

From Pixel to Planet: The UX Imperative for a Sustainable Digital Future

Abstract:

As digital transformation accelerates across sectors, the environmental and social impacts of our digital systems are often overlooked, hidden behind seamless interfaces and frictionless experiences. Yet, the design of user experiences (UX) directly influences energy consumption, data generation, user behaviour, and ultimately, the sustainability of our digital future.

This presentation bridges the worlds of UX design, technology, and sustainability, highlighting how public and private sector leaders, from policy makers to platform architects, can rethink digital engagement through a sustainability lens. We will examine how UX decisions can promote responsible consumption, reduce digital waste, and support sustainable behaviour change at scale.

Drawing on case studies, emerging research, and practical frameworks, this talk calls on designers, technologists, and decision-makers to move from convenience-first to conscience-first digital ecosystems. Because, in a world increasingly shaped by code and interaction, sustainable design is not optional, it is transformational.



From Pixel to Planet: The UX Imperative for a Sustainable Digital Future

UP TechX Conference, October 2025

Prof Hanlie Smuts

The best interface is
invisible - but so are its
consequences.

1

Digital
Sustainability
Context



2

UX and
Ecological
Footprint



3

Human
Behaviour and
Design



4

Frameworks
and Case
Studies



5

Call
to
Action





High energy: Study finds a single Cristiano Ronaldo Instagram post consumes as much power as TEN UK households for ONE YEAR



Social media giant: Cristiano Ronaldo © Reuters

A study into the environmental impact of social media has revealed that a single Instagram post from Portuguese star Cristiano Ronaldo to his 240 million followers consumes as much energy as ten United Kingdom households.



Ronaldo remains the single most followed figure on the social media platform, with around 35 million more followers than second-placed Ariana Grande. His legions of followers means that Ronaldo can command around \$1 million (€842,000 / £754,000) for a sponsored post - but as much as the platform can inflate the Juventus star's bank balance, it seems that it does incur further costs elsewhere.

program determined that a single image released online by Ronaldo is viewed hundreds of millions of times, and the impact of it can be seen on the national grid.

A study conducted as part of an investigation by Channel 4's "Dispatches" current affairs

