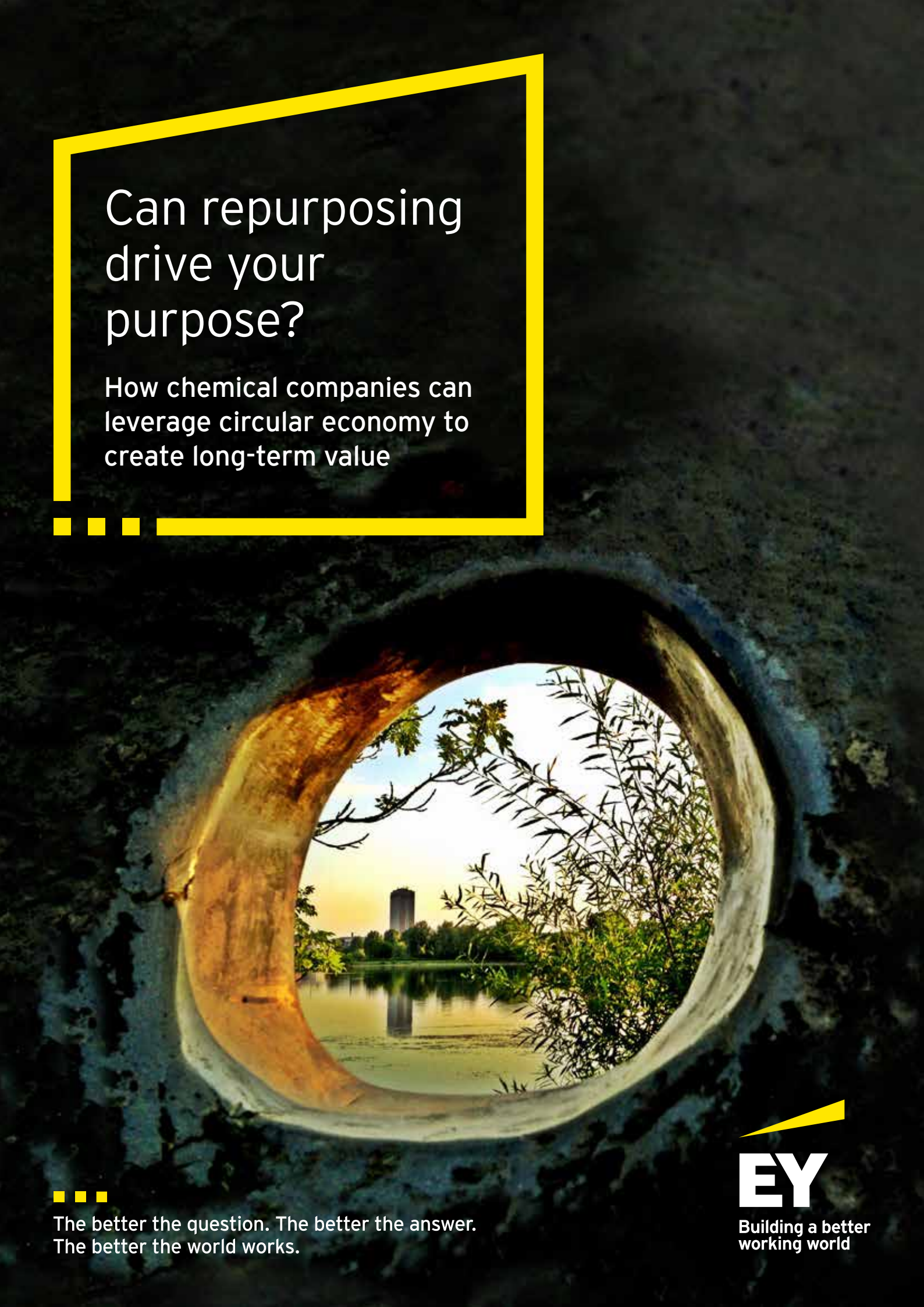
Can repurposing drive your purpose?

