A publication by Circular Technologies January 2023 003

Sustainable Things

The ICT Circular Magazine

A moment of radical change was the popularization of Color Television, our programs no longer had the velvet texture of black and white and we began to see the world in technicolor. The arrival of the PC was an analog revolution, perhaps longer but no less loaded with fundamental changes for everyday life as we knew it. At first, it was a window into a world of practical advantages such as being able to have a machine that consistently saved your work documents, also, Solitaire was the world's most famous game for many years. These futuristic machines came in a very particular combo: A heavy, rounded screen that served as a monitor, a pointer in the form of a mouse, and a tall, heavy box that housed the PC components. It looks almost like an image from a distant and blurry past (like the images of those CRT monitors).

By 2022 we have an almost infinite variety of components and ranges to create your PC, as well as an ocean of options and technologies to choose a monitor from. A workstation/studio was much more popular before the improvement of dedicated laptop technologies, which offer the advantage of portability and now compete with the convenience of a phablet or tablet. This is why Personal Computers (or towers) have lost market share even though their versatility makes them prime candidates for many industries and jobs. On the other hand, the specialization of monitors has expanded their use to all industries and users.

Personal Computers have broad and cross-sectoral use. To understand the impact of these ICT products we will walk through microcomputers, minicomputers,

“The Apple” personal computer - Image credit: Getty

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mainframes, and supercomputers. As well as the Monitor technologies currently in use: LCD, LED, OLED, Plasma, and CRT.

In this edition of Sustainable Things, we will delve into the fascinating world and market of PCs, specifically desktops. As a Personal Computer like this is always accompanied by a monitor we will analyze these two ICT products so massively used. The proliferation and diversification of their use have allowed several generations to adapt and optimize their use to improve our communications and systems. We will also discuss sustainability issues, such as non-financial reporting and commentary on the current state of semiconductor supply. Welcome once again to Sustainable Things.

Image credit: Pexels

ICT in 2022: Personal Computers and Monitors

First IBM personal computer from 1982 - Image credit: Britannica

PCs are for many the model of what a real computer represents: you are free to equip it with whatever you want or need, and there are no limits other than your budget, how much processing power you need, and the technology available on the market. This in principle sounds like a world of possibilities and it is, although the reality has evolved a lot since the launch of the first computer. PCs take the market with their modularity and adaptability to your needs. In the early days, portability was not a priority (nor could it be because of the technology available). This extends to the fact that the generalized use of a tower requires peripheral elements for the use of its components, i.e. a keyboard, a mouse, and a screen. This combo was necessary to be able to use the PC. The display has been an element that has also evolved a lot over time, to become a category in itself: developing products for all industries and special markets for different needs (such as medical monitors).

The possibilities and applications are endless. But the reality of the market is that about 30% of the market is fed by office spaces, where PCs show the advantage of being tailored exactly to the needs (professional offices, government offices, etc.). The total PC sales market has lost ground in recent years for several reasons: 1. The growth of the smartphone market due to improved performance, parts, features, and applications; 2.Pursuit of mobility with electronic devices.

We should also point out that the PC market is not totally dead. In 2020 volumes reached record numbers: with 11% growth over 2019, 297 million units were sold, the highest number of shipments since 2014 (1), although projections indicate a steady decline in sales from this climax point.
Monitors respond to many needs, although they originally accompanied desktop monitors have become a flexible and fundamental tool for many industries and work practices.

MacBook Pro circa 2018 - Image credit: Pexels

PCs: Future and trends

The last 10 years have been complex for desktop computers. The portability advantage that a laptop offers, among the reasons mentioned above, has caused their volume to fluctuate within limits that are projected to be constrained in the coming years. One of the most important factors in the growth of PC usage was the growth of Internet users, which has been the case since 2000. This is also true for laptops and tablets, which have also been growing steadily (2).

The actual volume of units sold for the first quarter of 2022 decreased by 30% from the previous quarter. Surprising given that chip manufacturing has regained ground in the face of COVID-19 challenges and supply chain issues. A clear trend of wanting immediate access to entertainment and work has set the latest trends.

Although there are still many users of these devices who prefer a desktop: for comfort, convenience, or specific needs to perform their work. Added to this is the pandemic that has shrunk the market even further. While the main CPU competitors for desktops (AMD and Intel) have managed to maintain sales during the pandemic as a result of excess inventory, in 2022 they saw the worst quarter in history: a 30% drop in units sold compared to the previous quarter (3). These differences in volumes between the 2020 peak and the 2022 figures respond to the short trends created by the pandemic: where remote work and education became a priority to continue in a quarantined everyday life.

The truth is that a negative trend is expected for the coming years: portable devices are expected to continue to gain market share given advances in design, chip technology, displays, and storage; as well as battery development and applications suitable for performing tasks that only a few years ago could only be done by a PC. The peak seen in 2020 is expected to respond to the Pandemic and its effect will be short-lived, the trend is towards a decrease in demand: from 150 million units in 2010 to 79 million in 2020 (3).

Monitors: Market, projections, and market segmentation

Monitors have expanded their uses and applications. The gaming sector is one of the fastest-growing markets in recent years. The demand for more modern monitors that support high response time, which is the time it takes for individual pixels to change color (4). Another growth factor has been the pandemic, as workers have purchased more computer peripherals. One of the most important restraining factors for the monitor market is the growth in the use of smartphones (5).

The monitor market is projected to be valued at $195,400.4 million by 2028 and is expected to grow at a compound annual growth rate of 3.50% over the forecast period 2021 to 2028 (6). Similar to the PC market, monitors have common counterfactors with the difference that monitors have expanded their uses and processing units to create unique markets such as scientific and medical monitors. Another sector pushing the growth of units sold is the automotive industry which uses monitors for internal displays such as digital dashboards, rear-view mirrors, navigation systems, and prevention systems. The transportation and distribution industry has become a major user of new monitor technologies designed especially for sectors such as those used in train systems, airports, and bus stops. A final factor coming from the IoT (Internet of Things) growth is the introduction of smart displays to assist access to real-time monitoring of any sensor or device remotely (7). In 2021 a historical volume of 143 million units will be reached, figures not seen since 2012 (8).

