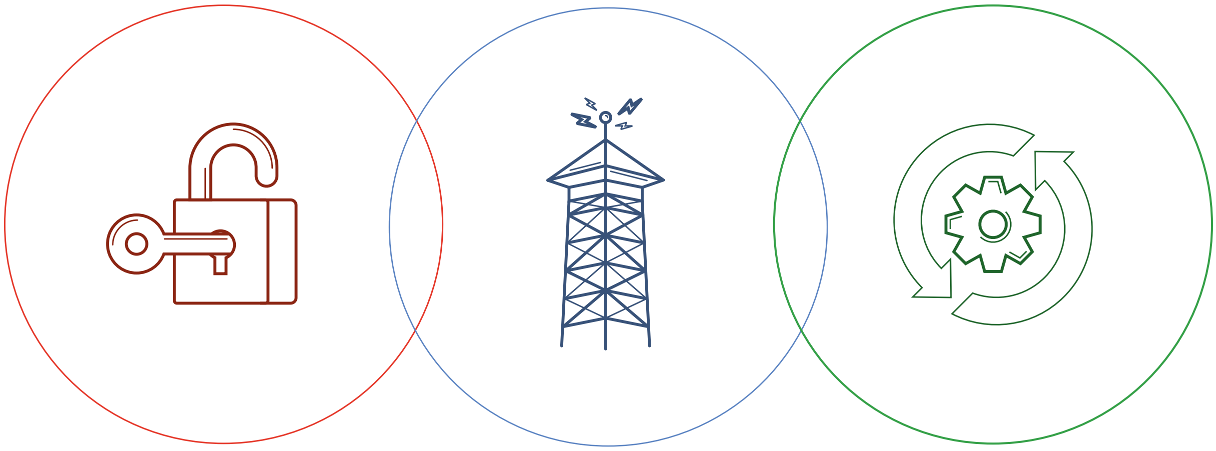
THE ROLE OF SAFE CHEMISTRY AND HEALTHY MATERIALS IN UNLOCKING THE CIRCULAR ECONOMY



MIKE WERNER,
ROBIN BASS,
PRIYA PREMCHANDRAN,
KATE BRANDT AND DARIEN STURGES

ELLEN MACARTHUR FOUNDATION

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At the Ellen MacArthur Foundation, our mission is to accelerate the transition to a circular economy - one that is consistently regenerative and restorative. By contrast, the prevalent economic model is enormously wasteful. Most of the materials we use, we lose, and the things we make are consistently under-utilized. At the Foundation we believe there is a compelling case for generating economic value and environmental benefit from putting materials into perpetual use cycles – rather than just consuming them. This vision has seen rapid uptake in the past few years and has been embraced by businesses across different industries, including large companies such as Google.

The principles of a circular economy are to design out the concept of waste; to rebuild natural capital; and to keep products, materials, and molecules flowing effectively through the economy at their highest value. While this requires the adoption of circular design principles and the establishment of appropriate recovery systems, these cycles of recovery and recirculation make system-appropriate materials choices a prerequisite. Making such choices is a major challenge across industries today. Some materials should not be used because they contain substances of concern that negatively impact human health and the environment. In other cases, the way materials are combined in a product inhibits their separation and capture after use. The result is additional waste and lost economic value.

The importance of safe chemistry in a circular economy

"If we are going to keep materials flowing in commerce longer, we have to design them to be safe for human and environmental systems, because we can't change the chemistry of products once we put them out in the world."

- **Michael Werner**, Chemist, Google

Chemistry is the engine of modern material ecosystems. There are more than 50 million chemicals registered in the Chemical Abstracts Service (CAS) database, and nearly 80,000 to 120,000 currently on the market. The ingenuity of chemists results in the discovery of a new substance on average every 2.6 seconds. However, our understanding of the short- and long-term impacts of these new chemical substances has lagged behind the drive to create new molecules and materials. We can see the consequences around us, including "sick building syndrome," flame retardants accumulating in human breast milk and being passed along to newborns, or entire city populations toxified from local environmental exposures and contaminated drinking water.

