Security and privacy: Unlike public cloud models, private clouds carefully define who has access to crucial data and sensitive information and strictly prohibit public access.	It could have a greater initial cost compared to other cloud deployment models.
Customization: When compared to public cloud models, private clouds offer greater customization and solutions that are specifically tailored to the needs of a given business.	A private cloud requires staff to start it as well as the equipment, software, and training required to develop it, so budget extra money initially.
Reliability: Private clouds should be extended by adding extra hardware tiers that are only used by your firm, as opposed to public clouds, which can be readily scaled up or down.	

- Community cloud: Managed and used by a number of Organizations with related objectives, such as a shared security purpose. All community members can access the programs and data stored in the cloud.

The advantages and disadvantages of Community Cloud

Advantages	Disadvantages
Savings: After development, you can collaborate with other businesses to split maintenance costs and resources.	Rarity: Community cloud deployment is still less frequent than other deployment choices since it requires locating other businesses with comparable requirements.
Security and privacy: Similar to a private cloud deployment model with highly limited access to user information, community cloud deployment approaches offer greater data security and information privacy.	High cost: Depending on the number of partners, community cloud models may be more expensive to maintain as well as more costly to implement than public cloud models.
Collaboration: Because data sharing between organizations is possible through the community cloud, users can cooperate and work on common initiatives.	Limited storage and bandwidth: When numerous organizations share the same resources, availability of storage and bandwidth may be a problem.

- Hybrid Cloud: A hybrid cloud is made up of both public and private clouds that communicate with one another. In this arrangement, users often retain control over services and data that are

essential to their organization while outsourcing less important data and processing to the public cloud.

The advantages and disadvantages of Hybrid Cloud

Advantages	Disadvantages
Security and privacy: Similar to a private cloud, when only your business uses the private component of your infrastructure, you can be sure that your data is secure.	Implementation is often best handled by a service partner with strong knowledge of cloud deployments because it can be complex.
Potential cost savings: By storing less generic data overall and spending more on securing your most valuable assets, long-term cost savings may be possible.	
Superior flexibility and scalability: With hybrid cloud deployments, you may employ both flexibility and scalability in a way that makes sense for the specific challenges your organization is facing. Deployments on the public and private clouds are each flexible and scalable in different ways.	

2.2 Overview of environmental issues with cloud computing

III. Primary research

1. Introduce to collect data tools (Google Form)

Google Forms is known as a free online application that enables users to make forms, surveys, and quizzes. Users can also update the forms together and share them with others. Students can use Google forms to evaluate their own learning, define learning goals, and gather information for research projects. In my project, I used Google Forms to collect data for my project through quantitative research and qualitative research **(Demarest, 2021)**

According to (Sandra, 2018) The Advantages and Disadvantages of Google Form:

Advantages	Disadvantages
It is a free online tool that allows quick and effective information gathering.	To use this program, you must have access to the internet.
You can quickly build surveys using Google Forms to gather feedback about your goods or services from customers or partners.	There is very little design modification available. Advanced users can modify the design of the tool to use it for a wider range of objectives.

You only need a Google account to start use this service, the same one you use to access Gmail, YouTube, or Google Drive.	Some people have security issues. To strengthen security, the user must set a strong password and protect it.
The user interface is fairly simple. Using this tool, any person with a basic understanding of the Internet may develop forms.	Regarding this tool's capabilities, there are certain restrictions. Texts up to 500 Kb, photos up to 2 Mb, and spreadsheets with 256 cells or 40 sheets are all acceptable.
Utilizing the assistance is straightforward. Drag and drop form elements and event-based organization are made simple by the What-You-See-Is-What-You-Get interface.	
At the design level, you can select a color scheme and your own photographs to serve as the background.	
We can thoroughly analyze the input we receive because Google forms stores it.	
We have access to a spreadsheet view of the data collected because the forms are connected with Google spreadsheets.	
You can gather the recipient's email address and set a restriction on the answers thanks to the way that surveys and forms are often configured.	
The type of data that can be entered into a field can be tailored by experienced users using regular expressions. This makes the form even more individualized.	
Before submitting the survey to the respondents, we may preview it using Google Forms.	
We can use any method to distribute the form, including email, website integration, social media, and other channels.	
While other survey platforms charge based on the quantity of questions and receivers, with this tool you can get an unlimited amount of questions and replies for free.	

2. Survey online using Google Form

We use an online survey as the data collection technique to collect the information needed to support the initial premise. We use Google Forms software to carry out online surveys (Survey questions in Appendix). The purpose of this study was to support the primary study's hypothesis. I will start by asking my surveyor if they have heard of the cloud to gauge the level how familiar university students are with it. We question them about the evolution of cloud computing to determine whether they anticipate further development of cloud centers in the future or not. I also conduct a survey to see whether cloud computing is used by everyone at the university. In addition, we assess their understanding of the impact on the environment of cloud

computing by asking them “What do you think about the impact of Cloud Data Centers to the environment?”, the advantages and the impact of Cloud Data Centers to the environment in Google Forms, and then The following inquiry will focus on the impact of cloud computing on the hardware sector, asking them to weigh its advantages and impact. We also conduct a study to find out more about how customers interact with the brand and their perceptions of the environmental advantages and disadvantages of cloud computing. Customers' knowledge of how cloud computing affects environmental issues is tested through survey questions. We finally get a survey asking users if they think cloud computing will develop further.

IV. Analyses the result of the primary research

I send a survey form email (Google Forms) to my friends at Greenwich University to collect data about the impact of Cloud Data Centers to the environment. Through a survey, I received 10 Responses and the results are shown below.

1, Analyses the result of Question 1

Question 1: Do you know about Cloud Services?

Answers include “Yes, No, Maybe”

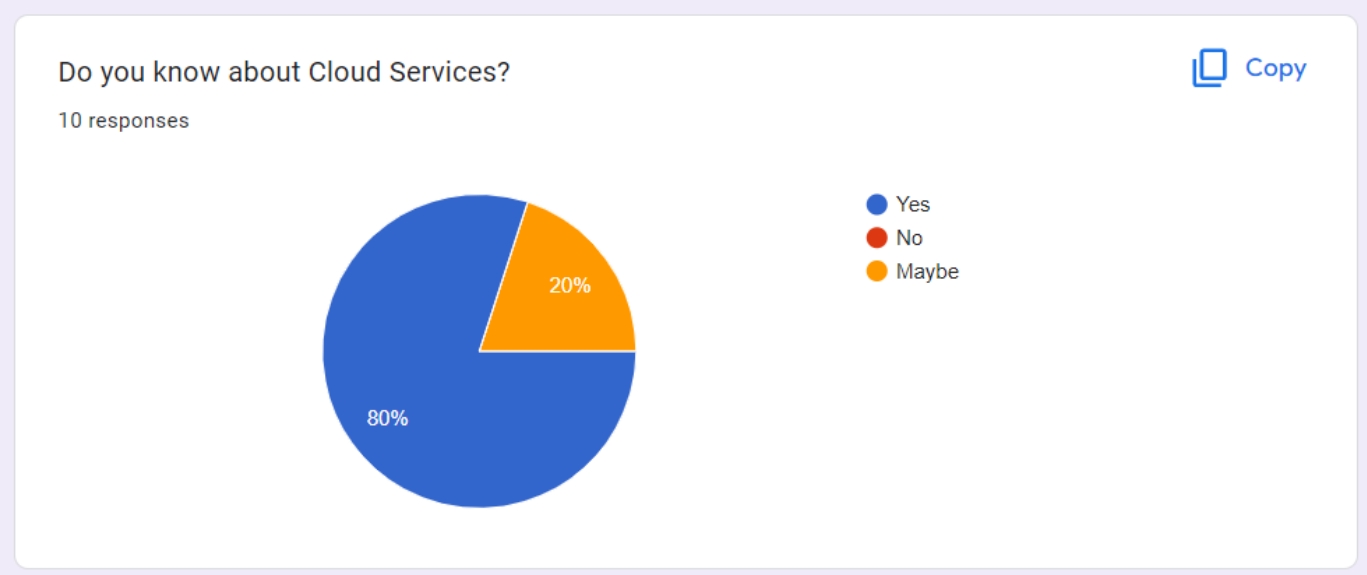

Figure 4 Question 1

In the chart, we can see that 80% (8/10) respondents choose “Yes”, 20% (2/10) respondents choose “Maybe”.

In conclusion: The majority of respondents know about Cloud Services. Therefore, we can be seen that Cloud Services have been widely known by many people, this will help my survey increase the accuracy.

2, Analyses the result of Question 2

Question 2: Do you use any Cloud services?

