1

Greening the Web

(The Elephant in the Room ?)

I'm going to talk about one major contributor to the generation of greenhouse gases - one which is either entirely overlooked or taken as justified by perceived benefits.
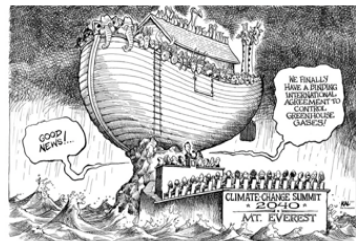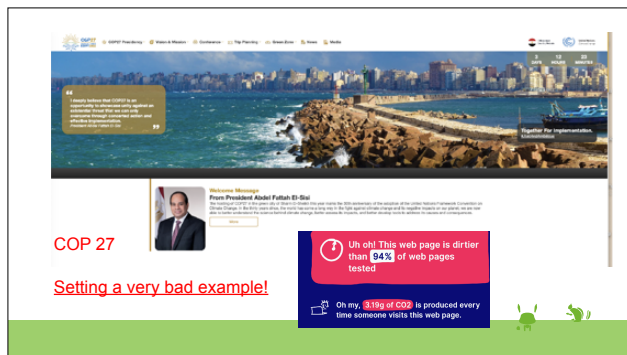

2

The view in 2009 (COP 15)

- and another 13 years have passed !

Let's just set the scene by mentioning COP27. Yes, it really was the 27th; the first was in Berlin in 1995. Here's the sceptical view in 2009 anticipating that the conferences will still be continuimg in 2040 in a submerged world.

Has anything changed?

3

COP 27 Home Page

And here's the COP 27 home page.

4

Looks good until we run a test on the page itself - a test, which as I will be explaining, is more important than you might think.

Are we really bothered about the production of 3.19 grams of CO2 for every visit to this page? Well yes, when billions of people are clicking away and when the page design could be so much more frugal and efficient.

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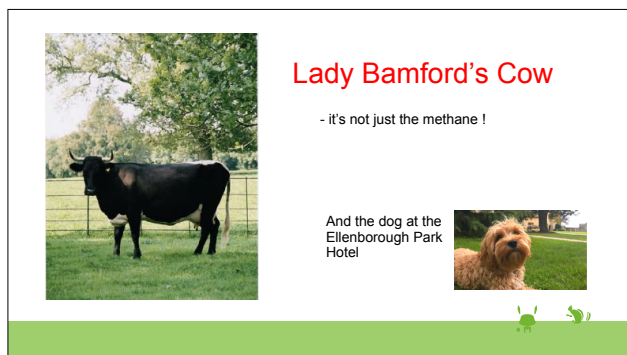
5

Here's Lady Bamford's cow which you will see much later is a very polluting animal. Yes, it really is part of this story.

It's a big subject - and one which I am ill- equipped to talk about with modern expertise.   But I can give you the flavour
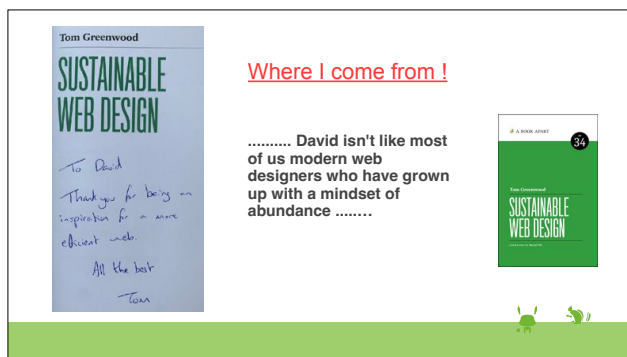
6

Last year Tom Greenwood who certainly does have the expertise, published his book "Sustainable Web Design". I get mentioned in it, as I will be explaining.

Tom writes that

.... David isn't like most of us modern web designers who have grown up with a mindset of abundance .... ("Sustainable Web Design")

The very first sentence in the book stresses that digital experiences are not free from environmental costs. And it is that mindset of abundance he mentions which has led to design approaches which appear extravagant to me - and to him.