In order to effectively instigate systems-level change and capture economic opportunities, we need chemists, engineers, material scientists, and designers to be systems thinkers. We need to develop new materials and processes that optimize chemistry for human and environmental health, as well as capture the whole value of molecules, polymers, and complex materials by keeping them flowing through commerce longer. Imagine if the challenge to the world's chemists and material scientists is not only to develop molecules and materials that achieve a performance or aesthetic outcome, but also to ensure that these substances are safe for people and the environment, can be cycled and used to create future products, and retain economic value throughout its lifecycle. We need safer chemistry to unlock the circular economy.

A DECADE OF WORK AT GOOGLE

Google's Real Estate and Workplace Services (REWS) teams have spent the last decade understanding how our office spaces impact the health, well-being, and productivity of our employees and, in the next decades, how we could accelerate toward a circular economy to solve some of the most pressing social and environmental problems we will face together. With a workspace footprint spanning more than 150 cities around the world, we recognize that our growth has scaled to where we are impacting not just Google employees but our hometowns and neighbors too. We take that impact seriously.

For the past two years, Google and the Ellen MacArthur Foundation have partnered on a range of circular economy **issues** and **initiatives**. However, Google has been focused on material health in the built environment since 2010, and that interest is now also focused on other parts of our business. One of the questions we continue asking ourselves is: "Are these products and sourced materials safe for people and the environment?" In the drive to answer this question, we have recognized the importance of grounding our approach in the best available science and leveraging industry standards or best practices when available. We have also looked to trusted experts to help inform our strategy, tools and processes.

In the early part of our journey, we discovered that holistic and comprehensive standards for safe chemistry and healthy materials in consumer and building products were nascent or did not exist. Most of our industry partners, instead, were focused only on addressing waste and/or increasing the use of recycled content, with the intention of keeping materials in the value chain longer. Often, that decision was made without also understanding the fundamental chemistry of building products and prioritizing the short-and long-term effects on human and environmental health. It wasn't an intentional omission of health as a parameter of returning materials to the value chain but just a statement of where the industry was in understanding the problem. We began our Healthy Materials program at Google in 2010 to keep health in the conversation and to work with the industry to find and scale solutions that make building products safe for humans and the environment; not just for Google but for everyone.

Material health optimization begins by first assessing the chemicals across a comprehensive set of human and environmental health criteria followed by selecting lower hazard chemistries. However, the road to optimization was not obvious for all of the stakeholders across the value chain who need to be invested in this goal with us. In 2013, Google awarded the US Green Building Council (USGBC) a USD 3 million dollar grant to accelerate industry transformation and align on a **scientific framework for material health optimization**. The resulting framework utilized rigorous industry standards such as the Health Product Declaration, Cradle to Cradle, and the GreenScreen® for Safer Chemicals. Each of these values transparency in the marketplace and shares the principles of understanding material chemistry through screening and inventorying, then assessing for human and environmental health hazards, followed by optimization.

To implement this framework, we partnered with key organizations on the development of new tools and initiatives such as **Portico**, an online product evaluation database, and the **Quartz Project**, an open source dataset that benchmarks human and environmental health data for commonly used building products. As more tools and standards become available, we intend to continue to adjust our approach so that we can increase our impact and incentivize industry transformation to improve material chemistry.

As a starting point to the framework, Google's hardware organizations have managed materials restrictions through product materials specifications and through our Responsible Supply Chain audit program. In 2014, with the evolution of our consumer hardware business, we created our

Restricted Substances Specification (RSS) to address chemicals of concern in Google-branded consumer devices and those used at manufacturing facilities. It includes substances of highest priority to eliminate from the supply chain as well as voluntary restrictions on other substances that we believe don't belong in consumer products or should be eliminated to protect the health of workers. We released our specification to the public through the RSS in 2017 with the intention of enabling our customers, suppliers, industry partners and government and non-government stakeholders around the world to clearly see our priorities and approach for closing the door on hazardous substances.

