CHOICE - OnLine training
Green IT

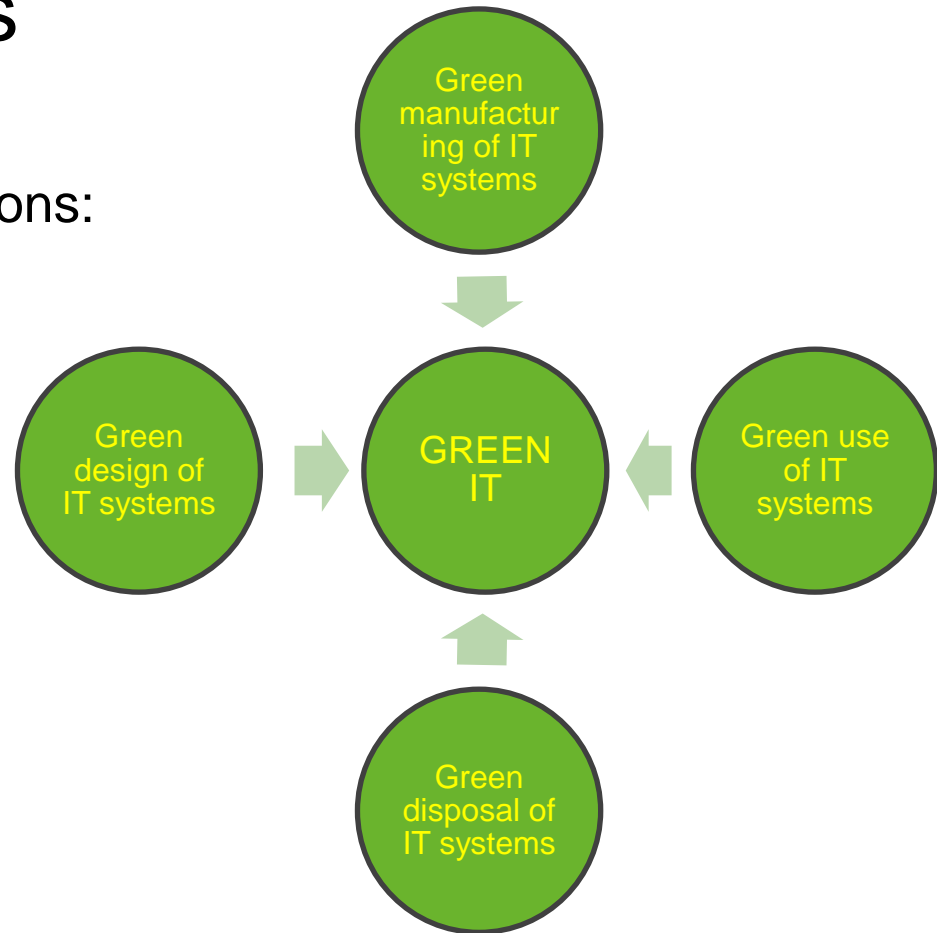Vyron Damasiotis, Panos Fitsilis
CTI

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What is Green IT?

➢ Green Information Technology (Green IT) refers to designing and using computers and IT resources efficiently and effectively with minimal, neutral, or even positive impact on the environment

➢ The concept of green IT emerged in 1992 when the U.S. Environmental Protection Agency launched **Energy Star**, a voluntary labeling program identifies products that offer superior energy efficiency.

Green IT goals

➢ Green IT has the following goals:

- o Improve IT systems **energy efficiency**

- o Use less **hazardous materials** in IT devices

- o Promote **recycling and reuse** of IT devices

- o Improve overall business **sustainability**

- o Use **renewable energy**

Green IT dimensions

➢ Green IT involves 4 dimensions:

Green manufacturing of IT systems → GREEN IT ← Green use of IT systems; Green design of IT systems → GREEN IT; Green disposal of IT systems → GREEN IT

Green IT benefits /1

➢ Green IT has the following benefits:
  - o **Reduce carbon emissions**. According to UN carbon emissions must be reducesd by 7.6% every year to 2030.
  - o **Less waste.** Through reuse and refurbishing can be reduced wastes and can be improved supply chain resiliency.
  - o **Cost savings.** The use energy efficient IT products reduces power consumption which in turns reduce their operating energy cost.

