

## MOOC ENVIRONMENTAL IMPACTS OF DIGITAL TECHNOLOGIES

### 3.3.1 What is the environmental footprint of a digital service?

#### Auteurs :

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### Activité 07.1 : What is the environmental footprint of a digital service?

We have just seen that a digital service works thanks to different equipment, infrastructures and human resources (your terminals, networks, equipment in data centres, developers, operators...).

This complex ecosystem that allows everyone to view websites, do research, etc. requires resources to be extracted to produce the equipment, consumes energy, uses refrigerant gases (with a high global warming potential): all of this is an essential part of the environmental footprint of the digital service.

But how do you measure it?

To do this properly, you need to carry out what is known as a Life Cycle Assessment. This is a complex and laborious task that requires the collection of a lot of data at all stages of the chain. But there are now various tools available to users and content producers. Although approximate, they allow us to get a more precise idea of the impact of our browsing or the way we design content for the web.

Capsule slide	Related text
<p><b>What is the impact of your Internet browsing?</b>            In this activity, we propose to analyze the environmental footprint of Internet browsing and to materialize the impact of the various features offered: reading articles, videos, interactive presentations...</p> <p>To do this activity, we have chosen the <b>Carbonalyser</b> tool that allows you to see the electricity consumption and greenhouse gas emissions associated with your internet browsing. Some other tools exist.</p> <p>Note the assumptions and basic data do not allow you to rely on this tool to finely measure the emissions of g CO2 eq related to your navigation. The result is therefore not to be taken as a measure. However, this tool will allow you to assess the relative difference in impacts of different websites.</p> <p><b>You will install an extension on your browser, then we will guide you to browse the web before analysing the results of Carbonalyser. This application only works on Firefox.</b> </p>	<p><b>What is the impact of your Internet browsing?</b></p> <p>In this activity, we propose to analyse the environmental footprint of Internet browsing and to materialise the impact of the various features offered: reading articles, videos, interactive presentations...</p> <p>To do this activity, we have chosen the <b>Carbonalyser</b> tool that allows you to see the electricity consumption and greenhouse gas emissions associated with your internet browsing. Some other tools exist.</p> <p>Note the assumptions and basic data do not allow you to rely on this tool to finely measure the emissions of g CO2 eq related to your navigation. The result is therefore not to be taken as a measure. However, this tool will allow you to assess the relative difference in impacts of different websites.</p> <p>You will install an extension on your browser, then we will guide you to browse the web before analysing the results of Carbonalyser. This application only works on <b>Firefox</b>.</p>

## Capsule slide

## Related text

### Installation of Carbonalyser

1. Download and Install the extension by clicking on the link corresponding to your browser. This application works on [Firefox](#). **Unfortunately, the extension was disabled from Chrome after the release of Mooc.**
2. Enable the Carbonalyser extension by clicking on the icon at the top right in your browser. Note, the current Carbonalyser extension works on the model of 2018 Shift based on Andrae 2015: [Shift de 2018 basé sur Andrae 2015](#) : the ratio kWh/Go used for the network part is overestimated and the ratio for data center is somewhat overvalued. [27/07/2021]
3. Click on "Start Analysis".

To find yourself in realistic conditions of experience, we offer you to consult some sources and answer questions. You can forget Carbonalyser for the moment, he lives his life :)

Source : <https://theshiftproject.org/en/carbonalyser-browser-extension/>

Source code is available in open access: <https://github.com/supertanuki/Carbonalyser>



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Source :

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Source code is available in open access:

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### 1 / 3 Navigation test

In the article [Internet Basics - Using a Web Browser](#) what is the name of the bookmark given in the chapter "Bookmarks and history"?

