FORCE FOR GOOD

Technology for a Secure, Sustainable and Superior Future

Technology as a Force for Good

The 'Force for Good' Initiative

In Support of the UN Secretary General's Strategy and Roadmap for Sustainable Development

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Technology for a Secure, Sustainable and Superior Future

Technology as a Force for Good, 2023 Report

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CONTEXT: DIGITAL TECHNOLOGY AS A FORCE FOR GOOD

Digital technologies sustain life, work, health and learning for billions of people

"Digital technologies sustain life, work, health and learning for billions of people. In the face of COVID-19, businesses, governments, and the digital community have proven resilient and innovative, helping to protect lives and livelihoods. These challenging times have accelerated the transformation everywhere.

Yet 3.7 billion people – nearly half the world's population – remain unconnected to the Internet; and of these, the majority are women. They, too, must be included if we are to make the possibilities of 5G, artificial intelligence, the Internet of Things, digital health, and other technologies truly transformative and sustainable.

We must also protect against the dangers of digital technologies, from the spread of hatred and misinformation to cyberattacks and the exploitation of our data.

The United Nations, through a Roadmap for Digital Cooperation and the vital work of the International Telecommunication Union, aims to make the transformation equitable, safe, inclusive, and affordable for all, with full respect for human rights.

Let us commit to work together to [...] ensure that digital technologies are a force for good that help us to achieve the Sustainable Development Goals and leave no one behind."

António Guterres, Secretary-General of the United Nations[i]

FOREWORD: TECHNOLOGY HAS TRANSFORMED MY LIFE

My name is Mariyam Reetha.

I live in Palluruthy village in Kerala with my husband and son, and I run a small business making recycled paper bags. Technology has truly helped transform my life by allowing me to start a business, access financing to grow it and now digital payments which have made running and growing my business even easier. My dream has always been to financially independent. Before starting my business, we were dependent on my husband's unstable income as a daily laborer. Seeing other women in my village engaging in small income generating activities and providing for their families with their micro enterprises gave me the motivation to start a business of my own.

Plastic bags are widely banned in India, so eight years ago, I saw an opportunity to produce recycled paper bags. At the time I got the initial financing to set up the business from a technology-enabled microfinance company. The paperwork was all done online, and they were able to fund my business within three days.

As a women entrepreneur, it was really tough to compete in the market, and in order to stand out in the market, I had to come up with some creative ideas, listening to my customers and working with them deliver what they needed. I took my time, and slowly and steadily started developing my business. Initially, the business was small, and I served only retail customers but later, step-by-step, the business expanded and enabled me also do wholesale business, and I am now supplying paper bags to the nearby naval base.

In recent years, the government in India has made a big effort in opening bank accounts and digitalization of all aspects of life, and in particular with digital mobile payments.* When they were first introduced, I didn't have any idea about what digital payments are. But when I understood the ease of digital payments, I incorporated them into my business and I have been using digital collections for the last two years. Before that, I hardly used banking transactions at all. I was afraid to go to the bank because I was not aware of the formalities there. Now I get most of my payments through Google Pay, which is as easy as sending a text message, and I do not even need to go to the bank, where the same transaction would cost me a whole workday given the travel, the queuing, and the paperwork.

This technology also helps me save and invest my money. When I had cash in hand, it prompted me to spend. Since most of my money is in the bank now, I am able to save more, and it is easier to plan financially. My son is all grown up and has joined my business as a screen printer. Right now, he still needs to work by hand we don't have a screen-printing machine. As a future plan, I am saving up to buy a screen printing and folding machine which would make my business grow to the next level.

Mariyam Reetha
Paullurhty Village, Kerala, India

*In 2014, India launched a mass financial inclusion initiative based on technology, which has resulted in nearly half a billion people opening bank accounts and accessing other financial services

MESSAGE FROM THE ADVISORY COUNCIL

Technology may be the deciding factor for the world to achieve the UN Sustainable Development Goals and in delivering human security for all.

The great breakthroughs of the industrial revolution have driven unprecedented human development, economic growth, and global prosperity. Over the course of the 20th century alone we have split the atom, decoded DNA as the language of life, and built machines that outperform the human brain by several orders of magnitude. But we have also honed our ability to make war during the past century, killing over 100 million people with increasingly lethal and innovative armaments.

Technology therefore is critical for human progress, but its impact depends entirely on how it is used. And the question of responsible use is becoming more and more important as technology is embedded ever deeper into our economies, our societies, and our daily lives through digitization.

At the same time, the world is facing a series of interrelated systemic challenges to prosperity, security, and sustainability. Climate change is having large scale impacts on global ecosystems, biodiversity is being lost at record rates, and between one third to half of the world is not fully participating in the financial system, formal work, higher education, or the digital age. The window to addressing these challenges, as encapsulated in the 2030 UN Sustainable Development Goals, is rapidly closing.

In our 2022 'Capital as a Force for Good' report, we estimated that levelling up the world to achieve the SDGs would cost US$176 trillion through 2030, and that ensuring human security over the same period would cost an additional US$60 trillion. Addressing climate change would require an additional c.US$85 trillion from 2030 to 2050. With the world's total stock of liquid capital standing at US$450 trillion, these are not sums that can be spent without destabilizing almost every government in the world, putting the prospect of universal secure sustainability out of reach. However, not solving for these challenges is not an option without risking the same destabilization.

Innovation and technology can change this equation. The emerging generation of digital technology, driven by data and artificial intelligence, is exploring humanity's every frontier, ranging from the inner mind to outer space, and today's technologists are at least as bold and resourceful as those that delivered the innovations that drove the transitions to the Industrial Age and the Information Age. This provides the hope that the world can be levelled up, with the sense to protect what we have and the compassion and commercial risk-taking to spread the solutions to where they are needed.

From this more stable footing we can fully harness the power of technology to create a secure, sustainable, and superior future for all. This report is about how technology is and can be the leverage to find solutions that make the world better for all.

Ketan Patel,
Chairman, Force for Good
Chair of the Advisory Council, Force for Good

Helen Alderson | Edward Braham | Chantal Line Carpentier | Nitin Desai | Garry Jacobs | Anja Kaspersen | Jonathan Miller | Nicky Newton King | Sir Alan Parker

Advisory Council, Force for Good

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ABOUT THIS REPORT

Force for Good is an impact-driven institution focused on transforming capitalism for a sustainable and resilient future. The organization seeks to influence the deployment of capital to address major global issues and opportunities in this regard. Force for Good engages key stakeholders, conducts research, publishes thought leadership and has an active outreach program to major global financial institutions as well as development banks, NGOs, and other stakeholders with the potential to act as a force for good in the world. It works with major institutions to accelerate their efforts to tackle increasingly complex and interrelated challenges like climate change, social inclusion, and sustainable development in the spirit of encouraging collaboration and spurring a race to the top in making an impact for good in the world.

The inaugural Technology as a Force for Good Report builds on the extensive work conducted by the Force for Good Initiative on the UN Sustainable Development Goals and its engagement with finance industry and other major stakeholders on how to achieve them. The report seeks to explore technology's, particularly digital technology's, potential in supporting the SDGs and the critical role than the technology industry and its leaders play in this regard. The report analyzes the engagement of 100 of the world's leading tech companies across ESG, sustainability and stakeholder engagement to identify the emerging common ground among leaders and their ambition to be a force for good in the world. The report further examines recent innovative and scaled initiatives with the potential to break new ground for the industry, with selected leaders effectively raising the bar for competitors to in terms of sustainable development, driving systemic change or accelerating the transition to the information age.

The Advisory Council for Force for Good comprises:

Helen Alderson, Head of Regional Delegation to the UK and Ireland, International Committee of the Red Cross; former CEO of the World Heart Federation

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ABBREVIATIONS AND NOTES

AI	Artificial Intelligence
AuM	Assets under Management
Bn	billion
CSR	Corporate Social Responsibility
ESG	Environmental, Social and Governance
GFANZ	Glasgow Financial Alliance for Net Zero
GHG	Greenhouse gases
ILO	International Labor Organization
ICT	Information and Communications Technology
IT	Information Technology
LDC	Least Developed Countries
M	million
p.a.	per annum
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
US	United States
US$	United States dollars
RoW	Rest of the World
SDG	United Nations Sustainable Development Goal
VR	Virtual Reality
XR	Extended Reality

Executive Summary

Key Messages

- **The world is not on track to achieve the SDGs and provide human security with as much as US$195 trillion now needed up to 2030, out of an estimated capital stock of US$450 trillion**
- **Technology can bridge this gap and reduce the cost to fund the SDGs by US$55 trillion, solving for c.40% of the SDGs, being key to 103 of the 169 targets associated with the SDGs**
- **Investing in innovation and breakthroughs would also lay the foundation for a more prosperous and superior future which could boost global GDP by 3x to 2060, raising average per capita income globally to that of South Korea today**
- **Tech companies have a critical leadership role in making capitalism work for all, being uniquely responsible for imagining, developing, and distributing innovations and solutions with the potential to change the world**
- **A sub-group of the largest tech companies are showing the way by embracing sustainable growth and impact, while making bold strategic investments across multiple critical future technologies that can build a far superior world for all**

I. Technology and the tech industry are likely the deciding factors determining whether the UN SDGs and human security needs of people are met or not

- Based on current trajectories and rates of progress, the world will fail to achieve the SDGs, as well as the climate goals of the Paris Agreement
- To avoid this, as much as US$195 trillion – comprising a US$135 trillion shortfall in meeting the UN SDGs, and an additional US$60 trillion for security in the wake of Russia's invasion of Ukraine – may be needed up to 2030, out of an estimated capital stock of US$450 trillion, to create a secure and sustainable world
- Technology has a critical role in driving the SDGs and in advancing human security, and will likely determine whether many of the goals can be met by 2030, directly impacting 103 of the 169 targets associated with the SDGs
- Driving global connectivity and deploying digital technologies could solve for as much as 20% of the SDGs, reducing the cost of achieving the goals by over US$30 trillion
- Rolling out digital solutions can enhance the impact on the goals even further, taking the total SDG targets addressed to c.40%, and reducing the cost of achieving the goals to 2030, bringing the total saving to up to c.US$55 trillion
- However, technology and its application also present a number of challenges that need to be managed, including structural employment shifts from automation, the risk of a deepening digital divide, a growing environmental impact, and the growing risks of cybercrime and cyber warfare, which some believe can lead to existential risks
- At an estimated US$5-10 trillion in annual revenue and c.80 million employees, expected to rise to half a billion by 2050, the tech sector is among the largest and most valuable industries in the world, providing it with global power and influence, and it has created a class of tech entrepreneurs who now include six of the world's ten richest people
- Given the pivotal role that tech (as an innovative force for change) and technologists (as powerful individuals) have in the fourth industrial revolution underway, they can have a transformative impact on the capitalist system itself though systemic change, power shifts between stakeholders and direct impact

II. Tech sector leaders have established a de facto 'common ground' across ESG, sustainability and stakeholder engagement, which has the potential to become a code for responsible global citizenship for the industry

- **c.96%** of companies have publicly committed to a multi-stakeholder approach, acknowledging the need for aligning the long-term interests of a wide range of stakeholders and have adopted ESG policies and practices
- **94%** have recognized the importance of workforce diversity, and have programs in place to drive inclusion and 93% have specific programs to support workers' wellbeing

- **84%** have committed to Net Zero and have adopted sustainability accounting standards to report on their emissions and long term decarbonization
- **5%** absolute reduction in tech sector leaders' GHG emissions over a two-year period with average revenue growth of c.45%, indicating the rapid decarbonization of operations by the sector
- **US$45 billion** of green and sustainability bonds have been raised by tech leaders with the capital invested across a range of green infrastructure and organizational projects
- **US$3.8 billion** spent on corporate social responsibility is indicative of tech leaders social impact priorities

III. A subset of leading tech companies is breaking new ground in their engagement as a force for good in the world, with ambitious initiatives that differentiate them from their peers and raise the bar for the entire industry

- Organizational breakthroughs by some of the leading companies include becoming net negative greenhouse gas emitters, eliminating waste, or driving to ambitious diversity and inclusion targets
- More aggressive breakthrough strategies are being pursued by a league of tech companies to leverage their core business to address some of the world's biggest sustainability challenges, innovating products and services that deliver both profit and impact
- A small set of industry leaders are pursuing breakthrough strategies with the potential create the future, using digital technology to transform a range of fields and blurring the boundaries of the tech sector with other industries
- As a result of these initiatives, these companies are undergoing a fundamental transformation in assets, strategies and competencies that will position them as potential future leaders of the sector in the world to come.

IV. Creating a more secure, sustainable, and superior future will require a middle path that addresses current existential sustainability challenges while investing to deliver fundamental technological breakthroughs that will reach the last mile and transform the world

- Humanity is estimated to be extracting 1.75x the resources that the planet can sustainably support, and yet saving the planet through deep cuts to consumption, production, and reduced is not likely to be accepted by citizens
- A strategy of going for growth at any cost has also proven to be unsustainable and is resulting in record economic dislocations, inequality, and natural disasters
- Growth and innovation are the only way we can get to sustainability, with breakthroughs across multiple areas of technology that blur the boundaries with and transform other sectors, and lay the foundation for a more prosperous and equitable future

- By 2060, technology could boost GDP by 3x, raising average per capita income globally to equal to that of South Korea today, and by more than 20x by 2080
- The tech sector has a critical leadership role, being uniquely responsible for developing, distributing, and leveraging innovations with the potential to create a better world for all, recognizing that regulation has a role to play in ensuring competitive markets and servicing the last mile.

I. Context: A World Torn by the Security and Sustainability Transition

Human security has risen to the top of the agenda in a year of war, recession, an unresolved pandemic, inflation leading to a global cost of living crisis, geopolitical tension, environmental disasters, mass migrations and declining democracy. This has undermined the global effort to achieve the United Nations Sustainable Development Goals, with governments reallocating attention and resources away from long-term sustainability to managing near-term risks. As a result, the goals are moving further away as we approach their midterm review while the funding gap is widening. However, global security and global sustainability are inextricably linked, and one cannot be adequately resolved without addressing the other. The challenge for the world is therefore to achieve both in an integrated fashion that minimizes near term trade-offs and sets the stage for a better future.

1. Event risk shifting global priorities

Our world is set to be fundamentally transformed over the course of the next generation, driven by a number of long-term developments. Among the most significant is climate change, the total cost of which, if left unchecked, could reach US$178 trillion over the next 50 years by some estimates.[2] But there are many others that are reshaping the world too. Long-term global economic power is shifting away from liberal (and mostly Western) democracies, while already significant inequalities in wealth and access to opportunities risk increasing further, with the

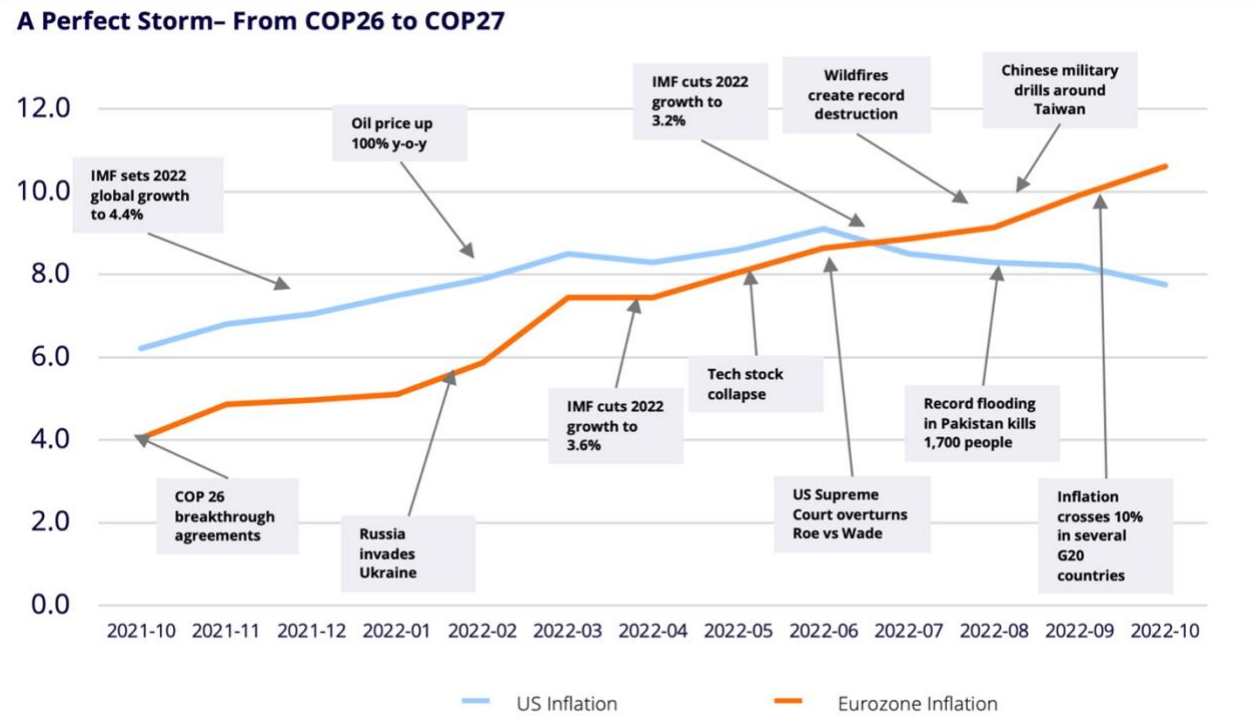
bottom 50% of the global population capturing just 2% of global wealth generated between 1995-2021.[3] Mass migration driven by such income disparities, conflict and climate is growing, with 270 million people currently classified as migrants, a number that is estimated to grow to as many as one billion people by 2050.[4]

Technology, which is a key driver of advancing societies is also disrupting them as well as economies, and politics, with the accompanying dislocations driving polarization and an increase in isolationism and nationalism. And the resulting civic disaffection and cultural conflict, further amplified by social media technologies and platforms, is increasingly bringing focus to technology and technologists with questions on whether they are a positive or destructive force.

The UN Millennium Goals set for 2015 had to be extended and broadened with the Sustainable Development Goals ... the big question remains of what the world must do to avoid another program to achieve a more secure, sustainable, and superior world for all

Recognizing the systemic nature of many of the challenges laid out above, the United Nations sponsored the creation of eight Millennium Goals in 2000 to eradicate hunger and poverty, achieve universal primary education, promote gender equality, and ensure environmental sustainability, among other fundamental goals. While significant progress was made across a number of targets, most of the UN's development goals had not be achieved by their target date in 2015. In response the UN again rallied the world behind an expanded list of 17 Sustainable Development Goals, secured by the agreement of all 193 UN members, to be met in a 15-year global effort creating a more inclusive and sustainable world.

Figure 1: A Perfect Storm –Global Disruptions from COP26 to COP27



Source: Force for Good Initiative, Rate Inflation

At the half-way mark of this effort however, the unfolding and interrelated political, security and economic and crises, put the achievement of the goals at risk and threaten to undo in some cases decades of development progress, while undermining global peace, prosperity, and freedom.

The past year, in particular, has provided a preview of the consequences of not addressing the major challenges facing the world. Industrialized countries emerged from a pandemic that has resulted in the death of an estimated 15 million people worldwide,[5] with little soul-searching on the inequities of vaccine and aid relief to poorer nations, ready to pursue old models of growth or solidarity once more, as developing countries' recovery was still slow. At the same time, the first inter-state war in Europe in nearly three generations erupted, shaking global security, more so than the c.100 conflicts being fought in the world today. With much of the world dependent on Russian energy and fertilizer supplies, global energy and fertilizer prices have spiked upwards, rising by 50% in 2022,[6] and driving inflation, expected to reach 8.80% for the year globally and peak at 11% in emerging markets. Ukraine and Russia also account for more than 50% of grain imports for several developing countries, creating a food supply shock and a cost-of-living crisis. These events overwhelmed global supply chains that were designed for a globalized and peaceful world, further fueling inflation in the process. The war also led to nearly five million refugees spilling into Europe. More broadly, 32 countries are engaged in war, covering cross-border conflicts, civil and drug wars, ethnic violence, and terrorist insurgencies.

2022 has provided a tragic preview of failures on security, economic and societal fronts ... Russia's war in Ukraine marking a monumental strategic and moral failure that is killing people and hope and absorbing focus and funds, leaving the world weaker in funding the SDGs, and addressing the world's most pressing issues

At the same time, the world has been hit by increasingly devastating natural disasters, with floods in Pakistan destroying nearly one million homes and impacting 33 million people, extreme heatwaves in Europe killing more than 16,000 people, and a major hurricane in the US causing in excess of US$50 billion in damage and 137 deaths.[7]

In a deeply interdependent world, these shocks have proven their power to wreak havoc within countries and across boundaries, afflicting rich and poor, and in turn create significant and unpredictable risks to global stability.

The cumulative impact of all these events has refocused the global agenda away from long-term sustainable development in favor of short-term security, and the two currently represent competing priorities for the world. The former includes the full range of issues encapsulated in the SDGs, from those that are immediate, related to hunger, poverty, and lack of clean water, or affordable energy, to the existential threat to the planet's ecosystem from climate change, biodiversity loss and pollution. Global security on the other hand captures both immediate threats to peace and the longer-term risks to security at the individual human level, the national level, and the geopolitical level, among others.

The need to address the interrelated security and economic crises has fundamentally shifted the priorities of global leaders. In the aftermath of the global pandemic, leaders at COP26 committed to address climate change as the world's biggest priority over the next 10 years.[8] 12 months later climate change has been replaced by a raft of interrelated near-term challenges including runaway inflation, stalled growth, energy, food, and national security. As a result, COP27 lacked the momentum of its predecessor, and while the summit made a breakthrough on loss and damage funding for developing nations, no further progress was made at the event on the phase out of fossil fuels or achieving global net zero.

Accordingly, most Western leaders would contend that spending hundreds of billions on long-term sustainable development in developing economies in the Global South,[9] is a luxury they can currently ill-afford. And while the cost of not addressing climate change now clearly outweighs the cost of inaction, it is unable to compete with economic stability or national security in times of perceived uncertainty.

Figure 2: Key Near Term Global Security Challenges[10]

Peace Dividend Exhausted. Following a decades long peace dividend in Western and Northern Europe, states including Sweden and Finland are abandoning longstanding policies of neutrality and joining NATO, with the region pledging over US$200 billion in increased defense spending as part of a global wave of rearmament.

Intensification of Geopolitical Competition. The conflict has further sharpened the fault lines between the West and Russia and its allies, threatening to intensify geopolitical competition with China, in particular.

Supply Chain Risks. The inadequacy of supply chains dependent on single points of failure being highly concentrated in a few countries for key commodities, or geopolitically risky supply sources already demonstrated during the pandemic has been further exposed by the ongoing Russia-Ukraine war.

Soaring Energy Prices. Uncertainty surrounding access to Russia's supply of c.8% of the world's primary energy with many countries highly or solely dependent on Russia for their energy has pushed global energy prices to record levels, with oil prices increasing over 100% between Q3 2021 and Q1 2022

Food and Commodities Stress. Similar concerns over the c.30% of global wheat exports from the Ukraine-Russia region has pushed wheat prices up over 70% over the same period. The UN-led Back Sea Grain initiative released some pressure but risks remain of interruption.

Global Inflation. Higher commodity prices are exacerbating inflationary pressures, with the IMF raising 2022 inflation projections to 8.8% globally and up to 11% in developing economies.

Reduced Economic Growth. As a result of these multi-dimensional challenges, global growth is expected to fall from 6.0% in 20221 to 3.2% in 2022 wiping out trillion dollars of output for the world.

Increase in Fossil Fuel Extraction. Nations formerly at the forefront of the energy transition are rushing to embrace oil and gas, with G7 energy ministers calling on the OPEC group of oil-producing countries to increase production, as well as developing new resources in their bids for energy security.

Global Food Crisis. The number of people experiencing acute food insecurity has increased by almost 90% to 345 million since 2019, and as many as 828 million people go to bed hungry every night due to the combined shocks of the pandemic, conflict (in Ukraine), climate impacts and spiraling prices.

Source: Updated from 2022 Capital as a Force for Good Report

The consequences of these challenges for the world are severe, putting global sustainability transition at risk. Lower growth, economic crises and increased spending for defense and security act as a major drain on capital available to fund sustainable development, while renewed exploitation of fossil fuels risks further undoing the world's insufficient progress on the energy transition.