Green IT benefits /2

> **Raise awareness.** Businesses through implementation of Green IT products contribute to the raising of their customer awareness about climate change.

> **Improve corporate culture.** Green IT adoption from a companies indicate to their employees that they work in a company that respect environment and encourage them to adapt more efficient ways of working.

> **Improved reputation.** Companies improve their reputation by demonstrating an ecological profile.

> **Customer satisfaction.** Customers feel satisfied that they consume products that respect and improve sustainability.

Question: Which IT aspects affects the environment?

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How IT affect environment /1

➢ **IT retail devices.** E.g.: PCs, laptops, printers, monitors, TVs, smartphones, tablets etc.

➢ **Data centers.** Are collection of IT devices that support the operation of various business IS, cloud computing etc. Usually have extensive energy requirements not only for their operation but for cooling purposes.

➢ **Networking equipment.** Are all network devices that are used to keep us online.

➢ **Data storage**. Through online storage a huge amount of data (eg: videos, photos, etc.) are transferred through network to cloud storage centers.

How IT affect environment /2

- ➤ **Cryptocurrency.** Cryptocurrency mining is a very resource intensive, requires significant computational power and hence power consumption.
- ➤ **Artificial intelligence**. Is also computationally intensive process.
- ➤ **IT wastes.** Pollution coming form retired or broken IT devices is among the biggest environmental problems.

What we can do…

➢ As far as concerning the dimensions of design and manufacturing of IT devices:
- o There are no direct actions someone can do.
- o However, anyone can indirectly contribute to this direction by developing attitudes that will force companies to create more eco-friendly products and services.

➢ However, for the dimensions of Green IT use and Green IT device disposal, there are actions that all people can do or learn to do even from their early ages.

Part A: IT devices recycling…

IT devices management (e-waste)

➢ Electronic waste or e-waste, is a term used to describe electronic products that have become **unwanted**, **non-working** or **obsolete**, or **have reached the end of their useful life**.

➢ Some examples of e-waste include computers and computer components (keyboard, mouse), printers, monitors, smartphones, microwaves, televisions, radios, electronic toys etc.

➢ Aspects of e-waste management are:
  o Re-use
  o Refurbishment
  o Recycling

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Why e-waste is harmful

➢ How e-waste is harming our world (environment, human health, food chain etc…)
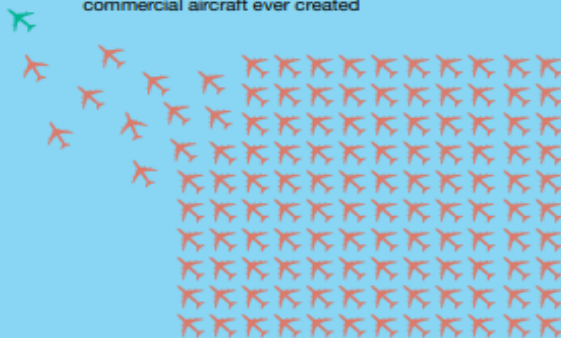
   ○ https://youtu.be/-uyIzKIw0xY?list=RDLVvufLW4xOsS4

➢ How big problem is e-wastes?

➢ Which is the number of e-wastes produced annually?

HOW MUCH E-WASTE DO WE GENERATE EVERY YEAR?

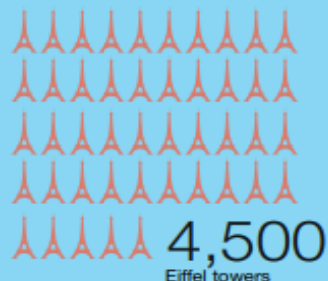We produce 50 million tonnes of e-waste a year that is the equivalent of....