Answers include “Yes, No”

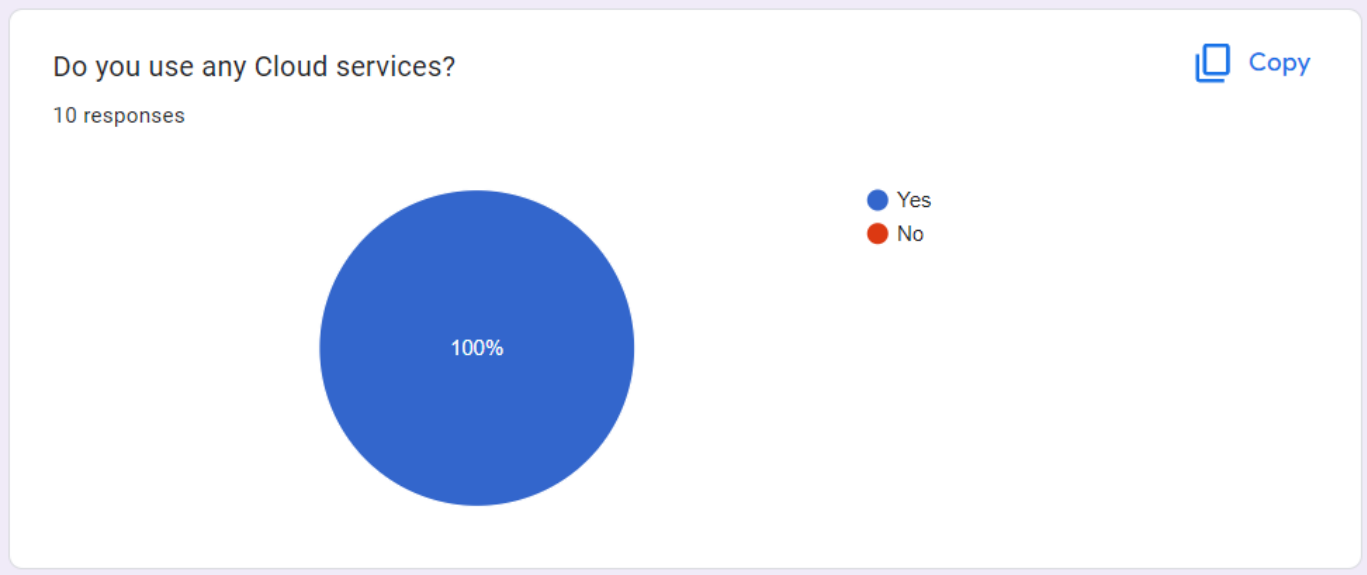

Figure 5 Question 2

In the chart, we can see that 100% (10/10) respondents choose “Yes”.

In conclusion: 100% respondents used Cloud Services. Therefore, we can be seen that Cloud Services have been widely used by many people, from that, I can get everyone's opinion on the impact of data cloud centers and their benefits. I will have results that more accurate than those who have never used.

3, Analyses the result of Question 3

Question 3: What Cloud Provider are you using?

Answers include “Microsoft Azure, Amazon Web Services (AWS), Google Cloud Platform (GCP), Other”

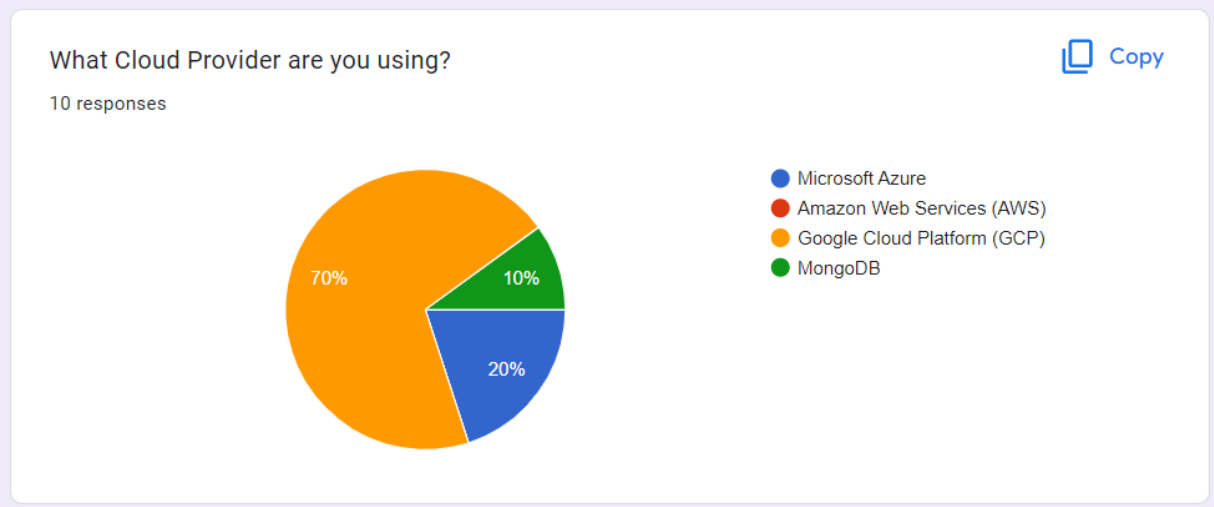

Figure 6 Question 3

In the chart, we can see that 70% (7/10) respondents choose "Google Cloud Platform (GCP)", 20% (2/10) respondents choose "Microsoft Azure" and 10% (1/10) respondents choose "Other (MongoDB)".

In conclusion: The majority of respondents are using Cloud Services of large corporations such as Google, Microsoft. I can collect data about the impact as well as the advantages of Cloud Data Center Through the results of these respondents.

4, Analyses the result of Question 4

Question 4: What are the advantages of cloud Services to the environment?

Answers include "it improve energy efficiency, It Reduces Greenhouse Gas Emissions, it Uses Virtualization for Sustainability, It is Powered by Renewable Energy, All"

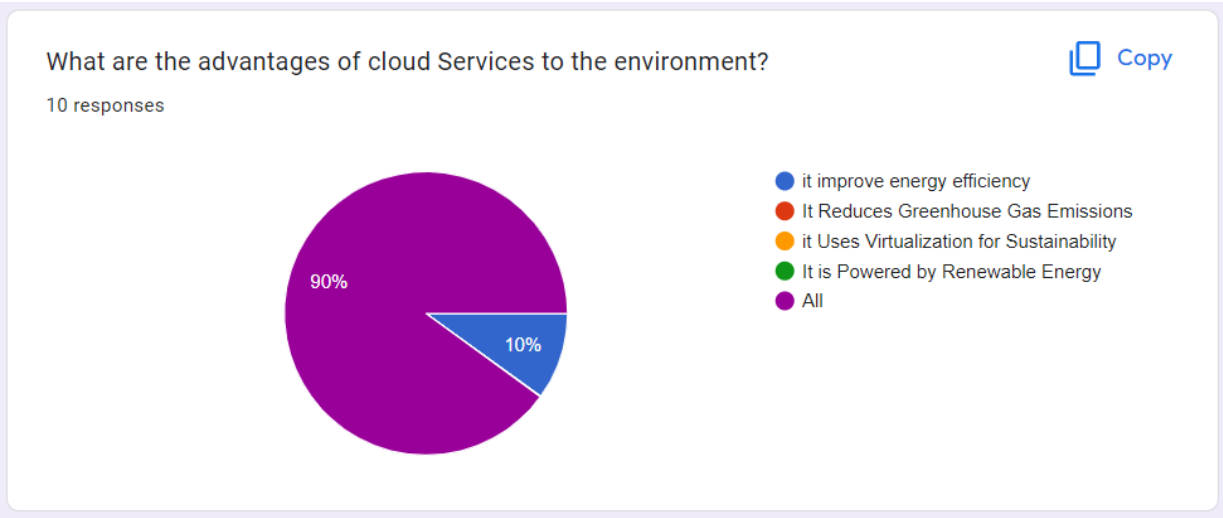

Figure 7 Question 4

In the chart, we can see that 90% (9/10) respondents choose “All”, 10% (1/10) choose “it improve energy efficiency”

In conclusion: The majority of respondents choose “All”, this indicates that they are fully aware of the effects that cloud Services have on the environment, they understand about the advantages of Cloud Services.

5, Analyses the result of Question 5

Question 5: Do you agree cloud services will develop strongly in the future?

