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Technology as a Force for Good

Catalyzing New Markets Globally

The Force for Good Initiative

Technology for a Secure, Sustainable and Superior Future

In support of the UN Secretary General's strategy and roadmap for sustainable development

Catalyzing New Markets Globally

Technology as a Force for Good, 2025 Report

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CONTEXT

Transition, Technology and Future Generations

Twenty-first century challenges require twenty-first century solutions: frameworks that are networked and inclusive; and that draw on the expertise of all of humanity.

… our world is heading off the rails — and we need tough decisions to get back on track. Conflicts are raging and multiplying, from the Middle East to Ukraine and Sudan, with no end in sight. Our collective security system is threatened by geopolitical divides, nuclear posturing and the development of new weapons and theatres of war.

Resources that could bring opportunities and hope are invested in death and destruction. Huge inequalities are a brake on sustainable development. Many developing countries are drowning in debt and unable to support their people. And we have no effective global response to emerging, complex and even existential threats.

The climate crisis is destroying lives, devastating communities and ravaging economies. We all know the solution — a just phase-out of fossil fuels — and yet, emissions are still rising. New technologies, including AI (artificial intelligence), are being developed in a moral and legal vacuum, without governance or guardrails.

In short, our multilateral tools and institutions are unable to respond effectively to today's political, economic, environmental and technological challenges. And tomorrow's will be even more difficult and even more dangerous.

When the United Nations was established nearly 80 years ago, it had 51 Member States. Today there are 193. The global economy was less than one twelfth of its current size. As a result, our peace and security tools and institutions, and our global financial architecture, reflect a bygone era …

Meanwhile, technology, geopolitics and globalization have transformed power relations. Our world is going through a time of turbulence and a period of transition.

But we cannot wait for perfect conditions. We must take the first decisive steps towards updating and reforming international cooperation and make it more networked, fair and inclusive – now.

The Pact for the Future, the Global Digital Compact and the Declaration on Future Generations open pathways to new possibilities and opportunities. On peace and security, they promise a breakthrough on reforms to make the Security Council more reflective of today's world, addressing the historic under-representation of Africa, Asia-Pacific and Latin America …

The Pact for the Future is about turbocharging the Sustainable Development Goals and the Paris Agreement, accelerating a just transition away from fossil fuels and securing a peaceful and liveable future for everyone on our planet. It includes a groundbreaking commitment by governments to listen to young people and include them in decision-making, at the national and global levels. And it commits to stronger partnerships with civil society, the private sector, local and regional authorities and more.

The Global Digital Compact is based on the principle that technology should benefit everyone. It includes the first truly universal agreement on the international governance of artificial intelligence. It commits Governments to establishing an independent international Scientific Panel on AI and initiating a global dialogue on its governance within the United Nations. The Global Digital Compact represents the first collective effort to reach agreed interoperability standards – essential for consistent measurement. And it supports networks and partnerships to build capacity on AI in developing countries.

The Declaration on Future Generations echoes the call of the United Nations Charter to save succeeding generations from the scourge of war, committing Governments for the first time to taking the interests of our descendants into account in decisions we take today.

We have unlocked the door. Now it is our common responsibility to walk through it. That demands not just agreement, but action. I challenge you to take that action.

To implement the Pact for the Future by prioritizing dialogue and negotiation, ending the wars tearing our world apart, and reforming the composition and working methods of the Security Council. To accelerate reforms of the international financial system — including at next year's Conference on Financing for Development. To put humanity's best interests, front and centre of new technologies. We stand and fall not by adopting agreements, but by our actions and their impact on the lives of the people we serve …

I have learned that people never agree on the past. To rebuild trust, we must start with the present and look to the future. People everywhere are hoping for a future of peace, dignity and prosperity. They are crying out for global action to solve the climate crisis, tackle inequality, and address new and emerging risks that threaten everyone … Now, let's get to work.

Antonio Guterres
UN Secretary General[i]

FOREWORD

I am Vinodh.

I live in Hyderabad, India.

I grew up in a family of four. My father worked as a daily laborer and had to work hard to make ends meet for us. Life took a challenging turn when I was in grade eight as I fractured my leg and was confined to bed for months. My father had to deal with medical expenses we could not afford, and also arranging for his sister's marriage. We had to sell our house and were suddenly struggling just to survive. As the eldest son, it would soon become my responsibility to try and support us as soon as I could.

I studied and was accepted into engineering college. While completing my engineering degree, I took a job in a steel factory earning Rs. 250 (approximately US$3) a day. The work was dangerous, and it was difficult to juggle the job and college, but there was no choice. After I finished college, I managed to find work as a freelancer, organizing PDF files for clients, where I had to work long nights, and earned Rs. 8,000 every month, while it was barely enough to keep us afloat, it was the best I could do at the time.

I wanted a better job that gave me stability and growth, so I decided to learn programming and take a shot at getting into the tech industry. While researching online, I came across an ed-tech platform which offered a cost-effective programming course, and I borrowed money to enroll in it. That turned out to be a transformational decision.

> Technology has been a force for good in my life. However, I believe more can and should be done to make such opportunities accessible to others

Through their AI-powered learning platform, I learned programming through sessions tailored to my pace and needs, which allowed me to learn complex technical concepts and apply them in real-world scenarios, boosting my confidence. The flexibility of an online platform allowed me to continue freelancing and earning money while building my tech skills. The platform even allowed me to learn in my native language, which gave me the confidence to engage deeply with the material, which was great since I had been worried about my English proficiency. Gradually, I built a solid foundation in programming and the skills needed to excel in the tech industry. After a few months, I managed to secure a job as an associate engineer at a fast-growing technology and data company. This was an important moment of immense pride, and relief, for my family.

Today, I am closer to fulfilling my dream of rebuilding our home and providing my family with the stability they deserve. The struggles I faced taught me that adversity can reveal

strengths you never knew you had. For every individual facing challenges, I want to say this: believe in yourself and take the first step toward change.

Technology has been a force for good in my life because it gave me the tools and the path I needed to achieve my dream, overcoming seemingly insurmountable obstacles. However, I believe more can and should be done to make such opportunities accessible to others. I would want to see governments, tech companies, and educational institutions must collaborate to create inclusive learning environments, provide affordable training, and support individuals with financial constraints. By doing so, they can help countless people transform their lives and contribute to society.

My story is a testament to the power of technology, and I hope that many other young and underprivileged people across the world have the opportunity for similarly fulfilling their dreams.

Vinodh, India

MESSAGE FROM THE ADVISORY COUNCIL

Technology is a mechanism that unlocks great power and great wealth, and as such, it has been prized and monopolized throughout history by individuals and governments. Today, as we transition from the Industrial era into a new age, we stand at a crossroads: one path leads to fear, greed, disruption, and violence, while the other offers the promise of opportunity, innovation, equity, and abundance, reflecting the dual nature of great change.

The Sustainable Development Goals are a measure of our civilization's ability to be united, be compassionate, and execute on our commitments. They represent perhaps the highest shared aspiration, in agreeing a collective effort to ensure that no one is left behind in the journey toward a more equitable, prosperous, and sustainable world. Yet nearly a decade after their adoption, the gap between ambition and action has become starkly evident. This report presents a roadmap built on actionable insights and transformative ideas to bridge that gap, offering a vision for how some of the key stakeholders on our collective future can collaborate to deliver on these goals.

Central to this vision are a set of nine "Big Ideas", innovative yet practical approaches to addressing the world's most pressing challenges, underpinned by the need to secure peace and dignity for all. The big ideas are grounded in the intelligent application of existing solutions rather than the promise of technological breakthroughs. They span critical domains, including climate and energy transitions, financial inclusion, basic service delivery, and the scaling of digital infrastructure. They draw on solutions that exist in the public, private and not-for-profit sectors, across rich and poorer countries, demonstrating that our diversity can deliver solutions for all of us.

Digital technology is a if not the critical enabler for all these solutions, becoming increasingly integral and embedded across all aspects of the global economy and societies around the world.

Scalable digital technologies can deliver education, healthcare, and economic opportunities more efficiently and inclusively, addressing structural barriers to progress and offering marginalized communities a chance to participate fully in the digital age. Equally critical is the deployment of technologies that address fundamental human needs, such as food, water, and medicine. These technologies, when deployed effectively, can unlock human potential at an unprecedented scale.

With the world far off track on progress against the SDGs despite global efforts, the need for such scaled solutions is greater than ever before. However, the scale of investment

required to achieve the SDGs, estimated at $14-17 trillion annually, far exceeds what will be released from current global financial flows.

This report describes how development needs can be turned into opportunities attracting capital and solutions in the places where they are most needed. It estimates that there is a US$15 trillion annual market opportunity to be created Policies that remove barriers to investment and enable enterprise are the initial catalyst for creating these markets, attracting solution owners and their funders to regions that were previously deemed inaccessible for scaled private sector engagement. The alignment of private sector goals with public priorities can unlock a virtuous cycle of growth, driving inclusion and sustainability. One deployed, scaled solutions arising from the Big Ideas can serve as flywheels for economic activity, catalyzing the growth needed to close the SDG funding gap.

Technology, is the key enabler, holding the potential to redefine the trajectory of global progress. The 19 core technologies explored in this report split into ones that can help level up the world today with artificial intelligence and renewables, and others that create a superior future tomorrow, including fusion power, quantum technologies and nanotech, among others. These technologies are also the subject of fierce competition between countries and companies, since they are key determinants of great power. The transition to a more sustainable and inclusive world will not be without its challenges. The geopolitical dynamics of technological leadership, the displacement caused by automation, and the inequalities between nations and within societies are significant hurdles.

This report provides a key to the journey ahead, including the transition to a dramatically different future. By embracing the Big Ideas, scaling impactful solutions, and changing the environments of countries that need these solutions, new markets can be created and an unparalleled opportunity realized to a sustainable, secure, and superior future.

Ketan Patel
Chair of the Advisory Council, Force for Good
On behalf of the Advisory Council

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ABOUT FORCE FOR GOOD

Force for Good's mission is to mobilize solutions and capital as a force for good at a time of profound and multi-dimensional change in the world. 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 such as inclusion, sustainable development, and climate change in the spirit of encouraging collaboration and spurring a race to the top in making an impact for good in the world.

The Advisory Council for Force for Good comprises:

Helen Alderson, Independent Board Member; Trustee ODI; Member of the Board of Trustees of the Overseas Development Institute; former member of the Directorate of the International Committee of the Red Cross; former CEO of the World Heart Federation.

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ABBREVIATIONS AND NOTES

AI	Artificial intelligence
AR/VR/XR	Augmented reality/virtual reality/extended reality
ASEAN	Association of Southeast Asian Nations
B2B	Business to business
B2C	Business to consumer
BCE	Before current era
Bn	billion
ESG	Environmental, Social and Governance
EU	European Union
GDP	Gross domestic product
GPU	Graphics processing unit
G7	The Group of 7 countries
IoT	Internet of things
IP	Intellectual property
IT	Information technology
ITU	International Telecommunications Union
M	million
MHEWS	Multi-hazard early warning system
MW	Megawatt
NGO	Non-government organization
R&D	Research and development
SDG	United Nations Sustainable Development Goal
STEM	Science, technology, engineering and mathematics
UK	United Kingdom
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UN DESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNOPS	United Nations Office for Project Services
US	United States
US$	United States dollars
WMO	World Meteorological Organization

HIGHLIGHTS

1. Technology, particularly digital technology, is the critical tool for putting the world back on track to meet the UN Sustainable Development Goals (SDGs) and create a superior future for all.
2. Nine tech-based or tech-enabled 'Big Idea' solutions, have the potential to drive global SDG progress to nearly 90%, positioning global technology companies as key players.
3. A US$15 trillion annual opportunity (across trade, consumption, and investment) can be created globally by deploying these solutions. Across nearly 30 countries the national opportunity to be created exceeds US$100 billion each.
4. Unlocking these markets requires removing barriers for private sector engagement across the world, particularly the Global South, through policy reforms and capacity building, turning what are currently development needs into commercial opportunities.
5. The future beyond the SDGs, is set to be determined by 19 core technologies cumulatively projected to create US$61 trillion in economic value by 2030, four of which (AI, Robotics, IoT and Renewables) are already rapidly scaling to deliver more than half of this total.
6. mil to AI, six technologies, (Nanotechnology, Fusion, Quantum Computing, AR/VR/XR, Autonomous Systems, and Gene Editing) with breakthroughs and scaling drive exponential growth and shape the future., conferring power and wealth to owner-deployers.
7. The world's top 20 tech companies are investing over US$360 billion in the ten most critical technologies, with US$200 billion being invested in AI as the key control point of the future and lever for success.
8. The transition underway to the Information Age will be one of economic upheaval, social fragmentation, and political power shifts, with US-China great power and tech rivalry at the core, with the winner likely determining the future trajectory of the world.
9. The United States currently leads the world in terms of investment, intellectual property and corporate scale across nine of the ten most critical technologies of the future with China and the EU advancing but trailing in key technologies, and India not (yet) a competitor.
10. The SDGs offer major opportunities for nations who recognize that technology is a key enabler of the required changes, offering economic growth, job security, national security and technology inclusion and huge new markets.
11. Managing the transition to the future can deliver human security for all and transform the world, with global GDP potentially rising to US$350 billion by 2060, and accelerating to US$1 trillion in this century driven by further technological breakthroughs.
12. It is uncertain whether the world will choose rivalry and predatory economic-politics or global cooperation and sharing, the former risks conflict and splintered geopolitics, taking the world away from a short, managed transition to the future.

I. Executive Summary

Amid multiplying global crises, there is an urgent need to tackle pressing global challenges by leveraging existing advanced solutions that also unlock unprecedented opportunities. Rising above sub-optimal rivalries and competition to execute these solutions creates the potential for a secure, sustainable and superior future for all.

This report outlines that path, presenting transformative solutions that exist today and the trillions of dollars in markets they can catalyze. The report finds that the opportunity to create new markets globally is immense, with an estimated $15 trillion potential in the developing world alone, projected to grow to $60 trillion by 2060, with a GDP of US$350 trillion.

The SDGs offer major opportunities for countries that can leverage technology as a key enabler of change, offering economic growth and job security, improved national security, technology leadership and the opening of new markets. It is a “win-win” if ambitious countries lean into the challenge presented by the SDGs, tackling them as opportunities, not as costs.

Nine “Big Idea” solutions, enabled by 19 identified technologies, which can substantially meet the SDGs, but require essential policies that remove the barriers to the flow of solutions, technologies and investments to the places where they are most needed. A sub-set of these technologies even has the potential to create a future superior to the one envisaged by the SDGs. Critically, these solutions solve for the most intractable human and environmental challenges of our times, from poverty and hunger, populations left-behind and climate change. They unlock the ingenuity required to raise the world.

The world is in a historic transition to the Information Age, and at this crossroads, if we follow the well-trodden path of history, we create a transition built on predatory, power politics and economic hegemony for those that have the technology and the wealth over those that do not. This path will spur rivalry and conflict, endangering many across the world. However, a better version of us can choose a path built on collaboration and shared prosperity, with no one left behind. The level of the world's solutions and the science, technology, global networks of trade, finance and distribution are perfectly suited to such an agenda. Technology has the potential to create a superior sustainable future with human security for all at its core. The choices the world makes about which path to take will determine whether this is a better future for all or just some, and how painful the transition will be.

I. Technology's Role in a World in Crisis and Transition and Power Shift

The world is facing an unprecedented set of crises whose impacts threaten to overwhelm the liberal international order in a time of the global transition to the Information Age and technology is a key enabler of this transition, which is fueling competition between nations and companies.

- World Facing a Polycrisis Threatening the International Order. A series of interrelated economic, environmental, social, and political crises are posing increasingly existential threats to countries around the world, threatening to overwhelm countries' abilities to respond in a coordinated fashion, undermining the international order.
- Global Transition Underway. This polycrisis is a source of significant disruption to the broader global transition underway from a past built on fossil fuels and industrials to one built on new energies and information technologies, resulting in political, social, economic, security and environmental conflicts between those building the future, those resisting change, and opportunists.
- Technology Is a Critical Enabler of the Transition and Source of Power and Wealth. Technology, particularly digital technology, is a critical enabler of this global change, with 19 technologies identified that can deliver both geopolitical power and wealth creation being the subject of fierce competition.
- Technology's Significant Potential as a Force for Good. Technology is a powerful change agent in the world, the scientific progress driving innovation breakthroughs appears to be unstoppable. Ensuring that breakthroughs are a force for good in the world, improving outcomes and human security for all, however, needs to be a conscious choice, whose implementation is a multistakeholder effort involving policy makers, technology companies and product end users, creating an overlapping system of tech oversight, development, deployment and use within shared ethical frameworks.

II. Lifting the World: Harnessing Technology to Meet the SDGs

Progress on the UN Sustainable Development Goals (SDGs) is failing, and their success hinges on the world's ability to quickly implement scalable mass solutions, in which technology plays a critical role. This however requires addressing critical barriers to implementation around the world, relating to technology access, policy, finance and trust.

- The SDGS are Failing and Increasingly Unaffordable. Despite global efforts, none of the 17 SDGs are currently on trajectory for full realization by 2030 and, with an annual funding gap of US$14–17 trillion are increasingly unaffordable, highlighting the urgent need for transformative efforts.
- Nine Big Idea Solutions for 88% SDG Achievement. Nine 'Big Idea' solutions with proven use cases across policy, finance, service delivery, capacity building and civil society, among others, all of which are tech based or tech-enabled, have the potential to drive global SDG progress to nearly 90%, and global technology companies are well suited to lead in their deployment.
- Over Four Billion People Can be Digitally Included. Universal technology access is key to unlocking its positive impact potential, implying the need to fully digitally include a further 4.4 billion people worldwide. This will require a 'solutions stack' to be implemented comprising policies and regulations, infrastructure, hardware and software and even cultural norms.

III. Creating Whole New Markets is the Key to Levelling Up the World

Deploying the Big Idea Solutions in the places where they are most needed, transforming development needs into commercial opportunities, removing barriers to private sector engagement, building local capacities to create new markets that drive economic growth and development.

- US$15 Trillion Markets to Be Created. The total market opportunity (across trade, consumption and investment) of meeting the SDGs is US$15 trillion globally, with 29 countries having the potential for incremental US$100 billion or greater opportunities each.
- Multiple Trillion Dollar Opportunity Sets. There are multiple trillion-dollar opportunity sets arising from the SDGs, led by Food Systems (US$3.2 trillion), climate change, biodiversity and pollution (US$2.4 trillion), Solutions driving Gender Equality (US$2.4 trillion) and Inclusive Digitization (US$2.1 trillion).
- Raising Countries and Unlocking Solution Deployment Requires Policy as a Catalyst. Addressing these barriers requires policy reform and capacity building, which are a catalyst for transforming development needs into commercial opportunities, creating new markets to attract solutions and capital.

IV. Creating the Future: Transforming the World Beyond Sustainable Development

A subset of the 19 core technologies identified are key to the world's longer-term transition to a sustainable secure and superior future, expected to generate trillions of dollars of economic value before the end of the decade.

- 19 Technologies Can Create US$61 trillion in Value by 2030. Cumulatively, the 19 technologies are projected to create US$61 trillion in annual economic value by the end of the decade.
- Four Ready-to-Deploy Technologies Have Potential Value of US$35 trillion. Four technologies alone have the potential to deliver more than US$35 trillion by 2030: AI (US$16.5 trillion), IoT (US$9.1 Trillion), Robotics (US$6.8 trillion) and Renewables (US$5.2 trillion).
- Six Technologies are the Long-term Creators of the Future. In addition to AI, six technologies, Nanotechnology, Fusion, Quantum Computing, AR/VR/XR, Autonomous Systems, and Gene Editing, are awaiting breakthroughs and/or scaling that will make them commercially ready, driving exponential growth to transform the world and delivering 'Great Power' status to those that master them.
- Big Tech Investing US$363 Billion Annually to Win the Technology Race for the Future. The world's top 20 tech companies are cumulative investing over US$360 billion in the ten most critical technologies, with the largest company along spending over US$100 billion.
- AI is a c.US$200 billion Annual Priority and Lever for Success. AI is the only technology focused on by all 20 companies, each of which has both R&D programs underway as well as commercial products, with nearly US$200 billion in annual spending.
- IoT, AR/VR/XR, Autonomous Systems and Quantum Technologies, Emerging as Commercial Priorities Too. Four technologies attract US$25-30 billion of annual spending, of which IoT and AR/VR/XR are already commercialized with marketed products, with Quantum Technologies and Autonomous Systems awaiting scaled commercial rollouts.
- US$50 billion Renewables Investments Reflecting High Tech Industry Business Needs. The fight over ESG and clean energies in the US is a distraction given that electricity from renewables is more cost effective than that from fossil fuels, and Big Tech is accordingly relying on renewables for their rising energy needs, whose data centers alone are projected to represent nearly 10% of US electricity consumption.

V. Great Power Rivalry in Race to the Future

Given the potential of technology to drive economic growth and create new markets, as well the importance of technological advancements in maintaining national security, technology competition is increasingly geopolitical in nature and a source of great power rivalry between

the US and China, with future breakthroughs determining who dominates the next era of the world.

- Tech Rivalry at the Core of US-China Great Power Competition. Great power and technology rivalry is at the core of US-China competition and the winner likely determines the world's transition to the future as a great power and can choose the mode or balance of power between hegemony and a multilateral system.
- US leading Across Nine out of Ten Critical Technologies. The United States leads the world in terms of investment, intellectual property and corporate scale across nine of the ten most critical technologies with China and the EU advancing but trailing far behind in key technologies, and India not (yet) appearing as a competitor.
- Clear Chinese Indication of Future Leadership in its Early-Stage Research. Having made enormous strides in terms of high impact technology research, China leads the world across early-stage research underlying the majority of key technologies, indicating its rising leadership ambition.
- Competition Between US Hyper-Monopolies and Chinese State Capitalism Determines Future Leadership. Global tech rivalry is a competition between two different innovation models, US hyper-monopolies and Chinese state capitalism, with the winner likely to secure the key tech control points of the future. The EU's rule of law platform is an interesting play too, and as India rises, its market size will also count.
- Breakthroughs in AI, Fusion Energy, Gene Editing, and Quantum Technologies Determine Winner. The mastery of four technologies likely determines who geopolitically dominates the next era of the world, and controls global markets, backed by the tools to reshape military capabilities, economic, financial and industrial systems, and ultimately transnational governance frameworks.

VI. The Dangerous Transition Ahead

The shift into the post-industrial era of the Information Age is poised to bring geopolitical conflict, economic turmoil, and social fragmentation. The world is at a crossroads with two alternative paths to the future open to it. Which path the world choose will determine how it manages the risk of the transition as well as the shape the future that it creates.

- Transition to the Future Promising Upheaval. The transition to the post-industrial era of the Information Age will be one of economic upheaval, social fragmentation, and political power shifts, as rising powers challenge the dominant order, and existing systems prove incapable of managing change.
- Alternative Paths to the Future, War and Peace in the 21st Century. Two alternative paths to the future are clear; one is a short transition focused on execution, innovation and sharing solutions and the other is one where the powerful monopolize the solutions and wealth

creation, fighting for supremacy, sanctioning rivals, with no constraints resulting in a far more dangerous and likely extended transition featuring conflict and a breakdown of global order

- Existential Risk on the Path to the Future. Risks remain unaddressed in the struggle for power and wealth, and the world faces climate disasters as the world marches to 2.5^{0}C, risks war between nuclear powers and a shift from the UN principles of rule of law, multilateralism and human rights to a might-based order compromised by power struggles, war and the movement towards National Populism.
- Transition to the Future Shaped by Innovation. The shape of the transition to the future can be determined by the timing, place and nature of innovation breakthroughs making the choice which technologies to prioritize, and their intended use cases critical considerations for both the public and private sectors, but how that is used depends on the goodwill of leaders and the public that allows them to rule.
- An Economic Prize of US$350 trillion GDP by 2060 is Feasible and Can Raise all of Humanity. A short transition path underwriting secure, sustainable development while continuing to invest in the future can transform the world within a generation, with global GDP rising to US$350 billion by 2060, and potentially accelerating further beyond this driven by further technological breakthroughs, raising all of humanity in the process, if wealth creators are prepared to share.

VII. Conclusion: The World That Technology Will Shape

The world stands at a juncture between two civilizational eras with a future underpinned by new technologies that allow all of humanity to be raised to a new level, affecting every aspect of life on earth and fueling our journey into space.

- Solving Today's Global Crisis are a Litmus Test of the Nature of Man. The multiple crises of the world are real and growing and lacking a commitment to work together to solve, and so constitute existential threats from intertwined economic, environmental, and political-military crises.
- Technology Exists to Level the World and Identified to Create a Superior Future for All. Technology can be the tool to bridge the digital divide for over 4 billion people by creating new markets to help those in need.
- Technology Use for Good is a Human Choice. Embracing technology as force for good can provide the means for peace, prosperity and freedom for the world, but it can also be a tool for insecurity and instability, being weaponized by geopolitical rivals seeking hegemony. The choices that determine technology's role are very human choices, revealing character of leaders and nations.
- Peaceful Transition Requires Collaboration Over Unilateralism, Rivalry and Conflict
  The peaceful path forward hinges on global cooperation, prioritizing innovation for mutual

growth and development rather than succumbing to great power rivalries, and this rests on delivering a short, managed transition.

While the tendency towards fear and rivalry may well lead mankind to a far more dangerous path, the rational, humane and peaceful road is clear and awaits the people of the world to choose it.

II. Technology's Role in a World in Crisis and Transition

The world is facing an unprecedented "polycrisis," where interlinked challenges – including armed conflicts, economic turbulence, climate change, and geopolitical instability – compound one another, amplifying their impacts far beyond their individual effects. Major crises are straining global governance structures, driving political shifts, and eroding public trust in institutions, and threaten to overwhelm the liberal international order in a time of global transition. Technology has a critical role to play in this transition, with 19 core technologies serving as the building blocks of the Information Age, building the world's future. These technologies have the potential to be a powerful force for good in the world, but access to them remains highly uneven. The world will need to bridge this digital divide in a coordinated manner, empowering communities worldwide to participate in the digital economy and its benefits.

1. A World in Crisis…and Transition

The Rising Global Polycrisis

We are living in interesting times. While the supposedly Chinese curse wishing this on others is apocryphal, it is undoubtedly true that the world today is in a phase of elevated risk and uncertainty. A series of interlinked crises, from armed conflicts and energy shocks to deglobalization, climate change, and economic turbulence, risk negatively impacting the global economy, geopolitical stability, and societies across the world. Major issues, including the Ukraine

conflict, the Israel-Gaza crisis, surging inflation, and mass migration, are not only straining global governance structures, but also driving fundamental political shifts across countries (as the results of the 2024 US Presidential election have demonstrated) that are in turn impacting how they respond to these challenges. These include:

1. U.S.-China Rivalry. Increasing U.S.-China rivalry amplifies global risk by heightening geopolitical tensions, disrupting trade and economic stability, and intensifying competition in critical areas like technology and military power, with 81% and 75% of Americans and Chinese, respectively now holding unfavorable views of each other's countries.[2]
2. Wars Against Civilians. 2024 marks the 25th anniversary of Security Council's consideration of the protection of civilians as an item on its agenda, the 75th anniversary of the Geneva Conventions of 1949, a cornerstone of international humanitarian law, and the continued mass killing of civilians in Sudan, Yemen, Syria, DRC, Myanmar, Nigeria, Sahel, Somalia, Israel and Gaza.[3]
3. Russia-Ukraine War. The Russia-Ukraine war has resulted in up to one million dead or wounded since its beginning in 2022,[4] and risks escalating with Russia threatening nuclear reprisals for Ukraine's use of American long-range missiles impacting global security.
4. Israel, Gaza, and the Middle East. Israel's war in Gaza has led to nearly 45,000 deaths[5] and has spread to several neighboring countries, increasing regional instability and exposing the inability of multilateral institutions to enforce international laws and norms.
5. Deglobalization and Economic Fragmentation. Rising economic fragmentation due to geopolitical tensions and increasing isolationism around the world is leading to disrupted trade and investment flows.
6. Climate-Driven Crises. Environmental risks, such as extreme weather events and biodiversity loss emphasize the urgency of addressing climate change, with greenhouse gas concentrations, ocean heat content, the global mean sea levels reaching all-time highs in 2023.[6]
7. Energy Security and Transition. The transition to renewable energy sources and the associated risks to energy security, highlight the challenges in balancing energy needs with sustainability goals, with global oil production increasing 1% in 2023 to reach a record high.[7]
8. AI and Emerging Technologies. The rapid advancement of technologies like artificial intelligence is raising increasing concerns about global governance and the ethical deployment of tech, with the number of countries passing AI related legislation increasing from one in 2016 to 37 today.[8]
9. Cybersecurity Threats. The increasing frequency and sophistication of cyberattacks pose significant risks to global security and economic stability, with the annual cost of cybercrime estimated at US$9.5 trillion in 2024.[9]
10. Nationalism, Populism and Extremism. The rise of nationalism, populism and extremism in its many forms has the potential to disrupt international cooperation and exacerbate global

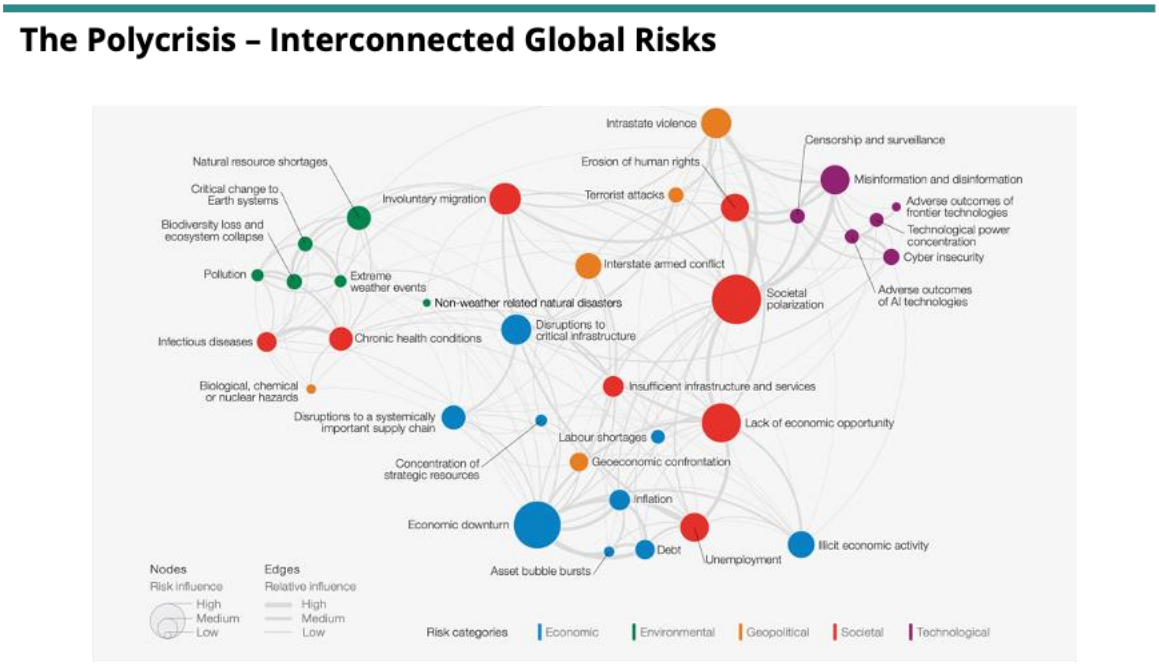
risks, with populist parties securing nearly 30% of the seats in the European Parliament in 2024.[10]

11. Migration and Demographic Shifts. Demographic changes and migration patterns are impacting social cohesion and economic stability across the world, with 220 million internal displacements in the last 10 years from climate,[11] over one billion people unable to mitigate for climate and natural disaster are potential refugees by 2050, not considering wars and economics.[12]
12. Food and Water Security Undermined. Social, ecological and economic challenges are escalating global food and water security risks, with 281 million people currenting facing acute food insecurity, and the number of people impacted by absolute water scarcity expected to reach 1.8 billion by 2025.[13]

The financial, social, and political fallout from these crises poses existential risks for many nations, prompting the world to focus intensely on navigating the immediate waves of disruption. This shift in focus often means diverting resources and funding from longer-term priorities like the SDGs and the energy transition.

