footsprint.

presents

Digital pollution: Ranking the websites of the TSX60.

with LABELIUM
The Global Digital Performance Agency

Summary.

About **footsprint.**

By empowering companies in transitioning towards more responsible and sustainable digital practices, footsprint aims to accelerate the decarbonization of the digital industry.

Part of the global e-commerce performance group Labelium, footsprint is an end-to-end digital sustainability agency.

By working at the crossroads of sciences with seasoned environmental and digital experts, footsprint reconciles sustainability and digital performance to build the digital ecosystem of the future.

From website foundations to multichannel digital advertising, the agency provides a full stack of sustainable digital solutions, built with a thorough methodology based on the latest industry research.

Find out more: footsprint.co
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Discover **our services.**

sustainable
web design.

responsible
media.

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About Juan Sotés, **our environmental expert.**

Throughout his more than 10 years of experience in environmental sciences and global warming, Juan has worked in both private and public sectors, and more specifically for the Toronto Atmospheric Fund as carbon and co-benefits analyst. He joined footsprint in order to help the industry accelerate the transition towards digital sobriety. His expertise in carbon measurement and GHG protocols will contribute to develop and strengthen industry frameworks.

2022 ranking.

Introduction.

“Every bit of warming matters, every year matters and every choice matters”. The latest IPCC reports have left no doubts about climate change: **it is here and moving faster than we are**. While its impacts are already being felt in all ecosystems, affecting the health of many people as well as our economies across the globe, **our actions to mitigate them in the last years have achieved close to nothing**. As we currently stay on a path to cross the 1.5°-2° C warming threshold, beyond which climate impacts are expected to increase to highly disrupting levels, **reducing carbon emissions quickly and decisively is an absolute priority**.

To have a chance of limiting our planet’s imbalance, we need **to achieve net-zero emissions in all our activities**. This obviously includes our transportation and construction industries as well as energy and agriculture but also digital. In fact, while its impacts have been overlooked so far, its weight in global CO_2e emissions (2%) is anything but negligible: as heavy as the entire civil aviation or a country like Canada.

If a click on a webpage is less than 1 gr of CO_2, **the real problem is the accumulation**. If we account for all the visits a website receives, the cumulative impact adds up to **300 thousand tons of CO_2e per year in Canada alone**. At a global scale, we already count over a billion sites in the world, and 250,000 new sites coming online every day…

The digital industry needs to undergo the same process other industries have already started: to retrofit existing websites and improve their energy efficiency while ensuring all new ones are built according to new sustainability standards.

Key numbers.

2.3M

tons of CO_2

The yearly CO_2 emissions of digital in Canada

Total internet emissions in North America are 30 times this value.

300,000

tons of CO_2

The yearly CO_2 emissions of website traffic in Canada

The equivalent of 70,000 homes' energy use for one year.

2,000

tons of CO_2

The lifetime emissions of the TSX60 websites over 3.5 years.

The equivalent absorbed by 2.3 acres of forest in one year.

About the ranking.

1. Objectives

The primary purpose of this study is to **draw attention to the very tangible impact of website traffic pollution**, particularly among high traffic industry leaders.

To do so, we calculated **not only the yearly emissions of a website**, but **its carbon emissions throughout its lifecycle**.

The ranking is based **on purely technical criteria** and does not take into account either the quality of the TSX's website content nor that of their sustainability programs.

2. Methodology & sources of emissions.

Our methodology is based on **the three core emissions sources of digital services:**

- Server emissions
- Network emissions
- End user devices emissions

Those criteria refer to **website energy efficiency and data transfer** (here estimated using page weight), **energy used by segment**, as well as **the grid intensity of web host, transmission network and end user locations** (see methodology section).

For each source, total emissions include manufacturing and use.

About the ranking.

3. Reading the ranking.

Each website below was **attributed a score from 1 to 100** (100 being the score for the most sustainable websites). The score reflects a website's ecological performance based on aforementioned emissions factors. So that comparison is fair amongst the different sites, the scoring does not reflect for website traffic. In this study, **scores for the TSX60 websites ranged from 12 (lowest score) to 81.**

To put these figures into perspective, the column **"Total website lifetime emissions"** enable us to understand the real carbon impact of each website by including **the volume of trafic, on an estimated 3.5 year lifespan.**

In case of a tie on points, the page generating the less emissions per visit was ranked higher (not included in the tab).

4. Results.

Among the TSX60, **the podium for the most sustainable websites** is surprisingly not held by the leading IT companies but instead is owned by the **energy & financial sectors**. In first place, **CDN Natural Res is the indisputable winner**, with less than 0.07 gCO_2e emitted per page visited.