For the Sustainable Things team, both products will be fundamental in the coming years, although the use of mobile and portable devices will continue to increase with no sign of slowing down. The Personal Computers and Monitors market represents a fundamental product in the ecosystem of ICT products used today and in the near and medium future.

TRS-80 Micro Display 1977 - Image credit: Wikipedia

Image credit: Pixabay

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Image credit: Envato Elements

What is Non-Financial Reporting?

Financial reports have been the golden rule to understanding the value of a company and a fundamental aspect for investors to decide whether their funds and trust are in one or another corporation or business. With the new requirements of the Paris agreement and especially since the signing of the European Green Deal this definition of how to analyze the value of a company, market or sector has been expanded. Factors such as how the business and activity influence the environment, society in general, and its own employees and managers.

One of the most important consequences of the European Green Deal is the incorporation of non-financial reporting for companies living within the EU. These reports are aimed at providing information on environmental, social, and governance (ESG) aspects, in line with the decarbonization strategy of the Paris Agreement and is a formalization of the United Nations 2030 Agenda. These reports follow the so-called Corporate Sustainability Reporting Directive (CSRD), coming into force in 3 phases:

January 1, 2024, for companies already subject to the Non-Financial Reporting Directive.

January 1, 2025, for large companies that are not currently subject to the Non-Financial Reporting Directive

January 1, 2026, for listed SMEs, small and non-complex credit institutions, and captive insurance companies (1).

By 2024, some 50,000 companies must submit their non-financial reports on a mandatory basis. For this, they must be certified and audited to comply with the correct measurement of social, environmental, and governance impacts and risks. This first group of companies must have more than 250 employees and an annual turnover of 40 million euros, whether or not they are listed on the stock exchange. These requirements are also extended to listed SMEs, although an opt-out will be possible during a transitional period that may last until 2028. Finally, non-European companies will be required to submit a sustainability report only if they generate a net turnover of EUR 150 million per year within the EU and have a subsidiary or branch at least within the EU territory.

By 2024, some 50,000 companies must submit their non-financial reports on a mandatory basis.

The CRD rules will apply to the above-mentioned groups of companies, while other companies will be subject to less stringent rules. Some SMEs will be able to wait until 2026 and others until 2028 (2). Non-financial statement (NFS) reports have to focus on different analyses such as:

1. Material analysis information,
2. Strategic plans for investors,
3. Active involvement of the companies management boards in sustainability issues,
4. The integration of non-financial boards in CEO remuneration policies,
5. The obligation of non-financial reporting can be traced back to three stages: Awareness, capability, and participation (3).

These reports serve investors and stakeholders to learn about the real impact of the company on social, environmental, human rights, and overall internal governance factors of this group of companies. This report should be included as a chapter of the Operations Report: A single document with the annual financial statements, corresponding annexes, and this ESG report.

Currently, less than 32% of all companies are required to comply with the Directive report on the strategy being addressed to meet the companies' ESG objectives and challenges. While 23% of this group of companies address specific climate risks.

Image credit: Envato Elements

How to make a Benchmark

A benchmark is a measurement of performance in order to compare ICT products and how they interact with different synergies of the Circular Economy. This analysis will enable a comparison between products with their projected life cycle for reuse or recycling, depending on which benchmark corresponds to which product and how it's comparable to other benchmarks of other products. Also, this benchmark will include the characteristics of the product (such as processing performance, energy consumption, and capacity), and the emissions created by the analyzed product between manufacturing, distribution, and use.

This kind of measurement goes hand in hand with the EU commission's efforts to standardize the use and interconnectivity of ICT products. These standardization efforts have been consistent in the last 9 years to construct a common dialogue between companies, organizations, nations, and multi-lateral organisms and institutions. Also, the technical dimension of the endeavor is well attended by representatives of academic and industry stakeholders in different institutions and standardization centers of the EU.

> **A benchmark is a measurement of performance in order to compare ICT products and how they interact with different synergies of the Circular Economy.**

To create a benchmark the EU takes into account two approaches: minimum performance criteria and best practice performance criteria. The minimum performance criteria are considered to provide benchmarks for industry performance within the supply market. Best practices performance refers to the ideal performance of the discussed product. In the case of a benchmark created to measure to Circular Economy potential of an ICT inventory, we will find a minimum performance that will entitle the minimum processing performance needed to use standard software used by any industry (namely software and office programs) and the emissions of such products. This compound number will be our benchmark to analyze the potential circularity of a given ICT inventory.
The technology, environmental, and performance analysis are what we are referring to as the elements of this benchmark. Three questions arise:

1. Which software you can run in the product?
2. Which year corresponds to the first software used by the product?
3. How many years does the product could be used in the future (Projections)?*
4. 4) Test under real-life conditions.

*The Constrains, in this case, correspond to processing power, display possibilities, and modular ability.

Digging into this we find different configurations of ICT inventories through sectors and size of the company. All sectors rely on a "basic" ICT inventory:

