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GS SUSTAIN

The evolution towards a

Circular Economy

The need to move towards a Circular Economy – one in which consumption of ecological resources is equal to or less than what the planet can regenerate – has been discussed for years but not sufficiently deployed, with resource consumption 75% more than Earth's regeneration capacity in 2021 and waste on track to be 70% higher by 2050 vs. 2016. However, we see three catalysts that can push forward deployment of Circular Economy solutions, which could potentially unlock $1 tn of annual materials savings, based on a World Economic Forum study. First, the spike in commodity prices is likely to increase deployment of energy/waste/food efficiency solutions from both individuals and corporates. Second, the intrinsic link between resource consumption/waste and GHG emissions will make Circular Economy solutions critical for transitioning towards a low carbon economy. Third, the extension of the EU Taxonomy to include Circular Economy categories is likely to increase corporate and investor focus on solutions as well as valuation uplift for strong performers. In this report, we detail seven Circular Economy themes.

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Executive Summary - Evolving towards a Circular Economy - back to the future

William McDonough, the founder of Cradle to Cradle®, stated that **the world doesn't have a 'waste issue', it has a 'design issue'**

A Circular Economy could help add $4.5 trillion in additional economic output by 2030, and $25 trillion by 2050[1]. The World Economic Forum estimates that by 2025 recycling, reuse, and remanufacturing could help the economy unlock $1 trillion a year untapped resource savings. We see rising commodity prices leading to increased deployment of energy/waste/food efficiency solutions from both individuals and corporates and the extension of the EU Taxonomy to include Circular Economy categories will provide a boost in recognition from corporates and investors.

70% of GHG emissions are directly linked to material handling and use - including from extraction, transport, processing, use, and end of life according to The Circularity Gap Report (2022)

Transitioning towards a Circular Economy will be pivotal to solving decarbonisation and will become an increasing focus for investors, corporates and regulators to achieve net zero carbon goals and decouple economic growth from resource consumption, in our view. Zero waste pledges are few and far between compared to the proliferation of net zero carbon pledges from companies, governments and investors, yet both are necessary for a sustainable low carbon economy due to the intrinsic link between resource usage, energy and emissions (resource-energy nexus). Decarbonisation efforts have traditionally focused heavily on scaling up renewable energy and increasing energy efficiency, while focusing little on the benefits that can be gained via circular economy solutions. We believe the decarbonisation synergies gained through transitioning towards a circular economy will become an increasing focus and priority among governments, corporates and investors in the years ahead.

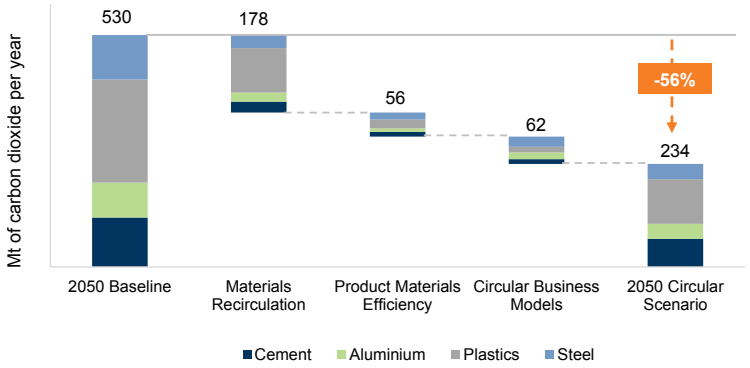
We identify 7 circular economy solutions that can help corporates reduce their dependence on increasingly scarce resources and create new service offerings, including: 1) Efficiency; 2) Substitution; 3) Durability; 4) Ecodesign; 5) Asset Utilisation; 6) Recyclability and Recycling; and 7) New business models and circular partnerships.

The next phase of the EU Taxonomy will catalyze investor and corporate focus on the circular economy. We see corporate and investor adoption of the EU Taxonomy as inevitable, serving as a tool for both investment and eventual corporate strategic decision-making. New sectors covered under the circular economy include some of the most underweight sectors in ESG funds currently, presenting opportunities for re-weighting. **We map the 21 new circular economy activities to our existing GS SUSTAIN EU Taxonomy tool.**

[1] Lacy, P. & Rutqvist, J.. (2016). Waste to wealth: The circular economy advantage. 10.1057/9781137530707.

Exhibit 1: Increasing circularity for four key materials in Europe could reduce CO2 emissions 56% vs business as usual

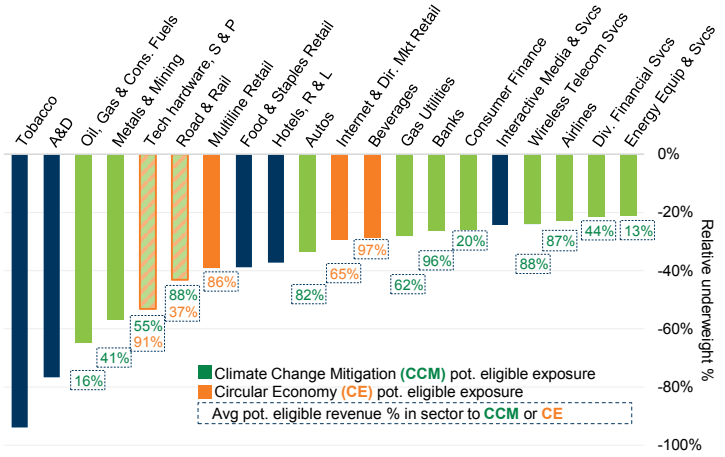
EU Emissions reduction potential from a more circular economy, Mt CO2 per year



Source: Material Economics, Data compiled by Goldman Sachs Global Investment Research

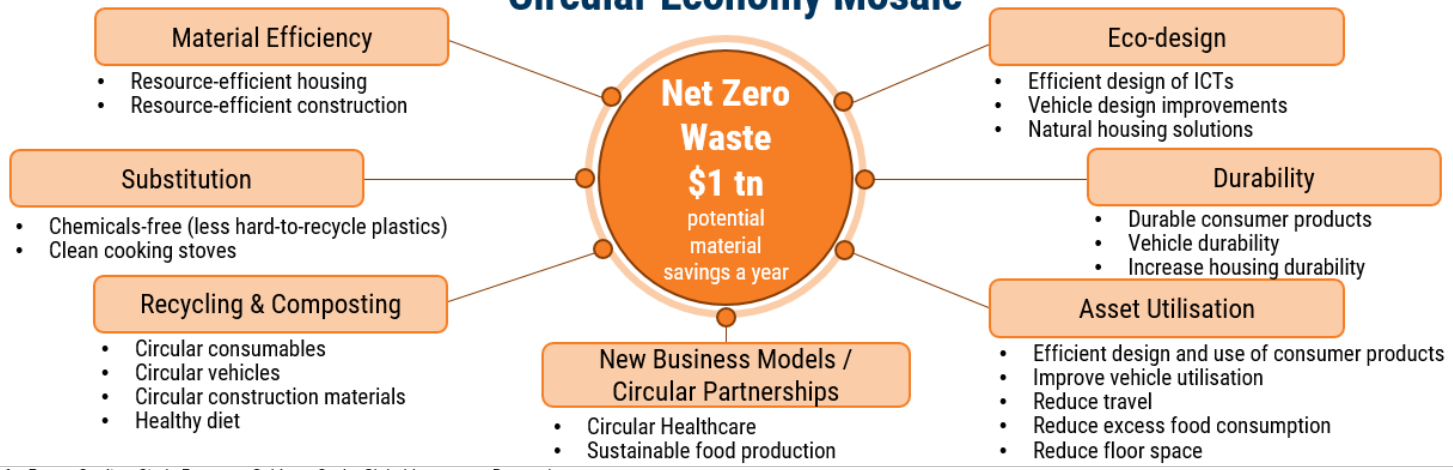
Exhibit 2: Some of the most underweight industries in ESG funds have portions of revenue that are eligible under the Taxonomy

GICS 3 industries most relatively underweight in ESG funds, Mar 2022, with avg. eligible revenue % in exposed sectors



Source: Morningstar, Goldman Sachs Global Investment Research

Circular Economy Mosaic



Source: Oxford Institute for Energy Studies, Circle Economy, Goldman Sachs Global Investment Research

The Circular Economy in Numbers

The Problem...

Global waste generation is set to increase **70%** by 2050

1.6 billion tonnes of CO2 emissions were generated from solid waste management alone in 2016

Over **70%** of global waste is disposed of in landfills, 33% of which is mismanaged through 'open dumping'

11 million metric tonnes of plastic were leaked into the ocean in 2016

Up to **40%** of food produced in the US ends up as waste, while the average UK family throws away **£720** worth of food per year

In 2018, the average amount of clothing and textile waste added up to **80 lbs** per person in the US

Progress and Solutions

A Circular Economy could help add **$4.5 trillion** in additional economic output by 2030 and $25 trillion by 2050

Landfilled waste fell **58%** in the EU between 1995 and 2020, while it increased **0.6%** in the US between 1990 and 2018

Circular economy solutions could help reduce global GHG emissions by **39%**

In the EU, materials recirculation, materials efficiency increase and circular business models for cement, aluminium, plastics and steel could reduce CO2 emissions by **56%** vs a business-as-usual scenario

Recycling cardboard takes **75%** of energy required to manufacture new cardboard; recycling plastic takes **84%** less energy than making it from raw materials

On average, it costs **44%** less to recycle trash than send it to landfills, and **54% - 60%** less to recycle trash than to incinerate it

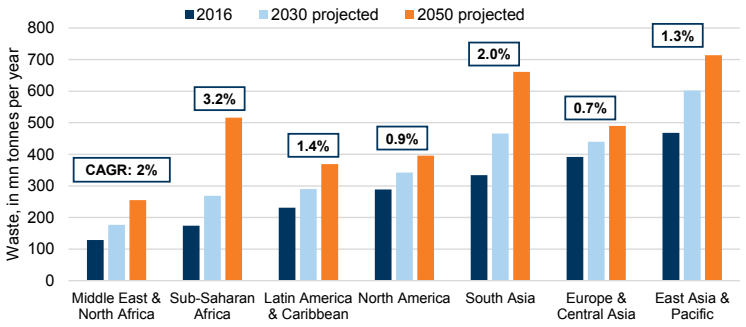
Sources: World Bank, Pew Charitable Trusts, Dept. for Environment Food & Rural Affairs, Ellen MacArthur Foundation, Waste to Wealth, Eurostat, EPA, Circle Economy, Recycling Revolution, data compiled by Goldman Sachs Global Investment Research

The linear world as we know it

Despite the world already consuming 1.75x more resources than the Earth produces annually in 2021, global waste generation is set to increase 70% by 2050 (from a 2016 base), according to the Global Footprint Network and World Bank, **highlighting the need to transition our linear economy to become more circular**. Current consumption and waste systems are not often designed and built with end-of-life in mind, and, as a result, a significant portion of materials face sub-optimal utilization and disposal. This traditional 'take-make-waste' economy contributes to negative impacts including excess emissions contributing to climate change, unwanted pollution, societal health issues, access to clean water, and more. **The transition to a circular economy is pivotal in the fight to mitigate climate change**, as excess emissions are released from inefficient use of resources and waste, with an estimated 1.6 billion tonnes of CO2e emissions generated from solid waste management alone in 2016 (1-3% of total GHG), the equivalent of ~350 million cars on the road.