On the other end of the podium, with a total score of 12%, Kinross emits more than 2 gCO_2e per page. In the IT sector, Shopify obtains the 5th rank, just ahead of CGI (#6) and Open Text (#7). Power Corp dominates the financial sector in the third place, ahead of SunLife (#9) and the Canadian Imperial Bank of Commerce (#10).

About the ranking.

Things get even more interesting **when we account for site volume and lifetime emissions**. Here we can see **TD and Rogers stand out with the heaviest impact** in terms of total pollution, with respectively 384 and 345 tons of CO_2e generated over the website lifecycle, despite not having the lowest scores.

This highlights that **the higher the traffic volume, the larger the carbon impact and the more responsibility companies have** to implement sustainability best practices. For example, in the case of TD, reducing unitary page emissions by 30% (only 0.1 gCO_2e/page) would generate lifetime savings of 112 TCO_2e, the equivalent of 27 homes' energy consumption for a year.

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The ranking.

Ranking criterias are detailed here

Rank	Name	Industry	Total website lifetime emissions (TCO_2e)	Scoring
1	CDN Natural Res	Energy	0.12	81
2	Suncor Energy Inc	Energy	0.13	77
3	Power Corp of Canada Sv	Financial Services	0.04	77
4	Weston George	Consumer Staples	0.03	75
5	Shopify Inc	Information Technology	1.97	72
6	CGI Group Inc Cl A Sv	Information Technology	2.81	71
7	Open Text Corp	Information Technology	3.88	68
8	Wheaton Precious Metals Corp	Basic Materials	0.02	67
9	Sun Life Financial Inc	Financial Services	64.73	66
10	Canadian Imperial Bank of Commerce	Financial Services	71.45	65

The ranking.

Ranking criterias are detailed here

Rank	Name	Industry	Total website lifetime emissions (TCO_2e)	Scoring
11	Dollarama Inc	Consumer Staples	2.10	64
12	Cenovus Energy Inc	Energy	0.54	61
13	Saputo Inc	Consumer Staples	0.20	60
14	Bausch Health Companies Inc	Healthcare	0.25	60
15	Ccl Industries Inc Cl B NV	Consumer Cyclical	0.04	60
16	Manulife Fin	Financial Services	10.09	59
17	Metro Inc	Consumer Staples	9.34	58
18	Canadian Tire Corp Cl A NV	Consumer Cyclical	129.93	57
19	Royal Bank of Canada	Financial Services	134.64	57
20	Bank of Nova Scotia	Financial Services	127.45	55

The ranking.

Ranking criterias are detailed here

Rank	Name	Industry	Total website lifetime emissions (TCO_2e)	Scoring
21	Brookfield Asset Management Inc Cl A Lv	Financial Services	0.13	54
22	Waste Connections Inc	Industrials	0.10	53
23	Shaw Communications Inc Cl B NV	Communication Services	65.85	53
24	National Bank of Canada	Financial Services	5.44	52
25	CDN Apartment Un	Real Estate	0.45	51
26	Emera Incorporated	Utilities	0.04	51
27	Franco-Nevada Corp	Basic Materials	0.04	51
28	Canopy Growth Corp	Healthcare	4.41	51
29	Brookfield Infra Partners LP Units	Utilities	0.16	49
30	Alimentation Couche-Tard Inc	Consumer Staples	0.60	48

The ranking.

Ranking criterias are detailed here

Rank	Name	Industry	Total website lifetime emissions (TCO_2e)	Scoring
31	Gildan Activewear Inc	Consumer Cyclical	4.17	48
32	Teck Resources Ltd Cl B	Basic Materials	0.87	46
33	Nutrien Ltd	Basic Materials	4.59	46
34	Algonquin Power and Utilities Corp	Utilities	0.10	45
35	Bank of Montreal	Financial Services	163.03	43
36	Firstservice Corp	Real Estate	0.12	40
37	Constellation Software Inc	Information Technology	0.59	39
38	Thomson Reuters Corp	Industrials	113.07	39
39	Pembina Pipeline Corp	Energy	0.52	36
40	Cameco Corp	Energy	0.99	36

The ranking.

Ranking criterias are detailed here

Rank	Name	Industry	Total website lifetime emissions (TCO_2e)	Scoring
41	Toronto-Dominion Bank	Financial Services	383.73	35
42	Imperial Oil	Energy	0.49	34
43	BCE Inc	Communication Services	1.20	31
44	Restaurant Brands International Inc	Consumer Cyclical	11.07	30
45	Rogers Communications Inc Cl B NV	Communication Services	344.56	29
46	Tc Energy Corp	Energy	1.63	27
47	Telus Corp	Communication Services	139.01	26
48	Canadian National Railway Co.	Industrials	6.51	25
49	Cae Inc	Industrials	10.65	25
50	Barrick Gold Corp	Basic Materials	9.91	25

The ranking.