Answers include “Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree”

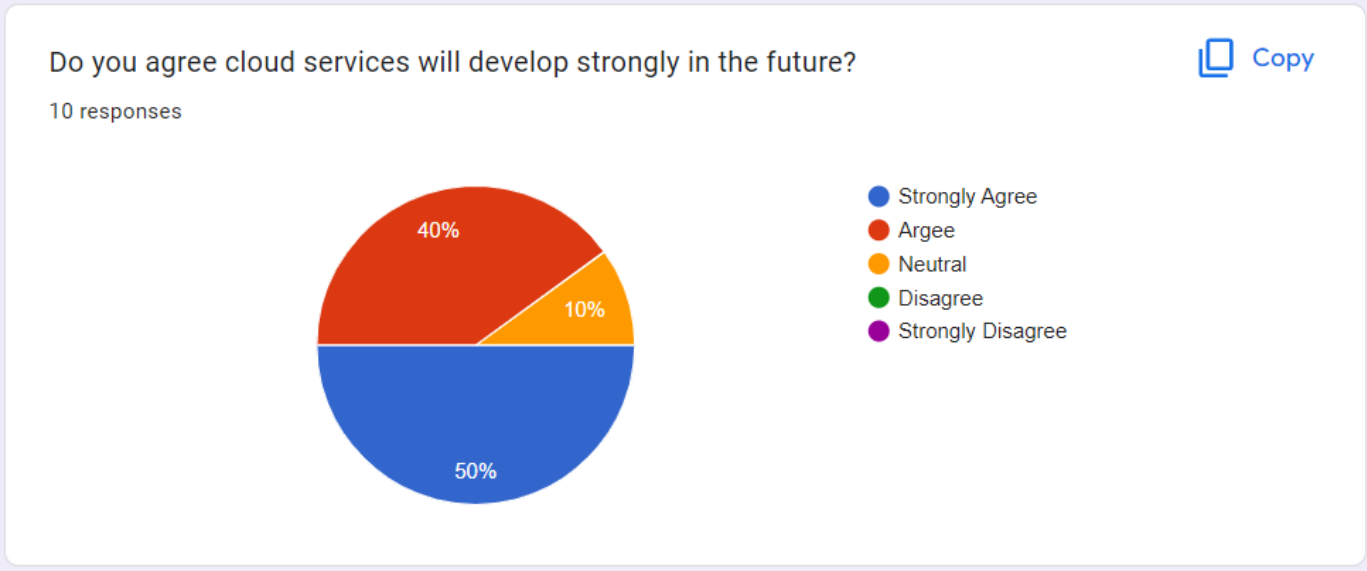

Figure 8 Question 5

In the chart, we can see that 50% (5/10) respondents choose “Strongly Agree”, 40% (4/10) respondents choose “Agree”, 10% (1/10) choose “Neutral”.

In conclusion: The majority of respondents (90%) agree that the cloud services will develop strongly in the future, while 10% they do not know whether or not Cloud services develop.

6, Analyses the result of Question 6

Question 6: What do you think about the impact of Cloud Data Centers to the environment?

Answers include “Seriously Influence, Medium Influence, Low Influence”

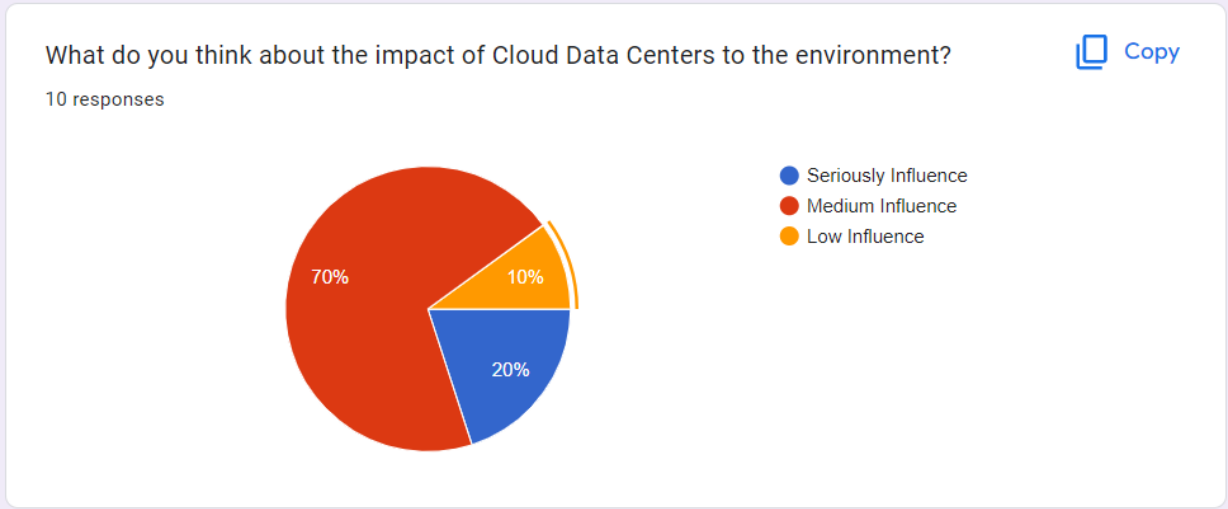

Figure 9 Question 6

In the chart, we can see that 70% (7/10) respondents choose "Medium influence", 20% (2/10) choose "Seriously Influence", 10% (1/10) choose "Low Influence".

In conclusion: All respondents are fully aware of the impact that cloud Data Centers have on the environment, so the majority of respondents indicate Cloud Data Centers have Medium Influence to the environment. While some people indicate Cloud Data Centers have "Seriously Influence" or "Low Influence". From that, we can see that the majority of respondents are fully aware about Advantages and impact of Cloud Data Centers to the environment.

7, Analyses the result of Question 7

Question 7: Which is the most impact of Cloud Data Centers to the environment?

Answers include "Electric Consumption and Carbon Footprint, Toxic Coolant, Noise Pollution"

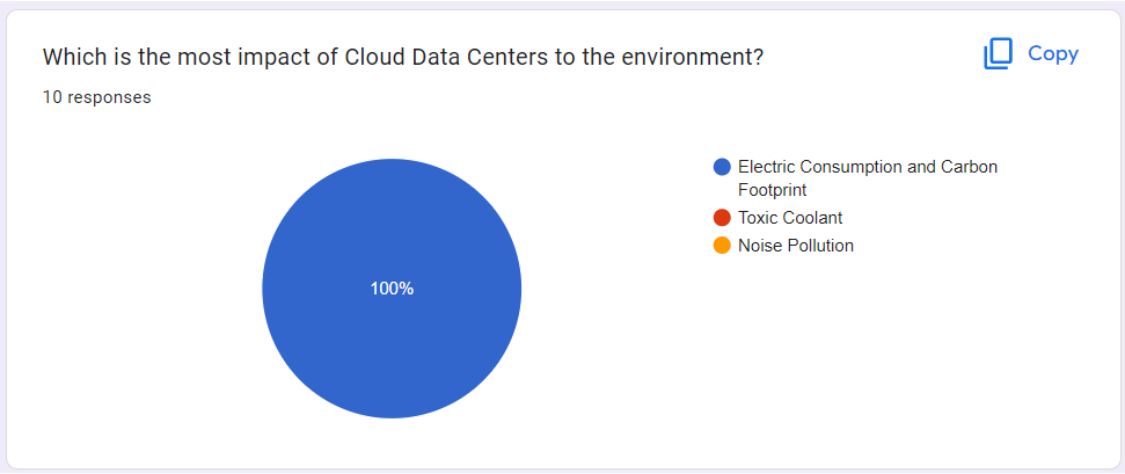

Figure 10 Question 7

In the chart, we can see that 100% (10/10) respondents choose “Electric Consumption and Carbon Footprint”.

In conclusion: All respondents indicate that Electric Consumption and Carbon Footprint is the main cause that Cloud Data Centers affect the environment.

8, Analyses the result of Question 8

Question 8: Which is the main cause of Cloud Data Centers that impact the environment?

Answers include “A lot of Computer equipment generates a lot of heat. Data centers must use electricity to keep cool, The electronic waste produced by the industry”

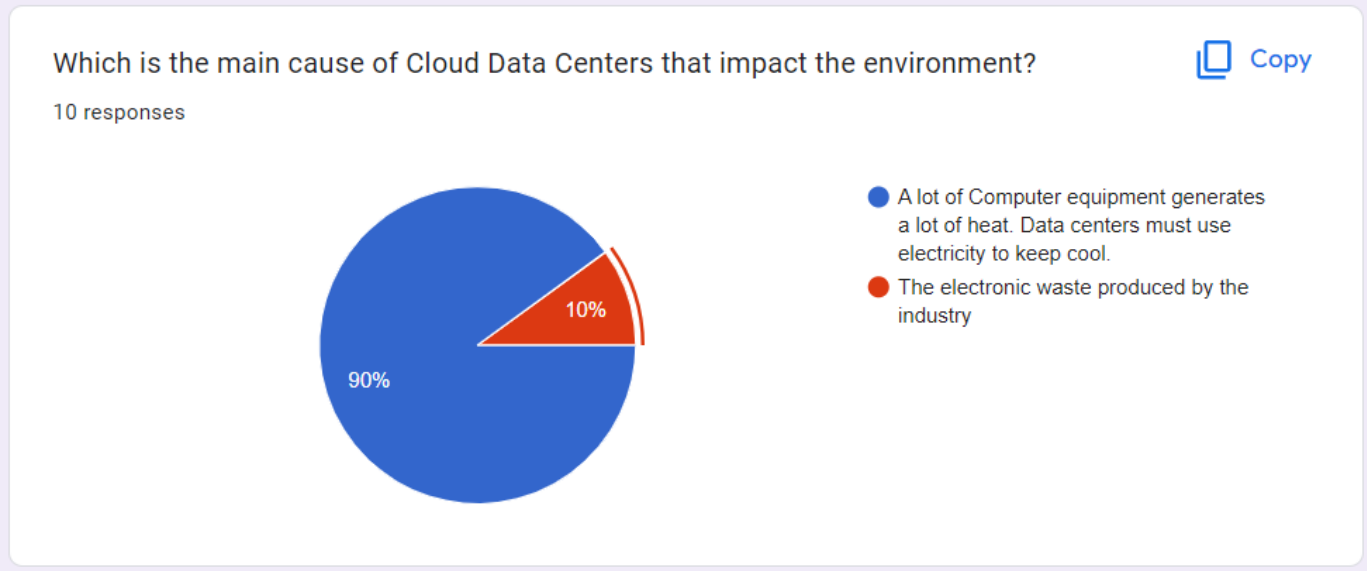

Figure 11 Question 8

In the chart, we can see that 90% (9/10) respondents choose “A lot of Computer equipment generates a lot of heat. Data centers must use electricity to keep cool”, 10% (1/10) respondents choose “The electronic waste produced by the industry”.