BBC

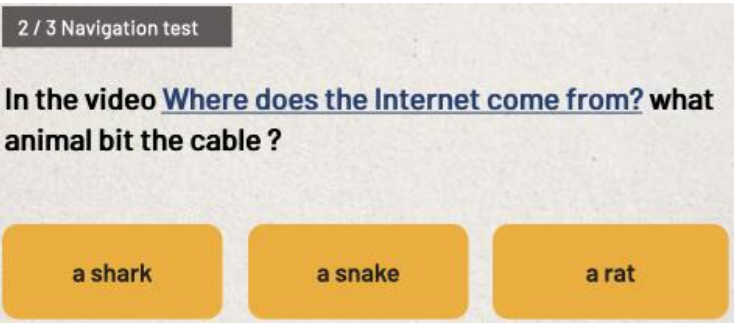
BBC - Travel - Home


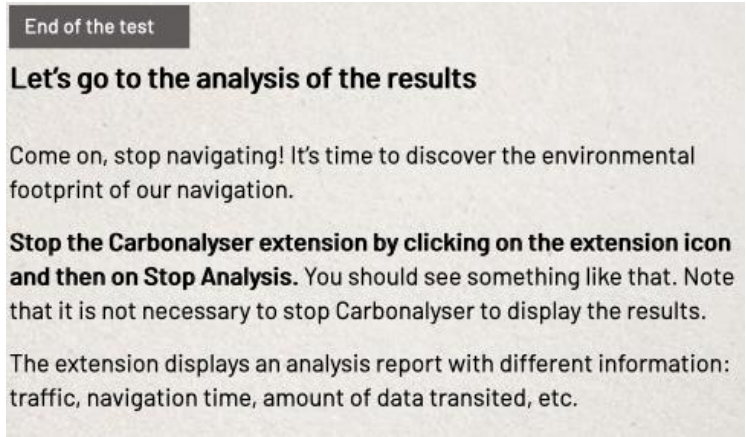
No name

### Test de navigation 1 / 3

In the article [Internet Basics - Using a Web Browser](#) what is the name of the bookmark given in the chapter "Bookmarks and history"?

- BBC
- BBC - Travel - Home (**right answer**)
- No name

Capsule slide	Related text
<p><b>Feedback</b></p> <p>About bookmarks, you can also read in the article : "If you find a website you want to view later, it can be hard to memorize the exact web address. <b>Bookmarks</b>, also known as <b>favorites</b>, are a great way to save and organize specific websites so you can revisit them again and again"</p> <p>Source  <a href="https://www.gcfglobal.org/learn/internet-basics-using-a-web-browser/">Internet Basics - Using a Web Browser, edu.gcfglobal.org</a>  [accessed on: 04/04/2022]</p>	<p><b>Feedback</b></p> <p>About bookmarks, you can also read in the article : "If you find a website you want to view later, it can be hard to memorize the exact web address. Bookmarks, also known as favorites, are a great way to save and organize specific websites so you can revisit them again and again"</p> <p>Source : <a href="https://www.gcfglobal.org/learn/internet-basics-using-a-web-browser/">Internet Basics - Using a Web Browser, edu.gcfglobal.org</a> [accessed on: 04/04/2022]</p>
 <p><b>Feedback</b></p> <p><b>Did you know that...</b></p> <p>Every time you send a query over Internet, an entire infrastructure is requested. So, if you type a query on a search engine, we will first query the server that hosts the search engine, then send a second query by clicking on the site link. <b>By typing the address directly</b>, you avoid an additional request. The information contained on the server is then transmitted to the browser of your computer, which interprets it to display the data in the desired way.</p> <p>Source :  <a href="https://www.youtube.com/watch?v=...">"Where does the Internet come from?", YouTube</a>  [accessed on: 04/04/2022]</p>	<p><b>Test de navigation 2 / 3</b></p> <p>In the video <a href="#">Where does the Internet come from?</a> what animal bit the cable ?</p> <ul style="list-style-type: none"> <li>• <b>A shark (right answer)</b></li> <li>• A snake</li> <li>• A rat</li> </ul> <p><b>Feedback</b></p> <p>Every time you send a query over Internet, an entire infrastructure is requested. So, if you type a query on a search engine, we will first query the server that hosts the search engine, then send a second query by clicking on the site link. By typing the address directly, you avoid an additional request. The information contained on the server is then transmitted to the browser of your computer, which interprets it to display the data in the desired way.</p> <p>Source :  <a href="https://www.youtube.com/watch?v=...">"Where does the Internet come from?", YouTube</a> [accessed on: 04/04/2022]</p>

Capsule slide	Related text
 <p><b>Feedback</b></p> <p>As shown in the infography: "It really is greenhouse gasses. Atmospheric CO2 levels are 40% higher today than they were in 1750. It's not the sun...it's us. There's no contest."</p> <p>Sources : <a href="https://www.bloomberg.com/news/articles/2022-05-04/whats-really-warming-the-world">What's Really Warming the World?, bloomberg.com</a> [ accessed on: 05/04/2022 ]</p>	<p><b>Test de navigation 3 / 3</b></p> <p>In the infographic <a href="#">A GUIDE TO CLIMATE CHANGE NEGOTIATIONS</a>,</p> <p><b>Feedback</b></p> <p>: "It really is greenhouse gases.</p> <p>Atmospheric CO2 levels are 40% higher today than they were in 1750. It's not the sun...it's us. There's no contest."</p> <p>Sources : <a href="#">A GUIDE TO CLIMATE CHANGE NEGOTIATIONS</a> [ accessed on: 27/01/2023 ]</p>
 <p><b>End of the test</b></p> <p><b>Let's go to the analysis of the results</b></p> <p>Come on, stop navigating! It's time to discover the environmental footprint of our navigation.</p> <p><b>Stop the Carbonalyser extension by clicking on the extension icon and then on Stop Analysis.</b> You should see something like that. Note that it is not necessary to stop Carbonalyser to display the results.</p> <p>The extension displays an analysis report with different information: traffic, navigation time, amount of data transited, etc.</p>	<p><b>End of the test</b></p> <p><b>Let's go to the analysis of the results</b></p> <p>Come on, stop navigating! It's time to discover the environmental footprint of our navigation.</p> <p>Stop the Carbonalyser extension by clicking on the extension icon and then on Stop Analysis. You should see something like that.</p> <p>Note that it is not necessary to stop Carbonalyser to display the results.</p> <p>The extension displays an analysis report with different information: traffic, navigation time, amount of data transited, etc.</p>



