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assuming responsibility for Climate change

Topic: Integrating e-learning in traditional education models

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Partner: Middlesex University

Agenda

- Assessing the carbon footprint of education
- Understanding the basics of e-learning
- Determining the role of e-learning in climate change
- Shifting education towards online delivery
- Using digital technologies to support e-learning

Assessing the carbon footprint of education

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Distance learning is good for the environment

- **Distance learning is associated with a variety of benefits such as:**
  - Reduced use of campus facilities
  - Increased accessibility
  - Control of disease transmission

- **Distance learning has been associated with a number of positive outcomes of interest to campus administrators, including:**
  - Accessibility (for non-traditional and disabled students)
  - Flexibility (no scheduling conflicts)
  - Increased participation in class discussion by shy students (using web-based forums)
  - Decreased disease transmission (relevant during flu season)
  - Cost for facilities (no classroom space needed).

- **An additional advantage for teaching with an online format (Campbell and Campbell, 2011)**
  - Distance learning is good for the environment!

Source: https://www.westga.edu/~distance/ojdla/winter144/campbell_campell144.html

Study on savings in Greenhouse emissions

- **Hypothesis 1: Offering a course online will result in fewer student commute trips to campus and the reduction in driving will result in less carbon dioxide emitted into the environment.**

- **Hypothesis 2: Knowledge of the environmental benefits of online instruction will elicit positive attitudes regarding this teaching format.**

- **Method**
  - 500 undergraduate students on three California campuses enrolled in eight online courses
  - One University of California campus and two California State University campuses
  - Three disciplines were included (Engineering, Psychology, Child Development)
  - Four lower-division and four upper-division classes were included
  - Class size varied from 4 to 128 students
  - Most of the participants were 18-21 years old
  - Approximately 60% were female
- **Survey responses:**
  - The weighted mean response rate was 71% for lower-division classes and 83% for upper-division classes.

Source: https://www.westga.edu/~distance/ojdla/winter144/campbell_campell144.html

Commuter Fuel Savings and CO2 Mitigation

- On average, the CO2 mitigation varies from 103 pounds to 338 pounds per enrolled student in a distance learning class (as opposed to a traditional on-campus class).

- The weighted mean savings is 148 pounds of CO2 per enrolled student over the course of a semester

Class	CT-F08	His-F08	CD-F08	CT-S09	Psy-S09	Eng-S09	CT-F09	His-F09
Enrollmt	108	14	29	105	87	4	128	25
% Resp	48	71	79	70	83	100	83	92
% Drive	37	50	91	28	28	100	24	42
RT Dist	17	13	24	15	24	23	18	16
Mi Less	17213	2880	5947	13455	22861	1844	20390	4694
Gal Less	665	124	248	549	922	69	971	200
CO2 Tot	6.5	1.2	2.4	5.4	9.0	0.7	9.5	2.0
CO2/Std	121	173	168	103	208	338	149	157

Column 1 headings

class enrolment, response rate, percentage who drive to campus, reported reduction in driving trips due to online format (round-trip distance), reduction in miles driven over the semester, gallons of fuel saved, total CO2 mitigation (tons) over the semester for these commuters, savings per enrolled online student (in pounds, averaged over the whole class including nondrivers)

Source: https://www.westga.edu/~distance/ojdla/winter144/campbell_campell144.html

Carbon footprint defined

- **Carbon footprint is defined as…**
  - ….. a measure of the exclusive total amount of carbon dioxide (CO_2) emissions that is directly or i caused by an activity or is accumulated over the life stages of a product (Wiedmann and Minx, 2008)

- **The Greenhouse Gas Protocol Initiative is an internationally accepted Greenhouse Gas (GHG) accounting and reporting standard for companies and organisations**

- **It provides a guideline which companies can use to quantify and report their GHG emissions**

- **The GHG protocol divides the emission sources into three scopes (Versteijlen et al, 2017)**

Scope	Description [7]	Examples
Scope 1	Direct emissions from sources that are owned and controlled by the institution	Heating and cooling systems, vehicles (owned by the institution)
Scope 2	Indirect emissions from the generation of the purchased electricity consumed by the institution	Purchased electricity
Scope 3	Other indirect emissions as a consequence of the activities of the institution, but that occur from sources not owned or not controlled by the institution	Waste, procurement, education-related student travel, commute of staff, business travel

Source: https://www.sciencedirect.com/science/article/pii/S1877343517300349#bib0245

Carbon emissions in HEIs

- Percentages of carbon footprint of HEIs attributed to scope 3 emissions (student and staff travel) of an HEI in a specific year, calculated using the GHG protocol, as reported by Dutch HEIs

- Includes CO_2 emissions for student and staff commute in kg per person per year

Higher educational institution	Year	Student and staff travel (total) (% of carbon footprint HEI)	Student commute (% of carbon footprint HEI)	Staff commute (% of carbon footprint HEI)	Student commute (kg CO_2e per student)	Staff commute (kg CO_2e per employee)
Utrecht UAS	2014	91	–	–	–	–
Utrecht University	2015	40	–	–	–	–
Amsterdam UAS	2014	81	71.7	4.4	630	540
University of Amsterdam	2014	58	35.4	8.1	340	410
Rotterdam UAS	2011	85	–	–	–	–
Erasmus University Rotterdam	2011	70	50	10	–	–

–: not specified by HEIs.

Student commute was calculated to be 630 Kg CO2 per student!

Source: https://www.sciencedirect.com/science/article/pii/S1877343517300349#bib0245

Online delivery may be the solution

- Classification of learning courses according to Allen and Seaman (Ally, 2004)
- The more we shift online the less the need for travel responsible for carbon emissions

Proportion of content delivered online	Type of course	Typical description
0%	Face-to-face	Course with no online technology used. Content is delivered in writing or orally in a classroom.
1–29%	Web facilitated	Course that uses web-based technology to facilitate what is essentially a face-to-face course. Uses a course management system (CMS) or web pages to post the syllabus and assignments, for example.
30–79%	Blended/hybrid	Course that blends online and face-to-face delivery. Substantial proportion of the content is delivered online, typically uses online discussions, and typically has some face-to-face meetings.
80+%	Online	A course where most or all of the content is delivered online. Typically has no or very few face-to-face meetings.

Source: https://www.sciencedirect.com/science/article/pii/S1877343517300349#bib0245

Advantages of online education

Student-content interactions

- Challenging online (or blended) course design, which is a balanced combination of content, didactics and technology activates the student and leads to deep learning.
- Personalised education is possible by adapting the learning materials, coaching and monitoring the needs of the student
- Digital Learning Environment (DLE) and digital tools provide the means to practise a presentation multiple times and discuss the result on a forum with or without the lecturer present, time-independently

Student-lecturer interactions

- The lecturer becomes a moderator, activating the student instead of giving a lecture
- The best lecturers are online available to give a lecture
- Online technology provides the means to structure the learning materials and to monitor the progress of the student

Student-student interactions

- In a collaborative learning community students can interact with each other face-to-face as well as virtually

Source: https://www.sciencedirect.com/science/article/pii/S1877343517300349#bib0355

Disadvantages of online education

Student-content interactions

- Non-committal behaviour of students, because of not being at the institution
- A lack of discipline and self-dependence leads to underachievement in online education
- Ineffectiveness of online communication to learn, social skills, such as presenting and discussion

Student-lecturer interactions

- Less flexibility. Online interaction does not provide the means to react immediately to signals of misunderstanding and misconceptions of students
- Less positive influence on students' learning through the presence of a lecturer, teaching face-to-face
- A lack of face-to-face supervision of first-years can lead to underachievement

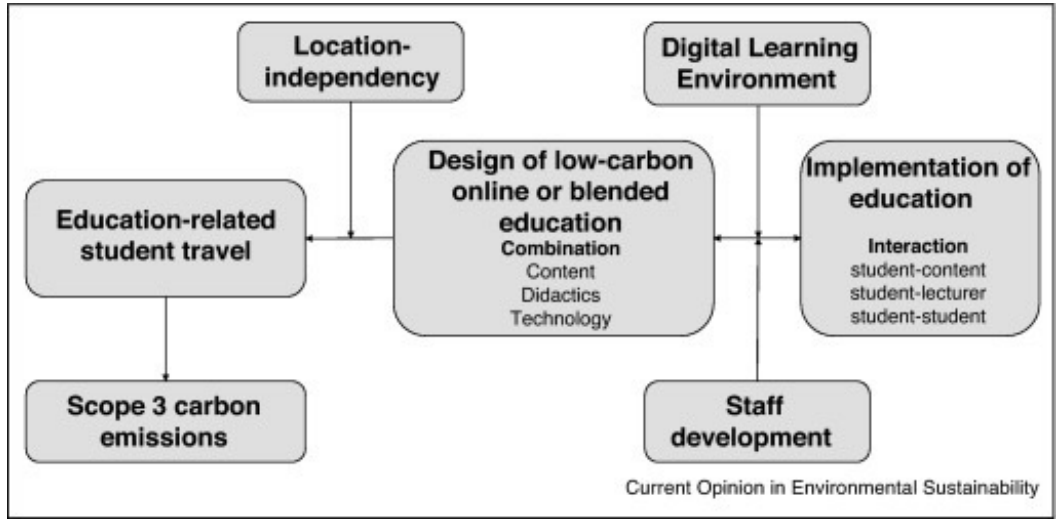
Student-student interactions

- Deterioration of collaboration and informal learning by not/less seeing other students face-to-face

Source: https://www.sciencedirect.com/science/article/pii/S1877343517300349#bib0355

Relationships between online education and scope 3 carbon emissions

- Education-related student travel has an impact on scope 3 carbon emissions
- The impact can be lowered by incorporating location independency in the design of online education
- Online education should be properly designed and be accompanied with a good Digital Learning Environment (DLE) and proper staff development



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Understanding the basics of e-learning

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E-learning benefits

- Variety of programs
- Self-paced learning
- Comfort
- Lower costs
- Career advancement

Source: https://www.ecoleglobale.com/blog/what-are-the-benefits-of-e-learning/

Challenges of e-learning implementation

- Awareness
- Bandwidth issue and connectivity
- Low adoption rate
- Computer literacy and digital divide
- Difficulty in engaging learners online
- Language barrier

Source: https://www.researchgate.net/publication/331523247_A_STUDY_ON_E-TRAINING_ADOPTION_FOR_HIGHER_LEARNING_INSTITUTIONS