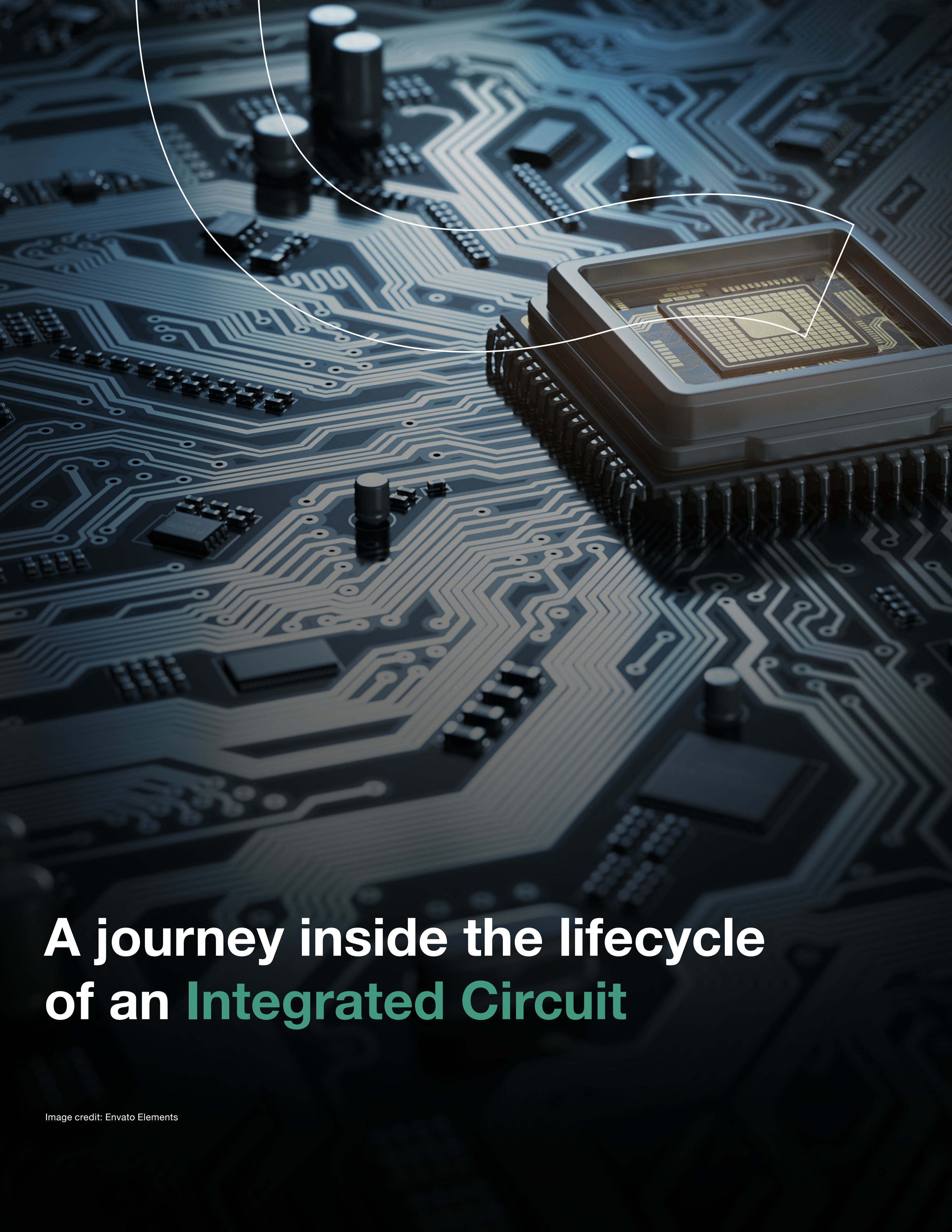
PCs, Laptops, Monitors, Routers & Printers. While others have at their core a more diverse array of ICT products through their industrial processes. Let's take for example the automotive industry (one of the core sectors in Italy) we will find other ICT products such as industrial sensors, automated servos, etc. These chips can be automated for different functions and re-use for minimal tasks, pieces that can be refurbished and given a new life-cycle.

Image credit: Envato Elements

Circular Technologies is creating this benchmark in order to examine the life cycle of different ICT products and analyze the possibility of a 2nd and 3rd cycle of use. This will enable:

- ✓ Make better decisions on ICT procurement
- ✓ Save money and time in this decision process
- ✓ Track emissions accurately through certifications

Find out more about solutions on this matter at:
www.circulartech.world



A journey inside the lifecycle of an Integrated Circuit

Image credit: Envato Elements

If anything characterizes our days, is the invisible interconnection and the massive exchange of information and data. Telecommunications and information have marked a new era for humanity, one that was coming out of a violent beginning of the 20th century, but full of scientific discoveries that would mark the path for our current societies connected by the Internet and its infinite channels for information exchange. This constant flow of data allows us to see a world that is updated in real-time, every day, everywhere; on the tip of our fingers. This world of information has at its veins and arteries the devices we use every day (such as laptops, smartphones, tablets, monitors, etc.) and machines that enable this (servers, switches, routers, satellites, etc.).

Estimates of annual emissions from the ICT sector have varying ranges of estimates from source to source: some researchers account for 14% of GHG (1), others speak of 1.8 - 2.8%, up to 3.9% of global emissions for the whole ICT sector (2). ICT use and application projections are expected to continue to increase: the global market for semi-conductors increased from USD 340 billion in 2015 to USD 440 billion in 2019 and is predicted to reach USD 650 billion in 2025 (3), as well as the e-waste created annually by their disuse. To understand how this interconnected world populated by equipment and devices works, we have to analyze the lifecycle of its cornerstone: Integrated Circuits.

All ICT equipment begins its life on the drawing board, although this phase goes through an extensive testing process before production is considered. In the first phase, the system specifications are analyzed:

1. The functional requirements
2. The system to be used by the processor
3. The external interfaces (e.g. SLIC, SD Card, Internal SSD, External SDD, WIFI, HPAV2, etc.)

The second step entails designing the architecture, afterward, we move on to a verification phase where a software version of the hardware system is crafted in C, C++, or SystemC.

After this hardware model is created a formal verification is performed: property checking system requirements are defined using property specification languages. After this, the Design Entry is created, which includes: IC Input and Output Pins, IP Block instantiations, design connectivity, clock, reset strategy, etc. A functional simulation of the design entry takes place and a subsequent formal verification for equivalence checking is done afterward. After all this testing the design goes through pre-silicon validation: verification of design in hardware before sending it to manufacturing, it validates high-risk o newly developed IPs and saves costs on re-spinning ICs via an emulator or FPGA. After this a phase of synthesis takes place, then an STA (Statistical Timing Analysis) and a DFT (Design For Test) are created. This DFT goes through a pre-layout simulation and a Physical layout is created, which subsequently goes to a post-layout simulation. All of these steps comprise the design of an Integrated Circuit.

Now ready for production we move from the designers to the fabric (usually called fab). Manufacturers follow strict rules to ensure the conditions needed to create the Integrated Circuits. The designers send a GDSII file to the foundry, also called the tapeout. The first step is to create the raw material that entitles the wafer: sheets of purified silicon. After this, the wafer is cut and the layering starts. Via lithography (exposure to UV rays) and masking, the circuits are carved and created on the wafer. Once the layering is completed the Wafer is cut into the individual ICs and tested providing an input stimulus to the IC and verifying the output, also verifying the electrical and thermal characteristics of the Integrated Circuit and finding the ideal operating conditions. This test permits to filter of defective Integrated Circuits early on. After this, a real-world environment conditions test is conducted (Post-Silicon Validation). If the IC in question surpasses this test, its package and distributed to the corresponding client.

