



# Operationalizing the Circular Economy

How HP is Reinventing  
Sustainability for the Tech Sector

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# Executive Summary

- At its current rate of growth, e-waste—discarded electronic devices and components—is expected to reach approximately 75 million metric tons by 2030, contributing to the roughly 2 billion tons of municipal waste generated each year. The negative impacts of this global problem are not only ecological. They have already begun to affect human health and put strain on material costs and supply chains.

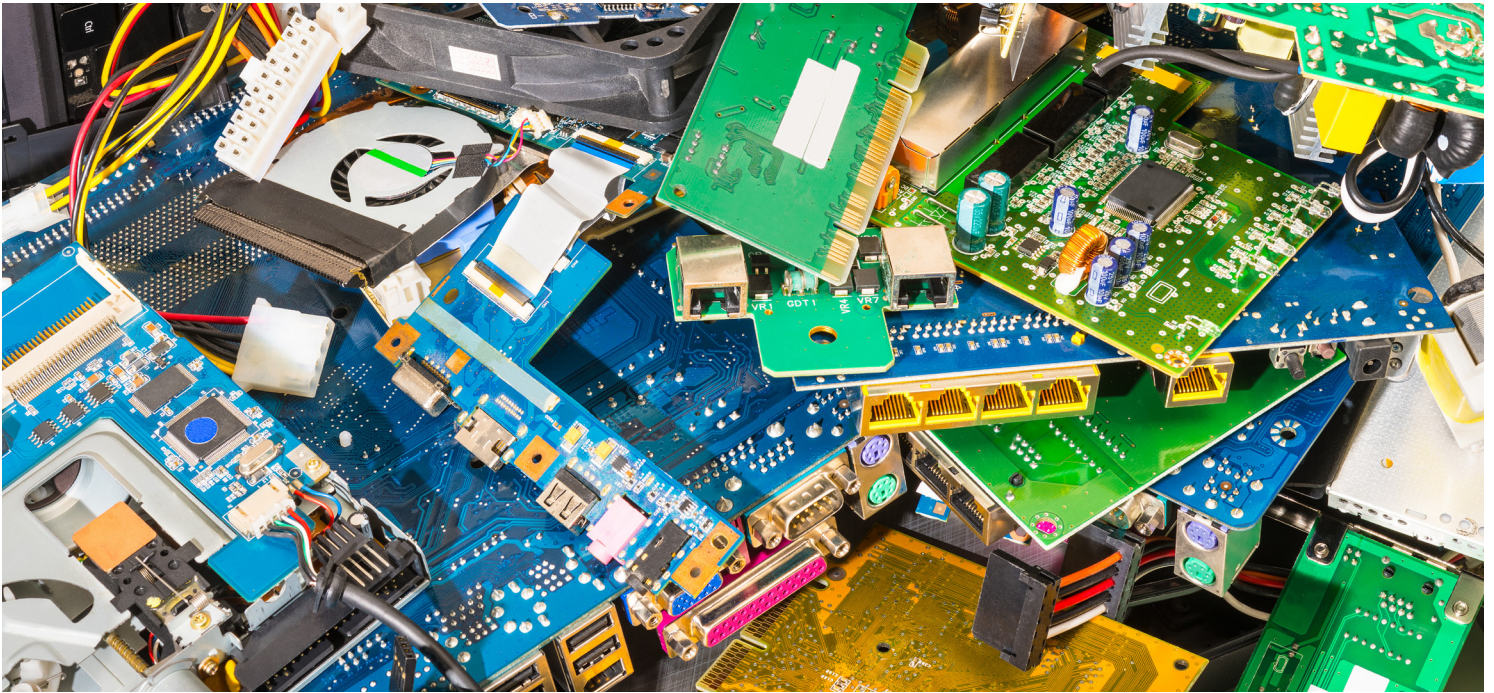
Two critical linear economic inputs driving the global waste crisis are systemic failures to:

- Design products with the intent to minimize their negative environmental impact.
  - Develop sustainable economic and supply chain systems that capture those products and their materials before they end up in landfills. Shifting to a circular model will not only transition “waste management” to a more impactful and sustainable repair-reuse-recycle model; it could also potentially reduce the volume of plastics making their way into the oceans by as much as 80% by 2040.
- The tech sector has a unique opportunity to play a critical role in addressing these challenges by:
    - Designing more sustainable products.
    - Adopting more sustainable business models.
    - Helping build circular supply chains for their organizations and partners.