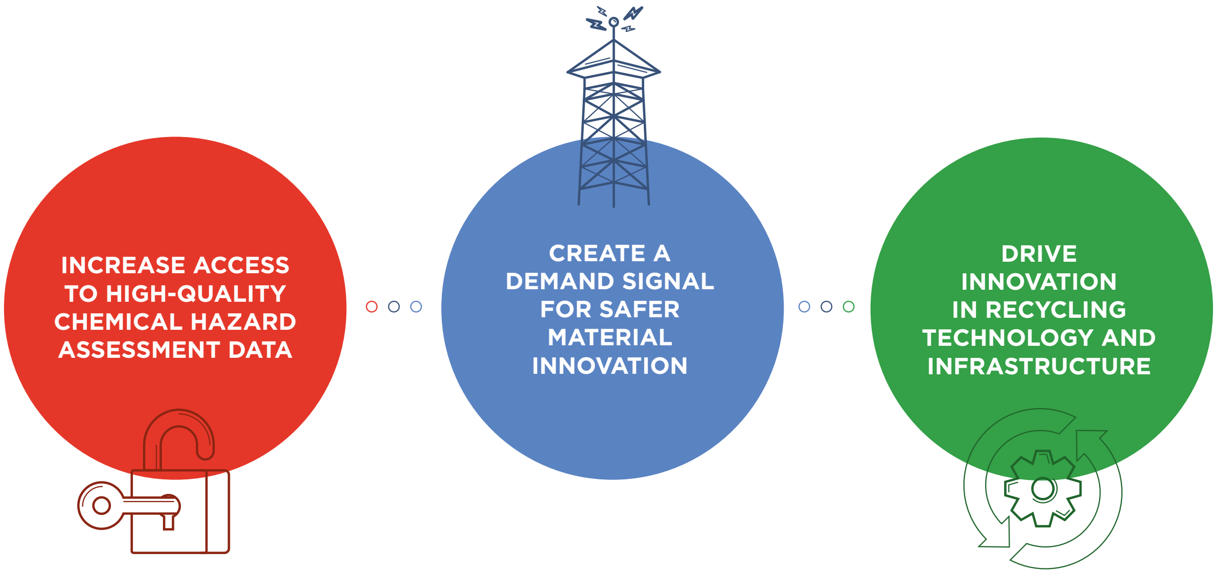
While it's necessary to eliminate and avoid certain problematic chemistries in the supply chain and in our products, we also know that a restricted substance list approach is fundamentally inadequate because it doesn't designate what is safe or preferred for use. We need a strategy that proactively assesses and screens material chemistry to avoid regrettable substitutions and reduces the toxicity of the materials circulating in commerce. Some of the early lessons learned from our efforts to build a better strategy included the difficulty of obtaining high-quality data on chemical content, toxicity and environmental impact, due to both supply chain complexity and the fact that manufacturers have limited visibility into the chemicals going into their product designs. And even when manufacturers do have this data, there is little incentive and there are often barriers to sharing that information with others.

This continues to present a fundamental dilemma—how can a chemist or a product designer optimize material chemistry for human and environmental health when we lack transparency into chemical ingredient data and their impacts? How do we both avoid regrettable chemical substitutions and increase the availability of safer alternatives in the market? How can the average company, with limited resources, make better design decisions to avoid the existing toxic legacy and advance safer materials flowing through a circular economy? We need new tools and new thinking. We need collaboration across industries and supply chains. We need systems-level change.

WHAT'S NEXT AND WHERE CAN INDUSTRY GO COLLECTIVELY?

The circular economy provides a vision for systems-level change that optimizes for human and environmental health, social equity and the growth of business. Both the Ellen MacArthur Foundation and Google recognize the importance of collaboration to realize the massive changes necessary. Industry collaboration will be an essential ingredient for several reasons:

1. **We are stronger together.** Consortia of companies send stronger demand signals to the entire industry, whether that's to manufacturers, designers, architects or consumers.
2. **Mutual goals and actions will reduce cost.** Achieving economies of scale will reduce costs and make healthy materials competitive with established products.
3. **Shared platforms align incentives.** Collaborative platforms allow industry to test new business models that align incentives among various stakeholders.
4. **Common tools and approaches provide focus and accelerate change.** Industries can come together to coordinate and agree on standards, certifications and regulations that are aligned with a common vision for safe chemistry and can help accelerate progress towards optimized products.



Future Opportunities

We must radically enable and then accelerate safer material innovation if we want to realize a future where materials cycle perpetually in closed loop systems without toxifying people and the planet. We believe there are three essential steps that we can take to advance this critical work:

1. INCREASE ACCESS TO HIGH-QUALITY CHEMICAL HAZARD ASSESSMENT DATA

Today, there are significant challenges with access to and availability of toxicity data on the tens-of-thousands of chemicals already in commerce. Access to this data underpins safe chemistry objectives because we need to understand the known and potential health hazard impacts of the chemicals flowing through the economy. The key challenges that limit access, availability and quality of chemical hazard assessment data today include:

- **Comprehensive chemical hazard assessments are expensive, duplicative and protected on private systems.** Individual companies are often paying between USD 2,500 and USD 4,500 for each chemical hazard assessment assembled by a licensed toxicologist. Licensing and non-disclosure agreements prevent the assessments from being shared beyond the company that paid for it. If a medium-size consumer product company uses 8,000 unique chemicals in its products, that puts the cost of assessing only those chemicals at more than USD 20 million dollars. That's a very expensive investment that can't be shared with upstream suppliers or downstream users and it certainly isn't helping to scale safer material innovation.