Online instructor competences

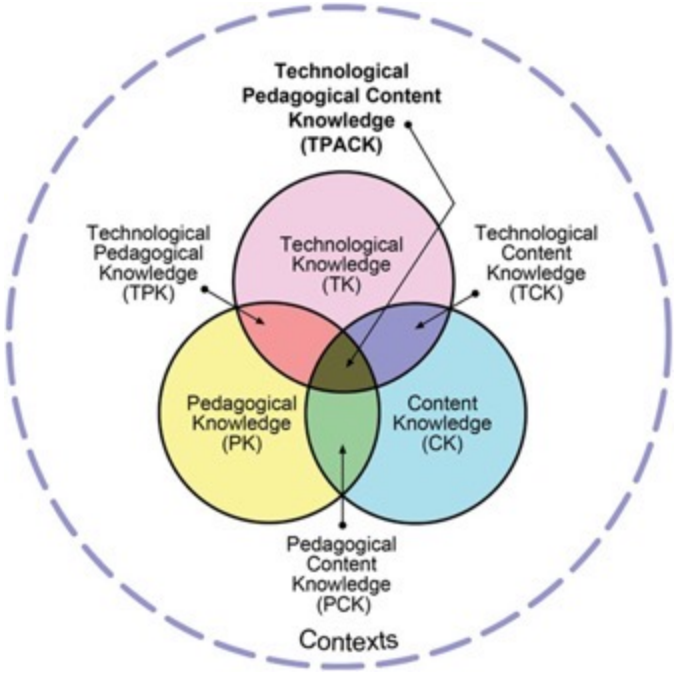
- Communication skills
- Technological competence
- Provision of informative feedback
- Administrative skills
- Responsiveness
- Monitoring learning
- Providing student support

Roddy et al, 2017

Source: https://www.frontiersin.org/articles/10.3389/feduc.2017.00059/full

Technological Pedagogical Content Knowledge (TPACK) model

- A useful framework through which to view teacher competencies across multiple levels
- We can apply this model to consider teacher skills in intensive online environments
  - Technological Pedagogical Knowledge (TPK)
  - Technological Content Knowledge (TCK)
  - Pedagogical Content Knowledge (PCK)



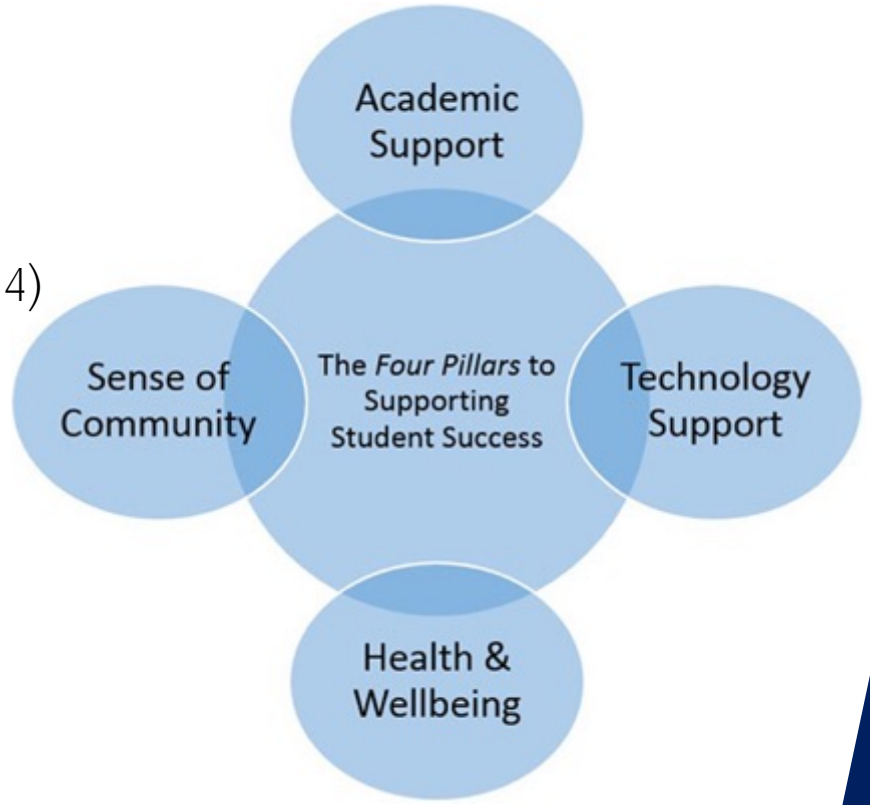
Mishra and Koehler, 2006

Source: https://www.frontiersin.org/articles/10.3389/feduc.2017.00059/full

The “four pillars” to supporting student success

These pillars include:

- Online-friendly academic support (Coonin et al., 2011; Huwiler, 2015)
- Assistance with navigating technology (Lee, 2010)
- Health and well-being facilities (Anderson, 2008)
- A sense of belongingness, or community (Kumar and Heathcock, 2014)



Source: https://www.frontiersin.org/articles/10.3389/feduc.2017.00059/full

Pedagogical options for environmentally sustainable education

- **2005 – the Higher Education Funding Council for England (HEFCE) set out a 10 year vision and action plan to make sustainable development a central part of Higher Education**
- **2008 – the HEFCE issued a policy development consultation as part of efforts to further contribute to the sustainable education development agenda (HEFCE, 2008)**
- **Environmentally sustainable education can be achieved as follows**
  - Engaging with stakeholders to bring about policy synergies
  - Building capacity of people to manage sustainable development
  - Sharing good practice
  - Rewarding more sustainable behaviour

Source: https://www2.le.ac.uk/departments/beyond-distance-research-alliance/documents/HOW%20GREEN%20IS%20YOUR%20LEARNING%20-%20SAMUEL%20NIKOI%20-%20UNIVERSITY%20OF%20LEICESTER.pdf

Institutional approaches towards environmentally friendly education

- **Estate management strategies**
  - Improved management of buildings and physical infrastructure
- **Energy efficiency strategies**
  - Cost effective low energy buildings that have low impact on the environment
- **Space management strategies**
  - Reassess use of space and associated energy consumption
- **Information Technology strategies**
  - ICT may account for up to 18% of a University's electricity bill
- **Mobility strategies**
  - Avoiding car travel for learning purposes can help the environment and cut carbon emissions

Space	% of average higher education campus
Teaching	25
Research	20
Lecture Hall	5
Office	30
Library	10
Catering	25
Recreation	7.5
Total academic	**100% of academic (75% of total)**
Total residential	**100% of residential (25% of total)**

Source: https://www2.le.ac.uk/departments/beyond-distance-research-alliance/documents/HOW%20GREEN%20IS%20YOUR%20LEARNING%20-%20SAMUEL%20NIKOI%20-%20UNIVERSITY%20OF%20LEICESTER.pdf

Good practices for reducing ICT-related emissions

- Powering down PCs when not in use
- Harvesting ideal CPUs through grid computing techniques
- Purchasing devices with low power consumptions
- Substituting thin client devices for PCs
- Changing practices with regards to replacement and disposal of ICT equipment

JISC and SusteIT, 2008

Source: https://www2.le.ac.uk/departments/beyond-distance-research-alliance/documents/HOW%20GREEN%20IS%20YOUR%20LEARNING%20-%20SAMUEL%20NIKOI%20-%20UNIVERSITY%20OF%20LEICESTER.pdf

Greening of e-learning

Greening of Elearning CheckK Out (GeCKO)

- University of Leicester project on how to improve the environmental impact of education

GECKO compared two different modes of learning and teaching delivery with the aim to inform institutional policy on the environmental sustainability of learning and teaching at the university

- Data was gathered through a survey over a three week period
- Sixteen students from two programmes voluntarily participated in the research
- Students on the blended learning programme were issued with laptops at the beginning of their programme
- The other programme was delivered through the traditional face to face on campus method
- Self entry of data helped towards weekly estimation of consumption under four key variables directly linked to teaching and learning related CO2 emission

Variables

- ICT use covering computers, laptops, photocopiers and scanners
- Paper use covering printing and photocopy
- Energy use covering electricity and heating
- Mode of travel for example car, bus, walking

Source: https://www2.le.ac.uk/departments/beyond-distance-research-alliance/documents/HOW%20GREEN%20IS%20YOUR%20LEARNING%20-%20SAMUEL%20NIKOI%20-%20UNIVERSITY%20OF%20LEICESTER.pdf

Greening of e-learning

Use of ICT

Period	I – Science (online)		Physics (face-to-face)	
	Usage per student per wk (kg)	Average per student (kg)	Usage per student per wk (kg)	Average per student (kg)
wk1	1.341	0.891	3.831	2.907
wk2	0.804		2.378	
wk3	0.528		2.513	

Use of paper

Period	I – Science (online)		Physics (face-to-face)	
	Usage per student per wk (kg)	Average per student (kg)	Usage per student per wk (kg)	Average per student (kg)
wk1	0	0.055	0.173	0.275
wk2	0.039		0.361	
wk3	0.126		0.290	

Source: https://www2.le.ac.uk/departments/beyond-distance-research-alliance/documents/HOW%20GREEN%20IS%20YOUR%20LEARNING%20-%20SAMUEL%20NIKOI%20-%20UNIVERSITY%20OF%20LEICESTER.pdf

Greening of e-learning

Use of energy

Period	I – Science (online)		Physics (face-to-face)	
	Usage per student per wk (kg)	Average per student (kg)	Usage per student per wk (kg)	Average per student (kg)
wk1	6.282	7.219	5.714	4.987
wk2	8.369		4.533	
wk3	7.008		4.715	

Travel to and from university

Period	I – Science (online)		Physics (face-to-face)	
	Usage per student per wk (kg)	Average per student (kg)	Usage per student per wk (kg)	Average per student (kg)
wk1	7.008	2.336	0.093	0.052
wk2	0		0	
wk3	0		0.063	

Source: https://www2.le.ac.uk/departments/beyond-distance-research-alliance/documents/HOW%20GREEN%20IS%20YOUR%20LEARNING%20-%20SAMUEL%20NIKOI%20-%20UNIVERSITY%20OF%20LEICESTER.pdf

Determining the role of e-learning in climate change

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Environmental benefits to e-learning

