

User Manual

Impact Calculator for ICT equipment

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1. Introduction

This impact calculator for IT equipment is intended to be used as a management tool to help public entities obtain an overview of, assess, implement, and evaluate measures to reduce the climate impact of an organisation's use of ICT equipment.

This guide describes how to use the calculator, as well as information about the data sources utilized.

The calculator includes measures that can be implemented to reduce an organization's climate footprint from the purchase of ICT equipment. There are several kinds of environmental impacts associated with the purchase of ICT equipment, and there are many measures that can reduce this environmental impact. More information on these measures, as well as how to set requirements to ensure sustainable procurement can be found on anskaffelser.no.

2. Impact calculator for ICT equipment

2.1. Categories and subcategories

The calculator includes multiple categories of ICT equipment. Categories have been selected based on the degree to which the category is relevant for public procurement, the estimated (relative) impact of each type of purchase in terms of cost and emissions, and available emissions data. We have also prioritized categories where climate footprint reductions are possible through concrete measures.

The climate footprint of ICT equipment is often correlated with weight and screen size (for devices with a screen). This means that in most cases the climate footprint is higher for heavier devices, and those with larger screens. There is a weaker correlation for smaller products, which contain a smaller proportion of internal components. For each category of equipment, a set of subcategories has been defined based on relevant product sizes.

Based on an analysis we performed of product environmental footprint datasheets published by IT manufacturers, we concluded that specific product models cannot be compared directly based only on the published information. Therefore, specific product models cannot be selected in the calculator.

Table 2-1: Categories and subcategories available in the tool.

Category	Subcategory
Computer screen	Average
	22"
	24"
	27"
	30"
	32"
	34"
Laptop	Average
	12"
	13"
	14"
	15"
	16"

Desktop computer	Average Powerful Regular
Mobile phone	Average 4" 5" 6" 7"
Tablet	Average 8" 10" 12"
Meeting room screen	Average 55" 60" 65" 70" 75" 80" 85"
Router	Typical product
Printer	Typical product

Printer

The printer category encompasses multi-function / all-in-one printers, like the one shown below.



Figure 2-1: An example of the type of printer used in the calculations. The picture is from PCF JR-AI-20058E-A

Computer mice, headsets, and keyboards are excluded from the calculator, as our analysis showed that they have a relatively small contribution to the overall climate footprint (less than 2% of the annual climate footprint from public procurement of ICT equipment).

2.2. Life cycle phases

The calculator is limited to the impacts of greenhouse gas emissions and does not include other environmental impacts.

Not all life cycles phases are included in the calculations. When a product is manufactured, it will generate emissions connected to its production (A1-A3), transport (A4), use (B phase), and end of life (C1-C4). The calculator only considers emissions related to production, a phase often called cradle-to-gate. During the data analysis, we found that the production phase typically accounts for most of the climate footprint of ICT equipment (50 – 80%). The relative contribution of the production phase varies greatly based on the emissions intensity factor used for electricity.

This means that emissions from transport, use phase (energy use and maintenance), and waste treatment at the end of a device's life are not included in the calculations.

Emissions from **transport** typically have a relatively modest contribution to the total climate footprint but can be more significant in cases where heavier equipment (such as large screens or printers) is shipped by air from Asia. This generally occurs if insufficient delivery time is accounted for in procurement and expedited shipping is required.

Emissions from **energy use** during the use phase are highly dependent on the emissions intensity factor selected for electricity. By using an emissions factor of 100 gCO₂e/kWh (which corresponds approximately to the Nordic emissions mix), the relative contribution of energy use during the use phase is roughly:

- 15% for mobile phones and laptops
- 25% for computer screens
- 40% for TV (meeting room) screens
- 50% for desktop computers

Emissions from **waste treatment** contribute relatively little to the climate footprint based on the data analysis. However, from a resource perspective the consequences of ICT equipment disposal are greater than what is reflected in the climate footprint.