7

So what is this all about? Each one of us has a carbon footprint and we think we know what activities make the major contributions. Or do we? Most people would identify personal transportation, energy costs for heating, lighting and appliances. And they would understand the Secondary Carbon Footprint covering 'stuff' - all the things you buy - all physical stuff. Many would think that our online activities make little or no contribution to the carbon footprint.

But in fact every activity you perform online comes with a small incremental cost – a few grams of carbon dioxide are produced due to the energy needed to run your devices and power the wireless networks you access. Less obvious, but even more energy intensive, are the data centres, vast servers, and communication networks needed to support the internet and store and distribute the content we access over it. Every click is significant - but we will see that some clicks are far more significant than others..
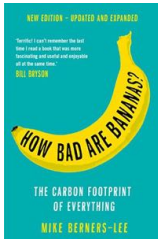

8

It all adds up to an estimated 416 tWh per year - more than the entire U.K.. If the internet was a country it would be the worlds 6th biggest polluter with a total carbon footprint exceeding that of the entire aviation sector of the world!

What a huge electricity bill - which we all contribute to in indirect ways.

Although the energy needed for a single page viewing, internet search or email is small, at least 4 billion people now use the internet. Those minute scraps of energy, and the associated greenhouse gases emitted with each online activity, add up to a huge total.


9

Here's another important statistic, but I will not be saying much more on this. I'll be sticking to the website visits in this talk,
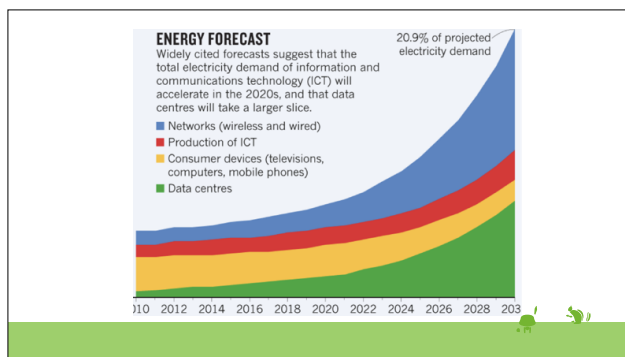
10

Here's the trend looking forward to 2030

Online activity has benefits, for example in saving actual journeys, or saving physical resources like paper. But it must still be right to scrutinise the expenditure of energy and see if savings can be made. That still applies even if Renewable Energy is being used,

. My emphasis will be on the web and websites. I am not going to talk about activities like streaming and video even though they make large contributions to the energy costs of the internet.
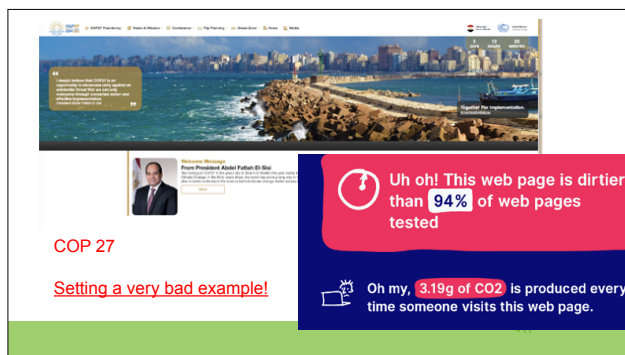
11

One needs some measure of the greenness of a website. Tom Greenwood's online website carbon calculator provides this. That is what produced the figure on the COP27 slide. Another rough and ready guide is that every megabyte downloaded is associated with, say, half a gram of CO2. Those grams of carbon dioxide will be the currency of this talk, but energy efficiency is what it's all about, and that must be a valuable goal in its own right.