How chemical companies can leverage circular economy to create long-term value



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Executive summary

Over the past five decades, the global population has doubled, and extraction of natural resources has tripled.[1*] If present trends continue, by 2060, global resource use will more than double again, and greenhouse gas emissions will rise by 43%.[1] Currently, humanity – all 7.8 billion of us – produces around 2 billion tons of waste every year, representing around 256 kilograms per person.

This rate of resource consumption threatens the thresholds of our planetary boundaries, which define the safe operating space for humanity within Earth's systems. Governments, businesses, investors and consumers are now all largely in agreement: if the human race is to survive, we must learn to live sustainably within these planetary boundaries.

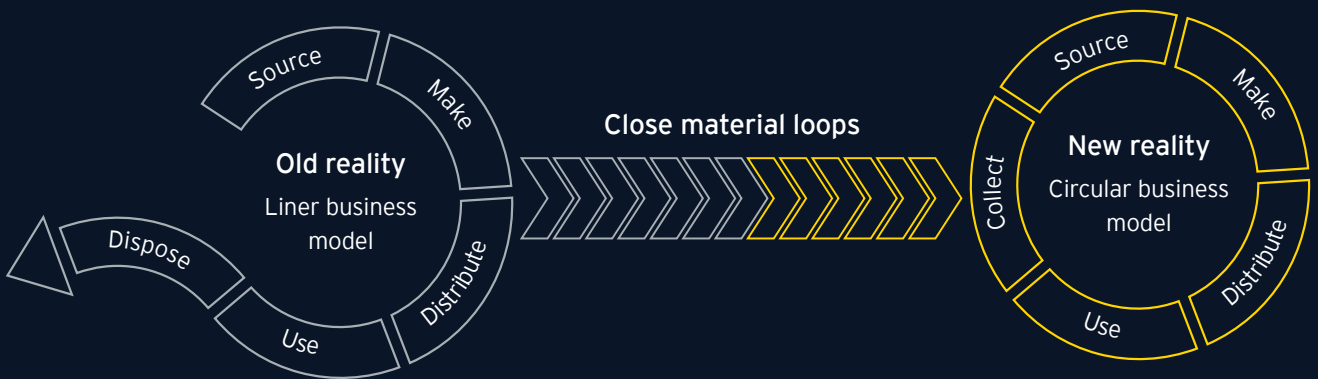
However, although the aspiration may be shared, much of the work required to achieve this goal will fall on the shoulders of businesses, which must decouple economic growth from the consumption of finite resources. One way to achieve this is to replace old linear value chains (following a traditional take-make-waste model) with cycles that keep products and materials in use at the item, component or molecular level.

Chemical companies can play a critical role in advancing the development of these circular value chains, thus enabling the growth of true circular economies. The pace of innovation is already accelerating — many chemicals producers are piloting new models for chemical "leasing" — advanced recycling technologies for plastic-to-plastic repurposing and conversion of solid wastes to hydrogen.

But companies will also need to demonstrate that these pilots can be commercially viable at scale, requiring significant long-term investments to R&D, infrastructure development, collaboration with new upstream and downstream players, and a demonstrable return on investment.

Chemical companies that are actively pursuing circular business innovation now — and integrating it into their growth strategies over the short, medium and long term — are well-positioned to capitalize on the growing interest and investment of governments, regulators and even consumers. Companies that lag in this area risk being outpaced by peers that achieve first-mover advantages through their selection of like-minded value chain partners and establishment of new supply chains.

Figure 1: Circular economy — old reality vs. new reality



Source: EY analysis

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Using circular principles to create value

Accelerating value chain collaboration to achieve mutual goals for supply chain resilience and net beneficial societal outcomes is driving the development of new revenue streams, which are proving to be sustainable over the long term.

Strengthen local supply chains

As borders closed to both humans and international trade during the COVID-19 pandemic, the global supply chains of various industries were rattled by disruption, and demand-based shortages from lumber to chlorine began to emerge. Focus on the benefits of local sourcing has intensified, as operational strategists look to strengthen domestic supply chains and design new processes to make their companies more resilient.