2.3. Measures

The tool allows for the selection of several measures that can reduce the climate footprint of ICT equipment, but there are additional measures that are not covered by the calculator. For example, reducing the total amount of ICT equipment purchased will always be beneficial compared to purchasing new or used equipment. That is, it is always better from an environmental standpoint to avoid making a purchase. This can be achieved by, for example, optimizing workstations and standard equipment configurations, and optimizing equipment based on the user's needs. There are other environmental impacts beyond the climate footprint that can also be reduced. More information about various measures to reduce environmental impacts can be found on anskaffelser.no.

The impacts of the following measures are explicitly quantified in the calculator:

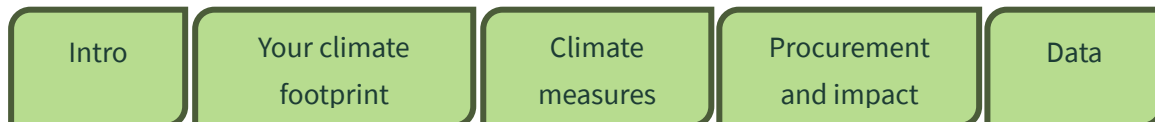
- **New purchase with extended warranty.** This means that the warranty period increases by one year, and it is assumed that this also extends the device's lifespan by one year.
- **Secondhand purchase.** This means buying devices that are refurbished or otherwise prepared for reuse by a third-party. Refurbishment typically consists of cleaning, repairs, a security check including a factory reset and deletion of data, and product testing.

- **Repairs** can span from simple soldering jobs to swapping batteries, screens, circuit boards, or hard disks. We have assumed an “average” repair job, and that this is performed by an external actor.
- **Internal reuse** encompasses reuse within one’s own organization. For example, PC screens from a municipality’s administration being reused in municipal schools. The lifetime of devices is assumed to be extended by internal reuse.

3. User guide

3.1. Calculator layout

The impact calculator contains five tabs with different purposes.



Intro: Contains a short introduction to the various tabs and how they can be used

Your climate footprint: Intended to be used for calculating the climate footprint of the existing ICT equipment currently in use in the organization.

Climate measures: Compares the effect of different measures for different categories of ICT equipment. Not all possible measures are included in the calculator, but the included measures are all compared in this tab.

Procurement and impact: Allows you to estimate the specific effect of climate measures implemented during or after procurement. The impact is calculated relative to buying everything new.

Data: Presents an overview of footprint, expected lifespan, and price data for new ICT equipment. More details about the data can be found in Chapter 4 of this guide.

3.2. Intro

The 'Intro' tab presents general information about how the different sheets in the spreadsheet can be used, and what each sheet is useful for.

3.3. Your climate footprint

'Your climate footprint' can be used for calculating the climate footprint of ICT equipment currently in use in your organization. You must fill out the number of employees and the number of categories of ICT equipment in use in your organization. You can then see the total emissions

associated with your organization's ICT equipment, per year and per employee. If some categories of ICT equipment aren't relevant for your organization, simply leave them blank.

In the result sections, you can toggle between figures that show:

- Annual climate footprint [kg CO₂e/year]
- Total climate footprint [kg CO₂e]
- Estimated annual costs [NOK]

The climate footprint is given in kg CO₂-equivalents, abbreviated to kg CO₂e. CO₂-equivalents are a common method to calculate the impact of greenhouse gas emissions. They take into account the impact of all greenhouse gases and their relative global warming potential.

The results also show a set of indicators, which are key numbers that can be used to monitor the progress of your organization's footprint over time. The indicators are:

- Climate footprint for ICT equipment per year [kg CO₂e/year]
- Climate footprint for ICT equipment per employee [kg CO₂e/employee]
- Total expenses per year [NOK/year]
- Climate footprint per employee per year [kg CO₂e/employee/year]

3.4. Climate measures

The 'Climate measures' tab allows you to compare the impact of different measures for categories and subcategories. First select a category from the dropdown, then select a subcategory. You can select a specific screen size / type or an average device. See Table 2-1 for all options.