There's a huge spread in the results. We'll just be looking at home pages which is where every visit to a site starts.
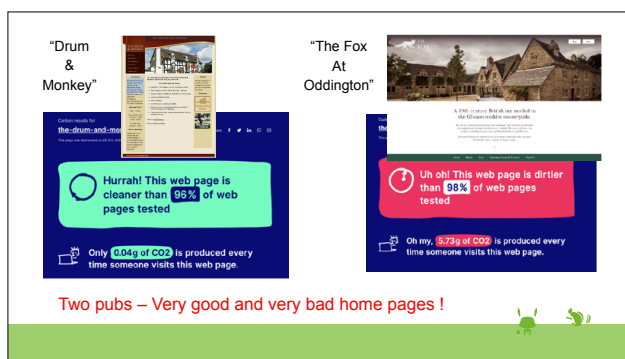
12

Let's start by looking at the hospitality sector where almost every pub has a flashy website - competing in visual appearance, but much the same in function.

At the green end of the scale we have the Drum and Monkey, a modest pub near Upton Upon Severn. It has an effective though old-fashioned website, and the website carbon calculator rates it at just 40 milligrams per access. So why does the far more trendy Fox Inn at Oddington need a website which tots up 5.73 grams per access - over 140 times as polluting! We'll see why.

And that extra 5 grams corresponds to wasted energy. And it's not an insignificant amount of energy. 500 grams is very roughly equivalent to 1kWh or 1 unit of electricity.
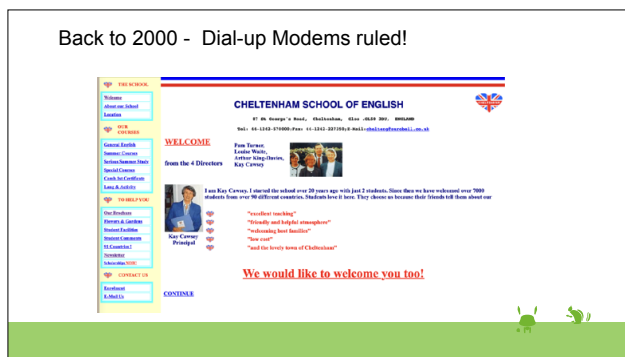
13   From this point of view, there are lots of bad, inefficient sites. Here's a shocking example - almost 17 grams of CO2 per visit. But it's not the worst; that's a website that I will mention later.

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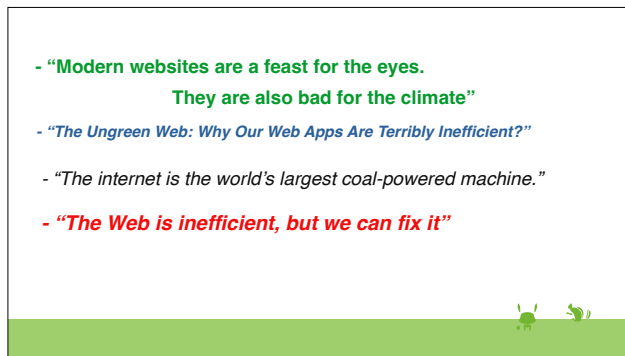
14   Here are a few quotes; I wish I could be more hopeful about the last one.

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15   Let me now take you back 25 years and see how we got where we are. The first websites were appearing in the 1990s. But access was by dial-up modems operating at a speed of 56kb/s, compared with todays 30 Mb/s or more. Even very simple web pages appeared progressively on the screen as they slowly down-loaded.

Here's a website I did for Kay's school in about the year 2000. It's not a bit like today's beautiful web pages, in particular because of the tiny images. And it was the same with the sites belonging to large organisations.
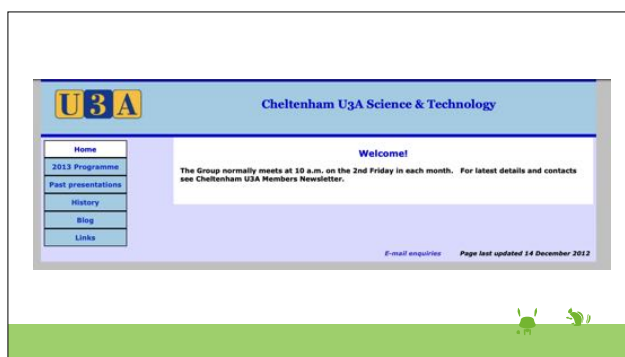
Early Tesco Home Page