LCY Chemical Corporation — one of the largest chemical producers for semiconductor makers — is one such company that has recognized the value of relocating its supply chain closer to its customers. The producer is considering building a factory in Arizona (its largest outside of Taiwan) to supply Taiwan Semiconductor in Phoenix. The proposed plant would have a strong focus on recycling semiconductor chemicals, which can be used in other industries and applications, such as coatings and construction.[2]

Advance the sustainability goals of your customers

Around 2017, a handful of global consumer companies began announcing a series of ambitious goals to improve the recyclability of their packaging and to increase the volume of recycled content they utilize. Today, thousands of companies worldwide across a wide range of industries have made similar commitments, with initiatives such as the New Plastics Economy and The Plastics Pact helping to define the level of ambition required to enable transformative change at a global level.

This presents a significant level of opportunity for chemical companies that can create — and articulate — their value proposition in helping their customers achieve these goals. Additives and catalysts that can reduce the amount of virgin polymers required during production processes, improve recycling yields or reduce degradation, are just some examples of products that are increasing customers' abilities to achieve their packaging goals in a resource-efficient manner.

Drive new revenue sources

EY analysis identified that more than 35% of innovations announced by top global chemical manufacturers in 2020 included investment in the circular economy or hydrogen technology.[3] Of these, over 40% related to bio-based or recycled material for feedstock, and another 35% are intended to make processes more sustainable.[4]

A circular economy could unlock GDP growth of $4.5 trillion by 2030.[5] However, in this growth and transition phase, the chemical industry will have to gradually increase its share of alternative feedstock. Value chains and capital markets are strengthened by bold quantitative company commitments to new technologies and products.

BASF is one of a handful of leading chemical companies that have set a clear societal and commercial ambition for their circular economy solutions – "BASF will aim by 2030 to double its sales generated with solutions for the circular economy to €17 billion, and by 2025 will aim to process 250,000 metric tons of recycled and waste-based raw materials annually, replacing fossil raw materials," the company says on its website.[6]

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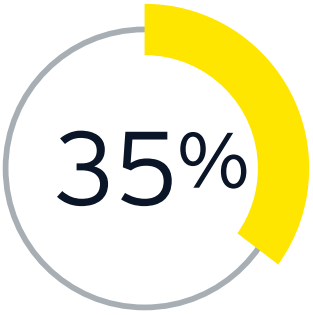

of innovations announced by top global chemical manufacturers in 2020 included investment in the circular economy or hydrogen technology.

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A circular economy could unlock GDP growth of $4.5 trillion by 2030.[5]

2

Circular business models are continuing to develop and evolve

A variety of circular models is continuing to develop[7] with the majority of them falling into four promising categories.

"Leasing" or "renting" chemicals

The ownership of the product (chemical) remains with the producer. Companies no longer buy and handle chemicals, but instead purchase them as a service. In this way, manufacturers are compensated by the chemicals' end use, not volume – for example, number of assembly line machines cleaned, or product components painted or coated.[8] This further incentivizes the producer to focus on developing the efficiency of products and reducing waste.

Incentivizing return

Extended producer responsibility programs are an increasingly common model that assigns responsibility for recovery of a product at its end-of-life to its producer, to encourage reuse, repurposing or proper disposal. Legislated programs are common in the EU, with well-established programs for tires, waste oil, batteries, plastic bags, photo-chemicals and chemicals, refrigerants, pesticides and herbicides, and electronics, among others.

Case study

The Global Chemical Leasing Award aims to acknowledge best practices, innovative approaches and ideas related to chemical leasing and similar performance-based business models for sustainable chemicals management. In 2018, over 90 applications were received from 20 countries. Ecolab Ukraine was an award winner for its implementation of a performance-based service model at a customer's brewery in Italy. By implementing a new payment basis for the maintenance of the lubrication of conveyer belts (based on euro per hectoliter of produced beverages)[9,10] the chemical producer and its customer were able to align their incentive to improve sustainability performance and reduce costs. The winners for Global Chemical Leasing Award 2021 will be announced in September this year.