- **Chemical profiles are not peer reviewed or validated by an independent panel.** Board certified and licensed toxicologists are trained to thoroughly review the body of toxicological literature, assess the weight of available evidence, apply tools to fill data gaps, and determine if a particular hazard endpoint (e.g. cancer, mutagenicity, endocrine disruption) is considered low, moderate, high, or very high. Despite the rigor of the scientific process, subjectivity in interpretation of data remains, and no two toxicologists arrive at the same conclusions across all human and environmental health endpoints. The consequence of having the same chemical assessed differently means that we increase the potential of having regrettable substitutions.

- **Chemical hazard assessment schemes are not harmonized.** There are a range of chemical hazard evaluation protocols that can be employed. Some include the GreenScreen® for Safer Chemicals, US Environmental Protection Agency's Safer Choice framework, the Global Harmonization System, the Cradle to Cradle Certified Material Health Assessment Methodology, and some that are proprietary which combine various elements of these frameworks into one custom framework. The result is a confusing and inconsistent way to communicate about chemical hazards.

- **Toxicity data still isn't available for many human and environmental health endpoints.** Animal testing has been significantly reduced over the last three decades due, in part, to voluntary or government bans, ethical issues and cost. If companies do engage in animal testing, they often don't make those studies available to the public or scientific community. This makes it difficult to determine the health impacts associated with a new or existing chemical. While new tools have been created to leverage the power of computers to model toxicity based on chemical structure and comparing it to previously tested substances, the overall data set is far from complete.

Google is committed to supporting tools and companies that break down the barriers to safer chemistry innovation. We envision a platform that accelerates product optimization by improving the cost, access and quality of chemical hazard data for everyone. We believe that this platform must operate in a way that significantly reduces the cost over the present model by distributing fees over a wider user base. We also believe that we need comprehensive chemical hazard assessment profiles that are verified by an independent body to ensure consistency and reduce the chances of regrettable substitutions caused by differences in interpretation of the data. Where data gaps exist on certain toxicological endpoints, we need the world's scientists to develop innovative methods to fill those gaps (e.g. high throughput screening, QSAR, and novel machine learning algorithms that predict toxicity based on similar molecules).

To help solve this problem, Google, along with other industry leaders such as Levis Strauss, Method, Nike, Steelcase and Target, have partnered with the Cradle to Cradle Product Innovation Institute on an initiative called **MaterialWise**. MaterialWise is a value chain collaboration to advance better chemistry in the course of product design and manufacturing by providing cost-efficient access to verified chemical hazard data. The project aims to support chemical policies with:

- The evidence base to drive change toward safer chemistry;
- Pre-competitive cooperative processes for industry engagement; and
- A cloud-based platform for equitable sharing.

The platform brings some immediate benefits to designers and manufacturers who already have knowledge of which chemicals are in their products, including:

- Free access to a screening tool for the identification of known high hazard chemicals that can be prioritized for immediate or short-term phase out;
- Move beyond compliance and restricted substances lists with verified chemical hazard information to avoid regrettable substitutions; and
- Identify low hazard/preferred chemicals that can become part of an approved ingredient library for future material development to empower positive decisions early in the design process.

The intention of MaterialWise is to empower more manufacturers and suppliers to make confident, informed decisions to reduce hazardous chemistry, avoid regrettable substitutions, and optimize their products and processes in a cost effective way.

2. CREATE A DEMAND SIGNAL FOR SAFER MATERIAL INNOVATION

The MaterialWise platform enables businesses to send a demand signal to material and product manufacturers to use and create materials with safer, lower hazard chemistry. Our goal is to help implant a new toolset into the material innovation process so that we can create a vibrant materials economy where high performing materials and products are designed to support long-term use and recycling. This serves the traditional needs of business including: reducing the cost of regulatory compliance by eliminating high hazard chemistry, reducing liability from customer and worker exposures, strengthening relationships with customers who are expecting brands to be proactively protecting them, and creating opportunities to market new products that differentiate with new and innovative materials.