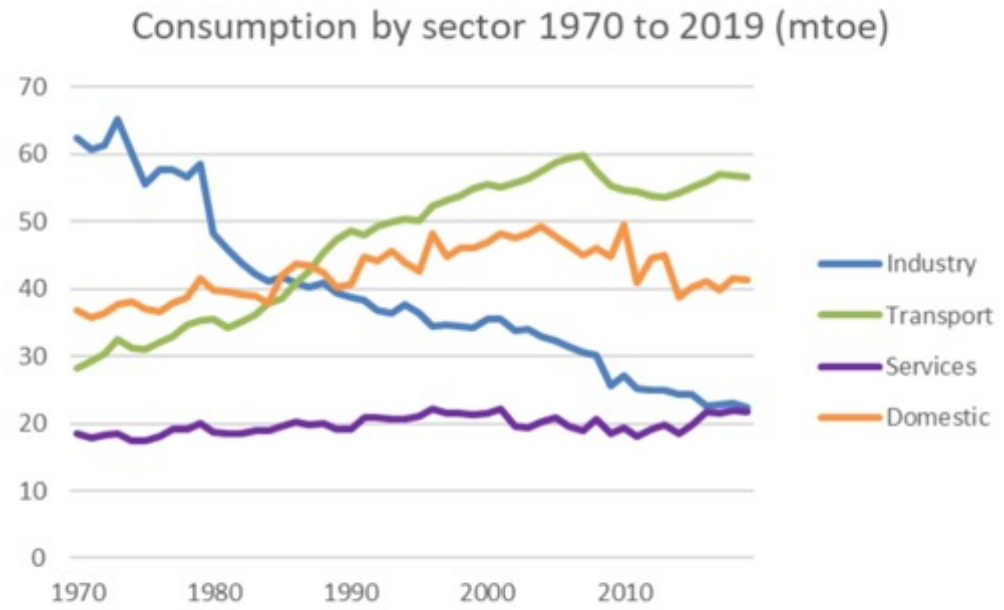
- Reducing fuel consumption
- Reducing pollution and carbon emissions
- Reducing energy consumption
- Reducing paper waste

Source:

Reducing fuel consumption

E-learning reduces fuel consumption

- There is evidence of spiralling energy consumption in the transport sector
- Students who travel every day for just a few classes' waste gas and natural resources
- Online learning allows the student to learn from the comfort of their home while avoiding wear-and-tear on their vehicle and local roads



Source: https://www.triplepundit.com/story/2015/4-unsung-environmental-benefits-online-education/35151
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/928350/2020_Energy_Consumption_in_the_UK__ECUK_.pdf

Reducing pollution and carbon emissions

E-learning reduces pollution

- For every 100 students who did not commute to school, carbon dioxide emissions were reduced by up to 10 tons every semester (University of West Georgia study)
- Online learning courses resulted in a 90 percent emission reduction (Stockholm Environmental Institute (SEI) study)

Source: https://www.triplepundit.com/story/2015/4-unsung-environmental-benefits-online-education/35151

Reducing pollution and carbon emissions

E-learning reduces pollution

- E-learning provides impressive carbon dioxide savings over conventional classroom education
- Economies of scale give online education the edge by spreading campus impacts over a larger number of students, reducing campus site CO2 emissions from 81 kg (178.5 lbs) for a full time to student to about 2 kg (4.4 lbs) for a blended online and print-based course
- Distance learning courses (including online education) resulted in an 89 percent reduction in travel-related emissions over full-time onsite courses

Source: https://blog.nwf.org/2009/05/is-online-learning-better-for-the-planet/

Reducing energy consumption

E-learning reduces energy consumption

- Online learning consumes up to 90 percent less energy compared to traditional sources (U.K.'s Open University Design Innovation Group (DIG))
- Constructing schools and educational institutions need
  - Plastic
  - Metal
  - Wood
  - Other building materials
- Online education reduces the demand for these raw goods which protects the environment

Source: https://www.triplepundit.com/story/2015/4-unsung-environmental-benefits-online-education/35151
https://thestarfish.ca/journal/2020/08/environmental-benefits-of-online-learning-2/

Reducing energy consumption

E-learning reduces energy consumption

- Air conditioning and heating of traditional classrooms is a key factor for increasing energy consumption in traditional learning environments
- Typical higher-education buildings of around 55,000 square feet consume the equivalent of $100,000 worth of energy per year, with lighting, ventilation, and cooling making up the lion's share of energy usage
- This is a significant footprint, and many older campuses are ill-equipped to make necessary, energy-saving upgrades

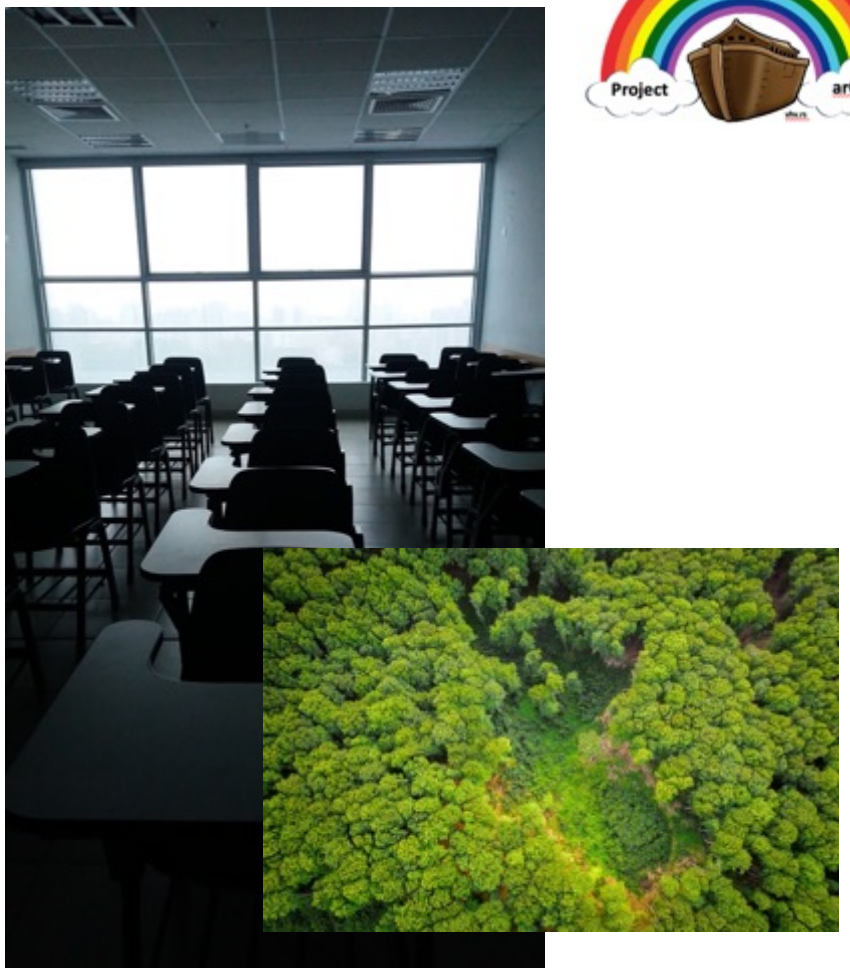
- In cases where the electricity is being provided by a clean fuel source, like hydro, wind, or nuclear power, there isn't' as much of an impact on the environment
- Unfortunately, there are still many cities that still supply their power through fossil fuels and coal

Source: https://csuglobal.edu/blog/environmental-benefits-of-online-education
https://www.ecomena.org/online-education-to-save-environment/

Reducing paper waste

E-learning reduces paper waste

- Deforestation is a serious global issue – one ton of paper waste is equal to 16 large trees
- 60% of school waste is paper (National Wildlife Foundation)
- Recycling 10 tons of paper is equal to the use of up to 100 barrels of crude oil
- E-learning saves paper with the digitisation of the curriculum, assignments and even textbooks
- Administration paperwork, registration, finances can all be done through online portals.
- Online learning even reduces the energy and resources used to recycle paper.



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https://thestarfish.ca/journal/2020/08/environmental-benefits-of-online-learning-2/

Reducing paper waste

E-learning reduces paper waste

- About a third of the paper used in the United States comes directly from trees (the rest comes from recycled paper and scraps)
- In order to supply every office and school in the US, between 55 and 100 million trees are cut down every year
- Only about 53% of the paper used is recycled
- That means that nearly half of the paper us (the vast majority of it recyclable) ends up in landfills...

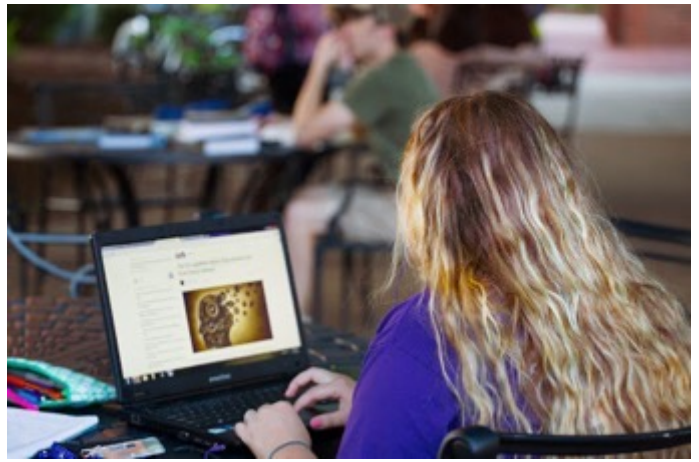
Source: https://csuglobal.edu/blog/environmental-benefits-of-online-education
https://www.ecomena.org/online-education-to-save-environment/

E-learning also has additional costs

Environmental impact of e-learning

- The largest environmental impact of online education is computing
- It adds 24 kg (53 lbs) of CO2 to the atmosphere per student
- However, the 90% savings in energy and emissions in the areas of transport, campus site, and residential energy far outweighed this downside

  (Joint study conducted by the Stockholm Environmental Institute (SEI) and the United Kingdom's Open University Design Innovation Group (DIG))



Financial impact of e-learning

- In many cases if students live more than 20 miles away, the costs of getting to and from campus can exceed those for tuition and fees
- residential energy for full-time students in regular classrooms come to 102 kg (225 lbs) versus 4.4 kg (9.7 lbs) for primarily online students