Each of these crises independently demands urgent attention from global leaders, requiring complex and coordinated responses. Yet, these crises are not occurring in isolation; they are interlinked, amplifying each other's effects. When sudden events like wars and pandemics intersect with long-term systemic risks like climate change and geopolitical instability, they create a "polycrisis" – a situation where the combined impact far exceeds the sum of its parts, compounding and complicating the world's most pressing challenges.

Figure 1: Global Risk Landscape[14]



Source: World Economic Forum, 2024

The evolving polycrisis has wrought severe economic and social consequences on a global scale, resulting in trillions of dollars in economic damage, millions of deaths, and widespread loss of livelihoods. Economic disruptions, including infrastructure destruction, volatile markets, and supply chain breakdowns, have deepened poverty, especially in developing economies, and widened the gap between wealthier and poorer nations. Socially, the polycrisis has strained healthcare systems, worsened health outcomes, and led to mass displacement, which in turn fuels social tensions and increases civil unrest. Compounded by misinformation and inadequate government responses, public trust in institutions has eroded, creating a fractured global society. These interconnected challenges threaten to set back development gains by decades, leaving a lasting impact on human well-being.

The impact on human security and global stability has been equally severe, as crises intersect in unpredictable ways. Geopolitical tensions, such as those between the U.S. and China or within the Middle East, are intensified by resource competition and migration pressures resulting from climate change. The overlapping crises strain diplomatic relations and challenge the operational capacity of multilateral institutions like the United Nations, NATO, and regional alliances, as they struggle to address diverse member interests amid competing national priorities.

The Liberal International Order Is Under Threat or Already in Transition

For the past 75 years the liberal international order has provided a framework for addressing global challenges. Based on the principles of the rule of law, multilateral action and fundamental human rights, the order has given rise to institutions, codes of conduct and networks of relationships between states that have underwritten peace, prosperity and freedom around the world since the 1950s.

This order has largely prevented major conflicts between superpowers, creating a relatively stable global environment, despite the periodic occurrence of regional conflicts. It has promoted trade liberalization and economic cooperation, significantly contributing to global economic growth. It has improved human development around the world across nearly all dimensions, including poverty reduction, health, and education. And it has sought to embed human rights and democratic values as global norms.

Despite its successes the liberal international order today finds itself under existential threat, with different aspects of the polycrisis eroding its foundations in a vicious circle of cause and effect

Despite these successes however, the liberal international order today finds itself under existential threat, with different aspects of the polycrisis eroding its foundations in a vicious circle of cause and effect. The key challenges facing the world collectively threaten to overwhelm the liberal international order.

Multilateral organizations at the core of the order, including the UN, IMF or the WTO are struggling to maintain their ability to enforce their authority and the rules and principles they

were established for, and therefore their relevance, in addressing the overlapping crises facing the world today. This challenge is compounded by eroding trust in these institutions' given their more limited ability to act effectively, further diminishing their capacity to foster international collaboration. For example, the UN has the difficult task of calling out those committing atrocities and is therefore bound to receive negative opinion from these countries and their allies.[15] At the same time, escalating geopolitical rivalries over resources, technology, and influence further fragment the global landscape, undermining countries' support of these institutions as countries increasingly prioritize national interests over cooperative solutions.

Economic shocks and supply chain disruptions have also led to a weakening commitment to free trade, with many nations turning to protectionism and self-sufficiency, disrupting decades of globalization and interconnected economic progress. These economic shocks have also contributed to economic hardships and political disillusionment, enabling the rise of anti-establishment nationalism and isolationism around the world. Such movements challenge governments' ability to engage in multilateral efforts and erode collective problem-solving.

The two ongoing wars have done profound damage to the world's sense of unity, purpose and the potential for constructive dialogue

While there are several ongoing wars, two wars in particular have done profound damage to the sense of unity, purpose and constructive dialogue and raised the stakes for the rest of the world, namely Russia's war in Ukraine and Israel's war in Gaza and its expansion across borders. Russia's war in Ukraine saw 40 countries, including India and China, vote against or abstain, a UN general assembly resolution condemning Russia's annexation of parts of Eastern Ukraine.[16] Secondly, the Israel war in Gaza has seen over 120 countries call for a humanitarian truce, while the US has exercised its veto power four times in the United Nations Security Council to block resolutions calling for a ceasefire, most recently in November 2024.[17]

Moreover, some governments, under pressure from multiple crises, have deprioritized human rights and democratic norms, embracing measures with various shades of authoritarian rule that accelerate democratic backsliding, and create exclusionary politics for sub-sections of the population.[18] Sustainability challenges, including diverted resources from long-term goals like poverty reduction and the SDG, further destabilize global stability. Together, these trends threaten the liberal order's principles of cooperation, democracy, and equitable development, risking setbacks in global progress.

Many of the challenges described above are systemic and structural in nature, with the order proving to be incapable of addressing them effectively. Some risks, like climate change, are outside of the scope of governance envisaged by the order's architects and therefore lack ready-made mechanisms that can manage them. Other risks, like rising income inequality, are indirect consequences of the order functioning as it is intended. The globalizing effect of the order, when coupled with the now globally dominant economic models of capitalism and free trade drives significant economic growth but leads to significant regional dislocations in the process. The failure of the existing order, both at national and international levels, to address these challenges has driven significant anti-establishment populism, positing that the 'system is broken', and

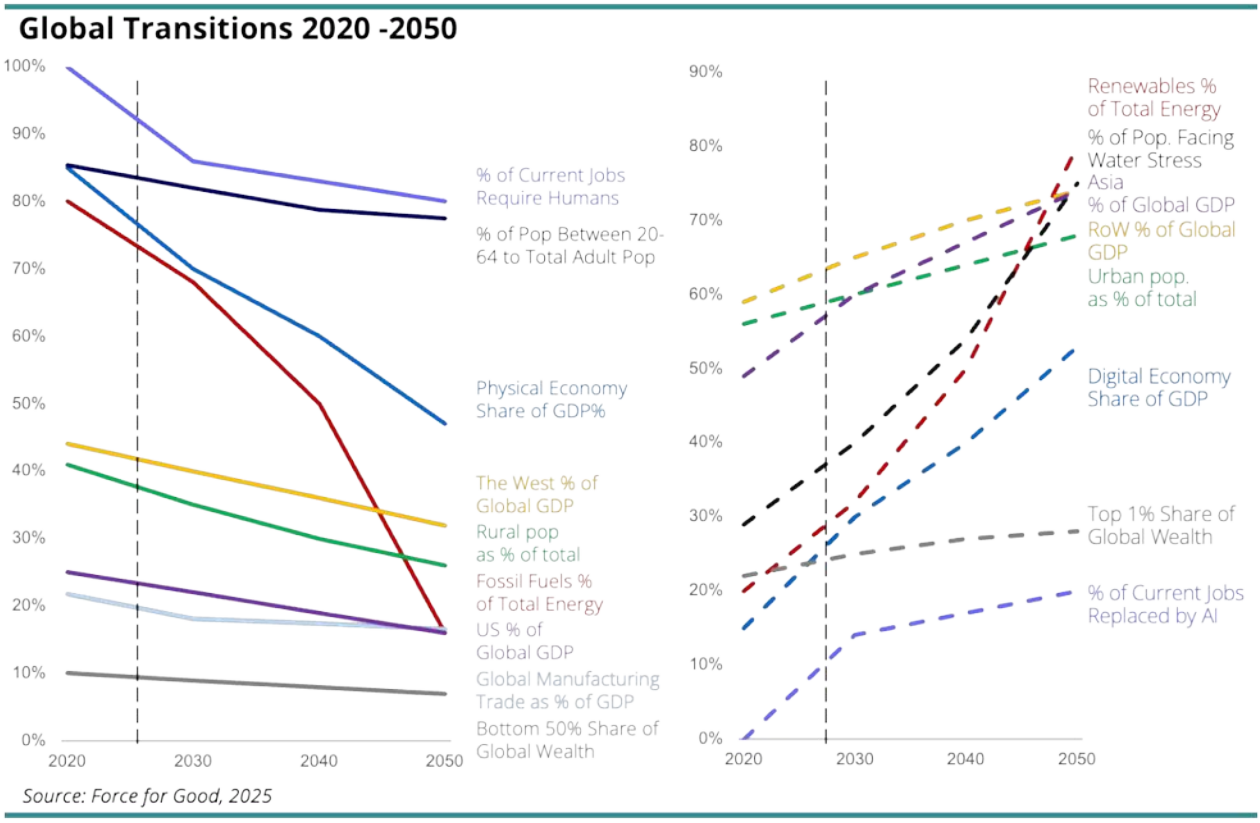
leading to the explicit rejection of its rules and organizations, further undermining its effectiveness.

Driven by economic hardships and public dissatisfaction, an increasing number of populist governments are adopting unilateral security measures, such as tightening border controls, limiting resource exports, promoting isolationist policies, weakening international commitments and further complicating coordinated crisis responses. In the face of electoral defeat and pressure, mainstream political parties will also need to find solutions to these pressures. In the US presidential election, the voting public elected a government that has explicitly rejected key tenets of the international order and America's leading role within it, is perhaps the clearest evidence of the liberal order's failure to deliver, and likely to drive renewed pressure on it, potentially accelerating its demise.

Global Transition Underway

Stepping back further, the decline of the liberal international order is but one of several political, social and economic transitions underway that are set to reshape the current world system, the key elements in decline also include economic liberalism, industrial capitalism, and globalization. These transitions represent the end of many things, as well as a series of new beginnings.

Figure 2: The End of Things … and New Beginnings



Source: Force for Good, 2025

1. The End of Carbon. Fossil fuels' reign as the world's primary energy source is ending — following a two-century period which witnessed a near hundred-fold expansion in the global economy, and a staggering thousandfold rise in CO_2 emissions.
2. The End of 'Western' Economic Leadership. Similarly, the West's economic and political global domination is widely expected to decline as a share of the total, as the world's economic center of gravity is shifting away from the G7 and its allies towards Asia and over the longer-term to the Global South more generally.
3. The End of American Unipolar Power. America's hyperpower status and is hegemonic role as the world's policeman is ending, both by the choice (based on the principle of "America First") and by necessity (based on the escalating cost of dominating rising powers), and so the unipolar or one superpower world of the past 30 years cedes way to a multi-polar one distributed around a growing number of power blocs.
4. The End of Physical World Primacy. Digital technology is weaving more deeply into industries, governments, institutions, and societies, transforming each and, driven by AI, poised to blur the boundaries between the physical, digital, and biological realms.
5. The End of Human Labor as a Factor of Production. The trend to automate physical labor using technology has already transformed industrial production around many parts of the world and is now increasingly extending to mental labor (or knowledge work) with AI estimated to replace up to 300 million jobs in the coming decades.[19]
6. End of Demographic Dividends. Following 70 years of rapid global growth that has seen countries around the world reap significant economic benefits from young and growing workforces, the global population is set to age significantly with the percentage of the population aged 65 or older expected to grow from less than 10% today to nearly 20% by 2050.[20]
7. End of Globalization. Globalization is in retreat for the first time since the Second World War, as countries around the world increasingly adopting protectionist measures and prioritize local production over international supply chains.

Fundamentally, the current world system is nearing a tipping point. Centuries of accelerating industrial-driven growth have pushed humanity's environmental footprint to the planet's boundaries. Global CO2 emissions from fossil fuels and industrial activity is altering long term climate systems in a manner that risk making large parts of the world unlivable. Further, resource extraction has powered remarkable advancements in productivity, economic development, and wealth creation, but has also driven the increasingly rapid depletion of carbon-based energy sources and minerals, and even of renewable resources like water, fishing stocks and timber. And global patterns of industrialization and development have led to significant pollution and environmental degradation that threatens biodiversity and continued human flourishing.

These challenges highlight the urgent need for the world to transition toward a more sustainable development model. Given that the world's current development model is inextricably linked to its political, economic and social systems, this transition will require a system wide shift for global civilization, redrawing the relationship between societies, economies, and the environment, in a manner that harmonizes economic development, human security and flourishing, and planetary sustainability.

Wars, revolutions, market crashes, economic and political turmoil, supply chain challenges and resource shortages, as well as social upheavals risking increasing the cost and duration of the current transitions and therefore delay the emergence of a stable future world order

Like almost all major events in history the transition will be disruptive in nature. With every transition creating its own winners and losers, the future is set to be marked by conflict between those who stand to gain and those who stand to lose. The resulting wars, revolutions, market crashes, economic and political turmoil, supply chain challenges and resource shortages, as well as social upheavals stand to increase the cost and the duration of each of these transitions and therefore delay the emergence of a stable future world order.

Delay has serious implications for human security, which focuses on protecting human rights and enhancing security at the individual, community, regional and international levels through peaceful and non-violent approaches, aiming to foster greater stability and development. Traditionally, the United Nations has defined human security as encompassing seven key dimensions: food security, environmental security, personal safety, community security, economic security, healthcare access, and political security. However, given the pivotal role technology plays across these dimensions as an enabler, a force multiplier, and a direct contributor, "access to technology" has recently been acknowledged as the eighth pillar of human security, solidifying its status as an essential component in promoting well-being and resilience across societies.

However, humanity's ecological footprint is pushing ecosystems worldwide toward a breaking point, with the cumulative impact of climate change, biodiversity loss and pollution fueling rising temperatures, sea level increases, and escalating risks of floods, droughts, and wildfires. The world is already far off track to meet the 1.5 C temperate targets agreed in the Paris Agreement, currently trending towards a temperature increase of 2.6-3.1°C over the course of this century,[21] with potentially catastrophic implications: projected sea level rises of up to 1m could inundate two million square kilometers of land and displace 100 million people,[22] while global crop yields of staple crops like rice and maize could decline by 10-25% due to heat stress, water shortages, and shifting growing seasons.[23]

The world is already far off track to meet the 1.5 C temperate targets agreed in the Paris Agreement, currently trending towards a temperature increase of 2.6-3.1°C over the course of this century

These environmental challenges risk being drivers of conflict around the world, as countries compete over the shifting stock of natural resources like water and arable land, or as environmental degradation, climate change, and natural disasters create mass climate refugee

flows that cause both tensions in host regions and economic destabilization in their countries of origin.

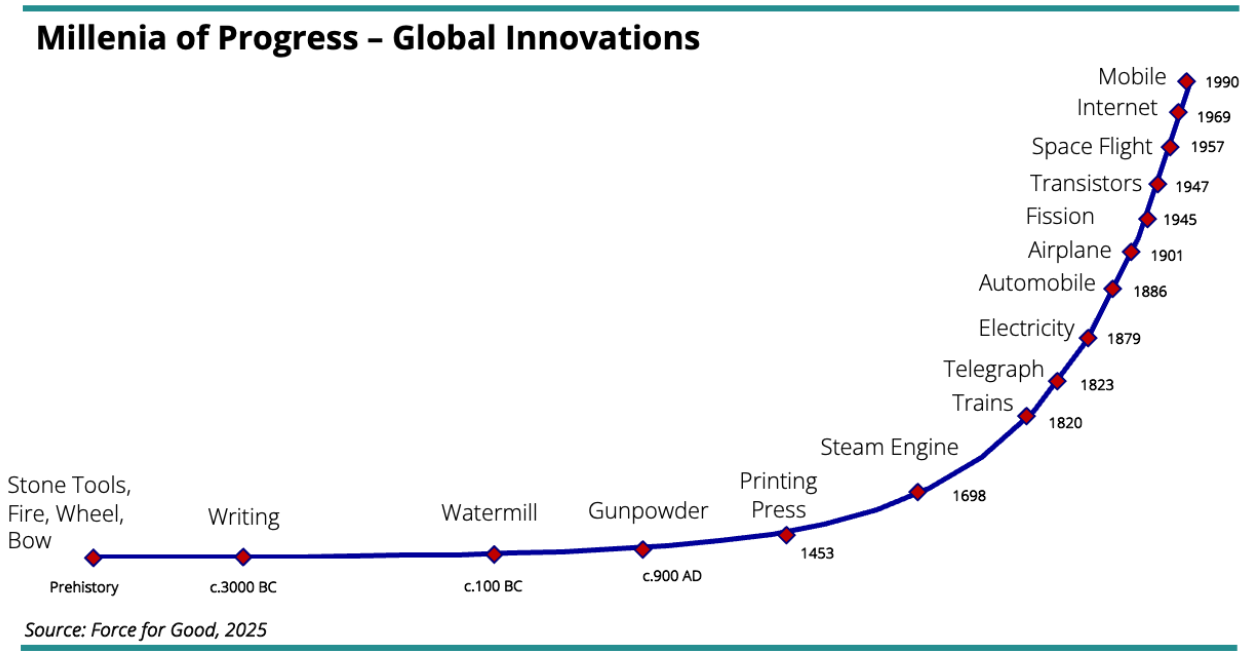
The length, severity, and pace of the resulting global decline in security and sustainability will depend on numerous factors. One of the most critical is how swiftly science and technology can bridge the gaps by replacing the old model with innovative solutions that create a new model. The longer this process takes, the greater the risk of irreversible damage to the planet and its societies. Navigating the path to a future era demands resilience in the face of crisis, bold leadership, and groundbreaking investments in transformative solutions.

2. Technology Is a Critical Enabler of the Transition

Technology at the Forefront of Global Change

Technology has been a central force driving progress throughout human history, instrumental in shaping revolutions in human culture, societies, and politics, and playing a critical role in shaping the future for the world. The growth of knowledge has underpinned nearly all human progress, with leaps in scientific understanding driving innovation. The resulting transformative technologies have been a powerful catalyst for productivity growth and prosperity, elevating incomes and significantly reducing poverty worldwide. It has propelled remarkable advancements in healthcare and medicine, leading to sharp declines in childhood mortality and increased life expectancy. Additionally, technology has enabled more efficient extraction and utilization of natural resources, fueling agricultural productivity and supporting global population growth. It has also revolutionized the spread of knowledge, accelerating literacy rates across the world.

Figure 3: Technological Progress Throughout History



Technology's impact throughout history has been not only transformative, but also at times highly disruptive. The expansion of human knowledge, which drives all technology and innovation, is an ongoing process, as is the advancement it brings. However, this advancement does not occur in a uniform way. Punctuated equilibrium is a theory in evolutionary biology that suggests evolution is characterized by long periods of relative stability punctuated by (relatively) brief periods of intense change. While evolution and tech innovation are clearly governed by different principles, the concept of punctuated equilibrium can be applied to the latter as well. When sufficiently interconnected disruptive technological breakthroughs occur within proximity to one another, they can spur rapid growth and profoundly reshape human civilization, transforming the means of production, the sources of economic and political power, primary energy sources, the pillars of social organization, and global power dynamics, among other things.

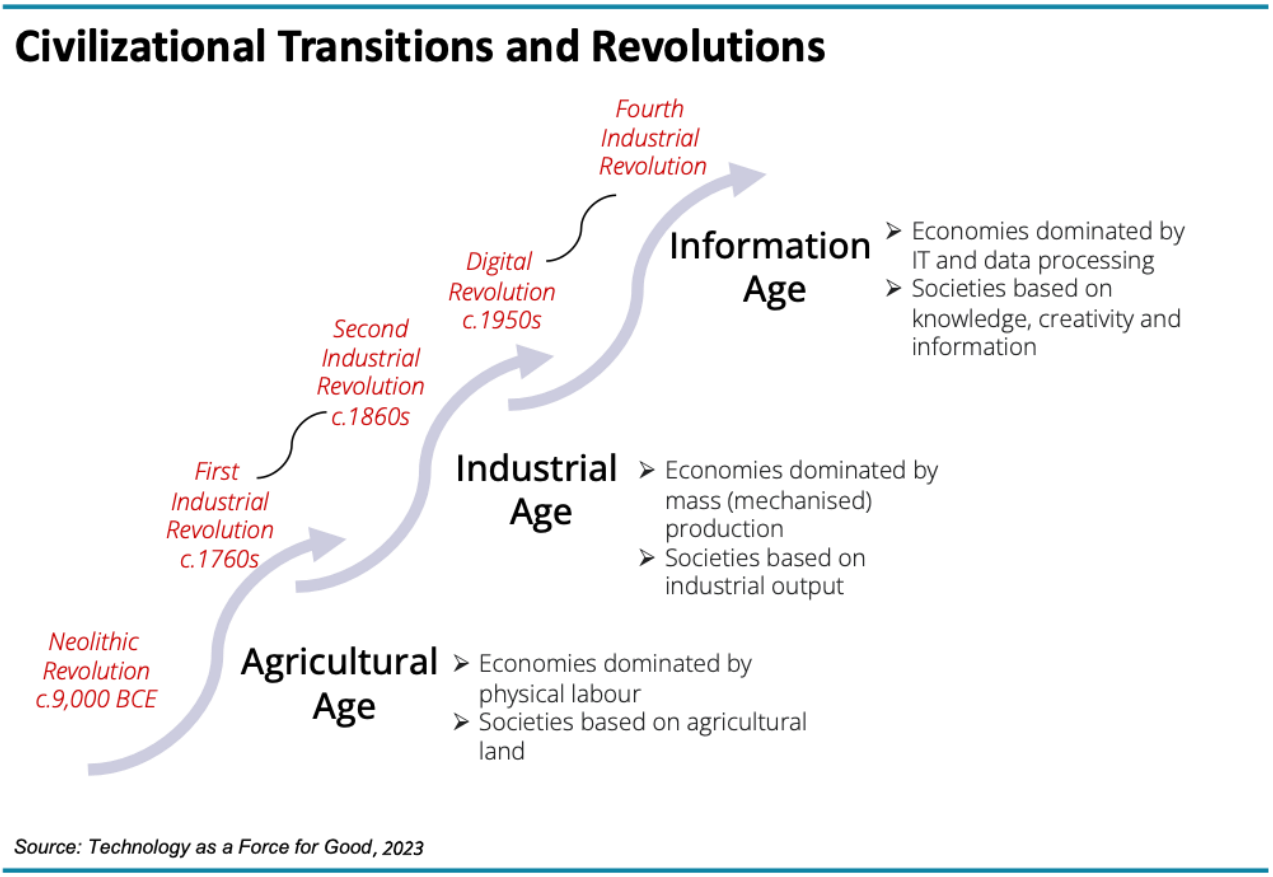
When sufficiently interconnected disruptive technological breakthroughs occur within proximity to one another, they can profoundly reshape human civilization, transforming the means of production, the sources of economic and political power, primary energy sources, the pillars of social organization, and global power dynamics

The world has been through a series of such revolutions throughout history, which have marked the transitions between different modes of civilization.

In summary, the most recent major shift began with the Industrial Age around 250 years ago, starting with the First Industrial Revolution in late 18th-century Britain, where Northern European nations transitioned from agrarian to industrial economies. Defined by machinery and innovations like the spinning jenny and mechanized loom, coal replaced traditional wood and muscle power, revolutionizing textile production and expanding ironworks.

The Second Industrial Revolution, spanning the late 19th to early 20th centuries, brought widespread social, political, and economic change, spreading industrialization globally. Marked by advancements such as the electric generator, large-scale steel production, and refrigeration, as well as communication technologies like wireless radio, this era spurred the rise of electric streetcars and long-distance railways, reshaping urban development and accelerating European economic and colonial expansion worldwide.

Figure 4: The Transition to the Next Stage of the Information Age



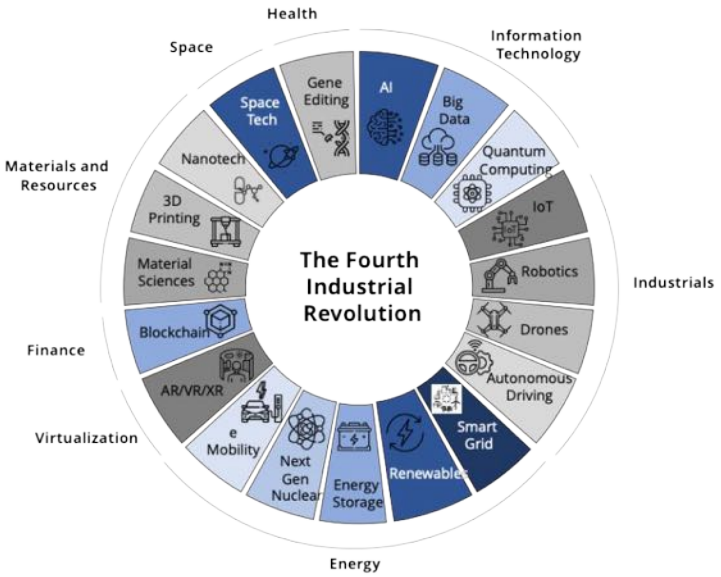
The shift from the Industrial Age to the Information Age began in the 1950s with what's known as the Third Industrial Revolution or the Digital Revolution, marking the rise of information technology as the main economic driver over manufacturing. This era saw a shift from analog to digital technology, led by the computer, which has since transformed all aspects of modern life — from healthcare and education to commerce and personal interactions.

Today, the world is entering the next phase of the Information Age (also called the Fourth Industrial Revolution), where the economic, social, and environmental impacts of information technology are deepening. This era is driven by technologies merging the physical, digital, and biological spheres, particularly through integrating digital intelligence into physical and biological systems.

Core Technologies Shaping the Fourth Industrial Revolution

There are 19 'disruptive' technologies at the core of the Fourth Industrial Revolution across IT, industrials, energy, virtualization, materials and resources, space (and aeronautics) and health, which together represent the building blocks of the future.

Figure 5: Core Technologies of The Fourth Industrial Revolution[24]

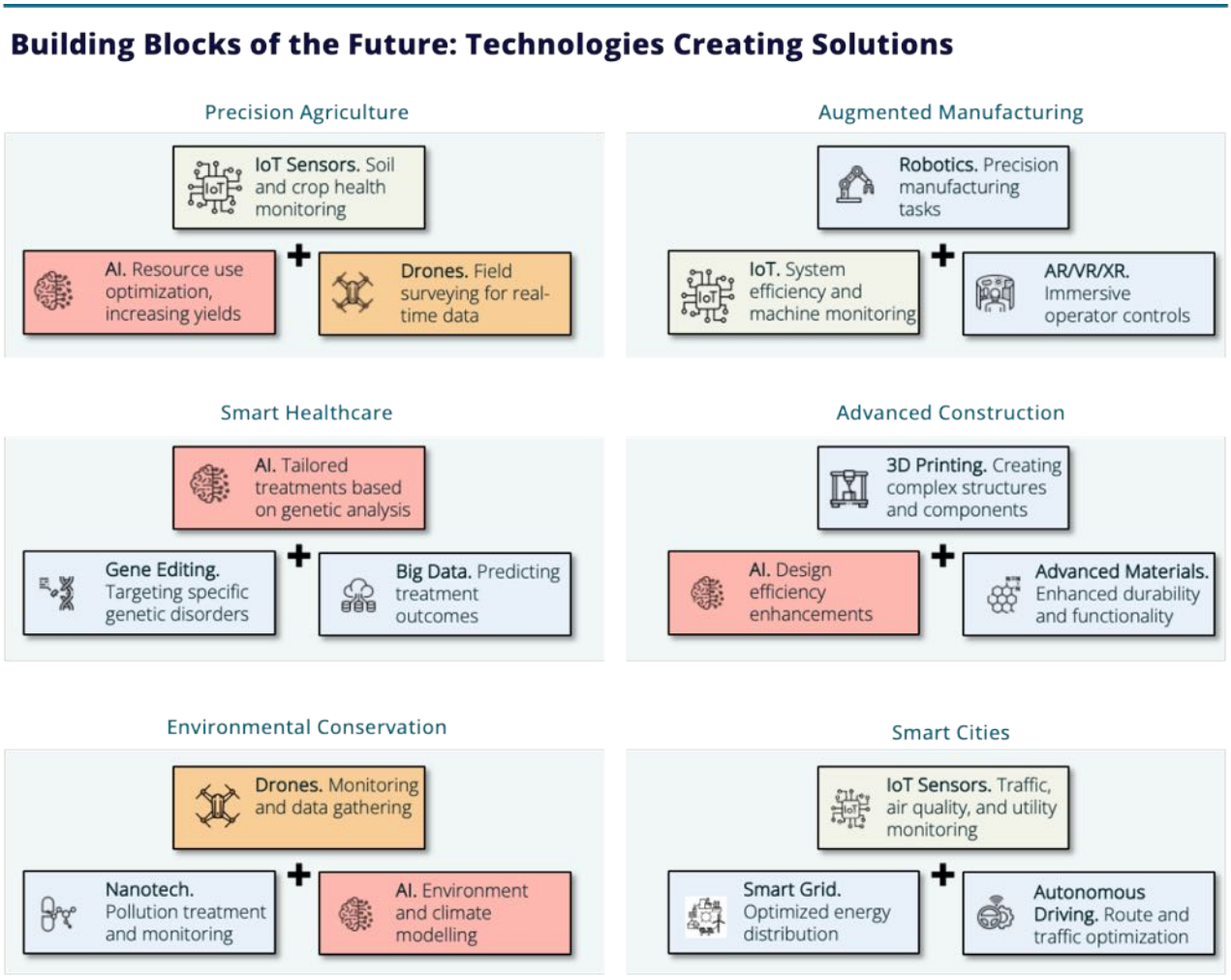


Source: Force for Good, 2025

True to the status as building blocks these technologies are most impactful when deployed in combination with one another. The common glue that binds these technologies together and lets them interact is their digital nature. Digital technology – comprising tools, systems, devices, and resources that generate, store, or process data – is a critical enabler of each of the 19 technologies. Having already started to redefine health, finance, education, entertainment, and commerce over the past two decades, digital technologies are now revolutionizing fields such as transportation, government, energy systems, construction and manufacturing.

