Review of Carbon Offset Programmes by leading Information Technology Companies

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***Abstract* — The present study reviews the carbon offset programmes by various IT companies. IT infrastructure usage and Cloud Servers and IT enabled Services are increasing at an alarming rate around the globe and the rise in energy consumption and carbon emission is also taking place in parallel. The environment is badly impacted by massive use of Information Technology infrastructure and by products of servers and data centers. Cloud computing has settled as a strong and valuable solution to install entire virtualized IT resources under pay-as-you-go model for the users. Numerous cloud deployment approaches have evolved as per the fresh need of clients which include users, institutions, businesses and companies. All the big data like social media pictures, videos, tweets, queries etc. are associated with a carbon footprint. The chapter discusses the various recent natural calamities which occurred in last one year.**

The carbon footprints of various social media sites and websites give an insight of the amount of carbon released by the companies. The last section of the chapter tries to establish an association between the digital activities and its impact on environment. This paper describes the process used by Google, Microsoft and Facebook to select carbon offset projects and earn carbon credits to their carbon footprint. The study also sheds light on the green initiatives of Google, Facebook and Microsoft and how they meet their carbon footprints. The paper also suggests some immediate solution to minimize carbon on the earth.

Keywords— Paris Agreement, Digital Carbon Footprint, Cloud Computing, Greenhouse Gas, Carbon Neutral Program, Big Data, Data Center, Green Plan, CO2e

I. NEED OF RESEARCH ON DIGITAL CARBON FOOTPRINTS

The current research is on digital carbon footprints in the environment to understand the digital carbons which are increasing at an alarming rate on the planet. With the invent of AI and apps involved in AI, usage of query data and the search algorithms involved in finding the solutions have also increased manifold. The data is stored on servers and servers need coolants to cool the system. Due to this, fossil fuels are burnt to cool the data farms.

Thus with the digital technology penetrating in our lives and AI based solutions, there is a huge need to understand the cooling systems and the amount of carbon released on the planet. Also there is a need to understand that exactly what the IT companies are doing to attain NetZero as per the Paris agreement.

These companies have been selected because they are mainly on social media and millions of users are using their free and paid services. The tech giants must take care of the planet and with due diligence adopt carbon neutral programme to neutralize their digital carbons.

II. INTRODUCTION TO CARBON OFFSETS

A carbon offset is an investment done by a company in an activity that reduces carbon emissions. The reduction in carbon emissions is termed as 'carbon credit' which is given to the company and it is cross checked by a third party. One credit is equal to one metric ton of CO2 prohibited from entering into the air and Google utilize the credit for carbon accounting. Thus the carbon released by their servers are neutralised by adopting carbon offset programmes by their companies. Releasing carbons by their servers to store data is eventually mitigated by doing best practices where these companies clean carbon at some other location, thereby keeping the carbon quotient low in the environment.

III. CASE : GOOGLE

A. Introduction

Google has huge array of products and all are releasing digital carbon. Google produce profits by bringing performance advertising and brand advertising. Android, Chrome, Gmail, Google Drive, Google Maps, Google Play, Search, and YouTube are most frequently used products of Google. Each has more than 1 billion monthly active users. Also their cloud-based products and services, including G Suite business productivity apps like Docs, Drive, and Calendar and satellite mapping and analysis platforms like Google Earth and Google Earth Engine is becoming very popular and engaging. 'In recent years they we've expanded into consumer electronics with products including Chromecast, Google Home, Google Nest Hub, Google Pixel, and Google Pixelbook.' [3]

B. How google meet their carbon footprints?

Google decrease their carbon footprint through two ways;

(1) Google is continuously refining competence by producing on-site solar power and buying green power.

(2) They buy carbon offsets to bring down their carbon footprints.

Before BUYING a carbon offset, Google conduct rigorous research, collaboration, make benchmarks and ensure that it receive a high value offset that serves long-term global advantage. This research helps them in ensuring that the time, money and energy involved in their best practice would eventually cut carbons from the environment in the best possible way.