Moreover, given the perceived urgency of current events, security and sustainable development risk competing with one another for the world's attention, resources, and capital.

2. Global security and its cost taking priority

The security challenges facing the world today are both global in reach and severe in nature. These risks are damaging individuals' basic freedoms, even in advanced economies – including access to sustenance, personal safety, and basic rights – and are multi-dimensional in coming from powerful social, economic, environmental, and political sources. Indeed, global safety and human security decreased for the first time in five years, while Human Development index decreased for the first time in decades.[11]

Other key security risks that have arisen in the past year span defense, energy, food, economic and political security challenges across the world's major countries. Taken together, they represent a threat to geopolitical security and the liberal international order that has underwritten it. Cumulatively the world's recent security challenges may cost an estimated incremental US$59.4 trillion to 2030, globally.

Military Security. Countries around the world have committed to increases in defense spending in the wake of Russia's invasion of Ukraine. NATO expansion and the formalization of new alliances like the Asian Quad sweep in a new global wave of rearmament. While this may make many feel more secure, it is no substitute for diplomacy and strategic engagement. Moreover, it will make multi-lateral engagement on sustainable development more challenging, diverting resources and political goodwill away from international collaboration.

Figure 3: The Rising Cost of Global Security, Partial List

The Rising Cost of Global Security, Partial List

Security Category	Strategic Risk Management Measures (Actual and Potential)	Estimated Global Cost Through 2030
Military Security	Defense spending (G20 countries lift annual defense spending (to 2% of GDP)	US$23.6 trillion
Domestic Political Security	Protectionism and barriers to trade increase	US$18 trillion
National Economic Security	Creation of recovery and stimulus funding reserves	US$16.9 trillion
Energy Security	Upstream oil and gas investments (announcements by 20 largest oil majors)	US$0.9 trillion
Total		**US$59.4 trillion**

Source: Capital as a Force for Good Initiative

Domestic Political Security.

Liberal democracy across many countries is being threatened by increasing waves of nationalism and populism, further exacerbated by the cost-of-living crisis, driving social unrest and conflict. With many governments feeling that they lack the mandate to focus on international sustainable

development, some nations have been adopting isolationist and 'country'-first policies. Non-tariff trade barriers have risen seven-fold in the decade since 2010,[12] export restrictions keep increasing and restrictions on foreign investment on the basis of national security concerns are also increasing,[13] further damaging global cohesion.

National Economic Security. While the current economic downturn may well take years to work through, governments will need to deal with further global shocks in the coming decade, including both investments to build greater resilience and providing relief when this resilience is insufficient. This may well require deploying similar amounts in fiscal stimulus to the US$16.9 trillion deployed during 2020/21 to boost recovery from the coronavirus pandemic, further driving global indebtedness.

Energy Security. Western countries are moving to reduce or eliminate fully imports from Russia, Europe's largest energy trading partner. This in turn is driving renewed investment in fossil fuel exploitation, risking the Paris Agreement to reduce these investments by US$500 billion by 2030.

Technology and the tech sector cut across all these security priorities and are deeply intertwined with them. The semiconductor industry for example is of strategic importance to military security, powering all modern defense systems and platforms and the fragility of its supply chain has been exposed during the pandemic. Similar concerns have been apparent in the last half a decade regarding the technologies embedded in telecom networks and the data analytics technologies used in social media networks with concerns on how these technologies and platforms are critical to cyber security. The combined force of these security challenges is reshaping global supply chains and globalization, not just for technology but globally, in a manner that further tests global leaders' resolve to work together to make a better world.

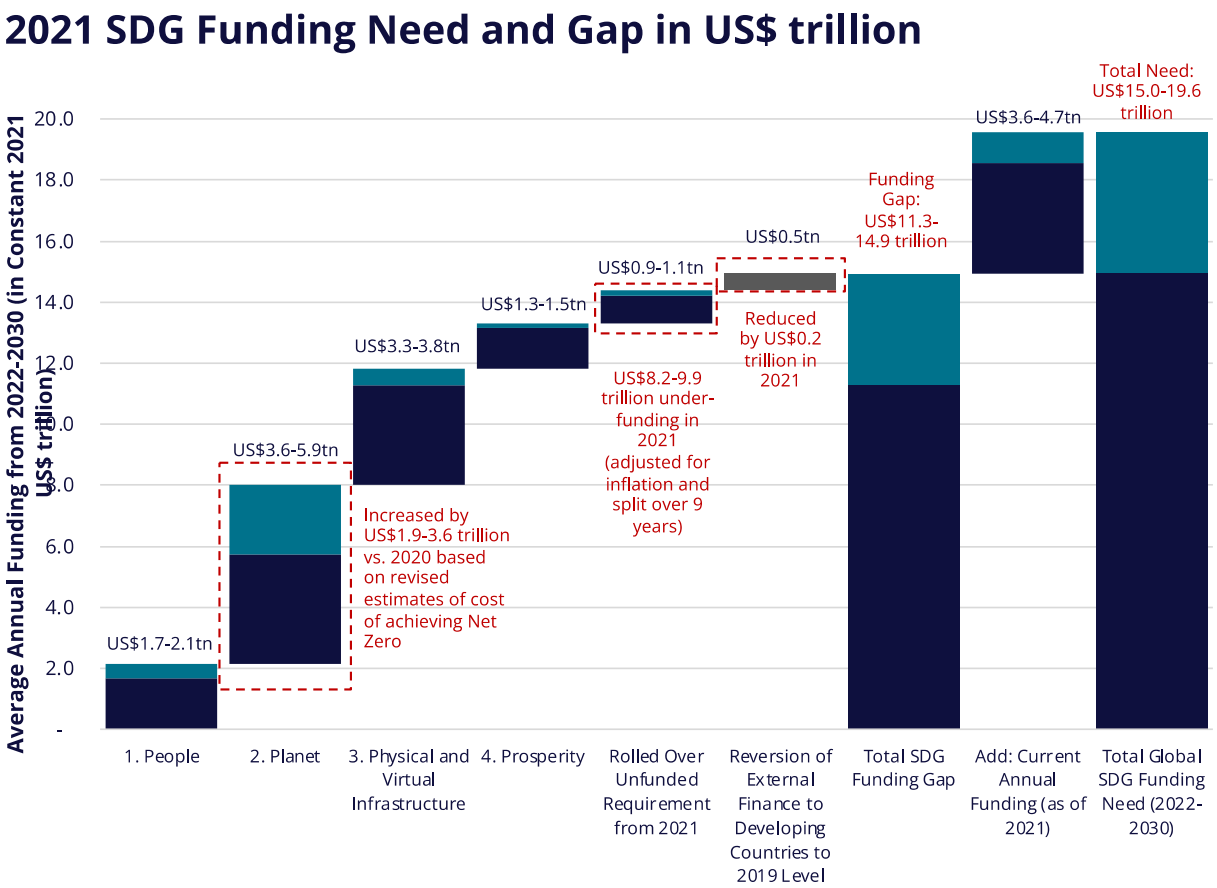
Additionally, the perceived near-term urgency of these challenges and the financial cost of addressing them (perhaps as high as c.5% of global GDP annually through 2030 based on the above estimates) risks crowding out other spending priorities like sustainable development for the world.

3. Costs of achieving the SDGs rising dramatically

At the halfway mark of the UN Sustainable Development Goals' 15-year lifespan, it is increasingly clear that meeting the goals will be a tall order for the world. Slow but steady progress, in some cases decades long, across multiple goals has been undone by the global pandemic and current macroeconomic crisis, with c.100 million more people slipping into extreme poverty,[14] nearly 200 million more people suffering from chronic hunger,[15] and 100 million more children falling below minimum reading proficiency since the start of the pandemic.[16] And, with the world's current energy, food and security challenges risking pushing back key SDGs even further, representing alternative calls on global funds that threaten the continued funding of the SDGs.

Force for Good has re-examined the cost and the gap to deliver the SDGs, taking into account the many disruptions of the last year, as well as the impact of continuing funding shortfalls. These factors have increased the annual cost of funding the SDGs by US$3-5 trillion over and above previous estimates to a current estimate of c.US$15-20 trillion annually, an increase of c.30-40%. The recalculation estimates a total cost to fund the SDGs of US$135-176 trillion to 2030, on the same assumption regarding resources and deployment of these. [17]

Figure 4: Updated SDG Funding Need



Source: Capital as a Force for Good Initiative

Given that only a quarter of the current need is being funded, the annual funding shortfall is estimated at US$11.4-15.0 trillion, a c.35-50% increase, with a gap of US$103-135 trillion to 2030. The implications are dramatic. The world is currently investing 4-5% of its GDP annually towards the SDGs. Fully funding the SDGs would require spending to increase four-fold to 16-20% of GDP.

The importance of the SDGs in underpinning peace, prosperity and freedom in the world is well established. The achievement of the SDGs within the next decade is critical for the world to avert the crises that will result from over-exploitation of resources, extreme weather events, pollution and biodiversity loss, poverty and inequality, political and social strife, and mass migration.

As it stands however, the world is set to fail to meet both the SDGs and longer-term Paris Agreement goals of limiting global temperature increases to 1.5C by the end of the century.

Based on current trajectories the achievement of the SDGs remains multiple decades away in some countries, and the world is heading towards temperature increases of 2.0C or higher.

4. Human security goals and the SDGs are intertwined

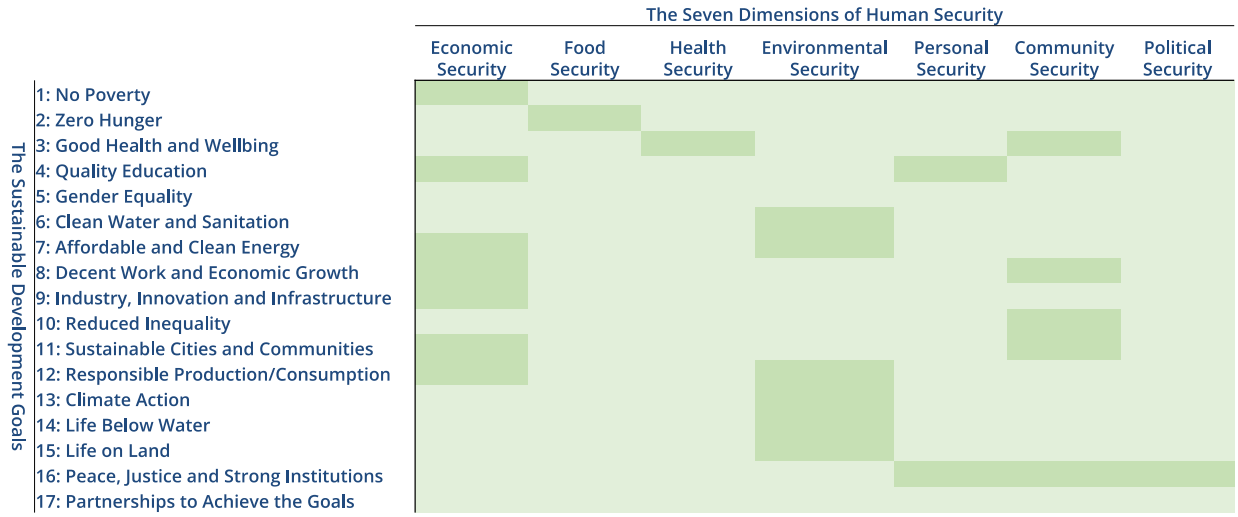
Meeting the SDGs, with a funding requirement over the next decade of approximately US$135-176 trillion, would be extremely challenging under any circumstances, even without the competing security priorities raised by recent and ongoing events.

Fundamentally however, the notion that global security and sustainability goals are mutually exclusive is fundamentally flawed. With both ultimately serving to underpin human flourishing, the major difference between global security and sustainability is one of timing and emphasis, with the SDGs focused on addressing longer-term systemic challenges, and global security priorities being highly responsive to immediate near-term risks. The UN's human security initiatives, like the Human Security for All initiative,[18] explicitly recognize the links between security and sustainability, and the seven dimensions of human security, economic, food, health, environmental, personal, community and political security, are deeply intertwined with the 17 SDGs, as laid out below.

The choice between security and development is an illusory one since there can be no sustainable development without security, and there is no meaningful security without sustainable development

Figure 5: Interrelated Nature of Global Security and Sustainability Goals

Security and Sustainable Development



Source: Capital as a Force for Good Initiative

Any shortfalls in addressing sustainable development issues will ultimately drive human security risks and any shortfalls in human security will raise the bar for further sustainable development. Without security there can be no meaningful sustainable development, and without sustainable development, human security risk increases.

The choice between security and development therefore is an illusory one. Both need to be met to underwrite the world's continued peace, prosperity, and freedom, implying that the world will need to fund the total sum US$195-236 trillion through 2030.

The emerging challenge for the world therefore is to fund both security and sustainability while minimizing any near-term trade-offs between the two, delivering 'secure sustainable development'.

5. Creating the future also has a cost

There are of course other demands on the world's resources that need to be met. Today, most of the world's total capital is already being fully utilized to support existing consumption and production, savings, and investment requirements, and to maintain ongoing security and sustainability commitments, thereby "keeping the lights on." Allocations to secure sustainability have a tough task to compete with these incumbent calls on capital and resources.

In addition, there is one other major category that is set to place perhaps the largest demand on the world's resources, and that is managing the transition to the future. The world's most successful entrepreneurs have always been those that have harnessed innovation to drive progress and development, such as the railroad barons and industrialists in the 19th century, and information technology companies in the 20th, and the world's most successful investors have been those that backed them. The wealth creation of companies that achieve innovation breakthroughs is a powerful lure for holders of capital gravitating to the highest return opportunities.

In the historic transition from an industrial era to a digital one, while global security and the SDGs are required to create prosperity and security for all, ultimately, the biggest investments will be made to create a future functionally superior in almost every way to todays

While global security is needed to establish a stable world in which to build the future, and the SDGs need to level up the world so that a just transition can be managed, the most value will be created by those with the innovation that drive that transition and shape the world to come. The innovations required are manifold, encompassing breakthroughs in artificial intelligence, computing, and data sciences, and technology that delivers a more distributed form of capitalism that drives mass inclusion, and an interconnected empowered global population leveraging augmented and virtual realities for digital experiences and consumption. The future also requires new energy sources and natural resources that replace carbon with ones that are clean, scaled, cheap and global based on fundamental scientific breakthroughs. The funding needed to build this

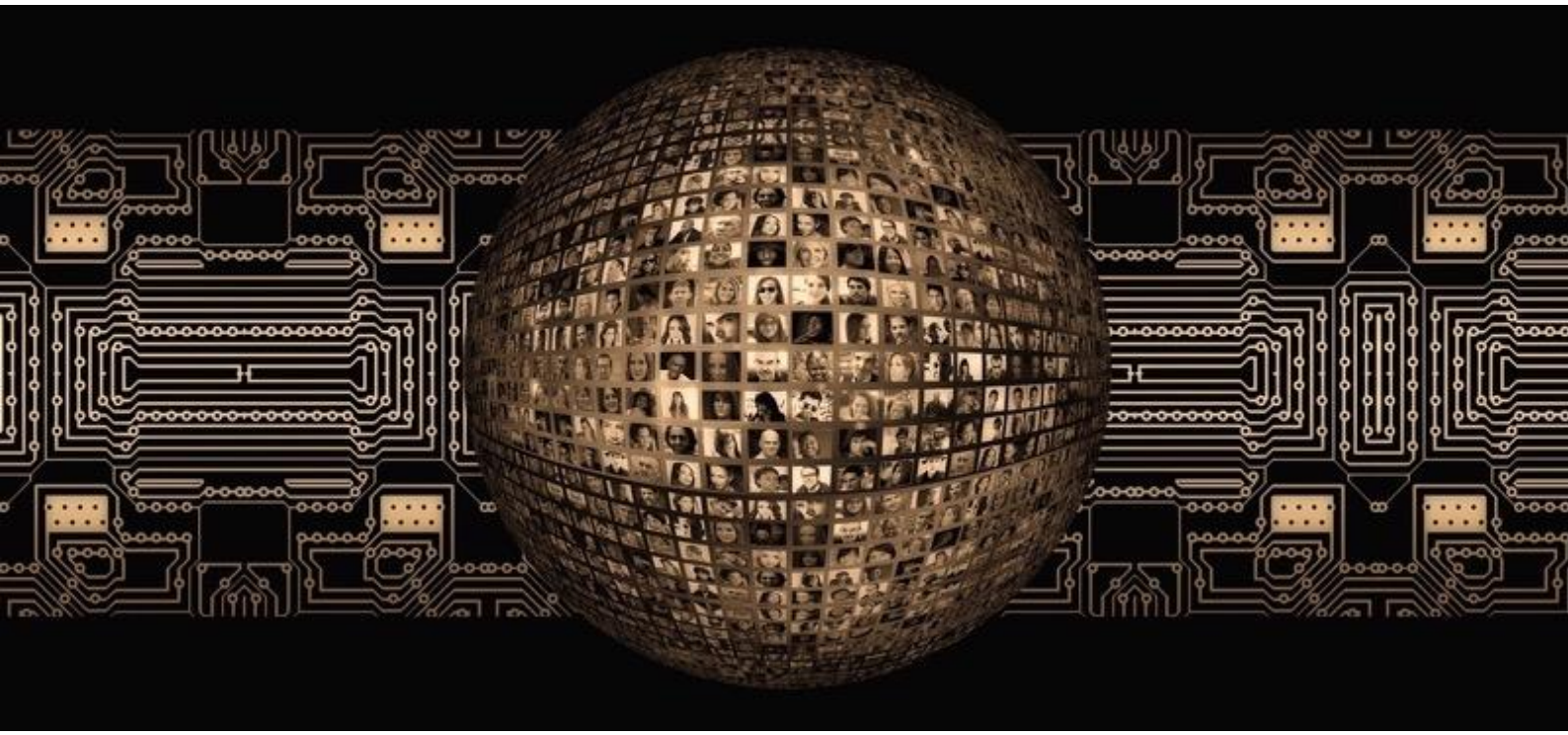
future is difficult to estimate but is likely to be vast, dwarfing the needs of secure sustainability or even all of the world's capital that exists today

The resulting overlapping and competing demands for global resources are scaled and complex, and meeting these will require the alignment of a broad set of global stakeholders. While reconciling these demands is clearly a matter of finance, politics and policy, the fields of science and technology have perhaps the most significant role to play in ensuring that humankind can actually deliver secure sustainability or a just transition to the future.

In summary

- The world is undergoing a series of shocks that are threatening global security and risk the SDGs being neglected by the global community
- These shocks have also had a direct impact on the SDGs, undoing progress from previous years and widening the total funding gap to US$103-135 trillion.
- This amount, combined with the c.US$60 trillion of additional capital required to fund global security raises the total need to US$194-235 trillion and represents a significant portion of the world's liquid capital which needs to be unlocked.
- Ultimately, security and sustainability are two sides of the same coin and can only be solved together, requiring the world to adopt an integrative approach to meeting these challenges.
- Investing in the future represents a potential short-term competitor to the theme of 'secure sustainability' over the short-term, but over the long term it can deliver the innovation and the capital needed to achieve the SDGs.
- Based on current trajectories, the world will fail to meet the goals, implying the need for a different approach to solving sustainable development challenges, deploying new approaches and significant innovation.

II. Technology is Key to Meeting the SDGs



Technology and innovation have played a fundamental role in all major transitions in human history, from the Agricultural Revolution to the Industrial Revolution, and now the Digital Revolution. Information technology, in particular, is transforming the global economy and society as a whole as industries and communities become increasingly digitized and value migrates online. Given its transformative potential, information technology has a critical role in driving secure sustainable development, both in terms of basic impact and in terms of targeted innovations addressing specific goals. Unlocking its potential will require the tech industry to play a growing role not just in developing technological solutions, but also in reshaping the global capitalist system to ensure that these solutions are funded, deployed, and scaled where and when they are needed most, particularly in developing countries currently far behind on access to these technologies.

1. Technology driving human progress

Evolution of technology with human and planetary impact potential

Innovation lies at the core of all human progress throughout history a driving force of change that has shaped and reshaped societies, culture, politics, and values, and that is no different today. Throughout history, technology has undergone a series of fundamental transitions based on leaps in the scientific knowledge that underpins its development and use. The First Industrial Revolution in the 18th century based on harnessing the power of steam, the Second Industrial

Revolution and its use of electric power, and the Third Industrial Revolution (also known as the Digital Revolution) based on transistors and semiconductors that power. information technology.

Today, we are in the middle of the Fourth Industrial Revolution which has thus far been built on IT using a range of technologies like mobile, the internet of things, artificial intelligence, and data analytics, but is increasingly blurring the boundaries between the physical, digital, and biological spheres by integrating technologies like robotics, autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, and energy storage.

In the midst of the Fourth Industrial Revolution, we are seeing the blurring of boundaries between the physical, digital, and biological spheres and with it the integration of technologies such as robotics, 3-D printing, nanotechnology, biotechnology, materials science, and energy storage; expanding the scope and potential of the 'tech sector' such that it can have the pivotal impact on life on the planet

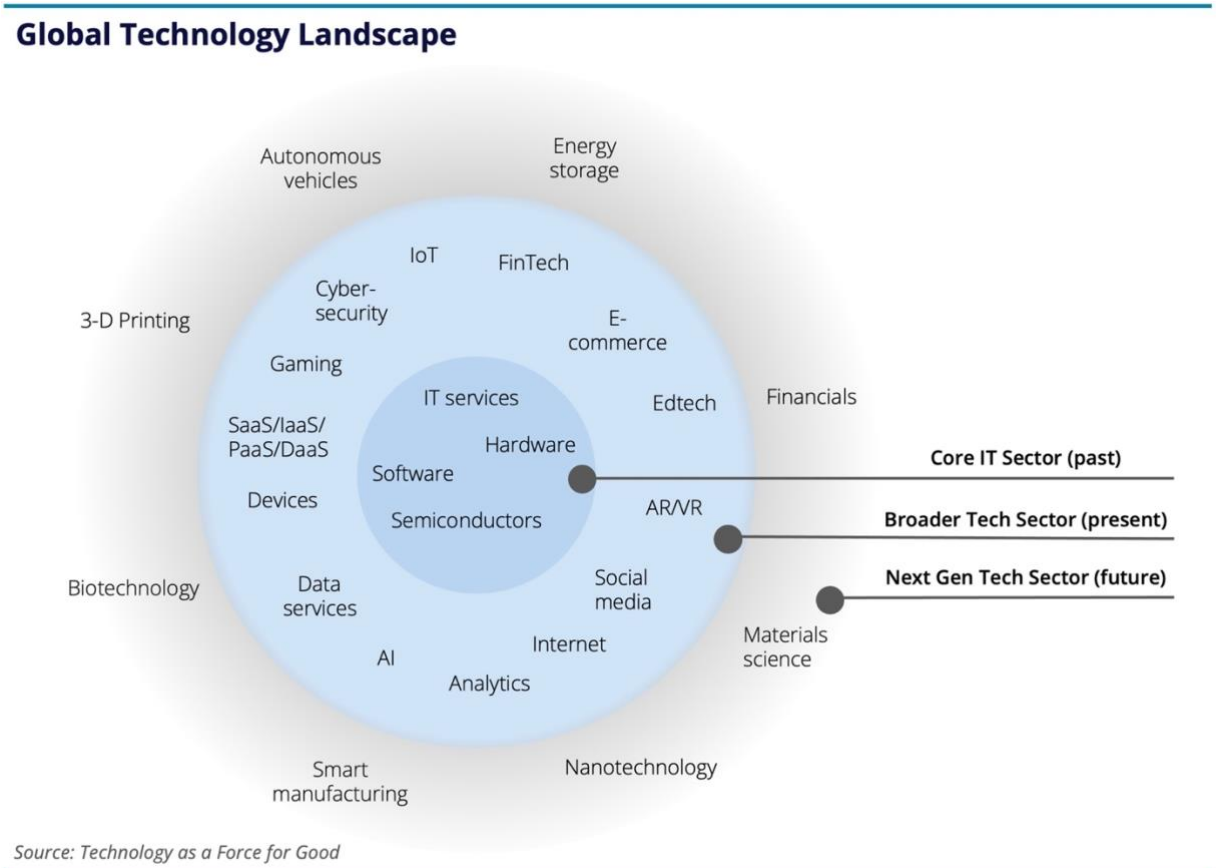
As a result, this transition has been expanding the definition of what is commonly understood as the 'tech sector'.