Cristiano Ronaldo hits 1bn social media followers

13 September 2024

Share  Save 

Tom Gerken
Technology reporter



Getty Images

Maintaining a balance

Economic

Social



Environment





The Digital UX Paradox



Prioritizes User Satisfaction



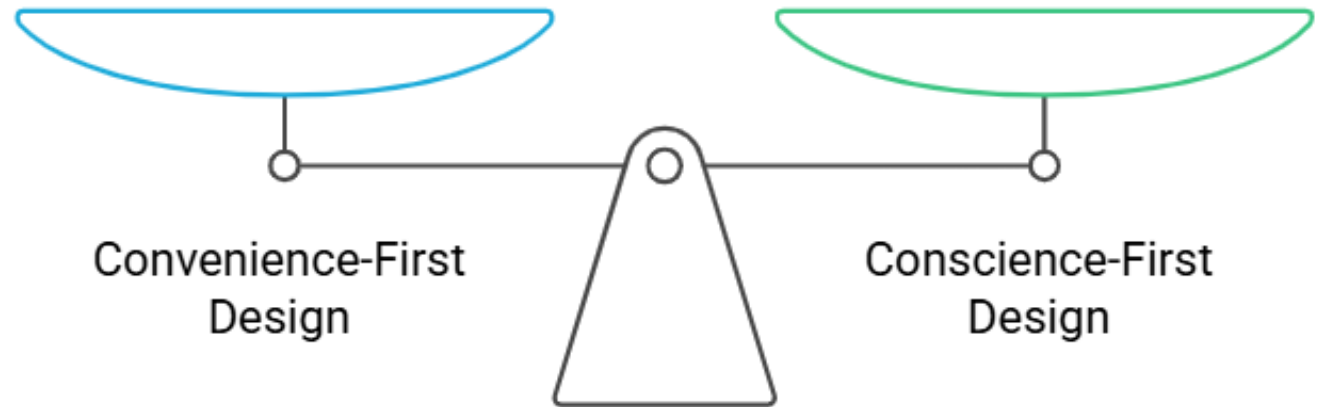
Emphasizes Ethical Responsibility



Overlooks Sustainability



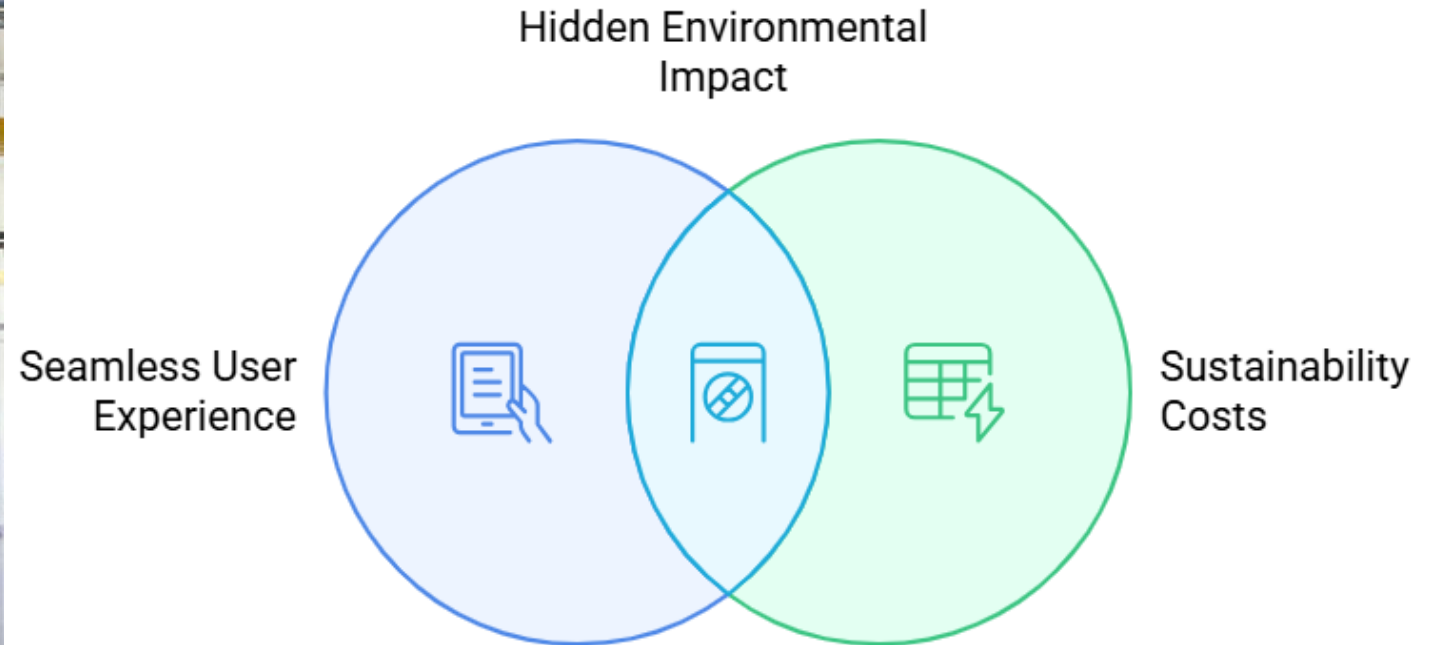
Promotes Sustainability



Seamless experiences often hide sustainability costs



Hidden impact of digital design

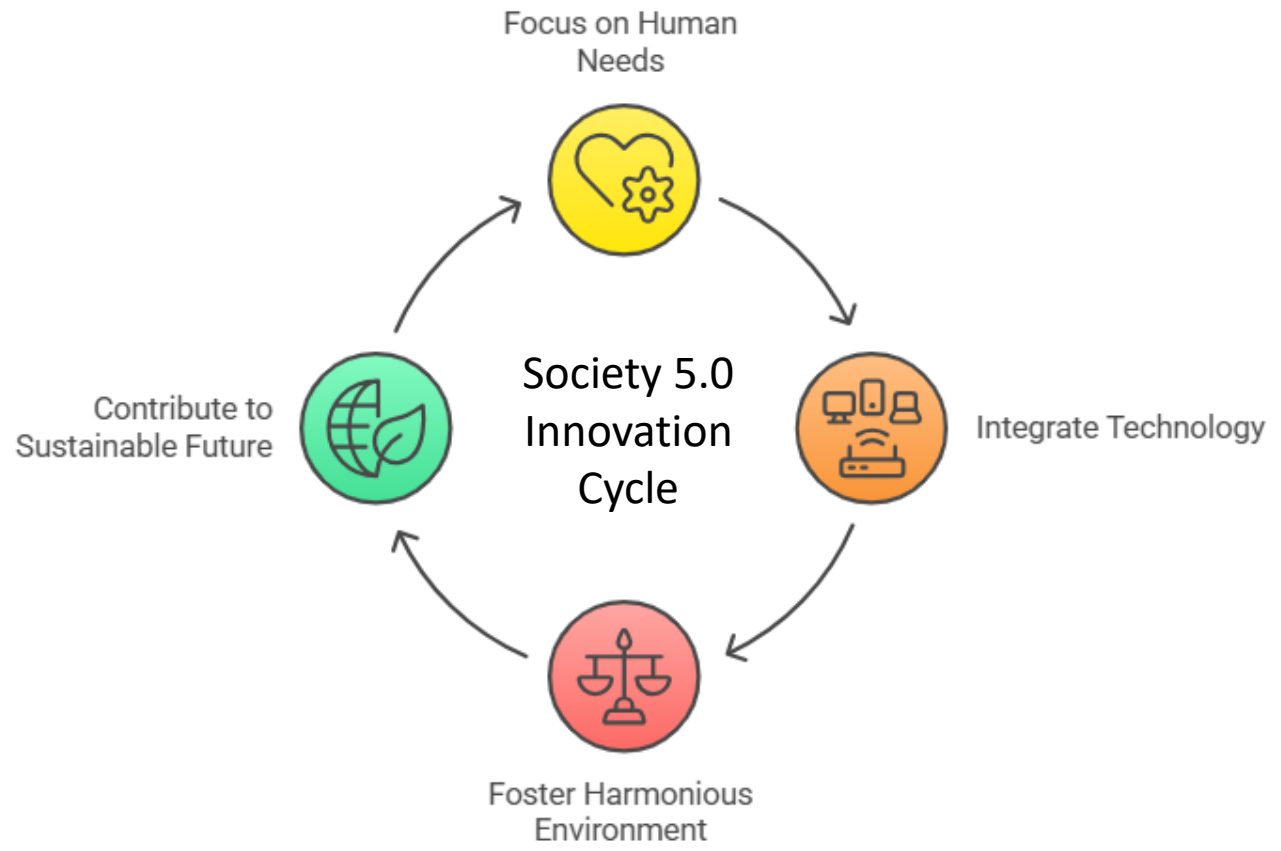


Digital services and digital customer journeys have a material footprint:

- Server energy
- Data storage
- Device use
- Network traffic
- Etc.



Defining Digital Sustainability



Sustainable digital ecosystems balance access, innovation, and responsibility

The Carbon Cost of Digitalisation