125,000
jumbo jets which is more than all the commercial aircraft ever created

It would take Heathrow Airport in London up to six months, day in and day out, to clear that many aircraft from its runways.

6 months
to clear the runways at Heathrow

This is an equivalent of almost 4,500 Eiffel towers.

Jam them all in one space, side by side, and they would cover an area the size of Manhattan.

the size of
Manhattan

4,500
Eiffel towers

E-wastes management…

- ➢ E-waste management is a difficult process as usually IT devices are not made for recycling.
- ➢ E-waste contain:
  - o Plastic
  - o Toxic materials
  - o Precious materials
- ➢ Ways of e-waste management are:
  - o Reuse
  - o Refurbishment
  - o Recycling

How E-waste recycling is made

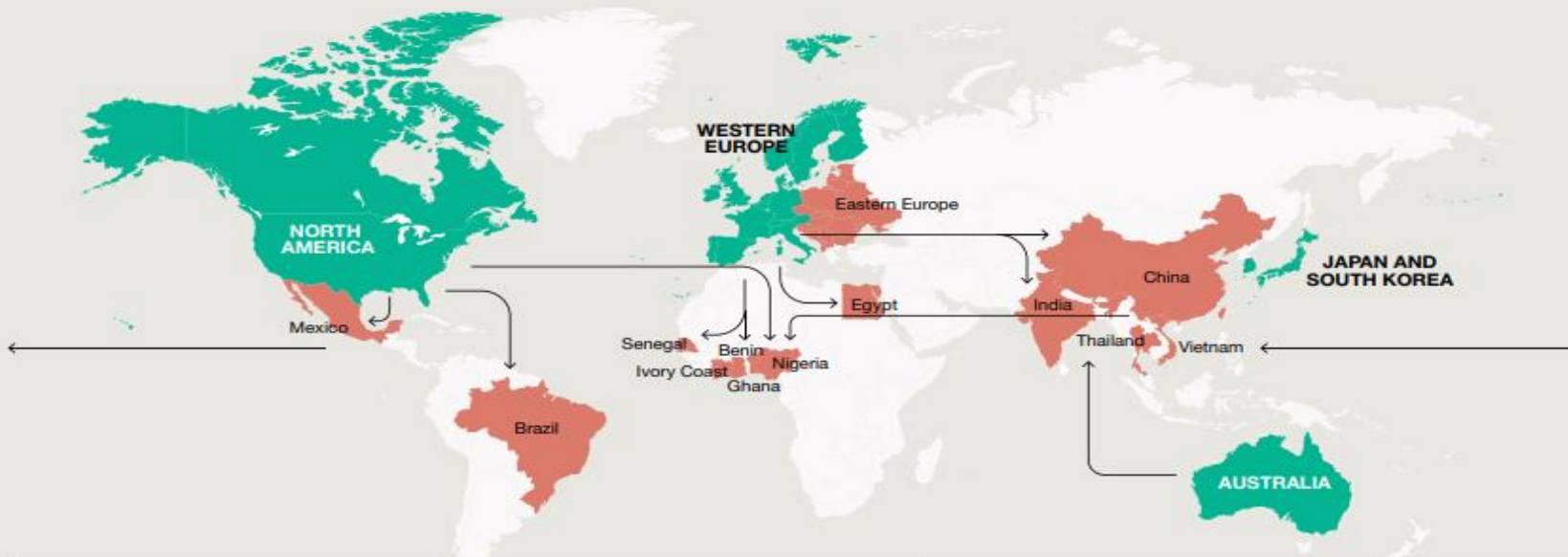How 6 Million Pounds Of Electronic Waste Gets Recycled A Month
- o https://youtu.be/S2lmPIa1iWE

(Big Business)

How much of e-wastes recycled?