## Capsule slide

## Related text

The screenshot shows the Carbonalyser interface. On the left, there's a sidebar with a red circular progress indicator and some statistics. The main content area is titled 'Analysis 1 / 4' and contains a question: 'Classify the following actions from the largest traffic (1) to the least significant (3)'. Below the question are three input boxes numbered 1, 2, and 3. To the right of the input boxes are three buttons: 'Consult an infography', 'Watch a video', and 'Read an article'. A legend at the top right indicates that a green square represents 'Correct placement' and an orange square represents 'Incorrect placement'.

### Feedback

#### The weight of data, a key element of the impact of digital services

Streaming video requires a significant exchange of data between the server and your computer, but the infographic is not neutral either. In comparison, reading a single article is derisory. The weight of data and how they travel have a major environmental impact on digital services.

We took a case of specific use here but each use of the web has its own impact. Depending on what you do (read a text, watch a video, look for a film in a VOD catalog), the site on which you do it but also how you access an internet connection (wire, wifi, 3G/4G/5G), the impact will be different.

### Analyse 1 / 4

**Classify the following actions from the largest traffic (1) to the least significant (3).**

*(these answers are already in a right order)*

1 - watch a video

2 - consult an infography

3 - read an article

### Feedback

#### The weight of data, a key element of the impact of digital services

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## Capsule slide

Analysis 2 / 4

**What is the impact of navigation in g eq.CO2 of the Carbonalyser balance sheet displayed on the left?**  
(gram equivalent CO2)

Write a number

Ok

### Feedback

#### How is this impact calculated?

To quantify these impacts, the program counts the amount of data passing through the browser or traffic. It then translates this traffic into electricity consumption (Kwh) with some approximations, and then into grams of CO2 equivalent (gCO2). These two indicators, although approximate, give orders of magnitude and make analogies: charging smartphones, driving, etc.

50 % of the environmental impacts of a digital service is associated with the user terminal: not only its production but also its electricity consumption. The other half of the impacts are associated with the energy consumption of networks and data centres.

Source : ["Lean ICT: Towards digital sobriety": Our new report on the environmental impact of ICT. The shift project. 2018](#)

[ Accessed on: 04/04/2022 ]

## Related text

### Analyse 2 / 4

**What is the impact of navigation in g eq.CO2 of the Carbonalyser balance sheet displayed on the left?** (gram equivalent CO2)

### Feedback

**The right answer is 7 g CO2 eq.**

#### Comment est calculé cet impact?

To quantify these impacts, the program counts the amount of data passing through the browser or traffic. It then translates this traffic into electricity consumption (Kwh) with some approximations, and then into grams of CO2 equivalent (gCO2). These two indicators, although approximate, give orders of magnitude and make analogies: charging smartphones, driving, etc.

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## Capsule slide

## Related text

Analysis 3 / 4

If you were in China, the environmental footprint of your navigation would be:

Higher

Same

Lower

### Feedback

#### Kilowatts to CO2 equivalents

Indeed, when based on the electricity consumed during the use of the digital service, it is the approximate environmental impact of this electricity that is calculated.

In France, electricity generation is mainly nuclear, with low CO2 impact. In China or the United States, coal and other fossil fuels are more used.

But electricity generation has other impacts (e.g. freshwater consumption) and a digital service does not only consume electricity, but also the manufacturing of the terminal used to access that service, for example.

### Analyse 3 / 4

If you were in China, the environmental footprint of your navigation would be:

- Higher (right answer)
- Same
- Lower

### Feedback

#### Kilowatts to CO2 equivalents

Indeed, when based on the electricity consumed during the use of the digital service, it is the approximate environmental impact of this electricity that is calculated.

In France, electricity generation is mainly nuclear, with low CO2 impact. In China or the United States, coal and other fossil fuels are more used. But electricity generation has other impacts (e.g. freshwater consumption) and a digital service does not only consume electricity, but also the manufacturing of the terminal used to access that service, for example.



## Capsule slide

## Related text

Analysis 4 / 4

To gain a better view of the digital services footprint, what other indicators could be used?