Internet users account for

3.7%

of the global CO2 emissions-equivalent to the amount produced by the entire global **Airline Industry**



These figures are expected to double by 2025

Out of 7.83 billion people in the world

4.66

billion of them are active users of the internet

(59%)



The Internet relies on physical servers in data centers around the world



Data centers are connected with miles of undersea cables, switches, and routers that need energy to run



Much of that energy comes from power sources like coal, natural gas, and petroleum that emit CO2 as they burn fossil fuels

The Carbon Cost of Digitalisation

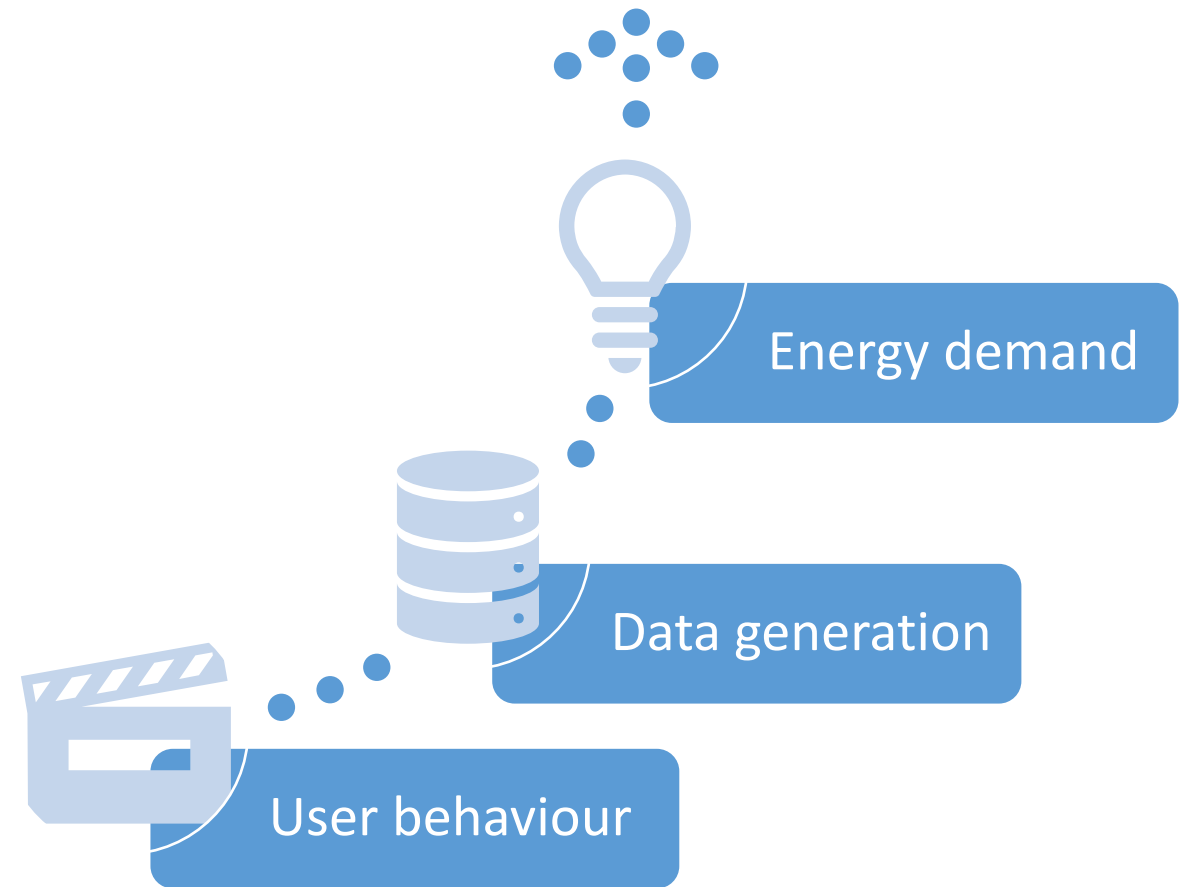


Digital ecosystem components in support of UX, such as

- Digital repositories
- Learning platforms
- Online catalogues
- Cloud-based systems