16   Here's Tesco's site from about that time.

Cheltenham u3a - 2007
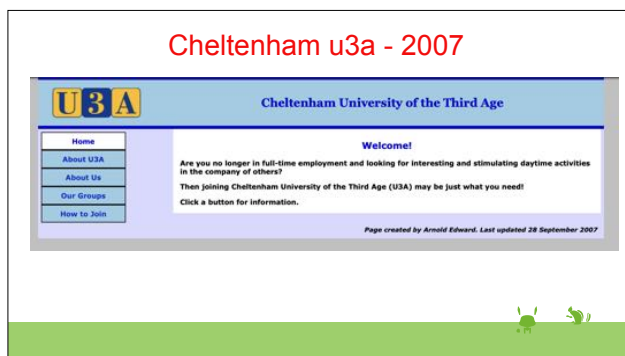
17   Broadband ADSL began to arrive in about 2002, but until 2008, say, websites still had to allow for dial-up users.

In about 2007, Arnold Edward wrote the first website for Cheltenham u3a.

18   And a year or so later I adopted the style of Arnold's site and launched our first Science and Technology site - like this. In those days many internet service providers gave you free web space for personal use and some still do.

Broadband ADSL brought the huge growth in internet users, doubling between 2006 and 2011.

- hosted at home on Raspberry Pi Server
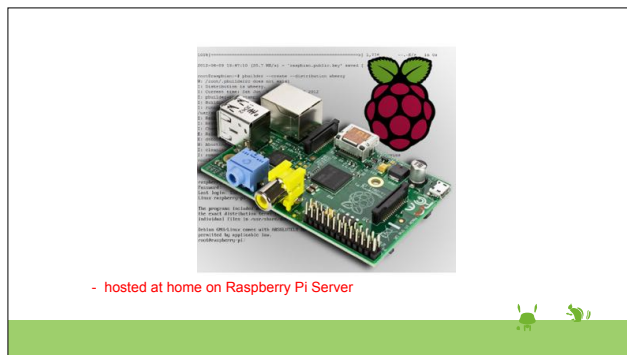
19

Now the first Raspberry Pi arrived in 2012. I soon had one, and found out how to use it as a home server to host a website - a very simple one at first..



davidandkay.me.uk 2013

20

The site was davidandkay.me.uk which was live in January 2013 and has continued 24/7 since then with almost no interruption - almost 10 years . Our Science and Technology had pages within that website until this year.
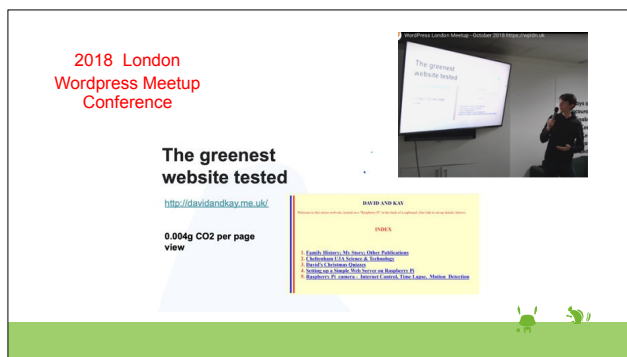
21

I'd certainly given no thought to climate-change considerations in 2013. But I was to be woken up. In October 2018 Tom Greenwood addressed the London Wordpress Meetup conference. He had been testing the green credentials of many websites and rather fortuitously had tested davidandkay.me.uk. Not only was it the greenest website tested (0.004 grams), but other things caught his interest - the hosting on a Raspberry Pi, and the simplification of the server. It was a useful and simple example for him to make important points about website design.