Ranking criterias are detailed here

Rank	Name	Industry	Total website lifetime emissions (TCO_2e)	Scoring
51	Fortis Inc	Utilities	0.18	24
52	Hydro One Ltd	Utilities	9.30	22
53	Enbridge Inc	Energy	4.08	22
54	Canadian Pacific Railway Ltd	Industrials	27.51	21
55	Agnico Eagle Mines Ltd	Basic Materials	1.70	21
56	Loblaw CO	Consumer Staples	18.34	20
57	First Quantum Minerals Ltd	Basic Materials	2.19	20
58	Magna International Inc	Consumer Cyclical	9.07	19
59	Snc-Lavalin Sv	Industrials	13.83	12
60	Kinross Gold Corp	Basic Materials	11.60	12

2022 ranking:
key learnings.

Focus 1. Server emissions

why green hosting is not enough.

Many websites today proudly bear the label “Green Hosted”, yet **sustainable web hosting** turns out to be a **very complex topic**, and there is a lot more to consider than simply picking a “green” hosting company.

Today, some self-proclaimed green hosting companies **solely purchase carbon credits** (clean energy generation certificates used to offset emissions) while running on fossil fuel, while others **run on 100% renewable energy**. While it is difficult for brands to have control or even influence within the full supply chain infrastructure, **better understanding the key emissions factors** when selecting a web host is **vital to reducing its digital emissions.**

Choosing right is important for two main reasons:

- While nowadays servers only account for a little over 13% of internet’s energy consumption, their contribution is expected to increase up to 33% by 2030 **[1].**
- Choosing a web host is a decision that can generate "**carbon lock-in**". The latter occurs when fossil fuel-intensive systems perpetuate, delay or prevent the transition to low-carbon alternatives.

Focus 1.
Server emissions
why green hosting is not enough.

Two of the most important criteria when choosing a web host are:

- Server efficiency
- Server location

Data centers consume huge additional amounts of energy, for example to cool the servers. According to research, close to 40% of a data center's energy consumption goes to cooling and ventilation systems **[2]**. **Choosing a data center in a colder location** (e.g. in Northern Quebec) can therefore r**educe the amount of energy** its cooling system will require for adequate heat transfer to occur.

Additionally, **electricity grids across the world generate very different carbon emissions** depending on the amount of renewable energy in the mix.
For example, just one server in Alberta will generate more carbon emissions than 300 servers in Quebec. **Looking to host your server in clean grids close to your end users will also mitigate impact.**

Some organizations, including websites analyzed in this article, are aware of the problem and try to use web hosting services that limit carbon emissions. **We analyzed server providers chosen by TSX60 companies,** based on information available online:

- **AWS US West:** Amazon Web Services (AWS) is committing to powering their operations with 100% renewable energy by 2025. Until then, the company will be purchasing carbon credits to offset remaining emissions **[3].**

Focus 1.
Server emissions

why green hosting is not enough.

- **AWS Montreal:** same commitments as AWS US West, with the particularity that the Quebec grid is already powered almost entirely by clean, renewable hydro power **[3].**

- **Akamai Technologies, Inc.:** committed to sourcing renewable energy to power 100% of their global operations by 2030 and make their network 50% more efficient. They invest in their own clean energy projects but also buy carbon credits **[4].**

- **Cloudflare:** have committed to powering their network with 100% renewable energy, yet failed to precise a specific date. They also purchase different types of carbon credits to claim carbon neutrality. **[5]**

In our evaluation method, we took into consideration companies using a green server. However, for those **offsetting their emissions, the environmental impact was attributed a score of zero (0).**

Focus 2. Data transfer

why sustainability should be incorporated in the software development lifecycle.

In a world with ever increasing internet speeds and powerful computing systems, **we have increased website performance by building increasingly power hungry and energy consuming site**s. Today, research shows that the average page web is nearly 4.5 times the size of a web page in 2010 (HTTP Archive) **[6].**

Generally speaking, **the more data transferred, the more energy used in the data centers, telecom networks, and end user devices.** For web pages, data transfer for a single visit is best estimated using page weight, which enables us to compare the efficiency of web pages regardless of website volume.