Case study

PaintCare is a producer-led program that has advocated for the introduction of paint stewardship laws in 10 US states. As paints are not collected through most municipal recycling programs, participating producers provide a free drop-off service for households and businesses that is financed through a consumer fee on each can of paint sold. Returned paint is managed according to a policy of highest, best use – better quality paint is made available to consumers through reuse programs, and most of the paint is recycled. If it can't be reused or recycled, processors find the next best use for it.[11] To date, PaintCare has collected 184.4 liters of paint.

Enhancing recyclability

Chemical and plastics producers can enhance the recyclability of material by designing products to enable easy separation through additives, catalysts and more. The shorter the reverse cycle, the less embedded energy, labor and material is lost.

Ecosystem collaboration

As customers look to extend product life cycles through repairs, upgrades and re-purposing post-consumer waste, joining the expertise of vendors and customers through online "circular economy marketplaces" can be a useful platform to enable innovative new circular value chains to form.

Case study

In 2020, Clariant announced new technology that enabled the development of a range of dark-colored plastics that do not require the use of carbon black pigments. The benefit is, a line of products that will directly improve the recyclability of a range of plastics including polyethylene terephthalate (PET), polypropylene (PP) and high-density polyethylene (HDPE) in both virgin and post-consumer recycled forms. Automatic sorting systems will be able to identify these packaging types, which are normally undetectable when carbon black pigments are utilized.[12]

Case study

The Materials Marketplace (established by the United States Business Council for Sustainable Development) aims to create a closed-loop network of collaborative businesses. It connects manufacturers, recycling companies, entrepreneurs and other sellers to develop and scale new reuse and recycling market opportunities. Over 2,200 companies, academic institutions, and nonprofit organizations across North America are using the marketplace. As of June 2020, over 5,300 tons of material has been diverted to higher and better use.[13]

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Plastics recycling challenges in focus

The current state of plastics recycling illustrates the enormity of both the challenge and the opportunity for building circular economies. Over the past four decades, global plastics production has quadrupled and now accounts for over one-third of the chemicals industry's output – however, only 14% of plastics are currently recycled globally.[14] Despite an increasing number of state and country-level mandates for the use of recycled content in plastics production, existing models and technologies may not be sufficient to meet this increased recycled yield demand.

For the most part, recycling capacity remains focused on easier-to-recycle materials, where reverse logistics are manageable without additional investments, such as PET, PP or HDPE. However, mechanical recycling is challenged by the need for feedstock separation, cleaning and technical limitations on the number of times a material can be recycled. The requirements for food-grade recycled plastics are even higher – without greater incentive from higher recycled flake prices, recyclers may find it more economical to downcycle soda PET bottles to a carpet or fleece jacket.[15]

Dealing with hard-to-recycle products, mixed-stream plastics and a wider range of materials will be the next frontier for feedstock extraction – which is where chemical recycling holds great promise. As plastic waste is converted into shorter molecules for new chemical reactions, the utility of the recycled material is less limited, enabling products to be more readily converted into like-for-like applications.

However, four key challenges will need to continue to be advanced to truly catalyze investment and growth in the development of circular plastics:

Infrastructure

In the EU, the average rate of recycling for plastics stands at 15%. Similarly in the US, an estimated 91% of plastics will not see a recycling center and are sent straight to landfill.[16] A similar situation prevails in Southeast Asia, where only 9% of plastics are estimated to be recycled.[17] Once collected, contamination can further reduce yield – approximately 70% of the plastic currently collected for recycling in the US and 30% in the EU, goes to a landfill.[18] Most of the plastic collected is unsuited to the current mechanical recycling process and is contaminated with other waste materials including carpets, fibers and other polyesters that are usually sent to the landfill.

Competitive viability of chemical recycling

The European Recycling Industries' Confederation (EuRIC) estimates that plastic-waste-based feedstocks are competitive with virgin-based feedstock only when crude oil prices top US$65–US$70 per barrel,[19] which was challenged in 2020 as prices hit 15-year lows with trading between US$20–US$65. Further, scaling the recycling of certain hard-to-recycle plastics is limited due to high technology and startup costs.

