

Latest technology development in consumer electronics and their impacts on household energy use and their policy implementation for developing countries

Xianli Zhu
Copenhagen Centre on Energy Efficiency

7 Nov 2019

Outline

- About the Copenhagen Centre on Energy Efficiency
- Latest technology development in consumer electronics
- Their impacts on electricity consumption
- Policy implications

Copenhagen Centre on Energy Efficiency

The Energy Efficiency Hub for the UN initiative 'Sustainable Energy for ALL'

Collaboration between UNEP, Danish government, and Denmark Technical University; it is a further expansion of the over 20 years of the tri-party collaboration



Launched in September 2013

Copenhagen Centre on Energy Efficiency

One Goal - Three Objectives

Achieving Sustainable Energy for All by 2030

ENSURING
universal access
TO MODERN ENERGY
SERVICES.

DOUBLING THE GLOBAL
RATE OF IMPROVEMENT IN
**energy
efficiency.**

DOUBLING THE SHARE OF
renewable energy
IN THE GLOBAL
ENERGY MIX.

✓ Research and advisory
institution

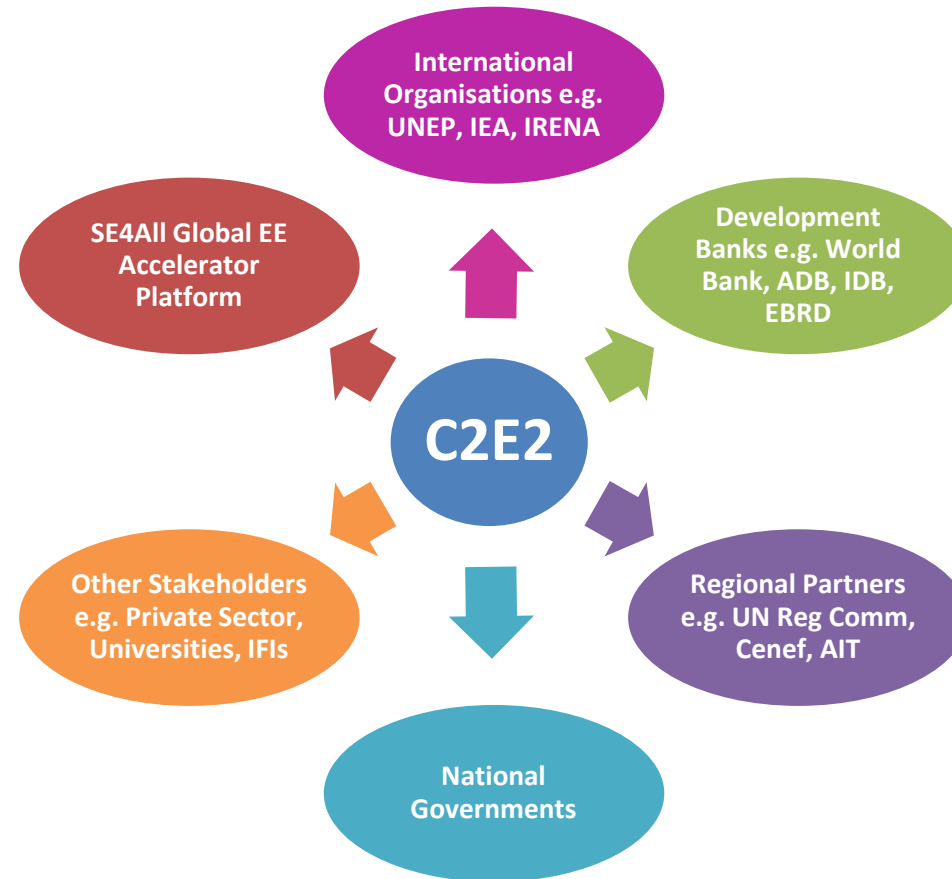
✓ **Energy Efficiency Hub** for
Sustainable Energy for All
(SE4All's)

Key Focus Areas

Capacity building in
target countries

Private sector
engagement
(including PPP)