Originally, the IT sector was limited to the tools and components needed to capture, process and store electronic information, like semiconductors, computer hardware, software, and IT services. However, the current 'Broader Tech Sector' now includes not just traditional providers of information technology, but also a series of new applications and platforms birthed by their power like robotics, virtual reality, and social media, as well as new business models for the delivery of IT, such as software as a service, or infrastructure as a service.

Further, the boundaries between tech and non-tech have become increasingly blurred as IT has become more and more embedded, with the tech sector also encompassing companies competing in non-tech sectors with business models that are wholly reliant on IT, with E-commerce and fintech being two of the most notable examples.

The Fourth Industrial Revolution is blurring this further, impacting sectors normally defined by the physical assets and the future "Next Gen Tech Sector' may well encompass companies active in areas like construction, manufacturing, energy, or pharmaceuticals, with a company like Tesla already seeming to straddle the middle ground between a tech and an automotive company.

Figure 6: The Definition (and Reach) of Tech is Expanding



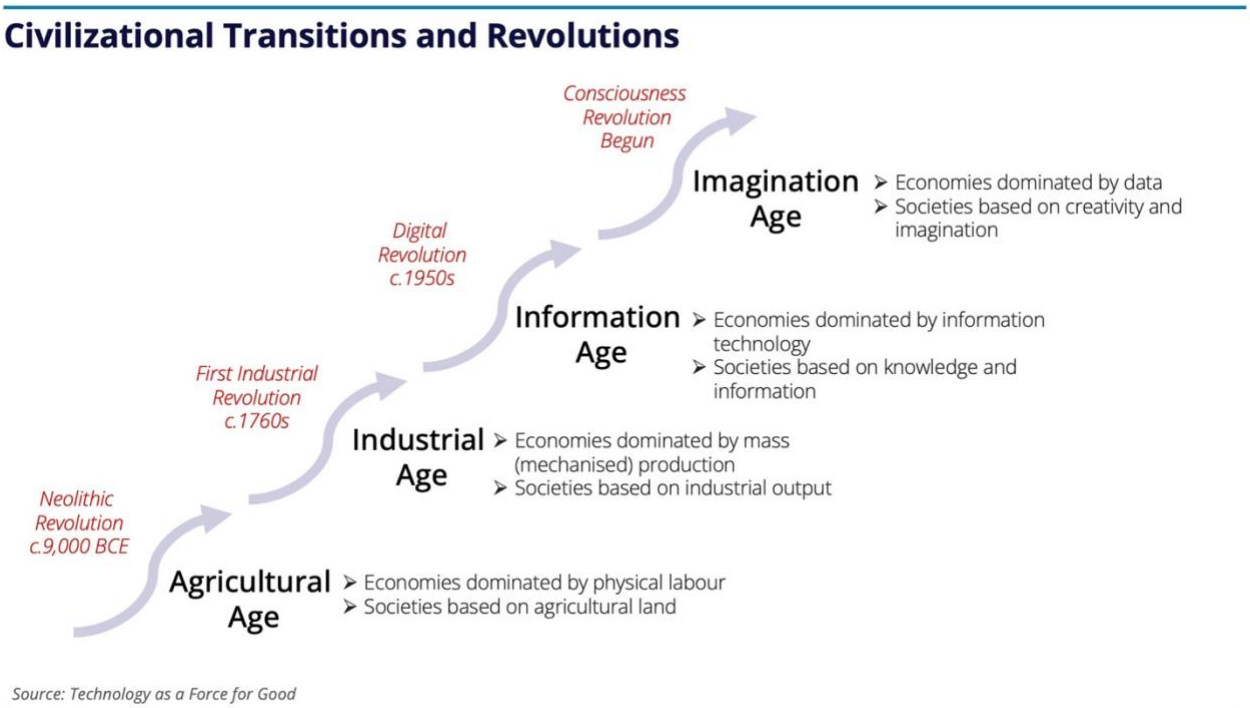
An indicator of the strategic rise of IT (and tech more generally) is that the private sector now spends more money on IT than it does on R&D, and more than half the world's software developers today are employed in non-tech industries.[19] Just like the industrial research lab was a hallmark of industrial-age corporate leaders across major sectors like chemicals (DuPont), electrical engineering (General Electric) and communications (AT&T), corporate IT departments are increasingly emerging from the back office to become strategic assets. As digital technology becomes ever more embedded in their organizations and central to their business models, the lines between tech and other sectors will become further.

The technological revolution currently underway is driving the transition to the 'Imagination' Age, where creativity and imagination become the primary creators of economic value thanks to embedded technologies, virtual reality and digital platforms and the early incarnation of this era provides an opportunity accelerate progress towards addressing secure sustainability

The fundamental changes being driven by technology can also be considered in terms of their impact on society over the course of millennia. Technology throughout history has been instrumental in shaping human culture, societies, and political organization, with a series of technological revolutions having driven the transition between civilizational ages (or epochs) for

the world. With previous revolutions having ushered in the Agricultural Age, the Industrial Age, and the Information Age (on an ever-accelerating timeline), the technological revolution currently underway is driving the transition to what has been called the 'Imagination' Age, where creativity and imagination become the primary creators of economic value thanks to embedded technologies, virtual reality, and digital platforms.

Figure 7: Technology Enabling the Transition to the Imagination Age



There are a number of signs that point to this civilizational transition being underway as digital technology transforms the lives of billons across the world. Today, 63% of the world's population, or five billion people are digitally connected, and among these over 90% use some form of social media.[20] This connectivity has proven to be transformative, with 64% of the online population using digital and mobile banking,[21] 43% of them using e-commerce to buy and sell goods,[22] and c.13% using it for training and learning purposes,[23] with digital healthcare also expanding rapidly. It is also transforming employment at an increasingly rapid pace, with nearly two-third of the jobs that will be done by today's elementary school students as adults not yet existing.[24]

Technology making a direct impact on the SDGs

Given its fundamental impact and transformative potential, technology has a critical role in driving the SDGs and human security over the near- to medium-term, too. The focus on capital and the financial institutions that manage capital has taken the primary position of interest for the UN and other transnational institutions, particularly as they observe the lack of progress, or even backsliding, in addressing the SDGs. While capital is a critical component, it is technology that is likely to determine whether many of the goals can be met by 2030.

On a basic level, information technology serves as a support structure for all 17 SDGs, enabling critical information processing, automation, communication, and knowledge sharing for the dissemination of best practices and coordinated action, thereby underpinning the achievement of nearly all the goals. Of the 169 targets associated with the SDGs, 103 have been found to be directly influenced by today's digital technology[25]

At their core, the SDGs were designed to level up the world and to create the foundation for a sustainable, peaceful, and prosperous future. Such a future will clearly be digital, making global connectivity and universal access to digital resources among the most basic building blocks for achieving the goals as a whole and beyond that, advanced technology can be a pivotal asset in achieving the SDGs. However, technology's potential impact goes beyond the SDGs, of course. The SDGs are not binary goals, but rather milestones on a scale of development that represent a threshold from which a just and sustainable future can be built. Technology will of course be critical in building such a future. As it continues to develop, there are three cumulative levels of impact the tech industry can have

"The spread of information and communications technology and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies."
UN General Assembly for the 2030 Agenda

Level I, Connecting the World (to c.2025): With connectivity and access, tech-enabled organizations can drive inclusion, raise productivity, and increase equality of opportunity. Simply achieving universal connectivity (with the deployment of existing digital technologies) has been estimated to accelerate progress against the goals by c.20% or more.[26]

Level II, Levelling Up (to c.2030): However, beyond this basic but fundamental impact, technology can drive critical progress on each SDG individually, with targeted innovation creating products services and solutions to overcome challenges and deliver outcomes related to specific goals across education, finance, and healthcare, among others. This will require companies to invest in new technologies and develop business cases to roll these out at scale where they are most required, particularly in the last mile.

Level III, Creating a Superior Position (c.2030+): As the Fourth Industrial Wave continues to transform the world, technology will become more and more embedded in virtually human activities, and the tech sector will therefore further blur with other industries, changing their nature in the process. As part of this longer-term development, tech will become the enabler for fundamental breakthroughs in fields like energy innovation, materials sciences, and biology in the Imagination Age.

The table below illustrates technology's impact potential on each of the 17 SDGs across three levels, the basic impact delivered by providing universal digital, the impact delivered by digital products and services that are tailored to meet specific targets, and the impact of emerging and future technologies that could go beyond meeting the SDGs towards a superior position for the world where human security for all is achieved.

Figure 8: Technology and the Sustainable Development Goals

SDG	Level One: **Connecting the World** (Universal Connectivity)	Level Two: **Levelling Up to Meet the SDGs** (Targeted IT Based Solutions)	Level Three: **Creating a Superior Position** (Advanced Technology Enabled Systemic Solutions)
1 NO POVERTY	Basic access to the digital economy	Fintech driving mass financial inclusion	Decentralized and democratized digital financial system
2 ZERO HUNGER	Real-time access to critical information (relevant to agriculture)	Information-intensive/ precision agriculture reduces agri-inputs optimizes food supply chains and financial access for farmers	Biotech and information - intensive agriculture delivering low-cost, environment-resilient food grains at low cost and scale
3 GOOD HEALTH AND WELL-BEING	Access to health information and telemedicine	Digital health solutions for diagnostics, wellness, and preventative medicine	Biomedical engineering delivering personalized wellness, resilience, longevity, and quality of life for all
4 QUALITY EDUCATION	Access to basic education materials and information	Edtech creating online learning and education platforms	Globally accessible and personalized, VR/AR-based education and skills development
5 GENDER EQUALITY	Bridging gender digital divide feasible	Women provided with equal access to digital tech, Edtech, Fintech ... and other opportunities	Real time and transparent information and analytics to inform behaviors supporting gender equality
6 CLEAN WATER AND SANITATION	Access to information on water and sanitation availability and risks	Smart water management and delivery systems	Sustainable water extraction from the environment through continuous synthesis, at scale
7 AFFORDABLE AND CLEAN ENERGY	Access to information on alternative energy and energy saving options	Digital energy technologies driving cleantech, smart grid, and smart energy mobility	Breakthroughs delivering low cost, at unlimited scale, and universally deployable, affordable clean energy source for all
8 DECENT WORK AND ECONOMIC GROWTH	Core access to the digital economy and remote work	Digital technology enabling productivity, re-thinking work itself, and global economic scope	Digital and AR/VR, with every individual a node in the network, enabling whole new modes of work, commerce, and globalization
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	Universal access to ICT (being a specific target of SDG9)	Industry 4.0 enabling smart manufacturing, and infrastructure on circular economy principles	Intelligent environments powering post-industrial, knowledge-based economies and infrastructures driven by IP and data

10 REDUCED INEQUALITIES	Digital divide bridged	Equal access for all to digital tech, Edtech, Fintech … and other opportunities	Real time and transparent information and analytics to inform behaviors supporting equality
11 SUSTAINABLE CITIES AND COMMUNITIES	–Access to information on saving energy, resources, waste and improving sustainability	Smart cities (Intelligent transport systems, grids, mobility, infrastructure) based on circular economy	Cities configured as nature-positive and human scale cities, with VR/AR worlds transforming use of physical urban environment.
12 RESPONSIBLE CONSUMPTION AND PRODUCTION	Access to information on companies, products and services and their impact on sustainability	Full value chain IT, linking agriculture to point of purchase, providing information to drive sustainable behavior	Real time full impact data, measured against the SDGs, delivered to all in consumable form at point of activity and transaction driving responsible decisions
13 CLIMATE ACTION	Access to information to change behaviors that harm the climate, changes in remote work reducing travel related impact	Emissions reductions through smart transportation, smart buildings, smart materials, smart manufacturing	Biosphere repair, safe and secure climate intervention to counteract climate crises (e.g., geo-engineering, biotech driven carbon capture) and achievement of net zero
14 LIFE BELOW WATER	Access to information on marine life and vessels' activities to avoid negative impact	Digital ecosystem IT (monitoring and ecosystem modelling and analysis), satellite tracking	Autonomous shipping, Scaled sea-waste removal, marine security, and enforcement drones
15 LIFE ON LAND	Access to information on life on land and externalities from human action	Digital monitoring and ecosystem modelling and analysis feeding into policy making	Nature positive activities and gene-based strategies for species preservation and restoration, Polar ice repair technologies
16 PEACE, JUSTICE AND STRONG INSTITUTIONS	Information on own government and situation in terms of peace, justice, security and more, and comparison to others	E-enablement of government and e-government services, and AI based regulation or online speech and security	Blockchain enabling fully transparent and accountable government services
17 PARTNERSHIPS FOR THE GOALS	Ability to access and share science and technology information (specific target 17.6)	Collaborative technologies to share knowledge, solutions, networks and enable collaboration for all	Mass digital collaborative partnership platforms for the SDGs for individuals, corporations, and member states

With progress on many SDGs stalled or even regressing and the time to achieve them running out, it is clear that achieving the goals will require transformative and rapid change, and the delivery of solutions at speed and scale. While a concentrated effort using conventional

approaches from 2015 onward may have had a chance to meet goals, these today look to be insufficient.

Further, the US$134-176 trillion total investment required to fund the SDGs represents a likely insurmountable hurdle.

Technology represents the only viable solutions to both these challenges. Only the mass deployment of existing – along with the innovation of new - technology can deliver the transformations on the required scale and timeline, while targeted innovations in health-tech, edtech, fintech and other areas can significantly reduce the costs for achieving the goals. Of course this will require that technology is deployed in a manner than maximizes inclusion, with the benefits of affluence reaching all, rather than being concentrated in industrialized nations.

Each of the three tech progressions described above has the potential to have a meaningful impact on the achievement of the goals and beyond. The first two progressions, in particular, will make a material impact on the world achieving the SDGs, while the third promises a far more radical longer-term impact beyond the goals, transforming the world.

In terms of achieving the SDGS, the world has changed substantially since 2015, information technology has progressed in functionality; technologies in the wider sense have advanced and become increasingly digital, and more intelligent as a result; life styles have changed enabled by technology in areas related to consumption, work, business and government not least because of the pandemic; and the world's most powerful nations have demonstrated their ability to move quickly (in response to the pandemic), and in a highly coordinated fashion (in implementing sanctions against Russia). All these changes point to new modes of cooperation, tools and solutions that can be used to meet the SDGs, with technology being key to potentially achieving breakthroughs across multiple goals.

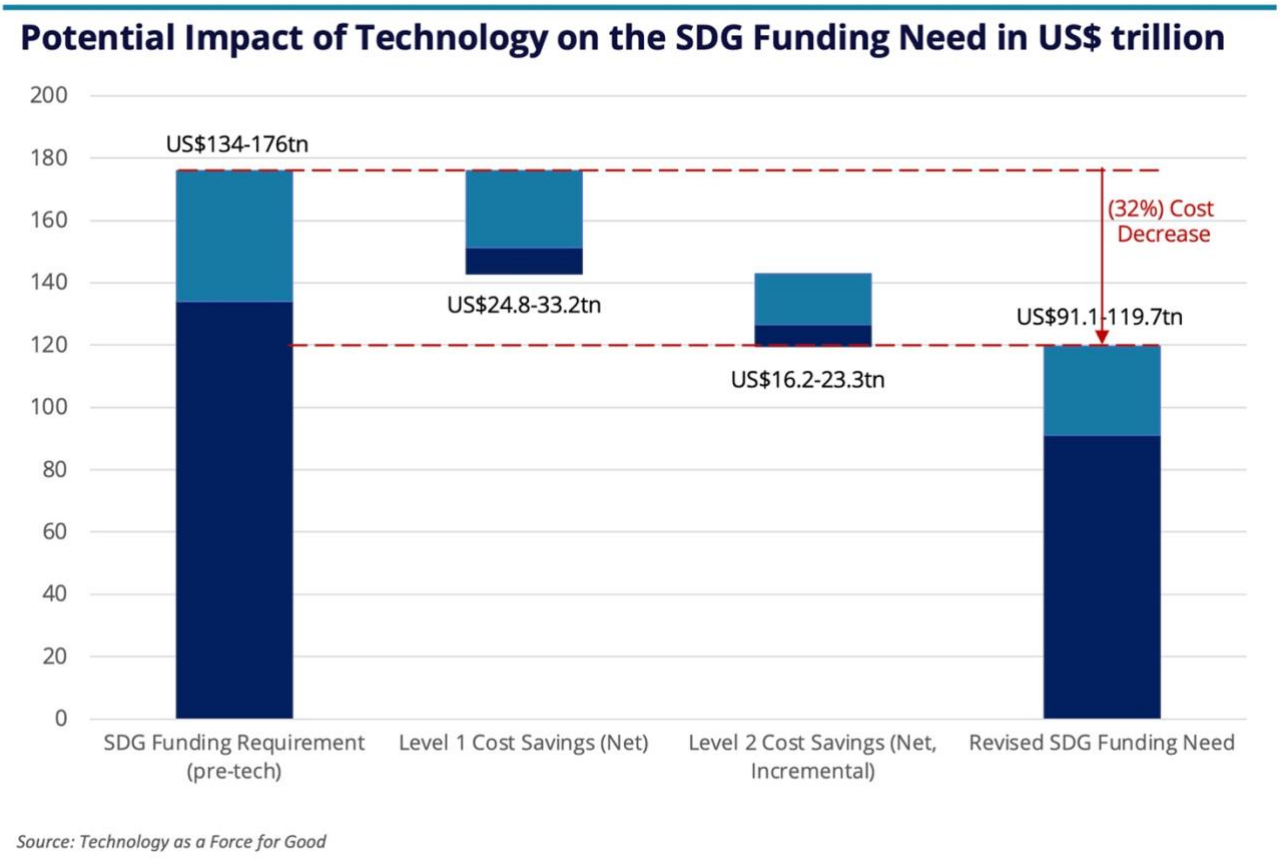
Figure 9: Benefits of Tech Deployment on Achieving the SDGs

Impact Level	**Level One:** **Connecting the World**	**Level Two:** **Levelling up, Driving the SDGs** **(Cumulative)**
Cost to Implement Technology to 2030 in US$	US$2.0 trillion	US$8.6 trillion
SDG Progress (% Achievement)	Up to 20%	Up to 37%
Potential SDG Cost Savings (Net) in US$	Up to c.US$25-33 trillion	Up to c.US$41-56 trillion

Note: Please see Research Process and Methodology for assumptions

The full implementation of both levels of technology (global connectivity and targeted innovation) could reduce the cost of achieving the SDG's by up to US$41-56 trillion, even after factoring in the cost of deployment. This represents a c.32% decrease in the total cost for the SDGs of US$134-176 trillion through 2030.

Figure 10: Tech and the SDG Funding Need



SDG 8.1, focused on sustained and inclusive economic growth, set an annual GDP per capita growth rate target of at least 7% for the world's least developed countries ("LDCs") through 2030, to drive progress, create decent jobs for all and improve living standards. Had this been achieved from 2015, this would have taken the median LDC's GDP per capita to c.US$2,800 by 2030, (roughly matching that of Bangladesh or the Congo today), and poorest LDC's GDP per capita to only c.US$800 (only slightly above Afghanistan's current per capita wealth.)

Meeting this SDG growth target would still leave these countries far below the current global average GDP per capita of US$13,400 (equivalent to Malaysia's current level), and aspirations to prosperity have evolved significantly since 2015, indicating that the original target may be too low, and that further economic development will likely be required for the goals to be met. Getting per

Driving global connectivity and deploying digital solutions can enhance the impact on the goals even further, taking the total SDG targets addressed to c.40%, and reducing the cost of achieving the goals to 2030, bringing the total saving to up to c.US$55 trillion

capita GDPs to the global average within the next twenty years (by say 2040) would require the median LDC to achieve annual growth rates of c.15%, while the poorest would need to grow by nearly 25% annually. Achieving such growth rates for a sustained period is clearly not feasible currently.

However, the Fourth Industrial Revolution has the potential to deliver an infection point in global economic growth from c.2030, with technology taking the world to a superior position by delivering solutions of the type called Level III in the table above. Breakthroughs in new technology and energy could drive the world, including developing countries to a different model and entirely different levels of economic growth from the end of the current decade onward. In the first phase of hyper growth following the breakthroughs, from c.2030 to c.2060, global GDP could rise approximately threefold, accelerating further thereafter to rise sevenfold between c.2060 to c.2080 (the underlying growth model is discussed in greater detail in Chapter IV).

2. Managing tech's negative impact

Given its transformative potential, it is perhaps unsurprising that tech can not only be a force for good, but also a highly disruptive one and can make a negative impact too. Much of the media's attention in this regard has focused on Big Tech, and specifically the consumer technology and social media platforms that they own. Concerns about these platforms and the quasi-monopolies they operate dominate the public discussion on the downsides of tech and the tech sector. Key concerns include the spread of fake news leading to the creation of post-truth societies, social media being platforms for hate speech and radicalization, while also censoring political views,[27] and the conflicts of interest arising from ad-based revenue models, where companies' revenue is generated not from the products and services they offer but from selling their users personal data, creating business models to maximize user engagement, in some case at the expense of user wellbeing and mental health. As a result, nearly half of Americans believe that Big Tech should be subject to greater regulation, with the pharmaceutical industry being the only sector where there are higher levels of support for more government oversight.[28]

In addition to these challenges, there are longer-term global risks intrinsic to technology that the tech industry will need to manage if it is to be, and be recognized as, a force for good in the world. These include:

Structural Mass Unemployment. Automation and digitization are driving large productivity gains, but also causing structural employment shifts and localized mass unemployment that many countries have struggled to manage well.
Impact: Automation is expected to displace 400-800 million jobs by 2030.

Digitally Divided Developing World. As the number of people connected increases further and societies and economies are increasingly digitized, the widening tech gap will exacerbate existing human development gaps, leaving those unconnected due to age, income, or geography falling further and further behind.
Impact: Gaps in digital inclusion can account for up to 20% differences in GDP.[29]

Growing Environmental Impact. The tech sector's current contribution to global CO2 emissions is relatively small, and even its most emissions intensive companies don't rank among the world's top polluters. However, its CO2 footprint risks rising rapidly with increasing digitization and connectivity in the absence of proactive engagement by the industry. Further, tech hardware is increasingly dependent on rare earth elements, whose mining and processing creates significant health and environmental hazards.
Impact: The tech sectors share of global CO2 emission is 2-3%, but at current trends will represent 15% by 2040.

Cyber Warfare, Civil and Cross-Border. While the actions of criminals or rogue states can have significant economic and national security implications, states can also use digital technologies to surveil and exercise control over their own people, or to attack critical infrastructure.
Impact: The US Federal Bureau of Investigation conducted 3.4 million warrantless searches of Americans' electronic data in 2021.

Digital Security Risks. The digitization of information and universal connectivity have potentially significant security risks for governments, institutions, and individuals, including through identity theft, reality distortion via deep fakes.
Impact: The annual cost of cybercrime is growing at 15%, projected to cross US$10 trillion by 2025.

To this are added technology specific risk, such as AI-risk, (the risks substantial progress on artificial intelligence could result in human extinction or some other global catastrophe), whose impact many be significant but is difficult to estimate.

While society at large is more or less completely dependent on technology, it is increasingly cognizant of these challenges and risks, leading to an increasingly complex, and at times contradictory, relationship with technology. 61% of adults in the US believe that the pace of change in technology is too fast,[30] while 36% buy new mobile phones solely because they want to own the latest model with newer technology and features. Similarly, 57% think that the social media platforms they use are full of untrustworthy information, but between 30-50% of the populations of advanced industrialized countries (and up to 80% of the population of developing countries) continue to use these platforms as a source for news.

These statistics point to an increasingly complex relationship between technology and society, one that will be shaped by opportunities and risks, and costs and benefits. The question of which of these will prevail depends on how technology is deployed and by whom. Information technology is ultimately merely a tool, albeit a fundamental one with great potential, and its impact largely depends on the actions and intentions of the wielder. In practice however, much of this power is vested in tech industry, as, by definition, it is uniquely responsible for developing, distributing, and leveraging innovations with the potential to change the world.

3. Tech industry critical to driving change

The growing value of tech

The global tech industry is one of the world's largest industry sectors and can be expected to overtake all other sectors as technology and tech companies are the drivers of the information era. Size estimates for the industry today vary depending on the exact definition of 'tech' and the subsectors included in it, but the sector is generally estimated to generate in the order of US$5-10 trillion in annual sales, employing by some estimates over 80 million people. What is more, the sector is projected to grow well in excess of the global economy over the medium to long term in keeping with the increasing digitization of business, society and politics across the world. By 2030, the global tech workforce is expected to grow four- to five-fold to nearly half a billion people, out of a population of 8.6 billion. This would see the overall tech market expanding at between 5-15% annually, vs. global growth of c.3%.

