TD - Smartphone

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Environmental footprint of a smartphone

Let us consider the following variables for a smartphone :

- C_{prod} : production cost (kg of CO_2) ;
- C_{usage}^{annual} : cost of use per year (kg of CO_2) ;
- N_{years} : number of years of use ;
- N_{kWh}^{annual} : Number of kWatt-hours consumed during the year
- I_{carbon} : carbon intensity in g CO_2 per KWh

1. Calculate the total carbon cost, over the entire lifespan of the smartphone.
2. Calculate the annual carbon cost.
3. How does the production cost change relative to the total cost when the number of years is increased ?
4. What is carbon intensity I_{carbon} ?
5. Modify the annual cost equation to introduce I_{carbon}
6. Using https://ourworldindata.org/grapher/carbon-intensity-electricity and navigating between the different presentation modes (map, table, graph) :
   (a) What are the worst and best I_{carbon} if we consider all the countries in the world ?
   (b) What is the ratio of these countries to the world average ?
   (c) What are the worst and best I_{carbon} if we consider European countries ?
   (d) What is the ratio of these countries to the world average ?
   (e) From which primary source do they produce their electricity ? Help yourself with https://app.electricitymaps.com/map
   (f) How would you calculate the global average ?
7. The title of this section is **Environmental Footprint of a Smartphone**.
   (a) What environmental dimension have we considered so far ?
   (b) Cite other dimensions relevant to digital technology

Environmental footprint of a particular smartphone

Note : we picked a particular manufacturer, but the idea is not put the blame on it. Rather, we want to analyze public data as you must know how to interpret as (future)professionals in the field.

Our basic document is the environmental report of one of the latest iPhones at the time of writing this TD, namely the iPhone 15 https://www.apple.com/environment/pdf/products/iphone/iPhone_15_and_iPhone_15_Plus_PER_Sept2023.pdf.

8. What is the total carbon cost of the iPhone 15 ?
9. From figure 2, what is Apple's average market share in 2023 ? What assumption do you make in the calculation ?
10. From figure 1, what is the total carbon cost in 2023 in tons of CO_2 of Apple's smartphone sales, assuming only iPhone 15 purchases ?
11. How does the previous figure change if we assume Apple sales consist of its smallest iPhone ?
12. What assumption is made about the lifespan of the equipment ? Hint : search in the Definition section
13. Calculate the annual carbon cost.
14. What is the relative share of the production, transport, use, end-of-life parts (page 11) ?
15. In the production part (page 3), what is approximately the share due to materials and that due to electricity (in the production phase) ?
16. Assuming that :
    — carbon intensity is the global average
    — The battery has a capacity of 3,349 mAh [1]
    — Lithium-ion batteries have an internal voltage of 3.6 volts.

    How many annual recharges does the share of use correspond to ?

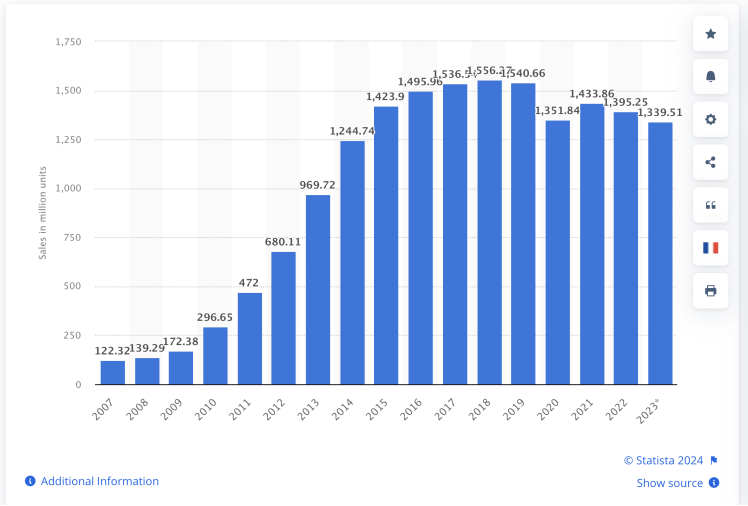

FIGURE 1 – Annual sales - smartphones

1. See https://www.01net.com/actualites/iphone-15-et-15-pro-quelle-autonomie-attente-par-rapport-aux-iphone-14.html

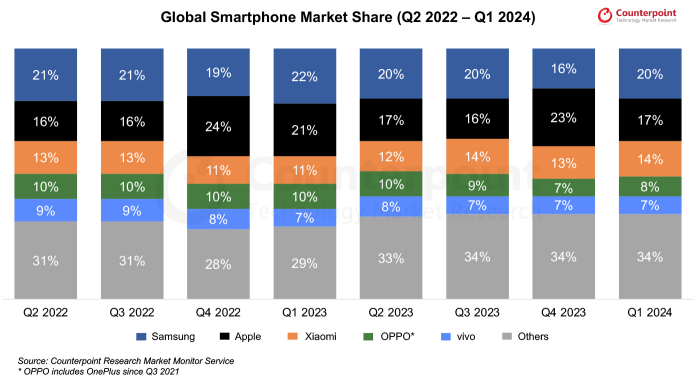

FIGURE 2 – Market shares - smartphones