Digital technologies transform systems in multiple ways, enabling automation, which minimizes errors, increases overall efficiency, and enables great scale and speed. Most importantly they add intelligence to systems, allowing these to become 'smart'. Linked by digital technology the 19 technologies are building blocks that can be combined in myriad and highly impact ways, including the following:

Figure 6: The Building Blocks of the Future, Examples[25]



Source: Force for Good, 2025

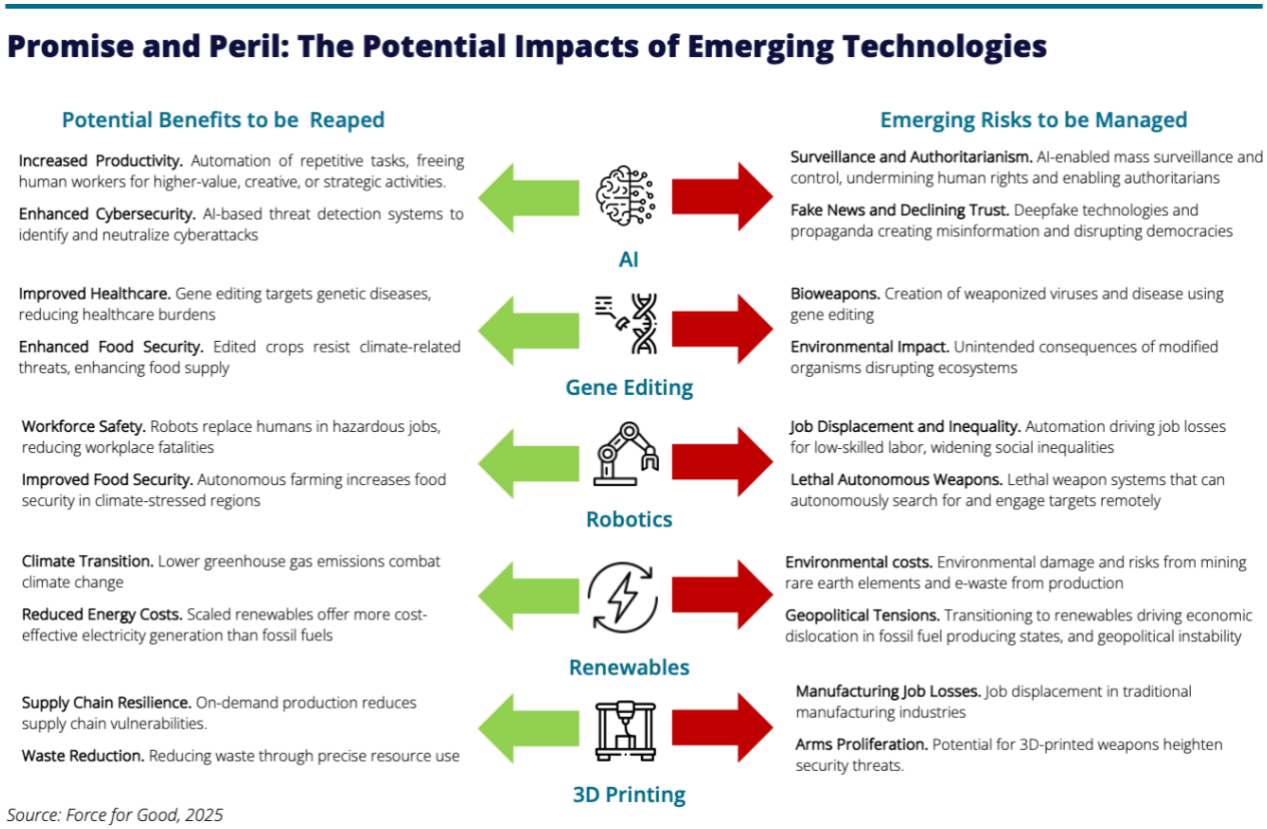
The combinatorial power of these technologies drives a nearly limitless number of use cases which add up to justify the moniker of 'revolution' applied to the Fourth Industrial Revolution.

A Force for Good … or Increased Instability

Technology's impact on society, much like that of other all-purpose mechanisms like money, power, or information, is however a double-edged sword, with the potential to drive remarkable progress or significant harm, depending largely on how it is deployed. For instance, AI promises to advance economic growth, streamline healthcare, and enhance communication, fostering connectivity and development. But is also enabling mass surveillance, privacy infringements, and even automated warfare. Similarly, big data can both guide effective policy making as well as enable invasive monitoring and control to undermine democratic freedoms. Thus, while technology holds unparalleled potential to address complex challenges, it remains a tool, and any tool's utility is ultimate a function of how it is used. Technology's impact for good or bad therefore depends on the intentions, policies, and safeguards established to guide its responsible use. The table below illustrates the double-edged nature of technology by highlighting the benefits and risk

inherent in a selection of the 19 technologies, (although a similar account can be made for all of them).

Figure 7: Technology Risks and Benefits – Selected Examples [26]



Source: Force for Good, 2025

Ensuring technology's use as a force for good underpinning human security for all is a multistakeholder effort - too important to be left to the market and its natural profit motive - that will require aligning the priorities and actions of policy makers, technology companies and product end users, creating an overlapping system of tech oversight, development, deployment and use within shared ethical frameworks.

For policy makers, governance and regulation are key. As a general principle, any regulation should be aligned with the public interest pursuing societal, environmental, and economic goals.[27] Seen through the lens of human security this implies several different priorities for policy makers.

Ensuring technology's use as a force for good is a multistakeholder effort, aligning policy makers, technology companies and product end users, within shared ethical frameworks

First, to regulate the development and use of certain technologies that could be weaponized such as drones, AI, or robotics, limiting their intentional use for harm. Second, to impose restrictions and requirements on products to increase their safety, limiting their potential for unintentional misuse or consequences. Health and safety regulations governing gene editing and nanotech are examples of this. And third, to mitigate the unavoidable side effects that arise from a technology when it is used as intended, such as the job displacement that will arise from the automation driven by AI or 3D

printing. Key to all these priorities are accountability mechanisms that ensure that developers, corporations, and users can be held accountable for technology misuse or harm. At the international level the UN has been a leader in terms of developing and championing technology policy frameworks like the UN Digital Compact, a digital tech governance framework adopted in 2024, as well as multiple proposals underway for the global governance of AI and digital public infrastructure.[28] A recent example of a binding regulatory framework is the EU's 2024 AI Directive, which focuses on the development and use of human centric and trustworthy artificial intelligence systems.

For technology companies, tech's role as a force for good needs to be embedded in design and deployment principles. Product design needs to be human-centric, incorporating user needs and conscious of longer-term societal impacts, rather than focusing solely on efficiency (or profitability). Product design also needs to incorporate robust safeguards to protect users (and society) from harm, such as cyberattacks or surveillance overreach. And more broadly, tech design needs to consider long term environmental and societal costs incurred throughout a product's lifecycle. The challenge of AI's power consumption is a good example, with a query to ChatGPT consuming nearly ten times the energy as an equivalent Google search.[29] And finally, tech companies need to deploy their technologies in a manner (and in places) where they can deliver a positive impact.

Ensuring that technology is used as a force for good needs to follow principles such as kindness, fairness, and the prohibition of harm which are deeply rooted in human nature and shared across cultures, covering unintended misuse of technology and intentional harm by bad actors committed to leveraging technology for harm[30]. For most of the world however, education, awareness and engagement are key, with digital literacy being a key element, equipping the public to understand, evaluate, and use technology responsibly.

History has demonstrated that the world has not always used technology as a force for good, particularly with regards to managing technological revolutions and their dislocations. The Industrial Revolution disrupted agrarian societies with millions of people migrating to cities in search of factory jobs, leading to overcrowded, unsanitary urban environments. Workers, often children, endured grueling and dangerous conditions and long hours in factories and mines. The mechanization of labor displaced skilled artisans, with industrialists amassing wealth while many laborers lived in penury, creating massive inequality and sowing the seeds of social unrest. And unchecked industrial pollution – air, water, and land – introduced long-term ecological harm, with the mass exploitation of fossil fuels kicking off the global warming process that continues to drive climate change to this day, (with the Paris Agreement explicitly using pre-industrial temperatures as the baseline for its climate goals as a result.)

The Information Era presents its own challenges that will need to be managed. Some of these, like job displacement and workforce inequality, social fragmentation and the concentration of power in monopolies that control key technologies rhyme with the challenges created by prior revolutions. Others, like the erosion of privacy due to the collection and misuse of personal data, or the potential loss of human agency with people being manipulated by AI and algorithms, are

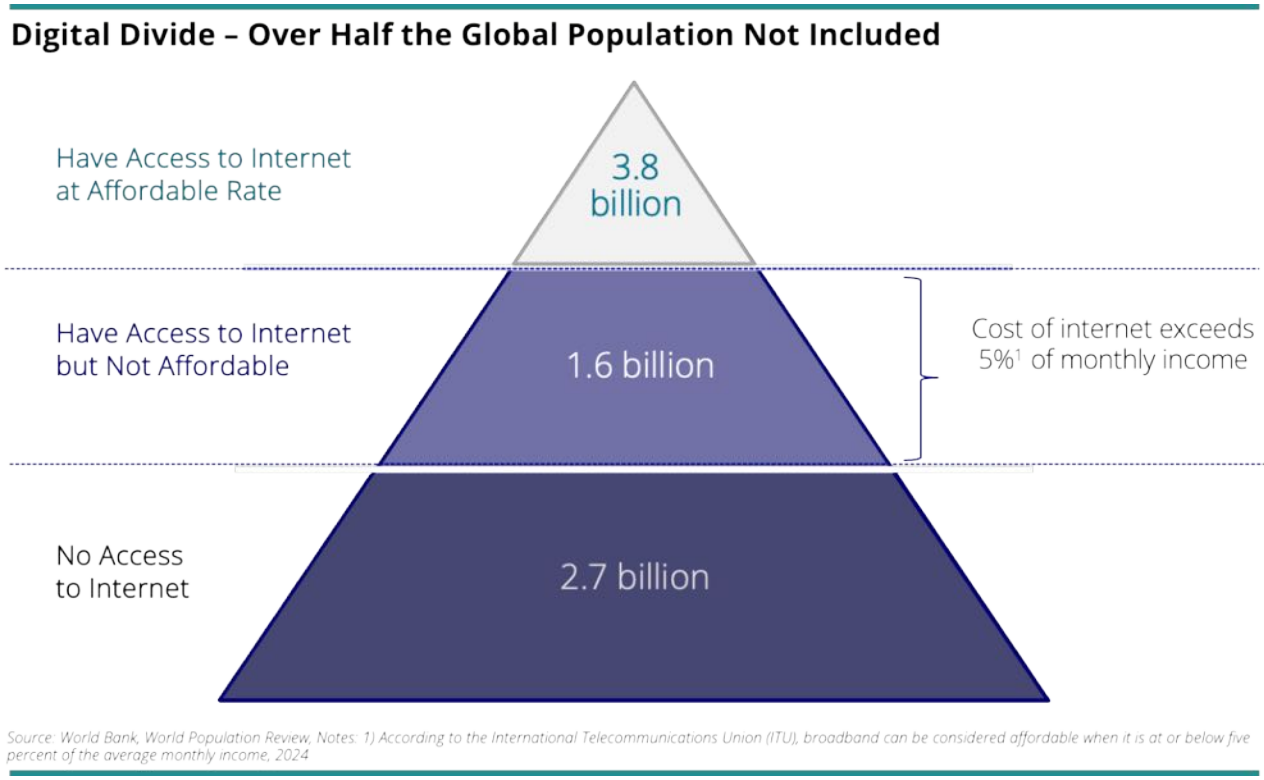
entirely new. Addressing these challenges will require regulatory, social and technological responses in a coordinated effort.

Of course, a key requisite for technology to have any meaningful impact, good or bad is its widespread deployment. Despite declining costs and rapid economic development across large parts of the world, access to digital technology varies significantly across and within countries, creating a digital divide that inhibits technology's potential as a force for good in the world.

Access to Technology Remains Uneven Across the World: Bridging the Digital Divide

Digital technology's scalability is a key driver of its impact potential, along with its ability to more easily overcome physical constraints that limit traditional infrastructure and service delivery. Yet despite these clear benefits, access to digital technology around the world remains highly uneven, giving rise to a 'Digital Divide' between those who are connected and those who are not, and therefore largely beyond the reach of the benefits the digital technology brings.

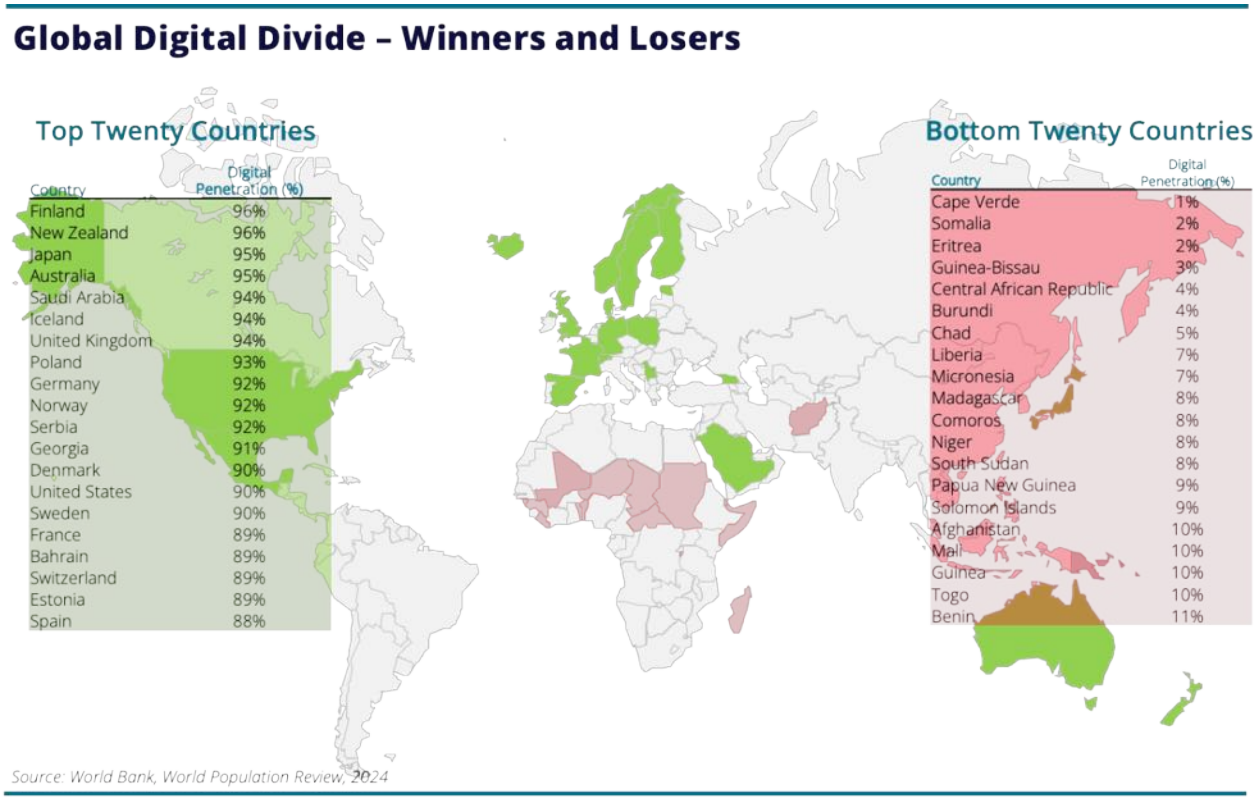
Figure 8: Global Digitization Inclusion Pyramid



Digital inclusion is not only a function of internet access, but also of affordability. While 5.4 billion people, (66% of the global (adult) population) are currently accessing the internet in some shape or form, for 1.6 billion people the costs of access remain prohibitive, which effectively excludes them from deriving meaningful benefits from being online, in terms of ubiquitous access to information, communications and services. This leaves over half of the global population not sufficiently (or not at all) digitally included, pointing to a significant global digital divide. While there is a strong geographic element to the divide (with African countries representing 17 of the 20

countries globally with the lowest internet penetrations[31]) the Digital Divide is both global and multi-dimensional, with access levels also varying across regions, income levels, and demographic groups within countries or individual communities even. The elderly, remote rural populations, and the socioeconomically disadvantaged in even the richest countries lag well behind the national average technology integration rates.[32] The consequences of this digital divide are set to become increasingly stark: The digital economy outgrowing the physical one by a factor of two and will reach over US$16 trillion by 2028.[33] As the value and volume of global economic activity shifts in digital's favor, an increasing number of new products and services across essential areas like finance, healthcare and education will only be offered online, leading to the exclusion of customers, patients and students who cannot migrate with them.

Figure 9: Global Digital Divide



Comprehensively addressing the global Digital Divide in a timely fashion will require an engagement that is as muti-dimensional as the problem that it is seeking to solve and to use an analogy from the technology industry itself, require a 'solutions stack', consisting of a set of subsystems or components to create a complete platform. These components consist of policies and regulations, infrastructure, hardware and software and even cultural norms, including the following:

Figure 10: Layers of Digital Inclusion

Digital Inclusion Layers	Description
Content and Services Layer	Applications, E-enabled services, and digital information providers
Transaction Infrastructure Layer	Digital public goods that facilitate exchanges between individuals (including payments, secure messaging, ID verification, and security)
Information, Education and Training Layer	User assistance and digital literacy training embedded in systems
Communication Layer	Core communication infrastructure enabling one to one and one to many data exchanges (i.e. the communications network)
Universal Access Layer	Hardware, software and services providing inclusive user interfaces and access and digital participation for all
Pervasive Availability Layer	Pervasive network(s) providing full coverage regardless of geographic limitations
Rules of Engagement Layer	Policy and regulatory framework underpinning affordable and universal access for people, enshrining digital public goods and regulating fair and free technology markets.
Human-Security Layer	Law and regulations enshrining human security and rights in an environment of increasing AI capabilities

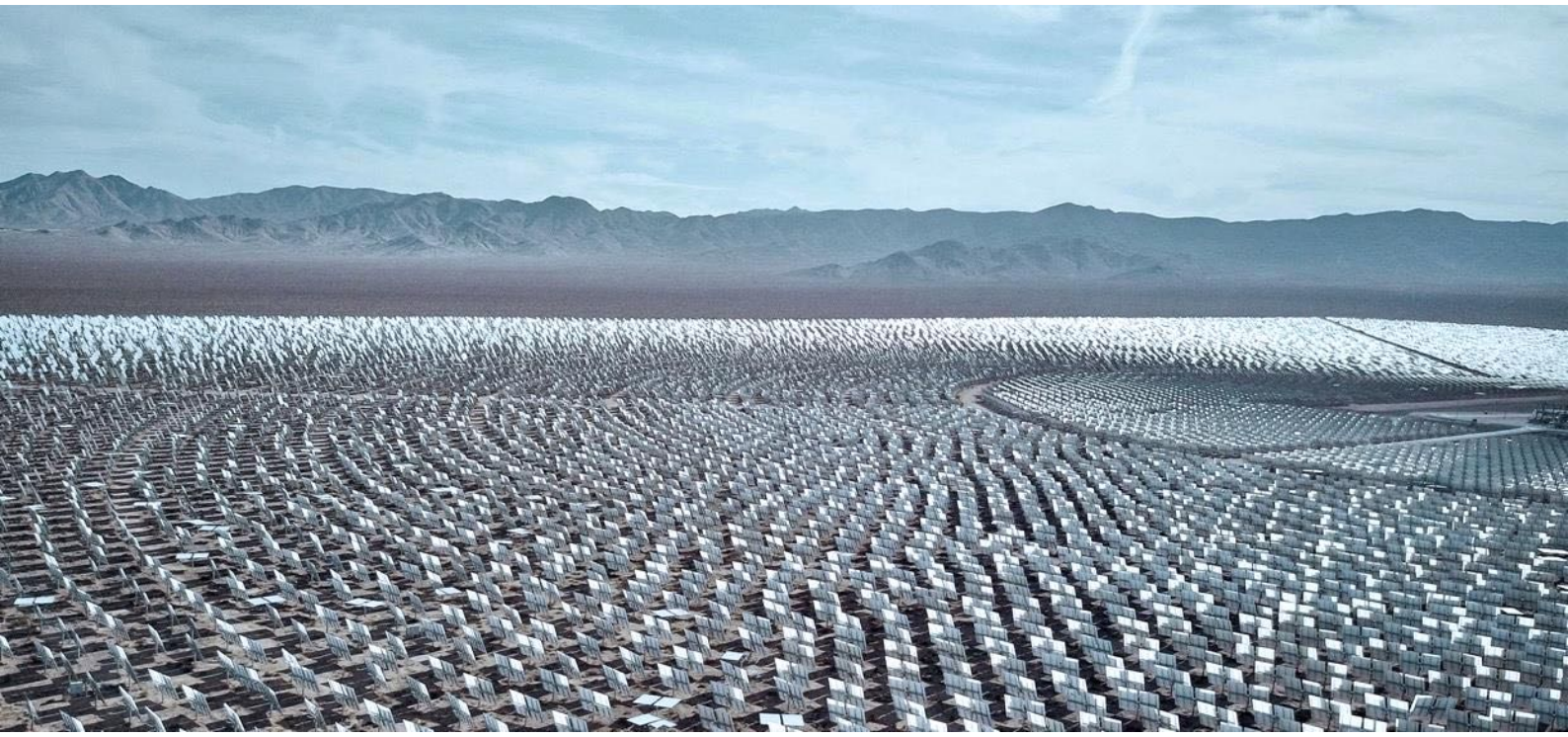
By addressing both the technological and socio-economic barriers to digital adoption in a coordinated manner, the global Digital Divide can be significantly reduced, empowering communities worldwide to participate in the digital economy.

A key consideration arising from digital inclusion is the management of unintended consequences that have arisen in other parts of the world as a result of pervasive digital technologies and communications networks, namely the rise of misinformation, the loss of trust in key institutions and the emergence of post-truth societies, where facts have lost their significance in public discourse to emotions, which are in turn manipulated by social media algorithms. While digital inclusion is critical to spreading education and information, it has also been a fount of misinformation, which has driven climate denial while scientists warn of existential risks, election result denial even as poll counts reveal winners and losers, and vaccine denial while millions die in the covid pandemic. The accompanying loss of trust in established political, civil and scientific institutions risks undermining democracy, civil liberties and freedoms, and social stability. This calls for a comprehensive global security pact, rigorously enforced, if the foundations of society are to be preserved. The UN work on the Technology Compact is one small but important step in that direction.[34]

In summary

- The interrelated risks facing the world today in the form of the "polycrisis," are symptoms of a larger transition underway, which is threatening to overwhelm the liberal international order.
- The current world system is at a tipping point, awaiting renewal and a transition towards a more sustainable development model. This will require a system wide shift redrawing the relationship between societies, economies, and the environment.
- Technology has a critical role to play in this transition, with 19 core technologies serving as the building blocks of the Fourth Industrial Revolution building the future. These technologies have the potential to be a powerful force for good in the world, but access to them remains highly uneven.
- The world will need to bridge this digital divide in a coordinated manner, empowering communities worldwide and engendering trust in technology to participate in the digital economy and its benefits.

III. Lifting the World: Harnessing Technology to Meet the SDGs



Despite global efforts, progress on the SDGs has stalled and none of the 17 goals are currently on track to be met by 2030, and the goals' estimated US$14-17 trillion annual funding shortfall is increasingly unaffordable, highlighting the urgent need for more transformative efforts. The success of the SDGs hinges on the world's ability to identify, scale, and implement mass solutions rapidly and globally, nine of which are outlined in this report and cumulative have the potential to drive global SDG progress to nearly 90%. Technology is a critical component of all these solutions and technology companies are well suited to lead in their deployment. However this requires addressing critical barriers to implementation around the world, which if removed unlock a US$15 trillion global market opportunity.

1. The World Needs to Execute Big Ideas for the SDGs

The interconnected nature of the world's long term systemic challenges is abundantly clear. Long term issues such as poverty, inequality, climate change, environmental degradation, and human security can only be solved comprehensively considering the interdependence of social, economic, and environmental factors. Against the backdrop of growing global inequality, environmental crises and increasing geopolitical instability, the United Nations in 2015 sponsored the SDGs as both a call to action and as a shared global blueprint for peace and prosperity for people and the planet with a deadline of 2030.

However, by the midpoint of 2023, despite adoption by all 193 UN member states, progress toward achieving the goals remains critically off track. Initial advancements have been undermined by inadequate action, persistent underinvestment, and the compounded effects of environmental, economic, and security shocks on an insufficiently resilient global system. Consequently, none of the 17 SDGs are currently on trajectory for full realization, highlighting the urgent need for transformative efforts.

At current rates of development, rather than delivering safe and affordable drinking water for all by 2030, 1.6 billion people approximately 19% of the global population will still lack access by then,[35] and the number of people requiring access to safe and affordable housing will nearly *double* to 3.0 billion over the same period[36], pointing to a trajectory of *decreasing* rather than increasing human security. Among the key challenges impeding progress toward the SDGs, current spending on sustainable development remains significantly below the required levels. Mobilizing the necessary capital faces substantial barriers, exacerbated by the economic disruptions of the past half-decade, including the global pandemic, energy shocks, wars, inflation, and, in many cases, currency depreciation. These factors have left many developing countries – and even some developed ones – poorer and more indebted, rendering them unable to afford the investments essential for sustainable development. Additionally, the rise of political and economic deglobalization has hindered coordination among the few countries capable of funding their own and others' sustainable development efforts, undermining effective deployment of resources. While estimates of the total funding needs and gaps to achieve the SDGs vary, with UNCTAD's currently estimating an annual shortfall of over US$4 trillion,[37] most estimates cover only a subset of countries, goals or capital requirements. A detailed analysis of the comprehensive cost of the goals suggests that the annual funding gap is approximately US$14–17 trillion through 2030, with the bulk of the shortfall concentrated in developing economies.[38]

The SDGs are both a call to action and a shared global blueprint for peace and prosperity for people and the planet with a deadline of 2030. However, at their midpoint of 2023 progress toward achieving the goals remains critically off track

The success of the SDGs hinges on rapidly identifying, scaling, and globally implementing high impact initiatives without relying on a comprehensive global action plan. The existence of such solutions developed by multilateral institutions, private sector corporations, NGOs, and national governments, makes achieving the goals a realistic possibility.

A second key challenge is time. The 2030 deadline for the goals is fast approaching and the world lacks the time required to develop and execute a comprehensive global multi-stakeholder action plan to meet the goals. Even if the capacity for the requisite multilateralism were present – an assumption undermined by current geopolitical tensions – the fragmentation among governments, exacerbated by global conflicts and rivalries, remains a formidable barrier. Superpower conflicts and actual conflicts, as well as the resulting deadlocks in multilateral organizations hinder global coordination, as does the systemic misalignment between

the prosperous Global North and the under-resourced Global South, coupled with disparities within nations and between the public and private sectors.

From an execution standpoint, the SDG have always been attainable, as they were designed to be achieved using existing technologies and solutions at the time of the goals' formation, rather than relying on further innovation or the development of untried and untested solutions.

The success of the SDGs will therefore hinge on the world's ability to identify, scale, and implement viable initiatives rapidly and globally, without relying on the creation of a comprehensive global action plan. Fortunately, numerous such initiatives already exist, developed and implemented by innovative and entrepreneurial entities, including financial institutions, global corporations, NGOs, international organizations, and national governments. Their availability makes achieving the goals a realistic possibility, centered on scaling and deploying these existing solutions worldwide.

Many large-scale initiatives have the potential to significantly impact specific SDGs or address broader underlying issues that impact multiple SDGs. Previous research by Force for Good reviewed over 2,000 initiatives and sustainability-related announcements, highlighting key efforts based on extensive research and leader interviews, with subsequent work diving further into the transformative role of digital technology in advancing the SDGs, identifying additional tech-driven initiatives.

Several "Big Ideas" or levers for large scale change emerge from these initiatives, which, if scaled globally, could generate the momentum needed to bridge the SDG gap. Importantly, these ideas do not rely on technological breakthroughs but rather on innovative approaches to deploying existing solutions. These include:

1. Accelerating the Climate and Energy Transition. Comprehensive policy and fiscal initiatives to drive national climate neutrality and energy transition, while fostering innovation, economic growth, a circular economy and the promotion of biodiversity.
2. Enhancing Universal Connectivity with AI. Universal internet connectivity enabling scalable, efficient, and innovative solutions that utilize AI to leapfrog current models of tech-enabled solutions delivery.
3. Scaling Online Basic Service Delivery Globally. Digital technologies to transform the delivery of basic services, particularly education, healthcare and commerce.
4. Fully Pricing Externalities to Promote Sustainable Behaviors. Placing a fair price on externalities to naturally drive sustainable valuations, markets and behaviors.
5. Democratizing Digital Mass Financial Inclusion. Core digital infrastructure enabling the delivery of financial services for mass inclusion.
6. Financing Impact with Innovative Solutions. Innovative capital market financing tools applied to address major issues for impact.

7. Leveraging Innovation to Deliver Human Essentials. Innovative technologies, deployed at scale, to transform secure access to key human essentials including food, water and medicine, and thereby provide for human dignity.
8. Unlocking Human Potential for Impact. The use of technology to unlock human potential for good ranging from responsible consumption to collaborative innovation with mobilization at scale, with COP30 providing a focal opportunity to re-galvanize worldwide.
9. Deploying Climate Change Resilience Solutions. Integrated solutions driving climate resilience to predict and mitigate key risks resulting from climate change.

This list is of course not exclusive, and notably absent are solutions for over-arching critical requirements such as peaceful co-existence, including disarmament, peace corps, and the criminalization of war. A 10th Big Idea that the world needs to embrace is a wide-ranging global peace offensive delivering peace and dignity for all, given the fact that war is diametrically opposed to sustainable progress. This is a pre-requisite for the deployment of any of the Big Ideas, indeed when peace and security levels are too low, solutions cannot be implemented. While the nine ideas above essentially cover the SDG related to people, planet and prosperity, the 10th Big Idea can galvanize SDG17 (Partnership for the Goals) and SDG16 (Peace Justice and Strong Institutions). A sufficient level of peace and stability is fundamental for countries to engage each other bi-and multilaterally on sustainable development, and for governments in turn to deliver on security and justice at home.

Given the right initiatives and solutions to execute them, these Big Ideas, have the potential to solve for many of the SDGs, with initiatives ranging from point solutions that make a significant impact on a single or a few goals to enabling solutions that have a smaller general impact across a wide range of goals. Previous research by Force for Good has highlighted solutions tied to nine 'Big Ideas' that if globally implemented could have a disproportionate impact on the world's progress towards the SDGs.

2. Technology Critical for Execution

Technology's Multidimensional Impact

Technology has a critical role to play in meeting the SDGs in general, and specifically in the initiatives that underly the Big Ideas outlined above. Technology's impact on the goals is across many levels. Some of the goals' underlying targets are specifically technology related, such as Target 5.b (Enhancing the use of enabling technology, in particular information and communications technology (ICT), to promote the empowerment of women). or Target 17.7 (Promoting the development, transfer, dissemination, and diffusion of environmentally sound technologies to developing countries), which are largely focused on the deployment, accessibility and use of digital technologies for a wide range of essential purposes.