With annual revenues of up to US$10 trillion, employing an estimated 80 million people today and by 2030 nearly half a billion people, the tech sector is a giant in the global economy … driving global connectivity can only create more customers for its technologies, making it a natural ally to achieve the SDGs and drive human security for all

Due to its growth and increasing importance, the tech sector has attracted strong capital inflows and has therefore captured an increasing share of global equity market, overtaking financial services as the world's most valuable industry sector by cumulative (global) market capitalization in 2017, as position it continues to occupy today. This long-term shift in the value across sectors is also reflected the composition of the world's most valuable companies, with tech companies capturing an increasing share of the ten most valuable companies globally, currently representing six of these.

Figure 11: Ten Largest Companies Globally by Market Cap 2004-2022

Rank	2004	2009	2014	2019	Q3 2022
1	General Electric	PetroChina	Apple	Microsoft	Apple
2	ExxonMobil	ExxonMobil	ExxonMobil	Amazon	Microsoft
3	Microsoft	ICBC	Alphabet	Apple	Alphabet
4	Pfizer	Microsoft	Microsoft	Alphabet	Amazon
5	Citigroup	China Mobile	Berkshire H	Meta	Tesla
6	Walmart	Walmart	J&J	Berkshire H	Berkshire H
7	BP	CCB	Shell	Alibaba	UnitedHealth
8	AIG	Petrobras	GE	Tencent	J&J
9	Intel	J&J	Wells Fargo	Visa	Visa
10	BofA	Shell	Roche	J&J	Meta

While the chart above appears to point to increasing value creation for the tech sector, 2022 has undeniably been a challenging year to date for valuations. Rising interest rates and slowing macro-economic growth have had a significant impact on the business outlook and investor sentiment, and the tech sector has been among the biggest losers in terms of equity market performance, with the world's five largest tech companies shedding a total of US$3 trillion in value between January and October 2022.

Against these headwinds, significant capital has been withdrawn from the sector, often in favor of oil and gas or mineral and mining investments, which have been buoyed high by skyrocketing commodity prices. Event risks and temporary disruptions aside, long-term global trends point to the continued growth of tech, and the world's future promises to be laden with digital technologies, rather than with combustion engines and carbon-based polluting industries. It is therefore unsurprising that, despite their share prices dropping by between c.20-75% during this period, the world's six biggest tech companies rank among the world's ten most valuable companies, indicative of the increasingly critical roles these companies are playing in the global economy.

While security concerns led to skyrocketing demand for oil and gas, and investors buying these stocks and dumping tech stocks, the future is clearly tech not carbon pollution

These companies, all US-based but with global reach, are colloquially (and inconsistently) known as "Big Tech" and have captured some of the most valuable areas of tech, dominating the market in their core areas, which include operating systems, e-commerce, search, social media, and devices. These companies sit on top of overlapping digital ecosystems and are looking to dominate emerging areas of tech like artificial intelligence, data analytics, payments, cloud computing, media streaming, smart home, and self-driving cars. As a result, their platforms are powerful players in the broader tech sector, are deeply embedded in the global economy, and touch billions of people daily. Critics point to the power that stems from such pervasive presence, particularly that this concentration and stacking of technology and intellectual property creates substantial barriers to scaling for potential competitors and therefore ultimately for innovation as well.

And the growing wealth and power of technologists

The global growth and dominant position of these companies has made their founders among the world's richest people. Just like the Industrial Age created a class of industrialist that included the Rockefellers, Carnegies, and Vanderbilts, so the Information Age has created a class of tech entrepreneurs who now include six of the world's ten richest people, (double the number 20 years ago). These individuals are putting their billions to a variety of uses at scale, ranging from fighting global poverty disease, and inequity to fighting to dominate the space industry, and everything in between. Admired, despised, or envied, many of these entrepreneurs are among the most influential people in the world.

Together with their companies, these entrepreneurs can shape global opinions on the scale of the media industry, and if they so choose, can deploy capital on the scale of the finance industry, in addition their technology can make a fundamental and positive impact for good, if that is their wish.

Figure 12: Big Tech Entrepreneur Reach and Influence

Company	Customers/ Users	Cash on Hand[31]	Entrepreneur(s)	Personal Wealth[32]	Twitter Followers	Facebook Followers	Total
Alphabet	4,300m (Google users)	US$116bn	Larry Page/ Sergei Brin	US$218bn	-	-	-
Meta	2,900 million (Facebook accounts)	US$42bn	Mark Zuckerberg	US$67bn	-	119m	119m
Microsoft	1,600 million (devices running Windows)	US$107bn	Bill Gates	US$129bn	61m	42m	103m
Amazon	310m (Amazon users)	US$59bn	Jeff Bezos	US$171bn	6m	-	6m
Tesla	3.2 million (cars produced)	US$21bn	Elon Musk	US$219bn	115m	-	115m

While many of the companies above have recently begun distributing significant amounts of cash back to investors, the current cash holdings of the largest of the group exceed the foreign currency reserves of countries like Canada or Turkey, while the personal wealth of the richest entrepreneur exceeds the reserves of countries such as Italy.

Thanks to the cumulative impact of their wealth, influence, and their platforms Big Tech are perhaps the most visible global tech leaders, and they account for approximately one third of the c.US$4.5 trillion in annual sales generated by the top 100 tech companies in the world, and a similar share of their R&D.

However, as a reflection of their power and prominence, Big Tech is today one third of the revenues of the overall tech sector. The other very significant two thirds of global tech revenues are generated by a rich and diverse industry, led by a deep second tier of scaled tech leaders from around the world that are developing and scaling innovations with the potential to transform civilization. This powerful cohort, active across the entire spectrum of the broader and next generation tech sectors are the ultimate arbiters of which technologies are developed, which technologies are scaled, and how these technologies are used and by whom, and may well be bought by Big Tech as part of the evolving plan of the industry leaders.

> *"The thing I've been thinking about most recently is what I will call the Western oligarchs, or the American oligarchs ... with a sort of uber capitalism ... where the aggregation of resources is so great that they somehow exceed the state ...*
> *Many of the Western oligarchs have this obsession with outer space ... symbolic in a way of this boundless or frontier-less kind of approach."*
> Joel H Rosenthal, President, Carnegie Council for Ethics in International Affairs

Technology as a stakeholder in capitalism

However, it is important to consider that while tech innovation has the potential to play a critical role in driving the sustainability transition and achieving the SDGs, its ultimate use occurs in a global system of multi-stakeholder capitalism in which the tech industry is one of the players. Much as the finance industry cannot simply 'fund the SDGs', despite administering c.90% of the world's liquid wealth of US$450 trillion, so the tech industry cannot solve the SDGs on their own.

The current system of demand driven capitalism incorporates economics, politics and society and is based on a worldview that equates progress with increasing consumption. All the world's global stakeholders play their roles in propagating this system. Households' consumer demand drives the system, and their consumption represents nearly 60% of global economic output. The world's political and economic systems operate to meet these demands, often at the expense of other long-term priorities. Governments rise and fall based on their ability to provide prosperity to its citizens that funds their consumption. Corporations, including technology companies, rise and fall based on their ability to deliver the goods and services desired, and financiers ultimately rise, and fall based on their ability to fund the companies that deliver. The media reinforce consumption as a value to respect, capital funds the system, and science and innovation focus on providing the stakeholders with technologies that allow them to fulfil their roles more efficiently and effectively.

In its current state, the system is not geared to deliver balanced social, environmental, and economic "outputs", but to maximize production and consumption. Rather than driving sustainability, this system, and the innovation it has driven has exacerbated the global sustainability challenges facing the world today, depleting global resources, driving pollution, and exacerbating inequalities between and within societies across the world. And while technology can have significant positive impact on all these issues, its funding, development, deployment, and scaling requires the alignment of all the stakeholders in the system. Each stakeholder can play a systemic role if they are determined to do so, for example, if households demand sustainable products, corporations innovate and make these, financiers fund their development and scaling, governments support their deployment, penalize negative social and environmental externalities and rewards positive ones, and the media promotes their adoption, then the SDG goals and a secure sustainable future can be achieved. The individual as a collective certainly has an outsized role as the consumer in a system based on mass consumerism.

However, given the pivotal role that tech (as an innovative force for change) and technologists (as uber powerful individuals) have in the emerging information era, the system is set for change at their hands. The transformation of global multistakeholder capitalism itself, a system that has shaped our economic, political, and social systems for nearly a century, is needed to deliver a more secure, sustainable, and superior future. Due to the circular nature of the system a transformative intervention at any point in it could, in theory, change the whole system. In practice however, given how robust and self-reinforcing the system has proven to be, any systemic change will likely require powerful catalysts that fundamentally change the ingrained nature of consumption and production that is consuming the planet itself.

The tech industry - and with it the technologists as the uber powerful individuals of our times - is not only a prominent stakeholder in the system of capitalism, but also one of its most important change agents whose innovations can transform the system itself to deliver a secure sustainable and superior future for the world.

Exempting a global catastrophe, technology has the potential to be such a catalyst. However, its role in capitalism is little understood, and capitalism (perhaps due to its nomenclature) is often mistakenly assumed to be the purview of the managers of capital, the financial institutions.

There are three predominant ways the tech industry's innovations can fundamentally change the way capitalism works:

1. **Changing the way the system works,** for example, by using big data to provide real time information to all participants of the consequences of their actions on the SDGs and human security, and ensuring that the big data necessary for public good decisions, pandemic, disaster preparedness, etc. are kept in the public domain.
2. **Changing the value and power of other stakeholders,** for example, through blockchain solutions that disintermediate corporations and financial institutions and enable citizens to transact with each other and with entities outside of their normal chain of trust.
3. **Making a direct impact,** for example, by creating data solutions that make a direct impact on SDG goals such as education, finance, and healthcare.

And so, the tech industry is not only a prominent stakeholder in the system, but also one of its most important change agents whose innovations can transform the system itself to deliver a secure sustainable future for the world. Other players can also make a difference including through consumer activism, the application of finance or the provision of regulation.

Tech industry leaders' actions therefore matter to the world, and their cumulative decisions, both at the macro and micro-level, will determine the role that the tech sector plays in the achievement of the SDGs and the transition to secure and sustainable future. As such the questions as to how the tech industry, and the individuals that lead it, perceives itself and its broader role in the world are critical ones, and the statements and actions undertaken to date point to the industry's likely future trajectory in this regard.

In summary

- The Fourth Industrial Revolution currently underway is blurring the boundaries between the physical, digital, and biological spheres, expanding what is commonly understood as the 'tech sector'
- The technological revolution underway is driving the transition to the 'Imagination' Age, where creativity and imagination become the primary creators of economic value thanks to embedded technologies, virtual reality, and digital platforms
- Technology has a critical role in driving the SDGs and human security, and will likely determine whether many of the goals can be met by 2030. Of the 169 targets associated with the SDGs, 103 have been found to be directly influenced by digital technology
- However, technology and its application also present a number of challenges that need to be managed, including structural employment shifts from automation, the risk of a deepening digital divide that leaves people ever further outside of the 'system',, a growing environmental impact, and the growing risks of cyber warfare and cybercrime

- At an estimated US$5-10 trillion in annual revenue, the tech sector is among the largest and most valuable industries in the world, providing it with global power and influence, and is has created class of tech entrepreneurs who now include six of the world's ten richest people.
- Given the pivotal role that tech (as an innovative force for change) and technologists (as powerful individuals) have in the industrial revolution underway, they have the ability to transform the capitalist system itself though systemic change, power shifts between stakeholders and direct impact.

III. Technology Establishing a Common Ground as a Force for Good

Given the tech sector's size and influence, there is a growing expectation from stakeholders for it drive positive social impact in the world as a 'force for good'. The leaders of the tech industry have clearly understood these expectations and have responded with a wide range of initiatives being executed across ESG, sustainability and stakeholder engagement. These are positive signals but need to be looked at in detail and evaluated against the role the tech sector must play for the SDGs to be met. This chapter analyzes the impact initiatives being undertaken by the top 100 tech companies and their progress on transforming themselves into a 'force for good' for the world.

1. Establishing the 'Force for Good' Framework

Cumulatively, the actions and initiatives of the leading tech companies establish a 'common ground', within an ESG code, embracing sustainability, and engaging stakeholders. Due to their size and influence, these companies set the bar for others in their industry and can potentially help catalyze positive change in the sector overall.

Defining a tech company being a 'Force for Good'

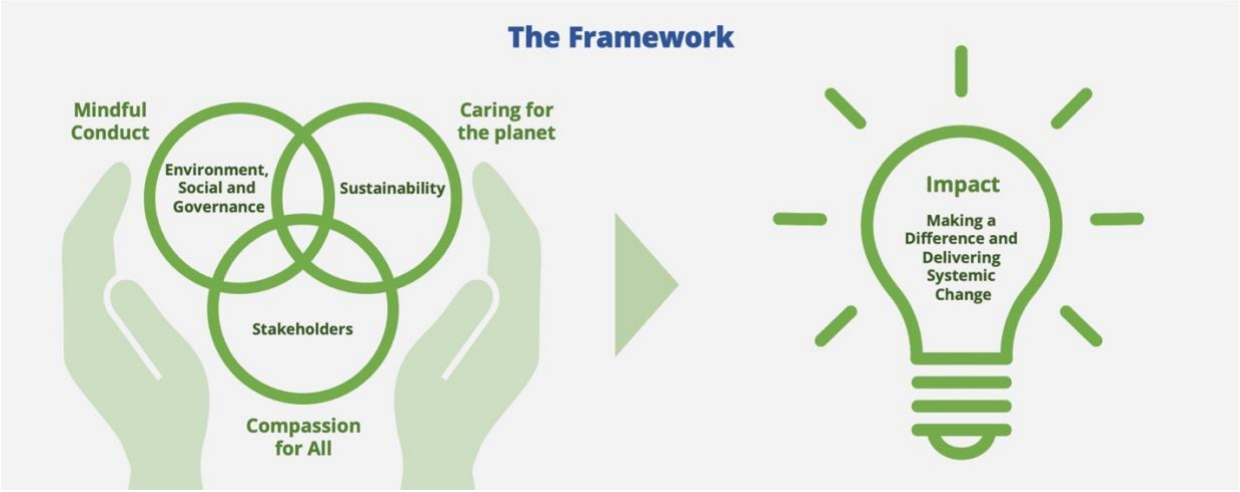
This report defines 'force for good' in terms of tech company activities in three overlapping areas in the context of transitioning to more sustainable business models:

(i) 'Mindful Conduct', adopting and integrating of ESG considerations into business processes;

(ii) 'Caring for the Planet', driving sustainability and sustainable development; and

(iii) 'Compassion for All', engaging deeply to drive value for other stakeholders, including employees, customers, and others.

Figure 13: A Framework for Being a Force for Good



The analysis builds an overall assessment of the leading companies in tech through their activities and initiatives across the three categories to identify the common ground between them, as well as the likely direction of travel for the industry based on areas where leaders are currently breaking new ground.

Summary of research process and methodology

This report analyzes the initiatives of the world's leading tech companies across ESG, sustainability, and broader stakeholder engagement, examining their relative levels of engagement, and the changing priority of these activities within the respective organizations. This chapter focuses on the 100 largest tech companies in world, with total annual revenues of US$3.7trillion, representing by some estimates over two thirds of total industry revenues. For the purposes of this report, the leaders have been selected from the "Broader Tech Sector" as defined in the previous section, rather than the more narrowly defined IT Sector, or the emerging "Next Gen Tech Sector", (whose early leaders are in any case at a more nascent stage of development, and far below the billions in annual revenue that even the smallest of the companies included in this analysis generate.)

This report has analyzed the published data of each of these 100 companies across the boundaries of various fields including ESG, CSR, people, and organizational sustainability.

Figure 14: Key Metrics of 100 Tech Industry Leaders Analyzed

	Total 2021 Revenues (US$bn)	Total Market Cap (as of 30/11/22) (US$bn)	Total 2021 Profits (US$bn)	Total Employees (as of 31/12/2021) in m
Total 100 Companies	US$3,708	US$14,457	US$982	6.57
64 North America Based Companies	2,486	11,402	716	4.32
22 Asia Based Companies	1,030	2,248	222	1.57
12 Europe Based Companies	183	731	44	0.64
2 RoW Based Companies	10	76	1	0.04

Figure 15: List of 100 Tech Industry Leaders

Activision Blizzard
Adobe
Adyen
Airbnb
Alibaba
Alphabet (Google)
Amazon
AMD
Analog Devices
Apple
Applied Materials
Arista Networks
ASML
Atlassian
Autodesk
Automatic Data Processing
Baidu
Block
Booking Holdings (Booking.com)
Broadcom
Cadence Design Systems
Checkout.com
Cisco
Constellation Software
CoStar Group
Coupang
CrowdStrike
Dassault Systemes
Dell
eBay
Electronic Arts
Enphase Energy
Equinix
Fidelity National (FIS)
Fiserv
Fortinet
Foxconn (Hon Hai Precision Industry)
Global Payments
GlobalFoundries
HP
IBM
Infineon
Intel
Intuit
IQVIA
JD Health
Jingdong Mall
Keyence
Keysight
KLA
Kuaishou Technology
Lam Research
Marvell Technology Group
MediaTek
Meituan
MercadoLibre
Meta Platforms (Facebook)
Microchip Technology
Micron Technology
Microsoft
Murata Manufacturing
NetEase
Netflix
Nintendo
Nokia
NVIDIA
NXP Semiconductors
ON Semiconductor
Oracle
Palo Alto Networks
PayPal
Pinduoduo
QUALCOMM
Roper Technologies
Salesforce
Samsung
SAP
Schneider Electric
Sea (Garena)
ServiceNow
Shopify
SK Hynix
Snowflake
Sony
STMicroelectronics
Stripe
Synopsys
TE Connectivity
Tencent
Tesla
Texas Instruments
Tokyo Electron
TSMC
Uber
Veeva Systems
Vmware
Wolters Kluwer
Workday
Xiaomi
Zoom

It is important to note that these companies do not represent an exclusive or exhaustive list of institutions in the tech sector that are leading on matters of ESG, sustainability or stakeholder engagement, and that by nature of the industry's size and diversity, many companies that may well be leading in this regard have not been included. Further, while the top 100 companies represent a wide range of sizes, all are multi-billion dollar scaled companies, most of which also have large public footprints. It goes without saying that in an industry driven by innovation and entrepreneurship, many of the most disruptive technologies and initiatives will be undertaken by start-ups and early-stage companies outside the scope of this analysis. Over time, the most disruptive of these will scale and their technologies will be adopted by the industry as a whole, to become part of the future common ground.

2. ESG being embraced, mindful conduct

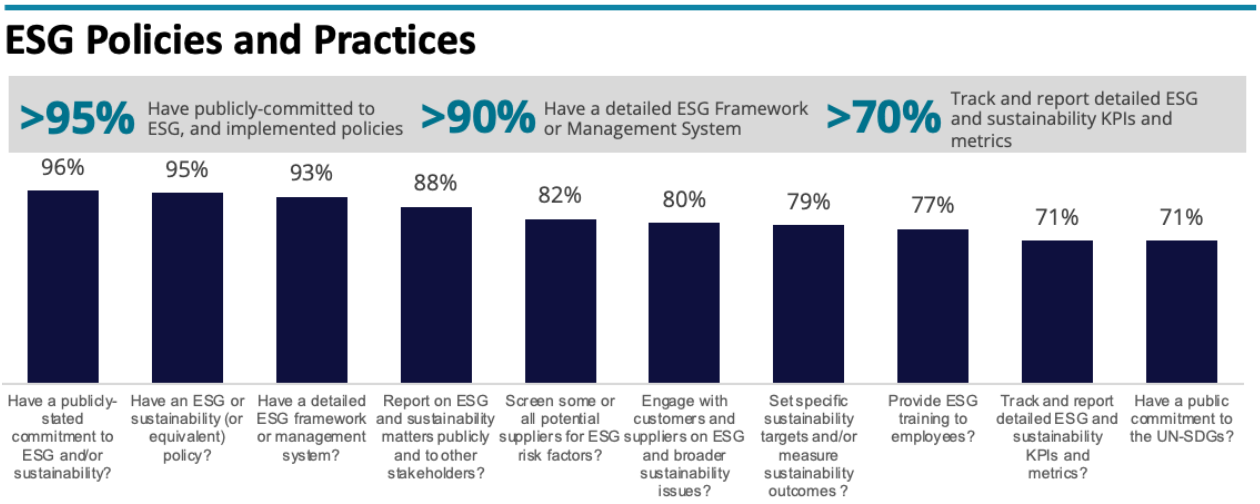
1.1 ESG policies and practices

ESG policies and practices have been embraced by a significant majority of industry leaders, although the level of integration and implementation varies across businesses.

ESG most commonly is used to measure a business's impact on society and the environment, as well as how transparent and accountable its governance is. While originally developed for the finance industry as a tool for assessing an investment's externalities and risks, ESG has been embraced by the wider business community to measure operational impacts and risks, too.

Almost all the institutions analyzed in this report have publicly declared their commitment to ESG and sustainability principles more broadly, have adopted ESG (or sustainability) policies accordingly, with a significant majority (93%) having put in place detailed environmental and social management systems to turn these policies into practices. A large number (88%) follow up their public commitment to ESG with some form of regular reporting to stakeholders. Similarly, many companies (79%) have set (operational) sustainability targets for their organizations.

Figure 16: Adoption of ESG Policies and Practices by Tech Sector Leaders



Source: Technology as a Force for Good

While the stated adoption of ESG is very high, only 71% of the companies track and report detailed ESG indicators and metrics, which is considered critical for both performance improvement and for transparency and accountability to stakeholders. Having said that, tracking and reporting may well increase rapidly, as it did in the finance industry which within the space of only a few years went from a similar share of leaders reporting to nearly universal reporting today. ESG training for employees also remains *relatively* low among tech industry leaders (at only 71 % providing it), although this may well reflect the fact that a significant part of a tech company's workforce is purely 'inward facing' with their day-to-day jobs unlikely to be impacted by ESG concerns.

1.2 Industry collaboration and cooperation

Industry leaders are increasingly working together to tackle global problems, developing and adopting standards for technologies and sustainability reporting, as well as coordinating the deployment of digital technologies for sustainability.

A growing number of tech companies are working together in industry and cross-industry associations in pursuit of sustainability objectives, demonstrating their belief that solving the world's sustainability challenges will require a significant collaborative effort. Over half of tech sector leaders have adopted the standards of the Sustainability Accounting Standards Board (SASB) and the Task Force on Climate Financial Disclosures (TCFD) to drive transparency in climate and emissions data disclosures. Over one-third of tech sector leaders have joined the UN Global Compact (35%) and/or the related Global Reporting Initiative (38%), the world's largest corporate sustainability organization, which works directly with members to embed sustainability strategies and practice into their organizations. Smaller, tech sector specific sustainability initiatives are also attracting a robust membership from among tech sector leaders.

Figure 17: Tech Sector Leaders' Participation in Associations

Tech Leaders' Participation in International Associations

Association	Brief Description	Membership from Dataset % of Firms
Sustainability Accounting Standards	**NGO which has developed a common sustainability accounting standards** to standardise the ESG data financial firms use to measure ESG impact	64%
Task Force on Climate Financial Disclosures	**Develop consistent climate-related financial risk disclosures** for use by companies, banks, and investors in providing information to stakeholders	50%
Global Reporting Initiative	**International independent standards organization** that helps businesses, governments and other organizations understand and communicate their impacts on issues such as climate change, human rights and corruption	38%

Source: Technology as a Force for Good

Tech Leaders' Participation in International Associations (cont'd)

Association	Brief Description	Membership from Dataset % of Firms
UN Global Compact	**World's largest corporate sustainability initiative** calling on companies across sectors to align strategies and operations with universal principles of	**35%**
Information Technology Industry Council	**Premier global advocate for technology**, representing the world's most innovative companies and promoting public policies and industry standards that advance competition and innovation worldwide	**31%**
Business Roundtable	**Association of CEOs of America's leading companies** who are working to promote a thriving U.S. economy and expanded opportunity for all Americans through sound public policy	**26%**
BSR	**BSR is a sustainable business network and consultancy** focused on creating a world in which all people can thrive on a healthy planet	**23%**
The Climate Pledge	**The Climate Pledge is a commitment to reach net-zero carbon emissions by 2040**—10 years ahead of the Paris Agreement	**12%**
European Green Digital Coalition	Initiative of companies which aims to **harness the enabling emission-reducing potential of digital solutions to all other sectors**	**9%**
World Business Council for Sustainable Development	Community of the world's leading sustainable businesses working collectively to accelerate the system transformations needed for a **net zero, nature positive, and more equitable future**	**8%**

Source: Technology as a Force for Good

Of course, more remains to be done, given that approximately half the industry leaders do not yet disclose, or report, climate-related issues using major frameworks and standards.