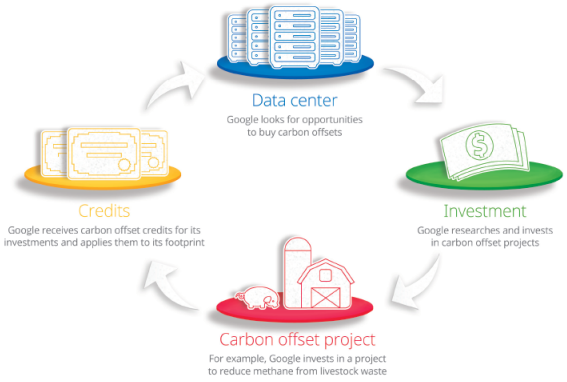

Figure 1: Source: Google's Carbon Offsets: Collaboration and Due Diligence [4]

Its well-known that one metric ton (1,000 kg or 2,204 pounds) of carbon dioxide equivalent (CO2e). Carbon dioxide equivalent is a quantity that describes, for a given mixture and amount of greenhouse gas, the amount of CO2 that would have the same global warming potential (GWP), when measured over a specified timescale (generally, 100 years). [4]

C. Project Standards of Google

The Net Zero strategies of Google are very impactful and they are ensuring that they maintain standards to confiscate carbon from the environment.

The objective of Google is to offset their carbon emissions and hence they only support projects that would not come into being without their investment and which are exceptionally critical and need their attention. They are doing a rigorous research to guarantee that they purchase only quality offsets, based on four standards: Additionality, leakage prevention, permanence and verifiability.

- **Additionality.** It means that the proposed project reduces GHG emissions that would not be reduced through other incentives. Google talk directly to project owners and operators and ensure that their investment would reduce carbon footprints that would not otherwise happen by any other party. Thus they ensure that they have adopted or taken the most critical location or project which remained unattended otherwise. This gives a standard to their actions that they are really interested in cleaning carbon from the planet and not just to get credits. This is a case of value based leadership where the company is leading in the carbon offset programme and touching the most critical or exceptional carbon neutral program.
- **Leakage prevention**. Leakage is a result or a bad outcome of forest protection where loggers move or shift to another location or another forest to chop trees. Thus, a reduction of Green House Gas emissions at one location through one project shifts, or leak, to another location. To stop leakage, Google investigate the community and environment of the project location. They ensure that forest protection should not lead to leakages at other locations. They conduct a thorough checkup of the sites and understands that the forest protections is not harming the locations in vicinity.
- **Permanence.** Google ensures that the projects they invest in are not temporary methods of carbon reduction from the planet. Hence, GHG prevented from entering the atmosphere is stopped permanently. Under these projects, they are looking for permanent solutions so that there is no re-release of carbon after few months or years. These projects ensures that the carbon is permanently stopped by their efforts on the planet.
- **Verifiability.** This is a task given to an objective third party who is neither the project developer nor an employee of Google. This third party verifies and ensure at project data and approve that the carbon reductions are real and can be credited into the account of Google. This is a project standard which is very close to self-evaluation or audit of the projects taken by Google and the impact of the programmes on the environment in cutting carbon from environment.[4]

D. Types of Carbon Offset Projects

Different project types qualify for carbon offsets with the advent of new technologies for reducing GHG. Goggle invests money carbon offset projects where methane is treated and reused.

- **Landfill gas capture.** Decomposing waste creates a GHG i.e. methane gas. Small and medium- sized landfills in many U.S. states are not required to capture or process methane, and thus the methane escapes easily into the atmosphere. [4] Destroying methane reduces the entire emissions of greenhouse gases. Trapped methane is burned to generate electricity or heat. Methane, after treatment can be either inoculated into a nearby natural gas grid or it can also be consumed locally as CNG for vehicles and other uses. When small volume of gas is released or the project is remotely located, the gas is burned in a flame.
- **Agricultural Methane Capture:** Google is also investing in Agricultural Methane Capture where methane produced at farms from decomposing animal waste is collected and processed into by products, like energy and heat. A digester, which is a huge circulating tank, collects waste, speeds up the bacterial growth, and break down the waste into organic fertilizer and methane. The methane is further captured and burned. Fertilizers are used further in agriculture.
- **Forestry Projects:** As we know that trees consume carbon and release oxygen, Google either protect

forests from destruction and degradation or develop new ones through tree plantation drives. They are doing this is huge quantity and also keeping a track of the quality of plants which can release maximum oxygen in the environment. They have used this old classical way of planting trees and saving trees in the environment and bringing the temperature down and consume carbon from the environment. This best practice is a very famous practice which almost all the countries are adopting and brining the carbon don in the environment.[4]