Now the IC it's added to the product it was designed for:

1. **ASIC (Application Specific Integrated Circuit)**: Routers, switches, modems;
2. **ASSP (Application Specific Standard Part)**: Ethernet controllers, PCIE controllers, USB interfaces;
3. **SoC (System on Chip)**: Voice, video, and image signal processing, wireless communication, automobiles, etc.;
4. **FPGA (Field Programmable Gate Array)**: Applications: Prototyping ASICS or SoCs, device controllers, signal processing systems, image processing systems, etc;
5. **Programmable SoC or SoC FPGA**: Networking, aerospace, defense, etc;
6. **Microprocessor (μP or MPU)**: Desktop PCs, laptops, notepads, automobiles, trains, etc;
7. **Microcontroller (μC or MCU)**: Microwave ovens, washing machines, DVD players, mobiles, etc.

The next phase is integrating the IC into the final product it uses is an essential part of the Integrated Circuit's electrical consumption and GHG emissions

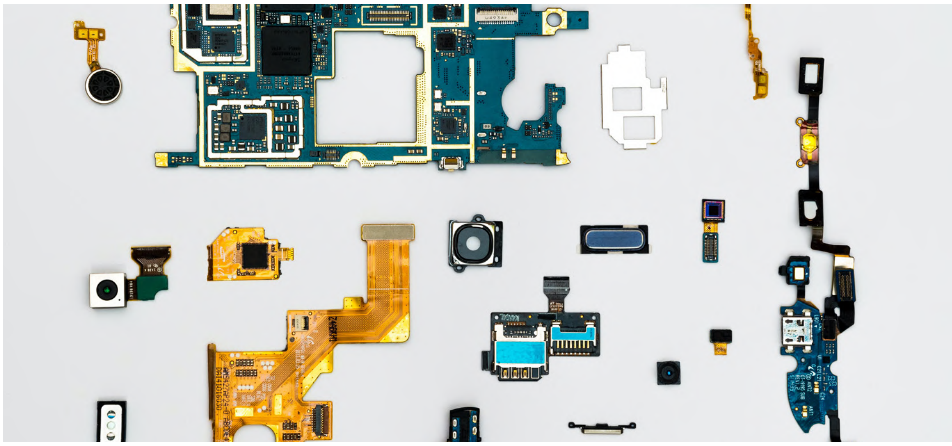


Image credit: Pexels

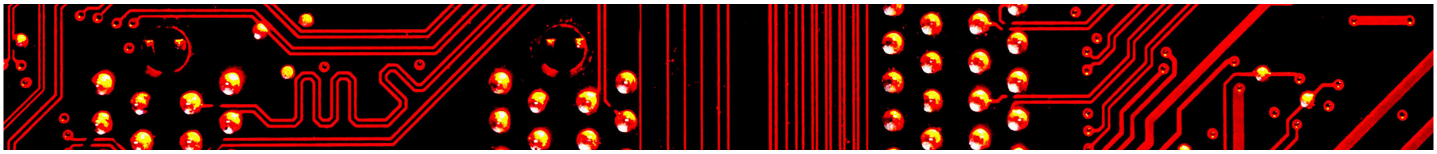


Image credit: Pexels

throughout the life cycle. This phase changes a lot between product categories: a notebook may be used for 3-5 years before getting replaced by a new one, and a monitor in an industrial complex can have a lifespan of over 8 years. The use given to a specific ICT product can vary widely.

The last phase of the life cycle of any ICT equipment it's called EoL (or End-of-Life). Here the product it's rendered as old, obsolete, or has had a cycle of use and could be used for longer but needs some repair. This phase could be organized into a checklist where the equipment fits in a solution depending on the kind of technology it uses and its usefulness in relation to software used in a specific sector. For example, A 2011 MacBook Pro runs perfectly if used for email sorting, spreadsheet creation, and overall simple office tasks; this computer could be used today for this same purpose in 2022 (having 2 cycles of use). The EoL should start with an analysis of the equipment for reuse, remanufacturing, or revamping for a second or third life. If none of the above could be possible the equipment is dismantled for part recovery, component recovery, and finally material recovery. In this sense, the decision to recover a specific material from a batch of equipment lies largely on the quantity of the material recovered and the market of the material.

In their report "End-of-life management for ICT equipment" the International Telecommunication Union (ITU) explains this perfectly:

"For example, although indium has a fairly high current market price, the amount in an LCD display screen is very small, and the cost of recovery is high; as a result, indium has traditionally not been recovered from end-of-life computing equipment. Lithium does not currently have a market price high enough to pay for the costs of recovery, and so the lithium contained in batteries, although available in relatively high amounts, has traditionally not been recovered, even if this is technically possible in the current battery recycling processes.

On the other hand, although the amount of gold and silver in a circuit board is quite small, the current market price of gold is much higher, and it has traditionally been recovered. In some cases, alloys can be recycled directly back into the same alloys, which improves the economic return and can be important with critical metals. (4)"

If no reuse or recovery could be applied to the equipment the last resource it's to recycle and dispose of it. First, the equipment must be collected and identified. Then sorting, dismantling, and pre-processing take place: in this stage hazardous substances are removed, safely handled, and properly disposed of (de-pollution). The remaining material is put into a conveyor belt where different machines separate plastics, metals, and (depending on the technology of the processing plant) critical raw materials.

Can something replace silicon for making chips?

Since its first use in microprocessors in 1965, silicon has been the go-to material that has enabled the proliferation of ICT equipment around the world and the development of the different processes and technical challenges in creating these amazing pieces of equipment. Its low cost and extensive natural deposits have led to the development of the most complex supply and manufacturing chain ever seen by mankind, allowing the number of transistors to be increased in nanometric spaces. This is reaching its physical limit: Moore's law has slowed down in recent years.