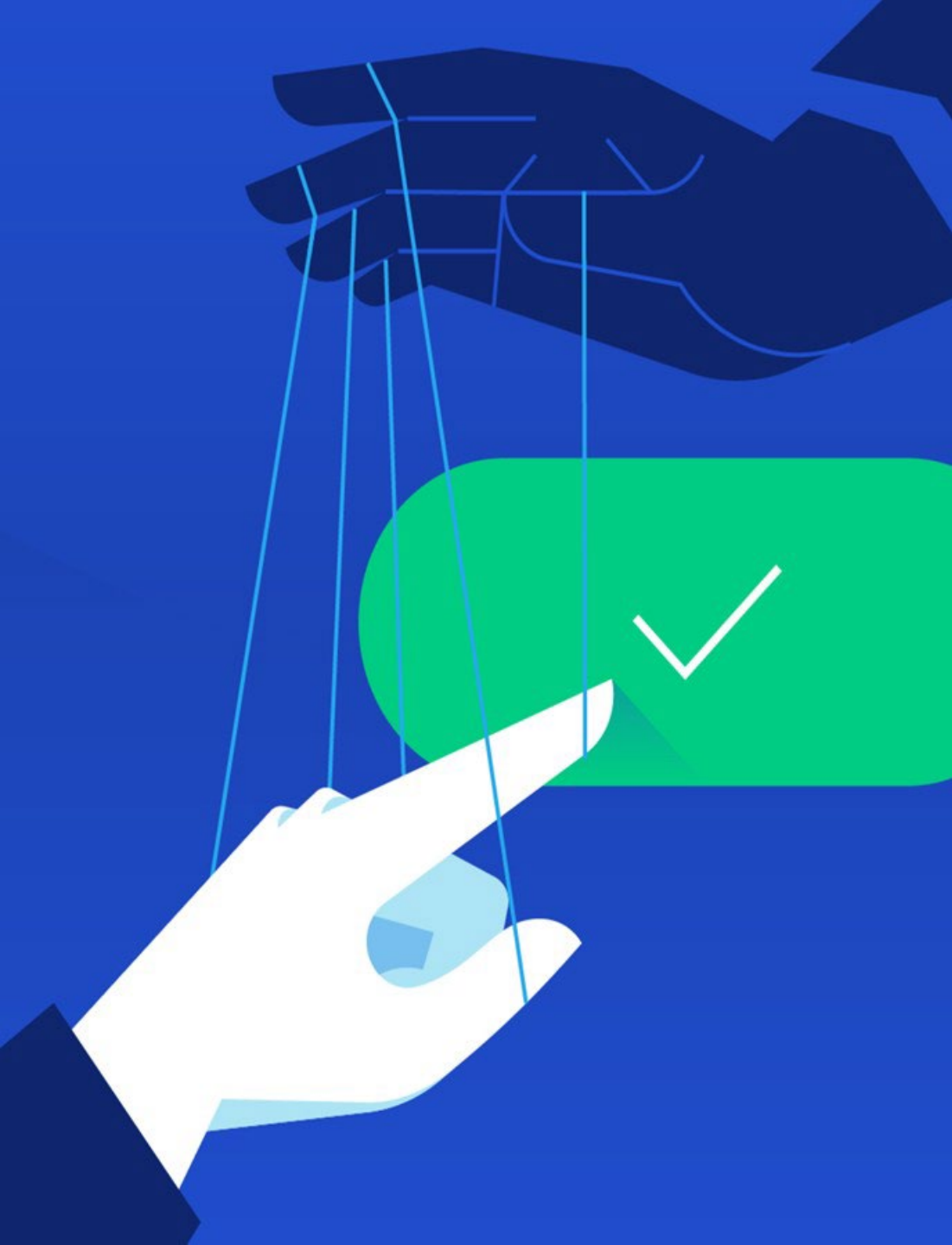


Why UX matters for sustainability



UX links interface design to sustainability outcomes...

KEY ISSUES



Dark patterns and over-consumption

- Over-notification
- Endless scrolls
- Data-heavy interfaces

Manipulative UX creates digital waste; even in academic settings (e.g., redundant alerts or downloads)



Cognitive load and energy load

Simplifying navigation and reducing visual clutter can save energy and improve accessibility.

Simpler UX = lower device and server strain



Dark data

80% of institutional data = dark, *“the data that lies beneath”*

- 12-15%: data that is critical to the business
- 23-25%: data that is redundant, obsolete and trivial (ROT)
- 60-65%: data that is hidden within networks, machines and people

UX metrics for sustainability

Beyond usability and usefulness measures: add energy and data efficiency indicators.