In conclusion: The majority of respondents believe that using electricity to keep cool Computer equipment in Cloud Data Centers is the main cause because most Cloud Data Centers are large areas with a lot of Computer Equipment, so Electricity Consumption is so high, the more Electricity Consumption, the more Carbon footprint to the environment is high. Besides, there is person believe that the main cause is The electronic waste produced by these Cloud Data Centers.

9, Analyses the result of Question 9

Question 9: Do you agree the Electric Consumption and Carbon Footprint of Cloud data Centers is one of the reasons that contribute to global warming

Answers include: “Strongly Agree, Argee, Neutral, Disagree, Strongly Disagree”

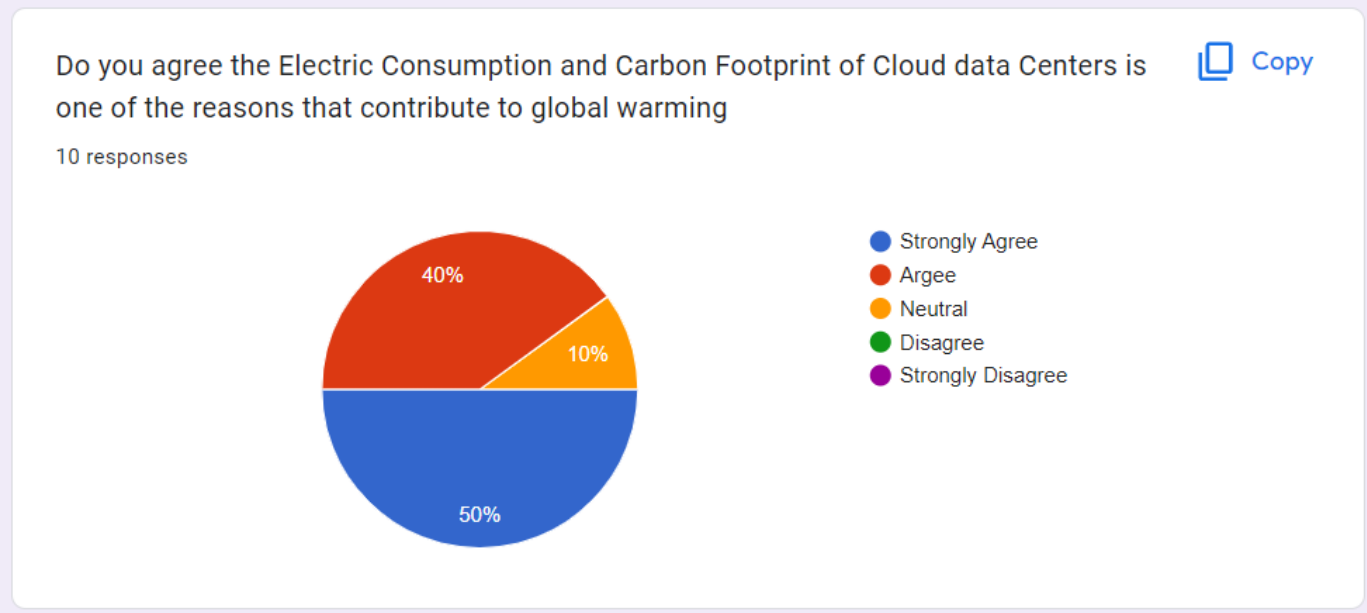

Figure 12 Question 9

In the chart, we can see that 50% (5/10) respondents choose “Strongly Agree”, 40% (4/10) respondents choose “Agree”, 10% (1/10) respondents choose “Neutral”.

In conclusion: Most respondents agree that the Electric Consumption and Carbon Footprint of Cloud data Centers is one of the reasons that contribute to global warming and others are not sure about that.

10, Analyses the result of Question 10

Question 10: What do you think between Cloud Computing and other hardware, which one will be more efficient for the environment?

Answers include “Cloud Computing is more effect , Other Hardware is more effect”

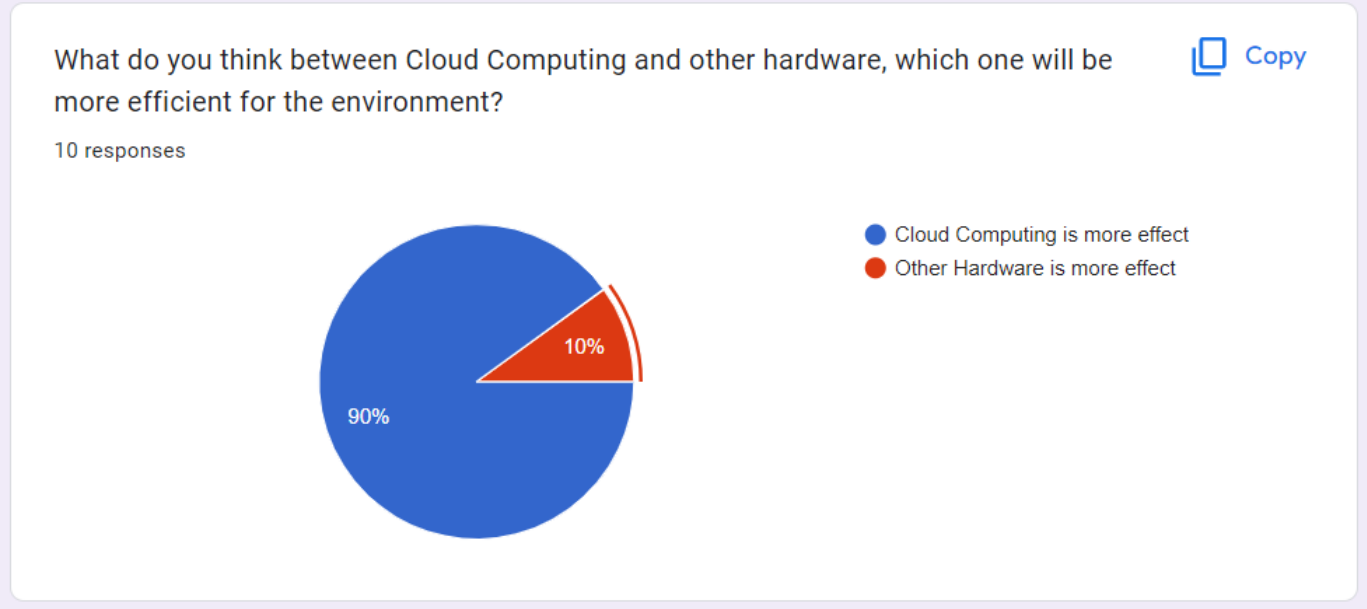

Figure 13 Question 10

In the chart, we can see that 90% (9/10) respondents choose "Cloud Computing is more effect", 10% (1/10) respondents choose "Other Hardware is more effect".

In conclusion: most respondents indicate that Cloud Computing is more effect than other hardware, but others believe that other hardware is more effect than Cloud Computing but do not know the specific hardware.

11, Analyses the result of Question 11

Question 11: Do you agree Cloud Services will be replaced by other technologies?