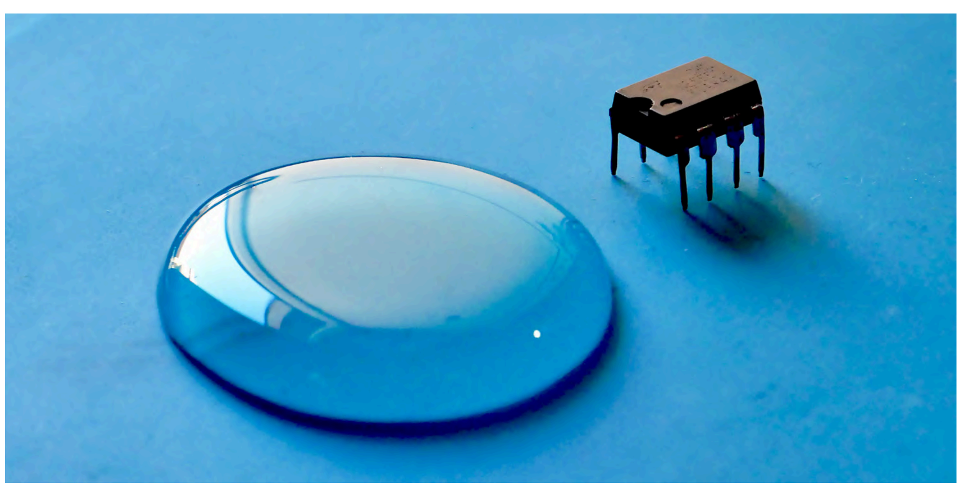


Image credit: Unsplash

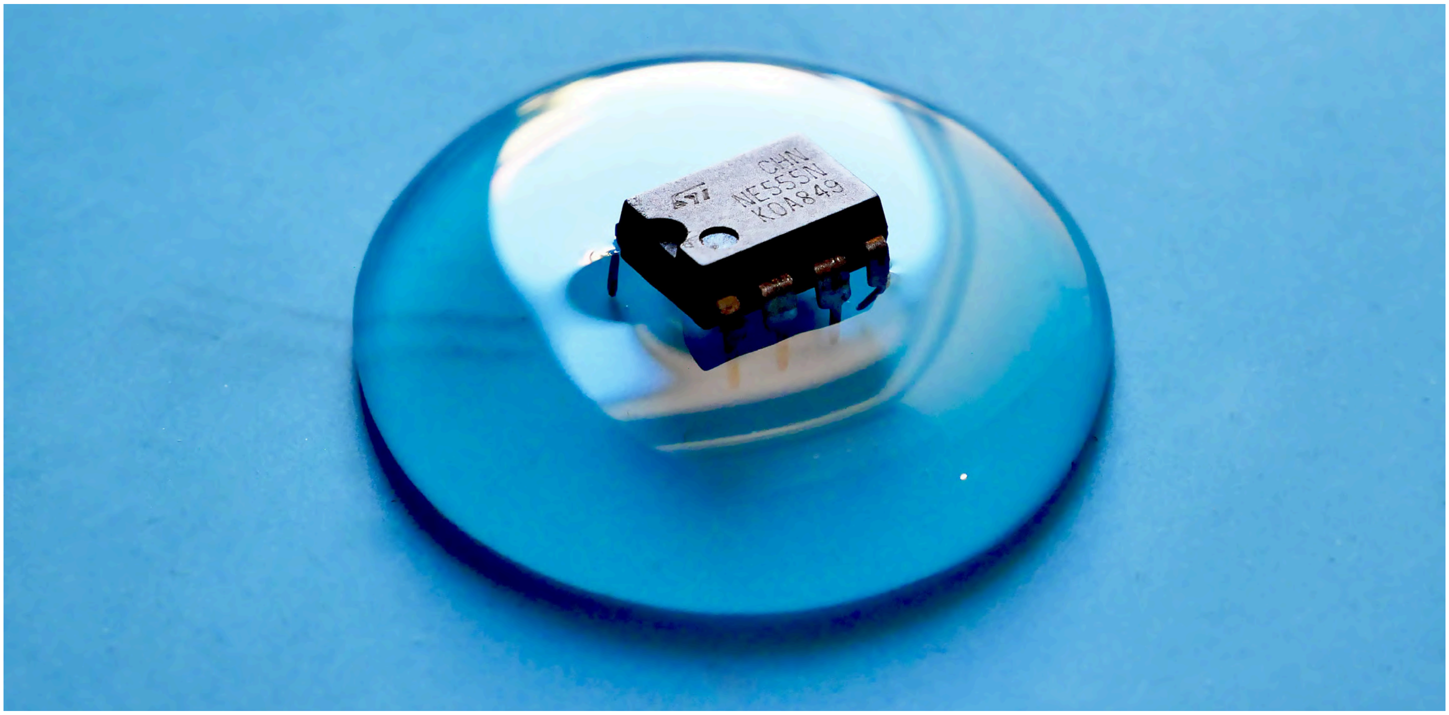


Image credit: Unsplash

Although silicon has been the king material for integrated circuits, it has several properties that do not work in its favor, as this Autodesk article points out:

Electrons Go Crazy. “Many of today’s circuits are as small as 7nm wide, and when you’re trying to send electrons down transistor pathways in these tiny silicon spaces, they often become unstable and difficult to control. What do you do when electrons go rogue and start interfering with other signals? Hope for the best, I guess.”

Mobility Issues. There’s also the problem of electron mobility. Yeah, you can pack billions of transistors into a space the size of a red blood cell, but silicon itself doesn’t provide the best environment for electron mobility as other materials do, like indium or graphene.

High Heat Problems. Another issue is that the more you pack into silicon, the higher the temperature climbs with all of that activity, leading to degraded performance. Today’s ICs with billions of transistors requires a ton of fans just to keep everything cool. Think of the giant heatsink strapped to your computer’s processor.

Lazy With Light. Silicon is also terrible at transmitting light. And with a widespread use of lasers and LEDs, manufacturers are starting to use alternative semiconductor materials for photonic applications to work around their silicon deficiencies.

Wasted Power. Despite all of the power pumping out of a silicon-based circuit, there’s also a ton of energy being lost in the process. Check out the graph below, and you’ll see what we mean. 20nm processors are already tipping the scales beyond 50/50 between usable power, and power that goes to waste.”(1)

Although silicon offers these disadvantages behind a multi-billion dollar industry and specialized distribution networks for this complex supply chain, there are several candidates to replace silicon in different industries and applications.