## Five Fundamental Challenges Standing in The Way of Transition

- 1 Shifting consumer uncertainty to consumer confidence
- 2 Rebooting product design for enhanced circularity
- 3 Injecting more operational agility into traditional business models
- 4 Operationalizing regulatory fluency
- 5 Building alternative and parallel supply chains

- HP’s approach to building a circularity model provides an actionable blueprint for the tech sector. Specifically: combining innovative material and design choices, material reduction strategies, minimizing complexity (and enabling recoverability), and extending device lifecycles to help device OEMs, IT leaders and service providers supercharge their own sustainability programs.
- This whitepaper also looks into how device OEMs, IT leaders and service providers can define circularity as a business opportunity for their own organizations and highlights actionable strategies to do so, from making product design more sustainable and supply chains more circular, to rethinking device procurement and lifecycle management.



## Sustainability Challenge: Reducing Waste and its Devastating Environmental and Public Health Impacts

The world is drowning in waste. The expansive scale of our globalized economy, a world population expected to surpass 9.5 billion by 2050, and decades of supply chain linearity, have stretched world resources beyond their ability to continue sustaining global needs. This economic model has led to an explosion of waste around the world, with roughly 2 billion tons of municipal waste being generated each year around the world (translating into 5.5 million tons of waste per day).

Waste is not merely an inconvenient aesthetic problem. In less than a century, it has grown into an existential environmental threat that no one is now safe from. At scale, the broad spectrum of environmental hazards posed by waste affects water and food safety, which in turn increasingly negatively impact human health and life expectancy. Waste is also directly related to a growing trend of critical ecosystem collapses around the world and contributes to the acceleration of climate change. While topics like climate change and environmental protections can often find themselves at the heart of contentious political debates, consumers, the scientific community, and industry leaders agree that waste is neither a debatable problem nor one we can continue to ignore or run away from.

Our global waste problem becomes all the more relevant when we zoom in on plastic waste and e-waste. According to the United Nations, of the 400 million tons of plastics produced each year around the world, half are still designed for single use. Perhaps more shocking, less than 10% of those 400 million tons of plastic per year is ever recycled. Additionally, it is estimated that 11 million tons of plastic waste flow into our oceans annually, with expectations of this volume tripling by 2040. It is important to understand that the threat posed by this explosion of plastic waste isn't limited to its impact on oceans, rivers, lakes, and the ecosystems they support. Medical researchers studying the effects of plastic exposure on human health have already warned that microplastics are beginning to accumulate and persist inside human tissue. To make matters worse, a recent study published by the American Chemical Society in [Environmental Science and Technology](#) confirms that microplastics are now starting to turn up inside the human heart and its innermost tissues.

Piling on to this problem is the growth of e-waste—discarded electronic devices and components that often contain hazardous materials such as lead and mercury. According to Statista, global e-waste volume continues to grow and is expected to reach approximately 75 million metric tons by 2030.

“Out of sight, out of mind” is therefore no longer a viable strategy when it comes to waste management policies, and certainly not when it comes to addressing the threat posed by the runaway rate of plastic waste and e-waste accumulation. The question we collectively face today is simple: what steps can we take to solve this problem effectively, ethically, and at scale, and preferably without inadvertently causing negative ripple effects of economic and social disruption?



## Sustainability Opportunity: How Shifting from Linearity to Circularity Can Help Organizations Supercharge Their Sustainability Programs

On the surface, the global explosion of waste is the predictable outcome of over a century of waste management policy failures, but it goes beyond that. First and foremost, our global waste problem is the result of a sustained failure to both design products with the intent to minimize their negative environmental impact and develop sustainable economic and supply chain systems to capture those products and their materials before they end up in landfills. In other words, the problem cannot be solved by reactive approaches alone, but rather through a combination of reactive and proactive approaches.