3. Broad industry consensus on environmental sustainability, caring for the planet

2.1 Sustainable investment and R&D

The tech industry is at the forefront of private sector engagement on environmental sustainability and have invested billions in sustainable infrastructure for their own operations, and multiples of this on developing sustainable technologies to deploy for the world at large.

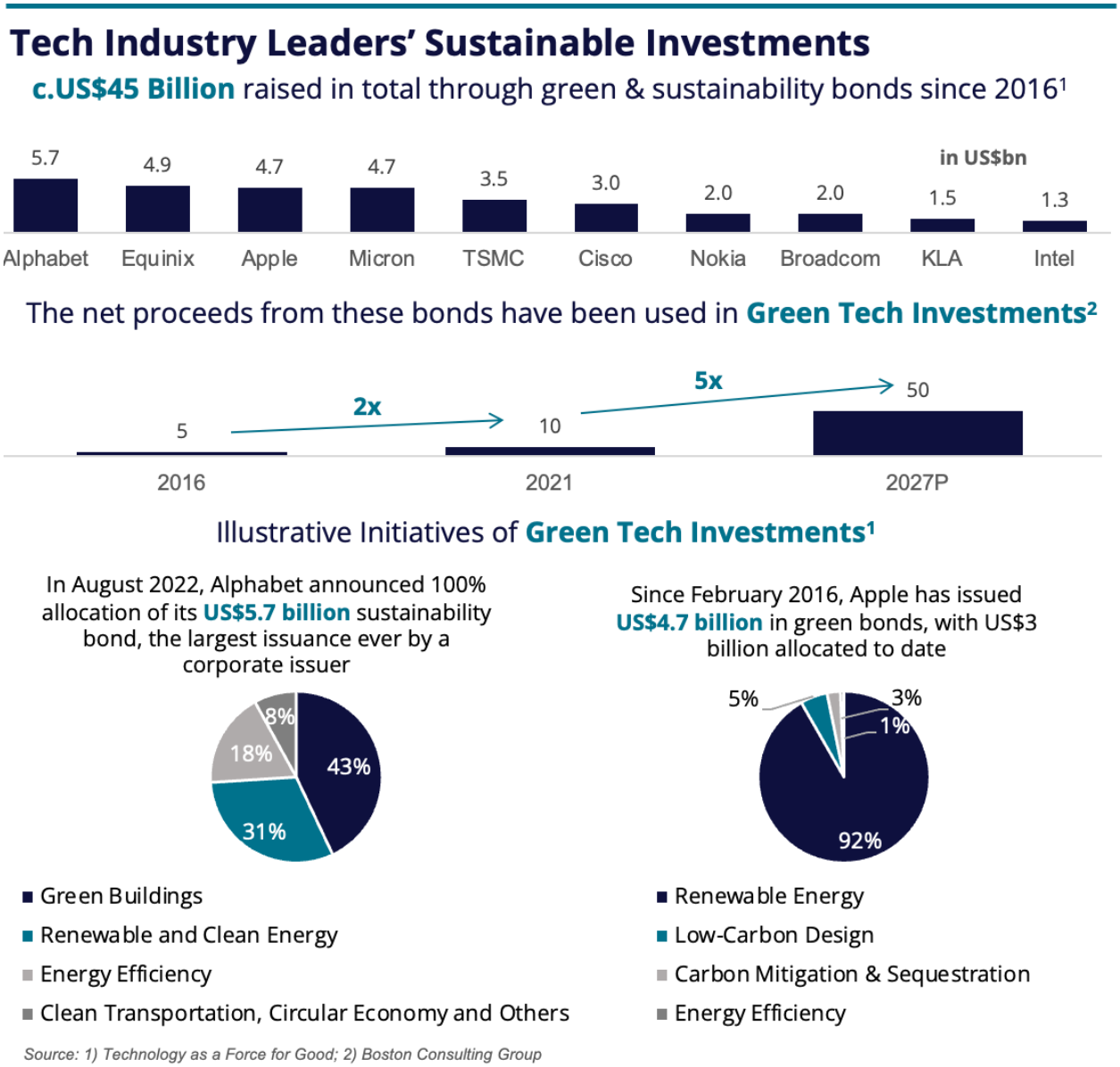
Climate tech and clean energy have emerged as the largest areas of global technology investing, attracting US$257 billion in 2021, more than other major sectors such as artificial intelligence (AI) (US$165 billion), mobile communications (US$166 billion), or internet technologies (Web3.0)

(US$110 billion).[33] Tech sector leaders are emerging as increasingly important players in this field alongside financial and other industrial investors.

Tech sector leaders are also becoming increasingly active in sustainable finance, particularly sustainable debt, issuing c.US$45 billion in green and sustainable bonds in the five-year period ending 2021 to finance their sustainability initiatives, representing a significant portion of overall global corporate green bond market,[34] making the tech sector one of the largest issuers of green bonds outside of the financial sector.

With regards to investments the tech sector is investing heavily across a range of sustainable technologies and infrastructure, with recently issued green bonds pegged to renewable and clean energy, green buildings, energy efficiency, transportation, and carbon mitigation among other technologies, deploying a total of c.US$10 billion across their organizations last year for sustainable investments overall.

Figure 18: Tech Sector Sustainable Investments

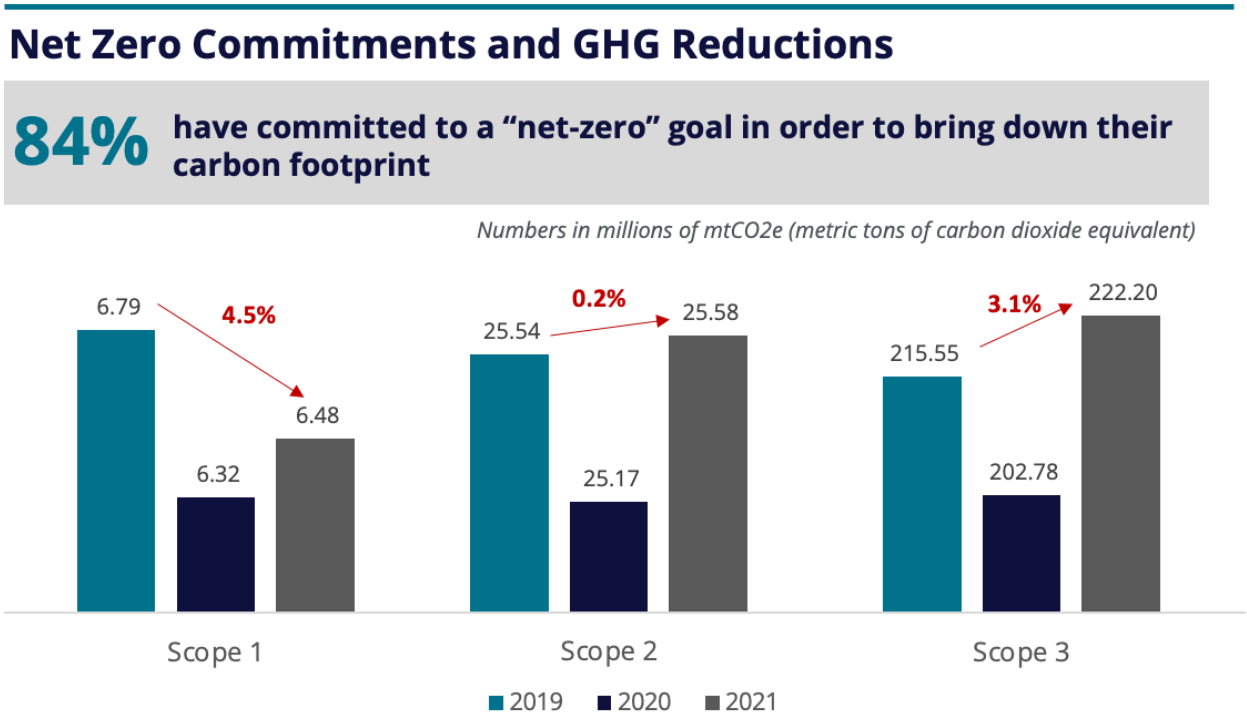


2.2 Climate transition and 'Net Zero' *Tech industry leaders are leading the private sector in terms of climate action, committing to 'Net Zero' and rapidly decarbonizing their operations and increasingly their supply chains as well.*

The tech industry is at the forefront of private sector climate action. While only 42% of Fortune Global 500 companies overall have committed to net zero and carbon neutrality, 80% of the tech companies on that list have. Looking at the larger dataset of the 100 tech companies considered in this report, 84% have committed to net zero, in some cases with detailed plans and highly ambitious targets. Some of the largest software and data focused companies have already achieved net zero across their own operations while many manufacturing focused businesses have set targets for 2030, for their own operations and in some cases for their supply chains as well.

As a result of these ambitious targets and plans, the tech sector is rapidly decarbonizing. Direct GHG emissions (scope 1 emissions) made by industry leaders have dropped by 4.5% over two years. While indirect emissions from purchased energy (scope 2 emission) were up slightly (0.2%) over the same period, the total energy consumption associated with these emissions grew by 15% (see Figure 19 below), pointing to a significant greening of the tech sector's energy supply, with the sector having become the largest corporate contractor of renewable power globally.

Figure 19: 'Net Zero' Commitments and GHG Reductions by Tech Sector Leaders



Scope 1: Direct emissions from owned or controlled sources
Scope 2: Indirect emissions from the generation of purchased energy consumed by the reporting company
Scope 3: All other indirect emissions that occur in a company's value chain

Source: Technology as a Force for Good - Note: Includes companies that have disclosed data for the previous three years

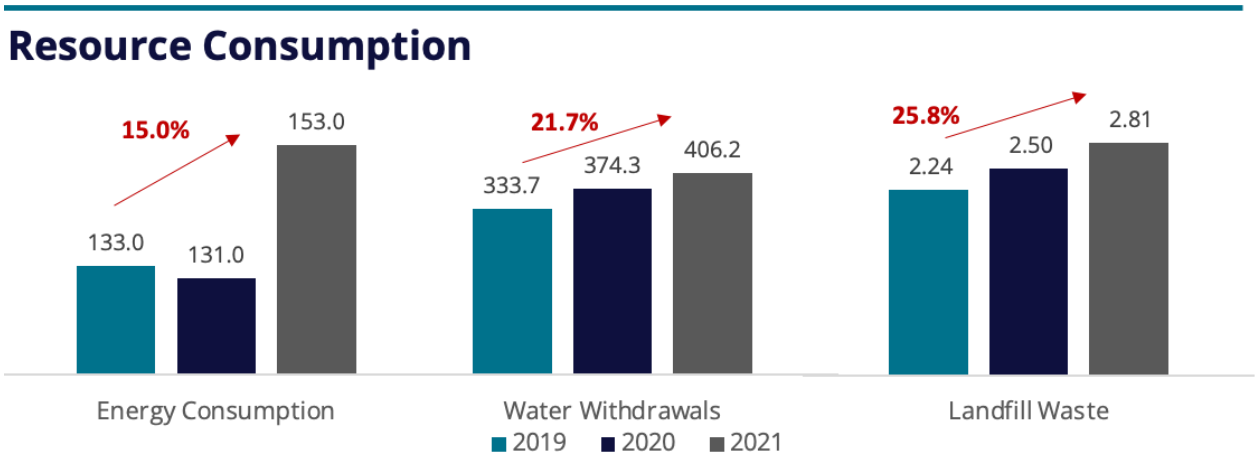
Conversely, the industry's scope 3 emissions, covering an organization's entire value chain, increased by 4% over the past two years, despite companies engaging activity to decarbonize their supply chains. This increase is due to a number of large organizations adopting updated GHG accounting methodologies to calculate their product end users' and suppliers' emissions, which they believe more accurately reflects the 'true' quantum of emissions allocatable to themselves. While this recalculation indicates that tech companies have much further to go in decarbonizing their supply chains than anticipated, the upside is that a greater portion of suppliers' emissions are now being reported and targeted for reduction, which will ultimately lead to more carbon being removed (or offset) in the end.

2.3. Resource Consumption

Tech sector leaders have adopted increasingly proactive resource management practices, reducing waste and overall resource consumption, and using recycling and other product lifecycle management tools to increase the sustainability of their products.

A growing number of tech sector leaders is focusing on their overall environmental footprint beyond carbon emissions, considering their energy and resource, particularly water, consumption and the waste that they generate. 71% of the companies analyzed in this report on non-GHG emissions and waste, with a significant portion of these companies having set reduction targets and implemented plans to achieve these. Despite these plans however, the absolute level of cumulative emissions and waste produced by these companies over the past two years has increased, by between 15% (energy consumption) and 26% (landfill waste). These increases were driven by business growth, which averaged 45% across the group as a whole over the same period, indicating that their resource efficiency is continuing to improve significantly. On a per unit of revenue basis, waste over a two-year period is down 13%, water usage 16% and energy consumption 21%.

Figure 20: Tech Sector Leaders' Resource Management



Energy Consumption: Reported Scope 1 Emissions (billions of kWh)
Water Withdrawals: Reported Scope 1 Emissions (millions of meter cube)
Landfill Waste: Reported Waste (millions of metric tonnes)

Source: Technology as a Force for Good - Note: Includes companies that have disclosed data for the previous three years

Efficiency increases aside, full sustainability would imply minimizing companies' environmental footprints to as close to zero as possible, while recognizing that nearly every business must consume resources to operate. For energy consumption, this will likely imply moving to 100% renewable energy, a move many companies are undertaking. For water usage, several companies are moving to net zero water, which preserves the quantity and quality of natural water resources with replacement strategies to counter industrial usage, while for waster production, full sustainability would see recycling/reusage rates approaching 100%.

4. Engaging deeply to drive value for other stakeholders, 'compassion for all',

3.1 Multi-Stakeholder Commitments

Tech sector leaders have committed to a broader multi-stakeholder approach, engaging employees, suppliers, customers, government, communities and even competitors

Virtually all institutions analyzed have publicly stated their focus on and care for all the stakeholders in their ecosystems including its employees, customers, communities, suppliers, regulators, and the government. This multi-stakeholder approach, which c.96% of the data set constituents support and have publicly affirmed, is based on the growing awareness that self-interest needs to align with the long-term interests of others. Tech sector leaders have also acknowledged their focus on individual stakeholders, with 95% specifically acknowledging employees, and 93% acknowledging suppliers, even more so than shareholders (89%). Given that many tech organizations are consumer focused, with the products and services being used by millions and in some cases billions of people daily, a significant number of leaders (84%) have affirmed their commitment to their customers, as well to broader stakeholders like communities, governments and even industry peers.

Figure 21: Multi-stakeholder Commitments by the Tech Sector

Tech Sector Leaders are Engaging A Range of Diverse Stakeholders

96% of tech industry leaders have publicly committed to working in the interests of multiple stakeholders, and not only shareholders

Key Stakeholders	% of Leaders Acknowledging
Employees	95%

Source: Technology as a Force for Good

Tech Sector Leaders are Engaging A Range of Diverse Stakeholders

Key Stakeholders	% of Leaders Acknowledging
Suppliers	93%
Local Communities	89%
Government & Regulators	89%
Shareholders	89%
Customers	84%
Industry Peers	41%

Source: Technology as a Force for Good

However, the translation of these commitments to stakeholder interests into specific actions and initiatives varies from company to company, but overall remains a work in progress. The importance of customers aside, public companies continue to have legal and fiduciary duties to their shareholders, and they continue to be measured by their performance in terms of shareholder returns, and management compensation continues to be closely tied to shareholder performance, creating incentives to prioritize these metrics over those benefiting other stakeholders.

3.2 Corporate Social Responsibility

The tech sector's corporate social responsibility programs reflect tech companies' desire to have a positive impact on society, recognizing tech leaders' ability to deploy significant resources in support of social goals

Tech sector leaders spent a total of US$3.8 billion on corporate social responsibility (CSR) initiatives during the past year, with a focus on addressing the most pressing challenges of the communities within which these companies operate. During 2021 this translated into significant

investments and engagement in initiatives relating to education, racial and social justice, and diversity and inclusion.

Figure 22: CSR Spending by Tech Sector Leaders

Tech Industry Leaders' and Corporate Social Responsibility

Total Spend on CSR and Philanthropic Initiatives ▶ **c.US$3.8 billion**

Education	Gender Equality	Racial Diversity
Illustrative Initiatives	**Illustrative Initiatives**	**Illustrative Initiatives**
▪ "**Commit US$150 million to fund STEM education** and drive technology modernization at four-year HBCUs"	▪ We seek to **promote more women** STEM careers through our work with a non-profit in Argentina **seeking to reduce the gender gap in technology in the region"**	▪ "Urgent responsibility to help d**ismantle systemic racism** and support opportunities for Black, Hispanic/Latinx, and Indigenous communities"
▪ "Training programs focused on young adult employability in the communities where our distribution centers are located. **These trainings focus on digital literacy and socio-emotional skills."**	▪ "Train young adults between the ages of 17 and 26 who have completed the basic cycle of high school. The courses and all materials necessary for the program are provided free of charge. **More than 50% of participants are women"**	▪ "Helping to create **economic opportunity for underrepresented communities all over the world**, with a focus on Black entrepreneurship and skill-building"

Source: Technology as a Force for Good

It is worth noting, that while tech sector leaders CSR investments are significant, the total sums mobilized 40% less than the world's largest financial institutions deployed over the same period, pointing to the higher bar to which tech industry leaders can raise to, particularly when corporate social responsibility goals can be aligned with business goals, allowing for the much greater capital deployment and therefore impact.

3.3 Employee Wellbeing

The tech sector's commitment to employees and their wellbeing reflects the high demand for skilled workers and the importance of ensuring worker productivity.

The resilience of an organization is highly dependent on the resilience of its people, making the prioritization of employee well-being an issue of strategic importance. 93% of tech sector leaders have employee wellness initiatives geared to keeping staff healthy and productive, maintaining a

healthy work-life balance across office, remote work, and hybrid environments. A significant portion of these (79%) also have programs focused on mental health specifically.

Figure 23: Tech Sector Leaders and Employee Wellness

The tech sector has historically been prone to chronic workplace stress and burnout, given high workloads, long working hours, and the resulting work-life imbalance. A recent study found that 40% of tech workers are at high risk of burnout, making stress management and reduction initiatives critical to maintaining employee's long-term health. Given this history, the tech sector has historically been a leader in employee wellness. However, other industries are quickly catching up in terms of their own engagement in this regard, leaving the tech sector with the need to innovate what the next level of "unlocking human potential looks" like for it to maintain its leadership position.

3.4 Inclusion and Diversity

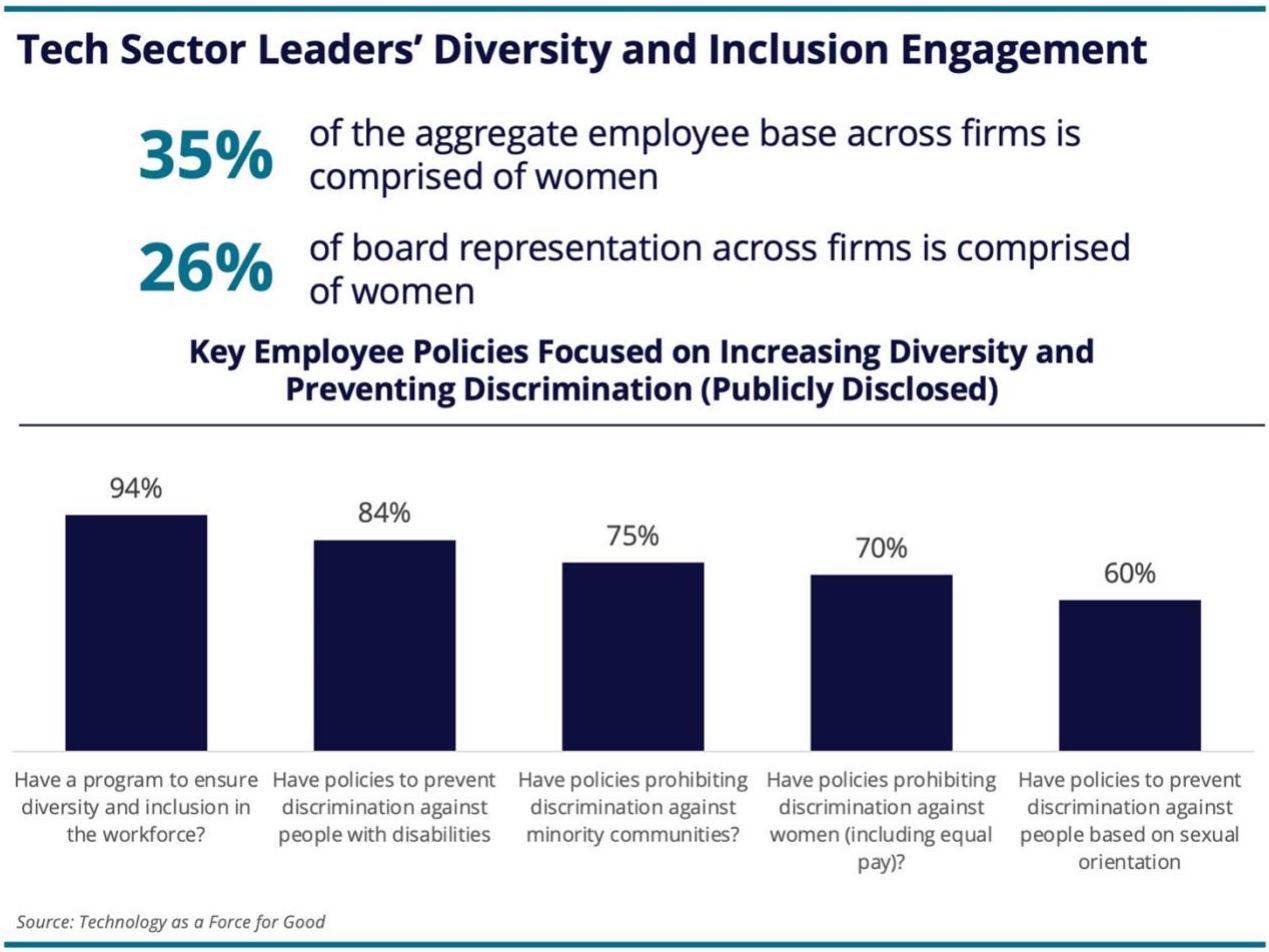
The industry continues to make progress, albeit slowly, on creating a more inclusive and diverse work environment

The tech sector has traditionally suffered from a significant diversity gap, of both gender and ethnicity, [1] lagging sectors like financial services, retail, healthcare, hospitality, education, professional services and public services in terms of workforce diversity (and lagging only behind construction, manufacturing and natural resources).[35].Industry leaders have clearly acknowledged this, having recognized the value of a more diverse workforce and the unconscious risk of "group-

[1] This analysis has not sought to calculate statistics on ethnic diversity given the global nature of the top 100 companies assessed and the lack of standards used to measure ethnic diversity in the workplace across them. However, in the world's largest tech market, the United States, non-white ethnicities comprise 22% of the overall workforce (roughly in line with their representation in the overall labor force nationally), but only 16% of IT/tech teams, and only 13% of product design and management teams. (Source: Cap Gemini)

think" that less diverse teams face. As a result, they have promoted equity, diversity, and inclusion at the board level and across the workforce, with 94% of companies have policies and initiatives focused on workforce diversity.