Incentive

Brand owners are not yet demonstrating willingness to pay a price premium for recycled content.[20] Although consumer expectations for companies to address waste plastics is high, their recognition of and their willingness to pay for recycled plastic products remains low. Unlike fair trade, organic or even recycled paper products, a recycled plastics certification or product label is yet to gain consumer recognition and market acceptance. However, according to a report published by Trivium Packaging, 74% of consumers are willing to pay more for sustainable packaging.[21]

Consumer protection

As new packaging materials are developed with recycled content from advanced recycling processes, regulators must verify the quality and safety of packaging for certain applications, such as food and beverages and health care. While regulations have historically only addressed requirements for mechanically recycled content, new guidance from regulators is expected from the EU and US in 2021 packaging.[22]

Next, we discuss what companies can do to adapt and convert these challenges into opportunities.

3 What should chemical companies do to adapt?

Now (to six months) – establishing the right foundation for a circular supply chain

In the near term, chemical companies should look to their own operational processes and value chains to identify opportunities for circular material loops that enable reuse and minimize waste, and to evaluate potential processes where feedstocks (including energy) could be substituted for bio-based or recycled sources.

Encouraging innovation from within the business can also be catalyzed through employee innovation challenges and direct investment in the organization's R&D capabilities. However, to seek direction on where to invest, the organization must look outward to emerging regulations and the long-term net-zero waste goals of cities, countries and regions, which offer both disruption and also immense opportunity for companies that can align their organizational purpose to these objectives. Yet to truly demonstrate commitment and to spur market confidence (and investment), ambitious and actionable goals should be set and publicly communicated.

Next (6 to 18 months) – integrating advanced digital technologies within the circular economy

Once the company has top-down buy-in on the importance of circular economy principles and how the organization can support them, product design should come to the forefront, as a new lens can be taken to re-evaluate existing products and services. Directly engaging your customers in conversations about their sustainability objectives can spur new ideas, and opportunities to consider the viability of alternate partnership models, such as chemicals leasing.

Advances in digital technology could also be leveraged to enhance transparency and credibility of circular value chains. Use of artificial intelligence and blockchain solutions for tracking and tracing material, can provide increased confidence in the true source, and circular nature, which a customer may be paying a premium for.

Recycled content certifications are another promising mechanism to do this. Whether for mechanical or chemical recycling, committing to a fully certified value chain (in alignment with your partners) strengthens the commercial value of the end product, and provides options for participating in potential credit-trading schemes (such as for plastics) as they emerge and mature.

Figure 2: How chemicals companies can adapt in the now, next and beyond

	Design	Sourcing	Manufacturing	Use	Recycling
Now	Innovate for easy-to-recycle products	Identify sources for bio-based and recycled feedstock	Modify process scan to optimize material waste, energy use, etc., and minimize emissions	Shift to chemical leasing or renting	Leverage mechanical and chemical recycling
Next	Integrate waste or recycled material into design	Redefine sourcing criteria and processes	Transition energy source strategy from fossils to renewable	Develop a material bank	Leverage, track and trace via blockchain technology
Beyond	Establish "Green Labs" – incubators for bio-circular economies	Modify supplier network fitting your sourcing policy	Smart and green factory which repurposes energy, waste and emissions	Leverage incentivized return in collaboration with other industries	Identify and explore potential of refurbishment and repair market
Ecosystem partners	▸ Peers ▸ Technology firms ▸ Resource management companies	▸ Suppliers ▸ Resource management companies	▸ Power companies ▸ Technology firms	▸ Customers ▸ Logistics providers	▸ Technology firms ▸ Resource management companies ▸ Customers

Source: EY analysis

Looking beyond (18 months to 5 years) — developing a wider circular community and culture

Once a chemical company has solidified its circular ambitions and has identified new revenue opportunities to do so, it should focus on encouraging the growth of the broader circular economy industry. Startup accelerator programs and incubators are one way a more established company may look to source new ideas and technologies, while offering a framework for replicating and scaling business models and technologies that demonstrate promise.