Tom and I were soon exchanging emails and some of what I told him got into his 2021 book Sustainable Web Design. The copy he sent me is inscribed, too generously, "To David. Thank you for being an inspiration for a more efficient web".
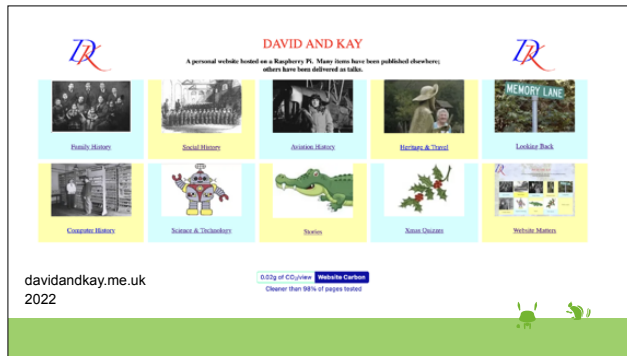
22

It would be nice to know the green credentials of the sites one visits. There are a few where this is possible. This is the current version of my own homepage displaying a website carbon badge, which provides the CO2 value from Tom Greenwood's calculator. It is easily added to any web page.

You'll see that the 0.004 grams of my original page has become 0.02 grams - the cost of prettying it up with images. Of course it is a very simple but functional page - like the far more important Google home page which I will soon refer to.
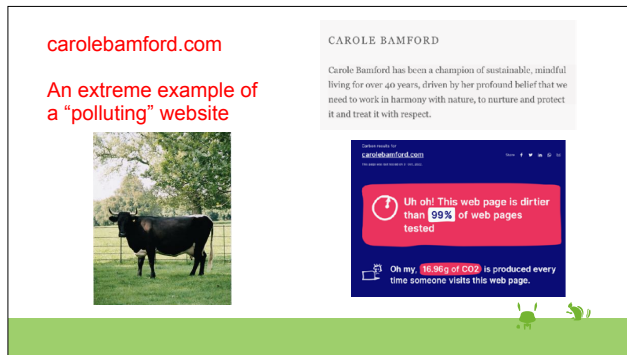
23

Near the other end of the scale is Carole Bamford's site, with a huge 17 gm per access. She is Lord Bamford's wife Lady Bamford, claiming the greenest of credentials, running Daylesford Organic and also owning the Fox at Oddington, an earlier example. I'll say no more - but I will be returning to the cow!
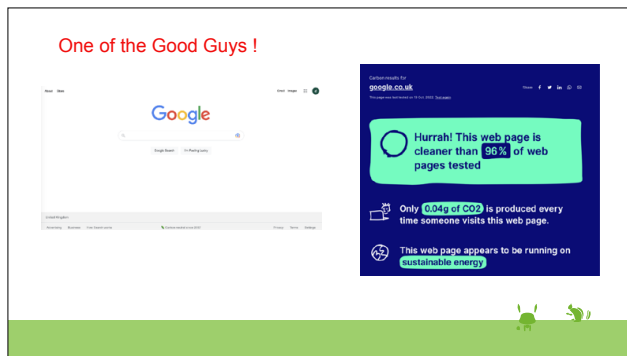
24

There are some good guys around. Google's search page is excellent. (0.04 grams) That's important of course for a home page which has billions of clicks.

25

And I've mentioned the Drum and Monkey. Again 0.04 grams.

26

But prominent life-style businesses claiming eco credentials often have inefficient, high CO2 websites. Here is the Manoir aux Quat'Saisons.

27

In order to understand this huge range of results, I must talk about website design.

Lot's of websites are static websites. They provide pages of information in a one-way feed from the server to you, Everyone sees the identical page and repeat viewings display the same page. All the server needs to do is to deliver that page on request.

These pages are basically written in HTML - hypertext mark-up language. In reading a script it is often easy to pick out the content such as paragraphs of text, headings and references to images. But in addition there are tags and keywords and elements which guide the browser in laying out the page. It is quite easy to write, and even easier with wysiwyg editors.

28

HTML , with CSS , has been hugely extended over the last 30 years. Here's a portion of the file which generates my home page. `My purpose in showing this is to emphasise that this method of page design is extremely efficient. Because of the powerful language, the down-loaded file is very small - at the expense of processing by the browser. Hence the low 'website carbon' figure of 0.02 gm.