The incumbent linear economic model is predicated on the assumption that waste, being an unavoidable byproduct of both production and consumption, must somehow be “dealt with” (disposed of in landfills and other waste disposal spaces). This model is by definition reactive: It waits until waste is created then assigns resources to move and store that waste to spaces where it then sits, accumulates, and spills over into water supplies and unprotected ecosystems. This type of model may have been manageable when the amount of waste human communities produced on a daily basis was negligible but given the 5.5 million tons of waste that our global economy now dumps into its already overflowing landfills every single day, linearity is no longer a viable course. We simply cannot continue to operate under this outdated and ill-adapted model.

Beyond linearity not making sense from either environmental or public health standpoints, treating precious, limited resources as mere throwaway, single-use commodities doesn't make long-term economic sense either: Why shorten the utility of increasingly scarce materials and products by throwing them away when they could be captured and reused instead? If a compelling economic reason to transition from linearity to circularity could be made, with positive ROI outcomes aligning with positive environmental and public health outcomes, the global waste problem could become far more addressable.

Enter circularity, one of the most promising economic models gaining real traction in sustainability circles. Circularity aims to apply complete system thinking to the problem of waste and responsible resource management. It pushes back against the assumption that waste is an inevitable byproduct of both production and consumption, and instead looks at product and resource lifecycles as self-perpetuating continuums of operationally effective, environmentally responsible, economically-sound use and reuse of materials products. In circular economic models, resources, materials, and products aren't merely collected and recycled. They are also designed to be reused, serviced, refurbished, and recycled for as long as possible to extend their utility. In addition, systems are put in place to aid in the collection phase to minimize friction and smooth the logistical stumbling blocks that have traditionally hindered broad adoption of recycling initiatives.

In terms of opportunity, shifting to a circular economy can begin to replace "waste management" with a dynamic, proactive, full-service repair-reuse-recycle model. At scale, such a shift could potentially reduce the volume of plastics making their way into the oceans by as much as 80% by 2040, but on a more targeted level, even a small shift toward circular-themed models within organizations could serve as a catalyst to supercharge their sustainability programs and make them more impactful. IT departments in particular have a unique opportunity to play a leading role in that effort.





## Operationalizing Circularity: Overcoming 5 Fundamental Challenges

Change is hard, especially at scale, and tackling a challenge as complex as transitioning from the ingrained linear economic model to which we are accustomed to an unfamiliar "circular economy" requires a lot of work and adaptation.

There are many moving parts to such a system and few companies have the resources, let alone the right incentives, in place to turn the idea of a circular model into reality. To execute a shift from linear to circular models, organizations require broad internal buy-in, the cost-benefit equation has to fit within P&Ls and budgets, and product design teams and manufacturing engineers have to be committed to the mission. The logistics of inbound capture can be daunting as well, especially at scale. In addition, product safety regulations and market expectations of product performance can often make it difficult for companies to make substantial changes to their products in the pursuit of becoming more sustainable and circular.

Five key challenges are particularly difficult to solve. In no particular order:

**Shifting consumer uncertainty to consumer confidence:** First among the most likely friction points in transitioning to a circular model is the challenge of shifting consumer expectations. Specifically, the core challenge here is to get consumers on board with the notion that a reused product is as reliable, durable, and valuable as a brand new one. This shift is especially challenging when that product normally fits into a premium pricing tier.

Ironically, the paradox that companies have to work with is that while consumers increasingly demand strong recycling and sustainability initiatives from the companies they do business with, they can be fickle when it comes to actually purchasing recycled or refurbished products. While many products align naturally with recycling programs and circularity models, others, such as technology products and high-ticket items, can require a little extra education and assurances to strengthen consumer confidence in their value.