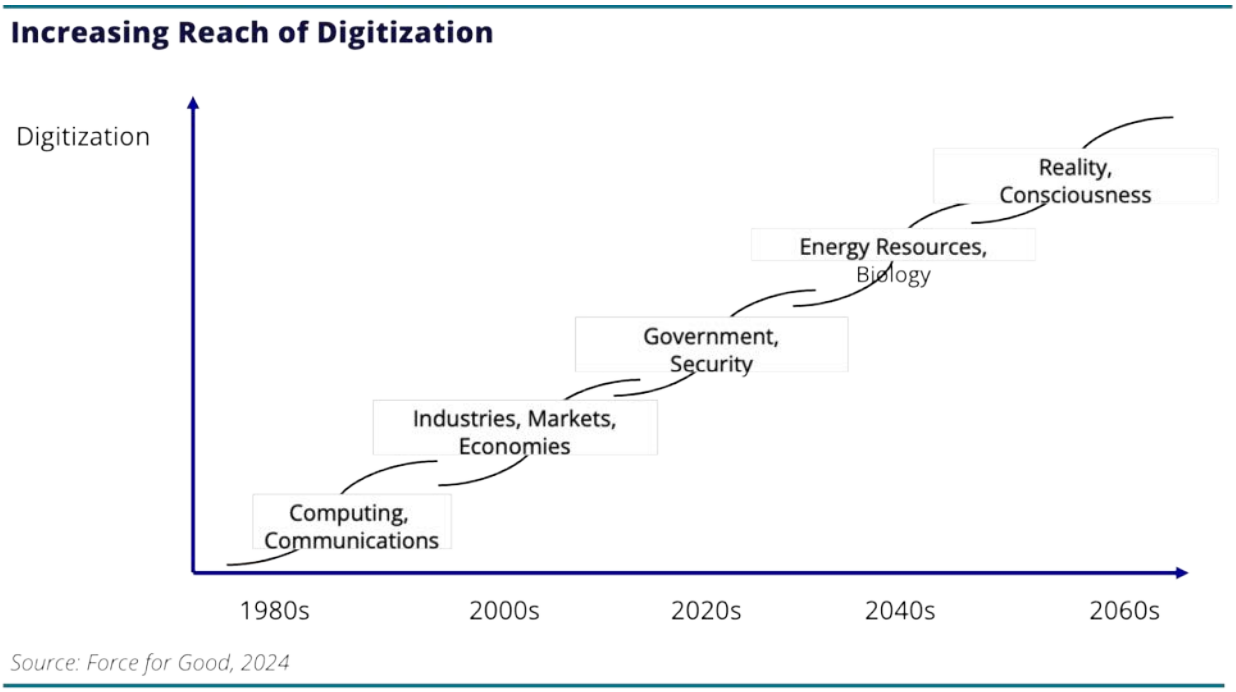
More generally however digital technology has a critical enabling role to play across most of the goals. Research by the ITU and UNDP indicate that the use of digital technology can impact nearly 70% of the 169 SDG targets.[39]

Technology's role in the solutions that implement the Big Ideas is similarly fundamental. For the small number of Big Ideas that are essentially financial or policy-driven in nature such as *"Climate and Energy Transition Blueprints", "Sustainability Standards", and "Developing Country Financing Tools"*, technology plays a critical role as a fundamental enabler. Among digital technologies, universal internet connectivity alone was estimated in a different study to potentially address c. 20% of the SDGs, given the general improvement in information access, sharing, processing, as well as decision making that this connectivity could drive around the world. If this connectivity can be further enhanced with the scaled deployment of artificial intelligence technologies, the impact could be even greater, solving for c.25% of the SDGs. Due to this transformative impact potential, "*AI-enhanced Universal Connectivity*" is one of the nine Big Ideas explored further in this report.

Digital technology has a critical role to play across the Sustainable Development Goals, impacting nearly 70% of the 169 SDG targets

Digital connectivity's impact potential is a function of digital technology becoming increasingly integral and embedded across all aspects of the economy and society. Over the past two decades, digital technologies have revolutionized fields such as health, finance, education, entertainment, and commerce. The breakthroughs being achieved today in areas such as electric vehicle design and precision medicine are made possible by the integration of advanced digital technologies, which are further expected to or already driving transformative changes in material sciences, energy, manufacturing, construction, and biology.

Figure 11: Digital Everything[40]



The increasing reach of digitization opens the door to scaled and targeted digital solutions to address not just connectivity, but also global health, education, financial inclusion, employment, sustainability, energy, and governance challenges, and indeed several of the Nine Big Ideas, including *"Democratizing Digital Mass Financial Inclusion", "Scaling Online Basic Service Delivery Globally",* and *"Unlocking Human Potential for Impact",* are built around or based on platforms that are digital in nature.

Of course, technology goes beyond digital, and includes engineering, biomedical technologies, material sciences, electronics, and chemistry to name just a few areas. Meeting the SDGs will of course require deploying many of these technologies too at scale around the world to increase food production, improve healthcare provision, build homes and roads, reduce waste, generate clean energy, and clean up the environment, among other things Big Ideas like *"Leveraging Innovation to Deliver Human Essentials"* and *"Climate Change Resilience Solutions"* for example rely specifically on the development and deployment of such physical technologies.

The most critical shared attribute among the highlighted solutions is not technological, it is their immense growth potential. Each has the capability to scale globally, delivering substantial impacts aligned with the SDGs. If deployed worldwide as preferred strategies to address their respective challenges, these nine initiatives could significantly advance progress toward the goals.

Figure 12: Nine Big Ideas to Achieve the SDGs

Big Idea	Initiative(s)	Role of Digital Technology	19 Core Technologies Utilized	Key SDGs Impacted
Enhancing Universal Connectivity with AI	**AI-enhanced Universal Connectivity.** Generative AI's ability to learn, adapt, and create offers new ways to solve complex problems, enhance human creativity, and improve decision making across all the goals.	Targeted Solution	AI Big Data IoT	
Democratizing Digital Mass Financial Inclusion	**Digital Financial Services.** Mass financial inclusion based on unique digital infrastructure, for broader social inclusion in both developing and advanced industrialized economies.	Targeted Solution	AI Big Data IoT Blockchain	
Scaling Online Basic Service Delivery Globally	**Digital and Telehealth.** Virtual medicine platforms including primary care, mental health, and chronic condition management, as well as mobile health. **eLearning.** Digital learning platforms to overcome barriers to education and to improve overall learning outcomes. **E-commerce.** B2B and B2C e-commerce platforms driving economic inclusion for small businesses.	Targeted Solution	AI Big Data IoT Blockchain	

Big Idea	Initiative(s)	Role of Digital Technology	19 Core Technologies Utilized	Key SDGs Impacted
Unlocking Human Potential for Impact	**Platforms for Individual and Societal Collaborative Development.** AI enabled tools for individual level awareness, empowerment, collaboration and transactions driving impact, and mass mobilization around key events.	Targeted Solutions	AI Big Data	
Accelerating the Climate and Energy Transition	**Climate and Energy Transition Blueprints.** The European Green Deal is an integrated blueprint of legislation, regulation, incentives and enabling policies to transform Europe's economy and societies for sustainability.	Enabling	AI Big Data Smart Grid Renewables Energy Stor.	
Fully Pricing Externalities to Promote Sustainable Behaviors	**Sustainability Standards.** The IFRS Sustainability Disclosure Standards developed by the ISSB provide a global baseline of sustainability disclosures for the capital markets and set the stage for pricing and accounting for externalities.	Enabling	AI Big Data	
Financing Impact with Innovative Solutions	**Developing Country Financing Tools.** Innovative capital market financing tools including environmental impact bonds and debt for SDG swaps, mobilizing private capital to fund public spending in developing countries.	Enabling	AI Big Data	
Leveraging Innovation to Deliver Human Essentials	**Affordable Medicine.** Quality low-cost drugs and therapeutics, critical for reducing global mortality and improve global health outcomes. **Filtration and Wastewater Technologies.** Innovative technologies improving the efficiency, reducing the cost, and driving the scalability of water treatment. **Gene Edited AgTech.** CRISPR/Cas9-based technologies can revolutionize global food systems with enhanced nutrition, improved food safety, greater resistance to disease, and better climate resilience.	Enabling	AI Big Data Gene Editing	
Deploying Climate Change Resilience Solutions	**Climate Change Adaptation Solutions.** Integrated climate resilience solutions combining multi-hazard early warning systems alongside innovative risk transfer mechanisms that increase the financial capacity of disaster response and recovery.	Enabling	AI Big Data IoT Drones	

The good news is that all the Big Ideas are based on proven use cases that leverage proven technologies, and none require further fundamental breakthroughs to be achieved. The SDGs in general were designed to be achieved by the technology available to the world at the time the goals were introduced, and while the solutions arising from the Big Ideas certainly benefit from technological advances made in the past decade, they need to be based on technologies that are proven, robust, flexible, scalable, and cost-effective if the goals are to be met by 2030. These requirements place the Big Ideas somewhat at odds with many of the 19 core technologies of the future, many of which remain in early stages of development or roll-out and have only limited use cases developed and validated at this time. Given this focus on the near term, the Big Ideas highlighted in this report mainly draw on those of the 19 technologies that are ready for roll-out, rather than cutting edge or early-stage technologies. The key core technologies most critical for solutions enabling the Big Ideas are AI and Big Data (deployed across all nine solutions), IoT (deployed across four), and Blockchain (deployed across two).

Figure 13: Critical Technologies Driving the Big Ideas

Technology	Big Ideas Impacted	Key Sources of Impact
Artificial Intelligence 	▪ Universal Connectivity with AI ▪ Digital Mass Financial Inclusion ▪ Online Basic Service Delivery ▪ Human Potential for Impact ▪ The Climate and Energy Transition ▪ Pricing Externalities for Sustainability ▪ Innovative Financing Solutions ▪ Innovation Delivering Human Essentials ▪ Climate Change Resilience Solutions	General enabling role based on ▪ Automation of repetitive tasks; ▪ Data -based decision-making support, and ▪ Improved efficiencies and process streamlining
Big Data 	▪ Universal Connectivity with AI ▪ Digital Mass Financial Inclusion ▪ Online Basic Service Delivery ▪ Human Potential for Impact ▪ The Climate and Energy Transition ▪ Pricing Externalities for Sustainability ▪ Innovative Financing Solutions ▪ Innovation Delivering Human Essentials ▪ Climate Change Resilience Solution	General enabling role based on ▪ Data -based decision-making support; ▪ Monitoring and progress tracking, and ▪ Predictive analytics
Internet of Things 	▪ Universal Connectivity with AI ▪ Digital Mass Financial Inclusion ▪ Online Basic Service Delivery ▪ Climate Change Resilience Solution	Specific enabling roles including ▪ Networked devices enhancing universal connectivity; ▪ Distributed applications across education, health, finance and commerce; ▪ Sensor and communication networks
Blockchain 	▪ Digital Mass Financial Inclusion ▪ Online Basic Service Delivery	Specific enabling roles based on ▪ Secure low-cost transaction platforms, and ▪ Data management and privacy enablement

Additionally Smart Grid, Renewables, Energy Storage, and Drones are each deployed across one of the Big Ideas. While innovation and the other 19 technologies will likely be critical enablers of

other longer-term solutions and initiatives, the need for near term large scale catalytic change precludes their having a large impact on the initiatives highlighted below.

It is essential to note that these nine solutions are neither exhaustive nor exclusive. Numerous other initiatives have the potential to drive equally profound impacts on the SDGs. While some may overlap with the highlighted solutions, others will address entirely different challenges that the selected programs do not fully encompass. Examples identified in the underlying research include diverse innovations such as circular economy systems and tools, decarbonization solutions, and collaborative platforms like crowdfunding and crowdsourcing. The breadth of these additional solutions highlights the scale of opportunities with the potential to accelerate progress toward the SDGs.

3. Nine Big Ideas – Summary Case Studies

Enhancing Global Connectivity with Artificial Intelligence

AI-Enabled Universal Connectivity

Enhancing internet connectivity's role as an enabler for almost every SDG with artificial intelligence to gather and process data, automate complex tasks, provide insights, and improve decision-making

Key Highlights

- Achieving universal internet connectivity requires just 0.45% of global GDP, making it a cost-efficient means of addressing numerous SDGs, particularly in low-income regions facing infrastructure challenges
- There are multiple multilateral initiatives underway to drive global internet connectivity, including UNICEF's Giga project, which seeks to mobilize US$5 billion to connect over two million students.
- Enhancing universal connectivity with AI transforms the value of digital information and data, improving data gathering, processing, and analysis to optimize resource allocation, automate tasks, and support decision making across all the goals.

➢ AI-Enabled Universal Connectivity is a critical and fundamental enabler of all 17 SDGs, supporting, augmenting and potentially replacing human problem solving and decision making for targeted actions

Core Technologies Leveraged

- AI: Identify Patterns and Optimize Performance
- Big Data: Storage, Analysis and Management of Large Data
- IoT: Efficient Infrastructure management

AI-Enabled Universal Connectivity: The Case for Global Scaling

Economic Transformation Potential

<2.5% uplift in GDP from increasing broadband penetration by 10% (ITU)

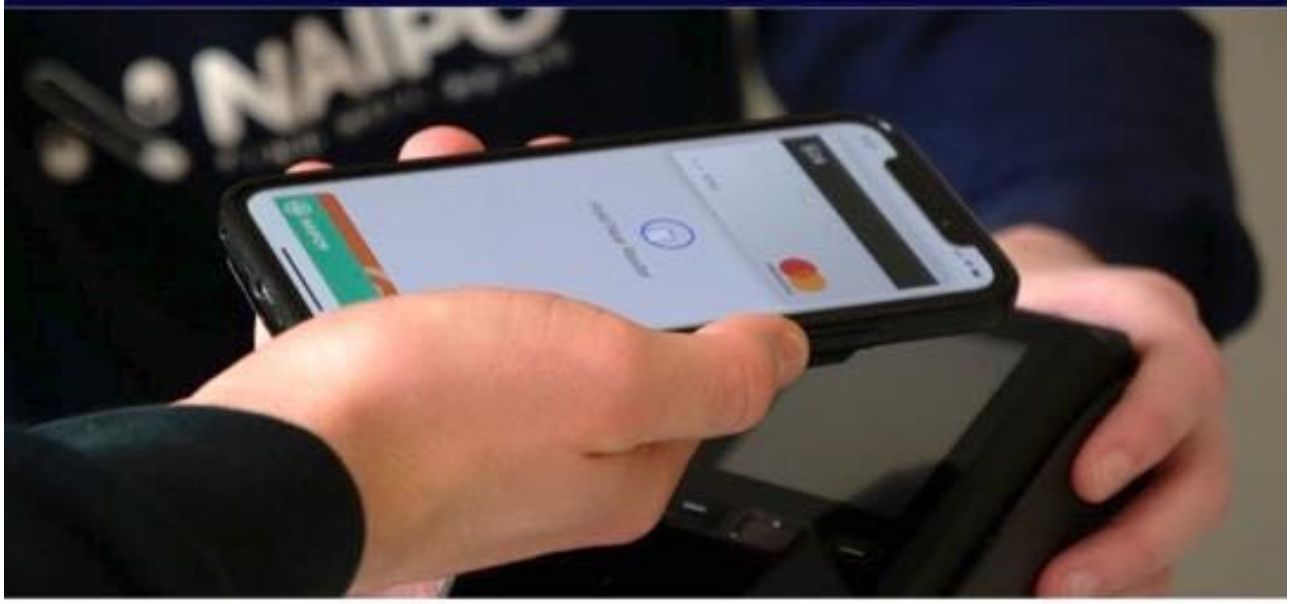
US$15.7 trillion potential contribution to the global economy from AI by 2030 (PWC)

+26% potential GDP uplift to local economies from AI by 2030 (PWC)

Potential Contributions to Key SDGs

Democratizing Digital Mass Financial Inclusion

Digital Financial Services Platforms



A unique digital infrastructure for the delivery of financial services, driving mass financial and social inclusion, and enabling the provision of broader digital services to people and businesses.

Key Highlights

- The 'India Stack' of technologies is a robust platform for financial inclusion through digital identity and payment solutions with a total of real-time mobile payments worth INR 14.05 trillion and 67 Billion digital identity verifications done to date.
- With demonstrated scalability of over 500 million people in India already financially included, technological advancements in microfinance can act as a catalyst for the industry and inclusion.
- Coordinated targeting of disadvantaged customer segments by financial services companies with tailored products delivered at scale can reduce inequalities globally.
- Customized deployment across diverse markets can target varying needs, such as microfinancing in less developed countries (LDCs) and driving social capital inclusion in advanced economies.

➢ Transfer of India Stack technologies for adoption and integration into national banking systems to drive global financial inclusion

Core Technologies Leveraged

- AI: Comprehensive and Inclusive Evaluation
- Big Data: Insightful Customer Behavior Analytics
- IoT: Device Connectivity and Digital Infrastructure
- Blockchain: Reduce Fraud and Increase Transaction Transparency

Digital Financial Services Platforms: The Case for Scaling

Global Requirement for Digital Inclusion

3 billion people in developing countries do not have access to loans, insurance and money transfers (The World Bank)

40% of world's population still live in rural areas which can be brought under the ambit of microfinance. (UN)

2%, the bottom half's share of global wealth. (World Inequality Report 2022)

Potential Contributions to Key SDGs

Scaling Online Basic Service Delivery Globally

E-Commerce, E-Health, and E-Learning

Leveraging digital technologies and broadband connectivity to scale and transform the delivery of basic services, particularly education, healthcare and commerce

Key Highlights

- Increasing penetration of e-commerce in developing markets is driving digital inclusion and bottom-up economic growth for small businesses and micro-entrepreneurs, with market access bringing rural upliftment.
- In 2024, there were over 116 million users of online doctor consultations worldwide, up from around 57 million in 2019, increasing the efficiency of national healthcare systems
- Digital learning platforms close education gaps through remote and personalized learning, teaching digital literacy and supporting and training teachers through c.500 national digital learning platforms in the world.

➢ E-learning, e-commerce, and e-health platforms collectively enhance scalability, reduce costs, and improve service efficiency by expanding access to global markets, personalized education, and healthcare services, enabling underserved populations to benefit from high-quality, accessible solutions that drive progress toward the SDGs .

Core Technologies Leveraged

- AI: Automated Support and Adaptive Learning
- Big Data: Personalization and Impactful Insights
- IoT: Enhanced Data Collection and Real-time Monitoring
- Blockchain: Secure Global Transactions

Online Basic Services : The Case for Global Scaling

Significant Global Unmet Needs

50-80% of employment in developing countries generated (M)SMEs, the vast majority of which do not have proprietary ecommerce capabilities (Accenture)

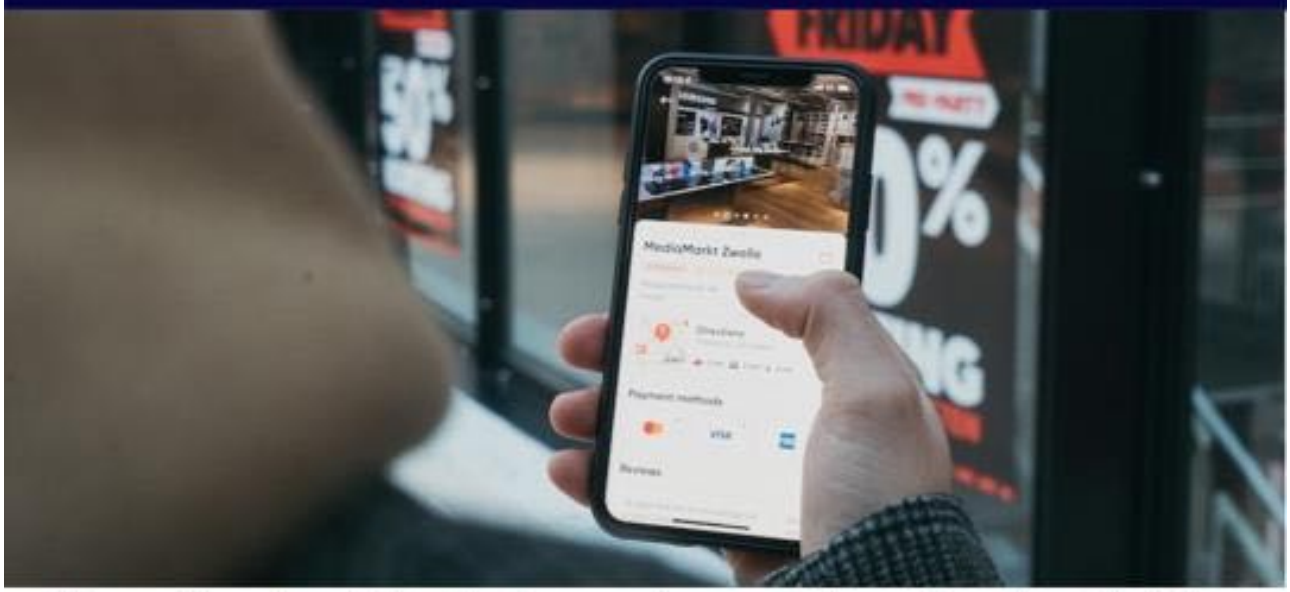
7 million current global shortage of health workers, rising to 13 million by 2035 (WHO)

244 million children currently out of school (UN)

Potential Contributions to Key SDGs

Unlocking Human Potential for Impact

Platforms for Individual and Societal Collaborative Development



Using social media and AI to drive human and corporate change through sustainability awareness, fostering collaboration and facilitating global impact on key developmental metrics

Key Highlights

- Social media platforms with billions of active users have the potential to reach nearly 60% of the global population, amplifying awareness and engagement with SDGs across diverse communities.
- AI enabled tools can can significantly impact individuals towards greater sustainability as consumers, voters, workers, and community members, driving awareness, empowering actions, enabling collaboration and facilitating transactions
- Campaigns focusing on key events can mobilize individuals at scale to act collectively, influencing peers, the private sector and governments, and deploying significant consumer and financial power

➢ Platforms can unlock human potential by amplifying SDG awareness, promoting sustainable content, and fostering peer-driven collaboration, as well as the mass mobilization of individuals to collectively drive sustainability

Core Technologies Leveraged

AI — Targeted and Coordinated Information Exposure

Big Data — Behavioral Analysis and Predictions

Platforms for Collaborative Development: The Case for Global Scaling

Collective Power of Individuals at Scale

5.2 billion social media users around the world (Kepios)

US$73 trillion of total annual household consumption expenditure (World Bank)

US$43 billion in funds raised and disbursed by the Global Citizen community action platform (Global Citizen)

Potential Contributions to Key SDGs

Accelerating the Climate and Energy Transition

Climate and Energy Transition Frameworks

Comprehensive policy and fiscal initiatives to drive national climate neutrality and energy transition, fostering innovation and sustainable economic growth

Summary Description

- Countries need to develop comprehensive policy frameworks to manage their economies and societies transitions to a net zero future, including the mobilization of significant capital to build new capacity and (particularly in industrialized countries) replace or upgrade existing industrial and energy capacity
- Successful transition frameworks include both comprehensive legislative and regulatory packages (like the EU Green Deal, or the Fit for 55 package) as well as capital mobilization in the form of investments and incentives (like the US Inflation Reduction Act.)
- Key areas to be addressed include (among others), emissions reductions, CO2 standards, emissions trading, renewable generation, hydrogen strategies, land use and biodiversity, energy taxation, social climate funding, energy efficiency, and sustainable buildings and transportation

➢ Potential best-in-class package of policy blueprints to be implemented by countries around the world (with local adaptation as required)

Core Technologies Leveraged

Energy Transition Tech and Algorithms	Predictive Modeling and Advanced Analytics	Real-time Pricing and Smart Tech	Clean Energy Alternatives	Consistent Renewable Energy Supply
AI	Big Data	Smart Grid	Renewables	Energy Storage

Climate and Energy Transition Frameworks: The Case for Scaling

Key Metrics: The European Green Deal

55% reduction in CO2 emissions by 2030 (European Commission)

35m buildings upgraded for sustainability across the region (European Commission)

100 cities across the union (c.12% of total) achieving climate neutrality (European Commission)

Potential Contributions to Key SDGs

Fully Pricing Externalities to Promote Sustainable Behaviors

Global Sustainability Standards

Developing global standards for corporate disclosure of sustainability impacts tied to financial reporting, enabling the pricing of externalities and incentives for corporate sustainability

Summary Description

- Corporate reporting provides critical transparency to stakeholders, allowing investors, customers and business partners to assess organizations performance against critical metrics
- Consistent standards for disclosing sustainability related metrics are a critical step in companies tracking and quantifying the sustainability impacts of their businesses
- Quantifying and valuing these impacts allows integrating sustainability data into financial reporting, capturing the value (and cost) of positive and negative externalities created, and providing the basis for internalising these externalities to fundamentally transform corporate behaviors.

➢ Fully accounting for externalities in financial reporting can transform corporate behavior and align businesses with the SDGs

Core Technologies Leveraged

AI — Resource Waste Minimization and Sustainable Pricing

Big Data — Data Collection and Analysis for Impact Measurement

Sustainability Standards: The Case for Scaling

The High Cost of Global Externalities

US$25 trillion combined externalities for the energy and transport sectors worldwide (University of Sussex)

US$21 trillion of projected external costs for GHG emissions and climate change in 2050 (BloombergNEF)

US$20 trillion of annual externalities of global food production (UN Food Systems Summit 2021 Scientific Group)

Potential Contributions to Key SDGs

Financing Impact with Innovative Solutions

Developing Country Financing Tools

Innovative structures for mobilizing private sector capital to fund developing country sovereign spending on the SDGs, tying funding to sustainability outcomes and leveraging multilateral development capital to scale

Key Highlights

- Innovative financial structures enable developing countries to access international capital markets to direct funds toward sustainability outcomes
- Environmental impact bonds, like the World Bank's Rhino Bond, showcase how private and public sector collaboration can share risk while driving conservation efforts globally.
- The "Galapagos Marine Bond" in Ecuador significantly reduced the country's sovereign debt while funding marine conservation, with credit enhancements increasing the attractiveness for all parties

➢ Innovative financial structures mobilize international capital markets to fund sustainability outcomes in developing countries by reducing sovereign debt and directing conservation investments.

Core Technologies Leveraged

AI — Intelligent Data Retrieval and Sustainability Solutions

Big Data — Risk Management and Extracting Insights

Developing Country Financing Tools: The Case for Scaling

Significant Funding Potential and Needs

US$30 trillion in total emerging market public debt (IIF)

c.28% of nominal debt burden available for funding future sustainable development (under the Galapagos Marine Bond structure)

c.US$8.5 trillion in potential public spending to be unlocked to meet the SDGs, vs a current debt-for-nature market estimate of US$800bn

Potential Contributions to Key SDGs

Leveraging Innovation to Deliver Human Essentials

Gene-edited AgTech, Affordable Medicine, Filtration and Wastewater Treatment Technologies

Leveraging technological innovation to create functionally superior, scalable, and cost-effective solutions delivering human essentials including water, food and basic medicine for all

Key Highlights

- Targeted gene editing technologies based on CRISPR/Cas9 have the potential to revolutionize global food systems with enhanced nutrition, improved food safety, greater resistance to disease, and better climate resilience.
- Vaccines produced by the Serum Institute of India against measles, rubella and meningitis have averted more than 25 million deaths, with doses selling for less than US$1 compared to more than US$100 for similar shots produced by developed countries.
- Scalable and distributed water purification and treatment technologies like aquaporins and nanotechnology are critical to underpinning health and sustainable development

➢ Effective adaptation of technology has the potential to fundamentally transform cost, functionality and sale of solutions that deliver on services essential to life.

Core Technologies Leveraged

AI — Tracking and Delivering of Essential Services

Big Data — Distribution Process Optimization

Gene Editing — Sustainable Crop Creation

Human Essentials: The Case for Global Scaling

Acute Global Need Across Key Essentials

238 million people in 48 countries facing acute food insecurity in 2022, up 10% annually (Reliefweb)

50 million deaths can be prevented through global immunization (US CDC)

US$260 billion is lost globally each year due to lack of basic water and sanitation (water.org)

Potential Contributions to Key SDGs

Deploying Climate Change Resilience Solutions

Climate Change Adaption [Solutions]

Teladoc

Integrated solutions to manage rising natural disaster risk resulting from climate change, including early warning systems, enhanced disaster response capabilities and risk transfer mechanisms for inevitable impacts

Key Highlights

- Multi-hazard early warning systems are critical to minimizing harm to people assets and livelihoods in the world's most vulnerable places, underpinning sustainable development efforts and adapting for inevitable climate change.
- With 300,000 disasters related deaths across 135 countries between 2015-2021, these systems provide early warning, allowing for better response preparedness.
- Insurance helps minimize economic damage from climate-related disasters, although only 30% of losses globally (and less than 5% in developing countries are insured, leaving uninsured annual damages of US$260bn
- Risk transfer mechanisms can unlock private sector funding for broader resilience at scale

➢ Integrated impact management solutions aid response to inevitable disasters from climate change by providing for early warning, better response capability and risk protection through insurance

Core Technologies Leveraged

- AI: Weather Modelling and Prediction
- Big Data: Improved Forecasts and Efforts
- IoT: Sensing and Data Capture
- Drones: Climate Risk Monitoring

Climate Change Adaption Solutions: The Case for Scaling

Inevitable Risks of Climate Change

5x increase in the number of natural disasters over the past 50-year period, driven by climate change, more extreme weather (WMO)

US$223 billion in economic damage from natural hazards and disasters worldwide in 2022, (Reliefweb)

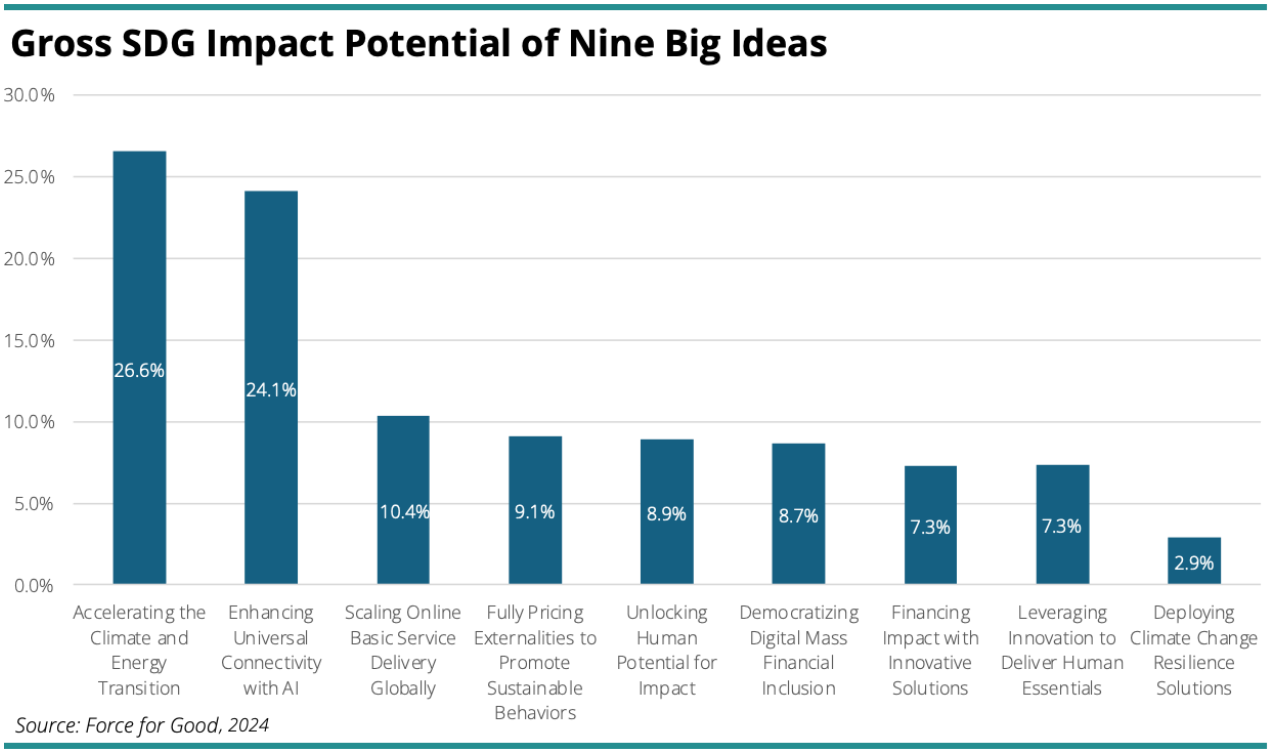
300,000 disasters related deaths across 135 countries between 2015-2021 (UN)

Potential Contributions to Key SDGs

4. Significant Contribution Potential on the SDGs

The impact potential on the SDGs of the solutions arising from the nine Big Ideas is substantial. An assessment of each solution's potential contribution on the targets underlying the goals demonstrates the significant impact on the goals overall that these solutions can make. The chart below indicates the average contribution each solution can make to fully meet the 169 SDG targets.