The results graph shows the climate footprint for different measures per year per device. The results can be used to compare the impact of different measures.

If the results are to be used in climate accounting, the emissions associated with devices procured during a single year should be reported. Emissions per year, which are distributed over the expected lifetime, are not suitable for climate accounting purposes. Use the 'Procurement and impact' sheet for to obtain total, not yearly, emissions for climate accounting.

Note that the calculator does not encompass all possible climate measures. There are many measures that are not quantified in the calculator, including measures that reduce other types of environmental impacts. Read more about these at anskaffelser.no.

3.5. Procurement and impact

In the 'Procurement and impact' tab, input a list of devices to be procured. You can then select measures from a menu to see their potential impact.

If you know the price of the devices you are procuring, it is possible to override the default pricing data. Otherwise, the estimated prices in the calculator are used.

For a procurement to show in the results, a category, subcategory, number of devices, and a measure must be selected. This means that if you are planning to buy some small computer screens (22") and some larger ones (34"), these purchases should be input in separate rows. If you are going to buy several mobile phones, but plan for some of these to be purchased second-hand and some new, these purchases also must be entered in separate rows.

Price and expected life of each device is suggested by the calculator but can be overridden. The climate footprint per device cannot be overridden.

The results section shows the climate footprint and costs per category, or for the sum of all items listed in the procurement table. If your procurement plan only includes buying new items, there will be no footprint savings. Both the total climate footprint and footprint per year are shown. Footprint per year is computed by dividing the total footprint by the expected lifespan of each type of device.

4. Data sources

4.1. New products

4.1.1. Pricing data

The estimated costs of purchasing new products are summarized in Table 4-1.

The estimated costs are based on DFØ's (The Norwegian Agency for Public and Financial Management) IT Category Strategy¹. In cases where a range of values is given in the strategy, the average value is used.

The category strategy does not include cost estimates for all categories. For categories without an estimate, costs are based on price data obtained for a sample of devices.

Table 4-1: Costs data for new ICT equipment, as used in the calculator

Category	Price per unit excl. VAT [NOK]	Data source
Computer screens	2 900	DFØ's IT Category Strategy
Laptops	10 150	DFØ's IT Category Strategy
Desktop computers	10 800	DFØ's IT Category Strategy
Mobile phones	6 100	DFØ's IT Category Strategy
Tablets	3 300	DFØ's IT Category Strategy
Meeting room screens	37 500	Prices of sample models
Routers	25 000	Prices of sample models and input from the user insight phase
Printers	80 000	Prices of example models and input from the user insight phase

4.1.2. Climate footprint

The calculator includes the emissions from production of ICT equipment.

¹ <https://anskaffelser.no/sites/default/files/2022-01/Kategoristrategi%202022-2026.pdf>

The climate footprint is based on “Product Environmental Report” / “Product Carbon Footprint” (PCF)² datasheets produced by IT manufacturers. For each category, data has been collected for a representative selection of products per category. The availability of PCFs varies between product categories. For smartphones and laptops, many PCFs are available from different manufacturers. For the other categories, the availability of PCFs is more limited, often from only a few manufacturers.

As previously mentioned, PCF datasheets are not suitable for comparison between specific models of a product. We have therefore calculated the average footprint per category, under the assumption that the overall trends from the PCF are representative. To calculate the footprint of devices of different screens sizes or subcategories, footprint data for different models has been linearly extrapolated as a function of their screen size and other relevant parameters.