Figure 24: Diversity and Inclusion in Tech



However, women continue to be significantly under-represented in tech, both in terms of aggregate employees (with women representing 47% of the US, and 46% of the EU workforce overall, but only 37% of the (global) tech sector) and in terms of board positions, where their share of corporate board seats, at 26%, is significantly lower than their representation across the US Fortune 500 (31%), EU-based large cap (32%), and FTSE100 companies (39%), indicating that much more can be done in this respect.[36]

5. Conclusion: A common ground emerging

Stepping back, it is clear that a 'common ground' for tech sector leaders' engagement as a force for good has emerged across ESG, sustainability and stakeholder engagement. This points to an increasingly alignment of leaders' goals and overall priorities, although the manner and speed of execution against these priorities varies widely of course. Given this alignment, the industry's position as a 'force for good' in the world, at the likely direction of future travel, are both

increasingly clear. In summary, the detailed analysis of the initiatives and programs across the 'force for good' categories supports several key conclusions on the common ground that has been established by industry leaders but will likely expand to the industry as a whole.:

I. **96%** of leaders have publicly committed to a multi-stakeholder approach, acknowledging the need for aligning the long-term interests of a wide range of stakeholders.

II. **95%** of industry leaders have adopted ESG policies and practices.

III. **94%** have recognized the importance of workforce diversity, and have programs in place to drive inclusion

IV. **93%** have specific programs to support workers' wellbeing, recognizing the strategic importance of a resilient workforce

V. **84%** have committed to Net Zero and have adopted sustainability accounting standards to report on their emissions and long term decarbonization

VI. **5%** absolute reduction in tech sector leaders' GHG emissions over two years despite strong business growth, indicating the importance being accorded to climate change by the sector

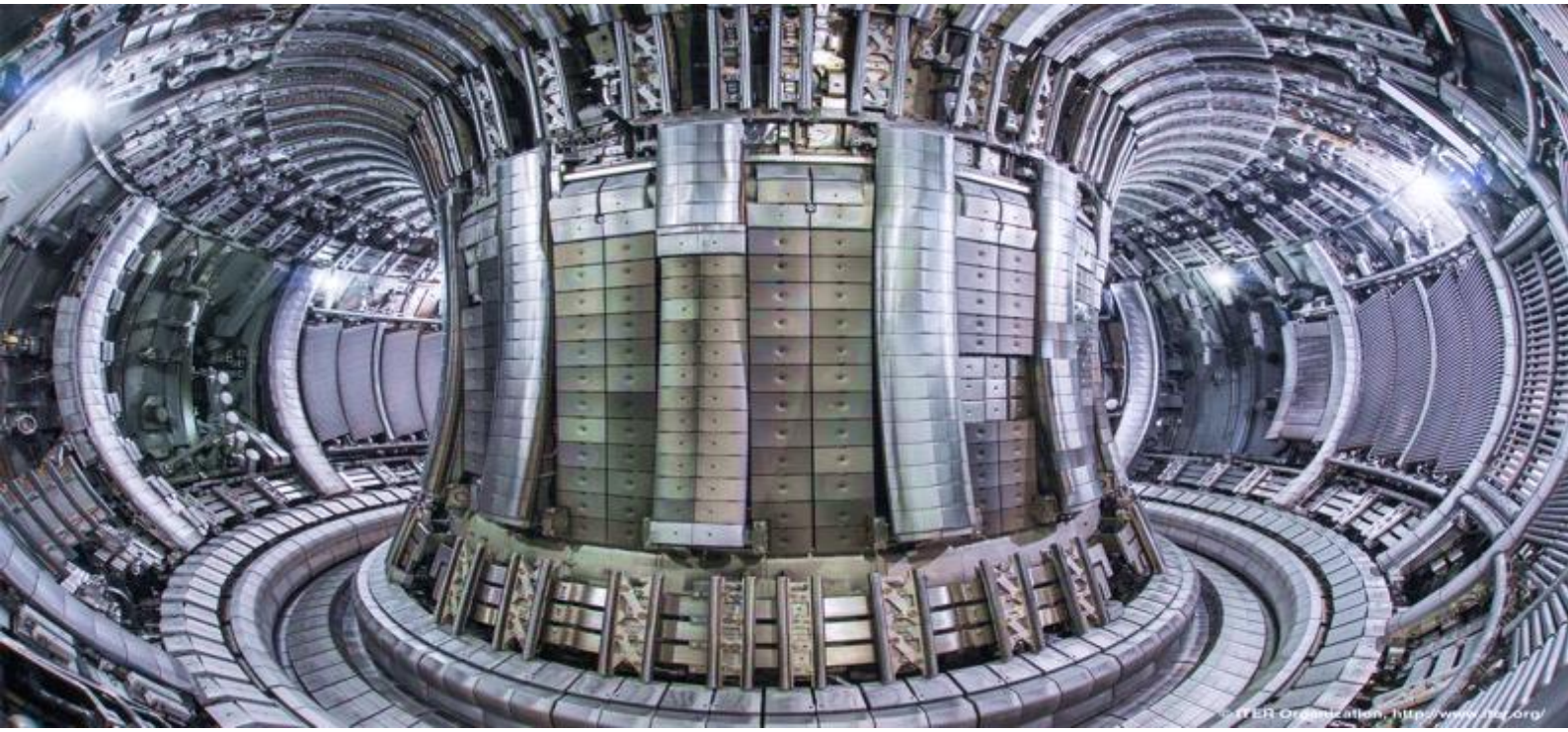
VII. **US$45 billion** of green and sustainability bonds raised, funding investments into a range of sustainable technologies like green buildings, renewables, clean transportation, carbon sequestration and energy efficiency.

VIII. **US$3.8 billion** spent on corporate social responsibility is indicative of tech leaders social impact priorities

The common ground that industry leaders have staked out points to an increasing alignment of the industry with the major development and sustainability challenges facing the world, positioning it to act as a 'force for good'. Importantly, this leader driven common ground also sets the bar in terms of standards that the broader tech sector will need to rise to if it is to follow their lead and act as a catalyst for change.

The next chapter of this report will look beyond the common ground to the innovators and initiatives that are breaking new ground, transforming their organizations, deploying resources at scale and developing target solutions to solve the SDGs, thereby pushing the boundaries of tech sector's engagement as a force for good. The at times fierce competition between leaders to lead on addressing specific issues points to the makings of a 'race to the top', with the largest technology companies vying with one to develop effective solution that leverage their core platforms.

IV. Breaking New Ground Through Innovation



A subset of tech sector leaders is breaking new ground in their ambition to have a positive impact on the world as a force for good, differentiating themselves from their peers in the process. The breakthrough initiatives these leaders are pursuing are varied, ranging from super scaled operational initiatives that are transforming their organizations, the adaptation of existing or development of new products to solve the world's biggest challenges, in many cases profitably, and the innovation of future technologies that will transform the world and further blur the boundaries between technology and other critical sectors. Over time, these initiatives set these leaders up for superior value creation, positioning them as the technology leaders of future. The most engaged and radical companies will themselves be fundamentally transformed by the efforts, establishing the DNA for successful technology companies of the future.

1. Industry leaders engaging across multiple fronts

While the tech industry's organizational efforts in ESG, sustainability and stakeholder engagement are significant and increasing, the sector's true potential as a force for good lies in its ability to deliver, deploy, and scale technological innovations with a significant impact on the world. Much like the finance industry's potential as a force for good rests on its ability to allocate capital, the

tech industry's potential rests on its ability to deploy technology – products, services, and platforms – in a targeted and innovative fashion that reaches all consumers.

A subset of tech company leaders is breaking new ground this regard, be it through the scale of their efforts, the level of innovation achieved, or the nature of their ambition, focusing on otherwise unaddressed issues. These companies are breaking new ground for the industry, raising the bar for the rest of tech sector to rise to in terms of its engagement as a force for good.

Tech leaders' breakthrough initiatives broadly fall into three categories

(i) **Breakthroughs Transforming the Organization for Impact,** being initiatives that originate from the industry's common ground, but on a scale and scope that is transformative for the positioning of the organization itself for a more sustainable future.

(ii) **Breakthroughs Changing the World for Good,** being initiatives where leaders leverage their core technologies to make meaningful progress on key social and environmental sustainability challenges related to major SDGs, and

(iii) **Breakthroughs Building the Future,** being initiatives that are driving to the post-industrial Imagination Age, where the boundaries between the tech industry and other major sectors like energy, healthcare, and manufacturing will blur even further, allowing significant advancements of human security.

2. Breakthroughs Transforming the Organization

Virtually all tech sector leaders have recognized the importance of long-term sustainability, both in terms of ecology and human development, as demonstrated by the large and growing common ground among them in terms of acting as a force for good. However, the scale and speed of industry leaders' efforts varies widely. The most ambitious companies are pursuing initiatives that are fundamentally transforming their organizations, repositioning them for long term impact on sustainability.

Selected Examples of Industry Leaders Breaking New Ground, Transforming the Organization for Impact	SDG Impact[37]
 **Apple sets 2030 Goal for Net Zero Emissions Across its Entire Supply Chain** Having already achieved net zero emissions across its own operations, Apple has expanded this goal to its supply chain, with every Apple device sold by 2030 having a net-zero climate impact. Specific measures include its suppliers transitioning to renewable energy, as well reducing the carbon footprint of materials through the increased use of recycling. In total, Apple has reduced its carbon emissions by 40 percent over the past five years. *Source: Apple Inc. Press Release*	

Google Eliminates Carbon Legacy, to be Fully Carbon Free by 2030

With its operations having run at net zero emissions (using offsets) since inception Google has eliminated its entire carbon legacy with a lifetime net carbon footprint of now zero. The company has now committed to operate on 24/7 carbon-free energy in all its data centers and campuses worldwide by 2030.

Source: Google Press Release

Intel Targets Net Water Positive and Zero Landfill Operations Globally by 2030

Intel has committed to achieving net positive water (consumption), by conserving 60 billion gallons of water and funding external water restoration projects, as well to achieving zero waste to landfill and implement circular economy strategies for its manufacturing waste streams in partnership with suppliers.

Source: Intel 2021-2022 Corporate Responsibility Report

Amazon Becomes the World's Largest Green Energy Purchaser

Amazon is the biggest single buyer globally of clean energy globally, accounting for over 20% of a record 31.1GW of clean-power purchase agreements by companies around the world, having assembled a clean energy portfolio that rivals those of the world's biggest utilities.

Source: Amazon Press Release

SAP Scales Global Mindfulness Program from Employees to Customers

SAP has begun offering its Global Mindfulness Practice program, which has trained over 14,000 employees in mindfulness techniques to its worldwide customer base, offering training across 35 locations globally.

Source: SAP.com

HP Commits to Ambitious Targets for Diversity and Inclusion

HP has committed to three ambitious targets for diversity and inclusion to be met by 2030: achieving 50/50 gender equality in HP leadership, women to represent 30% of technical and engineering staff, and to meet or exceed labor market representation for all ethnic minorities.

Source: HP Press Release

Snowflake Dissolves Corporate Headquarters Becoming "Globally Distributed."

Snowflake, the cloud data analytics vendor has dissolved its corporate headquarters moving to a globally distributed organizational model, offering employees a full range of benefits designed for working from home.

Source: Snowflake.com

3. Breakthroughs Changing the World for Good

In addition to significant but largely inward focused organizational initiatives, several tech sector leaders are also leveraging their core IP, platforms, and technologies as a force for good, making fundamental breakthroughs and/or significant progress on some of the world's most challenging sustainability issues as a result. These issues are naturally ones where technology has among the greatest impact potential, such as enabling universal digital connectivity, driving financial, education and healthcare inclusion, strengthening open liberal societies, and supporting the energy transition and climate action.

While these initiatives include charitable activities, as for-profit organizations tech sector leaders naturally can have the biggest impact where they can develop a scaled business case for doing good.

Selected Examples of Industry Leaders Breaking New Ground, Changing the World for Good	SDG Impact

Starlink provides high-speed, low-latency broadband internet across the globe

SpaceX has launched a satellite communications service focused on delivering high-speed, low-latency broadband internet in remote and rural locations globally. Currently available in 40 countries, Starlink services can be used to digitally connect any part of the planet to fully close the digital divide.

Source: SpaceX Press Release

Cisco Helps to Bridge the Digital Divide with Rural Broadband Network Solutions for Service Providers

Cisco has developed a series of network solutions to help connect 30m people in the US with broadband internet to close the digital divide. Additionally, the company has opened a Rural Broadband Innovation Center to enable more cost-effective broadband networking through wireless and wireline convergence, working with global services providers.

Source: Cisco Inclusive Future Report

Finastra and Microsoft Driving Digital Financial Services

Microsoft and fintech specialist Finastra are partnering to deliver cloud solutions to over 8,500 banking and financial institutions worldwide to drive the digitization of financial services on an open banking platform.

Source: Microsoft Press Release

Salesforce.com Launches Carbon Credit Marketplace, Empowering Any Organization to Take Climate Action

Salesforce, a global leader in CRM, has launched a digital platform that allows users to purchase carbon credits simply and transparently, accelerating the development of a market that will be critical for achieving global net zero.

Source: Salesforce.com Press Release

Google Using AI for Weather and Flood Prediction

Google is using AI Research to develop new methods to predict weather and floods as well as developing computational methods to increase forecasting technology for India and Bangladesh.

Source: Google Press Release

Adobe Digital Workflow Solutions Preserve Three Million Trees Annually

Adobe digital solutions have 95% smaller environmental footprint than corresponding paper workflows, with 30 billion paper documents in the US avoided annually.

Source: Adobe.com, 8 Million Trees

Amazon sets up US$2 billion Climate Pledge Fund

Amazon's Climate Pledge Fund is a US$2 billion venture investment program supporting the development of sustainable technologies and services that will enable the company to meet its own net-zero carbon goal.

Source: Amazon Press Release

Oracle Cloud Powers ESG Integration and Management

Oracle's Cloud EPM platform enables the collection, standardization, and aggregation of ESG data for analysis, insight, and reporting, helping companies to measure and integrate ESG practices into their organizations.

Source: Oracle.com

Texas Instruments Supporting STEM Education, from K-12 to Universities

Texas Instruments (and its TI Foundation) have given more than $150 million over the past five years to support education, including university research and STEM education, as well as free hardware and training for over 20,000 STEM teachers, both on-line and in-person.

Source: IT Foundation

Alibaba Develops World's Largest Digital Payments Platform

Alibaba's Alipay mobile and online payment platform (since spun out into an independent subsidiary is the world's largest digital payment system used by 1.3 billion people, with localized e-wallets providing financial inclusion across 13 countries in Asia and across the Global South.

Source: Ant Financial

Google Classroom Digitizing Global Education

Digital transformation in education is Google Classroom, a platform of online learning tools is driving the digital transformation of education globally, having been used by over 150m students worldwide (in 45 languages) as a learning management system during the Coronavirus pandemic.

Source: Google.com

Autodesk Acquire Smart Water Technology Company.

Autodesk, an engineering software company, has acquired Innovzye, a global leader in water infrastructure software, for US$1 billion, enabling end-to-end water infrastructure solutions that drive a more sustainable water industry.

Source: Autodesk.com

4. Breakthroughs Building the Future

Perhaps the greatest breakthroughs that the tech sector will achieve are those that will drive the shift to the Imagination Age and shape the world within it. The ubiquity of digital technology and its embedding into virtually all economic, political, and social activities will see the boundaries between the physical and the digital, and between the inorganic and the biological increasingly blurring. The most innovative tech sector leaders are therefore already investing heavily into this future, developing technologies with the potential to shape the transition path for the world and lay the ground for future breakthroughs in new energy sources, material sciences, next

generation manufacturing, virtual realities, new forms of finance, the empowerment of people and the exploitation of space.

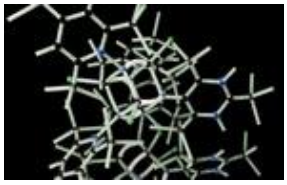
Selected Examples of Industry Leaders Breaking New Ground, Building the Future	Impact Focus
 **Facebook becomes Meta, Aiming to Drive the Development of the Metaverse** Social media company Facebook has rebranded as Meta, reflecting its future strategic focus on augmented reality, virtual reality, and Web3 technologies, deploying a cumulative US$100 billion R&D on these technologies *Source: Facebook Press Release and Filings*	AR/VR
 **NVIDIA and Atos to Build World's Fastest AI Supercomputer** NVIDIA, Atos, and the inter-university consortium CINECA are building the world's fastest AI supercomputer. With the platform offering high-performance simulation, data analytics, AI and machine learning, and visualization, expected uses include drug discovery, space research and weather modelling. *Source: NVIDIA Press Release*	Artificial Intelligence
 **Qualcomm launches Fund and Labs to Accelerate Extended and Augmented Reality Technologies** Qualcomm is driving research and development in the metaverse and spatial computing by supporting innovation and developers with multiple initiatives including a US$100m venture fund and the establishment of a dedicated innovation and R&D lab focused on XR technologies *Source: Qualcomm Press Note*	AR/VR
 **Samsung Creates Foundation for Hyperscale AI Research** Samsung is establishing a new foundation to drive global research in hyperscale AI, based on huge artificial neural network with hundreds of billions of parameters, with the potential to achieve new breakthroughs in cognitive generation tasks, processing natural language or generating programming codes. *Source: Samsung AI Forum 2022*	Artificial Intelligence

PayPal Supports Cryptocurrencies and Ecosystem

PayPal, the online payment system, supports the native transfer of cryptocurrencies between PayPal and other wallets and exchanges, integrating its digital payment platform with the wider crypto ecosystem

Blockchain

Source: PayPal.com



Google's AI DeepMind Solves Structure of All Proteins Known to Science

Google's DeepMind AI has predicted the 3D structure of 200 million proteins, driving advances in understanding of rare genetic diseases, developing new vaccines and drugs, and engineering biotech solutions for global environmental issues

Artificial Intelligence, Human Health,

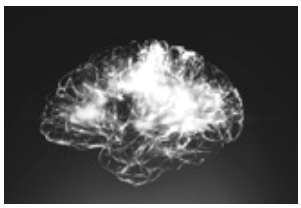
Source: Deepmind.com

Samsung Electronics Delivers Breakthrough Synthesis Method for Graphene

Samsung has achieved a breakthrough synthesis method to speed the commercialization of graphene. A unique material ideally suited for electronic devices, graphene has one hundred times greater electron mobility than silicon, is more durable than steel and flexible, making it the perfect material for next generation devices.

Material Science

Source: Samsung Press Release



Tencent Builds AI-Power Neurosurgical Navigation System

Tencent's AI Labs have developed a digital solution that provides a real-time digital map of the brain that guides clinicians during complex neurosurgery, significantly improving surgical reliability

Artificial Intelligence

Source: Tencent Press Release

Baidu to Operate Fully Autonomous Robotaxis

Chinese internet company Baidu has secured permits to offer a fully driverless commercial robotaxi service, with no human driver present, in two cities, following the launch of its first autonomous ride-hailing service in Beijing earlier this year.

Artificial Intelligence, IoT

Source: Baidu Press Release

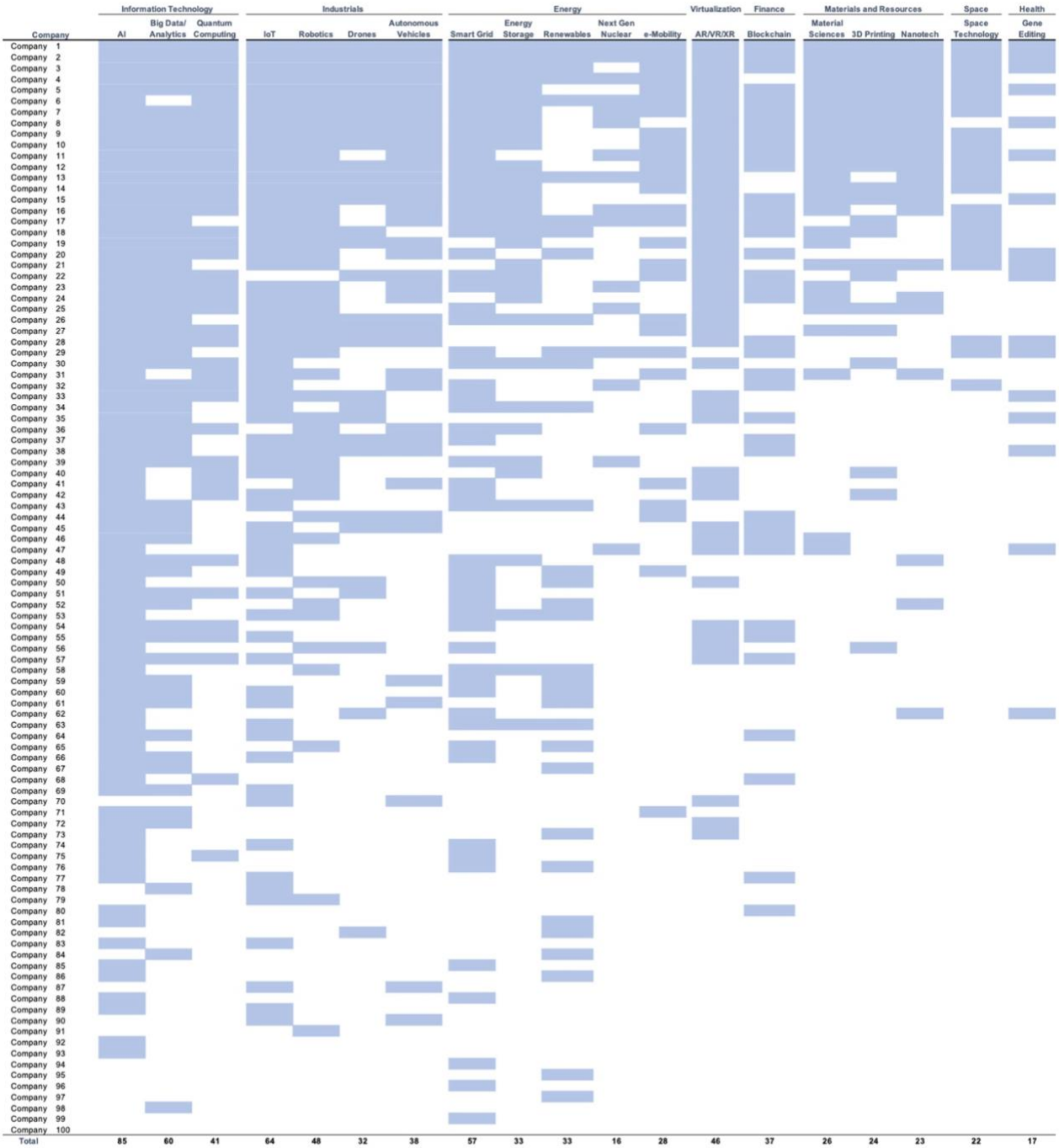
The list of breakthrough initiatives above is based on those using today's digital information technology, which is empowering and increasingly transforming a range of other sectors like finance, healthcare, and education. Over time technology will continue to blur the boundaries not just with these but with other sectors like nanotechnology, biotechnology, and even new energy sources, driving new breakthroughs with the potential to transform the world even further. Further, it is important to note that the examples listed above are illustrative. There are many

more disruptive technologies across the segments of energy, IT, virtualization, materials, industrials, finance, healthcare, and space than those listed, and there are many more companies with significant activities across one or more of these areas.

5. Emerging Leadership in the Fourth Industrial Revolution

The Fourth industrial Revolution is expected to drive the fusion of technologies and the blurring of boundaries between them, ultimately transforming other industries and the world at large. Tech sector leaders are positioning to create that future, embracing many of the disruptive technologies that will shape it. The table below gives a map of the initiatives (solutions, products, R&D, and partnerships) announced by the leading 100 companies examined across the world's major disruptive technologies.

Figure 25: Tech Sector Leaders' Focus on Disruptive Technologies[38]



Source: Technology as a Force for Good

There are a number of findings from the scope and scale of tech leaders' engagement with disruptive technologies across key segments of future tech.