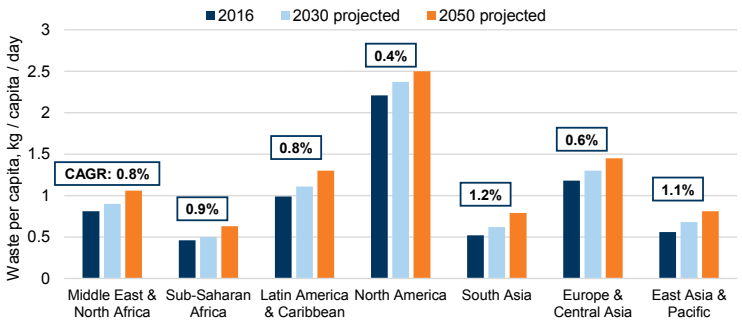
Current waste generation per capita is disproportionately generated by developed economies, while waste growth is set to come from developing countries. As low-income countries further develop, their waste footprint is expected to grow, making it critical to have proper means for recovery or safe disposal. While high-income countries are expected to grow their waste footprint at a smaller rate, this starts from a higher base, as the top quartile income level generates 34% of waste per year (World Bank). Municipal waste generation in the US increased 232% from 1960 to 2018 (40% since 1990), while generation in China increased 218% between 1990 and 2017 and in Europe (OECD) increased 28% between 1990 and 2020. Moving forward, North American waste is expected to increase 37% between 2016 and 2050 compared to 197% in Sub-Saharan Africa, 98% in South Asia and 53% in East Asia & Pacific (World Bank, Exhibit 3).

Exhibit 3: Sub-Saharan Africa and South Asia are expected to see the highest waste growth rate through 2050...
Total waste generation and projected waste generation, million tonnes per year



Source: World Bank, Goldman Sachs Global Investment Research

Exhibit 4: ... however, this growth among developing economies is not expected to lead to per capita waste generation even half that of North American levels
Total waste (and projected) generation per capita, in kg per capita per day



Source: World Bank, Goldman Sachs Global Investment Research

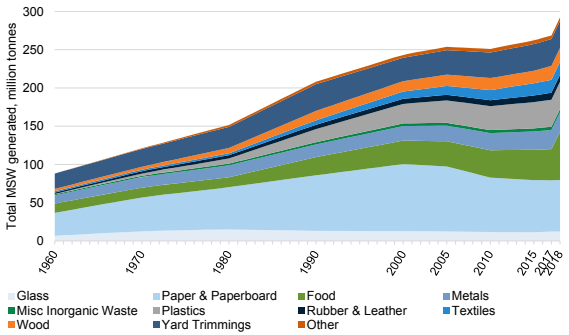
Open dumping as a means of waste disposal involves a site where solid waste is disposed of in a manner that does not protect the surrounding environment or society - leaving waste more susceptible to burning, scavengers and rodents, as well as leachate, landfill gases and other sanitary hazards.

Municipal solid waste landfills account for 14.5% of human-related methane emissions in the US, after natural gas and petroleum systems (32%) and enteric fermentation (27%), according to the EPA.

Issues associated with waste are interlinked with nearly every facet of the environment - from land, air and water, and significant portions of public health. Over 70% of global waste is sent to landfills, 33% of which is mismanaged through 'open dumping', leading to further issues around pollution, water, emissions, etc. Waste is inconsistently handled across geographies, and, according to the World Bank, open dumping in low-income countries accounts for 93% of waste disposal, where waste generation is expected to increase by more than 300% by 2050. This further amplifies waste's influence on the environment and society, as landfills are the third largest man-made source of methane gas in the US, a significant contributor to climate change and associated with negative health effects.

While landfill disposal has leveled off or declined in developed economies, further reductions are needed as cumulative waste continues to grow. While landfill growth has plateaued in high-income countries, significant volumes of wasted material are still being disposed of through landfills or incineration. Most progress on recovery and recycling is being made in developed economies. Total municipal waste landfilled in the EU fell 58% between 1995 and 2020 (Exhibit 7), from 54% of generation to 23%, though incineration increased 105% over that same time period. US municipal waste generation increased 40% between 1990 and 2018, but landfilled waste only increased 0.6% over that time due to more waste being incinerated (12% in 2018) and recycled - recycling rates increased from 14% in 1990 to 24% in 2018 (Exhibit 6). **Progress towards a circular economy will go beyond stopping growth to moving towards zero waste to landfill and increased resource utilization - and require a focus on solutions for both developed and developing economies**.

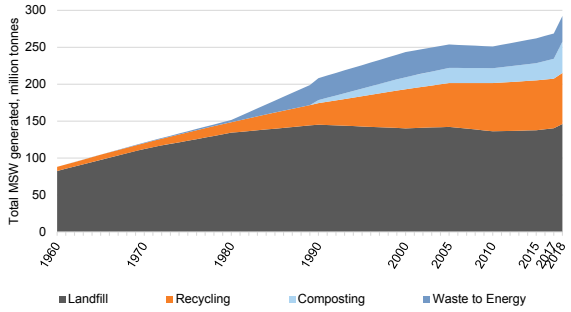
Exhibit 5: Waste generation in the US increased 232% between 1960 and 2018, and 40% since 1990
Total municipal solid waste generated by year in the US, million tonnes



Spike in 2018 is largely due to enhanced food measurement methodology to account for ways wasted food is managed.

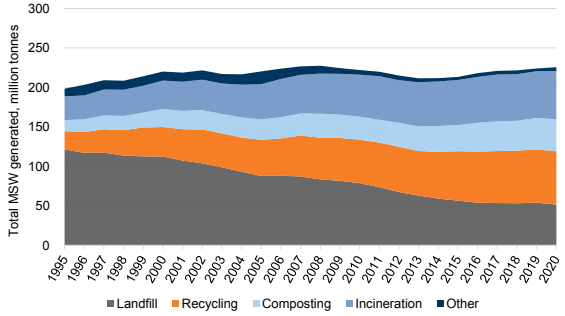
Source: EPA, Data compiled by Goldman Sachs Global Investment Research

Exhibit 6: 50% of municipal waste in the US was landfilled in 2018, compared to 24% recycled, 12% incinerated for energy and 12% composted/other food management
Total municipal solid waste generated by year in the US, 1960 - 2018, million tonnes



Source: EPA, Data compiled by Goldman Sachs Global Investment Research

Exhibit 7: While only 23% of municipal waste in the EU was landfilled in 2020, incineration has increased since 1995, at 18% of total waste disposal in 2020
Total municipal waste generated in the EU, 1995 - 2020, million tonnes



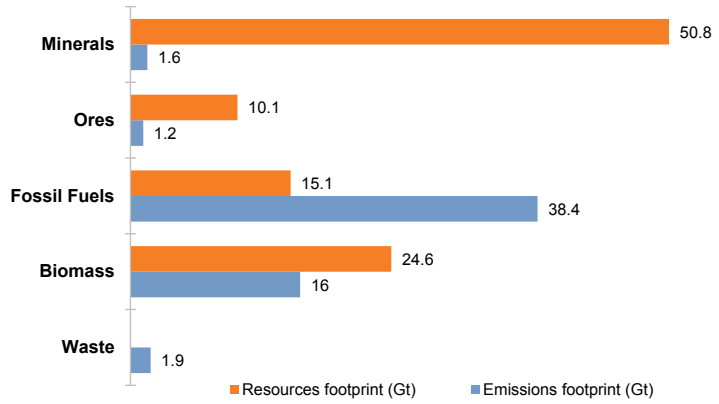
Source: Eurostat, Data compiled by Goldman Sachs Global Investment Research

Despite soft measures to reduce resource demand, especially with plastics, demand for plastics and other materials has not decreased on an absolute basis - while some material substitutes can do more harm than good. Some policy and legislative actions taken to reduce demand have resulted in substitution rather than reduced consumption, sometimes without analysis of whether the alternatives are better or worse for the environment. For example, bans on plastic bags are often met with paper and mixed material replacement bags that can have a higher climate impact depending on their weight. As the regulatory environment around waste and circularity continues to gain momentum, **we think the demand for virgin materials will be influenced by efforts to reduce consumption and increase recycled inputs, rather than material substitution.**

A Circular Economy = a Low Carbon Economy

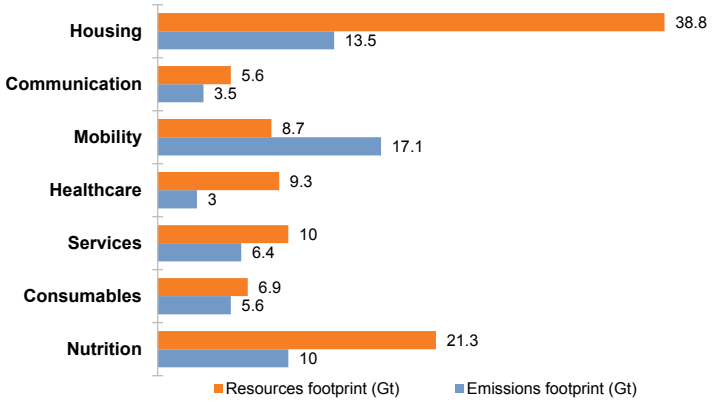
Material usage/throughput and associated emissions go hand in hand, as links between waste and emissions (resource-energy nexus) extend far beyond the emissions directly from landfills. Through each step of a resources value chain, emissions and waste are generated before products meet their end use, before further waste and emissions are generated from end-use of products and eventual disposal. Inputs like minerals and ores are much more material-intensive than their emissions profile, while other materials like fossil fuels and biomass are more emissions-intensive (Exhibit 8). As each resource moves towards its end use (Exhibit 9), the intrinsic link with emissions becomes clearer, along with a recognition that net zero carbon cannot be achieved without moving towards a circular economy.

Exhibit 8: Emissions and materials footprints are intrinsically linked, though some resources have a more material impact than emissions and vice versa
Material throughput and GHG emissions associated with resources and waste, in Gt for resource and CO2e for emissions, including overlap



Source: Platform for Accelerating the Circular Economy (PACE), Data compiled by Goldman Sachs Global Investment Research

Exhibit 9: This link moves beyond resources to the application of resources to meet societal needs
Material throughput and GHG emissions associated with seven key societal needs, in GT (CO2e for emissions)