Source: https://blog.nwf.org/2009/05/is-online-learning-better-for-the-planet/

Shifting education towards online delivery

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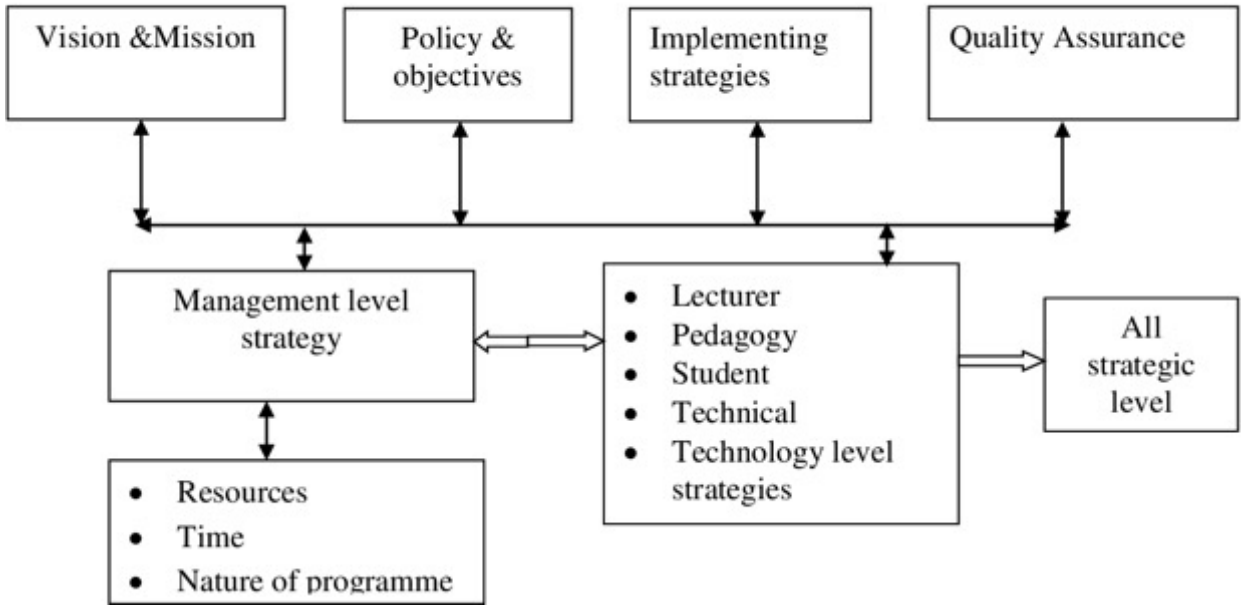
E-learning strategy formulation

- **Case study – Kenyatta University (Ondigi and Avot, 2015)**
  - Identify university policy on e-learning as a tool for training
  - Establish the implementation policy on e-learning as a training tool
  - Establish the training challenges experienced in implementing the policy
  - Development model on the implementation of e-learning as a tool for pedagogical training

Figure 2: A Proposed eLearning Formulation and Implementation Strategy for Gainful Training and Learning

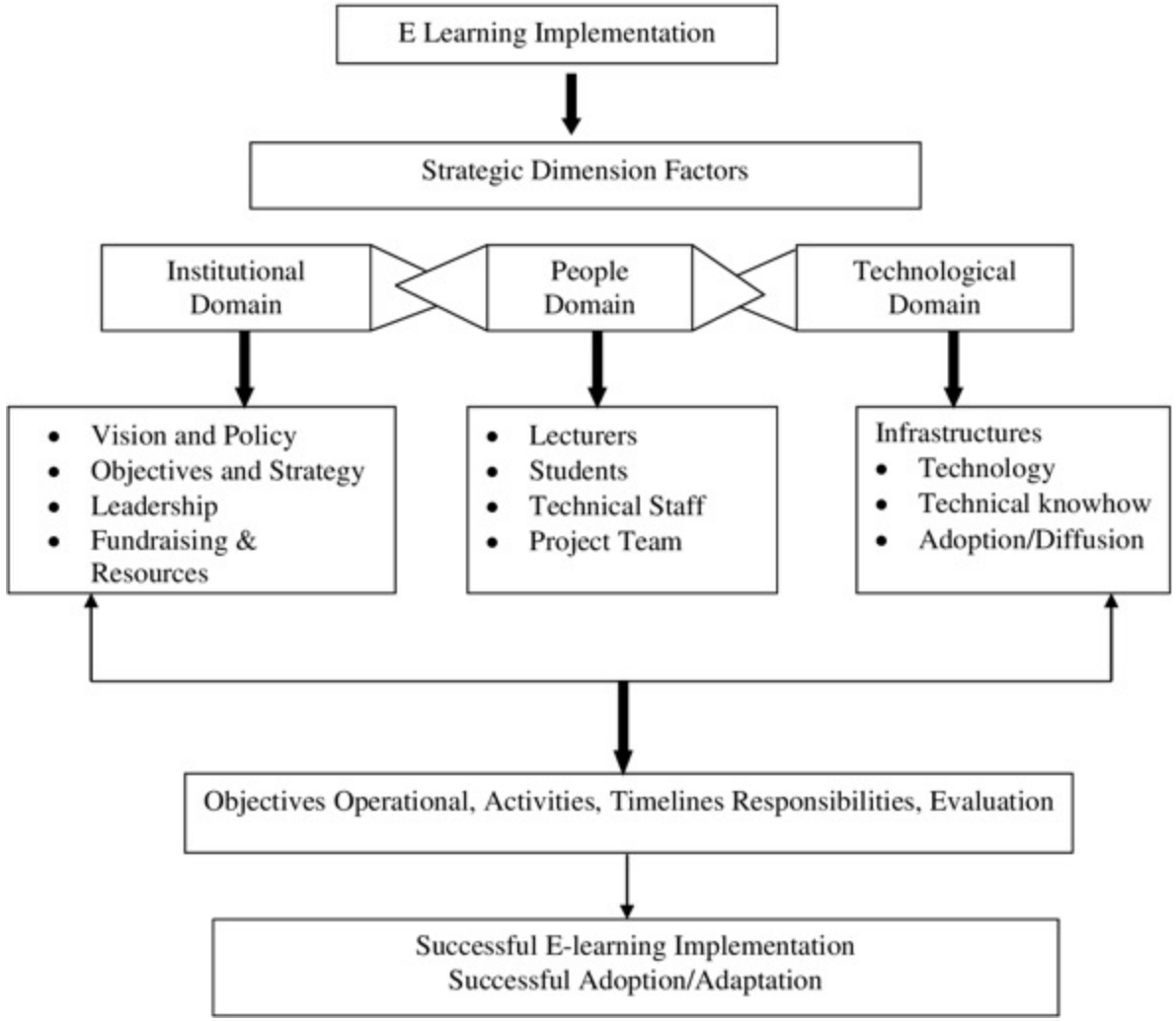


Source: https://www.semanticscholar.org/paper/Recent-developments-in-e-learning-pedagogy%3A-role-of-Ondigi-Ayot/19c48955cb9bf943a7508d8a00efdc72d8090d9a/figure/2

E-learning implementation policy

- **Case study – Kenyatta University**
  - Ondigi and Avot, 2015

Figure 3: Showing the eLearning Implementation Policy



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Designing low carbon higher education systems

- **Open University investigation on 'environmental impacts of campus and distance learr systems' reflected on the impact of the following course types**
  - Campus-based full time courses
  - Campus-based part time courses
  - Distance learning part time courses provided mainly via printed materials
  - Distance learning part time courses delivered mainly or partly online via the Internet

- **Energy consumption calculated using average MJ per student per 10 CAT points (100 study hours)**

Table I: Energy consumption of campus and distance learning courses (average MJ per student per 10 CAT points)

ENERGY (MJ)	Campus site	Travel	Comp-uting	Paper/ print	Resdl. heating	TOTAL
Campus: full time	883.0	2304.4	119.7	66.3	1193.5	4567.0
Campus: part time	461.5	875.1	104.4	49.7	125.9	1616.6
Distance: print-based	17.8	375.2	83.2	155.8	39.3	671.2
Distance: electronic	17.6	139.1	208.1	69.9	101.2	535.8

Notes: 1 kWh = 3.6 MJ
1 CAT point is equivalent to 10 hours total study. 360 CAT points are required for an UK undergraduate degree and 180 CAT points for a Masters degree.

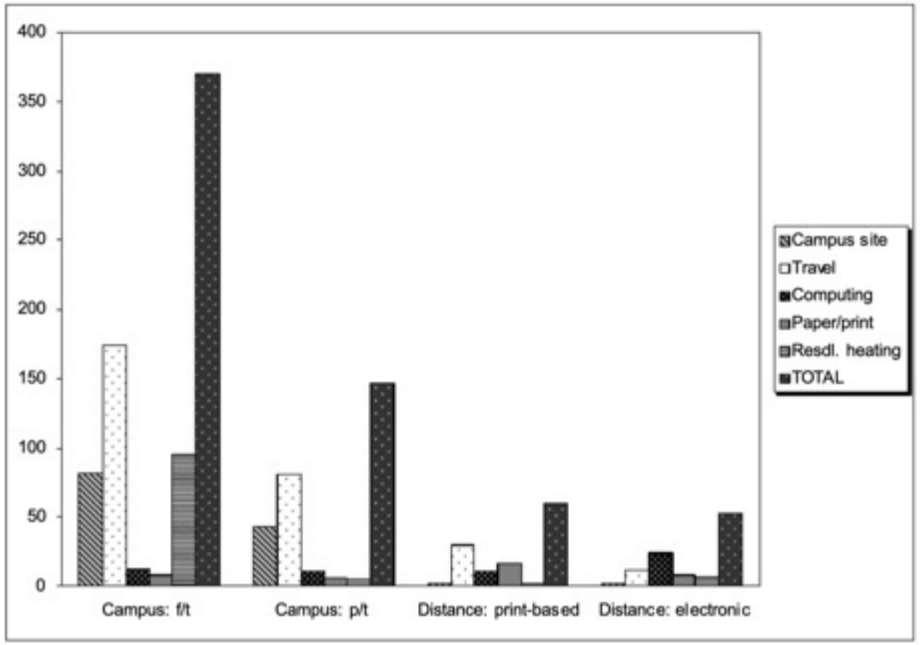
Source: https://www.researchgate.net/publication/42795067_Designing_low_carbon_higher_education_systems_Environmental_impacts_of_campus_and_distance_learning_systems

Designing low carbon higher education systems

- **Carbon dioxide emissions for campus and distance learning courses (average kg CO2 per student per 10 CAT points)**

- **Main finding:**
  - Compared to full-time campus-based courses, students undertaking part-time, face to face study at campus universities reduce energy use and CO2 emissions by 65% and 61% respectively per student per 10 CAT points.