One way to help move user perceptions is to, over time, demonstrate that the value and performance of refurbished devices, when designed properly, are indistinguishable from new products. Another is to remove some of the risk from the equation by shifting models of product acquisition from ownership to lease, rent, and hardware as a service models, where the device

provider takes on the responsibility to deliver, manage, collect, and replace devices as needed. This type of managed model is especially useful to organizations whose IT decision-makers (ITDMs) are too busy or otherwise ill-equipped to take on the complexity of creating and managing their own recycling and hardware sustainability programs. Partnering with a service provider or OEM that will manage the full lifecycle of PCs, tablets, handsets, point of sale (POS) terminals, sensors, cameras, printers, and other devices is a relatively low-risk, low-cost way for organizations to both participate in the circular economy and overdeliver on their baseline sustainability targets.

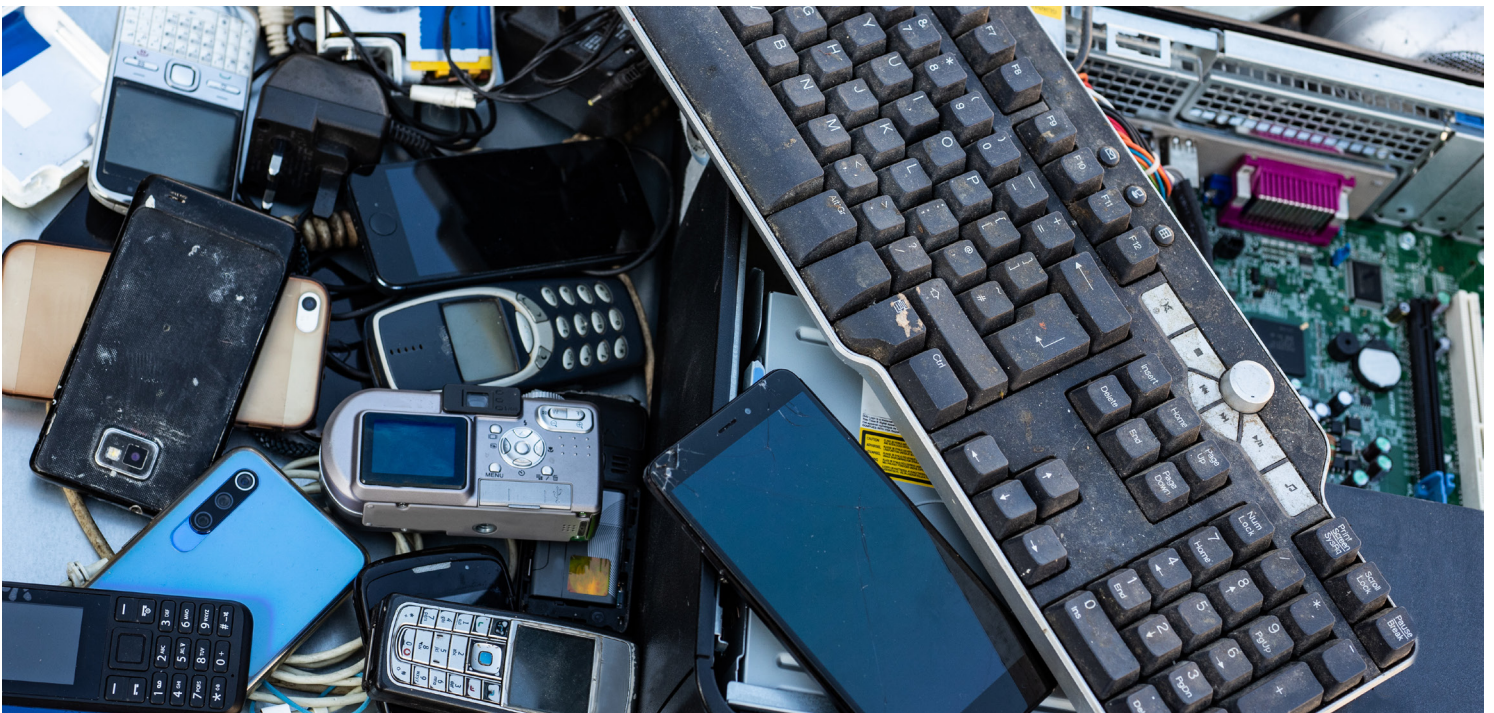
**Rebooting product design for enhanced circularity:** Second comes the challenge of deliberately designing products to be more easily refurbished and maintained, with more universally interchangeable parts to facilitate repairs and the recovery of materials during end-of-lifecycle disassembly.