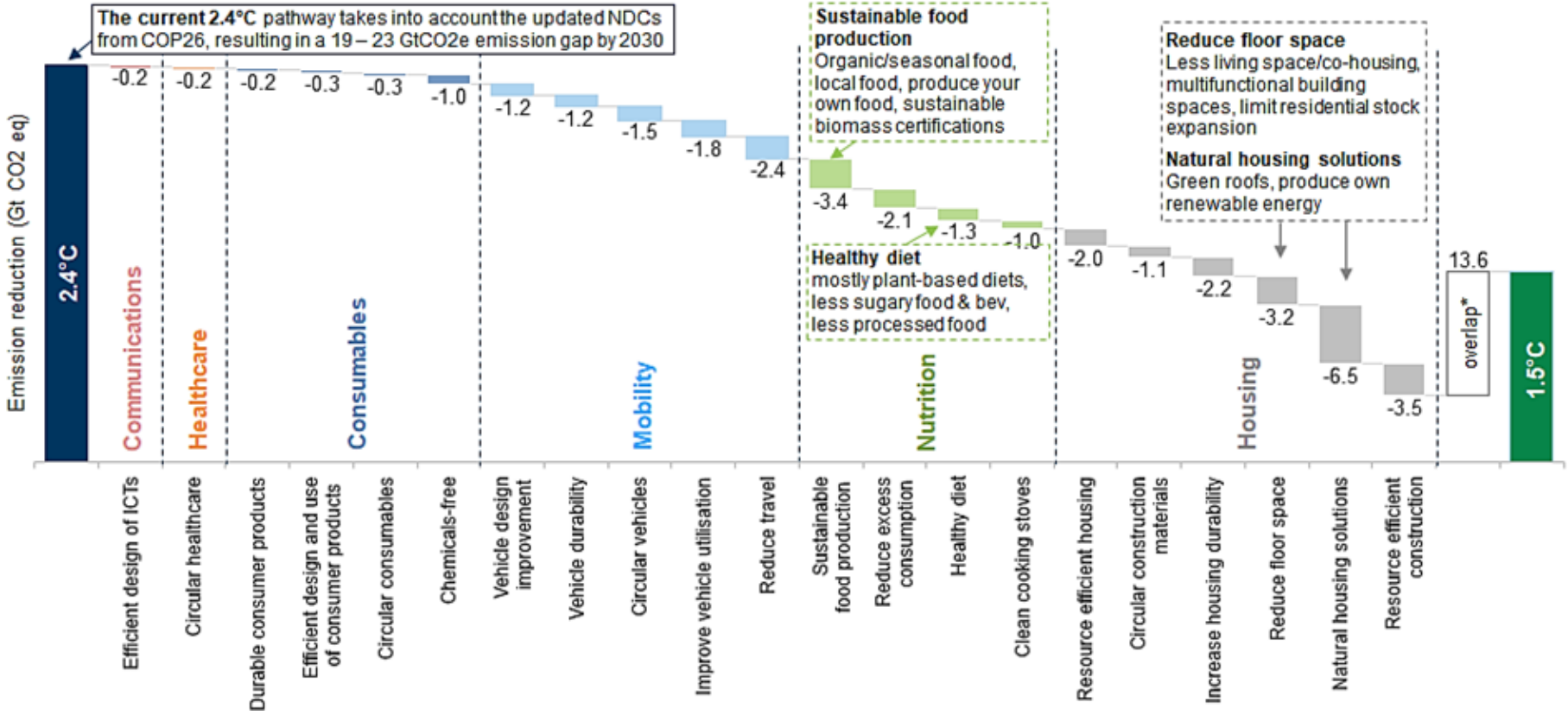


Source: Platform for Accelerating the Circular Economy (PACE), Data compiled by Goldman Sachs Global Investment Research

Circular Economy solutions could help reduce global GHG emissions by 39%, making the Circular Economy critical to any decarbonisation strategy. We highlight 21 circular solutions across various sectors of the economy that can collectively contribute to a 22.8Gt CO2e emissions reduction, helping to bridge the emission gap (19-23Gt) from the current 2.4C scenario, which takes into account latest COP26 Paris Commitments, towards a 1.5C scenario (Exhibit 10). Some of the biggest circular solutions aiding in GHG emissions reductions revolve around housing, including natural housing solutions (-6.5 Gt CO2e), resource-efficient construction (-3.5 Gt CO2e) and reducing floor space (-3.2 Gt CO2e). Nutrition and mobility are also key areas where circularity can reduce emissions, including sustainable food production (-3.4 Gt CO2e), and reducing travel (-2.4 Gt CO2e).

Exhibit 10: Circular solutions can help reduce global emissions by 22.8Gt, or 39% (from 2019 levels), helping to bridge the gap left by new COP26 Paris Commitments towards a 1.5 degree scenario by 2050

Emission reduction of 21 key circular solutions, Gt CO2 eq based on 2019 levels, assuming NDCs are met by 2032



*Some solutions' emissions reduction overlap with other solutions.

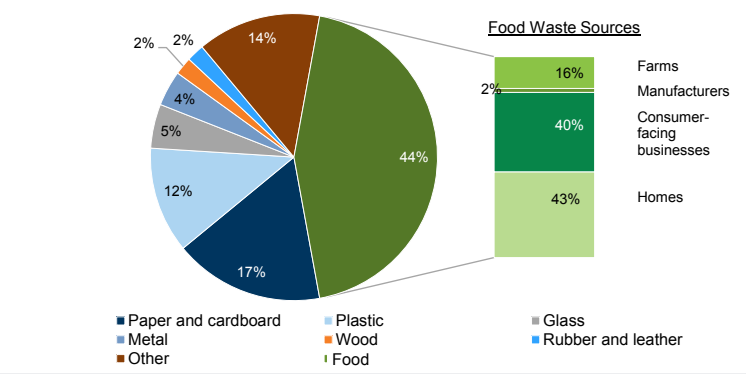
Source: Circle Economy, Data compiled by Goldman Sachs Global Investment Research

Other important considerations for a Circular Economy

A note on plastics: At least 42 plastics facilities have opened in the US since 2019 and the US plastics industry is responsible for over 230mn tonnes of CO2e emissions per year. Plastics make up over 12% of municipal waste generation in the US but 18% of waste sent to landfill. The UK has a much higher recovery rate for plastics, at 44% recovered/recycled, but globally 11 million metric tonnes of plastic were still leaked into the ocean in 2016, according to the Pew Charitable Trusts. Decarbonisation and plastic waste is not simply solved by substituting away from plastics, as alternative materials typically carry a higher emission profile per use case (Exhibit 17); rather improved recycling and technological advancements in pyrolysis (chemical recycling) are needed, in our view. We explore plastics recycling more below.

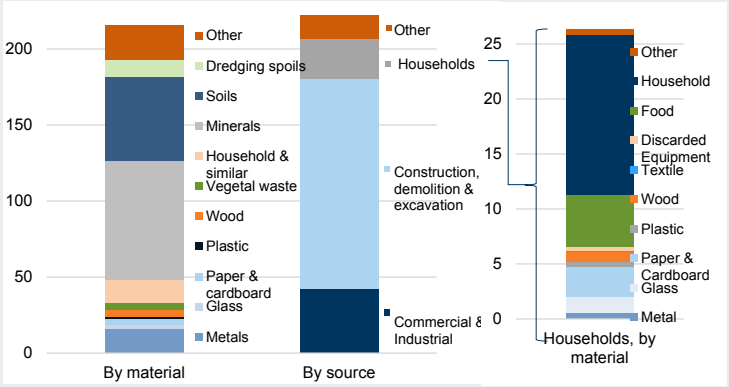
Food waste is still a massive problem. Up to 40% of global food produced ends up as waste, and the average family throws away approximately £720 worth of food per year, according to the Dept. for Environment Food & Rural Affairs, where homes make up 43% of total food waste by weight. Composting still makes up a very small portion of waste disposal methods, as food waste makes up 24% of landfilled material and 22% of combusted municipal solid waste in the US and results in $160 billion in food wasted every year (EPA & USDA). Uneaten and wasted food contains enough calories to support 150 million people each year, significantly more than the 35 million Americans facing food insecurity (EPA). US grocery chain **Grocery Outlet (GO)** helps to eliminate food waste throughout the food retail / distribution channels in the US by purchasing surplus inventory and repackaged products, much of which otherwise might have been wasted, while also providing cheaper food for lower-income populations.

Exhibit 11: Food makes up a huge portion of global waste, and each source requires different solutions to minimise disposal in landfills
Global waste production by type, with additional breakdown of sources of food waste



Source: World Bank, ReFed, Goldman Sachs Global Investment Research

Exhibit 12: Households made up only 12% of total waste generation in the UK in 2018 — Food made up 18% of household waste
Total waste generated in the UK by material and source, 2018, million tonnes



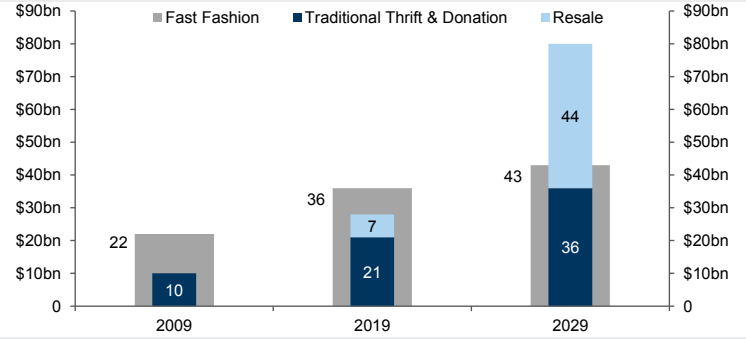
Source: Department for Environment Food & Rural Affairs, Data compiled by Goldman Sachs Global Investment Research

Electronics Waste: The potential value of raw materials in e-waste was valued at US $57bn in 2019 by the UN, and recycling rates across electronics are only 17%. Recycling electronics in order to salvage raw metals and materials can have other unexpected benefits, as recycled lithium-ion batteries were found in a study to perform better than new ones. Other efforts to tackle e-waste involve extending the useful life of products: Replacing a smartphone after 4 years instead of the typical 3 could prevent annual carbon emissions equal to the annual emissions generated by the entire country of Ireland.

Textiles and Apparel waste is an increasingly important challenge with the proliferation of fast-fashion and synthetic and mixed materials that reduce recyclability. Between 2000 and 2015, clothing production doubled while utilization (the number of times an item is worn before being thrown away) decreased by 36%, while only c.1% of clothing is recycled back into new clothing (Ellen MacArthur Foundation). And in 2018, the EPA found that the average amount of clothing and textile waste added up to 80 lbs (36 kg) per person. Also in 2018, the global fashion industry accounted for 4% of total global GHG emissions (2.1 bn tonnes).

Circular themes are picking up in the industry: resale, rental, repair and remaking, and resale and rental platforms like Depop, Rent the Runway, The RealReal, Vinted, Poshmark, ThredUp and Vestiaire Collective have reached billion-dollar valuations. The Ellen MacArthur Foundation estimates that circular business models and make up 23% of the global fashion market by 2030, providing significant environmental savings from increased product lifespans and reduced production of virgin materials and items. Additionally, the secondhand market is projected to grow to twice the size of the fast fashion industry by 2029 according to Global Data (Exhibit 13).

Exhibit 13: The total secondhand market is projected to grow to almost twice the size of fast fashion by 2029.
Secondhand market size in 2009, 2019 and 2029 ($USD)



Source: GlobalData, Goldman Sachs Global Investment Research

The business and environmental opportunity for transitioning to a Circular Economy

A Circular Economy could help contribute $4.5 trillion in additional economic output by 2030, and $25 trillion by 2050 - driving new revenue sources and reduced costs[2]. The World Economic Forum and Ellen MacArthur Foundation estimates that by 2025 recycling, reuse, and remanufacturing could help unlock $1 trillion a year in wasted resources and reduce 100 million tonnes of waste globally. **Given the emergence of a commodity super-cycle and higher material costs, we expect businesses and investors to give greater focus to the value potential of a circular economy to help alleviate dependence on scare resources and generate new revenue opportunities.**

Circular Partnership (Industrial Symbiosis) example: Kalundborg (Denmark) - an oil refinery, a power station, a gypsum board facility and a pharmaceutical company share ground, surface & waste-water, steam and fuel, and also exchange a variety of byproducts that become feedstocks in other processes.