Table 4-2: Climate footprint and expected lifespan for different new products. Only the product phase is included in the climate footprint (A1-A3)

Category	Subcategory	Expected lifespan [years]	Climate footprint [kg CO ₂ e/device]
Computer screen	Average	5	372
	22"	5	337
	24"	5	343
	27"	5	353
	30"	5	363
	32"	5	369
	34"	5	376
Laptop	Average	3	234
	12"	3	142
	13"	3	173
	14"	3	205
	15"	3	236
	16"	3	268
Desktop computer	Average	4	367

² Product Attribute to Impact Algorithm (PAIA) is a methodology commonly used by ICT equipment manufacturers to make “Product carbon footprint” (PCF) datasheets. PAIA was developed by researched at Massachusetts Institute of Technology, and is used by manufacturers such as Dell, Lenovo, Intel and others. The creators of PAIA emphasize that the tool was not created for comparability across products. They also highlight that there is a high uncertainty in data related to ICT equipment, because technologies and production techniques evolve rapidly.

	Powerful	4	417
	Standard	4	317
Mobile phone	Average	2.5	50
	4"	2.5	33
	5"	2.5	40
	6"	2.5	47
	7"	2.5	54
Tablet	Average	2	68
	8"	2	49
	10"	2	61
	12"	2	73
Meeting room screen	Average	5	1 016
	55"	5	784
	60"	5	869
	65"	5	955
	70"	5	1 041
	75"	5	1 127
	80"	5	1 212
	85"	5	1 298
Router	Average	3	76
Printer	Average	6	1 163

4.1.3. Expected lifespan

The expected life of different devices is based on experiential data from DFØ and data from PCFs. These values were verified through input from test-users of the calculator. The lifespans for new products within each category and subcategory are shown in Table 4-2.

4.2. Measures

To calculate the impact of the measures available in the calculator, the climate footprint, expected lifespan, and costs are adjusted.

Table 4-3 shows the adjustment factors used to calculate the impact of each measure. A value of 1 indicates that the value is the same as for a new product, while less than 1 means reduced climate footprint, life expectancy or costs.

Table 4-3: The effect of measures quantified in the calculator on climate footprint and costs

Measure	Cost adjustment factor	Footprint adjustment factor
----------------	-------------------------------	------------------------------------

New purchase with extended warranty	1.1	1
Secondhand purchase	0.7	0.15
Repair	0.4	0.15
Internal reuse	0	0

Expected lifespans are adjusted according to the selected measure in the following manner:

- New purchase with extended warranty: +1 year compared to the life expectancy of a new product
- Secondhand purchase: -1 year compared to the lifespan of a new product
- Repair: -1.5 years compared to the lifespan of a new product
- Internal reuse: -1.5 years compared to the lifespan of a new product

The assumptions and data sources used to establish each of these factors are discussed in the following sections.

4.2.1. Costs

The cost of implementing measures is mainly based on data collected for mobile phones and laptops, as these were the categories where historical figures were most readily available.

Table 4-4: Assumptions and data sources used to quantify the cost of performing different measures

Measure	Data sources and assumptions
New purchase with extended warranty	The cost of purchasing a new device with an extended warranty is based on data for computers. An extended warranty by one year compared to the standard warranty was found to increase the purchase price by 5-10%. This measure is assumed to increase the cost to 10% higher than new price for all categories in the calculator.
Secondhand purchase	Price data for used computers was obtained from Furbie ³ . The average cost of a used computer (as of December 2024) was 10 600 NOK, which is equal to the cost of an average new computer. Price data for used mobile phones was extracted from Furbie, as well as Telenor and Finn.no. The used prices were found to be 50 to 80% of new prices.