- **Factors for this reduction:**
  - The reduction in the residential energy for students who live at their main home while studying
  - A significant reduction in travel
  - A more intensive utilisation of campus facilities



Source: https://www.researchgate.net/publication/42795067_Designing_low_carbon_higher_education_systems_Environmental_impacts_of_campus_and_distance_learning_systems

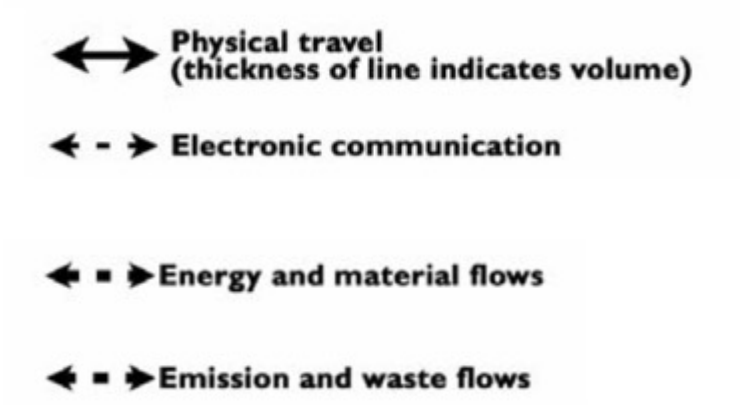
Rebound effects of online learning

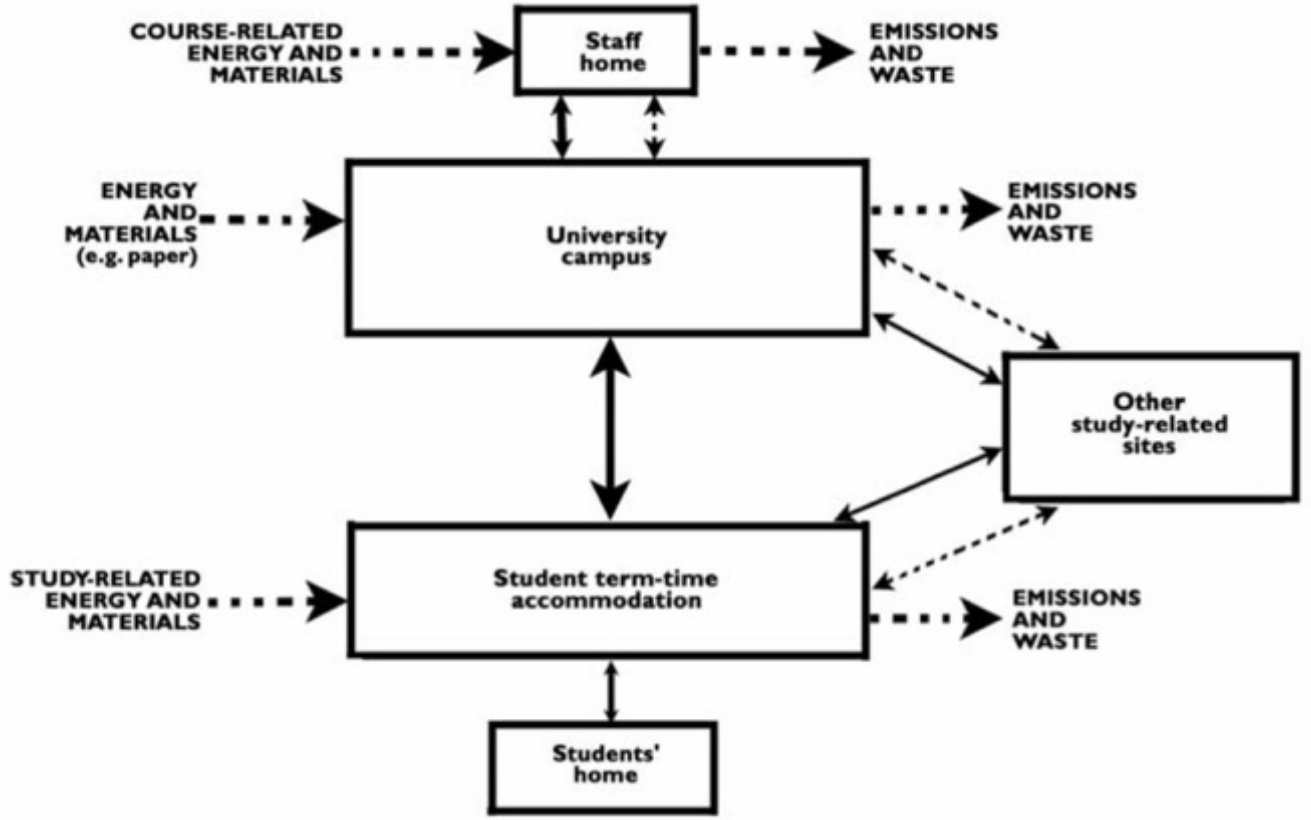
- **The Open University study also found three examples of so-called 'rebound' effects of learning:**
  - The preference of many students to download and print off a high proportion of online learning materials for reasons of portability, ease of reading, note making and reference
  - Another, less expected, effect is the apparent wish of some students to meet informally face to face, given the limited or no provision of formal face to face tutorials, thus involving local travel
  - Some students appear to heat their homes more than normal for study purposes, probably while staying up late accessing the Internet during winter months

Source: https://www.researchgate.net/publication/42795067_Designing_low_carbon_higher_education_systems_Environmental_impacts_of_campus_and_distance_learning_systems

Assessing the environmental impact of education

- Conventional system – full-time campus- based course

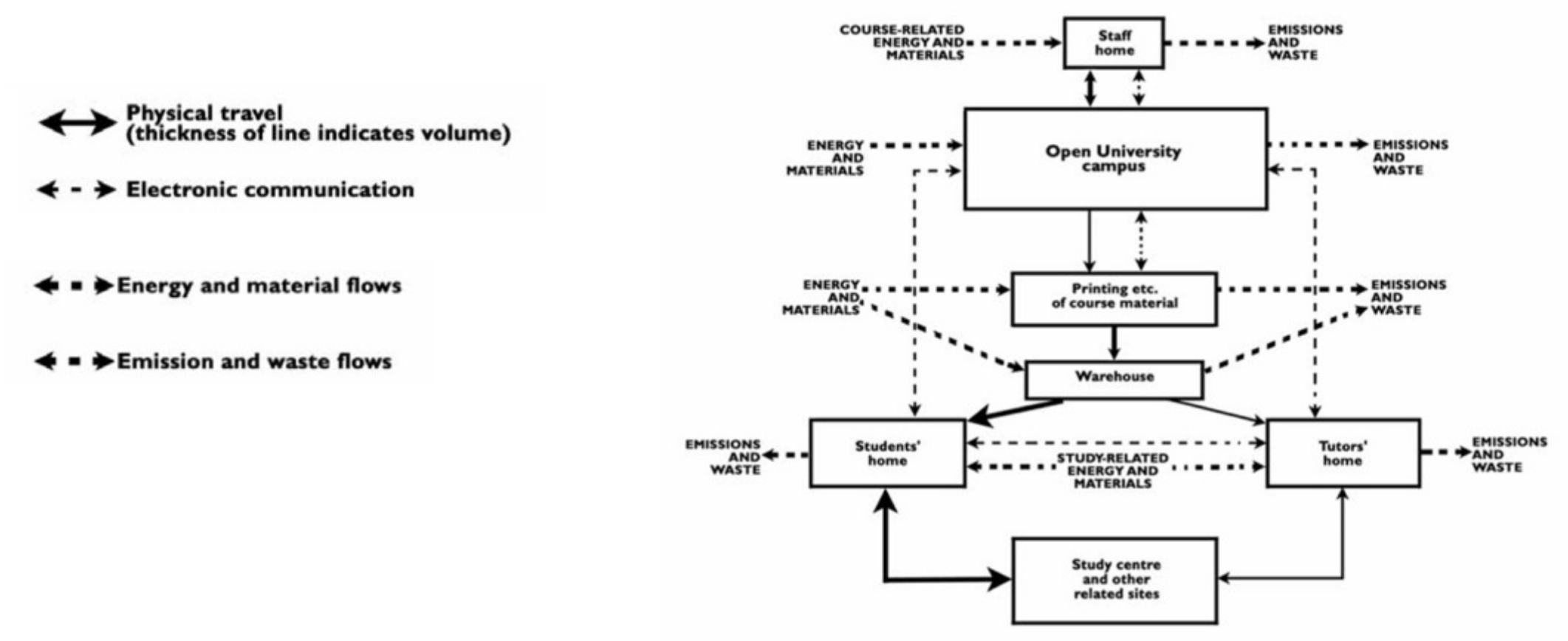




Source: https://www3.open.ac.uk/events/3/2005331_47403_o1.pdf

Assessing the environmental impact of education

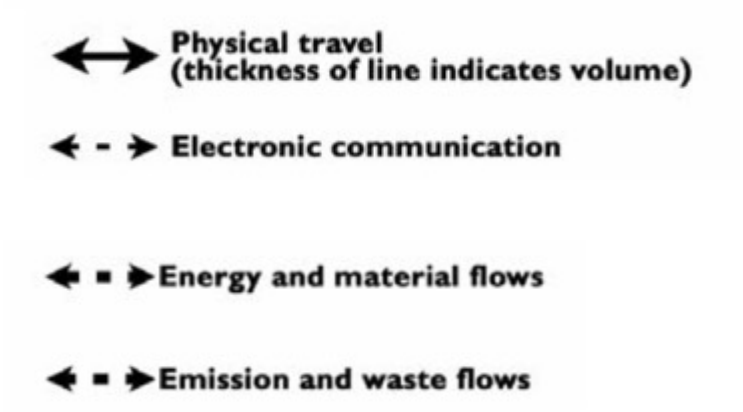
- Distance taught print-based distance/supported open learning course