Utilising the Oxford Institute for Energy Studies, we see seven critical components of a Circular Economy that can help to unlock this value:

1) Efficiency - improving material efficiency by reducing material volumes and energy required in production and use

2) Substitution - substituting hazardous or difficult-to-recycle materials with more circular alternatives

3) Durability - increasing useful life of products through enhanced durability

4) Ecodesign - designing products that are easier to maintain, repair, upgrade, re-manufacture, and recycle

5) Increased Asset Utilisation - increasing use intensity of goods and switching consumer focus towards services (rental, lending, sharing services)

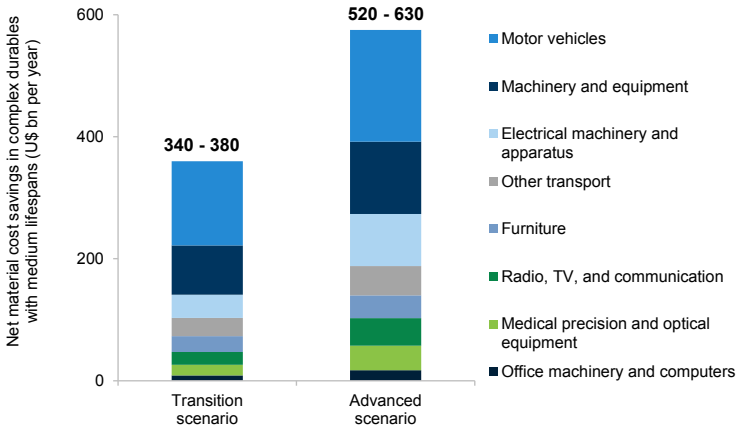
6) Increased recyclability and recycling - incentivise separate collection of materials among business and consumers and develop markets for secondary raw materials

7) New business models and circular partnerships - promote products-as-a-service, clustering industrial activities to prevent by-products from becoming waste (collaboration between businesses or value chain partners to ensure byproducts of industrial processes are maximally utilised rather than wasted).

[2] Lacy, P. & Rutqvist, J.. (2016). Waste to wealth: The circular economy advantage. 10.1057/9781137530707.

Exhibit 14: Circularity in manufacturing could yield net materials cost savings of up to US$630 billion p.a. in the EU alone

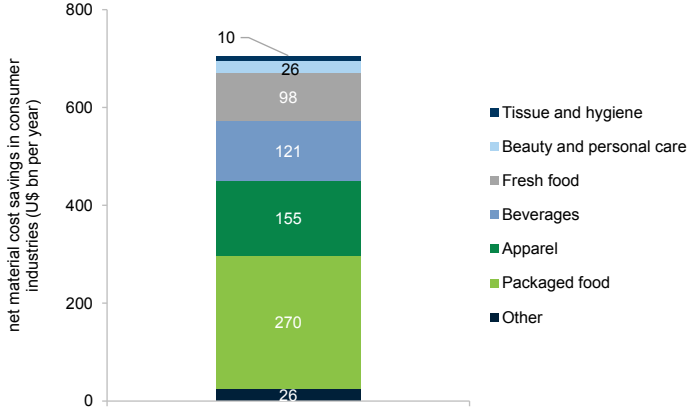
Net material cost savings in complex durables with medium lifespans, U$ bn per year, EU



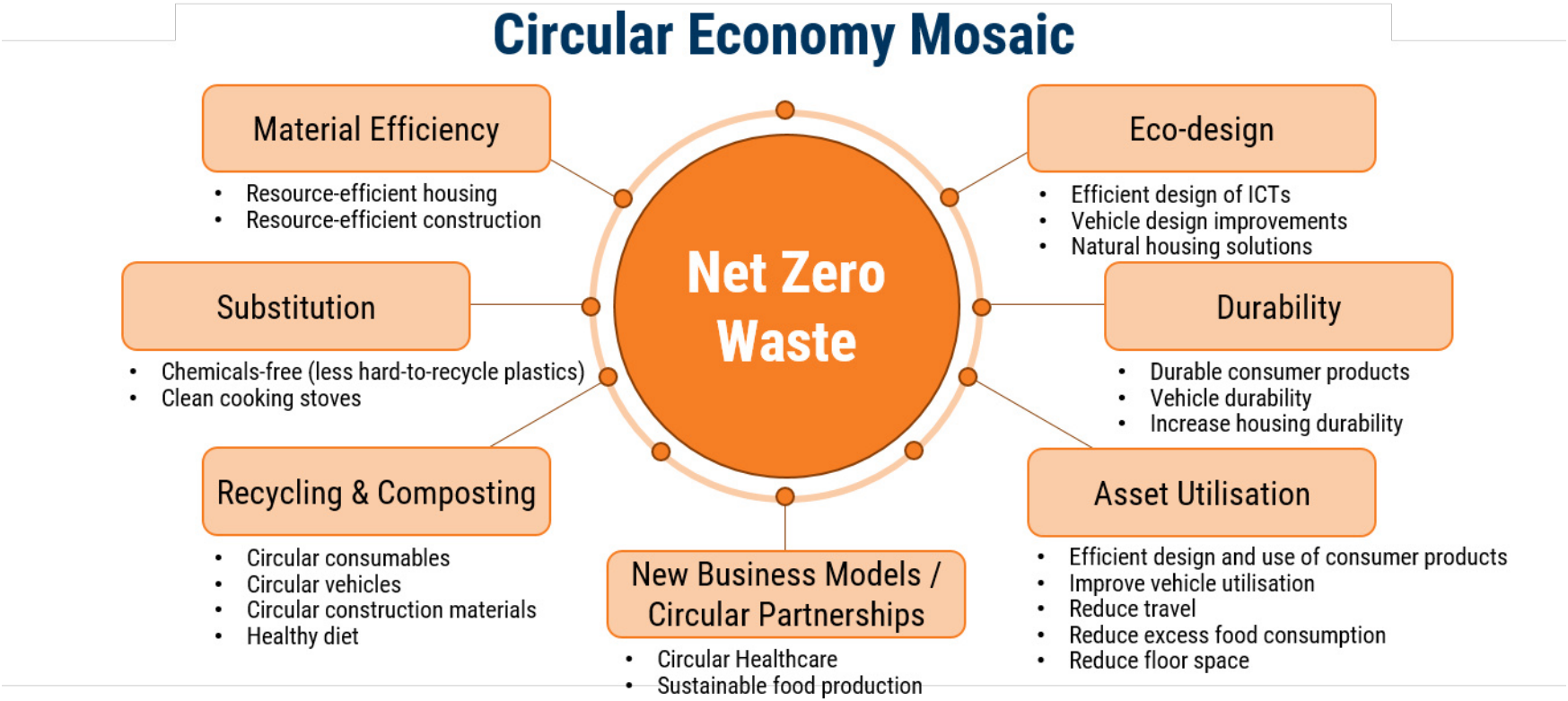
Source: World Economic Forum, Eurostat, Ellen MacArthur Foundation

Exhibit 15: Circularity in relevant fast-moving consumer goods sectors could yield net materials cost savings of ~US$700 billion p.a. globally

Net material cost savings in consumer industries, U$ bn per year, global



Source: World Economic Forum, Ellen MacArthur Foundation



Source: Oxford Institute for Energy Studies, Circle Economy, Goldman Sachs Global Investment Research

Most recyclable materials are still sent to landfills, resulting in significant opportunity costs. According to the World Bank, dry recyclables make up 38% of global waste, while compostables (food) make up an additional 44%. Of the remaining 18%, wood, leather and rubber (4%) can also be recycled/repurposed to avoid landfilling, leaving less than 14% of waste destined to be landfilled. Right now, however, 70% of global waste is sent to landfills or openly dumped. In the EU alone, ~180-190 million tonnes of steel, aluminum and plastics fall out of use in the EU economy, resulting in an estimated €87 billion in lost value every year (Material Economics).

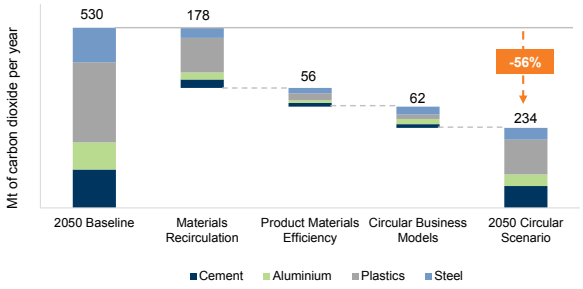
Improving circularity of key materials and reducing demand for virgin materials has the potential to cut CO2 emissions significantly. In Europe, materials recirculation, increasing product materials efficiency and circular business models for cement, aluminium, plastics and steel could reduce CO2 emissions 56% vs a baseline scenario of business as usual, according to Material Economics (Exhibit 16). Aluminium has the greatest differential in emissions saved from recycling, but an already high recycling rate means that the emissions-saving potential from reaching maximum recycling

rates is lower than the potential for plastics, where only 9% of plastics are recycled (Exhibit 17). Mechanically recycled plastics are set to displace over 1.7 mn tonnes of virgin polymer feedstocks by 2030, up 147% from 2020 (according to S&P Platts). Recycled PET can save 60% of GHG emissions for every unit of virgin PET replaced, according to NAPCOR.

Regarding steel, academic research suggests that 50% of steel production will still require virgin steel in 2050 to meet demand based on unchanged steel applications and corresponding lifetimes, as the accumulation of usable recycled material lags demand for new uses. But a recycling rate of 62% and residence time of 17 years[3] could lead to 60% of steel demand supported by recycling after 2070, a significant decline for virgin materials which could be further depressed with higher recycling rates. We take note of the recycling rates of a wide variety of materials below, where many are hypothetically 100% recyclable, including steel, aluminium, glass and copper. Other materials can only be downcycled, such as paper, textiles and plastics (mechanical), but are still not reaching their maximum circular potential (Exhibit 18).

Exhibit 16: Increasing circularity for four key materials in Europe could reduce CO2 emissions 56% vs business as usual

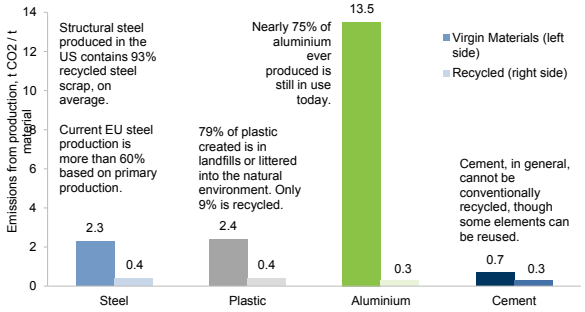
EU Emissions reduction potential from a more circular economy, Mt CO2 per year



Source: Material Economics, Data compiled by Goldman Sachs Global Investment Research

Exhibit 17: Emissions reduction potential varies across materials, and current recycling rates also influence total emissions reduction potential

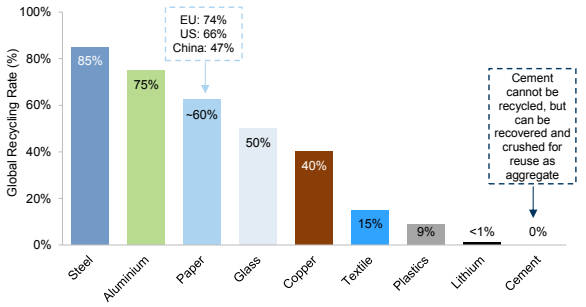
Emissions intensity of virgin vs. recycled materials in tCO2 per t material



Source: Material Economics, American Institute of Steel Construction, Aluminum Association, Goldman Sachs Global Investment Research

Exhibit 18: Some metals have high recycling rates already, while other materials like textiles and plastics have significant gaps

Estimated global recycling rates for a collection of materials



Source: International Resource Panel, UN Climate Technology Centre & Network, UN Environment Programme, US EPA, Ellen MacArthur Foundation, Glass Packaging Institute, Copper Alliance, Company data, Goldman Sachs Global Investment Research

[3] The length of time steel stays in a given use case before being repurposed, recycled, or disposed.