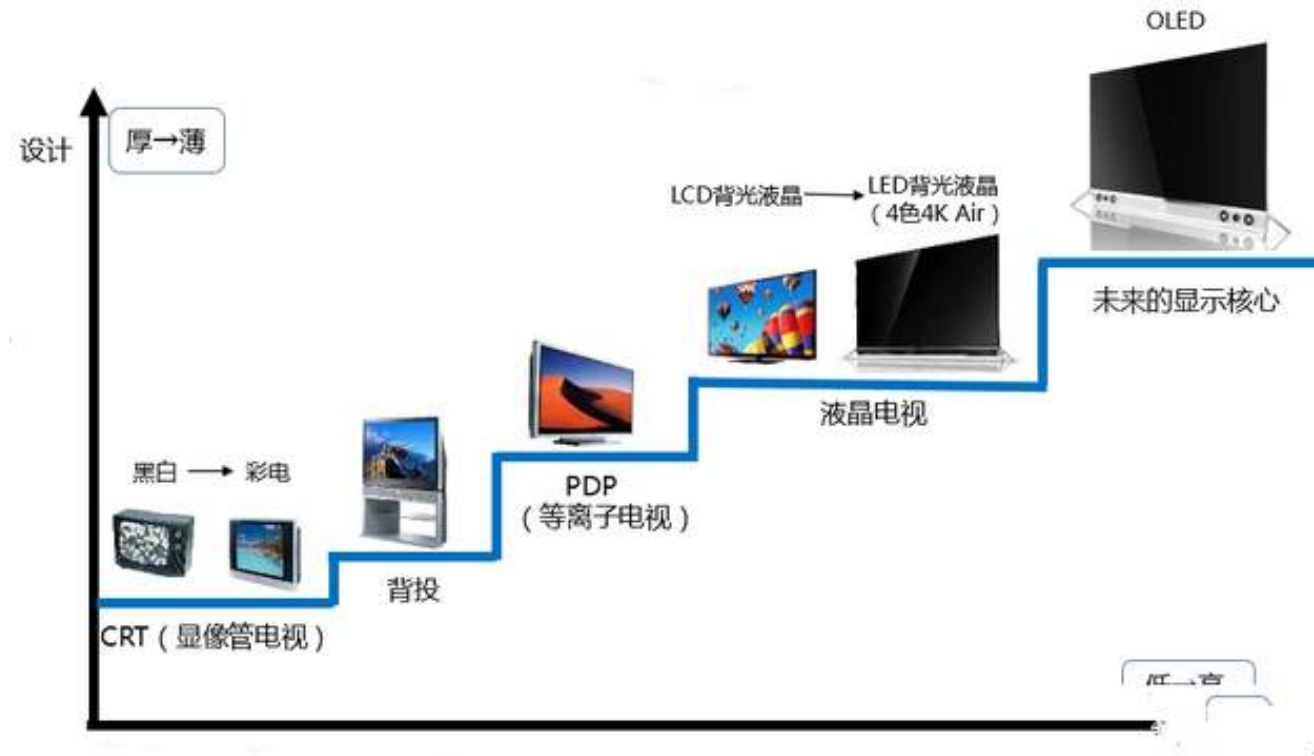
Championing EE and
SE4All objective -
knowledge dissemination



Latest technology developments in consumer electronics

- Touch screen/LED/OLED screens
- Digitalisation of video and audio files
- Increasing of storage and memory, and data processing capacity
- Built-in cameras in smart phones and better video and picture quality
- Wireless, reliable, and quick internet access
- Simplicity of multiple functions (a smart phone replaces the functions of over 20 things, like stop watch, alarm, camera, album, Walkman, notepad, calendar, torch, video and audio recorder and player, map/GPS, wallet/bankcard etc.)
- Constant price declines in ICT devices and equipment, data subscriptions

Developments in TV technologies



- Larger screens and better video and audio qualities;
- Simpler to control
- Wireless connections among smart phones, tablets, and TVs
- Internet access, programme recording, customised channel/film subscription

Quick developments in smart phone technologies

- The iPhone 1 was released in 2007. Since then, Apple has been releasing a new iPhone model every year.
- iPhone 1 has a storage capacity of 4 GB, a camera of 2.0 megapixels (MP), and a memory of 128 MB.
- The iPhone XS released in 2018 is equipped with 64 GB storage, 12 MB + 12 MP dual camera, up to 512 GB internal memory and storage capacity.
- By the end of 2018, 1.5 billion iPhones had been sold
- Quick ICT development has made Apple, Amazon, Facebook, Google, Netflix (FANG), Microsoft, the most valuable companies in the world



The network/telecommunication technologies

- From 1G to 5G, faster data transmission, increases in functions and reliability

A comparison of the main differences of different generation of communication technologies

	1G	2G	3G	4G	5G
Approximate deployment date	1980s	1990s	2000s	2010s	2020s
Theoretical download speed	2kbit/s	384kbit/s	56Mbit/s	1Gbit/s	10Gbit/s
Latency	N/A	629ms	212ms	60-98ms	<1ms