Figure 14: Gross Contribution to the SDG Targets



Based on these initiatives the six Big Ideas with the highest direct impact potential on the goals are:

- Accelerating the Climate and Energy Transition (27%), with initiatives like the European Union Green Deal and the US Inflation Reduction Act, providing a comprehensive set of laws, and regulations or investment incentives to manage the macro-economic, social, and political transitions to a low carbon future, collectively addressing over 26% if fully deployed.
- Enhancing Universal Connectivity with AI (24%), which will radically improve decision making across almost all the goals, generating new insights, incorporating more information to deliver better outcomes, and automating processes at speed and scale to support targeted actions, building on the benefits generated by universal internet connectivity. Given the speed of advances being made in generative AI, its potential impact on the SDGs is continuing to evolve and will likely grow significantly as it is applied to specific goals in a targeted fashion.
- Scaling Online Basic Service Delivery Globally (10%), has a potentiality significant impact on the SDGs, driven by e-learning solutions driving education, e-commerce platforms driving

economic integration of small businesses and, and e-health solutions improving access to and the quality of healthcare delivery.

- Fully Pricing Externalities to Promote Sustainable Behaviors (9%), with enhanced sustainability reporting standards that provide a consistent and transparent framework for companies to disclose their ESG impacts in a quantifiable manner, allowing capital markets to assess and compare true performance and to accurately price externalities.
- Unlocking Human Potential for Impact (9%), using digital tools and platforms to connect, empower, and educate individuals, changing behaviors and mobilizing people for sustainable action.
- Democratizing Digital Mass Financial Inclusion (9%), a broad-based digital infrastructure platform driving the digitization of society and the economy, enabling applications in financial services, healthcare, education and training, public services, transportation, commerce, among other things. Its impact on the goals is accordingly broad-based and fundamental in nature.

It is important to note that these estimates do not consider any of the progress the world has made to achieving specific goals, rather they represent the maximum impact that each Big Idea can deliver against the SDGs. The net impact these solutions can have on closing the world's current SDG gap depends on the extent and nature of the progress made against the goals, including the extent to which these solutions have already been implemented across parts of the world. For example, Democratizing Digital Mass Financial Inclusion can achieve 8.7% of the goals in circumstances where there is no existing digital financial services infrastructure or online banking.[41] However, given that there are currently an estimated 3.6 billion online banking users in the world, the actual net impact of deploying these solutions globally will be lower than the gross potential.

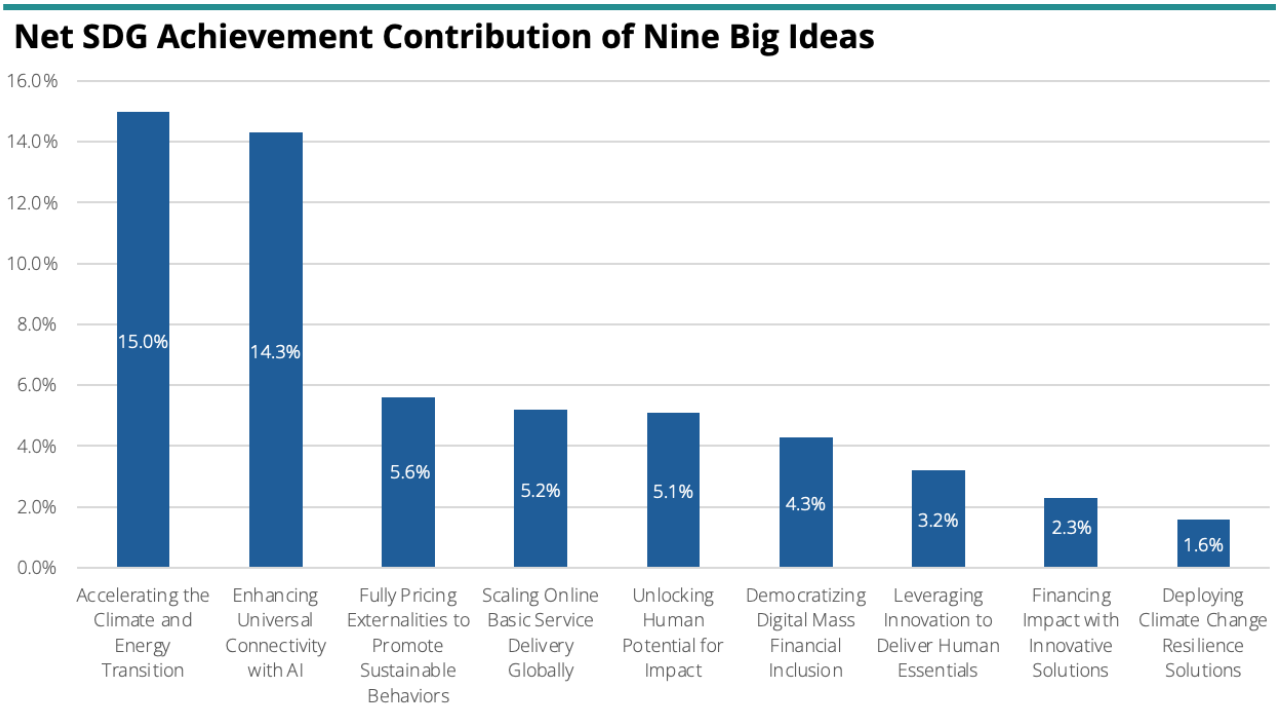
Country by Country Deployment for Net Impact

Calculating the *net* SDG impact that each initiative can have requires a country-by-country analysis of its level of development, specifically it progress against the each of the 17 goals, accounting for the progress made against specific targets to eliminate 'double counting' of the initiative's gross impact potential. Adding up all the country level net benefits provides a picture of the global net impact potential each solution can have.

The SDG impact of deploying initiatives on a country-by-country basis is assessed using data from the 2024 Sustainable Development Report,[42] which evaluates each country's performance against the underlying indicators of the SDGs to measure overall progress. Countries are scored on a scale of 1-100, approximately reflecting their percentage completion of the SDGs. To estimate the potential impact of an initiative on a country's SDG score, the analysis applies the percentage uplift that the initiative is expected to contribute to specific SDG targets to the corresponding national performance indicators. The resulting increase is then calculated to determine the overall improvement in the country's SDG score.

Although the Sustainable Development Report does not provide an aggregated global SDG score, it covers countries representing 99.6% of the global population. The global net impact of each initiative was therefore estimated by adding up its impact on each country's SDG score, weighted by a country's share of the global population.[43]

Figure 15: Net SDG Impact – All Initiatives

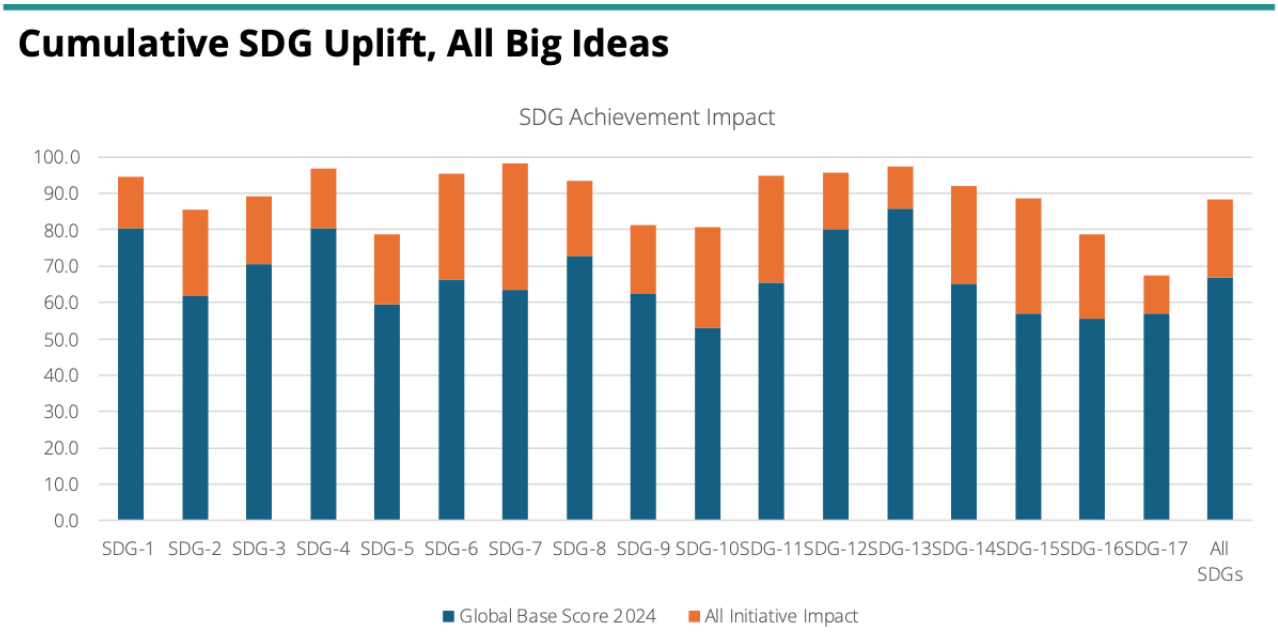


Source: Force for Good, 2024

The c.40% drop between the gross and the net impact that each initiative can have on the SDGs is a function of the world's current progress against the SDGs. The population weighted average SDG score globally stands at 66.8 out of 100, indicating that as of 2024 the world has achieved approximately two-thirds of the SDGs.[44]

Against this c.33% global achievement gap the cumulative net impact that the nine Big Ideas and the accompanying initiatives can have on the goals is transformative, taking the SDGs from c.67% achieved today to c.88%, (an uplift of 21%, net of any overlaps in the benefits that the initiatives provide), implying that many goals, in many parts of the world, would be substantially achieved, fundamentally underpinning human security for all.

Figure 16: Global SDG Impact – All Initiatives



Source: Force for Good, 2024

Deployed at scale globally, the initiatives cumulatively can contribute to seven of the SDGs being substantially met, with c.95% or greater achievement of SDG1 (Zero Poverty), SDG4 (Quality Education), SDG6 (Clean Water), SDG7 (Efficient and Clean Energy), SDG11 (Sustainable Cities and Communities), SDG12 (Responsible Production and Consumption), and SDG13 (Climate Action).

Further, significant progress, reaching 80% or more, can be made on nearly all the remaining goals, with the initiatives progressing some goals by more than 25%, including SDG10 (Reduced Inequalities), SDG14 (Life on Land), and SDG15 (Life under Water).

Conversely, SDG17 (Partnership for the Goals) is only marginally impacted by the initiatives, reflecting the ultimately political, and multilateral nature of the targets underlying this goal. Similarly, the SDGs relating to inequality SDG5 (Gender Equality) and SDG10 (Reduced Inequalities) will likely also require significant policy and societal change to address, (rather than point initiatives), while SDG9 (Infrastructure, Industry and Innovation) is largely a function of capital deployment and foreign direct investment.

Reaping these transformative benefits will however require rolling out and scaling these solutions globally, under a range of different local conditions and in the face of political, social and economic constraints. Overcoming these barriers to implementation will be critical for the world to meet the goals.

5. Creating New Markets to Attract Solutions

One of the defining features of the Big Ideas is that they are not necessarily new, nor do they demand groundbreaking innovation. For example, the water and filtration technologies essential to Deliver Human Essentials have been around for over a century, with recent advancements primarily aimed at making them more affordable, efficient, and accessible. However, the long

existence of some of these ideas have not necessarily made them any easier to execute. Indeed, the internet has been around for 30 years but nearly 2.7 billion people - almost one third of the global population - still lack internet access,[45] and 4.2 billion people live without safely managed sanitation services.[46] This starkly illustrates the gap between the availability of simple solutions and their effective implementation.

The reason for this gap lies in the significant implementation challenges that these solutions face around the world. At the core of this gap is the disconnect between development needs and the opportunities that can address them. Development circles often confuse "need" with "opportunity".[47] The existence of need on its own does not create viable opportunities to satisfy that need in the absence of critical catalysts. Policy and implementation are needed to create markets backed by a system of enterprise. In the absence of vibrant local markets, the necessary opportunities cannot materialize, and the SDGs will not be met, the many reasons for this include:

1.) The SDGs Are Increasingly Unaffordable … Despite Record Global Wealth. The US$14-17 trillion of annual spending across healthcare, education, infrastructure, conservation, and economic development required to meet (and maintain) the SDGs globally represents 13-15% of the world's current GDP, (or c.10-12% of estimated GDP in 2030)[48]. While the world in theory has sufficient capital to fund this amount today, with the annual requirement representing only 3-4% of the total global stock of US$433 trillion of liquid wealth, in practice sustainably funding the SDGs will require growing local economies to provide domestic capital for the goals.

The world's liquid wealth is overwhelmingly held in advanced industrialized economies and managed by the finance industry based on a mandate to generate an appropriate risk-adjusted returns. Based on these mandates the global economy currently generates a total of U$$1.3 trillion of annual foreign direct investment, less than 10% of the total funding required to meet the SDGs,[49] and less than 1% of global GDP. Growing global foreign direct investment ten-fold to fully fund the SDGs is a highly unlikely prospect, no matter how attractive developing countries may make themselves to international investors.

Development circles often confuse "need" with "opportunity". Need alone does not create viable opportunities to satisfy it in the absence of critical catalysts. Policy and implementation need to create a market backed by a system of enterprise

2.) The Imperative of Domestic Capital Formation to Fund the Goals. The limitations on deploying the world's current stock of wealth implies that much of the funding for the SDGs will need to come from local (and regional) sources, which in turns requires significant economic expansion and capital formation in developing countries. An average growth rate of 4.0% across the world's developing countries would imply that an incremental US$15 trillion of GDP annually could be generated as early as 2032,[50] (recognizing that some countries will by then be generating more output than is needed for the SDGs and others less, and that only a portion of any incremental economic activity generated can be applied to meet the goals.)

Nevertheless, for a significant number of developed countries, the prospect of sustained economic growth places the SDGs within reasonable reach. This sustained economic growth however presupposes the creation of an attractive domestic market within a broader system of enterprise.

3. Big Ideas Can Address SDG Progress … But Require International Engagement to Deploy. Scaled solutions like the ones arising from the nine Big Ideas are potential flywheels not just for the achievement of specific SDGs and targets but more generally for the economic activity and growth need to meet the goals. However as stated above, most countries around the world lack the technology, the capital and the capacity to implement these solutions on their own. This makes successfully engaging solution owners, technology providers and sources of foreign capital a critical precondition to starting the virtuous cycle of growth required to meet the SDGs.

4. Solution Owners and Capital Address Opportunities Based on Risk Adjusted Returns. With many of required solutions in the hand of private sector corporations, countries will need to offer commercially viable opportunities for these corporations to engage with, offering both the outlook of sufficiently attractive returns and the adequate transparency and management of risks, be they political, economic, physical or otherwise.

An average growth rate of 4.0% across the world's developing countries would imply that an incremental US$15 trillion of GDP annually could be generated as early as 2032

5. Implementing a system of enterprise creates the conditions for solutions deployment and the long-term condition for sustained economic growth. Removing barriers to investment and market entry create the opportunity required for solutions owners and their providers of capital to meet a country's existing needs. The opportunity for solutions owners in many cases is the market size and growth that their own engagement will help catalyze in a virous circle of development. Ultimately, countries need to implement a system of enterprise that combines rule of law, more open markets, financiers bearing various stages and levels of risk-return, skills capacity, IP protection, convertible currencies and more. This has proven to be a difficult endeavor even for advanced economies, with the US traditionally setting an example that others have struggled to follow.

The digital divide as we have seen is one of the major barriers to investment and implementation, but it is only one among many. The countries and regions with the greatest need for a given solution are often among the least attractive markets for tech companies to operate in. And conversely the countries with the greatest needs often lack the technical know-how and resources, the domestic conditions required for companies to enter their markets, and the capacity to implement what in some cases appear to be basic solutions.

For the Big Ideas to deliver meaningful progress against the SDG, these barriers will need to be systematically overcome. If political leaders can introduce conducive policies and solution owners can be mobilized, whole new markets will be created for technologies to be deployed at scale making profits at acceptable risk levels for positive impact.

Barrier 1: The Need to Mobilize and Align Solution Owners

Every Big Idea, or equivalent initiative requires the commitment of resources, not only of time, expertise and capital, but in many cases of infrastructure, capital goods and technology. Given the often-meaningful investment needs this implies the natural sponsors of most initiatives are the solution owners themselves, which for tech-based solutions are often technology companies. However, in some cases these companies' incentives are not aligned with the sustainable mass deployment of their technologies. Unlocking tech companies as a force for good may therefore require them to redesign their products (e.g. creating user devices that maximize affordability rather than margin) or even their business models (e.g. social media platforms capturing a share of the value generated for users, rather than monetizing them for advertisers.)

The key difference between technology haves and have nots is the presence or lack of a business case for the private sector to deliver their solutions. In most cases, this more a function of regulatory, legal, or policy risks and challenges than of unreasonable profit expectations on the part of companies themselves

But while incentives certainly play a role the key difference between technology haves and have nots is the business case for the private sector to deliver their solutions. In many cases, the lack of such is less a function of (unreasonable) profit expectations on the part of companies themselves, and more one of regulatory, legal and policy risks and challenges that a potential market presents to corporations. Given the right conditions for market entry, entrepreneurial companies will find ways to serve customers profitably at low price points. Affordable housing and microfinance are two examples from the finance industry in this regard. And this need for adequate regulatory, legal and policy frameworks apply to technology companies as well regardless of whether they are seeking to directly deploy a solution in-country or simply supplying their technology for others to do so. The technology cost of any solution rollout at scale will be in the billions of dollars, even for the most basic solutions. Every solution based on digital technologies for example will require building new data centers in regions where the solutions will be deployed, at a potentially prohibitive cost to the private sector. The cost of simply upgrading *existing* data centers around the world for AI capabilities has been estimated at US$1 trillion dollars.[51] Deploying solutions across the Global South will require building entirely new data center capacity: Pan-African data center deployments are below 1 Megawatt (MW) per million capita, while the Americas have 88.5MW, and Europe has 73.93MW.[52] Given Africa's 1.5 billion population, achieving only half the data center density that the West has (c.40MW per million) will require constructing 60,000MW of capacity, which at the average cost for existing African data centers (of US$9 to 12 million per MW) implies a total capital investment need of US$540-720 billion.[53] While most large tech companies engage in sometimes significant philanthropic and corporate social responsibility initiatives, as private sector companies they cannot deploy their

There is simply not enough philanthropic capital, ODA, or blended finance in the world to pay for the tech rollout required. Private sector engagement on commercial terms is critical, which will require the creation of new markets

assets and IP without the expected return on the scale that they are needed by countries whose markets are too small. And with the need for these solutions greatest in the developing world, there is simply not enough philanthropic capital (US$1.5 trillion in 2018,[54]), overseas development assistance (US$223 billion[55]), or (broadly defined) blended finance (c.US$145 billion[56]) deployed annually to pay for the tech rollout required. The only viable solution therefore appears to be the creation of new markets to attract private sector engagement on commercial terms.

Barrier 2: The Need to Mobilize Policy and Leadership

The list of factors inhibiting private sector engagement in developing countries is long: insufficient purchasing power or market size, weak governance and legal protections, a lack of critical infrastructure, macroeconomic and social stability, physical and security risks, to name a few. These factors reinforce each other to make countries too difficult, too unprofitable, and/or too risky for technology companies (and others) to engage in. Attracting international companies and investors to deploy and finance solutions will require countries to sufficiently change this equation. At its core, the challenge is one of governance and policy. Indeed, the SDGs were originally conceived as a policy agenda, rather than an investment plan or a technology solution set, recognizing that good governance and the right policies lead to the mobilization of private sector engagement and investment.

The SDGs were originally conceived with a policy agenda in mind, recognizing that good governance and the right policies are a catalyst for private sector engagement and attracting private capital

The catalyst for attracting private sector engagement and capital is therefore national governments implementing policies and reforms agendas while managing often competing priorities. For example, long term tax exemptions for multinational corporations may well serve to attract international companies but will also create an unfair competitive advantage against domestic companies that ultimately harms the local economy and hollows out the tax base.

Multilateral institutions, particularly the United Nations, have a crucial role to play advising national governments in this regard, with bodies like UN DESA, UNDP and UNOPS partnering with national governments to share best practices on governance and policies that address key economic, political, and social factors and create the conditions for private sector solutions deployment. Key actions include:

1. **Strengthening Governance and Institutions,** reducing corruption, ensuring transparency, and improving accountability mechanisms through strong, stable institutions including the rule of law, an independent judiciary, and well-functioning bureaucracies.
2. **Promoting Economic and Social Stability,** maintaining stable macroeconomic conditions, controlling inflation, and managing public debt, while maintaining political stability and public security, as well as creating the social inclusion required to ensure that the benefits of solutions can be shared by all.

3. Creating an Attractive Business Climate, simplifying regulations for running businesses, reducing bureaucratic red tape, and making it easier for foreign organizations to operate, as well as providing a clear, transparent and stable legal framework that protects investor rights, including property rights, IP, and the ability to repatriate profits.
4. Providing Attractive Investment Incentives, offering competitive tax breaks, exemptions, and incentives in key sectors critical to the initiatives being prioritized.
5. Prioritizing Initiatives for Deployment, developing clear plans for deploying and managing the most critical initiatives, including appointing national and local implementation partners oversee execution and ongoing monitoring.
6. Building Relationships with Initiative Champions, engaging with potential partners to ensure that the conditions for a smooth implementation are met, identifying and addressing execution challenges upfront.
7. Fostering Civil Society and Local Engagement, building trust in the solution and preparing citizens, local business and NGOs for the deployment of initiatives, both as local implementation partners and as potential future users and/beneficiaries of solutions to ensure rapid update and impact delivery.

If political leaders can introduce conducive policies and solution owners can be mobilized, whole new markets will be created for technologies to be deployed at scale making profits at acceptable risk levels for positive impact.

Barrier 3: Insufficient Local Execution Resources

National governments will need to be ready to partner with solution sponsors and technology owners to implement programs effectively to deliver the expected benefits, at acceptable risk levels and timing. This will likely require developing implementation pathways, appointing local "champions" or counterparts, and creating the systems and process to negotiate and rapidly implement initiatives at scale.

However, many developing countries lack the execution resources required to implement solutions at anything more than pilot, much less the commercially viable levels of scale needed to attract international companies on their own terms. Addressing this shortfall will require significant national and local capacity building. Effective capacity building in most countries will need to be a multi-stakeholder effort, involving a series of actions including:

Many developing countries lack the execution resources required to implement solutions at anything more than pilot, much less commercially viable levels of scale required to attract international companies on their own terms

1. Securing Government Commitment. Strong political leadership and a clear commitment to the initiative is essential, with visible support for senior leaders, and the appointment of respected (and accountable) officials to oversee execution.

2. Delivering Institutional Capacity and Infrastructure. Target countries will also need to allocate sufficient resources to plan, manage, implement, monitor, and evaluate initiatives' execution effectively and sustainably.
3. Working with Local Execution Partners. Civil society organizations and NGOs have an important role to play in the implementation of projects, especially at the local level.
4. Monitoring Progress and Evaluating Impact. Setting up systems to measure the impact and outcomes of initiatives ensures that resources are used effectively, and adjustments are made when needed. Reliable and timely data will be critical to tracking progress, creating the need for many developing countries to address challenges with data gaps and quality.
5. Facilitation Compromise. Rolling out large scale solutions countries that currently don't meet the policy, financial, commercial, governance, or security conditions for execution requires making these countries to be fit-for-implementation, and making solution providers fit for implementing, a process full of compromises that a powerful, respected intermediary needs to facilitate.

The requirements above are most urgent in developing countries of course but they are not limited to them. Advanced industrialized countries also lack critical capacities associated with the energy and sustainability transition, particularly with regards to green and digital skills.[57] In all cases, post implementation, initiatives will of course require ongoing monitoring and management. The UN may well have a role to play in creating the conditions for successful development of the market and resources.

Barrier 4: Insufficient National Scale

One final barrier, which cannot be overcome by capacity building or competence alone is the need for scale. While each individual solution has specific requirements for its deployment, the one requirement that all share is the need for scale. Like the SDGs themselves the solutions implementing Big Ideas are ideally rolled out on a country-by-country level.

This country level approach is necessitated on the one hand by the lack of multilateral institutions with sufficient resources to tackle the goals in a top-down fashion. While the United Nations has specialized agencies focused on advancing specific goals such as the Food and Agriculture Organization (FAO) for sustainable agriculture and food security, the International Labour Organization (ILO) for promoting decent work and economic growth, or the United Nations Environment Programme (UNEP) for environmental protection, these entities face significant funding limitations and, naturally, do not hold an exclusive domain over the solutions needed to implement these goals on a global scale.

National-level implementation also allows the most effective coordination and mobilization of resources described above. However, in many cases the size of a national economy is insufficient to justify to the provision of a given solution from the perspective of a private sector corporation. For one thing, many solutions require significant upfront investments in infrastructure and technology that cannot be sufficiently amortized across a small population, which is often also financially constrained, and/or widely disbursed geographically. For example, nearly 70 countries around the world today have populations of fewer than five million people,[58] the number of people that can be served by a single modern hyperscale data center. These challenges are of course exacerbated by any local customization requirements countries may have with regards to specific solutions, be the regulatory, technical or simply linguistic in nature.

Nearly 70 countries around the world today have populations of fewer than five million people,[1] the number of people that can be served by a single modern hyperscale data center

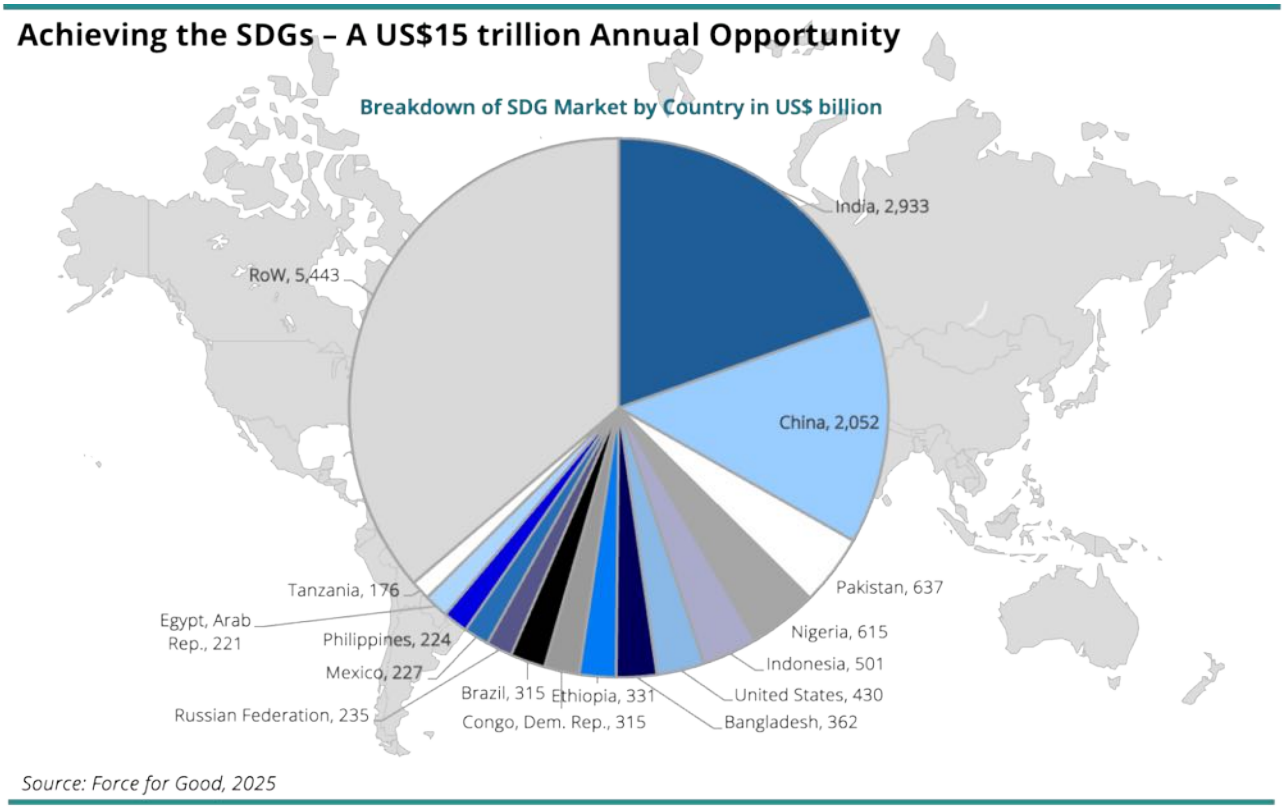
While this issue may be solved by countries working together to group their markets, such a solution requires the resulting challenges to be addressed, relating to governance, the adoption of standards, and more fundamentally questions of data sovereignty. These challenges point to the potentially critical role that regional supranational organizations will likely need to play in many cases, be they political, economic or security focused. Organizations like Mercosur, ASEAN and the African Union, for example will need to help members aggregate their potential markets in a cohesive way and (most likely also) assist in the implementation of technologies regionally.

The aspiration of nations to achieve the SDGs and the actions they take in this regard will therefore give birth to whole new markets around the world. The value of these markets will be significant, reflecting countries' success in creating policies that promote economic activity and deliver increasing consumption and rising standards of living for a country's population. Overcoming the four barriers outlined above is of course no easy task. It is not for lack of knowledge of the benefits of transparency and stability that large parts of the world continue to suffer from high levels of corruption, poor governance, and social and political instability. And multilateral organizations like the UN have been working to address the challenge of capacity building in the developing world for decades. While the necessity of meeting the SDGs is urgent and the benefits of creating new markets are both clear, the challenges facing not just developing countries in overcoming the barriers are considerable, even with support of multi-lateral organizations like the UN and the private sector. It must also be said that under the current system of liberal capitalism, the private sector's early-stage contributions in many instances are likely to consist of little more than goodwill. The world's financial and economic systems are not geared to developing opportunities in the Global South, where the needs are the greatest, and capital and technology therefore remain highly concentrated in the Global North. Good policy choices can help change this equation, but solutions owners and their financiers will also need to take a leap of faith given the urgent need to address the SDGs. The size of the potential market opportunity should make this a calculated risk that global organizations are well suited to underwrite.

A US$15 trillion Global Market Opportunity to Be Created

Previous research by Force for Good calculated in absolute terms the size of the SDG gap on a country-by-country basis, thereby determining (by way of each country's need) the potential impact that solving the SDGs would deliver in each country.[59] Given the importance of matching opportunity to need, this report seeks quantify the incremental market value that this impact would deliver. The US$14-17 trillion of annual spending required to meet the SDGs implies significant incremental consumption and investment particularly across the developing world. Allocating this additional economic activity to the world's countries based on the size of their populations and their current SDG achievement gaps provides an indication of the economic expansion potential associated with meeting the SDGs. The map/chart list below captures the total incremental market opportunity (across trade, consumption and investment) that meeting the SDGs creates on a country-by-country basis. (see Appendix 1 for the full list of countries and the methodology used)

Figure 17: The Value of Achieving the SDGs: US$15 trillion



Perhaps unsurprisingly the cumulative global annual market value of US$15 trillion is distributed across countries in a highly uneven fashion, being driven by the size of a country's population and it relative level of development. The five largest potential markets (India, China, Pakistan, Nigeria and Indonesia) are all among the six most populous countries in the world and represent 44% of the total potential SDG market opportunity. The ten largest markets represent 57% of the global market opportunity and the top twenty 69%, with a rapid drop off in market size thereafter. As stated above, there is much heavy lifting that needs to be done by governments, multilateral organizations, national economies, and the private sector for these markets to materialize. A glance at three the top five largest potential markets illustrates some of the systemic (and

idiosyncratic) challenges that states will face to unlocking this value. The second largest market, China, appears to have made conscious strategic decisions limiting the openness of it markets for foreign companies and capital, focusing primarily on the mobilization of domestic resources and (local technologies) for its development. Further, there is a geostrategic dimension to technology deployments in China, with barriers to tech deployment coming not just from the Chinese government but from the United States which is looking to limit Chinese access to strategic technologies.