Exhibit 19: Estimated global recycling rates for a collection of materials, along with other recycling facts

Material	Recycling Rates, Recyclability, and other Disposal Information
Steel	- Global recycling rate around 85% - Steel is 100% recyclable
Plastics	-9% of plastic produced since 1950 has been recycled -79% of plastic produced since 1950 has accumulated in landfills or the natural environment -Recycling efficiency is relatively low for plastic, meaning most recycling involves downcycling
Aluminium	-Around 75% of aluminium ever produced is still in use today -Global recycling efficiency rate is 76% -Recycled aluminium makes up 80% of US aluminium production
Cement / Concrete	-Cement alone cannot be recycled, but recovered concrete can be reused as aggregate
Paper and Cardboard	-Paper recycling inefficiency means that paper can only be recycled between 3 and 8 times -Europe's paper recycling rate stands at over 72%, while the US's rate stands around 68%
Glass	-Around 50% of glass, globally, is recycled -Glass is 100% infinitely recyclable
Food / Vegetal Waste	-Good waste per year is around 30% for cereals, 40-50% for root crops, fruits and vegetables, 20% for oilseeds, meat and dairy, and 30% for fish -One fourth of food currently lost or wasted could feed 870 million people in the world
Textiles	-15% of textile waste is recycled while 85% is incinerated or sent to landfills -Only 1% of textiles are recycled into new clothing every year -Garment usage has declined by 36% over the past 15 years
Lithium	-Less than 1% of lithium is recycled and recycled content for production input stands at less than 1%
Copper	-Around 65% of copper produced over the last 100 years is still in use today -Copper's global recycling rate stands around 40% -Copper is 100% recyclable

Source: International Resource Panel, UN Climate Technology Centre & Network, UN Environment Programme, US EPA, Ellen MacArthur Foundation, Glass Packaging Institute, Company data, Goldman Sachs Global Investment Research

An estimated $634-995 billion USD of investment is needed between 2020-2040 to close the plastics circularity gap - AFARA

Key hurdles and initiatives to achieving a Circular Economy

To tackle the gap between recyclability and actual recycling, a wide range of actions can help address challenges to circularity today. In order to accomplish circular economy goals, strategies to tackle waste, overconsumption and ecodesign must have technical feasibility, policy support and infrastructure capacity, where supporting infrastructure has capacity for maximum material flow. Using analysis from AFARA and Google on Closing the Plastics Circularity Gap as an example, we highlight the top interventions that can be useful for improving the circularity of plastics and other materials such as paper and cardboard, aluminum, copper, and others (Exhibit 20).

Exhibit 20: Top interventions reducing the Plastics Circularity Gap in 2025, 2030, and 2040

Timeline	Interventions	Key Outcomes	Examples
Top Interventions by 2025	Collection Programs / Services	Increase accessibility and convenience of collection by providing consumers with new programs/services to increase collection rates	Adding public bins/receptacles
			Emptying bins in a timely manner
			Offering pickup of recycling in residential and commercial areas
	Consumer Incentives to reuse and recycle plastic	Provide consumers with incentives, including monetary / loyalty / social rewards to shift towards reuse and correct recycling	Providing a discount when consumers bring their own cup/bag
	Consumer Incentives to reduce plastic consumption	Provide consumers with incentives/disincentives, including monetary/loyalty/social rewards, to encourage a shift toward reuse and correct recycling	Setting a fee on plastic bags
	Education and Awareness on reusing and recycling	Provide consumers with knowledge to improve plastic management through reuse and recycling correctly	Sharing positive sustainable impacts
			Launching local education and awareness campaigns
		Empower consumers to promote proper plastic management among others	
	Education and Awareness on reducing consumption	Provide consumers with knowledge to change plastic consumption behaviour by eliminating virgin plastics or reducing plastic use	Increasing participation in consumer-led movements
		Empower consumers to promote a change in plastic consumption behaviour	
	Inventory Management	Eliminate pre-consumer plastic waste, like product destructions due to quality issues, product losses during transportation, unsold products due to excess inventory, unsold products due to shelf life expiration, etc.	Optimizing delivery cycles based on consumer shopping habits
	Mechanical Recycling System	Increase the capacity and quality of the collection network to manage a higher throughput of plastic volumes	Retrofitting/building material recovery facilities (MRFs) and transfer stations
			Optimizing optical sensors
		Improve the sortation system to increase the quality and purity of raw materials for recycling (i.e. clean and homogenous bales)	Integrating artificial intelligence/machine learning to recognize waste streams and patterns
Top Interventions by 2030	Design for Recyclability	Redesign products and packaging to minimize use of plastics	Minimize the number of polymers used in a package or product
		Reduce complexity and barriers to recycling	Minimize the amount of inks used
		Design for fit with regional recycling infrastructure	Eliminate small/loose materials
			Leverage novel additives that improve recyclability
Top Interventions by 2040	Chemical Recycling	Expand the collection system with a network of infrastructure to increase capacity for managing throughput of plastic volumes	Developing new polyethylene to ethylene monomer technologies
		Increase purity of raw materials for recycling by improving the sortation system	Standardizing the definition of recycled content to include plastics derived from chemically recycled feedstocks
		Improve and develop polymer-to-polymer recycling technologies	
		Reduce barrier to entry for chemical recycling through clear regs	
	Plastics Tax	Encourage industry to minimize the use of virgin plastics throughout pricing signals	Setting a tax on all virgin plastic production
Deprioritized Interventions	Plastics Substitution	Substitute plastics with a material that has better environmental impacts and improved end of life than virgin plastics	Substituting plastics with edible packaging
	Reverse Supply Chain	Provide consumers convenient collection program for end-of-life plastics directly back to the manufacturer to encourage reuse	Offering pick up of recycling with product delivery
	Plastics Reduction Policy	Enforce industry to minimize the use of plastics through regulations and bans	Setting a standard for minimum recycled content
			Mandating mono-material products
		Provide industry with resources to adapt to changes	Banning certain plastic types
			Providing directories for recycled content suppliers

These are split by solutions that are targeted/feasible by 2025, 2030 and 2040 based on maturity and readiness to deploy. Grey shaded solutions overlap impact from other solutions

Source: AFARA, Google, Data compiled by Goldman Sachs Global Investment Research

Still, there are nuances to the benefits, challenges and implications of recycling. In the path to circularity, **many alternatives to recycling offer increased material, energy and or emissions savings** — reusing goods and materials prevents any inefficiencies from the recycling process, and reducing consumption of goods and services to begin with minimises the material and emissions associated with production, regardless of whether virgin or recycled materials are used. **Recycling often reduces the energy required to manufacture products:** recycling cardboard takes 75% of the energy required to manufacture new cardboard; recycling plastic takes 84% less energy than making it from raw materials. And on average, it costs 44% less to recycle trash than send it to landfills, and between 54% and 60% less to recycle trash than to incinerate it, according to Recycling Revolution.

Despite these benefits to recycling, there may be some balancing required between these and the benefits of single-use items, most notably plastics. Sending 1kg of food waste to landfill has a similar carbon footprint to landfilling 25,000 500ml plastic bottles, so if single-use plastic can extend the useful life of food and prevent food waste, it can often, on a relative basis, be net beneficial to both waste and carbon emissions. In addition, recycled PET, in a recent study[4], was discovered to leach more toxic chemicals into water bottles than bottles made with virgin plastic. In addition, single-use plastic bottles made of virgin materials are less energy and emissions intensive than making one reusable bottle, though these benefits reverse after sufficient reuse. One stainless steel water bottle requires seven times as much fossil fuel, releases 14 times more GHG emissions, requires many more metal resources, and has higher risk to biodiversity than one single-use plastic bottle. But if reused 50 times, it is climate positive relative to a plastic bottle, and if used 500 times is better on environmental-impact categories - requiring fewer fossil fuels, releases fewer emissions, requires fewer material resources and has lower risk to biodiversity.

Recycling economic bottlenecks and headwinds generally come from feedstock availability and, in the case of chemical recycling, supply chain, economies of scale, technology and capex. Demand for recycling comes from the downstream tailwinds (social perception, policies and incentives) that over time should offset some of the headwinds in the production process to make a circular economy more economically viable than a linear one. The table below highlights some key areas throughout the value chain where recycling and linearity have different challenges and benefits.

[4] Gerassimidou, S., Lanska, P., Hahladakis, J., Lovat, E., Vanzetto, S., Geueke, B., Groh, K., Muncke, J., Maffini, M., Martin, O., Iacovidou, E.. (2022). Unpacking the complexity of the PET drink bottles value chain: A chemicals perspective. 10.1016/j.hazmat.2022.128410.

Exhibit 21: Mechanical and chemical recycling have a number of economic bottlenecks in the upstream and manufacturing stages, but see more tailwinds downstream
Economic Drivers for the Linear and Circular Economy

Economic Drivers		Favorable Conditions	Linear Economy	Circular Economy: Mechanical Recycling	Circular Economy: Chemical Recycling
Upstream	Feedstock Availability	Easy access and proximity to feedstock	Tailwind	Headwind	Headwind
		Minimal pre-treatment requirements	Tailwind	Headwind	Headwind
	Feedstock Cost	Low cost of Feedstock	Tailwind	Tailwind	Tailwind
		Low volatility of feedstock prices	Tailwind	Tailwind	Tailwind
Plastic and Resin Manufacturing	Supply Chain	Integrated supply chain	Tailwind	Neutral	Headwind
	Economies of Scale	Large scale/high capacity	Tailwind	Tailwind	Headwind
	Technology	Mature and robust technology capable of accepting flexible feedstock	Tailwind	Neutral	Headwind
		High efficiency and yield	Tailwind	Neutral	Headwind
	CapEx	Lower capital investment	Tailwind	Tailwind	Headwind
		Favorable depreciation and lending	Tailwind	Tailwind	Headwind
	OpEx	Low energy and water requirements	Neutral	Neutral	Neutral
Downstream / Other	Polymer Price	High value output products	Neutral	Headwind	Neutral
	Social Perception	Promotes circularity and use of recycled content	Headwind	Tailwind	Tailwind
	Policy / Incentives	Recycling and/or circularity subsidies	Neutral	Tailwind	Tailwind
		Comprehensive definitions of recycling	Neutral	Tailwind	Tailwind

Headwind Neutral Tailwind

Source: AFARA analysis, Goldman Sachs Global Investment Research

Investable Ideas and companies investing for a Circular Economy

We highlight 19 companies that we see as aligned to the seven key components of circularity. While these are mapped to one circular theme, most of these companies contribute to many of these themes, again reiterating the interlinking nature of these themes all working together towards net zero waste.