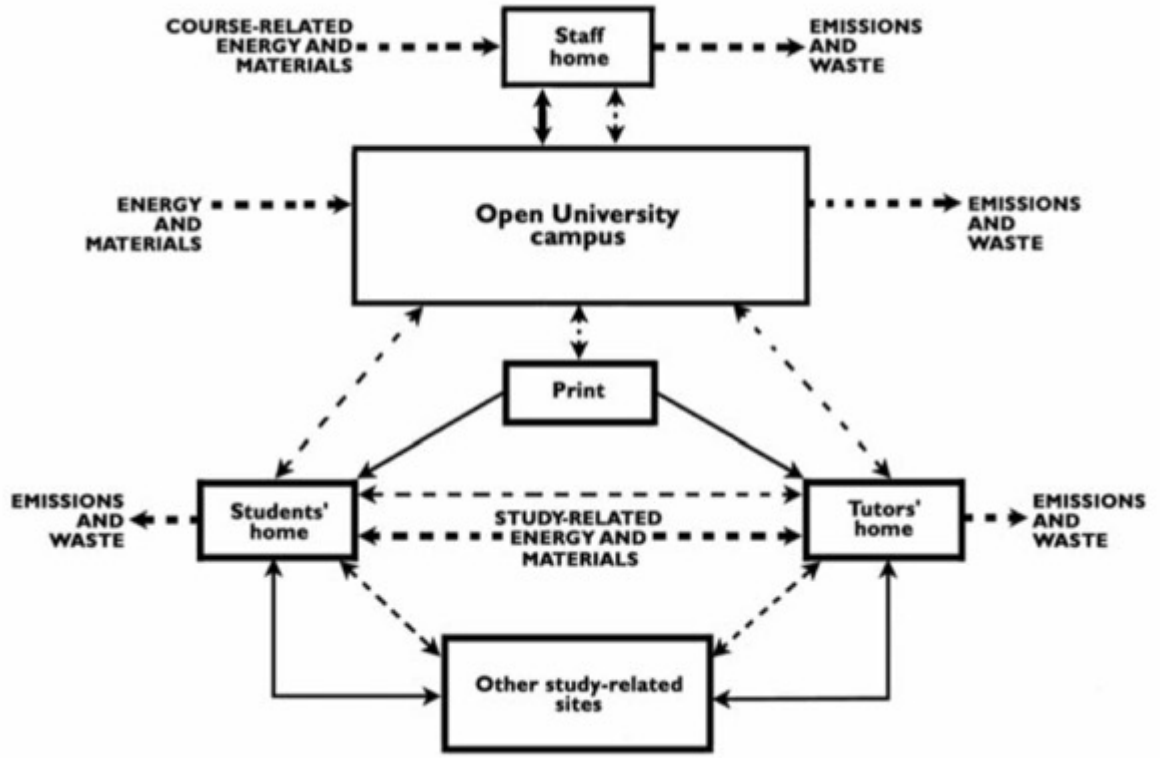


Source: https://www3.open.ac.uk/events/3/2005331_47403_01.pdf

Assessing the environmental impact of education

- Part electronically taught distance/supported open learning course



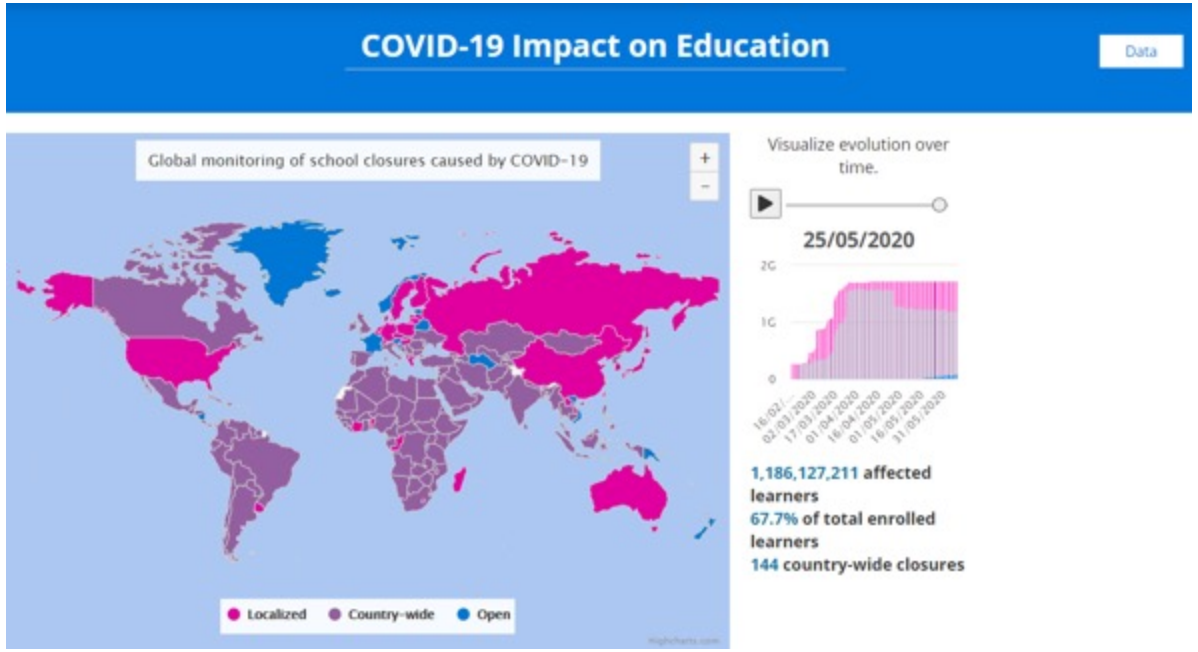


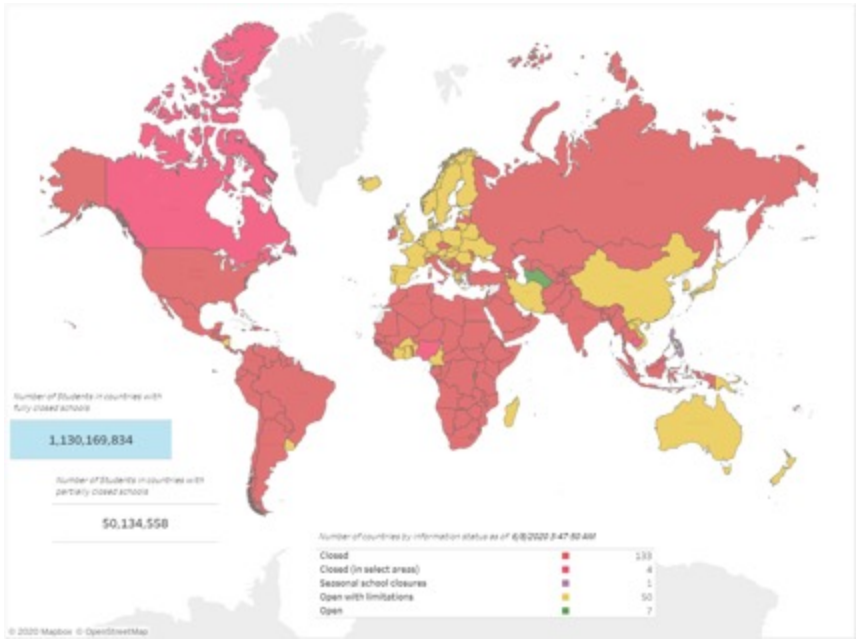
Source: https://www3.open.ac.uk/events/3/2005331_47403_o1.pdf

COVID19 impact on education

- **Transition to digital education – University and School closures**
  - 1,186,127,211 learners affected
  - 67.7% of total enrolled learners
  - 144 country-wide closures

- **How different countries dealt with COVID19 and campus closures**



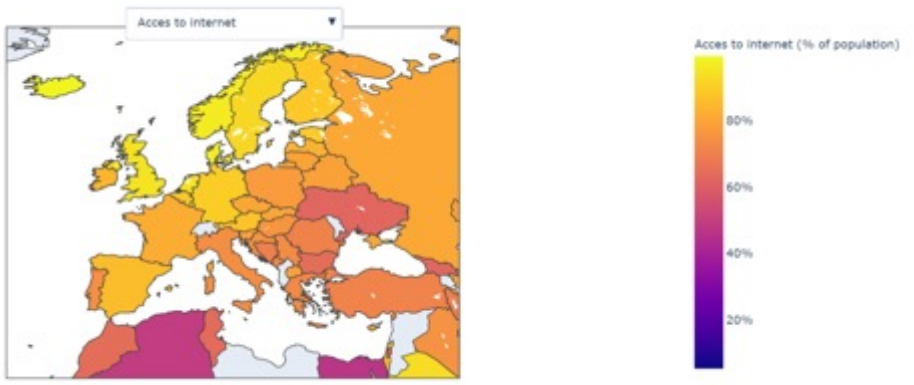


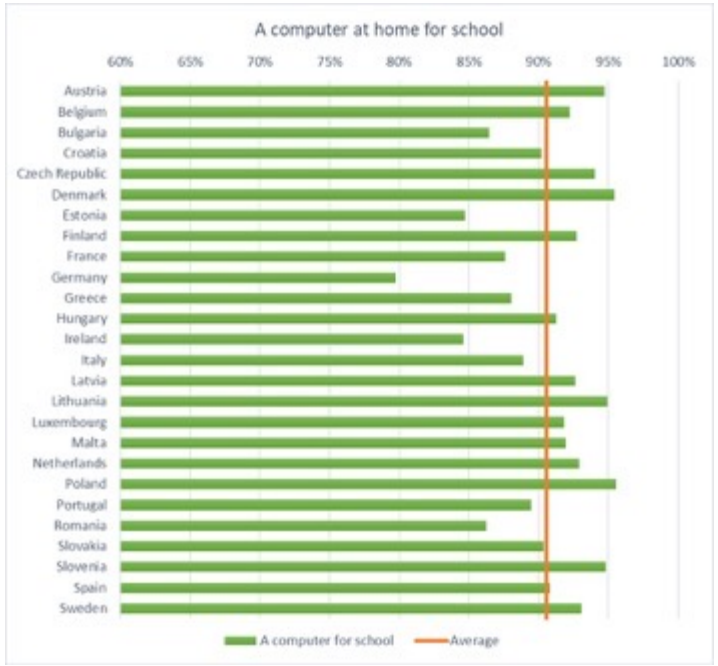
Source: https://data.europa.eu/en/impact-studies/covid-19/education-during-covid-19-moving-towards-e-learning

Ability to engage with e-learning

Percentage of population having…

- …Internet access
- …a quiet place to study
- …a computer at home for school





Source: https://data.europa.eu/en/impact-studies/covid-19/education-during-covid-19-moving-towards-e-learning

Simple steps for University infrastructure

- Replace old computers and equipment with new, energy-efficient equipment
- Check settings like monitor brightness and sleep mode, to keep computing energy-efficient
- Turn off devices when they are not in use
- Don't print if you don't need to

Source: https://www.quickclass.net/2018/05/08/let-elearning-reduce-carbon-footprint/

Using digital technologies to support e-learning

Middlesex University London

BRITISH COUNCIL

Oracle TES LTD

Project arCc

The impact of the ICT sector on climate

- Direct carbon emissions associated with ICT manufacturing, use and disposal (ICT's carbon footprint)
- Indirect positive or negative emission effects from using ICT (e.g. travel substitution and transportation optimization)
- Impacting behaviours and preferences (reshaping how we lead our lives on a societal level)