Pakistan on the other is the third largest potential SDG market and would likely welcome foreign capital and technology but struggles with high levels of economic and political instability,[60] as well as perceptions of security concerns,[61] that make it unattractive for most international companies and capital to engage with at scale. And Nigeria represents the fourth largest SDG market opportunity globally, (and has the fourth largest economy in Africa[62]), but is also currently ranked 145th out of 180 countries in terms of corruptions perception (and 35th out of 46 countries in Africa)[63] creating significant legal, ESG and economic barriers for potential foreign partners.

Every other country will likely have its own mix of shared and specific challenges to unlocking the value of meeting the SDGs and will likely address these at very different speeds. If countries can overcome these barriers the opportunities awaiting them are significant. The market opportunity sets associated with the SDGs are of course multi-dimensional given the breadth of the goals themselves and therefore span many industry sectors. These opportunity sets can be broken down into seven categories that collectively substantially cover the entire market value associated with meeting the SDGs within a given country, each which represents a trillion dollar or greater market opportunity. These include the following:

Figure 18: Commercial Opportunities Arising from the SDGs

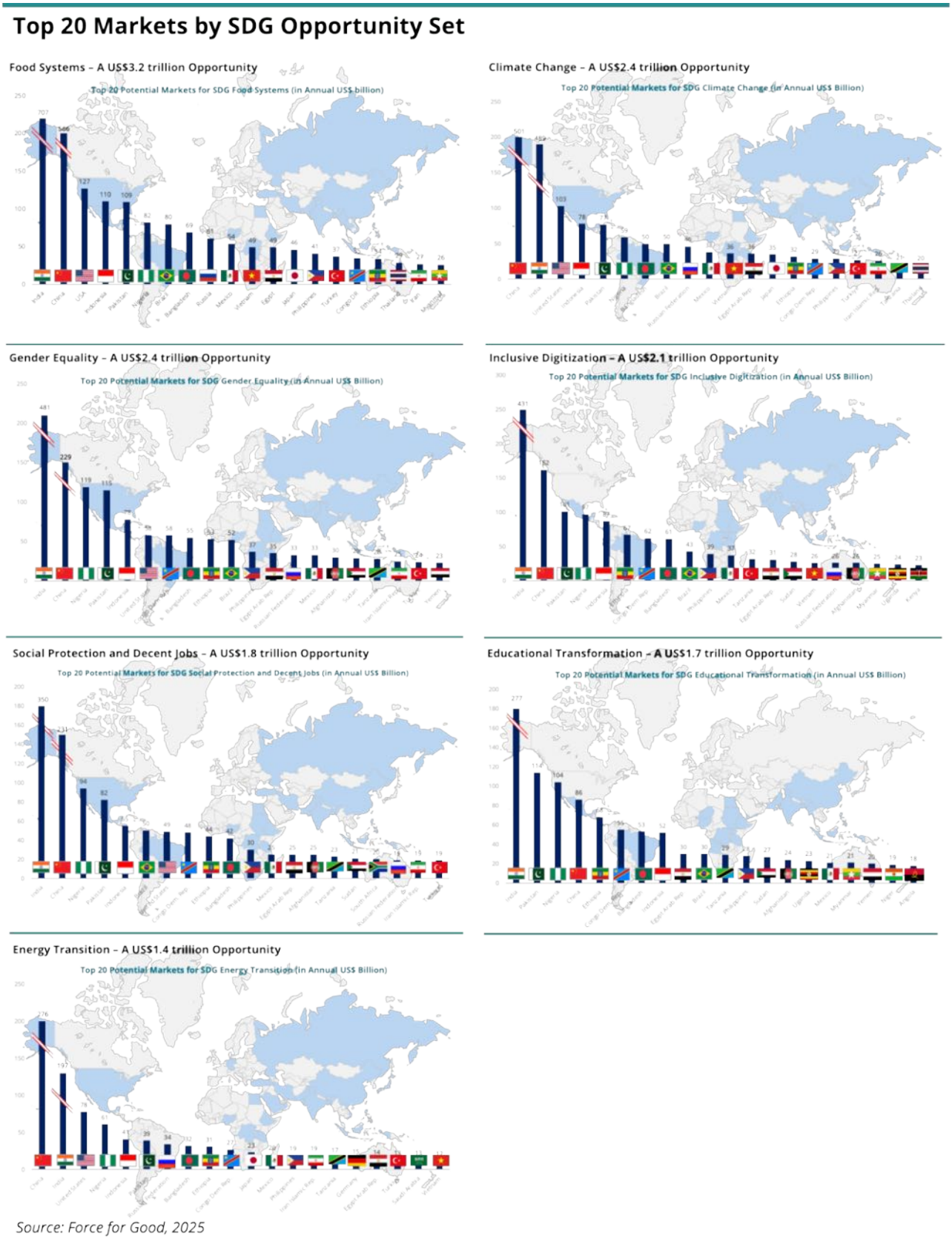
Commercial Opportunities Arising from the SDGs

Market Opportunity	Market Size (US$ trillion)	Key SDGs Impacted
Social Protection and Decent Jobs	US$1.9	
Gender Equality	US$2.4	
Climate Change, Biodiversity and Pollution	US$2.4	
Food Systems	US$3.2	
Energy Transition	US$1.4	
Education Transformation	US$1.7	
Inclusive Digitization	US$2.1	

Source: Force for Good, 2025

While the size of each of these market opportunities in-country of course remains strongly correlated to population size, there are meaningful variations in the top 20 national markets across the opportunity sets, as highlighted in the tables below:

Figure 19: Top 20 SDG Markets by Opportunity Sets



Source: Force for Good, 2025

While the total value of each of the SDG opportunity sets is measured in the trillions and hundreds of billions in large countries and even in smaller ones in the tens of billions of dollars annually, the solutions related to the nine Big Ideas will likely represent only fraction of this amount, implying that the economic value for solution owners will be much lower than the totals shown. However, these solutions are a critical flywheel for further sustainable development progress, economic growth, and capital flows. Provided that countries can sufficiently address the barriers to deployment laid out above, solutions owners will naturally be attracted to the countries with the largest market potential, given the incremental business opportunities that their solutions can unlock there.

Big Tech's Presence Across Key Future Markets Remains Nascent but Provides Knowledge and Relationships for the Future. Tech companies are natural solution owners given the critical role that digital technologies play across the nine Big Ideas, with Big Tech – the world's largest and most influential technology companies – owning the broadest set of digital assets for potential deployment, allowing these companies to capture an outsized share of the US$15 trillion SDG market opportunity. Like all private sector organizations, Big Tech companies are attracted to markets based on risk and return, and they will prioritize potential markets based on their size and the barriers to investment being addressed. Some of the largest *potential* SDG markets have already attracted several of the world's leading technology companies, (albeit often in a very limited manner), based on their *current* market size, likely making them the lowest cost and/or lowest risk entry points for any solutions deployment by these companies. Big Tech's existing presence in these countries provides an initial basis for creating markets. The table below captures the presence of the world's ten largest tech companies across the 20 largest global SDG markets.

Figure 20: SDG Market Size vs. Existing Big Tech Presence

Big Tech Company Presence Across Leading SDG Markets

Sources: Company websites, marketing materials and financial reporting, 2024

The table above demonstrates that Big Tech's presence remains highly concentrated around scaled mature and/or high growth markets, with (nearly) all the top ten tech companies globally active in the United States, China, India, Brazil and Japan. A small set of middle-income countries including Mexico, Indonesia and Vietnam represent a second priority tier, having attracted about half of the top ten companies. This leaves most the world's largest potential markets, countries including Ethiopia, Nigeria, Congo, and Pakistan largely unpenetrated by tech companies, raising further the likely hurdle that these countries will be passed to attract scaled solutions.

Other considerations that will change the relative attractiveness of markets include matchmaking by multi-lateral organizations between countries and multinational companies, which lowers the cost of engagement, or any custom incentives (in terms of policies, capacity building or government support) that countries can offer. One key consideration is the level of localization or customization involved in any technology deployment. Technology companies will naturally be drawn to opportunities where existing technologies can be scaled out of the box without lengthy or costly customization required, while countries will have a long list of local requirements that will need to be met for a technology's impact to be maximized. Language customization is an obvious example but there are many others, including the integration of technologies with existing national assets and standards, many of which may be idiosyncratic to a country. Legal and regulatory requirements around data privacy (or national security) can impose specific top-down requirements on technologies, while cultural differences across countries can require bottom-up changes technologies to ensure their adoption and use.

The resulting trade-off between one size fits all and localization will need to be navigated on a case-by-case basis. In practice this will likely create opportunities for domestic companies to participate in solutions deployment and management, providing local content and services on top of international companies' technology, and acting as local implementation and management partners. In other countries where governments and tech companies are unable to come to terms, local companies can scale capabilities to develop technologies and platforms of their own to become the primary provider of solutions that are highly tailored for local needs.

In summary

- The world needs Big Ideas for the SDGs to be met. This implies the rollout of scaled technology, policy and infrastructure solutions throughout the Global South, which is home to most the world's sustainable development needs.
- However most developing countries lack the domestic financial, technical and execution assets and capabilities required to roll out these solutions on their own, and the world's multilateral institutions also have limited resources in this regard, making private sector engagement essential to meeting the goals.
- Rolling out solutions to meet the SDGs represents a US$15 trillion market opportunity globally, the unlocking of which requires transforming needs into opportunities for private sector engagement. Policy and the enforcement of the rule of law are needed to create the

appropriate political, security and economic conditions for the private sector to engage on the scale that is needed.

- If this is achieved, scaled solutions can act as the catalyst for sustainable development and economic growth for the SDGs to be met, with solutions and capital flowing to countries that support sustainable systems of enterprise with growing market opportunities.

IV. Creating the Future: Transforming the World Beyond Sustainable Development

The world's longer-term transition to a sustainable secure and superior future is dependent on technological progress and innovation breakthroughs. The 19 core technologies of the Fourth Industrial Revolution are keystones to delivering further progress and are cumulatively expected to generate over US$60 trillion in annual economic output by 2030, led by four scaled technologies valued at over US$5 trillion each. Additionally, there are six technologies with exponential growth potential currently awaiting further breakthroughs. Each of these ten technologies represents a critical control point of the future and has emerged as areas of increasing competition both between states and the global technology companies that are driving them forward. Some of these technologies will be monopolized, with value centralized while others will be democratized, spreading their benefits widely.

1. Technology's Role in Creating a Superior Future

The Long-term Transition Underway: Sustainable, Secure, and Superior

As outlined in Chapter II the world is in a fundamental geopolitical, economic, social and technological transition. Effectively navigating this transition demands tackling interrelated challenges across varying timescales, with security and sustainability as constant tests to global systems. This involves addressing security risks and disruptions from ongoing economic, political, and social crises. Equally crucial is confronting sustainability issues tied to people, prosperity, the

planet, and peace, guided by the 17 SDGs as a roadmap for achieving global progress by 2030. These two goals are inseparable. Security without long-term sustainability is temporary, while insufficient security hinders the investments and decisions needed to achieve sustainability.

If the world however, can overcome these challenges to achieve sufficient secure sustainability, the future holds the promise of great potential, being functionally superior to the present across several dimensions, including:

- Political. Empowered governance with individuals and communities actively shaping policies.
- Economic. Post-scarcity economics with universal basic need fulfilment
- Social. Advanced personalization of goods and services with decentralized communication, transactions and engagement between individuals.
- Environmental. Net-Zero resource consumption based on closed loops processing and recycling systems.
- Energetic. A superior energy source, clean and abundant, driving mass automation
- Geopolitical. Human security, peace and dignity for all based on shared values and multidimensional solutions to safeguard it.
- Personal. Individuals empowered by technology as conscious agents of change, making conscious-aware choices and taking actions as citizens, consumers, customers, and community members.

While over the near term, global security is needed to create stability, and sustainability is needed to level up the world to achieve the SDGs, each of the dimensions of the future described above can only be achieved with further technological innovation and its deployment globally at scale. Technology therefore not only drives the world's transition (as explored in the previous chapter of this report), but it also fundamentally determines the shape of the future.

Technology's Role in Creating a Superior Future

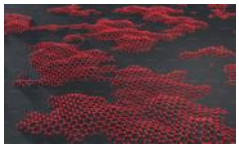
The path to a brighter future lies in continued technological breakthroughs. Civilizational shifts are ultimately driven by the growth of knowledge, leading to advancements that transform the world, societies, and individuals. For the future to be a superior one, it will need to be more peaceful, more prosperous, and more equitable than the present, with every aspect of civilization being re-shaped by technology and its transformative impact. This implies fundamental breakthroughs and innovation across multiple areas of technological development, including among others:

Figure 21: Technology Breakthroughs to Shape the Future

Pervasive Digital Worlds. The dissolution of the boundaries between the physical, digital, and biological spheres creates new possibilities to address major global issues in the physical world, and new opportunities for everything affecting life.

Limitless Energy. New energy sources replace carbon, with fusion and its derivatives being the most likely near-term prospect for commercialization, providing an abundant, clean, and near-free energy source.

Seamless Virtualization. The metaverse creates 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 also occupying digital spaces.



Universal Materials. Breakthroughs in material sciences replace the need for the extraction of finite natural resources with sustainable and cost-effective synthetic alternatives.

Instant Manufacturing. Increasing automation, material breakthroughs and abundant near-free energy allows for nearly limitless scaling that drives down the marginal costs of production towards zero.

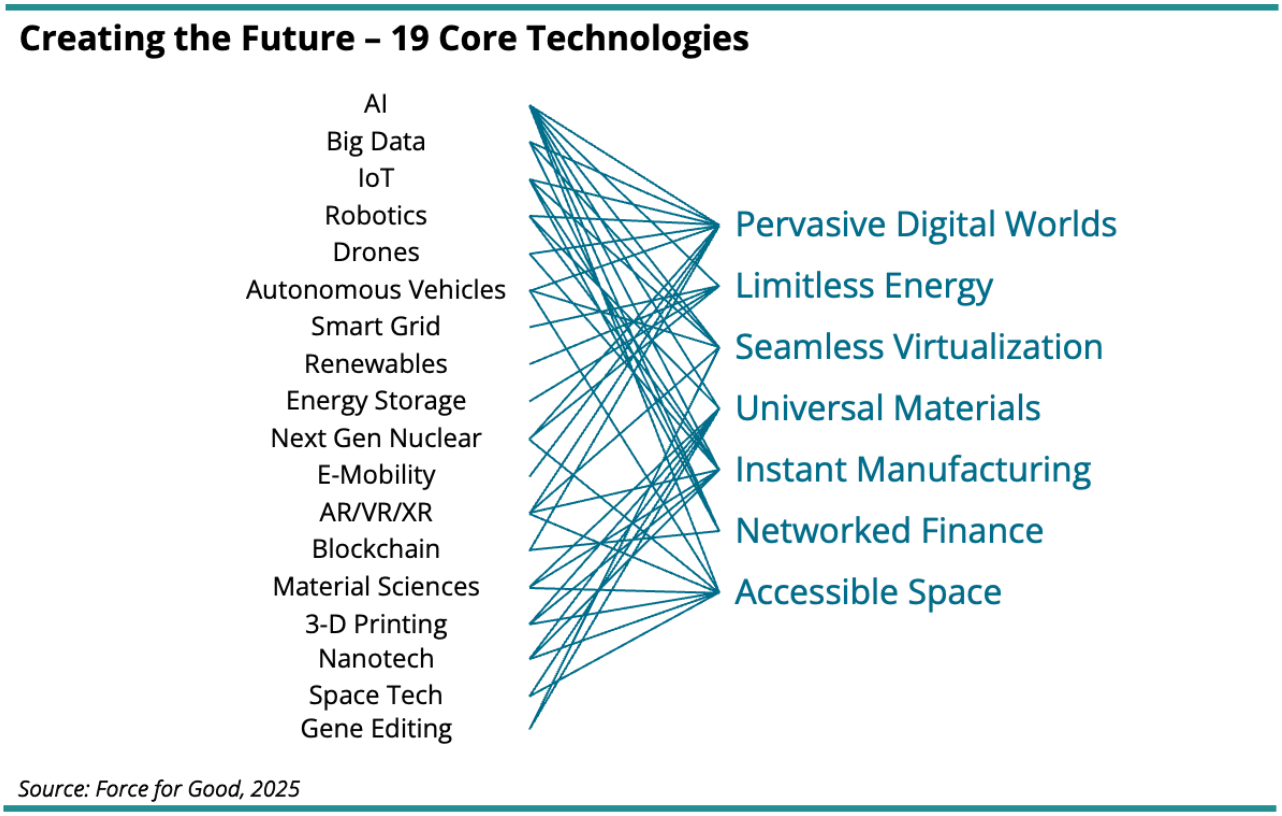
Networked Finance. The adoption of a pervasive distributed form of capitalism that drives mass inclusion, while renewing and reinventing global trade dramatically reduces the need for centralized control and financial intermediation.

Accessible Space. The leveraging of space becomes far more possible with a new energy source providing access to new resources, and new territories to live in, driving massive innovations of their own along the way.

The technological breakthroughs required to deliver the above will require quantum leaps in our current understanding of natural and data sciences, as well as fundamental research and development in engineering and applied sciences.

The 19 core technologies are heavily intertwined with the fundamental breakthroughs that will shape the future and will be the likely sources of the breakthroughs that that will drive progress in these areas. The chart below captures the 19 core technologies and their role in delivering a superior future.

Figure 22: Delivering a Superior Future



Source: Force for Good, 2025

There may well of course be technologies other than the 19 that emerge as critical in shaping the future. Climate engineering, focused on applications like carbon capture and solar reengineering, is one example, but there will likely be many other candidates that emerge. This report however focuses on 19 core technologies based on the current state of their development, likely commercial deployment opportunities and future macro-economic impact potential.

2. Core Technologies Driving Long Term Change

As previously stated, the 19 core technologies have a positive contribution to make towards the world's achievement of the SDGs, although the potential impact each one is likely to deliver varies significantly, given that low-cost scalability and technological maturity are key requirements in this regard. Over the longer term, beyond the 2030 deadline for the goals, the technologies have a much more significant role to play, being critical elements required to create the superior future described above.

Not all the 19 technologies are alike of course in terms of their potential impact and their roles in shaping the future.

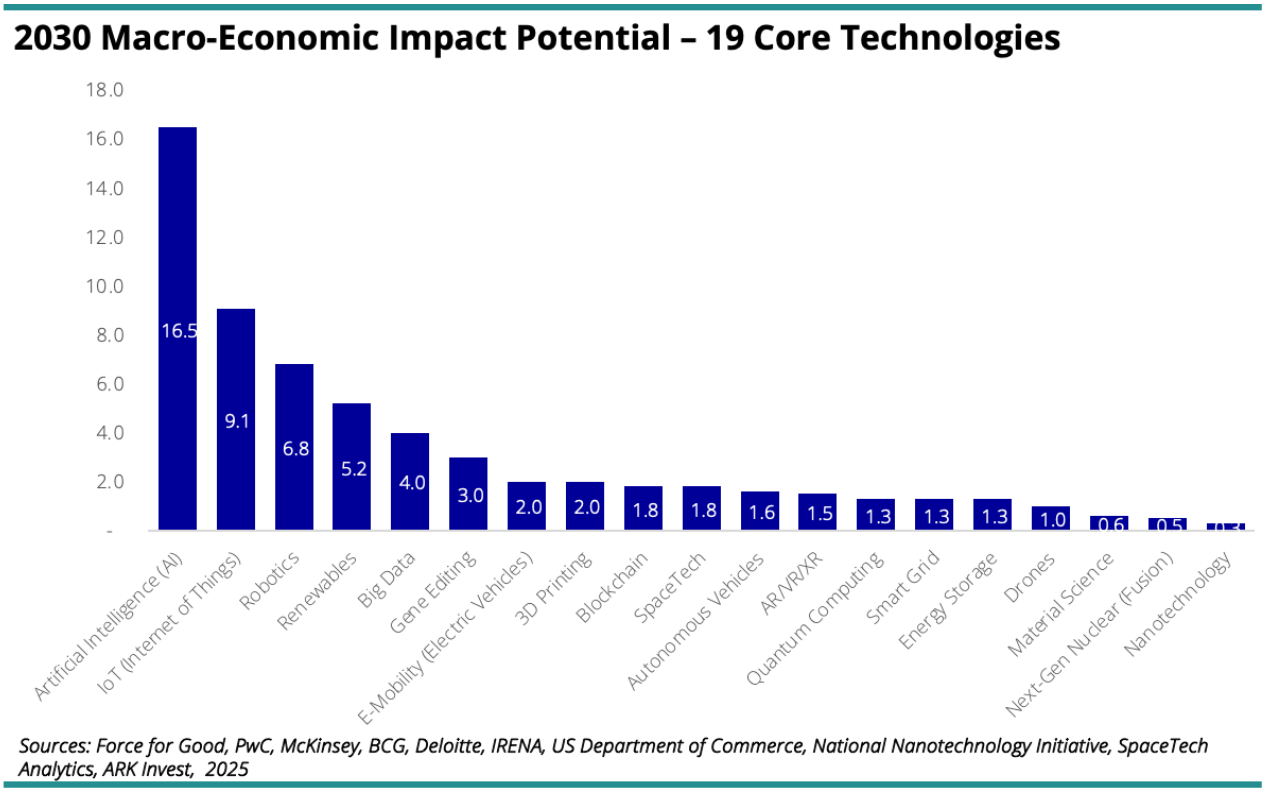
Analyzing the 19 technologies based on these variables gives rise to a subset of technologies that will be the key enablers of the future, with the countries and companies that control these technologies playing an outsized role in shaping the world.

Commercial Scale: Near to Medium Term Macro-Economic Impact

A technology's macroeconomic impact can go far beyond the size of the industry that develops, makes, deploys and maintains the technology, given its broader individual, societal and environmental impact. Much of a technology's impact is therefore directly tied to how it is applied in specific use cases. Taking AI as an example, an AI-based karaoke app that alters the users voice may be an attractive market opportunity for the developer, but it is unlikely to deliver any other impact benefits, unlike say AI-based medical diagnostics, which saves lives, improves treatment outcomes and reduces healthcare costs.

The table below lays out the (currently) estimated 2030 macroeconomic impact of the 19 technologies, including the total GDP generated both by the market for the technologies themselves and the indirect economic benefits that that their use can generate.

Figure 23: 2030 Macro-economic Impact of 19 Core Technologies



Sources: Force for Good, PwC, McKinsey, BCG, Deloitte, IRENA, US Department of Commerce, National Nanotechnology Initiative, SpaceTech Analytics, ARK Invest, 2025

Based on the above, the 19 technologies have the potential to generate over US$61 trillion in economic value annually by the end of the current decade, with four technologies alone capable of generating over US$35 trillion annually. These include the following:

Figure 24: Key Near Term Value Creating Technologies

Technology	2020 Impact in US$ billion	Key Drivers of Value
Artificial Intelligence 	US$16.5 trillion	▪ General productivity increases from automation, decision making support and improved efficiencies ▪ Creation of new products and services across industries, including healthcare, finance, manufacturing and logistics ▪ R&D and innovation acceleration
Internet of Things 	US$9.1 trillion	▪ Industrial productivity gains from smart manufacturing and supply chain management (Industry 4.0) ▪ Smart city enablement with enhanced public services and urban management, and ▪ Healthcare transformation through telehealth and smart medical devices
Robotics 	US$ 6.8 trillion	▪ Logistics and manufacturing automation, enabling 24/7 operation and reduce operating costs ▪ Process optimization across multiple sectors including agriculture, healthcare, and energy, ▪ Innovative applications in space exploration, autonomous vehicles, and renewable energy
Renewables 	US$5.2 trillion	▪ Decarbonization of global electricity supply creating industry growth ▪ Economic benefits from lower energy costs vs fossil fuels ▪ Cost savings from reduced pollution and environmental impacts

The list of near-term value creators unsurprisingly has considerable overlap with the list of technologies critical to the Nine Big Ideas, given their focus on proven and scalable technologies. The remaining 15 core technologies will deliver smaller economic impacts over the same period, with four technologies, Big Data, Gene Editing, E-Mobility and 3D Printing generating between US$2-5 trillion and a further eight generating US$1 trillion or more of economic value.

Shaping the Future: Long-Term Exponential Impact

However, given their fundamentally disruptive nature, all the technologies (and their impacts) are likely to continue to grow significantly beyond 2030, with some technologies having a potentially exponential impact on the world. These impacts are often hard to predict, given the challenges of accurately forecasting all the future use cases and applications of a new technology. For example, the expected use of electricity was initial for lighting, replacing gas lamps, but it ultimately created the modern world, transforming manufacturing, transportation, communications, urbanization and infrastructure and enabling scientific progress.

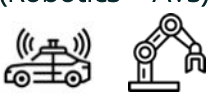
However, despite our inability to predict the impact of fundamental breakthroughs, particularly of these yet to be made, there are strong indications that a subset of the 19 technologies will play an outsized role in reshaping global civilization over the long term. There are several common features that these technologies have, each of which contributes to the exponential nature of the impact the technology can have, including:

1. Scalability. Exponential technologies have global deployment potential and often have rapid adoption curves, even in the face of potentially significant infrastructure requirements.
2. Versatility. Exponential technologies are not user or industry specific but can be deployed across a wide range of use cases, often with only minimal customization required.
3. Utility. In addition to direct user benefits, exponential technologies have second and third order benefits the create significant impact multipliers improving performance, productivity, efficiency across a range of areas.

Historic examples of such exponential technologies include electricity, as stated above. Another example is the internet, which has fundamentally transformed global communication, commerce, education, and entertainment since the introduction of the World Wide Web 30 years ago and now is directly tied to the generation of nearly 20% of the world's output.[64]

Seven of the 19 core technologies have the potential to deliver similarly exponential impacts for the world. This list includes both technologies with near term (2030) transformation potential, and technologies which remain commercially nascent, either because they are still at their early stages of development, awaiting significant breakthroughs, or because they are still at the early stages of scaling. Unlocking the full value of each of these technologies will require overcoming a series of barriers to remove critical scientific, technological, social, regulatory, economic and other barriers. The list of 'Exponential Technologies' includes the following:

Figure 25: Potential Long-Term Exponential Technologies

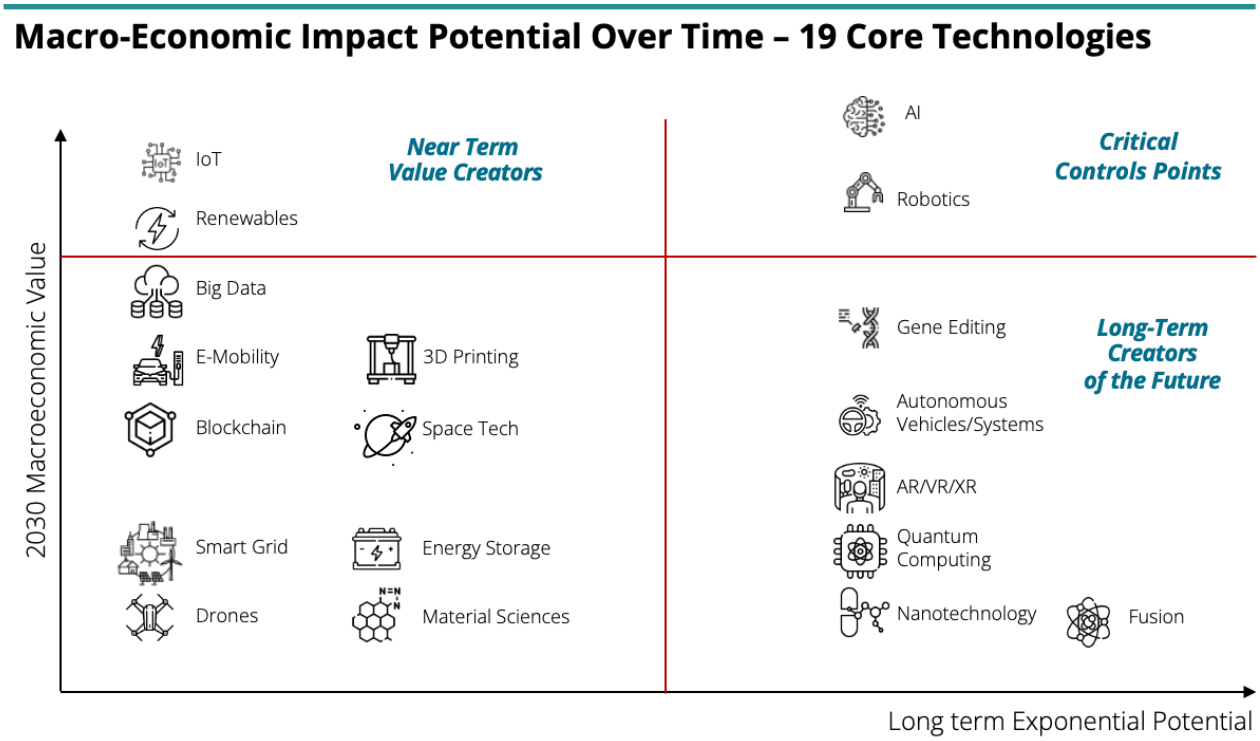
Exponential Technology	Drivers of Long-Term Transformation	Barriers to Impact
Artificial Intelligence 	The development of AGI – AI with human-level intelligence – could revolutionize every industry, enabling machines to solve problems and innovate autonomously and fully replacing human knowledge work.	▪ Scientific limitations including a lack of comprehensive theory of intelligence, and neuroscientific gaps in understanding human cognition ▪ Technological limitations around generalization, scaling beyond current narrow AI systems ▪ Resource limitations, including potential computational resource constraints given size of AI models
Autonomous Systems (Robotics + AVs) 	Robots with advanced autonomy could take over a wide range of labor-intensive and complex tasks, transforming industries and economies by largely replacing human physical work	▪ Technological limitations around perception and sensing, hardware durability and energy efficiency ▪ Economic limitations including high development and manufacturing costs, and complex infrastructure needs ▪ Regulatory limitations including adequate safety standards, and legal accountability considerations

Exponential Technology	Drivers of Long-Term Transformation	Barriers to Impact
Fusion 	Fusion technology can transform global energy systems given its superior energy density (10 million time more energy dense than fossil fuels), and its universal reliability and availability vs fossil fuels, creating universally available energy at a fraction of current costs.	▪ **Technological limitations** sustaining fusion reactions, containing plasma and building durable reactors ▪ **Economic limitations,** including high costs, low net energy gains and scaling challenges ▪ **Resource limitations,** creating efficient and sustainable tritium breeding systems
Gene Editing 	CRISPR and other gene-editing tools have the potential to eradicate genetic diseases, fundamentally transform human life and health-spans and even create new forms of life	▪ **Scientific limitations,** understanding and editing polygenic traits and/or complex regulatory networks ▪ **Technical limitations**, around precision delivery mechanism and off target effects ▪ **Regulatory limitations**, with many countries lacking clear regulatory frameworks for gene editing,
Quantum Technologies 	Harnessing quantum mechanics for computation can solve problems that are currently thought to be unsolvable, enabling unforeseen fundamental breakthroughs in science and engineering	▪ **Technical limitations**, scalability and hardware issues around decoherence, error rate correction, and cryogenic requirements ▪ **Economic limitations,** with systems prohibitively expensive for most applications ▪ **Resource limitations,** with significant shortages in quantum technology experts
Nanotechnology 	Unprecedented applications across healthcare, environmental restoration and materials and construction based on the regenerative (self-repair and self-replication) features of nanotech	▪ **Technical limitations**, relating to systems controls, material defects and reliability ▪ **Economic limitations,** including high production costs and limited scalability pathways developed to date ▪ **Safety limitations,** with the health and environmental impacts of nanomaterials still poorly understood
Virtual Worlds (AR/VR/XR) 	Persistent immersive virtual environments that reshape how humankind work, learn, play, socialize, and perceive reality, creating digital assets, identities, marketplaces and real estate to augment or even replace their physical counterparts	**Technical limitations**, hardware constraints of user haptic and visual equipment ▪ **Resource limitations,** requiring scaled low latency, high bandwidth networks and scale of GPU processing power ▪ **Economic limitations,** including significant energy costs and infrastructure requirements

Mapping the Control Points of the Future

Comparing the 19 technologies' near-term economic impact against their future potential to deliver exponential change results in a segmentation of the 19 technologies and their criticality to the world over time.