Select companies mapped to the 7 Circular Economy solutions

Theme	Why it's important	Focus stock	Relevance for the theme
Material Efficiency	Reducing material volumes and energy required in production and use allows for less virgin resource extraction and resulting waste.	**Befesa SA** **Clean Harbors, Inc**	Befesa closes resource loops by collecting hazardous waste and residues, recycling them, and reintroducing the materials into the production process. Befesa also minimizes material volumes required in production by collecting and recycling steel dust and other steel residues. Clean Harbors re-refines and recycles used oil, and provides parts cleaning and maintenance to increase efficiency and machine lifespans, and environmental services, through treatment of hazardous and non-hazardous waste.
Eco-design	Designing products that are easier to maintain, repair, upgrade, remanufacture and recycle means more products can be used for longer and avoid being landfilled.	**Nike Inc** **Adidas AG** **Unifi Inc**	Nike's Flyknit design is made of between 6-7 plastic bottles and is made with 60% less manufacturing waste than traditional footwear, on avg. Two upcoming sneakers are held together only by tension, with the lack of glue allowing the shoes to be taken apart at end of life and more easily recycled. Adidas's Primeblue yarn for the sports industry is made out of ocean plastic, and ocean and recycled plastic now make up over half the polyester used in their products and target zero virgin polyester by 2024. Unifi's REPREVE fiber is made from 100% recycled materials, including plastic bottles and industrial waste, with recycled polyester and nylon end uses including polyester non-wovens, staple fiber and PET products (strapping, containers, sheet & film, bottles).
Durability	Increasing the useful life of products through enhanced durability leads to fewer new products being consumed and thrown away over time.	**Duluth Holdings** **Columbia Sportswear**	Duluth's "No Bull Guarantee" offers a lifetime warranty on their clothing and outdoor gear against defects or poor performance. Columbia Sportswear designs products to last and offers a limited lifetime warranty on outerwear and when possible will repair items for consumers.
Substitution	Substituting hazardous or difficult-to-recycle materials with more circular alternatives can have health benefits in the case of hazardous materials and allow for increased recycling of products.	**Azek Company Inc**	Azek designs and manufactures decking, railing and other outdoor living products out of recycled materials. Their substitution of traditional outdoor living materials with recycled scrap materials also increases durability through increased water- and weatherproofing.
Asset Utilisation	Increasing the use intensity of goods, and also switching consumer focus towards service-oriented business models (rental, lending, sharing services) reduces new production and limits landfilling over time.	**Uber Technologies Inc.** **Lyft Inc.** **Ashtead Group** **Herc Holdings** **United Rentals**	Uber and Lyft's ride-sharing business models optimize demand for travel to reduce the number of cars on the road and increases the use intensity of vehicles. Ashtead, Herc and United Rentals are rental suppliers which rent construction, industrial and general equipment. Herc also sells used equipment and supplies, increasing use intensity.
New Business Models / Circular Partnerships	Promoting product-as-a-service reduces waste, and clustering industrial activities through business-to-business or value chain partner collaboration to ensure byproducts of industrial processes are maximally utilized rather than wasted can reduce waste sent to landfill by businesses.	**Grocery Outlet** **Waste Management** **Eastman Chemical**	GO helps to eliminate food waste throughout the food retail / distribution channels in the US by purchasing surplus inventory and repackaged products that otherwise would have been wasted, while also providing cheaper food for lower-income populations. WM is expanding their renewable nat. gas business, investing $825mn over next 4 years to increase capacity 6x, where they collect waste methane gas from landfills and other organic sources to turn into fuel. Eastman is part of the new National Materials Marketplace project to match materials and by-product waste streams. The company is also spending $1bn to build the world's largest chemical recycling plant in France.
Recycling & Composting	Incentivizing separate collection of materials amongst businesses and consumers, developing markets for secondary raw materials and building infrastructure to make recycling and composting feasible reduces improper disposal of waste in landfills.	**Veolia Environnement** **TOMRA** **Norsk Hydro**	Veolia's waste solutions business manages specialist sorting centers and platforms and responded to the UK Plastics Pact with further investment in its Dagenham plastic recycling to increase capacity 20%. Tomra provides waste collection and sorting technology solutions, with advanced sorting systems that optimize resource recovery to minimize waste sent to landfill. Norsk Hydro's remelting business sorts and remelts used and scrapped aluminium with a goal of doubling post-consumer aluminium scrap recycling by 2025.

Source: Goldman Sachs Global Investment Research, Company data

Exhibit 22: Circular Economy / Recycling projects and recent expansions from select companies

Material	Company	Project Overview
Aluminium	Norsk Hydro	**US:** In Michigan, Hydro will invest in the construction of a new aluminium recycling plant producing **120,000 tonnes of aluminium extrusion ingot** per year. The site is set to start production of Hydro CIRCAL in 2023. **EU:** Norway: Hydro will **invest NOK 105 mn to establish Høyanger Recycling**, a dedicated aluminium recycling facility located by the HydroHøyanger primary aluminium smelter. Hungary: Hydro will build a **new aluminium remelt facility**, at Hydro's aluminium extrusion plant in SzekesFehervar with an annual capacity of **90,000 tonnes**. In addition, Hydro is increasing the capacity for its Rackwitz recycling plant in Germany and Clervaux plant in Luxembourg. **UK**: Hydro is investing **£2.4 mn** in its Deeside recycling plant in the UK to increase the **aluminium recycling** capacity to **70,000 tonnes** per year.
Battery	Fortum	Will invest **c. €24 mn** to expand its **lithium-ion battery recycling capacity** by building a new hydrometallurgical plant in Finland. The new facility will recover scarce metals from old EV lithium-ion batteries while also recycling various waste fractions derived throughout the battery supply chain.
	Umicore	Umicore and Automotive Cells Company announced April 27, 2022 a long-term strategic supply agreement for EV cathode materials, where Umicore will supply ACC's future large-scale European battery plants with next-generation high nickel cathode materials, with first commercial volumes expected in early 2024.
	Johnson Matthey	Johnson Matthey partnered with Stena Recycling and European Metal Recycling to develop an efficient lithium-ion battery and cell materials recycling value chain in Europe. The company is developing processes to produce fully refined materials for lithium-ion batteries, looking to increase recycled content in new batteries.
	Stena Metall	Investing **SEK 250mn** into a new **battery recycling** facility in Halmstad, which can recycle 95% of a lithium-ion battery.
General waste	Zheneng Jinjiang Environment Holding	**In operation:** 25 Waste-To-Energy (WTE) facilities; 1 Organic Waste Treatment facility; 8 Resource Recycling projects *Treatment Capacity: 40,410 tons/day* **Under Construction & Expansion:** 3 WTE facilities; 1 Resource Recycling projects *Treatment Capacity: 3,100 tons/day* **In Preparation:** 18 WTE facilities and Kitchen Waste Treatment projects; 1 Resource Recycling project *Treatment Capacity: 14,645 tons/day*
	Huazhang Technology	Investing up to **HK$100 mn** to fund the waste recycling plants in Dubai.
	Shanaya	As of end of 2021, the group invested **U$2.72 mn in integrated recycling plant for general waste handling and oil waste handling**.
Glass	Ambev	Investing **870 mn Reais (c. U$154 mn)** in a new sustainable **glass plant** in Paran, which will have the capacity to produce bottles from recycled or broken glass, collected in partnership with local companies and organizations specializing in reverse logistics.
	Vetropack	Invested in the expansion of **glass recycling facilities** in the Czech Republic and Austria.
Metals	Aurubis	Investing **c. €300 mn** in a new recycling plant in Georgia. The project is **expected to process ~90,000t of complex recycling materials** after its completion in 2024.
	Befesa	Invested **c.€84m** into **two EAFD recycling plants** in China, with a combined capacity to **recycle 220kt EAFD p.a.** One has contracted EAFD for >80% plant utilisation in 2022; the other one is expecting commercial output H2 '22.
Chemicals & Plastics	OMV	Building a **chemical recycling** demo plant based on its proprietary ReOil® technology. The plant has a capacity of **16,000 t p.a.**
	Eurocell	Between 2016 and 2021, Eurocell **invested £6.3 mn** to expand Eurocell Recycle Midlands site, to increase output and improve reliability. The company acquired Eurocell Recycle North for **c. £6 mn** and made post-acquisition investment of **£4.5 mn**.
	Coca-Cola	Increasing onshore recycling capacity by investing in joint venture **PET recycling** plants in Australia and Indonesia. In Australia alone, the two new plants will build a combined annual capacity of **40,000 tonnes.**
	INEOS Styrolution	Investing into a pilot plant for advanced recycling of polystyrene in the UK. It is expected to be operational in H2 '22.
	BASF	By 2030, BASF will **invest up to €4.5 bn in battery materials and recycling**. BASF, Quantafuel and REMONDIS partnered up on a joint investment into a **pyrolysis plant for plastic waste**.
	Alfa	Invested **U$96 mn** in the acquisition of CarbonLITE's **PET recycling and pelletizing plant** in Pennsylvania, which enables the production of food-grade pellets required for bottle-to-bottle recycling.
	Alpla	Announced investment of **c. €50 mn a year** in expanding Alpla's recycling activities between now and 2025.
	Eastman Chemical	In **2021**: Eastman invested **U$250 mn** to expand the capacity of its molecular recycling facility, which uses **>110,000 metric tons** of waste plastic as raw material. Construction is expected to be mechanically complete by end 2022. In **2022**: the company announced that it will invest up to **U$1 bn** in a material-to-material molecular recycling facility in France, where the company's polyester renewal technology could be used to recycle **up to 160,000 metric tonnes** of hard-to-recycle plastic waste annually.
Textile	Zorlu	Invested **U$10 mn** in **Polymer Recycling Plant** in Europe, and started producing polyester yarn completely out of plastic bottles.
Used fuel	Orano	Orano is investing **over €80 mn** in its **Melox recycling** plant that produces Mox fuel assemblies made from a blend of uranium oxide and plutonium developed from spent fuel. They are intended to supply light water reactors for electricity production.

Source: Company data

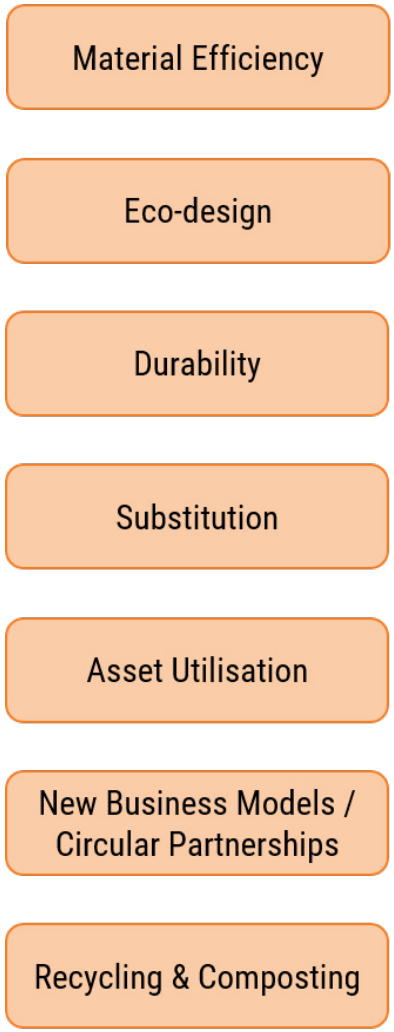
The EU Taxonomy - a potential catalyst to the Circular Economy

The Platform on Sustainable Finance released its final report on the next four environmental objectives of the EU Taxonomy, covering 56 activities under water, waste & the circular economy, pollution prevention and control, and biodiversity. **Circular activities are a big winner of the next phase of the Green Taxonomy**, capturing 21 of 56 activities (Exhibit 23), as spare parts manufacturing, servicing or repairing, recycling, products-as-a-service, and second-hand goods, among others, are due to gain greater recognition. New industries not previously covered under the current Climate Taxonomy include apparel and footwear, food and beverage, aircraft manufacturing, passenger and freight air transport, furniture manufacturing, plastic packaging, and animal and crop production. **We see circularity being a focal environmental objective alongside climate change mitigation in thematic investor decision-making.**

Investor attention towards tracking and following the EU Taxonomy will be unavoidable for ESG funds. The ambitions of the European Commission are to establish the Taxonomy as the definitive 'green label' to help capital markets facilitate the flow of capital towards sustainable outcomes. The EC must, by law, embed the Taxonomy criteria into all future relevant regulation, investment fund labels and standards, and will feature heavily in upcoming MiFID II amendments that will further catalyze the growth of sustainable investment funds, in our view. **We see the Taxonomy leading to significant implications for capital flows, cheaper cost of capital and higher valuations for companies that fit into the Taxonomy — which will have significance to global ESG and generalist investors.**

As market sentiment potentially shifts towards supporting ESG improvers, the Taxonomy could help provide basis for owning companies in transition. Thus the Taxonomy could reshuffle the balance of what gets owned in ESG funds - presenting opportunities for ESG 'value' or 'momentum' strategies where companies require significant transition financing. Sectors originally left out or not in scope of the initial climate change activities of the Taxonomy may see renewed focus after being included under the new objectives, including manufacturing of clothing, manufacturing of food and beverages, all civil engineering activities and road maintenance, and waste services. Based on our ESG fund holdings analysis, many of these sectors are currently underweight in ESG funds, including Beverages (-29%) and Transport Infrastructure (-14%). These industries will be pivotal to accomplish climate, circularity and pollution prevention goals, and will now in whole or partially be recognized as 'green' under the Taxonomy where meeting the strict criteria, which could improve their investability among ESG funds. **Gauging companies' taxonomy-aligned capex will be critical for assessing future revenue exposures and could support ESG improver/momentum strategies.**