Page weight has a critical impact on the energy consumption of a web application. If **page weight is minimized**, memory on the server (hosting) side is saved and less data needs to be transferred and used, which in turn leads to **less consumption of energy.**

In the evaluation of the TSX60 which we conducted, we identified a few critical points which negatively affect website page weight. We have conducted this analysis both using the TSX homepages and a deep page, here the TSX sustainability category pages.
While **front-end design** largely explains for drastic **page weight variation between the homepage and deep page** for some brands, the best performing brands in terms of web efficiency also owe it to back-end best practices.

Focus 2. Data transfer

why sustainability should be incorporated in the software development lifecycle.

Looking at **front-end design,** often one of the critical points, especially on the website homepage, is **non-optimized images and video assets**.
Large images and heavy videos can indeed drastically impact overall page weight. Therefore, prior to using an image (or a video), asking ourselves the following questions is crucial: is the image necessary to prove the point? Does it have an added value or contribute to the brand image?
When it is necessary, **using basic file compression and the most efficient file format** such as WEBP and AVIF for images (typically 30 to 50% more efficient than PNG or JPEG files) **can already go a long way in reducing overall page size.**

In this study, **the heaviest websites among the TSX often use videos**, longer than 30s, on their homepage. It drastically impacts the data load for about 30% of their website visits.

Ultimately, much beyond quick fix implementation of best practices, **sustainability should become an integral part of the software development lifecycle**, integrated at every stage from requirement gathering to deployment.

Conclusion.

Conclusion.

Fixing our websites for sustainability is **not just good for the planet,** but for business as well.

Building lighter, more efficient websites will help SEO ranking, page speed, and reduce friction, ultimately resulting in **higher conversion rates.**
From an accessibility standpoint, lighter websites will also mean **increased reach for audiences in less well served areas (**poor connectivity, slow devices etc).
Also, **hosting costs can be reduced** by implementing sustainability best practices through minimized server loads.

Finally, more attention needs to also be placed on **embodied emissions and e-waste**, although here we are looking at a 3.5 year lifespan, prolonging this lifetime and end of life reconditioning of our products will significantly reduce the sector's impact.

As digital sustainability is sure to become the next paradigm shift in our industry, **the COP26 announcement of a 45% emissions reduction objective** for the ICT sector by 2030 will doubtlessly be **followed by governing regulations on the lifecycle emissions of our digital products.**
In France for example, the industry is expecting the enforcement of the sustainable web design guidelines by 2024 **[12]**.

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Methodology and sources.

Methodology.

1. Sources of emissions.

This study aims to calculate not only the yearly emissions of a website, but its carbon emissions throughout its lifecycle. To do this, we must take into account the **three core emissions sources** of digital services:

- **Server emissions:** during their use and manufacturing
- **Network emissions:** during their use and manufacturing
- **End user devices emissions:** during their use and manufacturing

Incorporating the manufacturing of each of these emissions sources adds a layer of complexity to an already complex methodology, yet it is essential as **user devices such as smartphones and laptops consume eighty percent of their lifetime energy before being turned on for the first time [8]**.

Methodology.

2. System segments.

Recent research from the IEA [9] shows that **the energy efficiency of data centers and telecommunication networks is improving over time,** so that the majority of emissions today are generated by networks and end user devices. Accounting for the manufacturing of each segment, the numbers and percentages we use in our study (outlined below) rely on 2020/21 studies [10] from the IEA and other credible sources listed below:

- **Data center emissions:** global energy consumption of 250 TWh, which accounts for about 13% of the system
- **Networks emissions:** global energy consumption (including 4G and emerging 5G networks) of 450 TWh, which accounts for about 24% of the system
- **End user devices emission**s: global energy consumption of 1200 TWh, which accounts for about 63% of the system

These numbers need to be often revisited due to:

- **Efficiency improvements:** We expect continuous improvement of data center and network efficiency, as well as devices' energy consumption. These different components will achieve different efficiency gains, changing also the proportion in which each of them contribute to total energy consumption.
- **Internet growth:** While the previous factor will increase energy efficiency, this is expected to be offset by internet's growth and total energy consumption will increase in the near future [1].

For the purposes of this study, and in an effort to take a conservative approach that captures the full lifecycle impact of the systems in place, we have worked with a **total energy intensity of 0.38 kWh/GB**, including data storage, transfer and end device [9].
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Methodology.