29

And here's another page built in the same way. And again we have a low website carbon figure of 0.02 gm. So static sites built like this are very efficient and very 'green'.

So why the big problem, and why the huge carbon figures associated with sites I have already mentioned, most professionally built.

30
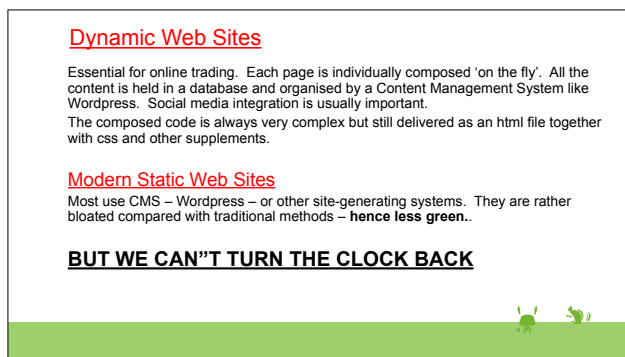
Well, dynamic websites came along and are universal for online trading sites. Each page is constructed on the fly, just for you, containing selected content from a database. That's achieved with a Content Management System. It needs a lot of processing, but these days we have processing power in abundance.   The files delivered to your web browser are still HTML and CSS. But they are very much more complicated - and I find it very difficult to comprehend them.

There are still plenty of static websites. But they too are almost all built by Content Management systems or Website Generating programs. They are very inefficient, creating unnecessarily large files.
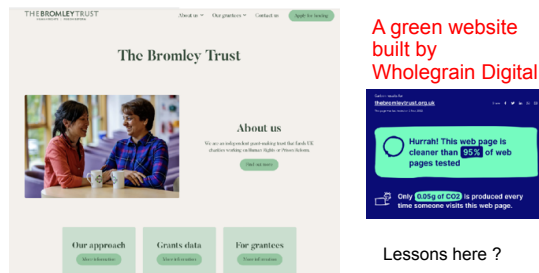
- but it would be very difficult to turn the clock back.

31

But these modern methods can still be used thoughtfully with fairly good results.

Tom's firm "Wholegrain Digital" successfully creates green websites with Wordpress.

A green website built by Wholegrain Digital

Lessons here ?

32

Here's one. That 0.05 gm figure places it among the 'cleanest' sites.

It clearly shows certain fundamentals.

The overall objective is to minimise the page weight - the kilobytes or megabytes downloaded.

Some Rules for 'Green' Websites

Minimise the page weight

Deliver the functionality - efficiently and simply
Home page is a gateway
Be sparing with images – and avoid videos
White space is effective - and free
Minimise file sizes, especially images
Take care with special fonts

33

The main 'rule' is the minimising of the page weight - the size of the down-loaded files. Images are usually the biggest contributors and there is much more to say on this. But let me just mention fonts. So-called 'system-fonts' add nothing to the page weight. But fancy fonts are tempting to apply in a website, but have to be down-loaded. So they are best avoided, though there are ways of minimising the down-load.

Now for images.

34

In addition to being sparing with nice-to-have images, the file size of images is really important.

Modern digital cameras including phones produce large high-resolution images such as this one (used in carolebamford.com). These can simply be downloaded just as they are (4.2 MB), and the browser then resizes them. No one will notice. But that's an unnecessarily large download.

35

So that's the wrong way of handling images, and Lady Bamford's cow will show this. The file that is actually downloaded and rendered in the carolebamford.com website is 814 kbyte, possibly the original camera image.

Now websites can't reproduce such high resolution. No one will notice the tiny degradation if we shrink the file by a factor of 10, to say 78 KB.

And we can take another step by using a more modern image format, .webp.

We're beginning to see the prime reason why many sites are so bloated and inefficient.