GLOBAL E-WASTE GENERATION
53.6 Mt

UNDOCUMENTED E-WASTE WORLDWIDE
44.3 Mt

SHARE OF E-WASTE DOCUMENTED TO BE COLLECTED AND PROPERLY RECYCLED
17.4%

Year 2019

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MAPPING OUT E-WASTE

- ◆ Regions sending e-waste
- ◆ Regions receivng e-waste
- ↲ Common routes for illegal shipments

WESTERN EUROPE

Eastern Europe

NORTH AMERICA

Mexico

Senegal
Ivory Coast
Benin
Ghana
Nigeria

Egypt

India

China

JAPAN AND SOUTH KOREA

Thailand
Vietnam

Brazil

AUSTRALIA

Some of the highest and lowest e-waste generating nations E-Waste generated (kg per capita), 2016

28.5	24.9	24.8	23.9	23.6	0.4	0.5	0.6	0.6	0.8
Norway	United Kingdom	Denmark	Netherlands	Australia	Niger	Ethiopia	Afganistan	Uganda	Nepal

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How are e-wastes treated there?

➢ Eco India: How a start-up in New Delhi has been processing 70% of India's formal e-waste

   ○ https://youtu.be/4JYtUKujZfY

➢ How precious materials is recovered in an unformal way.

   ○ https://youtu.be/o2vktoTFrIs?list=RDCMUCCTvK2MvFRfinoIoA7YSXtA

What lessons learned? What can we do?

Lessons learned – what we can do ….

➢ Change our lifestyle and try to buy new devices less frequently or only when we really need to do this

➢ Try to fix, if possible, e-devices instead of replacing them

➢ Always proper recycling old devices using trustworthy companies

➢ Always been aware of recycling processes

➢ Press companies to produce greener and easier to recycle products

➢ Press governments to create appropriate legislation and audit companies for their practices.

➢ Press international organizations and governments to help poor countries to create mechanisms for proper formal e-waste recycling, inform their citizens for the dangers of e-wastes, etc.

Part : Green IT use

Green IT use…..

Green IT use refers to:

➢ Reducing power consumption of our IT devices

➢ Applying new habits in the way we use IT devices

➢ Reducing large data centers power consumption

Standby, off-mode power….

➢ **Standby** power consumption also called **phantom** or **vampire** power, refers to the energy that is consumed by various electric devices when they seemed to be turned off.

  o These devices are only switched off through their electronic interface and not really switched off from the plug. So, they consume energy for displaying lights or have their sensors in operation.

➢ Beyond standby power consumption there is the **off-mode power** consumption which refers to power consumed by electronic devices when they are switched off, but they are connected to power outlet.

Phantom or vampire devices…

- ➢ Such devices are:
  - ○ Multimedia devices
  - ○ Gaming consoles
  - ○ Smart kitchen appliances and other smart devices
  - ○ Chargers
  - ○ TVs.
- ➢ Some investigators argue that such devices consume the 75% of the electricity their consume in their entire "life" when they on standby mode or off-mode.
  - ○ In fact, all that phantom power can add up to 10% of a home's energy costs.

Bad habits that enhance phantom power consumption

➢ To use "standby" (also called sleep, or rest mode) when you are finished with your computer of game console instead of "shut down".

➢ The same is also applied to TV's or other multimedia devices.
  ○ It must be noted that many modern such devices do not have anymore a switch off button

➢ The last years to these devices were added network devices (such modems, routers, switches, wi-fi repeaters etc.) that exist in every house and business building, that are always on.

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What authorities and industry did or do?

➢ Old device had a significant power consumption.

➢ Since 2009 such devices are required to switch into a low power mode (such as standby) after a reasonable amount of time

➢ In 2010, the European Commission (EC) under the recommendation of the International Energy Agency (IEA), banned devices with standby consumption of more than 1 watt.

What authorities and industry did/do? (continue)

➢ Since 2013, this limit was further reduced, so such devices must not consume more than 0.5 Watts in standby or in off mode.

- o These rules have reduced annual electricity consumption by around 35.5 TWh per year – the equivalent to the annual energy consumption of Romania.

- o This has saved consumers €25 billion per year and 39 Mt of CO_2 emissions.

➢ Since January 2017 networked standby devices must not consume more than 3 to 12 Watts depending on the product.