Investing in solutions to address upstream and end-of-life product challenges is another mechanism for companies to partner and magnify their impact. By strengthening collection, sorting and waste infrastructure, whether through voluntary or regulated requirements, provides the opportunity for a producer to obtain and reuse its own raw materials. Partnering with brands and retailers to address harder-to-recycle products, such as apparel, toys and automotive, could offer significant goodwill for companies that can identify commercially viable models to incentivize return, repair or refurbishment.

Lastly, numerous cross value-chain initiatives, alliances and marketplaces have formed in recent years to bring together entities interested in addressing issues of waste and reuse. The Global Alliance on Circular Economy and Resource Efficiency (GACERE) is one such alliance worthy of consideration. Formed in 2021 by the EU, the United Nations Environment Programme and the United Nations Industrial Development Organization, GACERE offers a platform for stakeholders to advance a global circular economy and take forward partnership initiatives, including those with major economies. With participation from 12 member countries and the EU, it is clear that the call for circular economy investment and transformation is now at the world scale.

The path forward toward a circular tomorrow

Whether you are just beginning your transition toward a circular business mindset or your journey is already well underway, here are some critical questions to consider:

- How could circular strategies align with — and advance — our organizational vision and strategy?
- Which circular models could generate reciprocal value and incentive for our customers and our business?
- Could a model focused on domestic supply chain loops help us to reduce supply chain vulnerabilities?
- What are the timeline considerations for the development, pilot, trial and commercialization of new products or models?
- Have we identified existing and new potential partners who might share our sustainability objectives and have a similar risk tolerance for new ideas?
- What metrics and tools will we use to measure our progress?
- How will we define success internally, and are there relevant external recognition goals that we should aspire to?

Those able to successfully make the transition have significant opportunity to generate long-term value, per the Embankment Project for Inclusive Capitalism framework.[1*] New revenue streams, strengthened brand value and competitiveness as a supplier and an employer,[23] and potential cost savings as traditional waste outputs are reused or on-sold are just some potential benefits.

For the less agile, the pace of change could soon challenge existing chemicals business models and revenues. As customer preferences transition toward recyclable products and packaging, and regulators strengthen their positions on single-use levies and extended producer responsibilities, investor and consumer enthusiasm for traditional take-make-waste businesses may wane.

The time is now for companies to acknowledge the strain on planetary boundaries through society's present path, and to identify the strategic opportunities which can truly position them to be leaders of the circular economy of tomorrow.

Source notes

[1*] Per the Embankment Project for Inclusive Capitalism framework — initiated and co-led by Ernst & Young Global Limited in collaboration with the Coalition for Inclusive Capitalism."

[1] "International Resource Panel (IRP) Global Resources Outlook 2019" (Materials include biomass, fossil fuels, metals and non-metallic minerals, while natural resources encompass all materials plus water and land.)

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[3] EY analysis. From 1 January 2020 to 5 November 2020, the data covered 176 news articles on innovation, of which 47 pertained to circular economy.

[4] "Revolutionizing recycling at the molecular level: Eastman begins commercial operation of innovative chemical recycling technology," *Eastman website*, accessed 15 April 2021.

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[5] "The world needs a circular economy. Help us make it happen," *World Economic Forum*, accessed 28 May 2021.

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[7] "Cleaning Up With RENT-A-CHEMICAL," *ENSIA website*, accessed 15 April 2021.

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[12] "Facilitating Company-To-Company Industrial Reuse Opportunities That Support The Culture Shift To A Circular, Closed-Loop Economy," *United States Business Council for Sustainable Development website*, accessed 15 April 2021.

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[15] "Ibid."

[16] "New recycling technologies can help solve the plastic waste problem," *Woodmac website*, accessed 15 April 2021.

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[18] "Chemical recycling 'promising' for circular economy, EU official says," *Euractive*, 26 August 2020.

[19] "Plastic has a problem; is chemical recycling the solution?" *C&EN website*, accessed 15 April 2021.

[20] "Ibid."

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[22] "Administrative guidance for the preparation of applications on recycling processes to produce recycled plastics intended to be used for manufacture of materials and articles in contact with food," *European Food Safety Authority website*, accessed 15 April 2021.

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