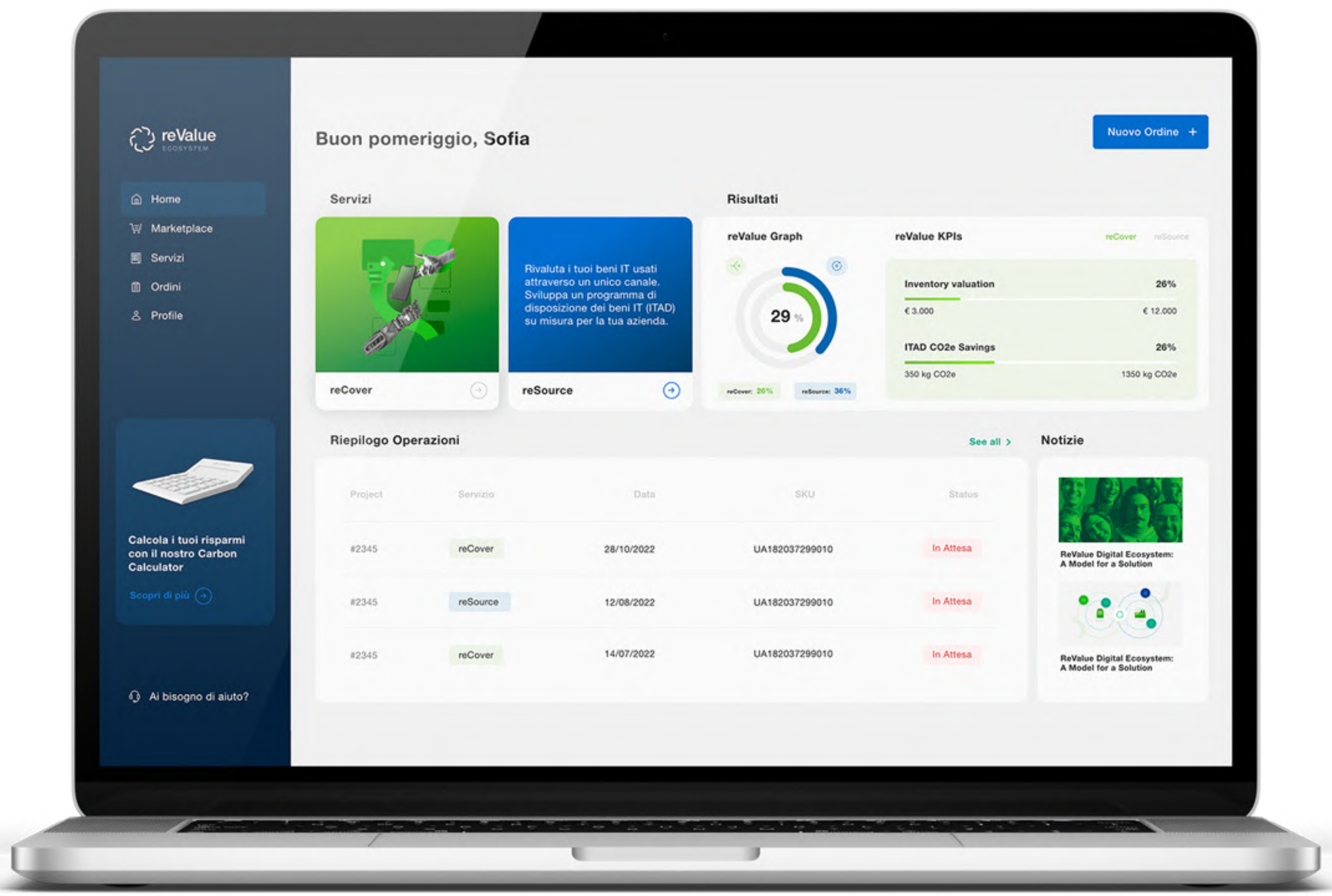
The application of flexible circuits in the healthcare industry is more than a decade old. Applications such as optical detectors, flat-panel displays, and sensor arrays have been developed under the model of thin-film transistors. These flexible integrated circuits can be used for thermal sensors for artificial skin, and flexible vibration and photodetectors could work as electrically powered artificial Auris Interna and retina, respectively; as well as electronic implants (2).

On the other hand, bronze is often used in integrated circuits, but is not always the best material for situations outside an office or home. There are also conditions that determine how resilient an integrated circuit must be. If for example, this integrated circuit must operate in a very corrosive environment: bronze should be replaced by stainless steel; if its activity is supercomputing, perhaps aluminum is better because of the low temperatures (3).

The last candidate to replace silicon could be graphite: it is a better conductor, more resistant to temperature changes, and very flexible. Although it has properties that make it a viable candidate, extracting a gram of usable graphite to create a processor would be economically unfeasible: it costs around $800 (1). On the other hand, graphite when doped with impurities to make it into a semiconductor starts to change its electrical behavior. Although it is a great option for many reasons, it still has a long way to go before it becomes a contender to replace silicon.

Zero-emission ICT has arrived to B2B

Discover the reCover Marketplace



reCover has gone digital

Circular Technologies brings us its new digital marketplace reCover, a solution for companies and industrial actors who want to dispose of their used ICT equipment with the greatest economic benefit and at the same time follow the environmental requirements that this equipment must meet during its End-of-Life stage. For Circular to extend the use of the products is the first solution to deal with electronic waste and recycling as a last resort. This new digital marketplace is aimed to optimize the value of this equipment, improving the exchange of these products by directing industrials and companies to reconditioners and recyclers with the best solutions, and finally having detailed documentation of the environmental conditions of these products; as well as the history of their use, repairs, and locations of use

With this new digital marketplace, Circular Technologies seeks to bring together on a single platform the possibility of giving ICT products new cycles of use, as well as sending inventories of old technology to recyclers to take advantage of raw materials. During the second half of 2022 Circular Technologies has conducted various tests of the platform and processes with commercial partners. These tests have successfully validated Circular's digitization, sorting, and documentation processes.