Exhibit 23: New Taxonomy-eligible activities for the circular economy environmental objective connect to the critical components of a circular economy in a variety of ways
Eligible activities under the EU Taxonomy for the circular economy mapped to the seven critical components of a Circular Economy



Taxonomy activity eligible under the transition to a circular economy	
Manufacturing	Manufacture of plastic packing goods
Manufacturing	Manufacture of electrical and electronic equipment
Buildings	Construction of new buildings
Buildings	Renovation of existing buildings
Manufacturing	Furniture: manufacturing, repairing/refurbishing/remanufacturing and sale of spare parts, sale of second-hand, product-as-a-service and other circular use- and result-oriented service models
Manufacturing	Manufacture of food products and beverages (making a substantial contribution to the transition to a circular economy)
Manufacturing	Wearing apparel, except fur and leather: manufacturing, repairing/refurbishing/remanufacturing and sale of spare parts, sale of second-hand, product-as-a-service and other circular use- and result-oriented service models
Manufacturing	Footwear and leather goods: manufacturing, repairing/refurbishing/remanufacturing and sale of spare parts, sale of second-hand, product-as-a-service and other circular use- and result-oriented service models
Manufacturing	Repair, refurbishment and remanufacturing, and sale of spare parts
Manufacturing	Preparation for re-use of end-of-life products and components
Manufacturing	Sale of second-hand goods
Civil Engineering	Maintenance of roads and motorways
Manufacturing	Product-as-a-service and other circular use- and result-oriented service models
Restoration, Remediation	Remediation activities for the transition to a circular economy
Sewerage	Phosphorus recovery from waste water
Sewerage	Production of alternative water resources
Waste Management	Collection and transport of non-hazardous and hazardous waste as a means for material recovery
Waste Management	Treatment of hazardous waste as a means for the transition to circular economy
Waste Management	Recovery of bio-waste by anaerobic digestion and/or composting
Waste Management	Depollution and dismantling of end-of-life products
Waste Management	Sorting and material recovery of non-hazardous waste

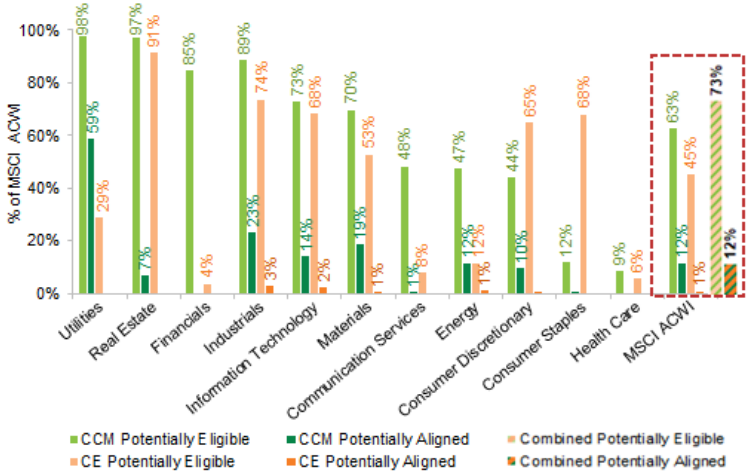
Source: Goldman Sachs Global Investment Research

The Climate Taxonomy recognizes the interconnection of the circular economy and GHG emissions savings - giving dual credit for circular economy solutions in many cases. The following activities can receive dual credit under both the climate change mitigation and circular economy objectives of the Taxonomy:

- **Manufacturing of plastics in primary form** - has provisions for both mechanical recycling, chemical recycling, and or renewable feedstock.
- **Manufacturing of biogas / biofuels** - has provisions for anaerobic digestion of organic material (eg. food waste).
- **Anaerobic digestion or composting of sewage and bio-waste.**
- **Landfill gas capture and utilisation.**
- **Collection and material recovery from non-hazardous waste -** captures both collection and recycling activities.
- **Maintenance and repair of low carbon / energy efficient technologies for buildings and renewables.**

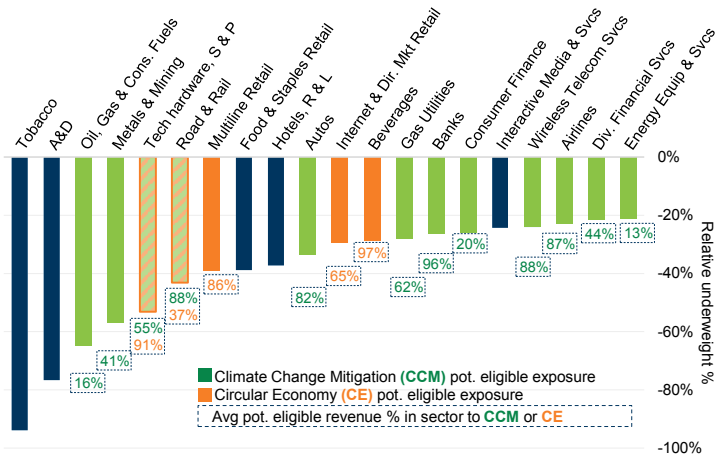
New circular economy activities expand coverage of existing Taxonomy. With the addition of the 21 new circular economy activities, company eligibility coverage increased from 62% of MSCI ACWI under just Climate Change Mitigation to now 73% (with revenues >5% eligible). While data currently remains sparse for measuring alignment to the Circular Economy technical screening criteria, alignment stayed at 12% of the MSCI ACWI given that many recycling covered under the Circular Economy activities are also covered under Climate Change Mitigation as described above (Exhibit 24).

Exhibit 24: Over half of global companies have some exposure to the EU Taxonomy, with only 12% potentially aligned under Climate Change Mitigation and 1% under Circular Economy (>5% rev.)
MSCI ACWI exposure by GICS 1, >5% rev potentially eligible/aligned under CCM, CE and combined



Source: European Commission, Goldman Sachs Global Investment Research

Exhibit 25: Some of the most underweight industries in ESG funds have portions of revenue that are eligible under the Taxonomy
GICS 3 industries most relatively underweight in ESG funds, Mar 2022, with avg. eligible revenue % in exposed sectors



Source: Morningstar, Goldman Sachs Global Investment Research

Europe Future of Food: Digesting the EU Taxonomy

In December, our European Consumer Staples sector team partnered with GS SUSTAIN to discuss the six environmental objectives of the Taxonomy and their **relevance to Consumer Staples**, particularly under the transition to a circular economy and the protection of biodiversity. Under the initial draft of the remaining four objectives released in August 2021, **the team examined how European Food companies under scope screen on both an eligibility and alignment basis based on their interpretations of the Taxonomy technical screening criteria, and leveraging the currently available disclosures from covered companies.** While the newest release of the Technical Screening Criteria for the remaining four objectives is not identical to the draft from August 2021, the alignment criteria for food and beverage remained the same.

It is hard to draw exact conclusions given inconsistency in company reporting, but the team tried to assess where the most progress on achievement of the Taxonomy criteria has been made, the biggest challenges ahead, and limitations of the EU Taxonomy proposals for the CPG space. Food manufacturing companies will have to comply with rules covered under the protection and restoration of biodiversity and ecosystems and transition to a circular economy. The team assessed the alignment to the Taxonomy criteria by identifying the proportion of raw materials defined as sustainably sourced and the proportion of packaging made up of recycled content. These disclosures are not uniform, and may not always meet the full criteria needed to be aligned with the EU taxonomy, but these figures still offer insight with respect to the relative performance of each business.

Updates to our EU Taxonomy Tool

Our updated GS SUSTAIN EU Taxonomy Tool expands our mapping of 1,700 unique revenue segments to the 21 circular economy activities (in addition to the already-mapped 90+ climate change mitigation and adaptation (where relevant) activities) defined in the platform's final report for the next four Environmental Objectives, and assess alignment where feasible. **We also now incorporate company reported Taxonomy eligibility and alignment figures for climate change mitigation where available.** Our Taxonomy eligibility and alignment framework covers >7,000 global companies where ~4,300 have some potentially eligible revenue and >700 companies have some potentially aligned revenue.

Conducting alignment tests for the circular economy remains difficult - Currently available data from companies is often not sufficient to test companies' alignment to the technical screening criteria today, leaving many companies as eligible, but requiring more information to assess full alignment. For example, food and beverage companies selling product in packaging made up of 95% recycled material can claim revenue as aligned (green) under the new criteria; however, very few companies report this information at a product level or only report figures on an aggregated basis with percentages significantly lower than the 95% threshold - Read *Europe Future of Food: Digesting the EU Taxonomy.* **Currently we can only qualify companies as aligned where business models clearly meet the technical screening criteria as is, such as sale of second-hand goods or 'recycling equipment manufacturers', 'products as a service', etc.**

We note that the activities and criteria released for the Circular Economy should be viewed as provisional as they are not yet finalised by the EU Commission and published in the Official Journal.

Exhibit 26: List of circular economy activities that meet the technical screening criteria as is and example of RBICS mapping to Taxonomy activities List of Taxonomy-defined economic activities under circular economy that can likely align directly to the technical screening criteria

RBICS Revenue Segments	Primary Taxonomy Circular Economy Activity Category	Activity already meets technical screening without further tests?
Recycling Services	Sorting and material recovery of non-hazardous waste	Y
Other Waste Services	Remediation activities for the transition to a circular economy	Y
Wastewater Treatment Services	Phosphorus recovery from waste water	Y
Environmental Services	Remediation activities for the transition to a circular economy	Y
Soil Remediation	Remediation activities for the transition to a circular economy	Y
Wastewater Residual Management	Phosphorus recovery from waste water	Y
Solid Waste Recycling Equipment Manufacturing	Sorting and material recovery of non-hazardous waste	Y
Manufacturing Industry Software	Product-as-a-service and other circular use- and result-oriented service models	Y-With circular biz. model check
Machinery, Equipment and Supplies Distributors	Repair, refurbishment and remanufacturing, and sale of spare parts	Y-With circular biz. model check
Maintenance/Repair/Overhaul Supplies Distributors	Repair, refurbishment and remanufacturing, and sale of spare parts	Y-With circular biz. model check
Metal Recycling Providers	Sorting and material recovery of non-hazardous waste	Y
Other Metal Processing and Recycling Providers	Sorting and material recovery of non-hazardous waste	Y-With circular biz. model check
Computer Aided Design (CAD) Software	Product-as-a-service and other circular use- and result-oriented service models	Y-With circular biz. model check
Software Design and Engineering Consulting	Product-as-a-service and other circular use- and result-oriented service models	Y-With circular biz. model check

Source: Platform for Sustainable Finance, Goldman Sachs Global Investment Research

Other circularity regulations impacting corporates:

Circularity regulation is increasing across global jurisdictions as focus on sustainability continues to push beyond decarbonization through energy. Expanding from our discussion on the Circular Economy Wave Coming to Europe, we outline a few examples of circularity-focused regulations and legislation being implemented around the globe with potentially significant implications for corporates. **This non-comprehensive list is just the start to circularity regulations, and momentum behind legislative efforts is and will continue to pick up as public focus on waste grows.**

Exhibit 27: Example regulations and legislation related to key circular economy components and themes