Injecting more operational agility into traditional business models: The third challenge focuses on developing new business model approaches that take into account shifts in demand as technology users purchase (and update) cycles for devices lengthen over time.

**Operationalizing regulatory fluency:** Fourth, keeping up with evolving regulations on what features devices must have when introduced to the market requires a more operationally integrated approach, not just in specialized roles but across the entire product-facing organization.

**Building alternative and parallel supply chains:** Last, establishing reverse supply chains—to get devices such as computers and printers back to recycling centers—presents a complex logistical puzzle that most IT organizations don't have the resources to handle, let alone a business case for. Third-party service providers looking to fill that circularity gap can help but can run into challenges when working outside of a device OEM's existing supply chain.

Thus, for circularity to work at scale, OEMs have to build their own alternative, parallel, reverse-supply chains to collect devices from their customers and transport them to properly equipped recycling facilities. The ideal solution to this logistical problem is therefore for IT organizations to partner either with an OEM or with an integrated service provider operating inside of an OEM's closed-loop circular supply chain.



# OEM Partnership Focus: Why HP's Turnkey Circularity as a Service Strategy Checks the Right Boxes

HP's approach to circularity is an example of how a legacy technology company can help solve a global problem by incorporating intentionality into its products' entire lifecycles—from initial material selection to their ultimate end of life. Key here is the ability to scale that operational mindset across the company's entire ecosystem: innovation centers, design groups, engineering teams, supply chains, customer services, and so on.

This approach can be broken down into two foundational, synergistic tracks: On the product design and engineering side, HP's design philosophy delivers products that are increasingly designed to be more serviceable and sustainable so that they can remain in use for as long as possible. On the service-based solutions side, HP works to reduce environmental impacts through extended life planning, service contracts, and product take-back programs. HP's repair, reuse, and recycling services also help to recover components and materials for use in the company's next generations of products.

Digging a little deeper into the ways that HP applies these principles tactically reveals inspired best practices that make the company's efforts stand out:

**Innovative material and design choices:** From a product development perspective, the intentionality of HP's circularity-focused thinking is evident in the initial material and design choices that go into every product. From the start, product design teams consider what the most significant waste issues might be for each product, including what materials are most easily replaced with recycled alternatives, and prioritize those based on which will have the biggest impact. This way, end-of-life considerations, which traditional linear models used to treat as afterthoughts, make their way into the very first iterative phases of product design. This model, in turn, drives creative approaches to material selection within the scope of a circular recycle-reuse-and-reduce operational mindset.

An example is the EvoCycle hybrid toner cartridge, which with 76% reused and recycled materials (excluding toner and parts that directly impact print quality), supports the circular economy and helps public sector and enterprise customers with their sustainability journeys by using less virgin plastic and lowering its production-phase carbon footprint (compared with standard Original HP toner cartridges).

This design philosophy has led to HP's expansive experimentation with abundantly available plastics and bio-circular waste materials looking for innovative new uses—among them are used cooking oil, coffee grounds, ocean-bound plastic, plastic hangers, plastic water bottles, bamboo, rice husks, recycled fiber, and more. These have all found creative and useful second lives in HP products. The use of coffee grounds as a replacement for mica in laptop covers is a great example of this type of successful experimentation, as coffee grounds can provide comparable aesthetic speckling as mica while allowing the plastic to which they are bonded to be more easily recycled.

**Material reduction:** HP's circularity-focused design mindset is also characterized by a focus on reducing the need for superfluous materials from the start. A recent example of how this translates into real-world innovation is HP's All-in-One laptop, introduced at CES 2023, whose detachable monitor stand allows it to be packaged in a box 60% smaller than its predecessor. While packaging in and of itself is an obvious focus area for material reduction initiatives, it is important to note that deliberate product design choices can be made to contribute packaging efficiency improvements as well.