Image credit: Pexels

How does the reCover platform work?

From the creation of the customer's profile, the process of digitizing the inventory begins, a process that Circular Technologies can perform with its own team, or, the customer can do it with the best practices guidelines for packaging and inventory management available on the platform. For all products, we create the necessary documents for the compliance that the customer needs: operational, financial, and environmental documents. All these documents allow full traceability of the equipment and batches, during the digitization process as well as marketing and distribution. Each step is reported through the platform and customers can access the corresponding batch or equipment information.

The product classification system is organized as follows: A, B, C, D, and R.

Each letter will be used depending on the amount of work to be done on the equipment to be reconditioned and have a new cycle of use (A, B, C, D), or if the equipment is to be recycled (R). It also allows for determining to whom this lot can be sold and how it would be used.

The customer through the platform will also be able to make a programmed disposal of its inventory: the products close to being sold or disposed of will be accepted on the platform in advance to find the best buyer.

Protected Data

In Circular, it is essential to protect the customer and his information: ICT equipment is a delicate piece of equipment that contains sensitive data. One of the most important processes for the correct management of inventories is data destruction. Certifying the correct implementation is an essential condition for selling the equipment to reconditioners and recyclers. At Circular Technologies we use Blancco technology to perform this process and ensure the protection of reCover customers.

blancco | Reduce Risk. Increase Efficiency. Be Sustainable.™

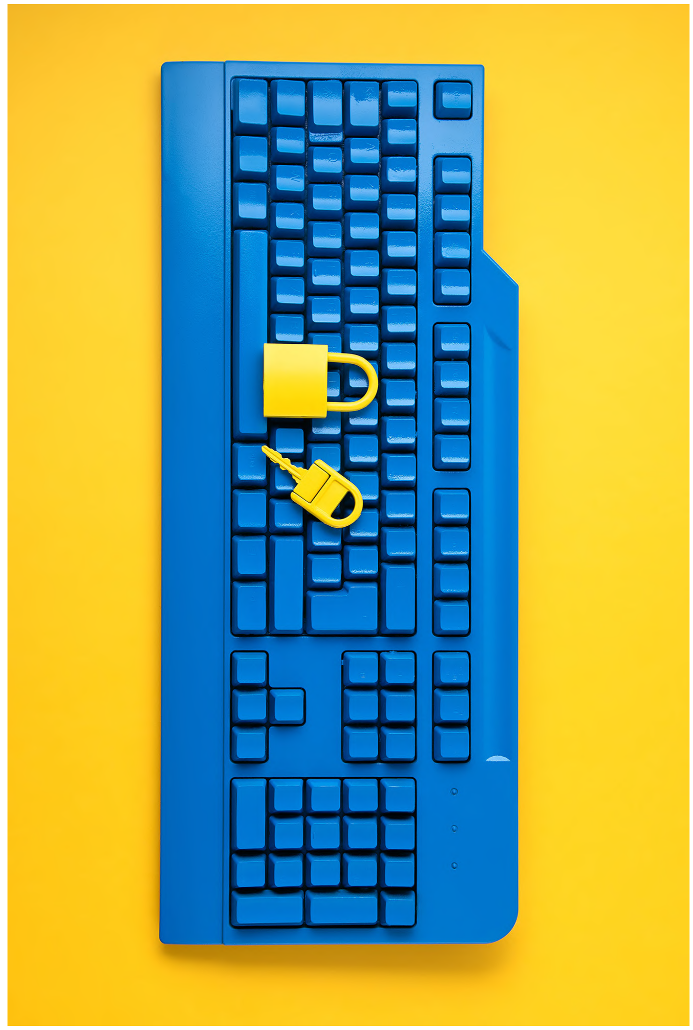


Image credit: Envato Elements

We are currently taking applications to sign up for the platform early. The platform is scheduled to go public on December 13.

If this is a solution that fits your ICT equipment disposition needs, we invite you to sign up at **www.circulartech.world.**