- o This compares to 20 to 80 Watts consumed previously. This decrease is expected to save an additional saving of 36-38 TWh per year.

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Examples /1

POWER DRAINS

LG washing machine
7W ■ On but not running
4W ■ Off

Apple TV, first generation
21W ■ On
17W ■ Off

Samsung cable box
28W ■ On and recording
26W ■ Off and not recording

Apple MacBook, plugged in
48W ■ Open, charging
48W ■ Closed, charging
27W ■ Open, fully charged

By The New York Times

Examples   /2

ALWAYS ON

Netgear router
4W ■ On

Technicolor cable modem
15W ■ On

Bang and Olufsen speakers
15W ■ On
0.3W ■ On standby

Vizio HDTV
21W ■ On
1W ■ On standby

But how much energy is this?

➢ Someone may state that power consumption of this size seems to be negligible.

➢ Alan Meier from Department of Energy of Berkeley Lab estimates that an average American household has roughly 50 devices that draw power even they seemed to be off.

➢ If we multiply all these small consumptions by the time they are plugged in, and by each and every one of the thousands of millions of devices in homes or in commercial buildings in the whole world, the result becomes an important share of all the electricity used

➢ Estimates define the cost of this consumption in more than $19 billion in electricity bills every year.

Is that only?

➢ Is this phantom power the only hidden power that we consume in our everyday use?

➢ **Unfortunately, it is not.** During the last two decades we have developed habits such as music and video streaming, use of smartphone apps etc. that consume a lot of energy that we usually do not consider.

➢ Cloud computing and IOT offer us new services and ways to work and enjoy ourselves which however have a significant power consumption.

Have you ever considered….

➢ Have you ever considered what and where is cloud?

➢ Where my photos are being stored?

➢ Where Facebook, Instagram, google etc. services are running?

➢ How much energy consumes a social media post?

➢ How much energy consumes a single search in google?

➢ How much energy consumes sending an email?

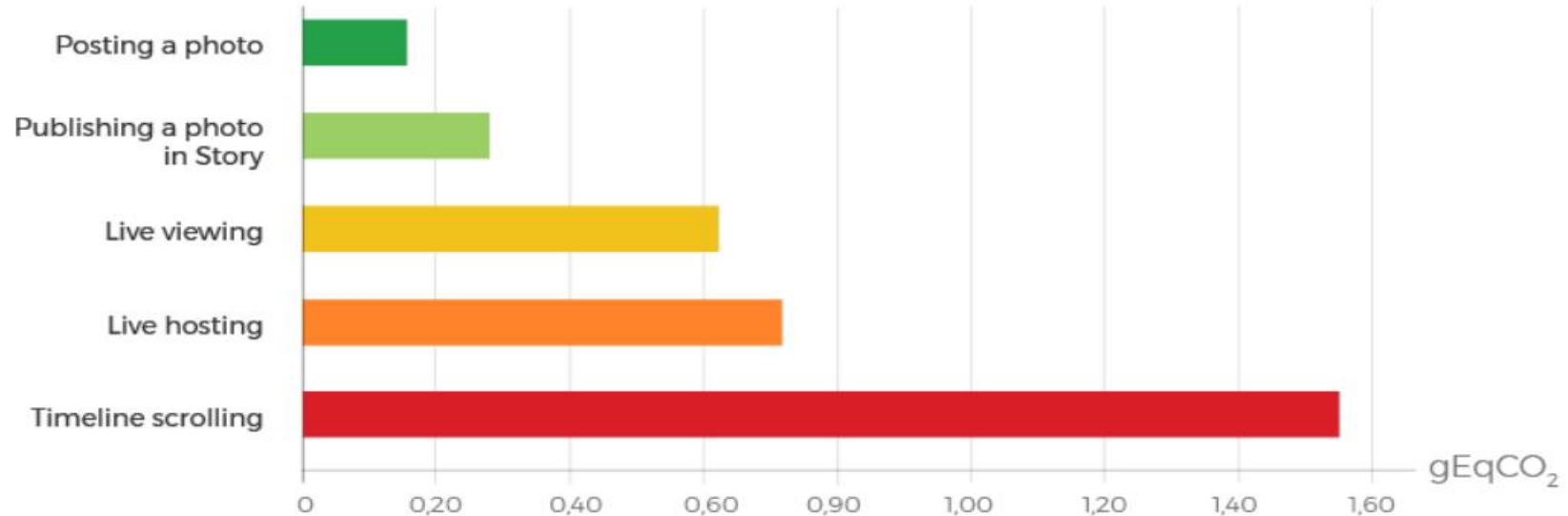➢ How much energy consumes a video streaming from a smartphone?