We believe this also provides a new opportunity to integrate chemical hazard assessment into industry sustainability and safety standards because a collective of brands with a clear position on increasing the use of safer chemistry will accelerate development of safer alternatives. At Google, we want to reward those who are doing the hard work of optimizing for human and environmental health. We need others to join the collective because our health, well-being, and the future of business depends on it. We're excited about the potential of an industry partnership with like-minded brands and manufacturers who are ready to create a better future with us.

Lessons in Optimizing Material Chemistry

In 2009, we toured a supplier facility that made molded polyurethane foam parts for consumer products. Polyurethane is a high performing and versatile material used in everything from home insulation to furniture, mattresses, hard coatings for wood floors, and rubber like materials. It is produced by the combination of hazardous isocyanates with a polyol in an exothermic reaction. In order to make polyurethane become a foam, a chemical called a 'blowing agent' is introduced into the mix. Most often this blowing agent is a low boiling point solvent such as isobutane, pentane, or a hydrofluorocarbon (HFC). The job of the solvent is to boil during the chemical reaction and create bubbles, which in turn causes the polyurethane to expand. Some of the gas is trapped within the foam but it also vents and escapes to the atmosphere.

The foam parts were made on a rotating carousel of two-part clamshell molds in a clean, modern factory. An automated spray gun squirted calibrated amounts of polyol and isocyanate mixture into the molds. They closed and the foam expanded against the interior walls of the mold. After a complete revolution of the carousel, the molds opened to reveal a finished black part. The manufacturing line was mostly automated but required the manual removal of the finished parts from the molds and a fresh application of mold release agent. The lead chemist indicated that the current formulation used a HFC, a class of chemically inert gases known for their high global warming potential (GWP) and very long half-lives in the environment.

In this case, the HFC being used had a global warming potential of approximately 1000 (relative to CO_2) and a half life of more than seven years in the atmosphere. A known lower impact alternative was either water or pentane. Water isn't a global warming pollutant and is necessary for life. Pentane is a short-chained hydrocarbon with a GWP of about ten and a half life in the atmosphere of a few days. From a material chemistry optimization standpoint, it was clear that either of them were better alternatives with lower impacts than the HFC. However, the lead chemist dismissed water as an option because it didn't provide the same aesthetic and performance characteristics as the HFC-based foam. Pentane could have provided the same aesthetics and performance but was dismissed because of explosivity concerns. Use of pentane would have required some additional engineering and administrative controls.

While many companies use pentane safely as a blowing agent, the lead chemist described the HFC as the best option because the gas went right up the ventilation stacks into the atmosphere without any additional permitting, engineering or administrative controls. The supplier was expected to produce tens-of-thousands of parts which meant venting thousands of pounds of the high global warming pollutant directly to the atmosphere. Fortunately, several key customers of the supplier believed that implementing the lower GWP alternative was the right approach. As a condition on keeping the business relationship, a few key customers required that the supplier use chemical hazard evaluation to identify a safer alternative and then develop an implementation/optimization plan to replace the HFC.

A few key lessons emerged from this experience. First, if chemical hazard evaluations were performed earlier in the formulation and design process, the chemist and process engineers could have chosen one of several other lower impact alternative blowing agents and then designed their process, plant layout, equipment, and training around that solution. Second, mistakes can be costly. It is often expensive to retrofit a plant or make changes once a formulation is chosen and a manufacturing process has been implemented. Finally, however, change is always possible. Market and customer demand can positively impact both upstream business decisions and improve downstream impacts. Aggregate demand from customers accelerates change.

3. DRIVE INNOVATION IN RECYCLING TECHNOLOGY AND INFRASTRUCTURE

Finally, we need innovative recycling technologies and systems to clean up our global toxic legacy and dramatically improve the quality and retention of molecules flowing through commerce. Modern recycling of many materials is about collecting, loosely sorting, cheaply reprocessing, and reselling at a higher price point to a market that can use the material for one more cycle. The reprocessing steps mainly focus on preserving the existing composition of the material. Attempts to wash, sort or separate similar grades of material often means increasing unit cost to the same level as higher performing virgin materials. These additional processing and transportation steps must be evaluated to understand and quantify any additional life cycle impacts.