Green UX

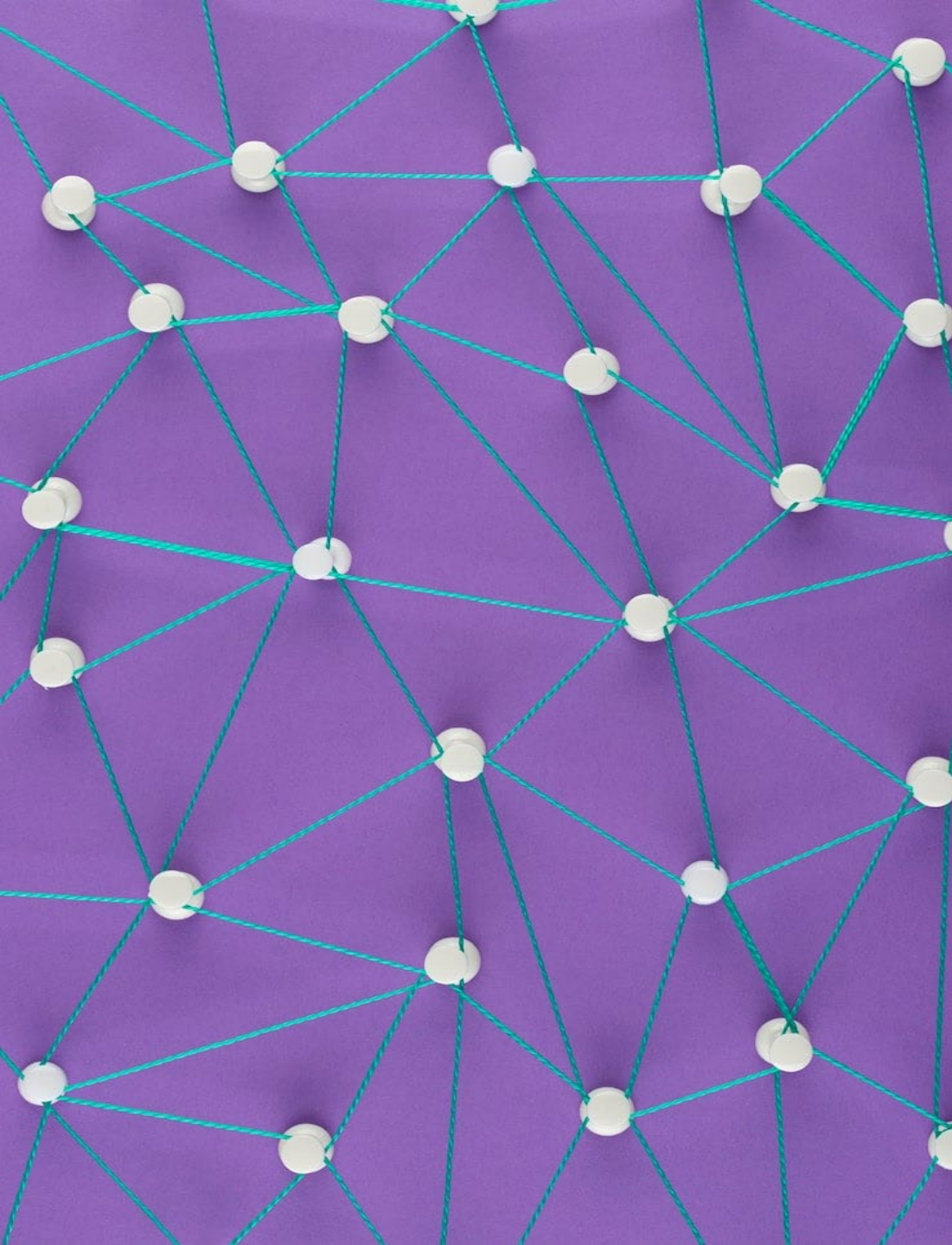


Behavioural design for sustainability

1. Design that shapes responsible digital habits
2. Empathy drives sustainable engagement
3. Emotionally intelligent design reduces cognitive waste
4. Inclusive design = long-term design

*Avoids waste from redesign
and exclusion.*





Sustainable interaction patterns

Patterns that minimise data and attention use:

- Low-bandwidth modes
- Offline access
- Minimal animations

The background is a vibrant green mosaic of small squares. A white grid pattern is overlaid on the mosaic, with the grid lines becoming more prominent and regular towards the right side of the image. The text 'Case studies' is centered in the middle of the image.

**Case
studies**

Eco feedback loops



Help us to plant trees with revenue from your internet searches by [adding the Ecosia extension to your browser](#) and [downloading the Ecosia app](#).

Ecosia - search engine that plants trees, integrates eco-impact directly into the interface — showing users how their searches contribute to reforestation.

Could libraries, corporates, and higher education do similar with green search or open access incentives?

News



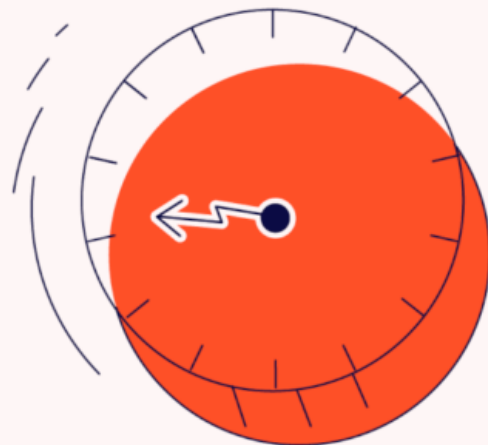
Eco-mode design

SUSTAINABILITY

The Low Impact Manifesto: Organic Basics' 10 Guidelines For Building Greener Websites

QUICK SUMMARY

Organic Basics has been in the business of producing and selling sustainable clothes online since 2014. We're constantly trying to figure out how to be even better at sustainability, and last year this led us to build a low-impact version of our online store. The low-impact version of our website reduces carbon emissions up to [...]