Source: https://www.ericsson.com/en/reports-and-papers/industrylab/reports/a-quick-guide-to-your-digital-carbon-footprint

Misconceptions about the footprint of ICT

- Digital devices are becoming increasingly widespread, but the carbon footprint of the ICT sector remains fairly stable, at around 1.4% of overall global emission
- The ICT sector's carbon footprint could be reduced by over 80% if all electricity consumed came from renewable energy sources
- The digital footprint of individuals makes up a small percentage of their total carbon footprint and could be reduced further e.g. by switching devices less frequently
- Calculating carbon footprints demands sufficient understanding of the technology itself in order to give accurate results
- Beyond carbon footprint, digital technologies are powerful tools that can be used either for better or for worse, depending on societal framing. Used well, they provide opportunities to accelerate decarbonization in line with societal goals. However, if framed incorrectly, they can also accelerate carbon intensive activities

Source: https://www.ericsson.com/en/reports-and-papers/industrylab/reports/a-quick-guide-to-your-digital-carbon-footprint

The reasons for demonizing ICT carbon emissions

Key reasons for incorrect statements on carbon emissions:

- Comparing "apples to oranges" (whole life cycle impact vs. electricity use alone)
- Using outdated figures and data due to insufficient technology knowledge
- Incorrect combinations of data

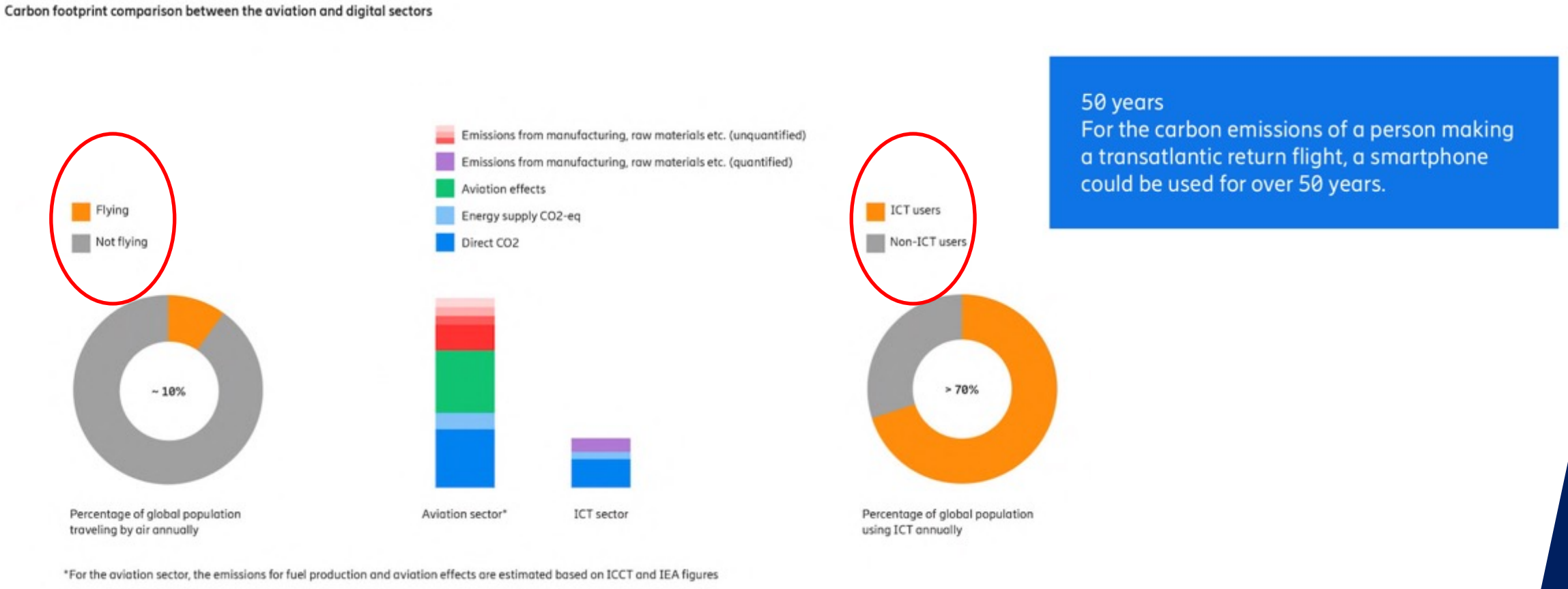
Examples of typical headlines

Smartphones consume as much energy as fridges	Data explosion will result in major electricity consumption	Social media use has a major carbon footprint	How badly is your streaming impacting the environment?

Source: https://www.ericsson.com/en/reports-and-papers/industrylab/reports/a-quick-guide-to-your-digital-carbon-footprint

Comparing the aviation and ICT sectors

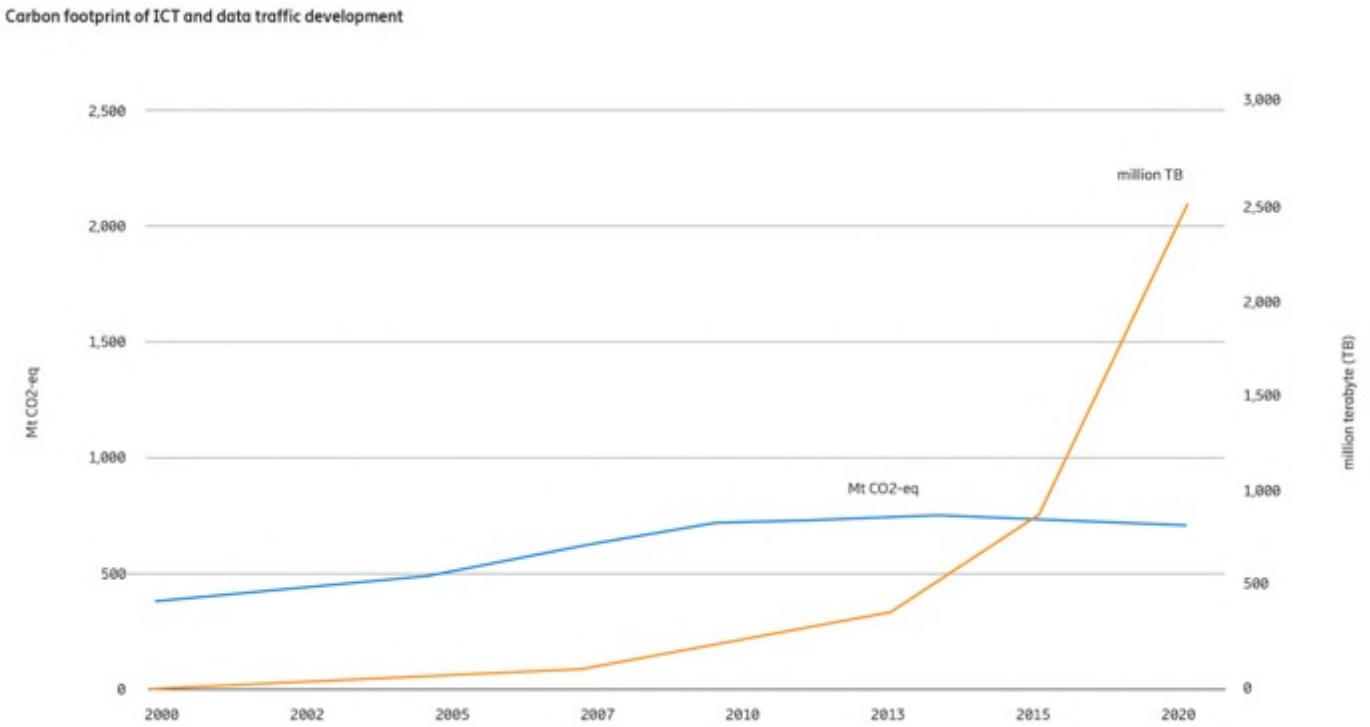
Carbon footprint comparison between the aviation and digital sectors



Source: https://www.ericsson.com/en/reports-and-papers/industrylab/reports/a-quick-guide-to-your-digital-carbon-footprint

More data, same carbon footprint

- Exploring the limited impact of ever-increasing data usage on ICT's carbon footprint
- Increased data traffic does not affect ICT carbon footprint



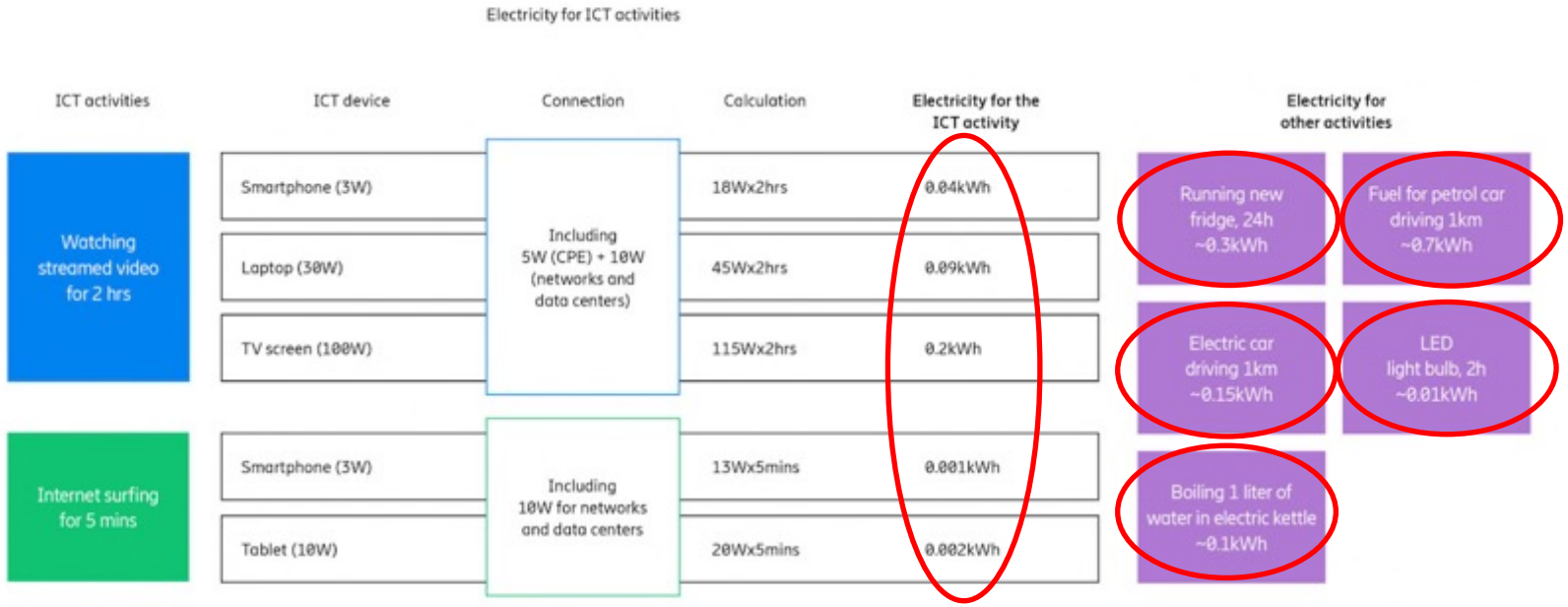
1.4%
ICT equipment accounts for about 1.4 percent of total carbon emissions and uses about 3.6 percent of global electricity consumption, while making up around 6 percent of the global economy.