**Reducing complexity and enabling recoverability:** HP has also found scalable success in designing to reduce complexity and to enable easier recoverability of materials. Nowhere is this more obvious than in ink cartridge innovations, which have already led to 80% of raw materials from 10,900 tons of Original HP ink cartridges being recovered and reincorporated into new products instead of ending up in landfills. [Today, more than 85% of HP's ink cartridges and 100% of toner cartridges, including some of the company's most popular models, contain recycled plastic.](#)

**Extending device lifecycles:** HP's new Device Life Extension Service, launching this year, aims to enable organizations to send PCs from their existing fleets to be refreshed or optimized for performance and returned to the customer. Aside from the obvious economic and operational benefits of extending the life of enterprise PCs where it makes sense to do so, this type of service adds valuable flexibility to the IT lifecycle management toolkit.

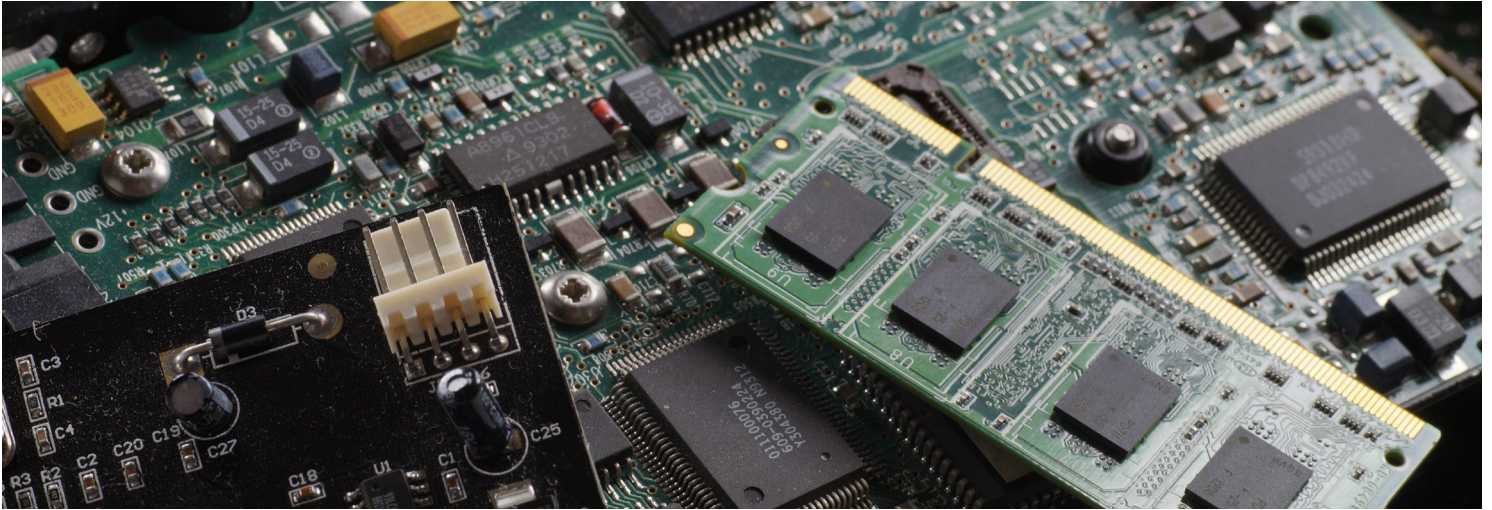
**Undertaking additional end-of-life considerations:** As previously stated, circularity requires considering the full lifespan of a product and what happens to it at the end of its lifecycle. One of several interesting projects that HP has undertaken in this space has been the creation of closed-loop systems for reusing its own materials, where HP acts as both the producer and the buyer. HP's Planet Partners ink cartridge recycling program, for example—through which more than 1 billion cartridges have been recycled and reused in new HP products to date—is a valuable test case for this type of initiative, especially as most open-source recycling programs have traditionally struggled to find end buyers for recycled materials.