Organics Basic - fashion retailer introduced a “low-impact” browsing mode that reduces energy use by switching to dark colors, minimizing animations, and compressing images. Gives users agency over their environmental footprint, a form of green choice architecture.

Could libraries, corporates, and higher education do similar by designing adaptive interfaces that offer eco-conscious user options?

Reduced data load

WHOLEGRAIN digital Find us in Sustainable Ventures |

☰ Contact →

Digital sustainability

It's baked into everything we do. Find out what digital sustainability is and how we can help you reduce the emissions of your website.

Trusted by

good energy UK GBC CAFE DIRECT olio LAVAZZA BRITISH LIBRARY

Wholegrain Digital
- measures the carbon footprint of every webpage they design

Could libraries, corporates, and higher education do similar, advocating for energy-efficient coding and lightweight media use?

Circular economy storytelling

Vélosophy NESPRESSO.

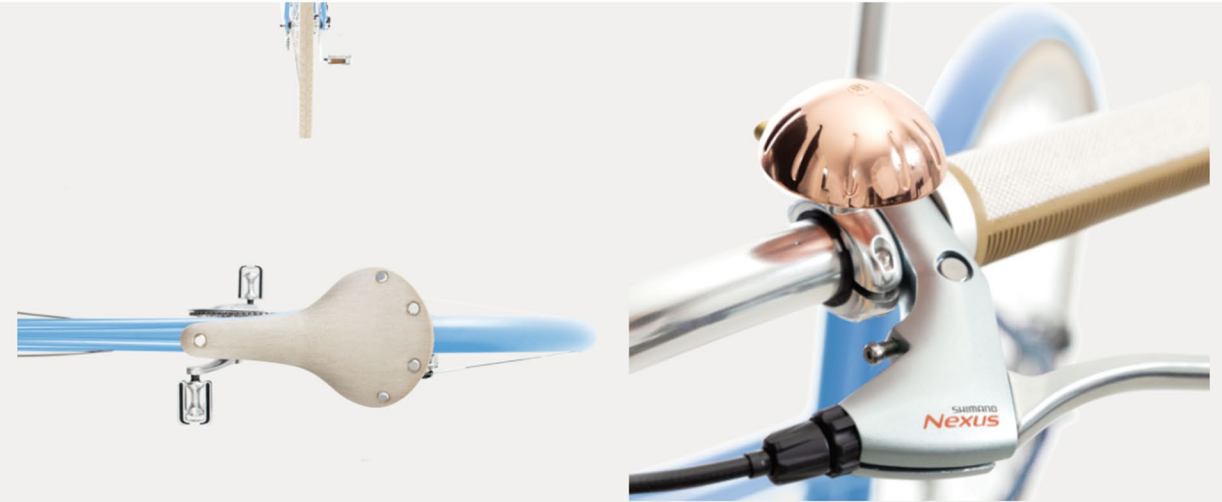
What goes around, comes around, so at Vélosophy we produce our bikes using recycled aluminium.

What is otherwise looked at as waste is given new life as a bike. It's a beautiful way to sustain our earth's resources and just one of the ways we put life in motion.

What better way for us to bring to life the potential of recycling than to partner with Nespresso and craft a bike from recycled aluminium coffee capsules? Introducing RE:CYCLE - a ride that's a perfect marriage of sustainability and design. An instant icon of circular economy design. Recycling upcycled. RE:CYCLE's got all the finishing touches you'd expect from Vélosophy - and then some surprise additions. The vivid color of the frame is inspired by Nespresso's Ice Leggero (our favourite

coffee for the season) while the bell is modelled on the iconic shape of the Vertuo capsule. The steam-bended oak carrier basket includes two cup holders, so you can take your coffee to go. This is the ultimate ride for any coffee fan. We've been working with Nespresso for a while, and we must say, we're impressed with their commitment to sustainability. From their efforts to empower farmers through climate-friendly agriculture that improves livelihoods, to their carbon-neutral factories and world-wide recycling

program coffee has a positive impact on the world. RE:CYCLE is a daily reminder that every small action we take can set off a process. Even something as small as recycling a coffee capsule can set a chain of re-creation in motion. Endlessly Recyclable. Infinitely Beautiful. [More information about Nespresso's recycling program in the UK](#)



Specifications

Frame	6061 recycled aluminium (95%) including recycled Nespresso capsules (20%)
Saddle	Brooks Cambium
Grips	Brooks Cambium
Basket	Laminated Scandinavian wood
Brakes	Mechanical disc brakes
Motor Hub	Zehus Bike+
Kickstand	Centre mounted single stand
Tires	700x35 (35-622) Urban ride
Weight	16 kg

Vélosophy - uses experience mapping to connect physical sustainability practices with digital brand storytelling.

Could libraries, corporates, and higher education do similar by integrating physical-digital sustainability narratives?

Radical design minimalism

Low-Tech Magazine - A solar-powered web server hosts this site; when the battery is low, the site goes offline; low-resolution design, static, and grayscale, forcing designers and users to reconsider what's "essential" in digital experience.