Source: https://www.ericsson.com/en/reports-and-papers/industrylab/reports/a-quick-guide-to-your-digital-carbon-footprint

Assessing video streaming footprint

- Streamed video and internet surfing compared to electricity consumption of other activities

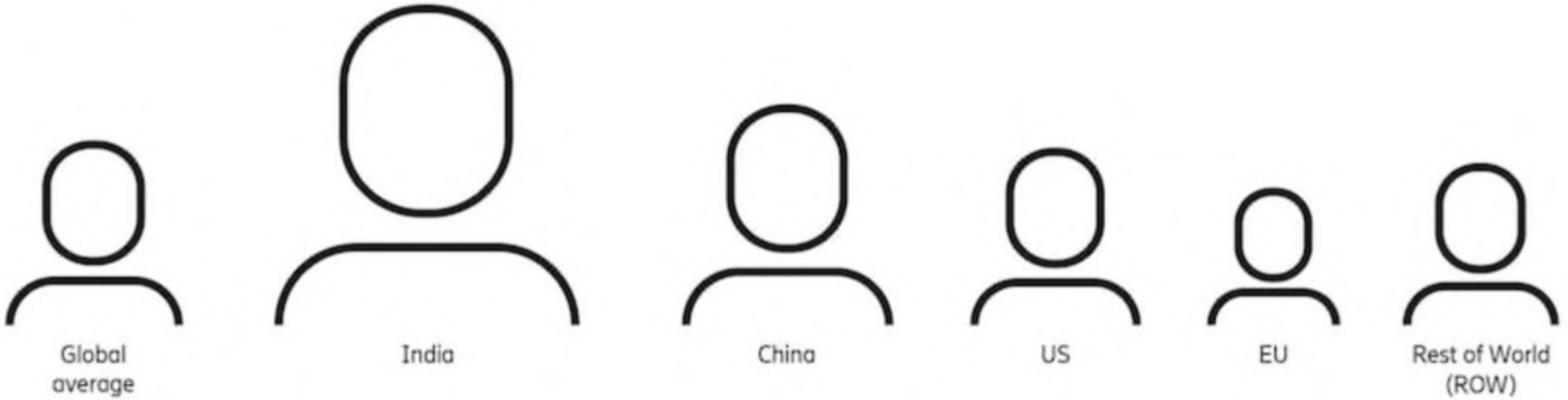
Streamed video and internet surfing compared to electricity consumption of other activities



Source: https://www.ericsson.com/en/reports-and-papers/industrylab/reports/a-quick-guide-to-your-digital-carbon-footprint

Location matters on digital carbon footprint

- Digital carbon footprint of a smartphone user (4hday) living in different regions with different energy supplies

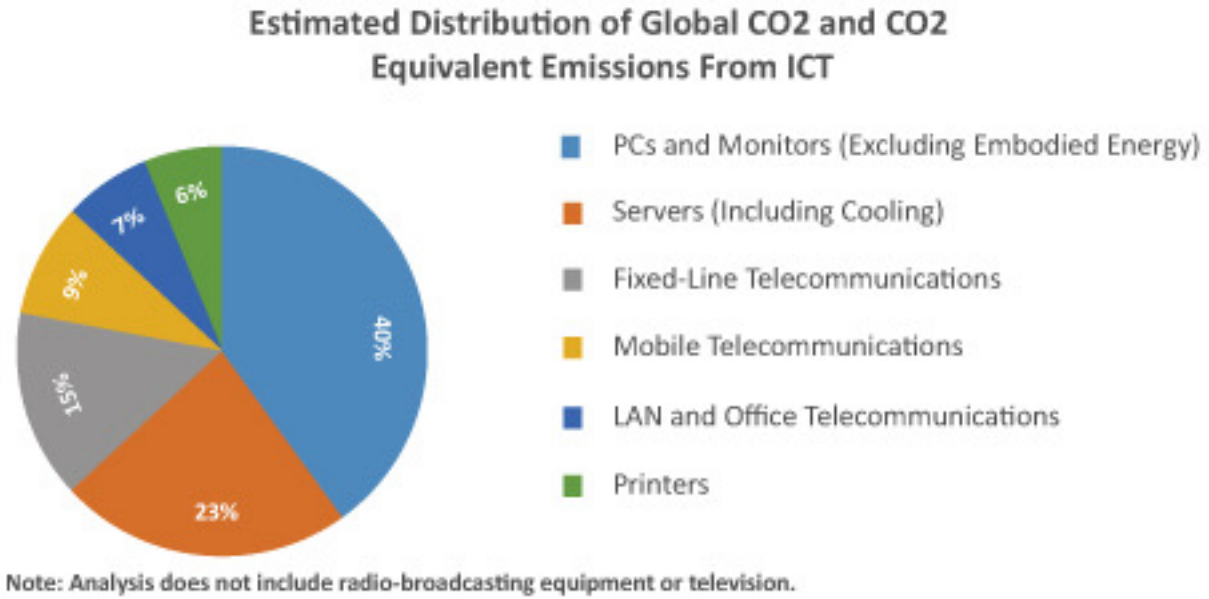


Source: https://www.ericsson.com/en/reports-and-papers/industrylab/reports/a-quick-guide-to-your-digital-carbon-footprint

The share of ICT sector's carbon emissions

- The Information and Communication Technology (ICT) sector accounts for 2% of the overall carbon footprint

- The share of ICT sector's carbon emissions is illustrated below



Source: https://www.ericsson.com/en/reports-and-papers/industrylab/reports/a-quick-guide-to-your-digital-carbon-footprint

Processes where carbon and its equivalent emissions take place

- Manufacturing – **Carbon is emitted during the manufacturing process of any product (e.g. servers, UPS, PC, and printers) and is commonly termed as embedded carbon**

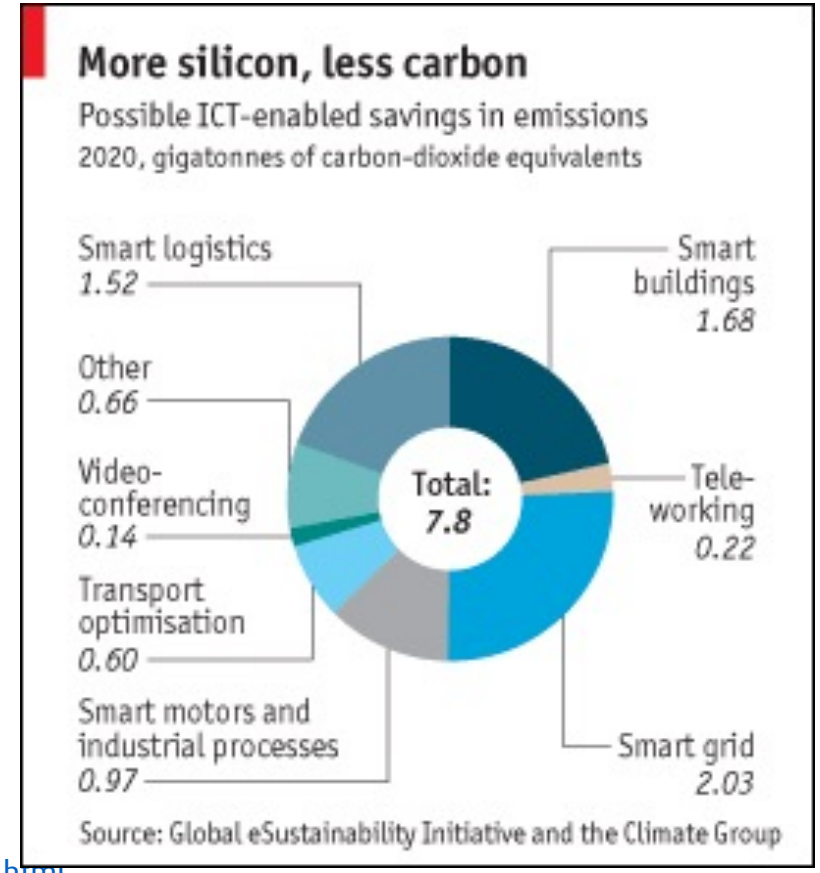
- Operational and Maintenance – **Carbon emission takes place whenever an electronic device is connected to an electricity source. Both operational and maintenance processes require energy**

- Disposal – **The electronic devices are are disposed as e-waste that generates huge amount of carbon emissions, at the end of their lifecycle**

Source: https://www.course5i.com/blogs/increasing-carbon-footprint-of-the-ict-sector-2/

More silicon less carbon

- One upside to increased ICT usage is the potential for it to reduce emissions in other segments of society
- This "enabling effect" has the potential to reduce emissions in other industries by 15% by 2020–equivalent to five times ICT's own carbon footprint
- These enabling effects range from reducing transport emissions by replacing face-to-face meetings with videoconferencing, to using computers to improve logistics



Source: http://bhhutchens.github.io/blog/c4-tech-issues.html

Ways of reducing your digital carbon footprint

- Use your smartphone or other ICT devices longer before upgrading
- Make sure you recycle or reuse ICT equipment
- Consume digital services on smaller devices
- Charge the batteries with electricity from renewable sources
- Avoid buying more ICT devices than you have time for (pass unused devices on)
- Show your suppliers that their footprint matters to you
- Buy your digital devices and services from companies that have SBTs
- Use ICT services that help to reduce carbon emissions

Source: https://www.ericsson.com/en/reports-and-papers/industrylab/reports/a-quick-guide-to-your-digital-carbon-footprint

Conclusions

- Assessing the carbon footprint of education
- Understanding the basics of e-learning
- Determining the role of e-learning in climate change
- Shifting education towards online delivery
- Using digital technologies to support e-learning

Any questions?

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