Source: ITU, 2018

Global ICT Penetration, 2018

	Mobile phone subscriptions	Individuals using the Internet	Fix-telephone subscriptions	Active mobile-broadband subscriptions	Fixed-broadband subscriptions
Per 100 inhabitants	107	51.2	12.4	69.3	12.4

Source: ITU World Telecommunications/ICT Indicators database

Changing trends of Consumer Electronics Ownership among Households in the UK

Type of device	2008	2018	Type of device	2008	2018
Digital TV	84%	95%	DAB radio	27%	64%
Smartphone	17%	78%	Smart TV (2012)	5%	42%
DVD player	83%	64%	Desktop PC	69%	28%
Laptop (2009)	44%	63%	MP3 player	44%	27%
Tablet (2011)	2%	58%	Smart speaker	no data	13%
Digital video recorder (DVR)	20%	56%	VR headset	no data	5%
Game console	46%	44%			

Evolution of global internet traffic

Year	Global Internet Traffic
1992	100 GB per day
1997	100 GB per hour
2002	100 GB per second
2007	2,000 GB per second
2017	46,600 GB per second
2022	150,700 GB per second

Source: Cisco, 2019

How people spend their time online?

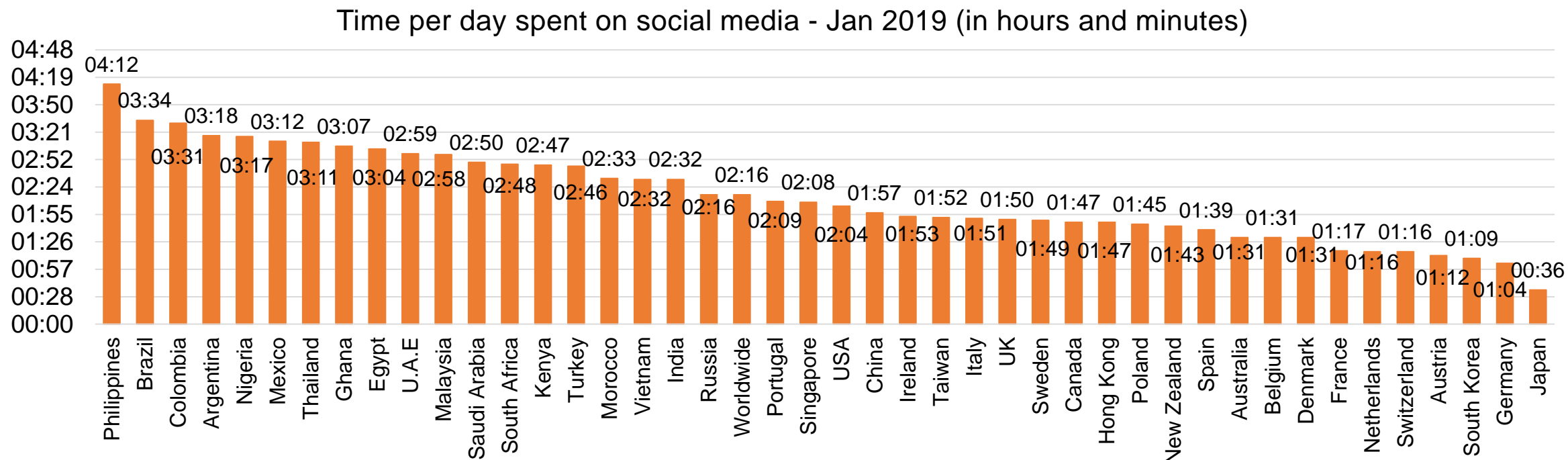
- Consumer electronics are changing people's lifestyle.
- People spend hours every day on their phones to check and update their social media account, reading news, searching for information, playing games, and watching videos.
- Among the global Internet traffic, **around 80% is made via consumer electronics, meaning that the majority of the global energy use by ICT sector** can also be attributed to the use of consumer electronics.
- In 2018, 52.2% of all website traffic worldwide was generated through mobile phones.
- Watching movies/videos online is the most popular mobile internet activity.
- The 2nd most popular internet activity among mobile users was checking emails while using social media came third (Statistita, 2019b).
- A global online survey indicated, in 2018, daily social media usage of global internet users amounted to 136 minutes per day, up from 135 daily minutes in the previous year. As the global penetration rate of social media is 37% and the most popular social media platforms include Facebook, WeChat, Twitter, Instagram, Tumblr and Sina Weibo.