LOW←TECH MAGAZINE

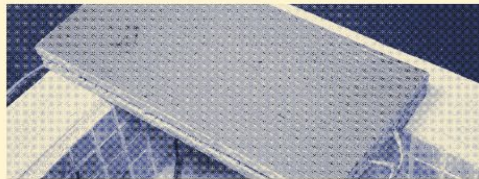
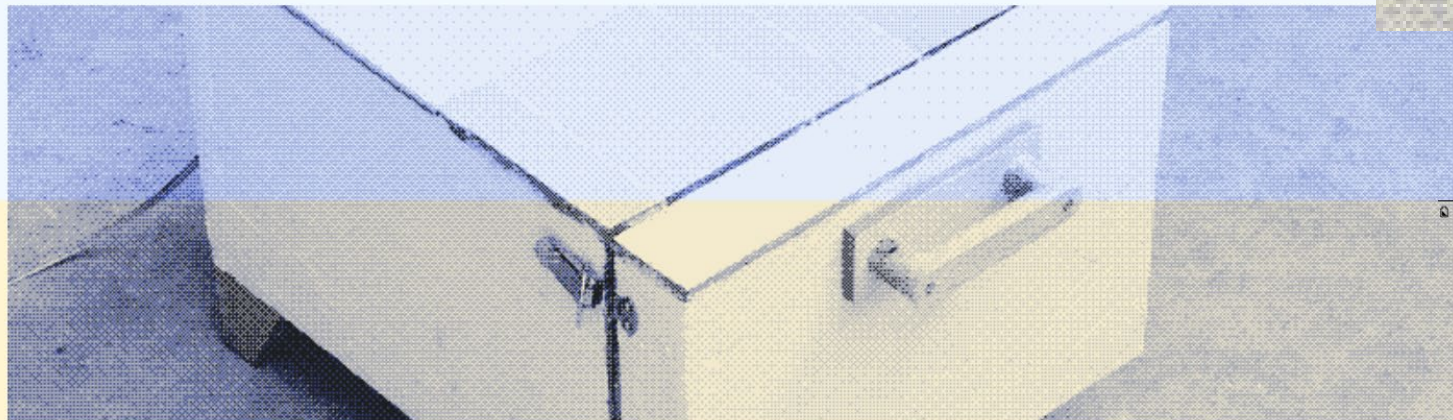
This is a solar-powered website, which means it sometimes goes offline *

About | [Low-tech Solutions](#) | [High-tech Problems](#) | [Obsolete Technology](#) | [Offline Reading](#) | [Archive](#) | [Donate](#) | [NTM](#) 

How to Build a Solar Powered Electric Oven

This guide explains how to construct an energy-efficient cooking appliance powered by a small solar panel. Thanks to its heat storage, the cooker remains ready to use even after sunset.

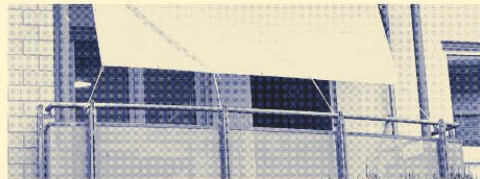
October 13, 2025



How to Assemble an Electric Heating Element from Scratch

This manual guides you through the process of building a 12V DC electric resistance heating element for a self-made heating or cooking device.

October 12, 2025



How to Mount a Balcony Awning

A balcony awning provides shading and cooling with minimal time, effort, and expense.

July 9, 2025



How to Dress and Undress your Home

Before the large-scale use of fossil fuels, removable textile layers kept homes warm in winter and cool in summer.

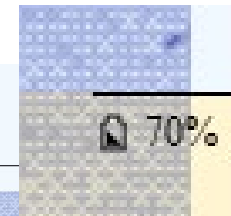
June 16, 2025



The Compressed Book Edition

How to make books more sustainable? Inspired by the image compression on our solar-powered website, we squeezed the article catalog of our three-volume book series into just one book.

March 28, 2025



Could libraries, corporates, and higher education do similar by exploring resilience design, minimal computing, and energy-awareness in UX?



yes
you
can!

There is

NO



PLANET B

The Pixel to Planet UX Mindset

1. **Consider cause and effect** - each digital action has a planetary impact
2. **Apply systems thinking** - connect UX micro-decisions to macro outcomes
3. **Collaborate for change** - UX professionals, IT, and sustainability officers
4. **Measure impact** - include energy and waste metrics in reports, annual reviews or strategic plans

Sustainable UX Toolkit

Sustainable UX Heuristics

- Efficiency of resources
- Visibility of impact

Sustainable UX Maturity Model

1. Awareness
2. Measurement
3. Integration
4. Transformation

Sustainable Design in Practice

Start small:

- Optimise assets
- Educate users
- Advocate internally

Institutionalizing Sustainable UX

Embed in:

- Design systems
- Procurement
- Governance

Examples:

1. Sustainable Web Manifesto
2. Planet-Centric Design
3. Green UX Canvas





**CALL to
ACTION**

UX design call to action

Designers, technologists, and decision-makers to move from **convenience-first** to **conscience-first** digital ecosystems for UX design.