More importantly, this means that we are currently **cycling materials that were never optimized** for human and environmental health. For example, polymeric materials such as foam, plastic food packaging, paper, rubber and textiles contain a range of coatings, modifiers, catalysts, residuals, and other performance enhancing additives. When we recycle them into the current system, the output tends to be highly contaminated, non-homogeneous, and impure. It is very difficult to assess them thoroughly for toxicological impacts. It's certainly not feasible to obtain full formulation information of mixed streams since there is no molecular chain of custody, and it would be impractical to attempt to reverse engineer a contaminated lot of material to identify all chemical constituents.

The chemical variability of these recycled material feedstreams begs the question: If we close the loop on materials and include recycled content in products, does that create the unintended consequence of simply moving our toxic legacy from a landfill into our homes and offices? We believe the two must not be mutually exclusive. However, the reality is that if recycling technology maintains its current path, we will undermine all of our efforts in designing and implementing safer materials when those optimized materials are recycled and co-mingled in a dirty system.

A Revolution in Recycling

It's time for a revolution in recycling. For the vast majority of substances on the market, a separate dedicated recovery process – such as that used for PET bottles – is not feasible. And even with the best performing mechanical recycling systems in the world, yields and qualities are damaged by complex mixes of substances that are difficult to separate. The future of recycling must be able to indiscriminately depolymerize, deconstruct, and dissociate the chemical makeup of materials so that the resulting by-products and constituents can be upcycled into higher value feedstocks for new and existing industrial processes. Chemical deconstruction serves to eliminate the toxic legacy of existing materials and enables the perpetual cycling of atoms and molecules, without subjecting future generations to the design choices of linear systems, where human and environmental health were never part of the objective.

The good news is that we are seeing increased momentum in this area every year. Companies and researchers are harnessing the use of catalysts, bacteria (enzymes), ionic liquids, thermolysis and other techniques to convert molecular composition of plastics, like polyester terephthalate (PET), polyethylene (PE), and polycarbonate (PC) into useful feedstocks. In 2016, **researchers from Kyoto University** discovered a new bacterium that is able to use the carbon in PET plastic water bottles as a food source. It uses two enzymes to convert PET back to its constituent monomers (terephthalic acid and ethylene glycol). While today a recycled PET water bottle is downcycled into a lower performing application, this discovery gives a potential pathway of upcycling the millions of PET water bottles produced every year into higher quality feedstocks. **Biocellection** is a startup that has developed a catalyst which cleaves very stable carbon-carbon bonds found in common plastic packaging waste and convert them to short chain acids. Their vision is to transform unrecyclable plastics into virgin-quality chemicals so that plastics are infinitely recyclable. A significant improvement in chemical recycling technologies is a key component of a well-functioning circular economy, not just for large-volume bulk materials, but for all substances. An essential next step will be to assess the landscape of technology that's both in development and currently available to understand which is best suited to scale for wider use.

REWS Case Study: 99% Waste Diversion Goal

In 2012, all Google design and construction projects were expected to track waste with the goal of 99% diversion from landfill. It started with basics, meaning we would need a common definition of waste and recycling to compare consistently across our global portfolio. For example, in some of our global offices, the local practice was to burn everything, which meant zero waste to landfill - healthy, right!? We also discovered that many landfills were employing "alternative daily cover" as part of their recycling calculations. Landfills are required to cover the landfill with soil on a daily basis to prevent debris from escaping and minimize odor. Instead of soil, landfill facilities sometimes grind up plastics that are not recyclable to meet this requirement. When higher recycling rates were sought after as demonstration of recycling best practices, landfills started counting

ADC in their recycling rates. We also realized the necessity of regional infrastructure to make high diversion rates across a spectrum of products a reality and finally the problem of the fluctuating market value for commodities that get recycled and need a easy re-entry to the value chain for manufacturers and consumers. The reality is that many of these factors are often absent and that makes realizing circularity incredibly challenging.

Our framework for how we calculated our impact is the same that your kids will parrot back to you—reduce, reuse, recycle—prioritize reducing and reusing, and recycle everything that is left.