IV. CASE: FACEBOOK

A. **Renewable Energy.** They are switching to renewable energy in the communities where they operate, hence all of their renewable energy projects are on the same electrical grids as the data center they support. They have claimed that 86% renewable energy is supporting their operations. In 2019, we achieved 86 percent renewable energy for our operations and have over 1.3 gigawatts of wind and solar projects online. In 2024 Meta-supported wind and solar projects are adding more than 15 GW of clean and renewable energy to grids globally. [14]

B. **Water Stewardship.** Since water is an essential resource and Facebook ranks water stewardship across their worldwide operations as a chief component of their sustainability program. Since 2017, they have funded more than 40 water restoration projects in nine watersheds. In 2019, we contracted four new water restoration projects that will restore 206,000 cubic meters of water per year in our data center communities [14]. In 2024, these operational restoration projects restored over 1.6 billion gallons of water to high and medium water stress regions. Once all projects are completely realized, they are predictable to reestablish more than 2.9 billion gallons of water annually.As per Renewable Energy Reports of 2020, Facebook is 100% based on renewable energy. [15]

C. **Net Zero Supplier Engagement Program.** They have developed the Net Zero Supplier Engagement Program to support key suppliers to accelerate their efforts to reduce their emissions. By 2026, they aim to engage two-thirds of our suppliers, based on their contribution to their emissions, to set science-aligned Green House Gas reduction targets. [14]

D. **Achieved LEED Volume precertification.** They achieved LEED Volume precertification of their prototype data center design and have reorganized more than 60% of the LEED measures for which they seek certification.

E. **Solution to operational data center campus footprint.** As of 2024, more than 50% of our operational data center campus footprint, more than 4,000 acres, was planned, installed, or preserved to intentionally support local, biodiverse habitats with native species.

V. CASE : MICROSOFT

Bill Gates says in his book 'How to avoid a Climate Disaster' that he has higher-than-average carbon footprint, hence he is taking extra steps to clean his carbon footprints. "In the book I briefly mention how I'm offsetting my own emissions. I spend about $5 million every year to offset my family's carbon footprint. As of now, the standard calculation for carbon footprints is based on an estimate of $400 per ton of emissions." [5] [6] He takes his family's carbon footprint and double it to ensure that they are fully covering their carbon footprint.

Microsoft is doing investments in zero-carbon technologies. These companies are responsible for removing higher amount of carbon than what Microsoft is emitting. Gates has donated more than $1 billion toward innovations and ideas which includes affordable and reliable clean energy, low-emissions cement and steel.

He openly admits in his book that though hefty emitters like Microsoft should use a smaller amount energy, the world overall should be using more energy to remove poverty and the economic growth of underdeveloped countries.

According to him, using more energy as long as it's carbon-free is absolutely perfect. His admission proves that cloud service providers are producing immense carbon footprints as by-products and worried about the planet as well. For the same, they are investing in green projects and green energy. The key to addressing climate change is to make clean energy just as inexpensive and reliable as what we get from fossil fuels. [11][13].

VI. FINDINGS OF THE STUDY

1. The study examined the factors impact on climate change leading to climate disasters is found to be highly impacted by carbon emissions due to uncontrolled usage of cloud computing physical.
2. The study result stated that the carbon neutral programs are planned for next 10 years where as the frequency of natural disasters are very high and increasing every day.
3. It has been observed that the government policies are not able to control the usage of social media and adherence to Paris agreement is not done practically.
4. Lot of carbon neutral programmes which Google and Microsoft are doing can be adopted by almost all the cloud service providers on some scale and they can contribute in reducing the carbon footprint.
5. There is a shift of entertainment industry on the cloud from cable network which is causing global warming.
6. Education is sidelined and the masses are more inclined towards watching videos on mobile and laptop which is wasting their precious time as well.
7. Lot of videos and memes of binod, useless anonymous videos on YouTube are causing lot of pressures on cloud which is neither giving any value addition nor also giving a load to the cloud service providers to clean the carbon footprints released by their clients.

8. It has been described that the Factors like watching unlimited videos on YouTube, social media, posting pictures on social media like Twitter, Instagram, Facebook, over dependency on cloud, not reading books, over dependency on Google search, unlimited charging of mobile and many such factors are found to be directly affecting the climate change.