In a world increasingly shaped by code and interaction, sustainable design is not optional, it is **transformational!**

Design the world
you want to live
in – sustainably!

The text "THANK YOU!" is rendered in a bold, sans-serif font. Each letter is a different color: 'T' is blue, 'H' is purple, 'A' is pink, 'N' is orange, 'K' is yellow, 'Y' is green, and 'O!' is teal. The letters have a slight 3D effect with shadows. The text is surrounded by a cluster of small, colorful dots in various colors including blue, yellow, orange, pink, and purple, scattered around the letters.

THANK YOU!

hanlie.smuts@up.ac.za

Resources

- <https://www.theinspirationspace.co/blog/clean-up-your-digital-act>
- <https://theretailexec.com/supply-chain/sustainable-ecommerce-brands/#h-it-s-on-all-of-us-to-ensure-a-greener-future>

10 points of the Organic Basics “Low Impact Manifesto”

#	Rule	Description
1	Do not load any images before they are actively requested by the user	Avoid pre-loading images that the user may never view. For instance, defer large product-photos or model shots until the user scrolls or clicks.
2	Minimise the power consumption on the user’s device	Beyond data transfer, reduce battery and CPU demands by limiting heavy animations, 3D scripts, and other processing-intensive features.
3	Adapt to reflect the amount of renewable energy your site is running on	Adjust the website’s behaviour based on grid carbon intensity—for example, serve lower-quality assets (images/animations) when the electricity supply is dirty.
4	Inform the user of the impact of their browsing behaviour	Make the user aware of the environmental cost of their browsing (e.g., display carbon emissions per page view or interaction) so they can make more informed decisions.
5	Do not make use of videos	Avoid embedding or auto-playing videos, as they massively increase data transfer and device usage. Use lighter alternatives (CSS/SVG/animations) instead.
6	Store data locally on the user’s device to minimise data transfer	Use caching, local storage, offline access and progressive web app patterns so that repeated downloads are avoided and browsing becomes more efficient.
7	Compress all data to the greatest extent possible	Minify scripts and CSS, compress images and other assets, so that payloads are as small and efficient as possible.
8	Load only the most crucial programming scripts, frameworks and cookies	Be ruthless about dependencies: every added JS library, cookie or script adds weight and energy cost. Keep only what is truly necessary.
9	Limit the amount of light emitted by the screen	Darker UI palettes, lower brightness suggestions, or adjusted colours can reduce energy usage (especially on OLED/AMOLED devices).
10	Optimise and limit the use of custom fonts	Custom fonts add to download size and processing; limit variants, character sets (drop unused glyphs/scripts) and use system fonts if possible.

Lean UX Canvas (v2)

Title of initiative:

Date:

Iteration:

Business Problem

What problem does the business have that you are trying to solve?
(Hint: Consider your current offerings and how they deliver value, changes in the market, delivery channels, competitive threats and customer behavior.)

1

Solutions

What can we make that will solve our business problem and meet the needs of our customers at the same time? List product, feature, or enhancement ideas here.

5

Business Outcomes

How will you know you solved the business problem? What will you measure?
(Hint: What will people/users be doing differently if your solutions work? Consider metrics that indicate customer success like average order value, time on site, and retention rate.)

2

Users

What types (i.e., personas) of users and customers should you focus on first?
(Hint: Who buys your product or service? Who uses it? Who configures it? Etc)

3

User Outcomes & Benefits

Why would your users seek out your product or service? What benefit would they gain from using it? What behavior change can we observe that tells us they've achieved their goal?
(Hint: Save money, get a promotion, spend more time with family)

4

Hypotheses

Combine the assumptions from 2, 3, 4 & 5 into the following hypothesis statement:
"We believe that [business outcome] will be achieved if [user] attains [benefit] with [feature]."
(Hint: Each hypothesis should focus on one feature only.)

6

What's the most important thing we need to learn first?

For each hypothesis from Box 6, identify its riskiest assumptions. Then determine the riskiest one right now. This is the assumption that will cause the entire idea to fail if it's wrong.

(Hint: In the early stages of a hypothesis focus on risks to value rather than feasibility.)

7

What's the least amount of work we need to do to learn the next most important thing?

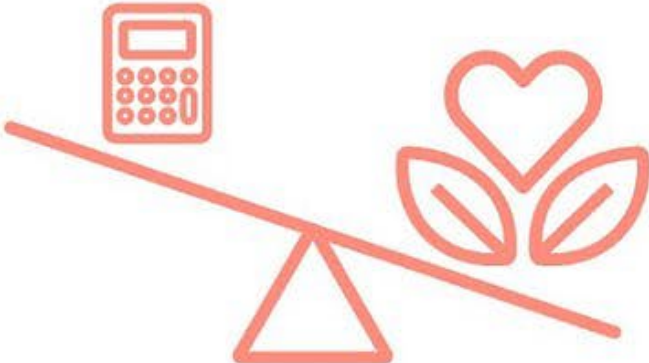
Design experiments to learn as fast as you can whether your riskiest assumption is true or false.

8

The four movements of planet-centric design



From humans to planet



From quantity to quality



From short- to long-term



From market fit to planet fit