Reduce: When we built out new spaces we would try to keep the existing interior architecture as the first step to limiting what came off the site to start with. This is hard to do if you are a tech company that prioritizes an open office and is moving into a space that has abundant private offices. Also interior materials are synonymous with brand and culture and go in and out of fashion. It makes them ripe for the rubbish bin when you do a new fit out. Analyzing all of the components through this lens made us start to ask questions about what we want to own. If we are not equipped to make these products useful as we turn over space - why do we own them?

Reuse: What we couldn't keep, we worked with deconstruction contractors to take furniture, carpet, doors, lights, plumbing fixtures and casework to architectural salvage and charities to keep them in the value chain. This is also hard as it takes more time to take something apart to be used again versus demolishing spaces with sledgehammers. It was at odds with tight construction schedules and requires a different skill set from laborers.

Recycle: We toured local recycling centers and MRF stations to find the ones with the best technology to sort materials into valuable second-use commodities and get the highest waste diversion from landfill. We often have limited ability to select the most efficient option as City contracts dictate which waste station you use from region to region.

REWS Case Study: Glass in Concrete

In 2016, Google started shifting from leasing other people's buildings to building and owning our own buildings. This opened up the material health question to a huge new suite of materials that would be used at that scale. We knew we would need a lot of concrete and in addition to material health, concrete has a carbon issue we would want to address. The cement in concrete has a 1:1 relationship with carbon, so for every ton of cement you produce a ton of carbon. It is common for fly ash and slag (by products of coal fired power plants) to replace a large portion of cement in concrete, and that post-industrial recycled content comes with chemicals we would want to avoid like mercury, arsenic and lead.

We were looking for a way to address both issues when we heard that many municipal recycling programs in the US were trying to remove glass recycling from their programs. Without a clear second use, glass often piles up at recycling centers until it gets taken to the landfill. So our question became, "could we use recycled glass in our concrete mixes to provide a much needed second use stream for recycled glass, make the concrete/carbon equation better and avoid potential negative health impacts?" Fortunately, we weren't the only ones asking this question. Building Product Ecosystems was already piloting glass in concrete with The Durst Organization in New York. We asked them to dig into the glass in concrete questions on the west coast for our upcoming development projects.

We had also recently become a global partner with the Ellen MacArthur Foundation, so the team started to come together. We quickly realized how local these issues are when we examined recycled glass in the Bay Area. Unlike New York, the Bay Area has strong legislation for bottle recycling; couple that with a thriving wine industry, and a perfect circular solution seemed to already exist. But, we discovered that a significant amount of glass still ends up in landfill in the form of 'glass fines' (pieces of broken glass smaller than can be sorted by current recycling technology). We were different from New York again when we looked for local technology partners that could clean and crush the glass into pozzolan that could be used in concrete admixtures. The three technology companies that were already making glass pozzolan were all on the east coast. Shipping glass that distance would not help our carbon footprint. We needed to help demonstrate a demand and available recycled glass supply to help those technology partners move west.

It had been our assumption at the beginning of the project that the most difficult piece of this work would be passing structural tests and convincing our engineers that glass pozzolan would perform equal to or better than fly ash and slag. But through precedent pilots and ASTM standardization being finalized, high performance has been demonstrated and quality controls developed. In reality, it was the lack of regional infrastructure that became the big challenge. Today, with some help in the form of a grant from CalRecycle and the state's climate investments program, we are expecting a technology partner to be bringing their first west coast glass pozzolan plant online in the second-half of 2018 and we expect to do selected pilots of glass in concrete at our new campus buildings in Mountain View shortly thereafter.

CONCLUSION

The consequences of the current linear take-make-waste economic model are evident—persistent toxification, ecosystem degradation and lost economic value. Unlocking and accelerating the realization of a circular economy requires that we create safe materials and build the systems, infrastructure and technology to keep safe molecules flowing endlessly. Achieving this requires that we leverage chemical hazard evaluation tools to assess and then optimize material chemistry for human and environmental health so that better decisions can be made in the design phase. It also requires collaboration across industries to send demand signals for providing materials and products that are both high performing and optimized to flow through commerce safely. We also need a revolution in recycling technologies to enable circular flow of materials. This kind of systems-level change is only possible when a consortium of like-minded individuals and companies band together and use the power of their collective intelligence and resources to solve the complex problems ahead of us. Google and the Ellen MacArthur Foundation are committed to investing in innovation that accelerates the creation and adoption of safer chemistry and healthy materials, new technologies that keep molecules flowing through the economy, and new operating models where our businesses and ecosystems flourish.