36

Similar examples are everywhere; here's a dog on the Ellenborough Park Hotel site - even more extreme since 1.4 Mb are loaded.
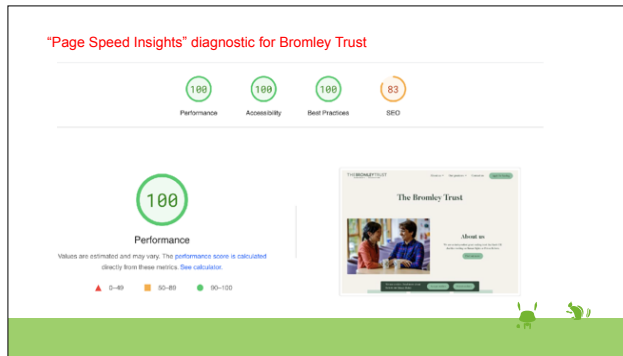
So building Green websites as Tom does, needs care and professionalism.

Diagnostics help. Google provides a powerful diagnostic called "Page Speed Insights" and this is what Page Speed Insights thinks of the lightweight Bromley Trust page.

It scores 100% on Performance as well as being 'Green'.

Wholegrain Digital and some other agencies are signatories of the "Sustainable Web Manifesto"

That highlights Efficiency, declaring that
"The products and services we provide will use the least amount of energy and material resources possible."

Signatories aim to create "Low Carbon" websites. There's no attempt to say just what this means - but keeping the figure for a home page well below 0.5 gram CO2 should not usually be difficult. This one for UNICEF is 0.2 grams.
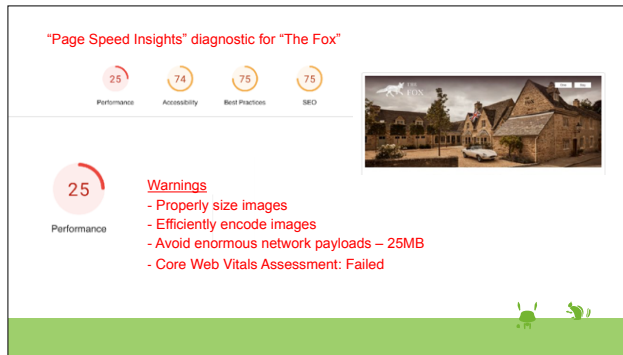

But a great many home pages are very far from achieving this, and seem to have no aspirations to do so!

40

Remember the Fox at Oddington, with a CO_2 figure of 5.73 grams.

Google Page Speed Insights rates it badly - Performance 25%, and warnings relating to the design. It would take very little time to resize the image files.

But this is the product of "web designers who have grown up with a mindset of abundance". Of course large image files provide the very best page quality. And 25MB page weight is nothing to them!

41

And would you believe it; there's a homepage which is far worse. 25.02 grams !!! This is the home page of a website designer who is proud of his 'showcase of design' which takes every possible advantage of digital abundance.

There are a great many design 'studios' in business`. The visual effects they produce are amazing – but often contribute little to functionality.

42

But these local websites are far more typical of today's 'feast for the eyes' websites which are 'bad for the climate'.

They almost certainly contain an excessive number of unnecessary images, many carelessly inserted as over-large down-loads

They would never satisfy the 'Sustainable Web Manifesto'

Slide 43: So where is website design going?

The Irresistable Lure of Site Builders

or

The Science of Sustainable Web Design

"With these programs, any Joe Bloggs, no matter what his computer-literacy level, can easily construct a fully-functional, attractive website."

(Gross inefficiency covered up by digital abundance

Designing with technical awareness, thoughtfulness and understanding.
(and not as difficult as the "Site Builders" would have you believe!)

GREEN !

So where is website design going?
I don't know!   The site builders on the left seem in control at present in today's unregulated consumerism.

But the performance angle is important.
Government and regulation may have a part to play?
Static design methods might return? They are the gold standard for efficiency.

Tom devotes a chapter to selling his dream of a green internet. He ends by quoting "What if it is all a big hoax, and we create a better world for nothing!"

"What if it is all a big hoax, and we create a better world for nothing!"

Refs:
1. https://www.websitecarbon.com
2. "Sustainable Web Design"
            (Tom Greenwood)
3. "How Bad are Bananas"
            (Mike Berners-Lee)