The exponential Growth of Internet Data Traffic

Year	1987	1997	2007	2017
Traffic to & from data centres	2TB	60 PB	50 EB	1.1 ZB
Note:	TB, terabyte, 10^{12} bytes	PB, petabyte, 10^{15} bytes	EB, Exabyte, 10^{18} byte	ZB, zettabyte, 10^{21} bytes

Source: IEA, 2017

Time per day spent on social media - Jan 2019



Source: Global WebIndex, 2019

Global trend of smart phone and internet use

- Children get their 1st smart phone earlier
- The average daily online time has been increasing
- The duration is especially high among children and young people
- Sometimes, too much time and attention on phones cause distraction, stress, indulgence in the virtual world, negligence of study and work, worse family relations, and even accidents
- In some cases, it becomes an obsession or addiction



Inactive websites and forgotten/no use data accumulate and use energy

- According to the Internet Live Stats (2019), in 2019, there are around 1.7 billion websites on the web, of which only 200 million are active. In other words, 88% of the websites are not active.
- The internet users leave behind huge volume of junk information (downloaded documents, apps, photos, streamed videos etc., messages on their, forgotten user accounts on their ICT equipment, servers, and the cloud), which they may never remember or have time to use, but remain in the internet space and consumes energy
- Fake information, misinformation, and online frauds/malware

Electricity consumption from online activities

- In 2017, ICT consumed around 2000 terawatt-hours (TWh) of power or roughly 10% of the global electricity demand.
- Data centres worldwide consumed around 194 TWh of electricity in 2014, or about 1% of total demand.
- Data networks, which form the backbone of the digital world, consumed around 185 TWh globally in 2015, or another 1% of total demand, with mobile networks accounting for around two-thirds of the total
- By 2030, the ICT share in global electricity consumption can be between 8% and 21%, depending on the ICT development path (IEA, 2017).

Energy Footprint of Common Internet Activities

There have been some energy efficiency improvement in the ICT devices, networks, and datacenters, but the energy use is still increasing due to fast device and usage increases

Activity	Data Transacted	Electricity Use per Visit (kWh)				Source
		End-User	Transportation	Data Center/POP	Total	
Visit Amazon.com - Main Page	567 KB	0.001	0.000	0.001	0.003	Firefox - Page Info
Streaming 5MB MP3 song	5,120 KB	0.01	0.004	0.013	0.026	Estimation
Watching 5 Minute YouTube Video	13,313 KB	0.026	0.009	0.033	0.068	YouTube - Calculated from reported kbps
Streaming 3GB Movie	3 GB	5.869	2.098	7.415	15.381	Estimation
Playing The Orange Box (Online Video Game)	16 GB	30.322	10.838	38.311	79.471	Steam Online Gaming Platform

Source: Costenaro and Duer, 2012

The environmental problems of e-waste

- Globally, the total e-waste has reached 46 million tonnes in 2017.
- A large share of the e-waste from developed countries are shipped to developing countries for processing and recycling.
- 60-90% of the e-waste is illegally traded or dumped
- While e-waste contains many recyclable and valuable components, they also contain some hazardous components and parts that are of low value
- The leaking of heavy metals, incineration and landfill of e-waste can cause serious environmental and health problems to the workers and the local communities.



Future trends

Projected global IP traffic by devices, 2017 - 2022

	2017	2022
Smartphones	18%	44%
TVs	32%	24%
PCs	41%	19%
M2M	3%	6%
Tablets	5%	6%
Non-smartphones	0.1%	0.1%
Other	0.01%	0.02%

Internet use

	2017	2022
Internet users	3.4 billion	4.6 billion
Devices and connections	18 billion	28.5 billion
Broadband speed	39.0 Mbps	75.4 Mbps
Video viewing traffic	75% of traffic	82% of traffic

Source: CISCO, 2018

Policies and measures for restricting the energy and environmental impacts of consumer electronics use

- Standards and labelling for the consumer electronics;
- Top-runner scheme
- Consumer information and education
- Limit the daily duration of screen time, especially among children (E.g. Chinese recent practice of restricting the daily time children playing mobile phone games)
- Government procurement/buyers' club
- Release and regularly update catalogues of energy efficient consumer electronics products
- Energy efficiency assessment and standards for data centres and networks
- Environmental and energy efficiency standards on the import of 2nd-hand consumer electronics and e-waste disposal and treatment

Thanks for your attention

Xianli Zhu, PhD

www.energyefficiencycentre.org