Answers include "Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree"

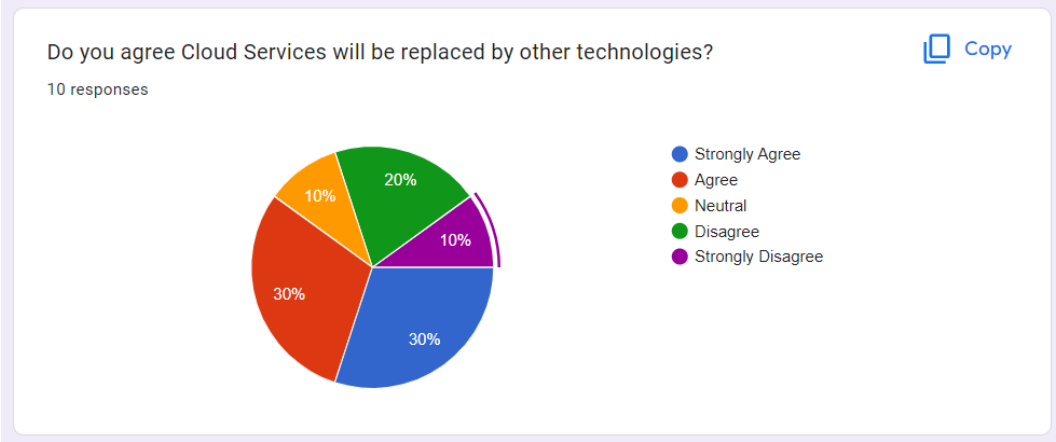

Figure 14 Question 11

In the chart, we can see that, 30% (3/10) respondents choose “Strongly Agree”, 30% (3/10) respondents choose “Agree”, 10% (1/10) respondents choose “Neutral”, 20% (2/10) respondents choose “Disagree”, 10% (1/10) respondents choose “Strongly Disagree”.

In conclusion: Most respondents agree that the Cloud Services will be replaced by other technologies, The remainders believe not or not sure.

V. Research findings and Improvements

1. Research findings

According to both primary and secondary research, the findings of primary research are comparable with those of secondary study.

About Question “Do you agree cloud services will develop strongly in the future?”, 90% of respondents agree that the Cloud Services will develop strongly in the future, 10% of respondents are not sure about that. Besides, parallel to the strong development is its impact on the environment, so I asked 3 questions “What do you think about the impact of Cloud Data Centers to the environment?”, 70% of respondents believe with the development of Cloud Data Centers only have the Medium influence to the environment, while 20% of people think that it will have the Seriously Influence and 10% believe that it will have the Low Influence, “Which is the most impact of Cloud Data Centers to the environment?”, 100% of respondents believe that Cloud Data Centers will affect to the environment through Electric Consumption and Carbon Footprint. Finally, 90% of respondents think that “A lot of Computer equipment generates a lot of heat. Data centers must use electricity to keep cool” is the main cause that increase Electric Consumption and Carbon Footprint and from that, it affects to the environment. From these questions, we can see that the electric consumption and Carbon Footprint of data center clouds will increase over time. In conclusion, all respondents are fully aware about Cloud Data Centers and from that, I have answers that the Cloud Services will develop in the future, but this will affect the environment through electricity consumption and Carbon Footprint.

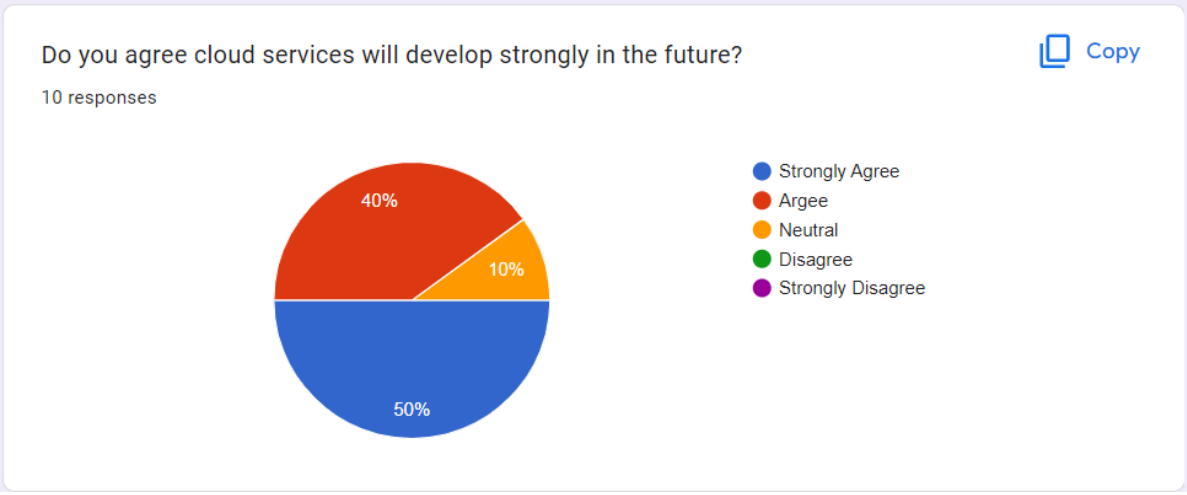

Figure 15 Question 5

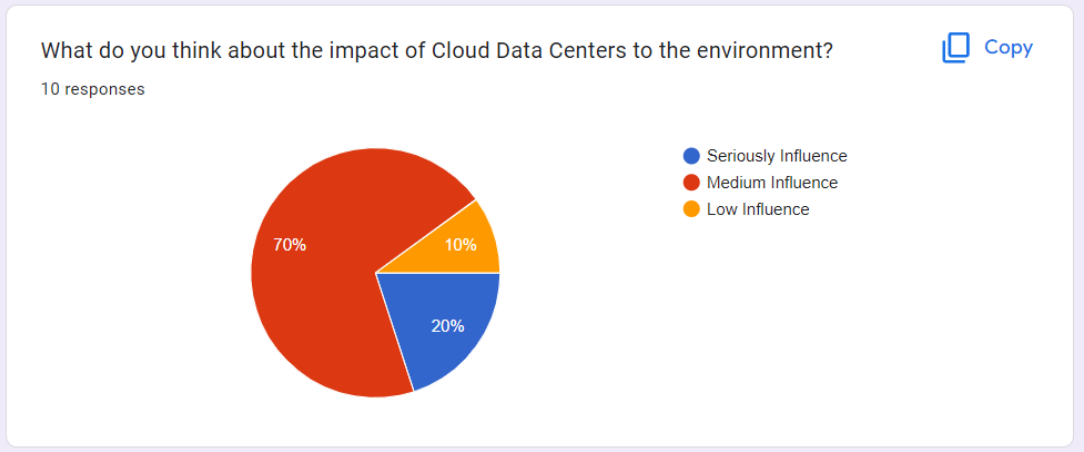

Figure 16 Question 6

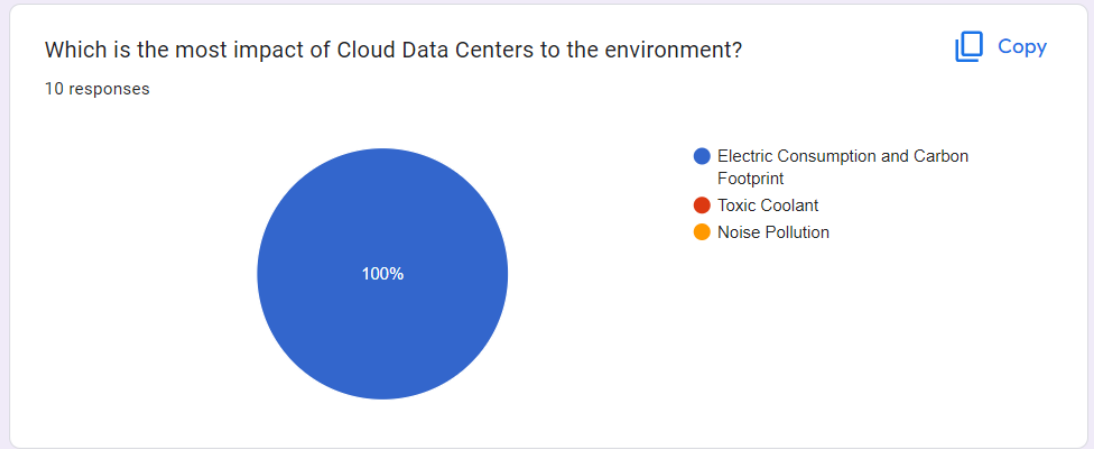

Figure 17 Question 7

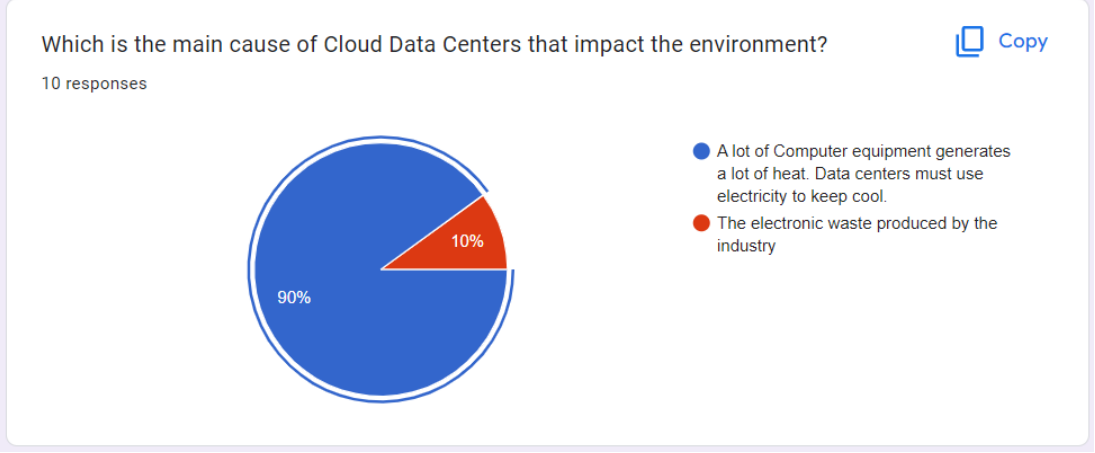

Figure 18 Question 8

About Question “What are the advantages of cloud Services to the environment?”, 90% of respondents think that Cloud services will have a lot of advantages to the environment, 10% of respondents choose “it improve

energy efficiency". According to our definition, the majority of cloud computing users are aware of the advantages of Cloud Services to the environment, besides, the rest are aware of how cloud computing affects the environment, but they are not particularly knowledgeable about it. In addition, 90% of respondents believe that Cloud computing is more effect than other hardware, 10% of respondents disagree with this opinion. In conclusion, we can see that most respondents are fully aware of the impact of Cloud Data Centers to the environment as well as its advantages.