HP is also engaged in the design of business models that allow for frictionless refurbishment and reuse. HP now offers HP Certified Refurbished PCs, enabling customers to purchase second-life devices. Every HP Certified Refurbished PC undergoes a rigorous refurbishment process and is then tested extensively and inspected to ensure optimal performance and reliability. HP introduced HP Certified Refurbished PCs in France and India in 2023. Offering refurbished PCs represents a transformational shift in the way HP does business. It also reflects HP's commitment to driving a more circular economy and marks a significant step toward the company's target of 75% circularity for products and packaging by 2030. Perhaps most important, this type of program is designed to help HP customers and partners meet their own sustainability targets.

The next phase of this program is the expansion of the HP Certified Refurbished PC offering to the US market, along with an HP Certified Partner Refurbishment program. HP Certified Partner Refurbished PCs will be available for purchase from select, third-party HP Certified Refurbishment Partners and will come with a 1-year Limited Warranty.

For older generation PCs that may not be suitable for the average commercial user, HP refurbishes them to the same HP Certified specifications and, through its Project HOPE program, donates them to underprivileged students around the world, helping bridge the digital divide.

Additionally, segments of HP's future portfolios will offer a subscription model designed to minimize risk for customers, create more logistical agility for HP, and align with the sharing and leasing elements of true, frictionless circularity. This model will not only benefit customers in terms of product needs and use cases but also provide significant benefits to the environment. By creating a closed-loop circle in which HP can easily recapture its own hardware, it can keep that hardware out of landfills and identify better reuse and remanufacturing processes for it. This approach also enables HP to fine-tune its global resource planning efforts. To that end, HP is actively working to transform its supply chain to better serve its sustainability and resilience objectives in service of its circular approach to product and service innovation.



# Operationalizing Circularity Strategies Into Existing Sustainability Initiatives

HP's work in leading the tech sector away from wasteful linear product lifecycle thinking and toward a more sustainable and economically sound circularity model proves that with focus, deliberate intent, and consistency, small changes in mindset, design thinking, and operationalization can add up to large-scale impact. OEMs, service providers, and ITDMs can leverage the following key takeaways from HP's successful to improve their own sustainability program outcomes.

## Device OEMs

- 1. Rethinking the product design process:** For device OEMs that haven't yet started incorporating circular product lifecycle discussions into their product development practices, now is the perfect time to start. Product development teams should partner with design engineers, manufacturing engineers, and product marketing teams to begin their design process with the end in mind and expand the existing design process to explore all the ways that refurbishment and reuse could be injected into early product ideation and market research discussions.

Device OEMs can also bring service and logistics-oriented segments of their business early into product development discussions and challenge themselves to think about how to build subscription services and take-back programs to either extend the lifespan of their products or give products a second life.

- 2. Defining circularity as a business opportunity:** Device OEMs should identify areas where their organization can have the most impact at scale. One way is to buy refurbished products or look for partnerships with refurbishment services for existing products. If it makes more operational and financial sense, another way is to build a closed-loop recycling business. Planet Partners and its over-a-billion recycled cartridges story is a great case study in how one company's closed-loop system keeps significant amounts of plastics and e-waste out of landfills, creates added differentiation and value to channel relationships, and makes an OEM's supply chain more financially and operationally sustainable.
- 3. Scaling buy-in across the organization:** Device OEMs should also cultivate an internal 360-degree buy-in culture for their circularity mission. Getting as many people involved as possible and empowering them to become program ambassadors within their respective business units is a vital component of this kind of strategy. Circularity didn't spread at HP by accident. It spread and took root because HP has made a point to make circularity everyone's business, not as an afterthought but as a core business mission.

HP's Renew Solutions program already looks like a useful, repeatable model for how device OEMs—by thinking of their sustainability and circularity objectives as business development opportunities—can unlock untapped utility and capabilities within their engineering, design, sales, strategic partnerships, marketing, and supply chain organizations. When the entire company is united in the pursuit of a common circularity-focused purpose, it becomes a lot easier to operationalize it.