3. Calculating carbon emissions per page visit.

Using the above data, the total carbon intensity per page visit, expressed in gCO_2e/visit, was calculated using the below formula:

$$HP_{ci} = HP_w \times DT_{ei} \times [(E_s \times GIs) \times (1 - GH) + (E_t \times GI_t) + (E_d \times GI_d)]$$

$$HP_{ci} = HP_w \times 0.38 \times [(13\% \times GIs) \times (1 - GH) + (24\% \times GI_t) + (63\% \times GI_d)]$$

HP_{ci} = Total Homepage carbon intensity (grCO_2 per visit)

Homepage energy consumption:

HP_w = Homepage weight (KB)

DT_{ei} = Data transfer and storage energy intensity (kWh/KB)

Server Impact:

E_s = % of energy dedicated to server

GI_s = Grid intensity where the server is hosted (grCO_2/kWh)

GH = % of additional server green energy proven by green hosting

Transmission network impact:

E_t = % of energy dedicated to transmission network

GI_t = Grid intensity in transmission networks (grCO_2/kWh)

End device impact:

E_d = % of energy dedicated to end user devices

GI_d = Grid intensity in end device location (grCO_2/kWh)

Methodology.

The carbon intensity of electricity where the server is hosted (GIs) was estimated based on the local carbon intensity of electricity in the state where the brand hosts its website (which we identified using competitive monitoring tools).

The carbon intensity of electricity in transmission networks (GIt) was estimated using different EFs depending on where servers and users are located.

The carbon intensity of electricity in end device location (GId) was estimated based on the local carbon intensity of electricity in the area where the majority of the website's users were located (which we identified using competitive monitoring tools).

4. Calculating carbon emissions for a benchmark of 4M visits.

The above calculations were made for each of the TSX60 for two of their web pages: **the home page, and their sustainability page** (taken as a relevant example of a deep page that is often lighter than the homepage).

The final ranking is a weighted average of these two metrics, taking into account that on average only 30% of site traffic goes through the homepage for non e-commerce websites (internal Labelium benchmarks). **Including a deep page** into the equation therefore gave **a more representative view of the real impact.**

Methodology.

5. Calculating lifetime emissions for a website.

To compute **the lifetime value of a website** we assumed the following:

- **A standard website lifespan was about 3.5 years** (weighted average of four different sources indicating a range between 2 and 5 years) **[11].**
- We estimated **yearly traffic** for each of the TSX60 using SimilarWeb data (a competitive monitoring tool).
- We assumed **30% of this yearly traffic would go through the homepage**, with corresponding emissions calculated for each of the TSX.
- We assumed 70**% of this yearly traffic would go through lighter category pages**, here represented by the websites' sustainability page, also with corresponding emissions calculated for each of the TSX.

6. Accounting for returning visitors and caching.

Caching data is a process that stores multiple copies of data or files in a temporary storage location - or cache - so that they can be accessed faster. This means users do not need to download information every time they access a website. To account for this, we have:

- Calculated the **page weight for a returning site visitor enabling caching** (usually around 2% of full page weight)
- Estimated that **returning visitors** account for about **30% of site traffic.**

Methodology.

7. footsprint scoring criterias.

We would like to warn that the scoring from 1 to 100 is a **light version of our full website audit** which contains more than 150 control points and require access to the back end of the websites.

For this study, our evaluation is based on the following criteria:

- **Homepage performance based on weight (/20):** comparison of the homepage weight with the 2021 global benchmark from HTTP Archives. For example, a page performing in the 99th percentile of the lightest sites will have a weight of approximately 497 KB, and will be assigned a score of 99
- **Deep page performance based on weight (/50):** same methodology as homepage.
- Use of green hosting (/5)
- Green host use of renewable energy (/5)
- Server location grid intensity (/10)
- End user location grid intensity (/10)

This scoring, although non-exhaustive compared to our full audit, reflects the website efficiency as well a conscious approach to hosting.

Methodology.

8. Methodology uncertainty and limitations.

- Uncertainty associated with certain variables in our methodology is very high (we have found values for the data transfer and storage energy intensity factor that range across several orders of magnitude). We will continue our research with the purpose of refining and consolidating those values, which will impact the final numbers, but not the position of organizations across the ranking.

- We assume that pages are hosted only on one server and apply the local grid EF to its energy consumption. This underestimates the real impact of data replication and use of CDN networks.

- We use average electricity emissions factors. Marginal Emissions Factors, which better capture the impact of additional loads on the grid, are expected to increase the total emissions. Estimating the full LCA impact of electricity generation will as well give us a better overview of the real impact of its consumption, increasing emissions in our results.

- While some of the websites are using data centers that claim green energy use, it is unclear at the moment which ones are using real green energy and which ones are buying RECs, or in which proportion for those providers that claim both. We will continue our research to refine this variable.

- The weight of home page visits and returning website visitors are estimated using global benchmarks. To gain in precision we would need to have access to the websites' analytics platforms and use their data.

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9. Sources.

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