- **Emerging field of competition for technology leadership.** Virtually all tech companies are pursuing some sort of initiatives across the 19 technologies, with varying levels of

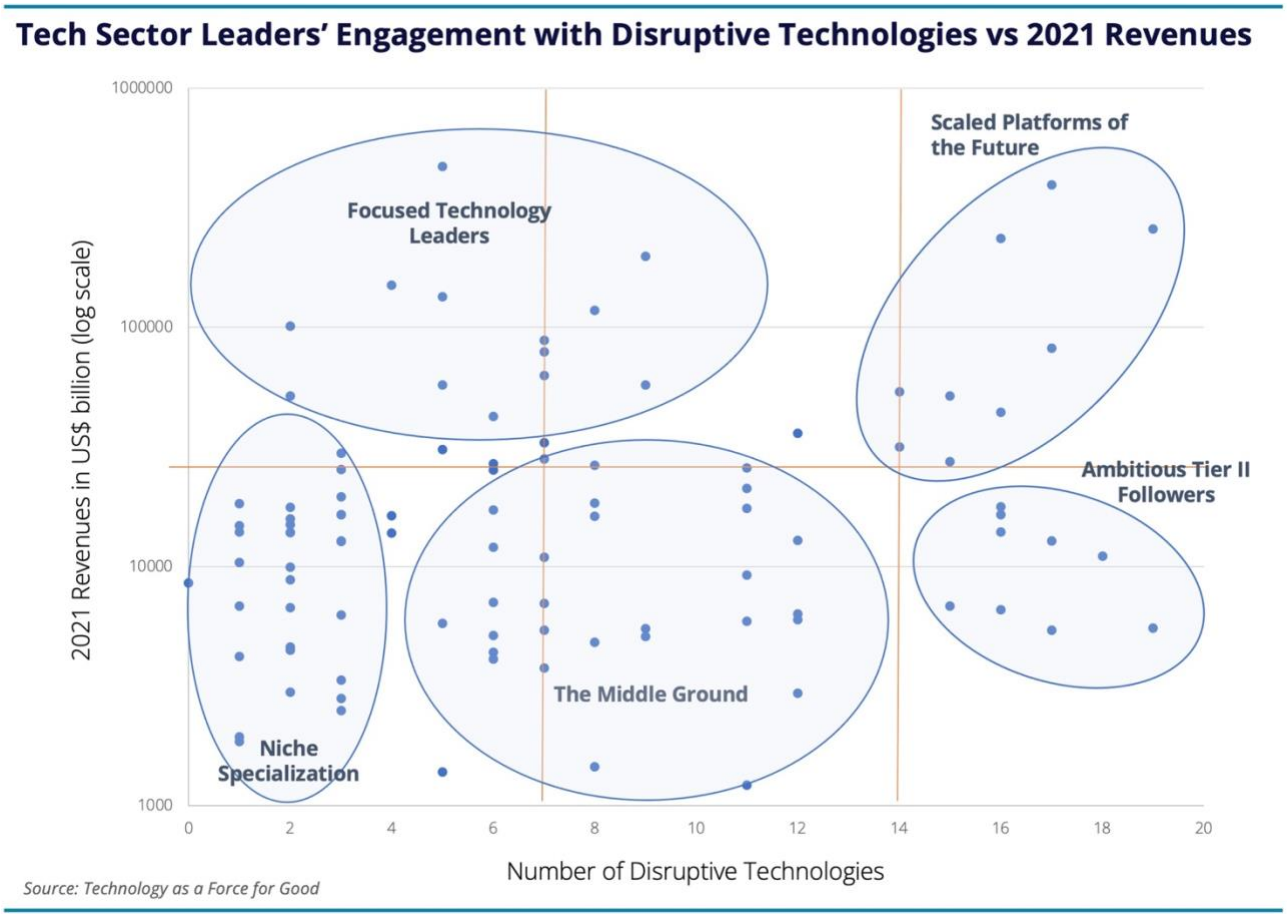
engagement, identified based on publicly available information. However, a significant part of tech companies' R&D development is confidential, and so the true scope of engagement by leaders may be significantly greater than shown above.

- **Hottest competition is in AI and big data analytics.** Enabling technologies that will define the future of IT, and therefore its impact on other sectors as well, are perhaps naturally receiving the most attention, with 85% of tech leaders pursuing AI initiatives and 60% focusing on big data analytics, too.
- **Energy and industrial technologies command intense competition too.** Tech companies are highly active in developing (and deploying) digital technologies that could transform the energy and industrial sectors, with 64% of leaders pursuing initiatives in IoT technologies, and 57% engaging with smart grid technologies, as well as related technologies that could architect the future of energy as the world seeks to replace or make more efficient transition use of carbon.
- **Virtualization and blockchain are both transformative technologies.** 46% and 37% of the industry's leaders are investing, respectively in technologies that will augment or create alternative realities or investing in technologies that may be instrumental in transforming and democratizing finance as well as other fields of commerce and transactions.
- **Space, advanced health, and material sciences remain specialist areas.** Technologies related to material sciences, gene-based medicine or space tech remain relatively niche, with only 17-23% of tech sector leaders active in these areas, despite the transformative impact that digital technology is having in them. This perhaps reflects the highly specialized nature of the underlying technologies.

Competing for the future of tech

Once scale is considered against technological priorities, the relative positions of major tech companies become clearer, as do their potential paths to leadership in the future of tech.

Figure 26: Five Competitive Positions in the Future of Tech



Five positions are evident in the future of tech:

- **Scaled Platforms of the Future.** The top tier of tech companies combines absolute scale (in terms of revenue) with a broad engagement across many technologies and have the potential to become platforms that will define the future beyond tech. Their investments can potentially blur the boundaries between IT and industries such as finance, healthcare, industrials, materials, and energy, among others. These companies, based on the breakthroughs they make, will become increasingly critical to all major sectors of the economy in the future, transcending information technology.
- **Ambitious Tier II Followers.** There is a small second tier of smaller companies that are investing broadly across disruptive technologies. While these companies are clearly ambitious and likely aspire to join the top tier of companies in the future, their more limited resources today imply that they are not funded to make sufficient breakthroughs across multiple areas, as Tier I players can, and so are unlikely to sustain a multi-tech position in the industry. Their exit may be to a leader in the industry.
- **Focused Technology Leaders.** Several of the world's largest tech companies appear to be taking a more concentrated approach to the technologies of the future, focusing their efforts on technologies across a limited number of segments. These companies have the potential to make targeted breakthroughs that could position them as the global leader in

specific areas in the future, setting de-facto standards and capturing large market shares, much like Microsoft did for operating systems in the 1990s and 2000s, or like Google does for search engines today.

- **Niche Specialization.** Nearly one third of tech sector leaders focus on three or fewer disruptive technologies, and the majority of these lack the scale of the broader but still Focused Technology Leaders. These companies are mainly niche specialists, focusing on one or two disruptive technologies beyond core IT, enabled by AI and/or big data, and have the potential to carve out successful niches in the future tech ecosystem, or stand to be bought by scaled players if they have built an attractive proposition.
- **The Middle Ground.** These companies have diversified initiatives across up to a dozen disruptive technologies, implying a focus on several segments beyond core IT. While more concentrated in the efforts than the Ambitious Tier II Followers, they also have fewer propositions with which they can make breakthroughs, and so while some will succeed, many others will end up being followers rather than innovative leaders in the technologies that will shape the future.

In summary

- A leading subset of tech sector leaders is breaking new ground in their engagement as a force for good in the world, differentiating themselves from their peers and raising the bar for the industry.
- Several companies are pursuing operational initiatives on a scale that is not just leading to a significant sustainability impact, but fundamentally transforming their own organizations in the process.
- A different subset of companies is leveraging their core business to address some of the world's biggest sustainability challenges, innovating products and services that deliver both profit and impact.
- Virtually all tech sector leaders are also pursuing longer term initiatives that will accelerate the shift the Imagination Age, investing in disruptive technologies to make breakthroughs across a range of fields that promise to further blur the boundaries of the tech sector with other industries.
- The most ambitious of these companies are investing across a broad range of technologies, looking to establish technology platforms with leadership positions across multiple areas that will define the future.

V. Technology to Build the Future

Technology and technologists have the potential to be the catalysts, if not drivers, of a new era where the SDGs are met and NetZero too. At current rate of progress, however our key global sustainability goals will be missed, indicating that a change in strategy is urgently needed. In the absence of radically cutting back consumption and reducing our standard of living, the world's sustainability challenges can only be met by continued innovation which drives both continued economic growth and the long-term transition to the Digital Age. Technology, and the use of data in particular, have the potential to fundamentally transform our economies and societies to be all but unrecognizable in the second half of this century. The tech industry has critical role to play in the innovation, deployment, and scaling of these technologies and thereby in building a more sustainable future for all.

Technology has an enormous potential to be a force for good in the world. It is a tool with the potential to help solve many of the world's major challenges, driving mass-inclusion and affordable access to services, and accelerating the long-term sustainability transition. The increasing ubiquity of digital technology is driving the explosive growth of information and knowledge, as well as blurring the boundaries with the physical world.

However, for technology to have its maximum impact it - like any tool - must be properly deployed and directed. The analysis of this report suggests that the tech industry and its leaders are

increasingly stepping up in this regard, having built a strong common ground in terms of what it means to be a force for good in the world, across ESG, sustainability and stakeholder engagement, as explained before.

The consequence of not using the SDGs to level up the world is likely its levelling down as ecosystem damage, conflict and economic strife drive mass migrations as countries become destabilized and bring instability to others

More significantly, a sub-set of industry leaders is breaking new ground in developing and deploying technology with the potential to create positive change in the world, enhancing both human security and development. These leaders have launched ambitious initiatives in key areas that have a significant impact potential on the Sustainable Development Goals and beyond. The scale of these initiatives is transforming the companies' own organizations, as they develop new products and services to profitably address some of the world's biggest issues in the short-term and help shape the world's future over the longer-term. As a result, these companies are positioning themselves for future leadership of not just the tech sector, but over time of the broader sectors of the future like energy, biotech and nanotech that are being blurred with digital technology.

Overall, the scale and ambition of these leaders raises the bar for the rest of the industry to rise to and therefore indicates the likely direction of travel for the broader tech sector in the coming years, further establishing technology as a force for good in the world.

But technology can clearly also be a force for destruction. The fundamentally strategic nature of technology makes it a potential source of geopolitical conflict, with competing nations and blocs looking to maximize their own progress and limit their competitors access to and ability to develop advanced technologies, thereby risking broader conflicts. Further, as the world becomes increasingly digital, the destructive power of cyberweapons is growing exponentially, with the ability to disrupt or even destroy markets, economies, governments and even nations, potentially. And the use of technology to these ends is not just limited to state actors but is open to other organized groups and individuals.

Ensuring technology's place as a force for good in the world will therefore require more than the tech sector's increasing engagement, it will require the commitment and alignment of global leaders to agree ground rules for its use and to ensure equitable and affordable access for everybody. If this can be achieved, then the SDGs and global Net Zero can possibly be achieved as well.

Based on current efforts, the world cannot mobilize the updated calculation of US$176 trillion required to fund the SDGs, nor can it implement current solutions – even if they were fully funded – at the scale and within the time frame required.[39] Technology, with targeted innovation properly leveraged and deployed, has the potential to impact every SDG and to make a meaningful impact on a majority of the underlying targets, solving for up to 37% of the SDGs, reducing the cost of achieving the goals by 2030 by up to c.US$55 trillion.

The consequence of not using the SDGs to level up the world is likely to result in a levelling down for the world. Failing to address the world's development challenges and continued inequalities will create increasing strife and suffering in the Global South, while failing to address the world's environmental challenges will see the deterioration of our ecosystems, with extreme weather events becoming endemic features of climate change that will threaten the wellbeing of all. However, there is no consensus globally on how to best achieve the world's major challenges, with two opposing views prevalent.

A longstanding body of thought, first publicized by the Club of Rome's 'Limits to Growth' report in 1972, believes that there are limits to growth on the planet based on physical resource constraints and that without significant changes to production and consumption, the world's population and industrial capacity are as risk. Its proponents argue that a moment of reckoning is near, in which resource depletion, environmental impacts and population growth are reaching a tipping point that creates existential risk. Under this view, sustainability can only be achieved if growth is curtailed, if not reversed back to a level that restabilizes the planet.

While success in meeting the SDGs is not guaranteed, neither is failure inevitable given humanity's increasing ambitions, evident in its endeavors to reach Mars, realize quantum computing, and create scaled fusion energy

However, to date, the rapid expansion of knowledge, and the breakthroughs it has delivered since the Industrial Revolution, has allowed the world to avoid a Malthusian crisis resulting from exponential growth in a world of finite resources, and potentially provides for extraordinary possibilities for the way ahead. Supporters of this view do not deny the need to for action to address global sustainability challenges, but believe that these will be solved through innovation, and that continued growth is not just possible but essential to delivering this innovation.

These world views may well be irreconcilable. While both paths to sustainability may be theoretically feasible, the longer the world waits to come together to solve its challenges, the stronger the calls for the world to stave off a global catastrophe by retreating into preservation and mitigation mode. If this were to be the prevailing scenario, mankind's footprint would need to be dramatically reduced to a sustainable level until the breakthroughs that allow renewed growth are achieved.

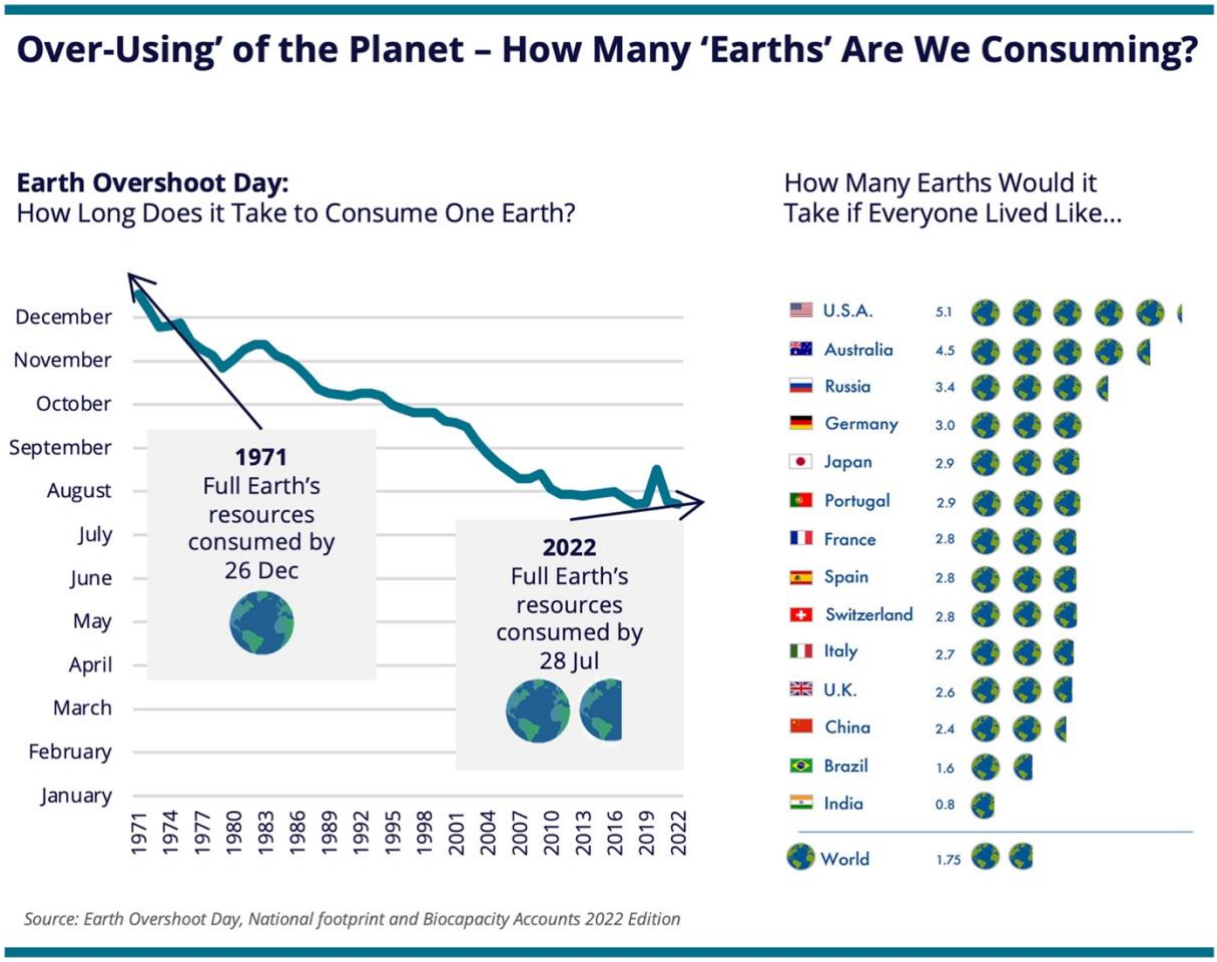
1. A world in retreat: preservation and mitigation mode

A world in preservation and mitigation mode is based on a conscious decision to limit the use of fossil fuels, reducing the footprint of man on the planet by restrictions on the use of resources and therefore activity.

The world that results from such a scenario is closer to the world in COVID lockdown than the one before it or after it for most countries, only it would be far more dramatic if its aim was to

return to the use of "one planet", since it would need to roll the world back to before 1971, when the world consumed c.40% less of nearly everything than it does today.

Figure 27: 'Over-Use' of the Planet – How Many 'Earths' Are We Consuming?



The implications for how the world would need to work are severe:

- **Energy.** Global energy consumption would need to drop by over 60% from over 10,000Mtoe to under 4,000Mtoe, assuming the world cannot quickly transition to a fully renewable mix of sources and less energy intensive economy.
- **Industry.** The reduction in global output would concentrate in global industrials, which are disproportionately resources intensive. Global industrial output which contributes c.28% of global GDP would need to be reduced by c.75% (assuming that industrial resource intensity is twice that of services on average), reducing GHG emissions by c.15% as a result. Cutting services by 40%, would reduce GHG by a further c.10%.
- **Materials.** There would likely be a continuing dependence on process innovation to allow mining of key natural resources in a manner which allowed for greater yield, inevitably with greater risk and cost.
- **People.** Individuals in advanced economies would need to drop their consumption levels by c.60-80%, assuming current levels of resource intensity.

- **Travel.** There would need to be a near total ban of almost all air travel and cars, including electric cars which remain reliant on a grid still largely powered by fossil fuels, reducing global GHG by c.15%. Travel and leisure would need to transition to virtual models as a result.
- **Finance.** The contraction of global consumption and production would need to be managed to avoid a global debt crisis and negative real returns, which would likely be possible once global wealth reduces proportionately to the drop in global output, wiping out c.US$350 trillion of global assets.
- **Planet.** We are currently calculated to consume 1.75 planets worth of resources, a shorthand for our current level of consumption and development. The adjustment would aim for a retrenchment below one planet.

Such a retreat would require the developed world, which is the biggest consumer of the planet and its resources (to live at America's level, we would need 5.1 earths) to take the most pain.

However, the austerity required to "reset" the world to a more sustainable trajectory is not one that the developed world is currently prepared for; not as consumers, family households, voters, nor as employees, employers, entrepreneurs, CEOs, or governments (democratic or autocratic) or any of the other roles that individuals in the world play.

Given a 'strategy of preservation' implies an extreme level of austerity across all aspects of human life across the world, the SDGs will likely move far further from achievability for both the rich and the poor

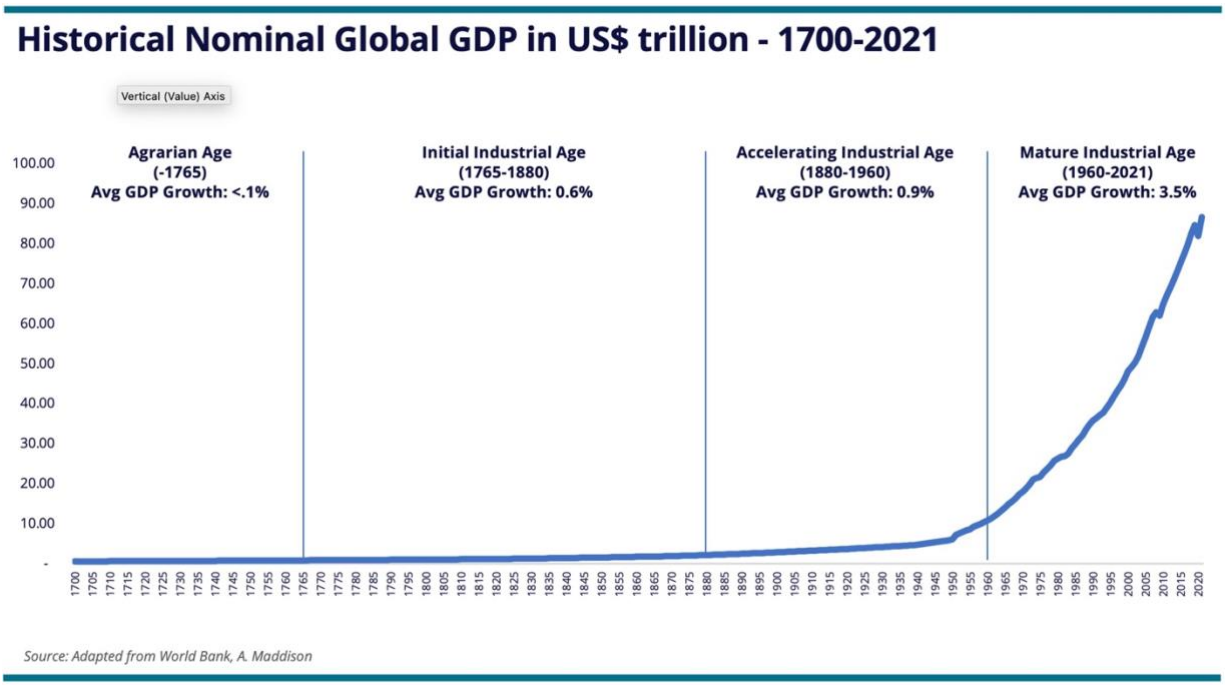
However, given the world's current level of progress on addressing global challenges, some level of retreat will be all but inevitable, and will likely only be achieved at a significant cost in environmental damage, economic destruction, and human suffering. And the longer the world waits, the greater this cost will be.

2. A world in growth: moving rapidly to a future model

The alternative for the world is to focus on growth and innovation to avoid the scenario laid out above. This requires rapid investment in a series of technological breakthroughs that can fundamentally alter current trajectories of ecosystem impacts and create a step change in human progress. Throughout history, these breakthroughs have been focused on energy technologies, such as the (coal driven) steam engine during the Industrial Revolution, electrification in the 19th Century and the transition to petroleum in the 20th Century.

As a result, global GDP growth has accelerated throughout the Industrial Age, increasing more than threefold between 1765-1880, nearly sixfold between 1880-1960 and nearly eightfold between 1960 and the present day.

Figure 28: Historical Nominal Global GDP 1700-2021



Similarly, unlocking further GDP growth in the coming Imagination Age will also require a new energy source, one that is functionally superior to current sources, allowing the world to address its pressing challenges without forcing it to accept unacceptable trade-offs.