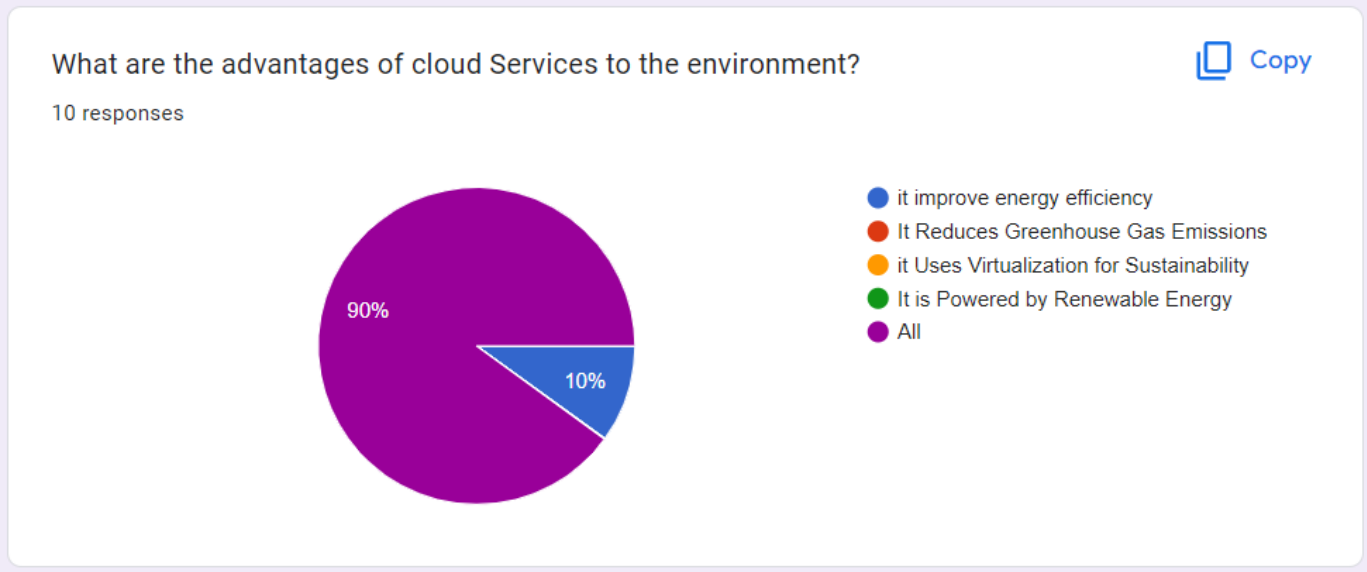

Figure 19 Question 4

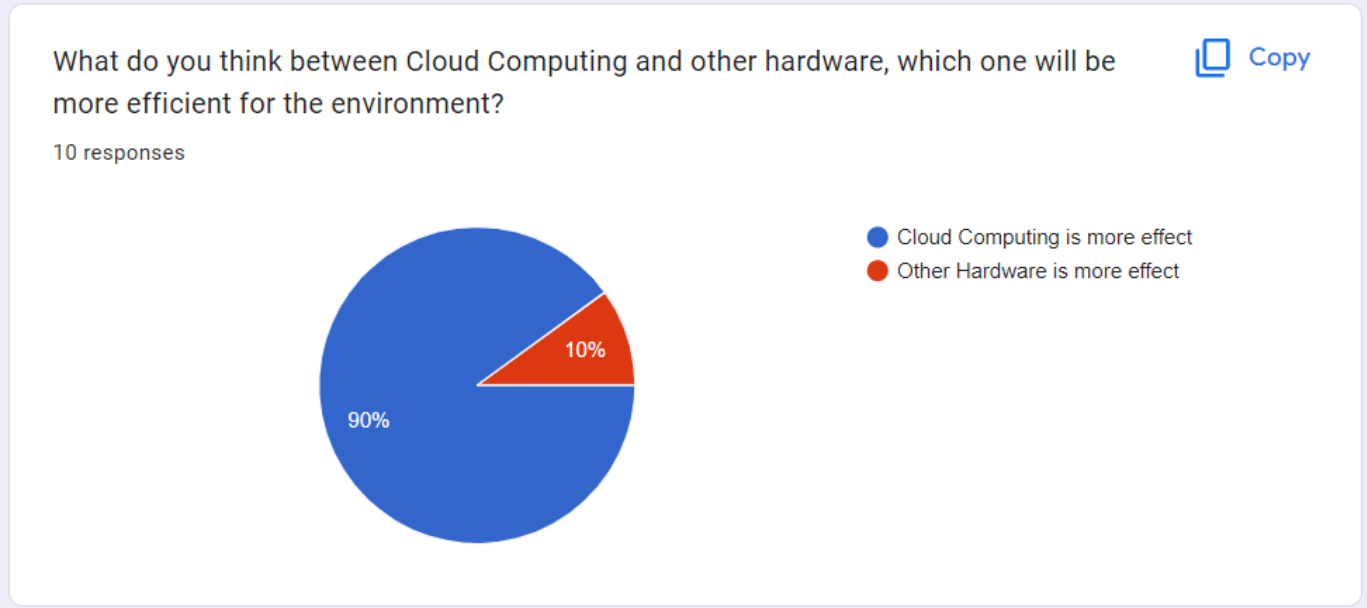

Figure 20 Question 10

VI. Appendix

Research Proposal Form

Student Name: Lam Phi Student Number: GCC200011

Tutor: Cu Vinh Loc Date: 03/02/2022

Unit 13: Computing research project

Propose title: “Electric Consumption and Carbon Footprint of Cloud data Centers to the environment.”

Section One: Title, objective, responsibilities
Research question: Electric Consumption and Carbon Footprint of Cloud data Centers to the environment **Objectives** I want to learn: • What is a cloud Computing? • What is main effect to environment of cloud data centre? • Why is the electric consumption and Carbon Footprint of cloud data centre effect to enviroment? • How are the effect of electric consumption and Carbon Footprint of cloud data centre to global warming? • Why is the electric consumption and Carbon Footprint of cloud data centre contributing to global warming?
Section Two: Reasons for choosing this research project
Reasons for choosing the project: • I have a strong interest in cloud computing and cloud data centre. • I'll probably select this topic for my research project in my senior year. Because of this research report, I will be able to complete the project with additional resources in the future. • I want to know what and why the electric consumption of cloud data centre contributing to global warming
Section Three: Literature sources searched
The initial sources which could help me to answer those questions:
Section Four: Activities and timescales

1. Obtain details about the objectives and research questions.
2. a comprehensive study proposal
3. Compile details on the question and objectives of the research.
4. Complete your study proposal.
5. **Milestone 1 [9- November]:** Get the tutor's advice on the research proposal.
6. Finding document and reference
7. Create a project plan with a WBS and Gantt chart.
8. Writing a review of the literature and presenting the results as hypotheses.
9. Monitor study idea, plan, and literature review progress.
10. Getting ready for primary research (to verify literature review findings or address any questions that may have arisen as a result of the literature review)
11. **Milestone 2 [15 - November]:** Obtain input on the principal research strategy from the tutor.
12. **Milestone 3 [22 - November]:** Obtain input from the tutor regarding the findings of the literature review.
13. Executing the primary research
14. **Milestone 4 [1 - December]:** Represent the findings in primary research and get feedback from Tutor
15. Writing assignment 1 which contains LO1, LO2
16. **Milestone 5 [10- December]:** Submit assignment 1 -Draft
17. **Milestone 6 [20 - December]:** Submit assignment 1- Final
18. Writing Assignment 2 which contain LO3, LO4
19. **Milestone 7 [17 - December]:** Submit assignment 2 -Draft
20. **Milestone 8 [18 - December]:** Presentation- put everything together.
21. **Milestone 9 [25 - December]:** Submit assignment 2- Final

Section Five: Research approach and methodologies

- Research process: sequential
- Research classes: quantitative and qualitative
- Research methods: case study, survey

Type of research approach and methodologies you are likely to use, and reasons for your choice:

What your areas of research will cover:

Comments and agreement from tutor

[This part not for student]
Comments (optional):

I confirm that the project is not work which has been or will be submitted for another qualification and is appropriate.