Region	Circular Economy Regulations
The USA	Extended producer responsibility (EPR) legislation that makes manufacturers responsible, to some extent, for the afterlife of their products is picking up at the state level. Successful bills in Maine and Oregon passed last summer have helped drive momentum for 8+ states that have introduced or plan to introduce EPR legislation in 2022. The draft Recycling Infrastructure and Accessibility Act would direct the US EPA to provide grants for projects that increase accessibility of recycling programs for rural and disadvantaged communities, and the draft Recycling and Composting Accountability Act would direct the EPA to collect data on recycling and composting at an increased level and look into implementing a national composting strategy.
Sweden and Luxembourg	Sweden and Luxembourg reduce the VAT rates for the repair of certain goods where increasing the useful life.
The UK	The UK's 'right to repair' law requires manufacturers to make spare parts for electrical appliances within two years of launches and for 7-10 years after the model is discontinued, which the Department for Food, the Environment and Rural Affairs says could extend the lifespan of products by up to 10 years.
The EU	The EU Ecodesign Working Plan and Circular Economy Action Plan (CEAP) set ambitious goals for the EU on pursuing circularity through making products more sustainable, increasing value chain transparency, enhancing eco-design and labelling efforts, and targeting key sectors including textiles and construction products. CEAP will encompass 35 policy actions aimed at increasing the transparency and available ESG data for sustainability analysis and assessment by investors, while increasing standards and introducing new incentives for sustainable products to empower consumers to make sustainable choices. The 2018 EU Plastics Strategy began widespread European efforts to reduce single-use plastics in order to reduce leakage into the environment and other negative impacts. The Single-Use Plastics Directive went into action in July, 2021, and includes product bans, design requirements, plastic beverages recycling targets, EPR obligations and education and awareness efforts. Banned items include cotton bud sticks, cutlery, straws, plates, and others made of single-use plastics.
Japan	Japan's Law for Promotion of Effective Utilization of Recyclables in 1991 kicked off a series of legislative efforts over the following decades, leading to the expanded Basic Law for Establishing the Recycling-based Society and Top Runner Program, where the government names the "top" product in a given category to use as a baseline for requirements related to energy efficiency over a certain timeline.
Vietnam	Vietnam's Law on Environmental Protection came into effect in January 2022, which includes extended producer responsibility (EPR) along with detailed requirements on collection, disposal and recycling of plastic and waste. Producers and importers of products are now responsible for collecting products or packages with recycling value for proper disposal and recycling.

Source: Goldman Sachs Global Investment Research

Our GS SUSTAIN ESG Framework - how we can help

GS SUSTAIN can provide access to proprietary tools and resources to quantify impact and identify ESG Improvers, enabling greater recognition of underappreciated opportunities across sectors. Our expanded offering of SUSTAIN tools can help investors to answer a myriad of ESG questions at the portfolio and security levels, enabling more systematized and quantitative reporting while providing detailed and transparent data sets for idea generation, security selection and corporate engagement.

- **Our multi-pronged SUSTAIN scoring framework** can help provide greater granularity and objectivity for asset managers in both security selection and reporting. The framework across >7,000 companies includes our recently introduced Product Alignment framework, based on the SDGs, EU Taxonomy and GS analyst views, and can help investors cast a wider net in the search for impact winners aligned to less obvious sustainability themes. Existing pillars detail performance around sector-specific environmental and social operational metrics, governance, and controversies.
- **Forward-looking estimates.** Looking ahead, we believe investment performance will be more driven by future change and have taken our first steps toward incorporating forward-looking estimates in our proprietary industry analyst inputs which now include sustainable product revenue and capex in select industries. Of more than 3,000 companies under GS coverage, 53% saw a change in net E&S scores as a result of our analyst survey inputs. Furthermore, we have taken first steps to offering quantitative forecasts of sustainable product revenue/capex for ~650 companies in 19 industries. We now add Scope 1 and 2 greenhouse gas emissions for a smaller segment of companies in 7 sectors.
- **EU Taxonomy revenue alignment.** We see the EU Taxonomy as one of the most seminal regulatory developments driving standardization in reporting for both corporates and asset managers. Our EU Taxonomy alignment tool maps companies' revenues to Taxonomy-defined activities to determine potential Taxonomy-eligible and aligned revenue based on technical screening checks where data exist, and "Do No Significant Harm" (DNSH) and "Minimum Social Safegards" (MSS) criteria.
- **SDG revenue alignment.** The UN Sustainable Development Goals (SDGs) have emerged as one of the most commonly used frameworks for taxonomizing impact across a broad set of sustainability challenges. Our SDG alignment tool employs granular revenue data, GS analyst inputs and other company metadata to map alignment, exposure and misalignment to ten of the SDGs we deem to be most investable.
  - **Company mapping for SDG 12: Responsible Consumption & Production:** Our SDG 12 screen targets companies advancing the circular economy or reducing the environmental impact of commonly used materials, logistics and shipping businesses, and companies that offer waste management, pollution control, maintenance, recycling, rental or reuse services or the equipment or machinery used in these services. Recycling facilities,

companies that produce RFID devices, recycling equipment and machinery, pollution control equipment, recyclable materials and companies that offer hazardous waste collection & treatment and environmental engineering & consulting services are considered aligned. Otherwise, to be aligned a company must have >10% clean energy revenue based on BNEF data, eco-design products or take-back initiatives. If the company is in paper & packaging, it must have labeled wood products. If the company is in the auto parts, brands, consumer durables, household & personal care or chemicals sectors, the company must have eco-design products and sustainable packaging or take-back initiatives.

- **ESG fund ownership.** Aggregating fund holdings across a universe of ~3,000 ESG funds we analyze this pool of ESG assets to better understand trends in ESG ownership at both the sector and company level. The full dataset provides absolute and momentum ESG ownership detail for well over 10,000 securities.
- **ESG fund flows, valuations and performance**. Our ESG Tracker series analyzes the aforementioned ESG fund universe to gauge ESG fund flow momentum and sizing relative to the broader market, breaking out differences by strategy, fund type and fund style. The tracker also examines valuation and performance across categories.

GS SUSTAIN ESG Pillars

Product Alignment

Key issues addressed
How do the company's products & services impact consumers, communities, & the environment in the use-phase and at end-of-life?

Outputs
1. **Headline Product Impact (NEW)**
   - Product Portfolio
   - Product Strategy
2. **Forward-looking forecasts (NEW)**

Inputs and sources
- Business activity taxonomy
- Specialized raw data
- Industry analyst qualitative and quantitative input

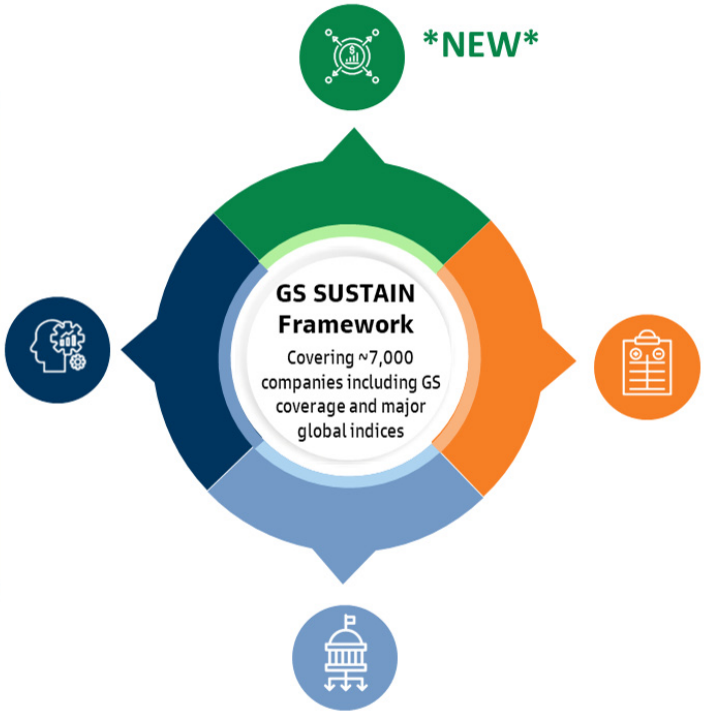
EU Taxonomy & SDG alignment
- Net revenue alignment to the SDGs and the EU Green Taxonomy

Operational E&S

Key issues addressed
What are the industry-relevant measurables offering insight into exposure and performance on key environmental & social issues?

Outputs
1. **Headline E&S Rank**
2. **E&S Momentum**
3. ***E&S Disclosure %***

Inputs and sources
- Corporate disclosure
- Specialized alt-data
- Industry analyst inputs



Controversies

Key issues addressed
Does the company have real-time or a history of ESG exposures not yet reflected in company disclosures or captured or quantified by available data?

Outputs
1. **Headline Controversy Rank**
   - Long-term track record
   - Long-term momentum
   - Short-term 1m sentiment
   - Short-term 3m sentiment

Inputs and sources
- Media controversy coverage
- News sentiment analysis

Governance

Key issues addressed
Has the company put in place foundational structures of accountability, checks & balances, and shareholder alignment?

Outputs
1. **Global-relative Governance Rank**
2. **Region-relative Governance Rank**

Inputs and sources
- Corporate disclosure
- Specialized raw data

ESG Fund Holdings

'Nifty Fifty Series'

- How widely owned, over/underweight (v. benchmark), companies are in ~3,000 ESG funds (active & passive) representing $2tn in AUM.
- Covers the market's view of ESG, **offering ESG discovery value**.

Source: Goldman Sachs Global Investment Research

Disclosure Appendix

Reg AC

We, Evan Tylenda, CFA, Madeline Meyer, Grace Chen, Georgina Fraser, Ph.D., Ajay Patel, Brian Singer, CFA, Derek R. Bingham, Sharmini Chetwode, Ph.D., Rachit Aggarwal and Emma Jones, hereby certify that all of the views expressed in this report accurately reflect our personal views about the subject company or companies and its or their securities. We also certify that no part of our compensation was, is or will be, directly or indirectly, related to the specific recommendations or views expressed in this report.

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Growth is based on a stock's forward-looking sales growth, EBITDA growth and EPS growth (for financial stocks, only EPS and sales growth), with a higher percentile indicating a higher growth company. **Financial Returns** is based on a stock's forward-looking ROE, ROCE and CROCI (for financial stocks, only ROE), with a higher percentile indicating a company with higher financial returns. **Multiple** is based on a stock's forward-looking P/E, P/B, price/dividend (P/D), EV/EBITDA, EV/FCF and EV/Debt Adjusted Cash Flow (DACF) (for financial stocks, only P/E, P/B and P/D), with a higher percentile indicating a stock trading at a higher multiple. The **Integrated** percentile is calculated as the average of the Growth percentile, Financial Returns percentile and (100% - Multiple percentile).

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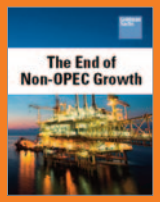
5G: From Lab to Launchpad

Climate Change

Carbonomics

The End of Non-OPEC Growth



Reimagining Big Oils

The Rise of Renewables

Shale Scale to Shale Tail

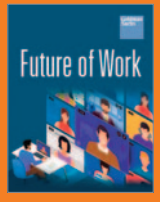
IMO 2020

The Genome Revolution

Digital Health

The Future of Finance

Future of Work



Drones

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eSports: From Wild West to Mainstream

Music in the Air

EVs: Back to Reality

Venture Capital Horizons

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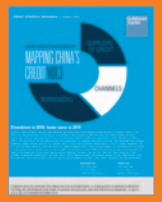
China A Shares in Anatomy

China's Credit Conundrum



Japan Aging

Made in Vietnam

What the Market Pays For

The Competitive Value of Data

What Matters for IPOs

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