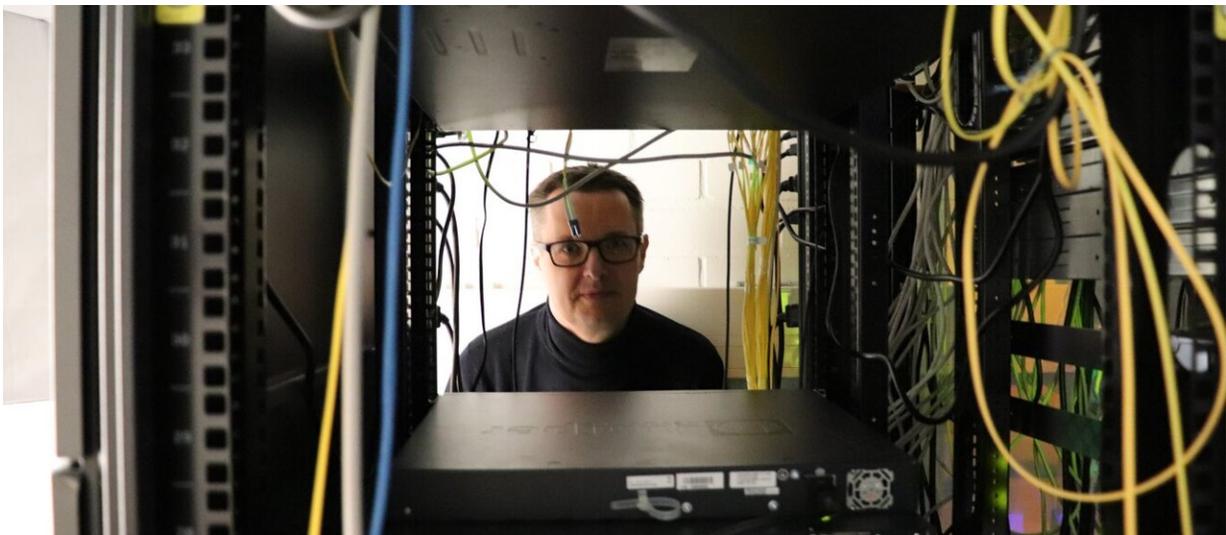


# Size of mobile web pages increased tenfold in ten years, with implications for energy consumption

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Professor Jukka Manner studied the size and energy consumption of Finland's most popular websites with his research group. Credit: Aalto University / Niina Norjamäki

According to estimates, the ICT sector's share of the world's energy consumption will surpass 20 percent by the end of this decade. One of the reasons is the huge increase in the number and size of websites, says Jukka Manner, Professor of Networking Technology at Aalto University. He recently studied the size and energy consumption of Finland's most

popular websites with his research group.

"In the past ten years, the size of websites has tripled, and the size of mobile pages has already increased tenfold. This is a concern for the environment, as [data transfer](#) over the [mobile network](#) consumes a great deal of energy and increases the electricity consumption of the whole society."

In the analysis, the front pages of 1,000 popular Finnish online services were loaded, in addition to the most popular front pages of different categories. The study included pages from the media, universities, largest companies and central government, for example.

The measurements were carried out in July 2021 with the open-source Lighthouse tool developed by Google, which provides data on websites, such as their resource sizes.

Resources are, for example, images, JavaScript files, CSS files that affect page appearance, fonts and media files, and the total size of the resources make up the page size. Some page resources can be from a third party, such as advertisements and analytics.

The researchers examined the first data loads and the scrolling pages separately.

"The difference in scrolling is due to the fact that modern websites optimize the content that is loaded first. We wanted to see the difference between what content the web service loads when the page is loaded for the first time and how much content is eventually transferred if the user scrolls down to the bottom of the page," Manner explains.

On a computer, the average page size was approximately 2.7 MB, while it was 3.4 MB for the scrolling pages, and on a mobile, the

corresponding numbers were 2.4 MB and 3.1 MB. Thus, mobile pages have almost caught up with traditional pages.

On a fiber network, to which computers are often connected, the energy consumption of the transferred bit is still moderate, whereas a mobile network, which is widely used in Finland, consumes up to a thousand times more energy. For example, watching a two-hour 4K resolution movie over a mobile network consumes the same amount of electricity as heating a sauna or driving an electric car for 20 kilometers.

Manner emphasizes that the size and energy consumption of pages can be significantly reduced, for example, by using PNG images instead of the JPG format, keeping an eye on the resolution of images and ensuring that the page does not contain unused data in the JavaScript files.

Although most pages were close to the average size, there were also substantially smaller and larger ones. The heaviest business page in the traditional network format was over 17 MB, while the lightest was only 1 MB. The largest mobile page of universities was in turn 7.1 MB, the smallest only 700 KB. The differences were even more pronounced with the [largest cities](#), as the pages ranged from the smallest of 1.2 MB to the largest of 61 MB.

What should then be done first to bring change?

"Less is simply more when it comes to web page design, as visuality increases the page size. Online stores have been the first to understand why websites need to be quickly browsable, as speed results in more purchases. Others should follow them but use resource efficiency as a motivation instead," Manner says.

Next, Manner and his colleagues will look more closely at how websites are implemented and where these solutions that transfer heavy data stem

from.

"I want to find out whether carelessness can explain the enormous increase in the amount of data on websites or whether there are flaws in some of the commonly used environments," he says.

**More information:** Full report (in Finnish):  
[aaltodoc.aalto.fi/handle/123456789/114010](https://aaltodoc.aalto.fi/handle/123456789/114010)

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