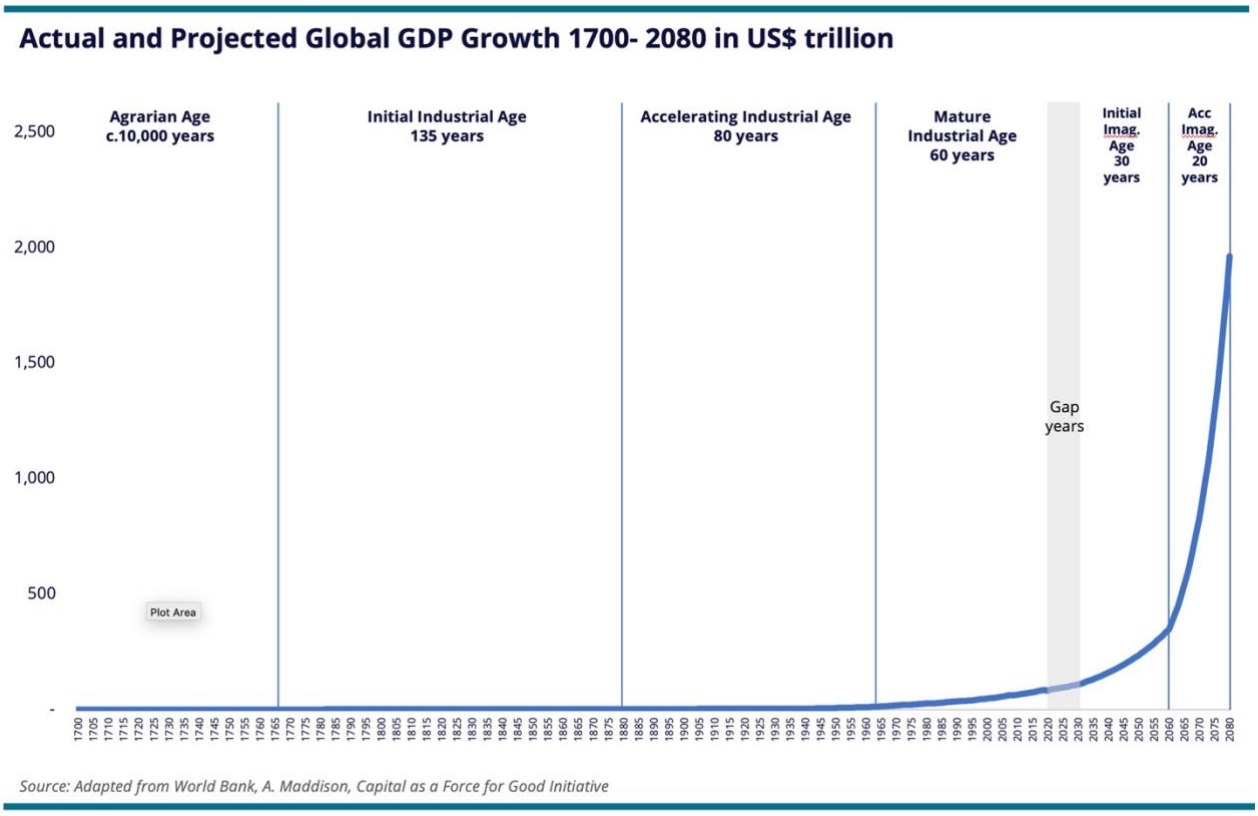
Until the world achieves the necessary energy breakthrough, it will continue to remain in a period of transition, where growth is delivered largely by marginal improvements in productivity, and where countries around the world are incentivized to compete more and share less, ignoring the plight of the developing world and failing to address pressing global challenges as a result. Ironically, due to its unsustainable nature, the longer the world tarries in this period, the greater the risk of needing to resort to the very e preservation and mitigation mode it is so desperately seeking to avoid.

A new clean, abundant, and more 'functional' energy source breakthrough is the driver of the next era ... Applying Moore's Law to the growth of the Industrial age on the Digital Age, the world would rapidly progress through changes leading to a staggering growth in global output during the 21st Century

Once this breakthrough has been made however, the world is likely to progress much quicker than it did during the Industrial Age, thanks to the accelerating rate of technological innovation.

Applying the principles of Moore's Law as a proxy for the increasing rate of technological innovation to these phases compresses them significantly, so that the world progresses through the first two phases of the Digital Age in 30 and 20 years, respectively, leading to a staggering growth in global output during the 21st Century, with a step change in growth during the middle of the century.

Figure 29: Global GDP Growth 1700-2080



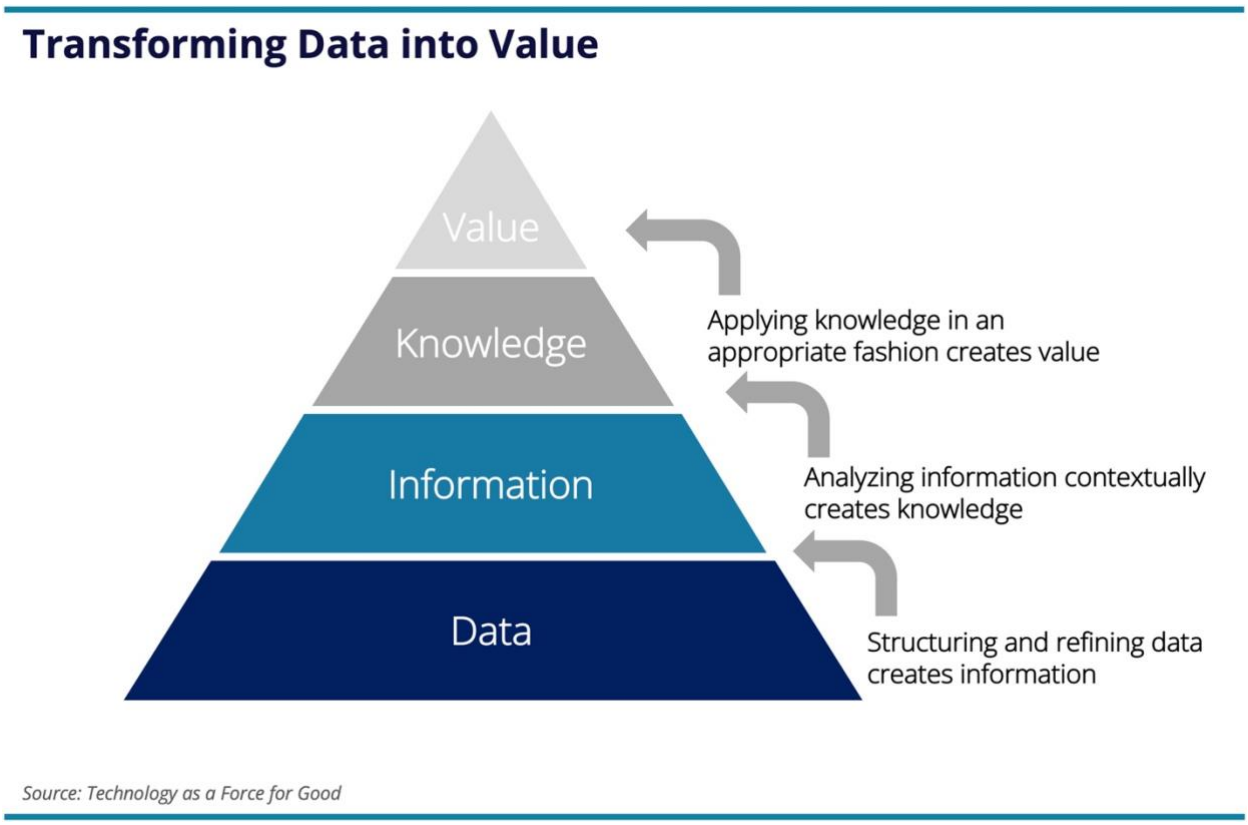
Conceptualizing the world up to this mid-century step change remains straightforward. Growth would be driven by familiar factors, like population growth, the benefits of sustainable development (i.e., meeting the SDGs), and incremental productivity gains from automation and digitization. The US$350 trillion of GDP by 2060 implies an *average* GDP per capita globally equal to that of countries like Italy or South Korea today.

From c.2060 onward however GDP under this model would continue to increase exponentially, reaching US$2 quadrillion by 2080, despite the global population being largely stagnant. At this level, the average GDP per capita would reach US$200,000. Achieving this level of output based on physical assets and the processing of resources to create manufactured goods is difficult to conceive, given the likely physical limits of "goods' that individuals can produce or consume. Just under half the world's GDP today (US$44 trillion) is dependent on nature and its associated ecosystem services, pointing to a ceiling to economic value generation from the natural world.[40] Instead, economic growth in this second phase would be driven by data and its applications. It is no coincidence that data has been labelled the 'new oil' of the digital economy. Like oil, it is worth more when it is processed: while oil transformed into energy, data is processed, analyzed, and

It is no coincidence that data has been labelled the 'new oil' of the digital economy ... However, oil is finite resource whose creation takes hundreds of millions of years, making, data is an infinite resource, growing at an exponential rate

utilized to create information and knowledge. However, while the creation of oil is a process that takes hundreds of millions of years, making it a finite resource, data generation is growing at an exponential rate, essentially making it an infinite resource, with the amount of data in the world roughly doubling every two years.

Figure 30: Data as a Driver of Value



Further, unlike oil, data is not consumed when processed, and can be reused to generate new value, making it the ultimate sustainable resource upon which the world's next civilization can be built.

Data is also the basis of all analytics, machine and deep learning and artificial intelligence, which will not only transform virtually every industry sector in terms of automation and productivity, but also drive a step change in the consumption and production of digital services which fundamentally change the physical constraints of other industries. It is also the path to wisdom and potentially a far more balanced world.

It is therefore difficult to imagine the resulting world in 2080 with nearly US$2 quadrillion in GDP. To envision what such a future might look like, it is worth considering the likely building blocks of that future civilization, and how technology and innovation will impact them

- **Energy.** New energy sources that replace carbon, with fusion and its derivatives being the most likely near-term prospect for commercialization, while other fundamental alternatives are explored.

- **Technology.** The blurring of the boundaries between the physical, digital, and biological spheres creates new possibilities to address the world's major physical issues and new opportunities for everything affecting life.
- **Virtualization.** The metaverse creating a shift in the human paradigm itself through the widespread adoption of virtual, augmented, and mixed reality platforms, with global economic and social activity increasingly migrating to digital spaces.
- **Materials.** Breakthroughs in material sciences replace the need for the extraction of finite natural resources with sustainable and cost-effective synthetic alternatives.
- **Industry.** Increasing automation, material breakthroughs and abundant near-free energy allow for nearly limitless scaling that drives down the marginal costs of production towards zero
- **Finance.** The adoption of a pervasive distributed form of capitalism that drives mass inclusion, while renewing and reinventing global trade without the need for centralized control or financial intermediaries.
- **People.** People empowered by technology with access to opportunities regardless of time, space, geography, demography, gender, race, or income levels.
- **Space.** The leveraging of space for access to new resources, exploration, and new territories to live in, will drive massive innovations of their own along the way.

A civilization based on the above would be all but unrecognizable to us, just like pre-industrial agriculturalists could not envisage the modern world of today. Making this civilization a reality will require bold investments that deliver breakthroughs across not just information technology but also energy, material sciences, engineering, and life sciences, that will fundamentally transform global industries.

If these breakthroughs could be achieved today or in the near future, rather than decades from now, they could also address the SDGs, subject to the necessary institutions ensuring a just transition being in place.

3. A just transition requires navigating a middle path

Today however, the world lacks a common plan with which to manage this transition, just or otherwise. A successful transition, one that is sustainable and inclusive, requires global collaboration, careful thought, and measured judgements to maximize the overall benefit and to minimize transition costs.

The blueprint for a just transition would need to address all three of the competing priorities for the world: maintaining what progress has been achieved to date, levelling up the rest of the world, and creating the future. Such as shift would therefore require:

I. **Preserving and Mitigating Damage to the Planet.** A successful transition depends on the world arresting further serious damage to the global ecosystem, preserving finite resources, protecting biodiversity, reducing pollution and waste, and reversing environmental degradation. This is in itself a tall order.

   Technology in its broadest sense has a role to play in this but it is a matter for policy makers to make policy that matters.

II. **Achieving the SDGs as a Basis for Further Growth.** Meeting the SDGs is a prerequisite for managing an efficient and just transition to the future, levelling up less developed countries, particularly driving mass inclusion provides a more level playing field for the world to transition in a coordinated and equitable fashion.

   Technology can make the SDGs achievable, something which finance alone cannot, and so technologists as innovators, entrepreneurs, corporations, and global industry groups have one of the most fundamental roles of play in the history of the SDGs.

III. **Launching High Impact Initiatives that Drive Step-Changes in Meeting the Goals.** The transition to such a future would need three requirements to play out: scaled and bold solutions, far higher-level risk taking, and large-scale mobilization of capital to investment in these solutions.

   Digital initiatives can be rolled out at speeds, costs, and scales unimaginable for purely physical alternatives.

IV. **Building the Future.** At the same time, the world will need to fund and achieve next generation energy, communications, information, and materials technologies that can provide a step-change in global progress, investing heavily into fundamental research and its translation into applied technologies.

   The world's next civilization will be built on new technologies realized from the blurring of boundaries between information technology and engineering, manufacturing, and medicine.

V. **Managing the Dislocations of the Transition.** All transitions, on some level, imply shifts in resources and opportunities, creating dislocations that risk leaving some stakeholders behind. The world will need to proactively manage the economic, political, and social dislocations that will accompany the transition, including significant investments in climate change adaptation, given that the world will likely face potentially severe local disruptions, even if the Paris goals are met by 2050.

   A multi-faceted plan will be required where technology deployment will need to go alongside societal, economic, and political change on a grand scale.

VI. **Efficient Maintenance and Preservation.** During the transition, the world still needs to "keep the lights on", maintaining its current infrastructure and operating existing systems, paying pensions, delivering healthcare, operating, and regulating markets, and feeding, clothing, and providing for its nearly eight billion people in an efficient manner.

Technological change is a complex matter and fraught with execution risks that will need to be managed so that the technology that already underpins the modern world and its economic, political, and social systems continues to deliver while the new is being rolled out.

VII. **Ensuring Peace and Building Resilience.** A smooth transition to the future can only be accomplished in a peaceful manner, with the global community working together to build global resilience to withstand the inevitable event risks, crises, and setbacks that emerge, as well as to benefit from any breakthroughs that materialize

Technology, and its leaders, have an important role to play in working with media and government and civil society leaders in enabling universal communication and information sharing, making it critical for global collaboration.

This is a daunting set of goals, the achievement of which will require the efforts of all global stakeholders. The tech industry has a critical role to play in managing the transition to a sustainable future. 'Creating the future' is what the tech sector does by default, with tech companies representing seven out of the top ten corporate R&D spenders globally, investing billions in emerging technologies like AI, autonomous vehicles, VR/AR, human health breakthroughs, drones, smart cities, and robotics. But the tech sector has equally important roles to play in levelling up the world and in preserving the progress made to date. The modern world is underpinned by its products and services, without which it would be impossible to maintain our financial, economic, social, and even political systems. Indeed, it is the immense profits generated by these products and services that are funding the sector's investments in future.

Similarly, tech will be critical to meeting the SDGs, creating a tremendous opportunity for the sector. The companies that connect the three billion people currently not online, or financially include the five billion people without full banking services, are creating new customers whose value will only continue to grow when the goals are achieved. Securing these customers today positions tech companies to be the winners of the Imagination Age, further blurring the boundaries with traditional sectors like retail, finance, media and entertainment, healthcare, and manufacturing, displacing their respective incumbents in the process.

A more secure, sustainable, and superior future requires rolling out digital technologies to drive inclusivity across the world and unleashing innovations at scale to allow all people to access affordable solutions, creating enormous wealth, such that there is a high degree of parity in accessing opportunity, achieving the UN SDGs. This is the foundation on which major breakthroughs will build a far superior world to the one we inherited from the industrial age. A world in which 'human security for all' is no longer an aspiration but a lived experience.

APPENDIX

1. Full List of Companies Featured in this Report

1 Activision Blizzard
2 Adobe
3 Adyen
4 Airbnb
5 Alibaba
6 Alphabet (Google)
7 Amazon
8 AMD
9 Analog Devices
10 Apple
11 Applied Materials
12 Arista Networks
13 ASML
14 Atlassian
15 Autodesk
16 Automatic Data Processing
17 Baidu
18 Block
19 Booking Holdings (Booking.com)
20 Broadcom
21 Cadence Design Systems
22 Checkout.com
23 Cisco
24 Constellation Software
25 CoStar Group
26 Coupang
27 CrowdStrike
28 Dassault Systemes
29 Dell
30 eBay
31 Electronic Arts
32 Enphase Energy
33 Equinix
34 Fidelity National (FIS)
35 Fiserv
36 Fortinet
37 Foxconn (Hon Hai Precision Industry)
38 Global Payments
39 GlobalFoundries
40 HP
41 IBM
42 Infineon
43 Intel
44 Intuit
45 IQVIA
46 JD Health
47 Jingdong Mall
48 Keyence
49 Keysight
50 KLA
51 Kuaishou Technology
52 Lam Research
53 Marvell Technology Group
54 MediaTek
55 Meituan
56 MercadoLibre
57 Meta Platforms (Facebook)
58 Microchip Technology
59 Micron Technology
60 Microsoft
61 Murata Manufacturing
62 NetEase
63 Netflix
64 Nintendo
65 Nokia
66 NVIDIA
67 NXP Semiconductors
68 ON Semiconductor
69 Oracle
70 Palo Alto Networks
71 PayPal
72 Pinduoduo
73 QUALCOMM
74 Roper Technologies
75 Salesforce
76 Samsung
77 SAP
78 Schneider Electric
79 Sea (Garena)
80 ServiceNow
81 Shopify
82 SK Hynix
83 Snowflake
84 Sony
85 STMicroelectronics
86 Stripe
87 Synopsys
88 TE Connectivity
89 Tencent
90 Tesla
91 Texas Instruments
92 Tokyo Electron
93 TSMC
94 Uber
95 Veeva Systems
96 Vmware
97 Wolters Kluwer
98 Workday
99 Xiaomi
100 Zoom

2. Report Leadership and Execution

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This report was prepared by Ketan Patel, and Christian Hansmeyer, with review, feedback, and insights from the Advisory Council.

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Christian Hansmeyer, Report lead, **Aditya Ajit,** Analytics and research, **Ushma Shah,** Analytics and research, **Lesley Whittle,** Project administration

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RESEARCH PROCESS AND METHODOLOGY

Data Collection Methodology

The dataset used in this report consists of publicly available quantitative and qualitative sources of information, covering a granular analysis of tech industry leaders' ESG, sustainability and stakeholder initiatives and policies.

Core Data Sources. All publicly available information on initiatives relating to ESG, sustainability, climate change, stakeholder engagement (including employee and corporate social responsibility programs) for the companies considered in this report was collected and reviewed. Information sources include annual reports to shareholders, ESG and sustainability reports, ESG policies and frameworks, company websites, and public statements by company leaders.

Data Collection Methodology. Information on the initiatives was extracted from the above sources, into a template designed to capture all publicly available information on these initiatives irrespective of how each institution captured it. The key categories in the information template are provided below.

Data Analysis. The information from the templates was then aggregated into a common database to complete the analysis which is shown in this report.

Key Categories of Data Captured

The information template for each of the institutions listed in Appendix 1 captures information on initiatives across two sections. All the information outlined was collected for all 1oo institutions in the dataset. The key information in each of these sections is shown below:

Basic Information Checklist: Data Supporting the Breadth of "Force for Good" Policies, Practices, and Initiatives

Women's empowerment including information on policies, % of employees and leadership

ESG policy, framework, and public reporting

Formal adoption of multi-stakeholder focus

Employee policies and programs including diversity and inclusion, wellness, mental health, and mindfulness

ESG oversight and governance

ESG integration with core business processes

Governance policies and training

ESG associations

Climate change, sustainability, and inclusion related associations

Greenhouse gas protocol accounting and reporting standards and carbon footprint data

Resource consumption, waste production, and energy consumption

Sustainability Related Financing: R&D spend, sustainable investments and CSR Spend

Corporate social responsibility (CSR) spending and key initiatives

Technology's Impact on the SDGs: Calculations and Assumptions

This report includes an estimate of the potential impact digital technology can have on the achievement of the SDGs, including the progress it can make against the goals, the associated cost of implementation, and an indication of the value this creates in terms of cost savings against solutions for the goals that are not technology led. The methodology and assumptions for these calculations are provided below.

Impact Level	**Level One:** **Connecting the World**	**Level Two:** **Levelling up, Driving the SDGs** **(Cumulative)**
Cost to Implement Technology to 2030 in US$	US$2.0 trillion	US$8.6 trillion
SDG Progress (% Achievement)	Up to 20%	Up to 37%
Potential SDG Cost Savings (Net) in US$	Up to c.US$25-33 trillion	Up to c.US$41-56 trillion

Cost to Implement Technology (Level 1): Force for Good considered both the fixed cost of achieving global connectivity coverage for the world and the likely annual spending required to deliver the benefits of this connectivity for the world's 2.5 billion unconnected people. (Source: Internet World Stats). Sources include

- **Cost of global wireline connectivity:** Based on estimates by the ITU Broadband Commission and UNICEF GIGA estimates.
- **Cost of global wireless connectivity:** Based on the estimated total investment cost for global StarLink satellite coverage
- **Global annual IT spending breakdown:** Global IT spending breakdown for data centers, devices, IT services and communications from Gartner (2022)
- **Incremental annual IT spending:** Incremental annual IT spending costs for the newly connected adjusted downward from global average based on using India's cost structure (across data centers, devices, IT services and communications) as a benchmark.

Cost to Implement Technology (Level 2): Force for Good pro-rated current global IT spending across the world's connected population to determine a per capita IT spending number of

US$705 p.a., setting this at the target for spending across the world's entire population by 2030. The implementation costs were calculated as the sum of:

- The cost of bringing up the spending for the world's 2.5 billion unconnected people to the global average, assuming per capita IT spending of US$132 in 2023 (India's current level) and rising to the global average of US$705 by 2030, and
- The cost of increasing per capita spending on currently connected people in regions of below average IT spend (including Asia, Latin America, and Africa), assuming a gradual increase from current levels of spending to the global average of US$705 by 203.

SDG Progress (Level 1): 20% progress against the SDG from universal connectivity sourced from "ICT and the Sustainable Development Goals" report published by Ericsson and Earth Institute at Columbia University.

SDG Progress (Level 2): SDG progress determined by considering the potential impact of digital technologies (including emerging technologies) against the specific targets associated with each SDG, determining a range of estimates for the percentage of each target that IT might achieve. For the purposes of this exercise, the analysis excluded the 38 (out of 169) targets whose achievement are largely a matter of legislation, regulation, or policy, focusing on the 131 remaining targets. The contribution of tech across these targets averaged 18% at the low end of the estimate range and 37% at the high end.

Potential SDG Cost Savings: The potential cost savings for both Levels 1 and 2 were calculated by applying the SDG Progress estimates against the US$176 trillion total cost of achieving the SDGs as calculated in the 2022 Capital as a Force for Good report, less the cost of implementation. For the low end of the range. The 'up to' numbers in the table above are based on the high end of the SDG progress estimate range.

Note: Given the methodologies used, the Level 2 cost of technology implementation and SDG progress includes the costs and progress associated with implementing Level 1, making the costs and impact of Level 2 in the table above cumulative rather than incremental.

DISCLAIMER, REFERENCES AND NOTES

Disclaimer

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References

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The boundaries and names shown, and designations used on the maps presented in this publication do not imply official endorsement or acceptance by the United Nations.

The following symbols have been used in the tables:

• A slash (/) between dates representing years, e.g., 2010/11, indicates a financial year.

• Use of a dash (–) between dates representing years, e.g., 2010–2011, signifies the full

period involved, including the beginning and end years.

• Reference to “dollars” ($) means United States dollars, unless otherwise indicated.

Annual rates of growth or change, unless otherwise stated, refer to annual compound rates. Details and percentages in tables do not necessarily add to totals because of rounding.

End Notes, Sources

[i] Opening Remarks, World Telecommunication and Information Society Day, 14 May 2021
[2] Source: Deloitte
[3] Source: World Inequality Report 2022
[4] Source: UN International Organization for Migration
[5] Source; WHO Model, May 2022
[6] Source: World Bank
[7] Source: RMS, Reuters
[8] Source; WEF 2021-22 Global Risk Report
[9] Source: Organisation for Economic Cooperation and Development
[10] Source: Updated from the 2022 Capital as a Force for Good Report
[11] 2021 Legatum Prosperity Index: Safety and Security Pillar
[12] Source: Global Trade Alert
[13] Source: World Investment Report 2022
[17] Source: 2022 Capital as a Force for Good Report
[18] An initiative of the UN Trust Fund for Human Security and the World Academy of Art and Science in support of the United Nations' commitment to Human Security
[19] Source: Gartner
[20] Source: ITU, Kepios
[21] Source: World Bank Findex Database
[22] Source: Shopify
[23] Source; Force for Good Research
[24] Source: WEF "Future of Jobs"
[25] Source: Digital with Purpose: Delivering a SMARTer2030, Deloitte
[26] Source: IBID, Earth Institute/Ericsson
[27] Source: Pew Research Center May 2022
[28] Source: https://www.hoover.org/sites/default/files/research/docs/22101_teg_working_paper_brady_rivers_final.pdf
[29] Source: Economist Intelligence Unit
[30] Source: Edelman Barometer 2020
[31] As of September 30, 2022
[32] Source; Forbes 2022
[33] Source: McKinsey, 2022
[34] Source: Climate Bonds Initiative
[35] Source: Bureau of Labour Statistics
[36] Source: European Institute for Gender Equality (EIGE) gender statistics database, Fortune, FTSE
[37] Mapping of initiatives to the SDGs is based on F4G Foundation analysis; SDGs from other categories which are indirectly impacted by the initiative (given the complex interlinkages between the SDGs) are shown in faded SDG icons
[38] Sources: Based on corporate announcements and reporting 2019-2022
[39] Source: 2022 Capital as a Force for Good report
[40] Source: WEF