³ <https://www.furbie.no/brukt-pc/b%C3%A6rbar>

	<p>Cordella et al. (2021)⁴ evaluated the cost of different measures for reducing the footprint from mobile phones. The price of used devices was calculated as 1/3 of the price of a new device, plus 40% margin. This gives about 50% of the price of a new device. Based on this, the average price of mobile phones and computers is 65% of the new price. Used devices from other categories are assumed to be more expensive since the market for resale is underdeveloped, and so an average cost of 70% of the new price is assumed for all categories in the calculator.</p>
Repair	<p>Cordella et al. (2021) found that the cost of a repair where a battery was replaced was 20% of the new price, and in cases where screens were replaced was 60% of the new prices. User input during the calculator development indicated that repairs are often performed if they cost less than 20% of the price of a new computer. In the calculator, we have assumed that half of the repairs are simple (such as changing a battery) and half are more complex (screen replacements or similar). An average price for repairs of 40% of the new price was used for all categories of the calculator.</p>
Internal reuse	<p>Internal reuse was assumed to be cost free. However, for an organization that does not current have a routine for internal reuse of devices, there is some overhead required to put in place a system for organizing internal reuse, as well as distributing and storing the devices.</p> <p>0% of the new price is assumed for alle categories in the calculator.</p>

In practice, the cost of purchasing used devices, repairing and internal reuse will vary greatly. We encourage a more thorough evaluation of the costs in each individual case.

In the calculator, you can override the automatically calculated costs in the “Procurement and impact” tab.

⁴ Cordella, M. et al. “Reducing the Carbon Footprint of ICT Products through Material Efficiency Strategies: A Life Cycle Analysis of Smartphones.” *Journal of Industrial Ecology* 25, no. 2 (2021): 448–64. <https://doi.org/10.1111/jiec.13119>.

4.2.2. Climate footprint

Table 4-5 The climate footprint of different measures

Measure	Data sources and assumptions
New purchase with extended warranty	<p>Extending the warranty period by a year is not assumed to change the climate footprint.</p> <p>0% of the climate footprint of new devices is used for all categories in the calculator.</p>
Secondhand purchase	<p>Data was obtained from the company Foxway, the Swedish “Product database: environmental advantages of reuse”,⁵ as well as a study from ADEME, the French Agency for Ecological Transition, exploring the environmental footprint of different types of refurbishments compared to new devices for laptops and desktop computers, mobile phones and tablets. An emissions reduction of 90% (or more) is likely for mobile phones and tablets, and 80% for computers, based on average repairs performed during refurbishment.</p> <p>The climate footprint of a used device is assumed to be 15% of that of a new device for all categories in the calculator.</p>
Repair	<p>Similarly to the ‘Secondhand purchase’ measure, we assumed an average repair, including transport. The climate footprint will vary greatly depending on what parts are changed, as replacing screens and hard disks are associated with the highest additional emissions. In the case of extensive repairs, savings can be approximately 85% for mobile phones and 65% for computers.</p> <p>The climate footprint of a repaired device is assumed to be 15% of the climate footprint of a new device for all categories of the calculator.</p>
Internal reuse	<p>Internal reuse is assumed to have no additional footprint. There are some emissions associated with distribution and storage, but these are assumed to be negligible. This assumption holds as long as the devices are not shipped over long distances (>2000 km) or by air.</p> <p>The climate footprint of an internally reused device is assumed to be 0% of the climate footprint of a new device for all categories of the calculator.</p>

⁵ [Produktdatabaser: miljöördelar med återbruk Klimatfördelar med återbruk av IT-produkter samt metod för databasskapande - IVL.se](https://www.ivl.se/produktdatabaser-miljofordelar-med-aterbruk)

4.2.3. Expected lifespan

The expected lifespan assumed for each measure was set in dialogue with participants in the project and based on feedback from user tests. The life expectancy of a device is assumed to change in the following manner for each measure, compare to the life expectancy of a new device:

- New purchase with extended warranty: +1 year
- Secondhand purchase: -1 year
- Repairs: -1.5 years
- Internal reuse: -1.5 years

In practice, the remaining lifespan of a device after enacting a measure will vary greatly. We encourage evaluating the lifespan of devices on a case-by-case basis. The lifespans can be adjusted in the calculator in the “Procurement and Impact” tab.