VII. DISCUSSION

As Leonardo Di Caprio says that over 97% of the scientific community is in complete agreement that we are contributing to climate change.[2] To deny that reveals that we are not a part of the modern world. We don't believe in modern science or facts. Hence, we can't argue it anymore as we don't have enough time. The same thought is also echoed by Barrack Obama. He strongly says that without bolder action taken now in 2021, our children won't have time to debate the existence of climate change in 2050 because they will be busy dealing with its hostile side effects.

This is quite visible post covid in 2021 when the Gen X and Gen Z are coping with fear psychosis, fake posts on social media, corona virus, masks, sanitization, shortage of water and virtual podium for education all over the world where they have n number of ways to cheat and pass the examination and get more marks. Lot of fake data has been generated and prediction on fake data can lead to accidents also, but it has become a part of our digital data as there is no regulatory system on the usage of internet access. It's sad to say that when the man made things are destroyed, we call it vandalism but if nature is destroyed, it's called progress.

VIII. RECOMMENDATION

- **Bring Awareness.** Help leaders understand, that think about the long-term problem of climate change as important as thinking about jobs or education or health care. Demand more funding for clean energy R&D or a price on carbon.
- **Talk International.** As carbon has no boundaries and it can cross borders easily. It can reach Pakistan or China or Australia, so whenever discussing this problem, consider mother Earth as one for all nations and climate change as a global problem hitting everyone on this planet.
- **Massive Awareness Program.** Awareness program on the usage of internet and its side effects should be done to find out the statistics. Some probable questions can be; how many hours do people charge their mobile? How many tweets, post on social media, and query people do on a daily basis? Do people understand the business and science behind cloud computing? How many video people watch is educational versus entertainment?
- **Self-discipline.** The people should ask themselves before watching a video that will that video add value to their personality or value to society?
- **Switch to books.** The people should follow the old practice of 90s, i.e., read books. They can also download e-books and read offline.
- **Incorporate Paris agreement in syllabus:** The Paris Agreement and IT act should be made mandatory in the curriculum of subjects pertaining to sustainable development like, environmental science, general knowledge, corporate socio responsibility etc.
- **Regulate Internet.** The carbon footprints are increasing because there is no upper limit to the usage of internet, dependency on cloud, search queries, posting on social media, posting on YouTube, length of videos etc. Hence there is an immediate need to regulate the usage and posting on social media so that masses use the facility provided to them wisely which can be useful to everyone.
- **Design Light Weighted Algorithms.** Since an algorithm executes in the background whenever a mouse click or touch operation occurs, the algorithms should be such that they consume less energy or gobble less Random Access Memory. The line of codes decided the turnaround time and the algorithms designed also decides the energy consumption. There are various light-weighted cryptographic algorithms are available and there is a huge scope of designing the algorithms is still there. [8]
- According to a research study, energy demand in the sensor nodes can be controlled. In a WSN that uses clustering methodology, the cluster heads need to bear the maximum amount of traffic load and thus choosing the fittest node as the head of the cluster is an important step to ensure the smooth functioning of that particular WSN. [9]

IX. CONCLUSION OF THE STUDY

The author with the help of discussion and secondary facts tries to bring a problem amongst the masses with probable solutions well in practice by top notch IT companies.

The current study largely focused on the carbon footprint which is having a key impact on the environment and climate change. The study discusses various eminent activists and environmentalists and their view on the climate change. Hence, there is a need to do further research in this area by considering the climate change and paradigm shift in the temperate in last 35 years. There exists an impact of digital data and the big data on climate, carbon and increase in temperature.

'Before The Flood' is a red alert from environmental advocate Leonardo Dicaprio and Oscar winning documentary producer Fisher Stevens. The value-pairs show that biospheric values, when a primary or secondary value, are a strong determinant of a low-carbon lifestyle and even as a secondary value can override primary hedonic values. [7]

Since the demand for computing in growing in an uncontrolled manner, we want habits through which we can distribute computing in a more capable, controlled, sensible and eco-friendly style. Cloud computing technology can bring such efficiencies but still as it has its limitations. Now, a question arises, can shifting more of our computational load to the cloud help keep the environment safe and greener? [10]

Daily the sun comes and reminds us to use him and the wind blow from all the directions saying to harness me but, plastic surgery is more popular than plastic pollution because of digital data and areas of interests. And there is a very big dustbin called ocean, where we can throw anything. Mummy whales used to tell baby whales that 'its junk food' but baby

whales were deaf and gulped all. It is an alarming situations and Paris agreement need to be revisited by not just the politicians and the top notch companies but each and every person residing on this planet.

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