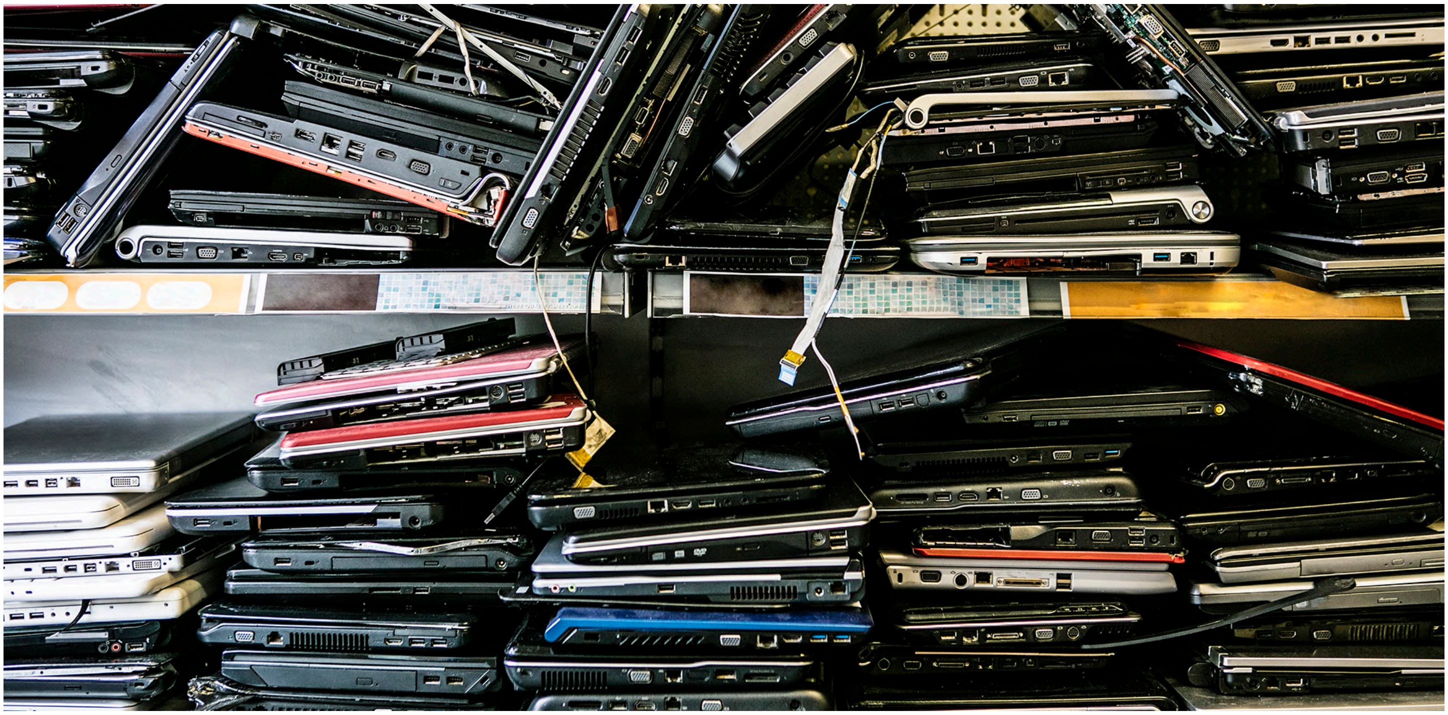


Image credit: Envato Elements

The shortage of ICT products and spare parts in 2022

By November 2022 we are still feeling the diminishing effects of a pandemic but many consequences are still very palpable in global, regional, and local economies. The ICT sector is still feeling and managing the by-product of these times. On the first order the disruption of the supply and manufacturing chain, on the second order a wave of canceled orders due to a lack of materials to produce parts and equipment has put stress on all players involved in the production, distribution, and sale of ICT equipment.

The factories of the components for the manufacture of ICT equipment are mainly located in Asia, specifically in China and Taiwan. The pandemic has resulted in temporary closures due to outbreaks, as well as a complete stop of segments of the production chain due to governmental prevention or prohibition. These cuts in OEM's activity have led assembly plants to cancel certain orders to prioritize some products over others. In a landscape with reduced supply companies like Intel choose to meet the demand for their higher-end products, having a better return for them:

"Intel, for example, until it rolled out its new 10 nm system, prioritized server and high-end desktop processors over low-end processors with its 14 nm capability" (1).

And precisely this prioritization causes the supply of parts and equipment to be reduced to the products that have the highest economic value for OEMs. These supply chain and production problems are forecast to persist through 2023. Prices will rise and lead times will increase significantly:

"The company's Commodity IQ platform predicted that 85% of price dimensions will increase and 83% of lead times in delivery time will extend as this quarter progresses.

The same forecast extends into next year, as prices are likely to increase and more than 70% of lead times will increase through Q1 2023."(2)

But it's not all bad news. The reality is that foundries have made a gigantic effort to supply the demand during 2022: increasing their production capacity (reaching in some cases to have 100% of the productive capacity of the plants) and reducing component hoarding. Another reality is that countries have seen an opening in their distribution routes as a consequence of the relaxation of the sanitary measures seen in 2021, causing the demand for ICT products such as laptops, tablets, and mobile devices to decrease little by little while companies and workers normalize their activities. We will see what 2023 has in store for us, possibly a normalization of demand and a possibility to reach a balance in production.

> **"...foundries have made a gigantic effort to supply the demand during 2022: increasing their production capacity and reducing component hoarding."**

5 budget laptops

Image credit: Envato Elements

The Sustainable Things team is always looking for great deals in ICT equipment, deals on laptops, refurbished routers, or anything that we could say has a great value between quality and price. In this issue we delved into the greatest budget laptops on the market:

Asus Chromebook CM3

CPU: MediaTek MT8183 Processor 2.0 GHz
(1M Cache, up to 2.0 GHz, 8 cores)
Graphics: Integrated Arm Mali-G72 MP3
RAM: 4 Gb
Screen: 12 Inches
Hard Disk: 32 GB
Connectivity: WiFi, Bluetooth, optional GPS, LTE
Weight: kg 2.51 Pounds
Dimensions: 269.24 x 215.9 x 16.7 mm (LxWxH)
OS: Chrome OS
Price: **EU 298,00**

Lenovo IdeaPad Duet 5 Chromebook

CPU: 2.55 GHz Snapdragon
Graphics: Qualcomm Snapdragon 7c
RAM: 4 GB LPDDR4X
Screen: 13.3 Inches
Storage: 64 GB
Connectivity: WiFi, Bluetooth, GPS, LTE, Ethernet
Weight: kg 4.09 pounds
Dimensions: 306.07 x 185.9 x 6.58 mm (LxWxH)
Price: **EU 396,12**

Asus E410

CPU: 9 GHz 1.2GHz Cortex A9
Graphics: Intel
RAM: GB
Screen: 14 Inches
Storage: 128 GB
Connectivity: WiFi, Bluetooth, GPS, LTE, Ethernet
Weight: kg 1 pound
Dimensions: 325 x 18.54 x 216.92 mm (LxWxH)
Price: **EU 211.67**

Samsung Galaxy Chromebook 4

CPU: Intel® Celeron® Processor N4000
(1.10 GHz up to 2.60 GHz 4 MB L2 Cache)
RAM: 4 GB LPDDR4 Memory
Graphics: Intel® UHD Graphics 600
Screen: 15.6" FHD LED Display (1920 x 1080)
Storage: 64 GB e.MMC
Connectivity: WiFi, Bluetooth,
Weight:1.7 kg
Dimensions: 359.7 x 244.9 x 16.5 ~ 16.5 mm (LxWxH)
OS: Chrome OS
Price: **EU 349**

Panasonic Toughbook CF-33

CPU: AMD Ryzen 5 5500U
Graphics:
RAM: 8 GB
Screen: 15.6 Inches
Storage: 256 GB SSD
Connectivity: WiFi, Bluetooth,
Weight: 1.76 kg
Dimensions: 250.5 x 363.4 x 17.9 mm
Price: **EU 419**

Our goal at Sustainable Things is to analyze markets, trends, and products in the context of improving our use of resources and finding solutions to the e-waste problem. We are proud to announce the creation of the ICT Circular Observatory, a place to work on solutions for the ICT sector and share information. This information center and meeting place come to life to provide a space for discussion and research on devices and their best use, circular economy, and sustainability.