*Several answers are possible*

<input type="checkbox"/> <b>Exhaustion of resources</b> non-renewable (oil, gas)	<input type="checkbox"/> <b>Emission of fine particles</b> energy production, transport
<input type="checkbox"/> <b>Water consumption</b>	<input type="checkbox"/> <b>Ionizing radiation</b> effect of radioactivity
<input type="checkbox"/> <b>Primary energy consumption</b> energy before any transformation	<input type="checkbox"/> <b>Impact on biodiversity</b> extinction, mutation of species

### Feedback

In order to better understand and reduce the impact of a service, it is recommended to **assess the environmental impact of the digital service as a whole**: from its creation to its end of life. A **Life Cycle Analysis (LCA)** will then be implemented. Thus, by broadening our vision, trying to list all relevant indicators and measuring the digital service as a whole, we have a holistic vision that allows us to adapt the design of services and our uses.

However, limiting the measurement to certain indicators and a narrower scope makes it easier to measure, which can be a good first step in comparing or identifying areas for improvement.

### Analyse 4 / 4

To gain a better view of the digital services footprint, what other indicators could be used?

Several answers are possible

- **Exhaustion of resources** non-renewable (oil, gas)
- **Emission of fine particles** (energy production, transport)
- **Ionizing radiation** (effect of radioactivity)
- **Water consumption**
- **Primary energy consumption** (energy before any transformation)
- **Impact on biodiversity** (extinction, mutation of species)

All answers are right

### Feedback

#### Life Cycle Analysis

In order to better understand and reduce the impact of a service, it is recommended to **assess the environmental impact of the digital service as a whole**: from its creation to its end of life. A **Life Cycle Analysis (LCA)** will then be implemented. Thus, by broadening our vision, trying to list all relevant indicators and measuring the digital service as a whole, we have a holistic vision that allows us to adapt the design of services and our uses.

However, limiting the measurement to certain indicators and a narrower scope makes it easier to measure, which can be a good first step in comparing or identifying areas for improvement.

Capsule slide	Related text
<p data-bbox="170 175 537 224">Life Cycle Analysis</p> <p data-bbox="170 272 1066 472">There are several types of tools to raise awareness and reduce digital impacts. Carbonalyser, a single-criterion and user-oriented tool, has enabled you to become aware of the impact of your navigation by highlighting the impact of transporting and processing site-by-site data.</p> <p data-bbox="170 526 1066 643">But nowadays the same site to see the same web page will combine different media (texts, videos, podcasts) in the same page. The way the site is designed and developed therefore has a direct impact.</p>	<p data-bbox="1129 172 1520 201"><b>Conclusion Life Cycle Analysis</b></p> <p data-bbox="1129 233 2032 386">There are several types of tools to raise awareness and reduce digital impacts. Carbonalyser, a single-criterion and user-oriented tool, has enabled you to become aware of the impact of your navigation by highlighting the impact of transporting and processing site-by-site data.</p> <p data-bbox="1129 423 2018 532">But nowadays the same site to see the same web page will combine different media (texts, videos, podcasts) in the same page. The way the site is designed and developed therefore has a direct impact.</p>

## Install the Carbonalyser extension:

1. Download and install the extension by clicking on the link for your browser. This application works on **Firefox**. Unfortunately, the extension was disabled in Chrome after the release of the Mooc.
2. Activate the Carbonalyser extension **The Shift Project** by clicking on the icon at the top right of your browser.

### Please note!

The current Carbonalyser extension works on the 2018 Shift model based on Andrae 2015: the kWh/Go ratio used for the network part is overestimated and the ratio for data centers is a bit overestimated. [27/07/2021]

3. Click on "Start analysis".

### To continue...



Follow the 2nd activity of the sequence: Compare the weight of elements on a web page ➡

In this activity, you have to classify the components of a web page according to their weight (videos, images, twitter feed, podcast..).

### **If you wish to go deeper into certain concepts**

[Life cycle assessment applied to digital services](#) explains why and how to assess the environmental impact of digital services using Life Cycle Assessment.

## Crédits :

<p><b>Authors :</b></p> <ul style="list-style-type: none"><li>● Julie Delmas-Orgelet, DDemain / NegOctet</li><li>● Laurent Devernay, Simplon.co</li></ul>	<p><b>A co-production of Class'Code / Inria</b></p> 
<p><b>Pedagogical team :</b></p> <ul style="list-style-type: none"><li>● Laurence Farhi, Tatiana Khomenko, Inria Learning Lab</li><li>● Sophie de Quatrebarbes, S24B for Class'Code</li></ul>	<p>With the support of the Minister of National Education, Youth and Sport and UNIT.</p> 
<p><b>Graphismes :</b></p> <ul style="list-style-type: none"><li>● Illustrations : Mikaël Cixous, 4 minutes 34</li><li>● Photographies of Guillaume Clémencin : Nicolas Ledu</li></ul>	
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