Figure 26: Technology Control Points of the Future



Sources: Force for Good, 2025

There are several key considerations arising from this comparison:

- Two Critical Control Points. Two of the largest near to medium-term opportunities, *AI and Robotics,* also have long-term exponential potential as they continue to develop and advance, making them 'critical control points' of the future,
- Two Near to Medium Term Value Creators. The two other near to medium term opportunities, *Renewables and IOT*, are important steppingstones to the future over the next 10-20 years, but lack exponential future impact potential of their own
- Six Long-term Creators of the Future. Six technologies: *Nanotechnology, Fusion, Quantum Technologies, AR/VR/XR, Autonomous Systems, Gene Editing* are long-term creators of the future, currently still lacking the commercial readiness and scale to deliver significant near-term impact but having fundamentally transformative future potential.

Taken together these ten technologies represent the most strategic global assets over both the near and long term, likely making the businesses that own these technologies the world's most valuable companies and turning the countries that dominate enough of these technologies into global powers of the future. Their strategic nature and economic value potential position these technologies as areas of increasing competition both between states and between companies looking to 'own' the future.

3. Competing to Own the Future

This process of competition to own the future is already underway, both between companies and countries, and the leaders are already beginning to reap the benefits of their positioning.

Five years ago, the ten most valuable companies in the world included Visa and Johnson & Johnson in addition to large tech platforms and 'hyperscalers' like Alibaba, Microsoft, Meta, Amazon, Alphabet and Apple. As of Q3 2024 the top ten companies included three semiconductor manufacturers and developers, specifically those focusing on AI chips, whose combined market cap of US$4.7 trillion is approximately equal to that of the top seven most valuable companies in 2019.[65] Moreover, of the seven remaining non-AI Chip companies in the top ten, six (Apple, Microsoft, Alphabet, Amazon, Meta, and Tesla) are each investing billions of dollars every year into AI research and infrastructure, highlighting both the scale of the commercial opportunity that AI represents as well as its strategic importance for the companies businesses.

AI has become an area of intense geostrategic competition between China and the United States, shaping every part of their bilateral engagement from trade policy to foreign policy to defense

At the level of countries, AI has also already become an area of intense geostrategic competition between the world's leading superpowers China and the United States, shaping everything from trade policy (in the forms tech export restrictions) to foreign policy (with regards to American support of Taiwan the world's leading semiconductor hub), and defense (with both countries developing AI-driven military systems including autonomous drones, cyber warfare tools, and decision-making algorithms). Similar competitive processes between companies and between countries are playing out across all 19 of the technologies to some degree, but quite definitively across the four near and longer-term control points of the future and the six secondary technologies.

Global Technology Superpower Competition

Technology has always been an area of competition between countries, and particularly between actual or aspiring superpowers. Technology is a strategic resource which provides states with the power to generate economic value and political capital at home, as well as enabling leverage in war and trade abroad. Given this power, states have competed to innovate and have jealously guarded the resulting technology breakthroughs to gain an advantage over their neighbors.

The ability to effectively harness and ideally monopolize (for a time) technological breakthroughs has driven the rise (and fall) of states and empires throughout history. In many cases these have been tied to technologies that enhanced the coercive power of states, like the Mongol's use of horse archery and composite bows, or the appropriately named 'Gunpowder Empires' of the 15th to 18th Century (which commonly include the Ottomans, Safavid Persia and the Mughal Empire of India). But non-military innovation has also been key. Portuguese naval and navigation technology

created the first global empire, while the British Empire relied as much on the power of steam engines and industrialization as it did on the flintlocks of the British Army (the main pattern of which had been in service for nearly a century when Britain was making its greatest territorial gains in India).[1]

Technologies lend themselves to a spectrum of central versus diffused control. Some such as nuclear are monopolistic or oligopolistic due to the science, risk and cost structures and controlled by governments and large players. Others begin that way until the breakthrough point and then tend to proliferation until they are democratized, like AI. Every technology sits on a spectrum which determines the nature of competition to make the breakthrough and whether the value lies in a few hands or is diffused.

Technology has always been an area of competition between countries, and particularly between existing and/or aspiring superpowers, being a strategic resource to generate economic value, domestic political capital, and international military and market power

Over the long run of course, no country can monopolize a given technology or innovation. Technological breakthroughs and the scientific knowledge that creates them are diffusive by nature, and will ultimately spread across the world, driven by market forces and human ingenuity. The speed at which technology diffuse appears to be closely tied to the speed of global progress, implying significant acceleration. It took centuries for the closely guarded technology of sericulture (silk cultivation) to escape from China (with silkworms smuggled out in the staffs of visiting Nestorian monks). North Korea, one of the world's ten poorest countries on a per capita basis, developed nuclear capabilities despite a global ban on nuclear arms development and rigorous sanctions in a matter of decades. And Iran has developed advanced cyber-capabilities capable of hacking critical US security infrastructure in a matter of years.

Now more than ever therefore securing a competitive advantage from a technological breakthrough requires having the financial and material resources to quickly scale and deploy it. Gaining a *sustainable* competitive advantage in technology on the other hand requires ongoing innovation, delivering and scaling new breakthroughs that compensate for the inevitable diffusion of innovation. This is particularly true in today's world of accelerating innovation and progress, which further increases the importance of technology as an area of focus for geopolitics. The world's leading power blocs are both competing and collaboration to control or at least secure access to the critical technologies underpinning national strategic interests, be they security related to economic in nature, leading to job creation and economic prosperity.

The world's leading power blocs are both competing and collaboration to control or at least secure access to the critical technologies that will shape the future

[1] The annexation of the Maratha Empire territories following the end of the Third Anglo-Maratha War in 1818 represents the largest single territorial gain made by Britain in India (c.1.5 sq km). The Brown Bess pattern of flintlock musket, which dominated British infantry warfare for over 130 years, was introduced in 1722

In today's potential transition from a singular superpower to one with multi-polarity, the intensifying great power rivalry between the US and China has become a focal point of competition. The other two large power blocs, being the European Union and India, are also seeking to secure positions in these technologies, although both seem more willing to collaborate across technologies, both with each other and with the other power blocs, perhaps reflecting their weaker positions across the technologies that matter. For each of these blocs, developing domestic capabilities in key technologies is critical to their continued status as powers, their political self-reliance, and their long-term prosperity.

Additionally, a second tier of countries drawn from the G20, are also competing for leadership across some or all the control points and secondary technologies, for a variety of motives ranging from the diversification of their economies to the maintaining geopolitical influence. These include Russia, Japan, the United Kingdom, and Saudi Arabia. The table below captures the positioning of the global power blocs and the second tier of countries across the five control points of the future and the five secondary technologies, with positioning being measured across four dimensions which point to the potential and actual leadership a country can have. These include:

1. Investment. The annual investment levels in each technology across the public and private sector into both R&D and infrastructure indicates both the level of commitment a country has as well as the potential levels of future output.
2. Intellectual Property. Patents, and their predecessor peer review academic papers on a given technology provide an indication of the innovation levels a country is achieving, and of the potential future control of key elements of that technology.
3. Commercialization Potential. Scaled domestic companies with leading global positions in a technology provide the means for countries to deploy and monetize that technology, particularly in technologies with a nearer-term impact. (They are less important in exclusively longer-term technologies still in the R&D stages of development, where public sector research and funding also can compensate for lacking private sector engagement)
4. Supportive Policy Regimes. Much of the success of failure of a given technology is ultimately tied to the existence or lack of a supportive policy regime that creates appropriate incentives for technology development and roll-out, as well as appropriate regulation that helps maximize a technology's overall value (and its distribution).

The presence of a large domestic market for a given technology was considered as a fifth dimension of tech positioning, but ultimately not included in the analysis. While it can be argued that both China and America as well as their domestic companies have benefitted from the presence of large markets for their products at home, there are many examples of countries leading global industries (and being home to global leaders) despite smaller to virtually non-existent domestic markets: South Korean electronics, Taiwanese semiconductors are just two examples or (straying outside of the tech industry), Saudi Arabian oil. Conversely, China is investing heavily into its domestic robotics industry, but it is investing even more heavily into buying robots from overseas for industrial automation, and in 2022 only exported 36% of the

value of robotics that it imported.[66] Whether large and potentially captive domestic markets are a meaningful factor in determining a country's position in each technology therefore varies on a case-by-case basis.

Figure 27: Technologies and Geopolitics

International Competition Across Key Technologies

	USA	China	EU	India	Russia	Saudi Arabia	Japan	U.K.
Near Term Value Creators/Critical Control Points								
Artificial Intelligence								
Annual Investment (US$ billion)	**414**	97.7	72.5	22	0.1	1	2.9	27.8
Patent Applications (as of 2023)	**36,830**	12,219	5,534	3,422	<122	<122	122	461
Number of Top 20 Companies	**17**	1	1	-	-	-	-	1
Robotics								
Annual Investment (US$ billion)	**13.5**	4.5	1.7	0.2	0.1	0.1	0.5	0.2
Patent Applications (as of 2023)	**33,833**	29,344	7,164	1675	<183	<183	1185	553
Number of Top 20 Companies	**6**	2	2	-	-	-	4	-
IoT								
Annual Investment (US$ billion)	**80.9**	19.8	8.77	1.37	0.3	0.3	0.4	5.08
Patent Applications (as of 2023)	**47,720**	9,701	6,535	2,616	<32	<32	<32	412
Number of Top 20 Companies	**16**	-	4	-	-	-	-	-
Renewables								
Annual Investment (US$ billion)	114	85	**266**	14	NA	NA	26	31
Patent Applications (as of 2023)	**7,384**	1,579	1,616	1,031	<100	<100	<100	317
Number of Top 20 Companies	3	**10**	4	1	-	-	-	-
Long Term Creators of the Future								
Autonomous Technologies								
Annual Investment (US$ billion)	**40.4**	5.9	7.9	0.05	0	0	0.5	2.35
Patent Applications (as of 2023)	**26,145**	1,773	4,380	691	<54	<54	189	541
Number of Top 20 Companies	**10**	4	1	-	-	1	-	1
Gene Editing								
Annual Investment (US$ billion)	**97.1**	17.7	8.77	0.95	0.06	<0.02	0.03	7.83
Patent Applications (as of 2023)	**27,996**	12,477	5,575	1,092	284	<284	1,332	<284
Number of Top 20 Companies	**17**	-	1	-	-	-	-	-
Quantum Technologies								
Annual Investment (US$ billion)	**3.5**	**3.5**	0.1	0.05	<0.05	<0.05	0.07	1.3
Patent Applications (as of 2023)	**15,484**	904	2,310	240	<34	<34	48	188
Number of Top 20 Companies	**12**	4	2	-	-	-	-	-
Nanotechnology								
Annual Investment (US$ billion)	**19.6**	2	1.9	<0.15	<0.15	<0.15	0.15	2.5
Patent Applications (as of 2023)	**1,889**	279	278	287	30	<18	<18	19
Number of Top 20 Companies	**13**	-	4	-	-	-	-	-
Next Gen Nuclear (Fusion)								
Annual Investment (US$ billion)	**23.3**	3.73	0.076	0	<0.01	<0.01	0.2	1.58
Patent Applications (as of 2023)	**9,525**	958	1,358	248	46	<46	109	121
Number of Top 20 Companies	**7**	-	-	-	-	-	-	-
AR/VR/XR								
Annual Investment (US$ billion)	**7.5**	1.6	0.6	0.2	0.1	0.1	0.1	0.8
Patent Applications (as of 2023)	**28,026**	1,945	4,870	830	<49	<49	128	389
Number of Top 20 Companies	**15**	1	-	-	-	-	2	-

The picture emerging from the data above is one of continued US technology dominance, across most critical technologies, with China and the EU advancing but trailing far behind in key technologies, and India not (yet) appearing as a credible competitor. The US, powered by its systems of enterprise – including a tradition of entrepreneurship, risk taking, strong capital markets, and its ecosystem of R&D that links academia and the private sector, rule of law, deep and broad stills pool, corporate-research lab links - leads in nine of the ten most critical technologies of the future, with renewables being a notable exception. US leadership across the nine technologies is both outsized and multifaceted. Outsized in the sense that its share of the global investments or patents filed across these technologies significantly exceeds America's share of global GDP, which stands at 26.5% in 2024.[67] By comparison the US accounts for between 60-70% of the reported global investment going into each of AI, IoT, robotics AR/VR/XR and nanotech, and an even greater share of global investment into autonomous systems, gene editing and fusion. Renewables is the only critical sector in which the US is underspending relative to its economic power.

US technology leadership is also multifaceted in the sense that its leadership spans both R&D and innovation (as measured by patents) as well as commercial scale (as measured by investments and a strong domestic industry) and in fact, leads the worlds across all the respective indicators in nine of the ten technologies. American leadership in these technologies reflects its commanding position in the broader global tech industry, with the US currently home to nine of the world's ten most valuable tech companies overall (the 10th being Chinese). These global tech giants and their multi-billion-dollar research budgets are playing an increasingly important role in American high impact fundamental research, and their priorities are an increasingly important factor in determining where the US leads and how, with the US tech industry exercising increasing influence over tech policy and regulations (trailing only behind in the pharmaceutical industry in terms of its annual lobbying spending).[68]

The US system of enterprise, China's state enterprise model, and the EU's rule of law platform are one view alternative models and in another competing systems, with the US ahead at this stage

China on the other hand is pursuing a state capitalism model with quite a different technology innovation model, driven by its relatively lower levels of economic development, and corporate sector maturity, and the industrial nature of its economy. Having now achieved middle-income status, China is increasingly looking to build high value and IP intensive sectors, investing heavily in tech R&D and innovation as a result. However, with China generally lacking private sector high tech giants on a US scale, much of the country's research is being conducted by universities or public research institutes, particularly by the Chinese Academy of Sciences, thought to be the world's largest research institute.

Further, having built up the world's largest manufacturing base in the previous growth phase, much of China's R&D focus has been focused on industrial-related rather than on purely digital sectors. Perhaps unsurprisingly therefore, China currently leads in technologies such as

renewables, (and other manufacturing related technologies among the longer list of the 19, including drones, electric vehicles, battery technology (energy storage)). Further, China's 32% share of global investment in renewables far exceeds its 18% share of the global economy, and it is also overweight in robotics spending, where it represents 21% of global spending. But it has also begun investing heavily into digital technologies like AI and autonomous systems, where its share of global spending lags only slightly behind its share of the global economy, (implying a very absolute big gap to US spending a result).

The EU's starting point in terms of tech competition shares some similarities with China's, despite Europe being much closer to the US in terms of overall economic development. Like China, the EU lacks 'domestic' tech companies on the scale of the US (having only three companies among the top 50 tech companies by market cap), making public research key in its high-tech efforts. And like China, the EU still has a meaningful industrial and manufacturing base. However, the EU in general lacks China's aggressive government driven technology push into strategic high-tech areas and lags China across most of the ten technologies both in terms of research (patent filings) and investment levels, with the only exceptions being renewables, which are key political priority and core to the European Green Deal agenda, and autonomous systems.[2]

However, despite the EU at least on paper seeming to hold an edge in these technologies, in practice China may be better positioned for the future. China's highly flexible regulatory regime based on state control, national interests and the protection of domestic companies creates strong domestic industries, while the EU's regime emphasizes consumer protection, market fairness, and individual rights can hold back both technology deployment and the creation of national champions. As a result, despite China spending less and creating less IP in renewables, its companies dominate the global solar and wind technology. Similarly, despite leading China in both autonomous technology IP and spending, the EU has yet to launch a commercial robotaxi service, while Chinese companies have already completed over six million rides. A recent EU-commissioned report has acknowledged that its intricate regulatory environment is a significant barrier to innovation and competitiveness and has further called for an annual investment boost of approximately €800 billion to support sectors like artificial intelligence, semiconductors, and green technologies.[69]

> Despite the EU holding an edge over China across core high tech sectors (at least on paper), in practice, China is better positioned for the future

Despite India's status as the fourth emerging geopolitical power bloc, and the large role that the technology sector is already playing in its economic development, representing over 7% of its GDP, the country's engagement with the ten key technologies of the future remains nascent, with total annual investment across all ten of less than US$40 billion. This is 16% of what China invests, 10% of the EU's investment, and less than 5% of what the US invests annually. The picture across earlier stage research and IP is similar, with India trailing far behind the three other power blocs in patent applications across all technologies. However, India is clearly ahead of the regional

[2] As well as being neck to neck to with China in nanotechnology.

powers like the UK or Japan in terms of patents, pointing to the scale of its ambition and its potentially growing position across many of these technologies.

Competing for Tech Leadership: Hyper Monopolies vs. State Capitalism.

The next four years seem poised to bring both US-China tech rivalry and the different models the countries are pursuing into sharper relief.

US – Potential for Hyper-Monopolies. The first Trump presidency launched a trade war against China in 2018, setting initial tariffs on Chinese exports. While not exclusively focused on technology, the tariffs included exports of solar panels, a market that China dominates. The Biden administration kept these tariffs in place and added additional levies on goods including electric vehicles, solar panels, and most recently solar wafers and polysilicon too, effectively seeking to limit China's leaderships across two core technologies (renewables and electric vehicles). The Biden administration also escalated the AI-rivalry between the two countries, restricting exports to China of cutting-edge GPU chips needed to train AI model, as well as exports of chip-making equipment to limit China's ability to manufacture its own alternatives. Trump has vowed to impose tariffs of up to 60% on Chinese goods, promising to intensify US-China rivalry across the biggest near-term areas of high tech.

The Trump administration will likely also turbo-charge the US model of Big Tech-led innovation. President-elect Trumps is widely expected to deregulate large areas of the US economy, and has specifically vowed to reduce key high tech regulations like the 2023 executive order on AI safety and security, further, the US Department of Justice (DOJ) is likely to change course on its currently assertive approach to monopoly concerns, particularly with regards to Big Tech companies, with three DOJ anti-trust lawsuits against Apple, Amazon and Google currently underway.

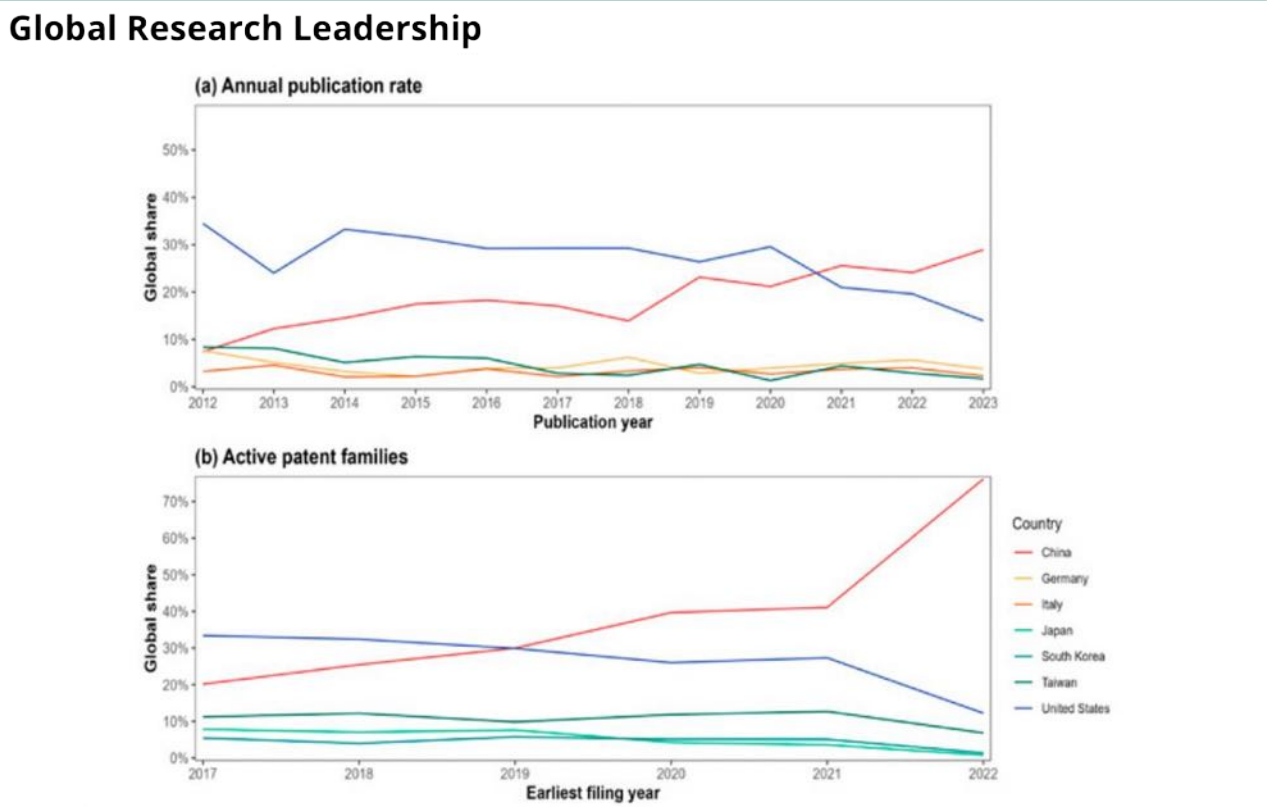
The result of these policies could be a further boost for the US tech sector over the near to medium-term, creating game-changing 'hyper-monopolies' in key areas of strategic technology. These 'hyper-monopolies' would not only represent an even greater share of overall US tech R&D, but also directly influence US government policy and research priorities, with tech entrepreneurs including Elon Musk and Jeff Bezos already seeming to align themselves with the President-elect, exercising potential regulatory capture that lets them effectively dictate the rules of engagement in their own sectors

China – State Capitalism. China on the other hand will likely continue its patient and consistent pursuit of tech leadership, largely led by public sector research, with the Chinese Academy of Sciences (CAS) incorporating 113 different institutes under its umbrella the world's largest research institute. While traditionally much of China's innovation has focused on process innovation or applied research, rather than fundamental tech breakthroughs, this picture appears to have fundamentally changed.

China has made enormous strides in terms of high impact technology research (defined as the top 10% of the most highly cited papers) over the past two decades. Measured across 64 critical technologies spanning defense, space, energy, the environment, artificial intelligence (AI),

biotechnology, robotics, cyber, computing, advanced materials and quantum technology areas, China has gone from leading the world in just three 20 years ago to now a staggering 57.[70] High impact research is a direct driver of patent activity, which indicates innovation and presages commercial activity.

Figure 28: Patents and High Impact Research by Country



Source: ASPI, 2024

Over the past two decades, China has been able to convert early research leadership in areas such as precision manufacturing, photovoltaics and batteries to global industry leadership in these areas. During this period, it has built up its scientific capability, developed talent and established institutional support for high impact research across six of the ten critical technologies including AI, (in areas like advanced integrated circuit design and fabrication, advanced data analytics and machine learning), robotics, parts of quantum technology (sensors, communications and cryptography), nuclear energy, autonomous systems, and nanotech. If China can repeat the feat it accomplished in other areas of tech here, its chances of dominating these technologies within the next decades are high.

China's approach to research meshes well with its broader industrial strategy of state capitalism, where economic growth is driven mainly by the private sector, supported by both private and state-owned capital support, with the government keeping firm control over all parties. In the digital and tech sector, this approach has led to the creation of scaled champions including Tencent, Alibaba, Baidu and Huawei which dominate their respective sectors domestically.

However, their power position relative to the Chinese government is effectively the reverse of their US competitors, with Chinese companies and their leaders fully in thrall to Beijing.

Potential Outlook. Despite their very different approaches and current positions, both China and the US have the potential to lead across the core technologies of the future. The question remains therefore is which of these two competing models is likely to prevail?

In the US, private-sector research is already increasingly concentrated in US technology giants, and the potential developments outlined above will accelerate further American technological progress in the fields like AI, IoT and autonomous vehicles that Big Tech chooses to focus on, further strengthening US competitiveness in these areas globally. However, this risks starving other (potentially critical) areas such as gene editing, and nanotechnology of both private and public financial and R&D resources, leading to a loss of American leadership in these areas over time. Big Tech's set of interests and priorities are naturally narrower than that of the country, making future gaps in American innovation likely in a scenario where Big Tech effectively determines government priorities.

Moreover, history has repeatedly shown that monopolies are inimical to innovation in the long run. The lack of competition faced by monopolies diminishes their need to innovate, and resources are often diverted from R&D toward protecting their position (e.g., lobbying, or anti-competitive practices). Monopolies also often create high barriers to entry through predatory pricing, exclusive contracts, or control of critical resources, stymieing competition, and seek to suppress disruptive technologies, rather than embracing them.

American Leadership Requirements. The continued success of the US system of enterprise in the context of American technology leadership over the long-term may therefore require a continuation of large scale government contracts and technology transfer to the private sector, fostering large scale players that can afford to compete on the global stage and regulatory protection of smaller enterprises that form the pool of innovators from which ground-breaking innovations emerge and giants can be quickly scaled without predatory competition from larger players, thereby creating an environment where US leadership continues. A key element of this is the maintenance of a competitive business environment, with regulations that incentivize private sector investment and innovation, while also preventing monopolistic behavior. Further it will require the US to further build out the collaboration between academia, industry, and government labs to accelerate innovation, with public research funding allocated to strategically compliment and enhance private sector R&D efforts (playing a similar role the development finance institutes play in attracting private sector capital to high-risk projects and emerging markets). If the US can find the right levels of both public oversight and support of its dynamic private sector, further innovation and tech leadership is likely to follow. However, as technologists gain power, the tendency to bend the system to support their vision and businesses will be a temptation for politicians.

China's Leadership Ambitions Fueled. China on the other hand, in keeping with its state-led approach to development, has already developed and is executing a series of national plans relating to different areas of high tech, including the Made in China 2025 strategy, launched in

2015, which focuses on several areas where China has now established strong positions such as robotics, advanced materials, and electric vehicles, and several areas where it has not yet, such as semiconductors and biotechnology. Separately, China is executing the “New Generation Artificial Intelligence Development Plan", which aims to see it making major breakthroughs in AI by 2025 and becoming the world’s primary AI innovator by 2030.

These high-tech plans sit within the context of China’s broader economic strategy that focuses on the fundamental R&D leadership described above, the generation of new growth from the high sectors that this creates, and use of their technologies to transform the traditional industries that form the core of China’s economy. The past 20 years have seen China begin to (more or less) successfully execute on this strategy. However, global technology leadership over the next 20 years will require different skill sets, building entirely new industries. This will require China to address several key limitations, including building an innovation ecosystem that bridge the gap between initial innovation and the commercial scaling of breakthrough technologies, integrating researchers, entrepreneurs, venture capitalists and the private sector to manage the risk inherent in early-stage technology. It will also require enlarging the pool of talent on which it can draw. While China produces many STEM graduates, the international flow of talent is not in its favor, with many of China’s top talents seek opportunities abroad, while cultural and institutional barriers make it challenging to attract talent from overseas. Finally, it will require China to more thoroughly embrace international R&D and scientific partnerships, creating opportunities for knowledge transfer and collaboration, something that current geopolitical tension are inhibiting rather than enabling, with trade restrictions hampering its access to sources and inputs required to scale key high-tech industries.

EU’s Imperative to be a Key Technology Zone. European leaders have acknowledged both the existence and the need to close the widening innovation gap with the US and China. Galvanizing private sector engagement is key in this regard, with European companies having invested approximately $270 billion less in R&D than their U.S. counterparts in 2021, largely due to a static industrial structure dominated by longstanding companies and technologies.[71] Narrowing this gap will require policy reforms to enhance the innovation ecosystem, encouraging startups to scale within Europe by removing regulatory hurdles, and facilitating the commercialization of research, and establishing universities and research institutions at the forefront of academic excellence. Despite having fallen behind in corporate innovation and fundamental research, the EU remains a major potential player in innovation: The size of the single market provides it with leverage as a setter of standards on the one hand and the ability to attract R&D resources and innovation infrastructure from abroad in exchange for market access, on the other hand.

Among the major fields of technology, renewables and other sustainability related technologies are a key priority for the EU given the policy initiatives and legislative proposals of the European Green Deal currently being implemented. Key to this strategy is the development of a competitive green high-tech industry. This involves investing in renewable energy, modernizing infrastructure, and implementing pragmatic energy policies that balance decarbonization with corporate competitiveness.[72]

India's Mass Market Frugal Innovator Development Model. India finds itself at a significantly different stage to the other three power blocs with regards to innovation. A market of 1.4 billion people rising to 1.6 billion by 2050,[73] with a current GDP per capital of US$ 2,700, (21% of China's, 6% of the EU's and only 3% of America's) , has the need for frugal innovation,[74] dictated by the scale of its needs rather than by its absolute size, given that it ranks among the world's five largest economies today, and is projected to be among the top three by 2030.[75] Perhaps unsurprisingly, India does not yet have a meaningful position across any of the ten critical technologies of the future. In the absence of scaled R&D capacities, an alternative strategy for technology leadership, (which India deployed to great effect in digital finance, leading to the financial inclusion of half a billion people within the last decade) is to become the leader in frugal innovation by leveraging its large domestic market to reengineer expensive foreign technologies to meet local price points. India has shown it can do this in sectors like pharmaceuticals and for technologies like smartphones. Such a strategy would provide a platform for India to become an exporter of transformed technologies to the Global South.

Global leadership across the ten critical technologies is playing out across a range of different timescales. At one end of the spectrum, renewable technologies have reached a point of commercial maturity where manufacturing scale and supply chain integration are among the key drivers of industry leadership (the importance of and potential for further innovation notwithstanding). At the other end of the spectrum is nanotechnology, still the subject of widespread basic research as the precursor of fundamental innovation breakthroughs. The actions countries will need to take to lead, and the resources that they can apply, will therefore vary significantly. In the competition of large power blocs, the danger for the rest of the world is that it is left behind. If taking all nations into the next era is not a multilateral endeavor in which the weak are protected from predation, countries that lack technology risk being exploited by owners of technology rather than being engaged on mutually beneficial terms.