Agreed: .....(Name) ..... (Date) .....
Comments and agreement from project proposal checker (if applicable)
[This part not for student] Comments (optional): Agreed: .....(Name) ..... (Date) .....

VII. Ethical Form

Before beginning their research, all researchers must obtain ethical approval if their project will involve human participants or the use of data gathered from those persons. Please complete all pertinent questions; if you do not, your form can be returned.

We advise that you properly discuss your intended research with your unit tutor before completing this form.

Please complete this form well in advance of the start of your research project.

Section One: Basic details

Project title: Electric Consumption and Carbon Footprint of Cloud data Centers to the environment

Student name: Lam Phi

Student number: GCC200011

Program: Majority of Computing Science

School: Greenwich University of Can Tho,

Vietnam

Intended research start date: 9 November

2022

Intended research end date: 24 December

2022

Section Two: Project summary

Please select all research methods that you plan to use as part of your project:

- ✓ Online Surveys
- ✓ Secondary research
- ✓ Primary research
- ✓ Data analysis

Other (please specify):

Section Three: Participants

Please answer the following questions, giving full details where necessary.

Will your research involve human participants?

- Including students, lectures are using cloud services at Greenwich University of Can Tho, Vietnam

Who are the participants? Tick all that apply:

- **Children aged 12–16**: ✕ **Young people aged 17–18**: ✕ **Adults**: ✓

How will participants be recruited (identified and approximately)?

- At University Greenwich Can Tho in Vietnam including lecturers and students.

Describe the processes you will use to inform participants about what you are doing:

- To let people, know how they can support our initiative by selecting the prepared response below, we'll include a survey in the email. Our research's findings will assess their contribution.

How will you obtain consent from participants? Will this be written?

- We will now try to convince the participants to give the survey some of their time.

Studies involving questionnaires:

Will participants be given the option of omitting questions they do not wish to answer?

Yes: ✓ No: ☐

If no, please explain why below and ensure that you cover any ethical issues arising from this:

Studies involving observation:

Confirm whether participants will be asked for their informed consent to be observed.

Yes: ✓ No: ☐

Will you debrief participants at the end of their participation (i.e. give them a brief explanation of the study)?

Yes: ✓ No: ☐

Will participants be given information about the findings of your study? (This could be a brief summary of your findings in general.)

Yes: ✓ No: ☐

Section Four: Data storage and security

Confirm that all personal data will be stored and processed in compliance with the Data Protection Act (1998):

Yes: ✓ No: ☐

Who will have access to the data and personal information?

- Only research of this project

During the research:

Where will the data be stored?

In OneDrive

Will mobile devices (such as USB storage and laptops) be used?

Yes: ✓ No: ☐

If yes, please provide further details:

After the research:

Where will the data be stored?

- In google cloud

How long will the data and records be kept for and in what format?

- Excel file and summary chart base on end of project.

Will data be kept for use by other researchers?

Yes: ☐ No: ✓

If yes, please provide further details:

Section Five: Ethical issues

Are there any particular features of your proposed work which may raise ethical concerns? If so, please outline how you will deal with these:

It is important that you demonstrate your awareness of potential risks that may arise as a result of your research. Please consider/address all issues that may apply. Ethical concerns may include, but are not limited to the following:

- ✓ Informed consent.
- Potentially vulnerable participants.
- Sensitive topics.
- Risks to participants and/or researchers.
- ✓ Confidentiality/anonymity.
- ✓ Disclosures/limits to confidentiality.
- Data storage and security, both during and after the research (including transfer, sharing, encryption, protection).
- ✓ Reporting.

Dissemination and use of your findings.

Section Six: Declaration

I have read, understood and will abide by Security Policy of Google Form:

Yes: ✓ No: ☐

I have discussed the ethical issues relating to my research with my Unit Tutor:

Yes: ✓ No: ☐

I confirm that to the best of my knowledge:

The above information is correct and that this is a full description of the ethics issues that may arise in the course of my research.

Name: Lam Phi

Date: 24 December 2022

Please submit your completed form to: Greenwich University of Can Tho, Vietnam.

VIII. Other materials

Link Google Form of Survey:
https://docs.google.com/forms/d/e/1FAIpQLSf10ZB1x19GXNlkNsODq3nHOyok3em-Y8u8P842dvLU2c5Uxw/viewform?usp=sf_link