## Sustainability Service Providers

- 1. Advisory services:** The circular economy opportunity for sustainability service providers is obviously to fill gaps in the market. One area that immediately comes to mind is consulting and advisory: OEMs and ITDMs, especially in the SMB space (small and midsize businesses) often need fresh, knowledgeable eyes to help them identify opportunities and partnerships. Experienced third-party subject matter experts (SMEs) can help them develop sustainability strategies and programs. No matter how mature or successful those programs are, most decision-makers, both in the OEM and ITDM spaces will also need external advice and guidance regarding any number of topics, from why and how to inject circularity into their programs, navigate regulatory currents, avoid costly hurdles, and achieve key certification milestones, to providing internal training, program metrics, and external reporting. For companies that may lack some of those key competencies internally or whose resources may be stretched to their limits, partnering with consulting and advisory services firms can help bridge the gap from mere opportunity to real-world execution.
- 2. Logistics and fulfillment services:** Another opportunity for sustainability service providers is to act as the missing link between IT organizations and OEMs. In instances where device OEMs may not have closed-loop circular programs in place, or where their buy-back and recycle programs may not be deployed in every market they serve, specialized service providers can step in to perform missing or underserved functions at any stage of these incomplete programs. Service partnership opportunities range from helping manage devices through service contracts to capturing, shipping, and participating in the recycling of discarded devices.

## ITDMs

- 1. Rethinking device procurement and lifecycle management:** As with device OEMs, now is a great time for ITDMs to start incorporating circular product lifecycle discussions into their organizations' procurement, device management, and sustainability practices. One way to get started is to think about how all three of the above functions can converge more synergistically. Scheduling discussions about how to expand existing procurement processes with a mind toward exploring all the ways that refurbishment, reuse, and more circular device management services could cut both cost and risk out of the model are good directions to shoot for.
- 2. Achieving company-wide buy-in for sustainability and circularity:** As with the other groups, it is important for ITDMs to cultivate an internal 360-degree buy-in culture for their circularity and sustainability missions. Getting as many people involved as possible and empowering them to become program ambassadors within their respective business units is a great way to scale. Circularity spreads at HP because HP makes circularity everyone's business. This exact strategy can be replicated across customer organizations, not only across IT departments but to all of the departments and teams those IT departments serve.

Just as HP's device refurbishment offering is a great example of how this principle can be operationalized on the device OEM side, connecting the company's supply chain, sustainability, marketing, engineering, and design teams and more in the pursuit of a common purpose, customer-side programs can be built to mirror the same mission focus. Because of its potential role in reducing plastic waste and e-waste, IT can leverage this model to transform into a value-center or hub for the organization's overall sustainability objectives.

We know that purpose-driven companies are successful and that employees want to work for them, but for it all to work long-term, employees and stakeholders must feel that the purpose they have bought into is meaningful and that their organization empowers them to help drive that purpose forward every single day.

- 3. Building on-ramps of subject-matter expertise:** To reduce risk and take the guesswork out of their sustainability and circularity initiatives, ITDMs should encourage and support the establishment of knowledge centers within their own organizations, particularly with regard to environmental legislation and regulations. This is especially relevant to organizations operating in states, countries, and regions with stringent rules and regulations and complex bureaucracies governing green program certifications, recycling, product safety, and public disclosures. On the one hand, these internal SMEs can identify geo-specific sustainability opportunities for the organization, including public-private partnerships and grants. On the other hand, they can help navigate bureaucratic, regulatory, and certification hurdles that could interfere with the organization's global sustainability and circularity programs.

Alternatively, this SME role could be outsourced, either to a third-party consulting organization or to recycling service providers, including OEM partners with their own closed-loop circularity programs and program expertise.

- 4. Making the most of the new era of sustainable IT:** ITDMs should work to identify areas where their organizations can have the most impact at scale. One way is to buy or lease refurbished products. Another way is to look for aftermarket refurbishment services to partner with. A third way is to partner with device OEMs with their own closed-loop recycling programs.

Planet Partners' one billion recycled cartridges demonstrates the efficiency of participating in that type of closed-loop system. This approach succeeds where most other recycling programs have struggled because in that kind of model, the recycling organization doesn't need to find buyers for recycled products.

When the sellers are the buyers, supply and demand exist as a mostly closed loop. This setup gives ITDMs the opportunity to opt into circularity at little or no cost to their organizations while deepening their operational connective tissue with key device OEMs.

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