An example….

Carbon impact of Instagram features
Greenspector - July 2020
The lower this value, the better the functionality!

60 seconds

Feature	
Posting a photo	
Publishing a photo in Story	
Live viewing	
Live hosting	
Timeline scrolling	

0   0,20   0,40   0,60   0,90   1,00   1,20   1,40   1,60   gEqCO$_2$

Measurements on a Samsung S7 smartphone (Android 8)

GREENSPECTOR

An example….

➢ According to a 2020 report on social media apps environmental impact, scrolling through Instagram news feed was the most impactful function on Instagram, generating approximately 1.55 grams of CO_2 equivalent per minute (gCO_2e).

➢ Viewing and hosting a live on Instagram followed, with CO_2 emissions of approximately 0.72 and 0.62 grams per minute, respectively.

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An example…

➢ Consider that 65.5% of the world's population – or 4.66 billion people – have access to the internet.

➢ According to Google in 2009, one Google search emits 0.2g of carbon dioxide and it takes another 1.76g of CO2 on average to load a website – although this can go up to 10 grams depending on the website's complexity (for instance, if it has videos)

➢ The carbon footprint of an email ranges from:

  o   0.3g of CO2 for each spam message,

  o   to 4g for a regular email,

  o   to 50g for an attachment or photo.

An example…

➢ The environmental damage caused by using Instagram isn't much better:

- o while posting a photo emits 0.15g of CO2,

- o scrolling on your newsfeed for 1 minute emits 1.5g of CO2.

- o This might not seem like much, but the average user spends 28 minutes scrolling daily – that amounts to 42g of CO2 on one social media platform every day.

- o This ends up to 15kg of CO2 per year/person

Digital Pollution

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And here it comes **Digital pollution**….

➢ Digital pollution is the pollution produced by the use of internet.

➢ Internet consists of:

 o Users' devices

 o Data Centers

 o Network

➢ All these require energy to operate.

➢ But how much is that energy?

The hidden pollution of Internet….

➢ Did you know that carbon emissions from internet represents the 3,7% of global emissions while the aviation industry is responsible for 3% of these emissions?

➢ That is going to be doubled by 2025.

  o https://youtu.be/GX8sOrz_-Fg

  o https://youtu.be/eOPetDY-nss (must see - excellent 46min video)

"Digital Gold" and Digital pollution

➢ Cryptocurrencies are the digital gold of our era.

➢ Bitcoin, probably the most known cryptocurrency nowadays, requires a huge amount of energy to be extracted.

➢ Bitcoin mining for example requires 129TWatts of energy while Google consumes 12,4TWatt of energy.

➢ The following video explains the process.

    o https://youtu.be/RzGQkYQ-rp8

What can we do?

The answer is not easy, but we can try to:

➢ Buy IT devices that consume less energy

➢ Restrict the use of sleep or standby mode of our IT devices.

➢ Develop less power consuming behaviors while using IT devices

➢ Think beyond the screen of our smartphone or laptop in terms of resources we consume.

Exercise

How much CO2 produced our video call meeting?

https://www.nolesserpanda.com/pages/video-conference-carbon-calculator.php

Exercise

How much CO2 you produce at home due to Internet usage?

https://ecotree.green/en/calculate-digital-co2

Which is your pc CO2 emissions?

http://calculator.green-algorithms.org/

Thank you for your attention