Question of Survey

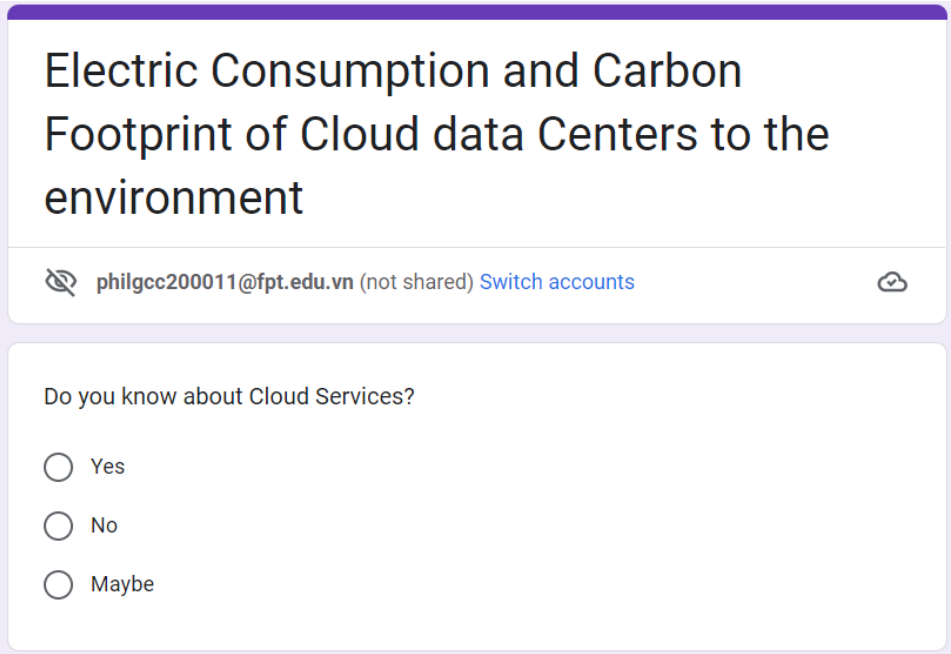

Figure 21 Question 1

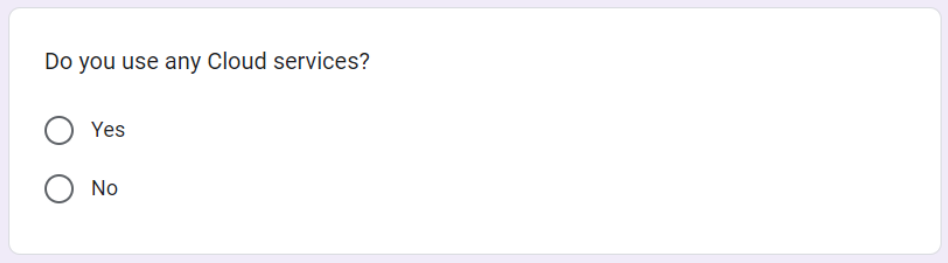

Figure 22 Question 2

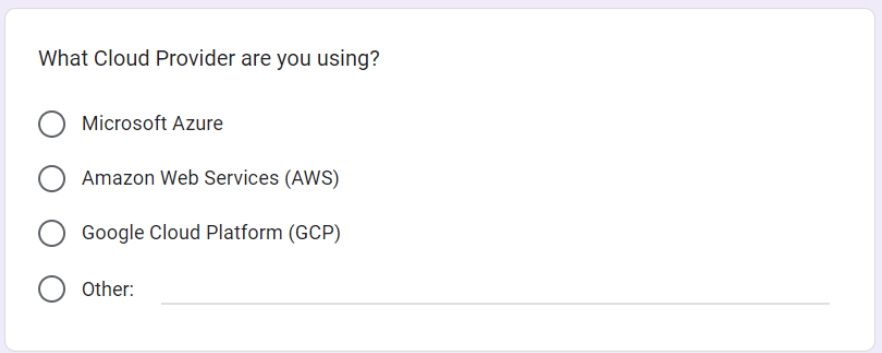

Figure 23 Question 3

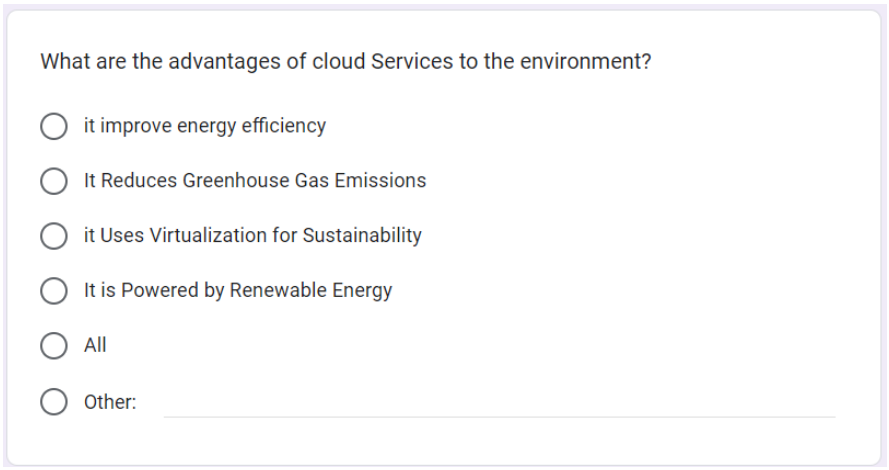

Figure 24 Question 4

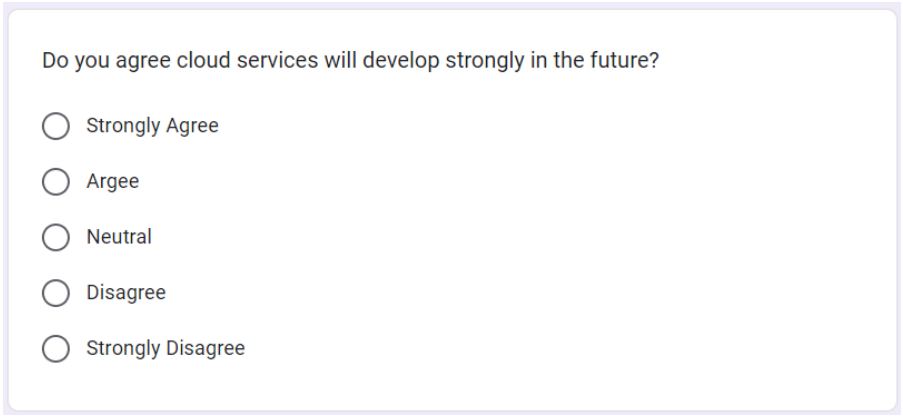

Figure 25 Question 5

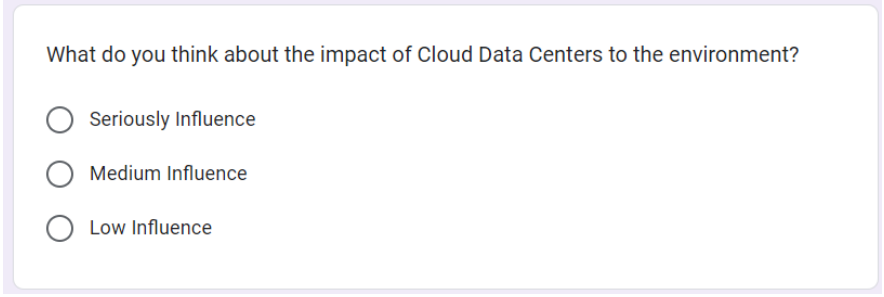

Figure 26 Question 6

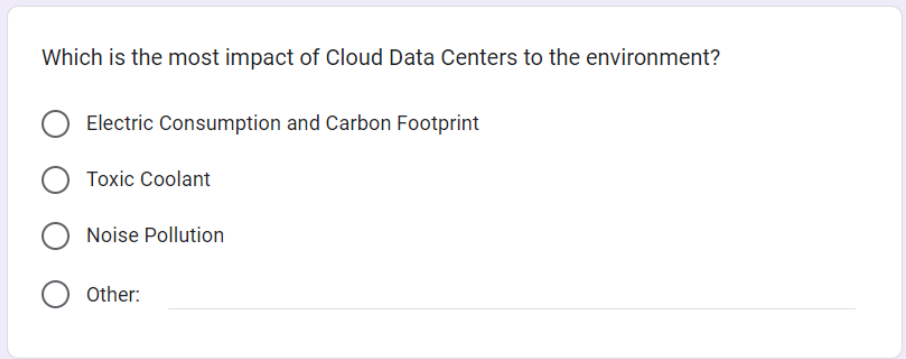

Figure 27 Question 7

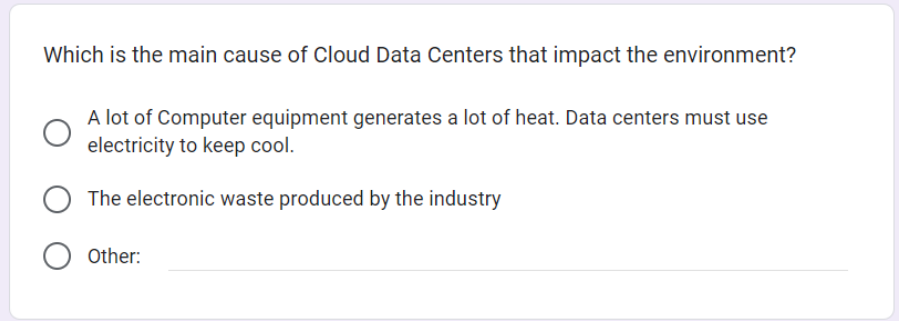

Figure 28 Question 8

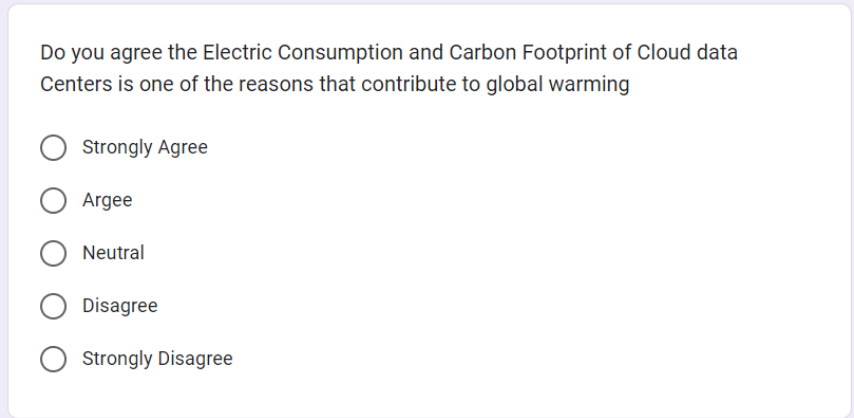

Figure 29 Question 9

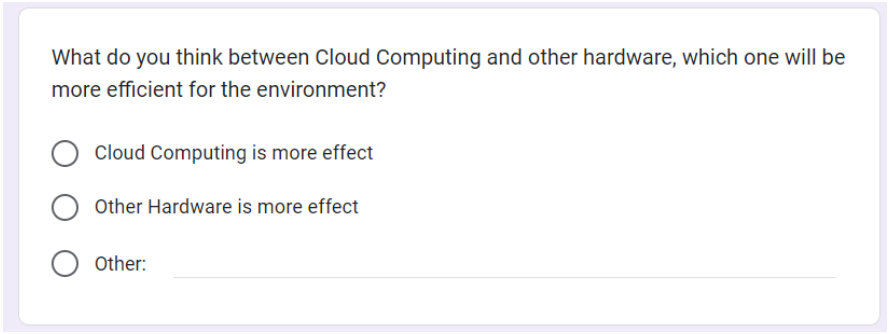

Figure 30 Question 10

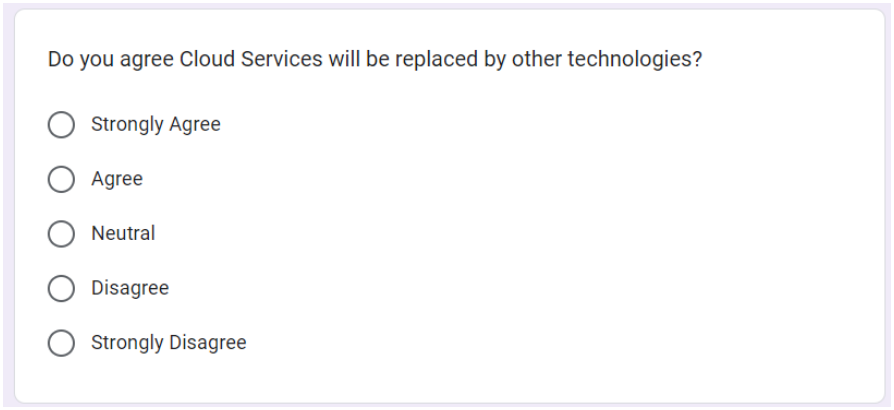

Figure 31 Question 11

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