The CO2 Emissions of Storage and Use of Digital Objects and Data

Impact measures to consider

|  |  |
| --- | --- |
| **Lotte Wijsman** | **Arie Groen** |
| *National Archives of the**Netherlands,**The Netherlands**lotte.wijsman@nationaalarchief.nl* | *National Library of the Netherlands,**The Netherlands**arie.groen@kb.nl* |
|  |  |

|  |  |
| --- | --- |
| **Tamara van Zwol** | **Robert Gillisse** |
| *Dutch Digital Heritage Network,**The Netherlands**tvzwol@beeldengeluid.nl* | *International Institute of Social History,**The Netherlands**robert.gillisse@iisg.nl* |

Abstract – The storage and use of digital heritage objects produce carbon dioxide (CO2) emissions. Cultural heritage organizations can take several measures into consideration in order to diminish these CO2 emissions. However, how much CO2 do storage and use produce and what measures could have (the most) effect? We examined the CO2 impact and possible measures on the basis of a case study. We have focused our investigation on the impact of servers, infrastructure, cloud storage and use.

Keywords – carbon footprint, sustainability, storage, users, carbon dioxide emissions

Conference Topics – Environment

# Introduction

Preserving digital objects for the public contributes, like many human activities, to carbon dioxide (CO2) emissions and consequently has an impact on the environment. The Dutch digital heritage community is (becoming) conscious of the subject and wishes to examine the facts. What is the environmental impact of the storage and use of collections? And what measures can be taken to lessen the CO2 impact?

This poster presentation provides insight into certain measures that can be taken, based on a CO2 impact case study of the Delpher platform [1]. In Delpher you can search and find millions of digitized text from Dutch newspapers, books, and. These documents come from the collections of various Dutch scientific institutions, libraries, and heritage institutions. Delpher is developed and managed by the National Library of The Netherlands (KB). The case study was executed by the company PHI Factory and the Green IT expert group within the Dutch Digital Heritage Network[[1]](#footnote-1). We have examined storage and data use in this case study, focusing on the CO2 impact of servers, the server environment/infrastructure, cloud storage, and the end use: searching through the files on the platform and downloading files. The poster presents our findings in those four areas [2].

# Servers

Servers provide the computing power and storage required to store and make digital collections available for users. These servers are the main cause of CO2 emissions. This is due to both the electricity consumption and the indirect CO2 emissions from the production of the servers.

Creating digital compartments in the servers, like the KB has done for the data on Delpher, ensures that the capacity of these servers can be used more efficiently. This can be done by means of virtual machines or containers. The KB's servers consume now 242 MWh (or: 242,000 kWh) annually, which is equivalent to the electricity consumption of 98 average Dutch households in a year.

# Server environment

The location/environment of the servers has a major influence on the total of CO2 emissions. If data is stored locally, on the level of one institution, there is a good chance that actions facilitating the servers, such as cooling them, consumes as much or even more energy than the servers themselves. To reduce the CO2 impact of the infrastructure around the servers you can think about sharing servers with multiple organizations to use them most effectively. By moving the servers from the KB local location to a more efficient, external colocation data center, as in the case of Delpher considerable savings can be made on electricity costs: saving annually the amount of 151 MWh. Because many servers are located here, facility systems such as cooling can do their job much more effectively. Therefore, this method is not only more sustainable, but also more economic.

You can also opt for more green energy, like the KB has done. Green energy is any energy type that is generated from natural resources, such as sunlight, wind or water. Because green energy is generated from a renewable source, the CO2 emissions are a whole lot lower than in the case of energy from fossil sources. The annual carbon footprint of Delpher's servers is less than 4 tons of CO2 equivalents per year, which equals 4 hot air balloons of 200 m2 (the size of a soccer field) filled with CO2.

# Cloud storage

With cloud storage, the data and computing power of many companies is divided over servers. This makes for very efficient use of (the capacity of) the servers since every available space is being occupied. The advantage of storage in a cloud environment is that the type of providers behind it (e.g. Microsoft and Amazon) are at the forefront of the development of facility systems and the use of containers to make the capacity of their servers as efficiently as possible. Naturally, cultural heritage organizations have to consider if they are willing to store their data in a large datacenter under the control of such a provider in perhaps a different country, under different rules and regulations. Because Delpher concerns itself with national Dutch cultural heritage, it has been decided to store the data at a Dutch colocation and not via an international cloud provider.

# Data use

Retrieving files from a digital collection, loading webpages and using the search index causes CO2 emissions. In the case of Delpher a large part of the digital collection will not be downloaded by a user, but searched, which has only a limited impact. Still, there are ways to even diminish this impact. This could be done by e.g. offering lower resolution versions of the digital object files. In addition, to make it even more effective, you can also limit the user features on the website so that fewer files have to be searched in the data store. For example if you do not offer 'search all' as a standard option, but let users indicate which specific material (newspapers, books or magazines) should be searched.

# Conclusions

With the findings from the case study and the aforementioned recommendations, cultural heritage institutions can start to examine the CO2 impact of their own digital collections and make choices for a climate-resilient future. Also, the case study does ideally stimulate further discussion about selection and deduplications of collections in and between cultural heritage institutes.

# REFERENCES

[1] Delpher platform <https://www.delpher.nl/>

[2] The Greenhous Gas Protocol <https://ghgprotocol.org/>

1. PHI Factory uses the guidelines from 'The Green House Gas Protocol' to measure the CO2 footprint. [↑](#footnote-ref-1)