Tech Companies Competing for the Future

The competition for the future playing out between leading global tech companies is no less intense, nor less global than the one between countries. One key (potential) difference between the two competitions is the number of competitors in each. There are 193 countries in the world today, compared to by some counts over seven million tech companies.[76] However, given the levels of resources, capital, and capacity required to develop and lead in emerging technologies, only a handful of countries (eight, if one considers the EU as one bloc rather than 27 countries) are serious contenders. The picture in the tech industry is even more extreme, with the technology industry today being very much a story of 'Big Tech' and the rest. The world's ten largest tech companies by revenue generated sales of US$2.5 trillion in 2023,

The world's ten largest tech companies by revenue generated sales of US$2.5 trillion in 2023, in a global tech market worth US$5 -10 trillion, implying that the top 0.0001% of tech companies globally generate 25-50% of the total industry revenues

in a global tech market whose estimated annual value ranges from US$5 -10 trillion,[77] implying that the top 0.0001% of tech companies globally represent 25-50% of the total industry value.

'Big Tech' was not long ago dominated by enterprise tech solutions companies like IBM, HP and Microsoft, and by diversified electronics companies like Sony, Panasonic and Samsung, but these companies have largely been overtaken by a set of competitors like Amazon, Alphabet, Alibaba and Meta that started as (consumer) internet companies but have evolved into today's cloud 'hyperscalers', a transition that most of the original Big Tech companies have struggled to execute (with Microsoft being a notable exception). Today, of the original Big Tech companies only Samsung remains in the top ten by revenue. For the purposes of analyzing Big Tech's engagement with critical technologies, this report focuses and reports on 20 of the world's 100 largest tech companies.

Figure 29: Big Tech The World's 20 Largest Technology Companies

Company	Q3 2024 TTM Revenue in US$ billion	Industry Sector
Amazon	US$620	Hyperscaler
Apple Inc	US$391	Hyperscaler
Alphabet Inc.	US$340	Hyperscaler
Microsoft	US$254	Hyperscaler
Samsung	US$220	Diversified electronics
Foxconn	US$208	Diversified electronics
Jingdong Mall	US$157	E-commerce
Meta Platforms	US$156	Hyperscaler
Alibaba Group	US$127	Hyperscaler
NVIDIA	US$113	Semiconductors
Dell Technologies:	US$92	Tech solutions
Sony Corporation	US$89	Diversified electronics
Tencent Holdings	US$86	Hyperscaler
TSMC	US$76	Semiconductors
LG Electronics	US$65	Diversified electronics
IBM	US$62	Hyperscaler
Panasonic	US$58	Diversified electronics
Lenovo	US$57	Tech solutions
Intel Corporation	US$54	Semiconductors
HP Inc.	US$53	Tech solutions

Given the breadth and scale of their businesses, today's Big Tech companies have launched many initiatives across all the 19 technologies. In 2023, each of the ten largest tech companies in the world had initiatives (including investments, R&D programs, partnerships, or products) across at least 17 of the 19 core technologies, with two of the top ten engaging across all 19. [78] And the engagement of the next ten largest companies was scarcely lower. However, in some cases the engagement with these technologies was tactical in nature rather reflective of a strategic desire to dominate a technology or to enter new markets. To use an analogy, IBM built the world's most advanced chess computer, but this was driven by its desire to develop and showcase its advanced AI models, rather than to strategically position it in the world of chess. In other words, the quantity of Big Tech's engagement with the 19 technologies is not necessarily an indication of its quality.

If Apple were a country, it would be the world's 40th largest economy, larger than Pakistan, Egypt and South Africa

In fact, many of the biggest investments and innovations for at least some of the19 technologies, are still being made by specialist tech companies, particularly in earlier state and tech-enabled rather than fully digital technologies like Nanotech, Fusion, or 3D-printing. However, with Big Tech companies approach nation-states in terms of their scale and reach, these technologies are fast becoming strategic. Based on its revenues, Apple would be the world's 40th largest economy based on its revenue, larger than Pakistan, Egypt and South Africa. Based on its 1.6 million employees, Amazon as a country would be the world's 153rd most populous nation. Between their global footprints and the breadth of their business interests, Big Tech will likely need to secure positions in all the critical technologies of the future. Scaled examples of this are the billions of dollars 'hyperscalers' are investing in energy, funding R&D, building infrastructure, or acquiring assets in both fusion and renewable technologies. These investments are highly strategic given the ever-increasing power demands of the growing number of AI data centers, the spending on which is projected to reach US$250 billion annually by 2030,[79] while the tech sector's share of global electricity consumption is projected to grow from 6% today to 10-20% by 2030.

'Hyperscalers' are investing billions of dollars funding R&D, building infrastructure, or acquiring assets across fusion and renewable technologies. These investments are highly strategic given the increasing power demands of AI data centers, which are driving the tech sector's share of global electricity consumption from 6% today to 10-20% by 2030

The table below list the current engagement of the top 20 global tech companies across the five control points of the future, with engagement broken down between (i) reported investments, which could include investments in tech infrastructure, funding for specialist companies in the space, or scaled purchases of technologies, (ii) reported R&D programs and partnerships, both focused on or significantly incorporating a given technology, and (iii) reported commercial product initiatives, with companies looking to monetize the technologies directly.

Figure 30: Big Tech Positioning Across Ten Critical Technologies

Big Tech and Technologies of the Future

	AI		IoT		AR/VR/XR		Quantum Technologies		Robotics		Autonomous Technologies		Nanotech		Fusion		Gene Editing		Renewables		Total Spending
	R&D Inv.	Prod	R&D Inv.	Prod	R&D Inv.	Prod	R&D Inv.	Prod	R&D Inv.	Prod	R&D Inv.	Prod	R&D Inv.	Prod	R&D Inv.	Prod	R&D Inv.	Prod	R&D Inv.	Prod	US$bn
Company 1	100										5				0.3		0.1		5.7		111.1
Company 2	38				25														14.2		77.2
Company 3	16		5				20				1.05								10		52.1
Company 4			1.2				0.1		0.1		0.81		0.15		0.1		0.1				2.4
Company 5	20								10.5		1		0.28						4.7		36.5
Company 6	1		15				11				0.7										27.7
Company 7	8		1						1		1.2				0.5		0.2		12.6		24.5
Company 8							0.1				15.3		7.86								23.2
Company 9	2.8						0		0.1										4.5		7.4
Company 10	0.5		3				0.1						3								6.6
Company 11	4.5										0.16										4.7
Company 12	1		1.2						2.2												4.4
Company 13	3		0.5						0.8						0		<0.1				4.4
Company 14					2.1		0														2.1
Company 15			1				0.1														1.1
Company 16	1																				1.0
Company 17			0.5																		0.5
Company 18					0.1				0.1												0.2
Company 19																					-
Company 20																					-
Total US$bn	196		28		27		31		15		25.2		11.3		0.9		0.4		51.7		386.9

Sources: Force for Good, Company Press Releases and Corporate information, 2024

There are several key takeaways emerging from the table above:

- US$386 billion in Total Investment Spend. Cumulatively, the world's top 20 tech companies report spending nearly US$400 billion annually investing in or developing the ten most critical technologies shaping the future.
- Significant Range in Tech Investments. Eight companies stand out for the scale of their investment, with reported annual spending of over US$20 billion each, with the largest investor spending more than US$100 billion across the ten technologies in 2023.
- AI is a c.US$200 billion Annual Priority. AI is the only technology focused on by all 20 companies, each of which has both R&D programs underway as well as commercial products, with nearly US$200 billion in annual spending.
- IoT, AR/VR/XR, Autonomous Systems and Quantum Are Commercial Priorities Too. Four technologies attract US$25-30 billion of annual spending, of which IoT and AR/VR/XR are already commercialized with marketed products, while Quantum Technologies and Autonomous Systems are still awaiting commercial scaling at this time.

- Fusion, Nanotech and Gene-Editing Remain Frontier Technologies. Spending across these technologies is low in absolute terms relative to the others and is largely still at the research stage.
- US$50 billion Renewables Investments Reflecting High Tech Business Needs. A subset of the largest tech companies are significant investors in renewable technologies and assets, the vast majority of which is driven by their own business' energy needs rather than being research or commercial priorities. Overall, global tech leaders' spending and research priorities remain highly focused on digital technologies, which is unsurprising perhaps given that digital is the common link across all the subsectors of high tech today. Further, their spending largely remains focused on technologies at the later stages of the R&D cycles, with investments focused on near-term commercialization opportunities rather than fundamental research, a fact that highlights the role that public sector research will continue to play in the future.

As the world makes its defining shift from the Industrial to the Informational Age, the competition between nations is critical to defining who will be the great power in the next era, and whether that is one nation and its assets or a bloc of nations, or a multilateral power structure. Today, America and American companies are far ahead across almost all critical technologies. However, this competition has many critical variables that determine the outcome including how powerful the resistance is to progress, the divisions in a country on the transition, whether the nation becomes embroiled in other missions (such as wars, ideologies) that divert attention or align rivals, accidental breakthroughs that position a nation to leapfrog others. The next decade is likely a critical one in determining the outcome of this transition, which is examined next.

In summary

- Ten of the 19 core technologies are projected to create trillions in near-term value and/or have the potential for exponential growth to transform the future.
- These ten technologies have emerged as the focal points of global tech competition, both between countries and Big Tech companies.
- The next decades promise to be one of increasing tech rivalry between the US and China across these technologies, with the US betting on its financial power, established innovation ecosystem and powerful corporate sector, and China placing a patient bet on its state capitalist system of innovation.
- Big tech companies are also competing across a growing range of these technologies, with a subset beginning to place bets on emerging technologies outside of their traditional franchises.
- Cumulatively, the world's top 20 tech companies report spending nearly US$400 billion annually investing in or developing the ten most critical technologies shaping the future.

- Alongside AI, four technologies are the most transformative in creating a far superior future, fusion, quantum technologies, gene editing, and nanotechnology, given they transform all knowledge and awareness, energy, all calculations, all materials, respectively and the country or company that creates, develops and dominates the markets for these probably creates the greatest power and wealth.
- Centralisation versus democratisation of technologies will be an important factor in the benefits accruing to people across the world, and that may be more a function of the technology than technologists.

V. The Road to the Information Era: Transition Scenarios

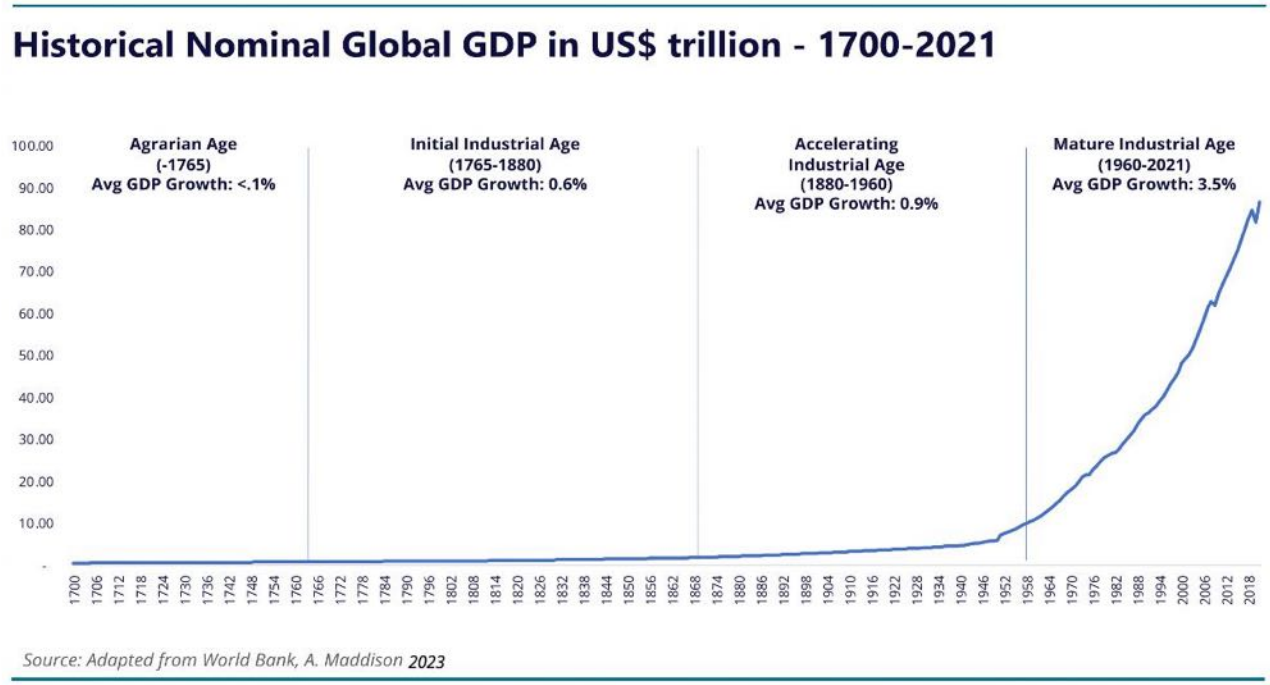
The shift into the post-industrial era of the Information Age is poised to bring geopolitical conflict, economic turmoil, and social fragmentation. Technological advancements will create widespread disruption, exacerbating inequality, transforming labor markets, and destabilizing political systems. This complex scenario is further intensified by environmental challenges, which pose a potential existential threat to humanity if left unaddressed as scientists warn that we are certain to reach a temperature rise of 2.5°C or greater based on current policies and modes of living. The world faces two distinct paths forward: a prolonged and turbulent transition characterized by conflict and missed opportunities, or a shorter, more cohesive transition driven by global cooperation and shared innovation. Which of the paths the world takes, and whether it leads to a more inclusive, equitable, and prosperous world will hinge on the decisions made over the coming decades.

1. Inevitable Progress, but with Uncertain Paths

Knowledge has been the fundamental driver of progress, and its cumulative nature has enabled this progress to be increasingly exponential. The history of human economic activity demonstrates this relationship well. For in, leading up to the Industrial Revolution, most human economic activity was agricultural in nature and global output grew largely in parallel with population growth, as human and animal labor served as the primary energy sources for work, with only limited innovation to increase their productivity. Since this past time, a series of

successive technological breakthroughs have fundamentally transformed global economic activity, starting with the steam engine unlocking new energy sources, followed by manufacturing technologies, new materials such as steel, electrification, communications, electronics and computers. The self-reinforcing nature of human knowledge accumulation ensures that innovation and progress are not only continuous but inevitable. Each new discovery or technological breakthrough builds upon prior knowledge, creating a compounding effect where advancements become faster and more transformative over time. As a result, global GDP following the Industrial Revolution increased more than threefold between 1765-1880, nearly sixfold between 1880-1960 and nearly eightfold between 1960 and the present day.

Figure 31: Global Economic Growth 1700-2021



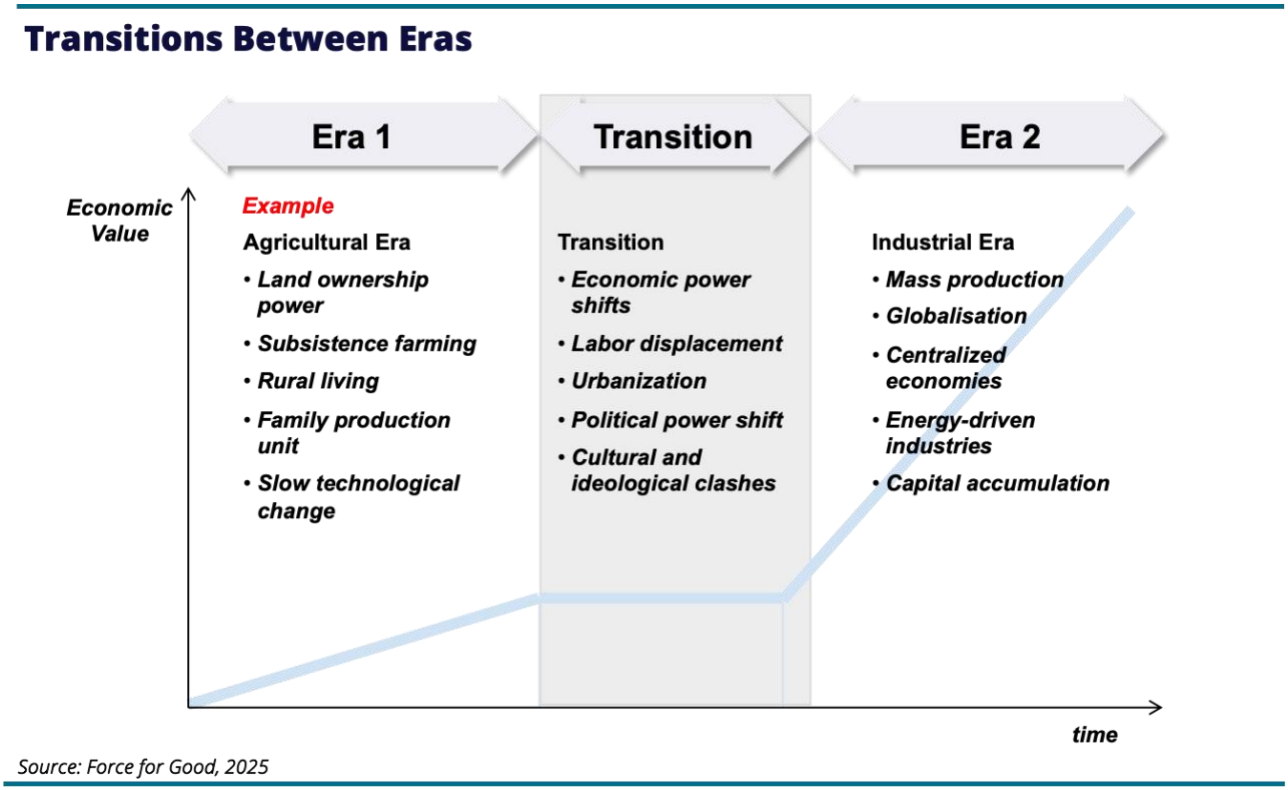
The Power Politics of Transition

The transformation of society as the world has progressed through successive ages has been fundamental, and the periods of transition between have been traumatic, shaped by struggle and upheaval. When technological advances herald sufficient political, economic, and social changes fundamentally disrupting the status quo, societies enter a transition phase. In this transition, economic power shifts, existing hierarchies are destabilized, new technologies displace traditional industries, and labor forces are displaced, exacerbating inequality and political discontent, as well as triggering migrations, creating new tensions. The transition also triggers political power shifts, both within and between nations, as rising powers challenge the dominant order, while existing systems prove incapable of managing change.

Simultaneously, cultural and ideological clashes emerge as societies grapple with the erosion of old norms and certainties. Innovation reshapes identities and call into question existing moral frameworks, fueling ideological divisions and revolutionary movements. It is during this period of

turbulence and conflict that the ultimate victors - whether nations, systems, or values - that will define the next era, and the new order are determined. Such transitions have been shaped by competition, conflict, and collaboration, and the current transition underway will be no different.

Figure 32: Political, Economic and Social Conflicts of the Transition Between Eras



Source: Force for Good, 2025

The transition to the post-industrial era of the Information Age will therefore not simply be a story of human progress but a theater of geopolitical struggle, economic upheaval, and social fragmentation. Much as the Industrial Revolution redefined the balance of power between nations, the exponential rise of transformative technologies of which the 19 technologies will play a potentially pivotal role, will reshape the global order.

At the center of this transition stands the United States, whose dominance as the world's geopolitical, military, technological and economic leader is increasingly contested, by its rivals, particularly China, but also amid the wars in Europe and Middle East, by most of the world's UN member states questioning its moral leadership. However, at the heart of this contest lies the race for technological supremacy, which will be driven, and potentially decided, by breakthroughs in AI superintelligence, fusion energy, and quantum technologies. Whoever wins this race will not only dominate global markets but also possess the tools to reshape military capabilities, economic, financial and industrial systems, and ultimately transnational governance frameworks. Further, this competition and its outcomes may well determine the nature of the political and social systems that emerge.

The disruption created by technologies, particularly related to AI and automation will reverberate across societies, deepening inequality, disrupting labor markets, and fueling political instability. In

the West, where industrial economies will be hollowed out by exponential technological change, these developments risk strengthening populist and nationalist movements that challenge existing liberal institutions that are increasingly struggling to address social issues including migration, economic growth, employment and inflation. In developing nations, the disruptions will be even more severe. Countries that cannot participate in the race to develop and adopt new technologies risk being relegated to near-permanent economic dependency, their labor forces rendered obsolete and their governments unable to maintain stability in the face of mass unemployment and growing resentment.

Who wins the contest for the future, and who is in power when the victors emerge therefore matters, impacting the political, economic, and cultural values that will define humanity's future. Whether the transition leads to a more open, equitable, and prosperous world or a darker era of authoritarian dominance will depend on the choices made in the coming decades. Whereas this battle has been painted as one between democracies and autocracies, the rise of far-right National Populism – autocracies within democracies - means that this is the wrong depiction. Hence, this is not merely a technological race; it is a battle for the nature of the 21st century.

Political-Environmental Futures in Transition

The broader transition ahead is further complicated by an environmental transition which represents a potentially existential threat to civilization. The UN Intergovernmental Panel on Climate Change warns that under present policy trajectories, global temperatures are projected to rise by approximately 3°C by 2100.

Managing this environmental risk will require mitigating and adapting to climate change, with the energy transition away from fossil fuels being key, given the scale of their contribution to the projected temperature increases. [80] Based on their historical and current industrial and energy policies China leads the world in current carbon emissions, while the United States has cumulatively emitted the most carbon to date.[81] Managing the environmental transition ahead therefore has not only technological and economic dimensions, but also a political one defined by America's climate policies and its ability (or willingness) to strike a deal with China.

The promises made during the 2024 US presidential election if played out broadly as broadcast, will likely profoundly reshape US climate and energy policy, and is expected to dismantle federal environmental and climate regulations, and backtrack on climate action, including withdrawing from multilateral commitments like the Paris Agreement. Such actions would undermine global cooperation and trust in America as a global leader addressing climate change, emboldening other nations - particularly those heavily reliant on fossil fuels - to delay decarbonization efforts. In a best case scenario, such economic deregulation and policies prioritizing growth over environmental concerns can put the world on a path closer to the high-emissions SSP5 scenario outlined by the IPCC, named "Fossil-Fueled Development," characterized by rapid technological advancements, high reliance on fossil fuels, and a focus on economic growth over sustainability, whose most optimistic variant would provide the technologies to address (and reverse) the

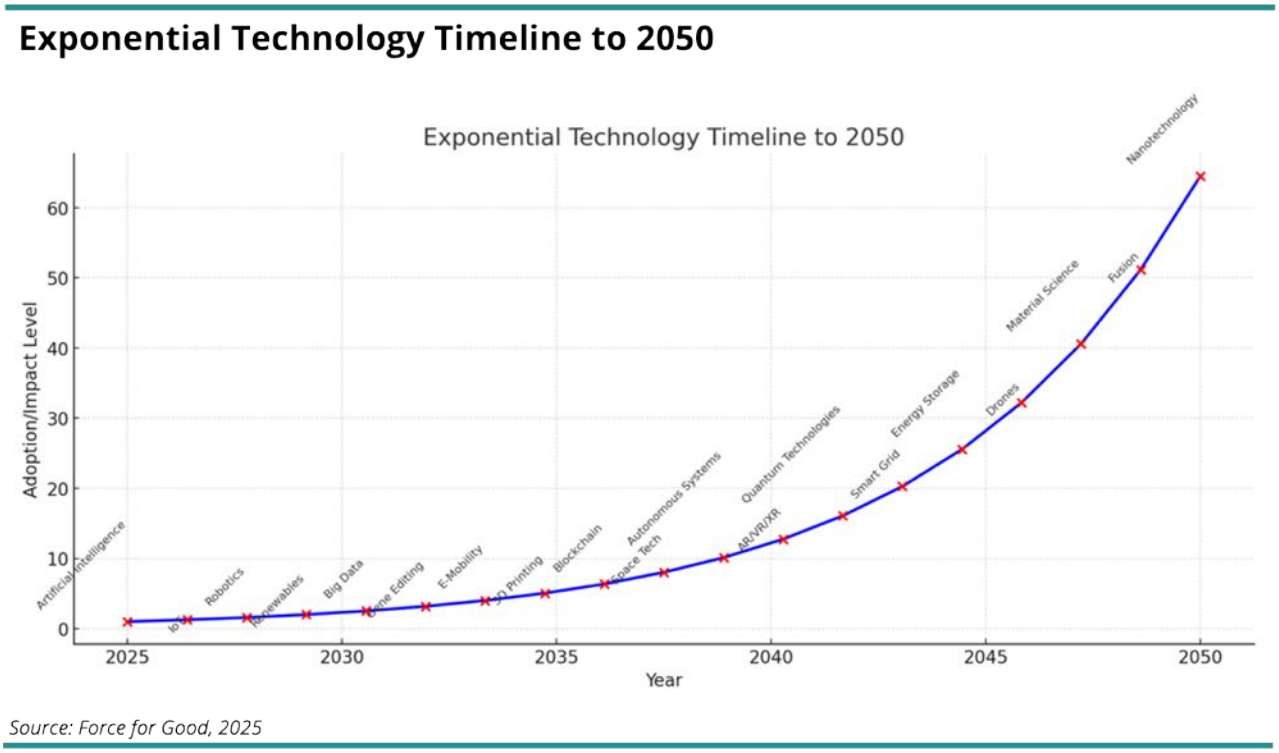
ravages of their growth policy.[82] However, in a down-side scenario, the global instability resulting from America's leadership withdrawal, could see the world slide toward the SSP3 scenario "Regional Rivalry" (where nationalist policies, energy security concerns, and fractured multilateralism exacerbate emissions and hinder climate adaptation, which could push temperature increases beyond 4°C.

The geopolitical vacuum potentially being left by the U.S. provides an opportunity for China to step forward, aligning itself to institutions and advanced industrialized countries committed to tackling the issue, such as the EU, as well as with the Global South, creating a hitherto unlikely alliance to manage the global energy transition. This scenario would complicate the role of American technological leadership in the transition of the next era.

Leveraging Technology to Manage the Transition

Technology will play a pivotal role in managing the transition and shaping the future that emerges from it. Much of this transition will be defined by the timing of and nature of the fundamental breakthroughs across the 19 technologies of the future, which together will continue to drive the world's exponential progress, as illustrated below.

Figure 33: Illustrative Technology Timeline to the Future



Source: Force for Good, 2025

Human ingenuity and the scientific process by their very nature will continue to drive innovation and lead to great breakthroughs. The nature of the breakthroughs achieved, their timing and the uses to which they are applied however are choices the world will need to make, with the interplay between the public and private sectors being key. The former needs to nurture

innovation and ensure that technology's benefits are distributed for the good of all, and the latter drives and develops this innovation.

The Public Sector – Nurturing Innovation and Enabling Access. Governments play a pivotal role in fostering innovation and promoting key technologies, driving their implementation and scaling for maximum impact. Through policies, incentives, and regulations, they create an environment that encourages creativity, R&D. Investments in education and infrastructure lay the groundwork for a thriving innovation ecosystem, while incentives like tax credits, grants, and subsidies drive investment in cutting-edge technologies, with regulations ideally creating a level playing field for competing ideas and innovation.

Critically of course, given limited resources, governments will need to select sectors and technologies for prioritization, based on their perception of national (and in some cases global) needs. While all countries have recognized the utility and strategic importance of AI, there is currently less than universal competition across the remaining core technologies, as major countries selectively choose to protect incumbent industries and structures rather than embracing technological change. Such gaps provide the opportunities for other countries to take the lead in potentially strategic technologies.

The domestic angle is also critical. Governments must also ensure that innovation meets their domestic priorities and development needs. In both democracies and autocracies this implies providing widespread access to technology and promoting digital inclusion. Access to technology has been recognized as a fundamental pillar of human security, alongside economic, environmental, and health security,[83] which form the basis of the social, economic and political stability that is needed to mitigate the shocks that the transition to the future will bring.

The Private Sector - Driving and Deploying Innovation. While the public sector and academia have an important role to play in scientific research and technology innovation, much of the heavy lifting, particularly in the commercialization and scaling of technologies will be done by the private sector. Entrepreneurs and tech companies develop technologies based on the dictates of the market, with the aim of most private companies (across any sector) being the maximization of profits, alongside (often secondary) objectives around the delivery of value to a broader set of stakeholders beyond its shareholders. Commercial opportunities therefore not only determine where and how technological innovations are deployed, they also shape which innovations are prioritized and thereby which breakthroughs are achieved.

Based on the political, technological and environmental factors discussed, there are two transition paths that the world can take to the future, an extended transition path marred by conflict and wasted opportunities, and a short transition path shaped by global collaboration and shared innovation. Which path the world follows depends on the choices of global stakeholders, be they geopolitical rivals, governments or innovators and tech solution owners. The role of the society in an AI-enabled world should of course not be underestimated as individuals suffer a deluge of misinformation and propaganda on the one hand and, on the other hand, the

opportunity to develop a technology-enabled, far more enlightened future powered by information and tools they never had access to before.

2. Short Transition: Focus on Execution and Innovation

At one end of the spectrum, countries around the world can embrace a collaborative and cooperative model, prioritizing global solidarity and collective action over narrow national interests. In this scenario, nations recognize the interconnected nature of the global polycrisis and the necessity of unified efforts to address cascading political, economic, security, technological, and environmental challenges.

This scenario is one of alignment among states, who commit to multilateralism, strengthening institutions like the United Nations, World Trade Organization, and regional alliances. Policies and agreements are crafted as a basic framework for equitable sharing of technologies and solutions for the benefit of all. Key technologies, such as universal connectivity, digital platforms for basic services, and innovations delivering human essentials, are recognized as global public goods and distributed equitably, and countries increase collaboration on research and development for further technological breakthroughs in these areas.

National and regional rivalries, while not eliminated, subside in the face of greater engagement, with diplomatic efforts focusing on conflict resolution and building trust between rival states, enhancing regional stability, while trade policies emphasize openness and fairness, reducing protectionism. In this environment, states can develop and implement coordinated strategies to tackle environmental challenges, mitigate the effects of economic shocks, and further enhance global security.

The R&D efforts of such a world would be aligned with the priorities above. Importantly, the same multilateralism would govern the approach to using the breakthroughs that emerge, ensuring that technology fulfills its potential as a force for good and underpins human security for all, by addressing, among other things:

1. Global Challenges of People. Advances in renewable energy, energy storage, and carbon capture technologies accelerate the transition to a sustainable economy, while innovations in biotechnology, telemedicine, and global health infrastructure improve global health outcomes, and precision agriculture and supply chain digitization enhance food production and distribution, to address global hunger.
2. Environmental and Planetary Sustainability. Breakthroughs in green technology, such as smart grids, electric vehicles, and water purification systems, support global climate goals and reduce resource exploitation, while circular economy technologies, including advanced recycling and waste-to-energy systems, enable sustainable consumption patterns.

3. Mass Connectivity Platforms for All. Digital infrastructures, such as universal internet access and affordable devices, bridges the digital divide, enabling global participation in the digital economy, while innovations in education technology democratize access to high-quality education and skills training, particularly for marginalized communities.
4. Peace and Global Security. AI-driven early warning systems predict and manage risks from natural disasters, economic shocks, and geopolitical conflicts, while cybersecurity innovations focus on protecting critical infrastructure and foster trust in digital systems used for governance and commerce.
5. Sustainable and Inclusive Economic Growth. While addressing each of the aforementioned priorities will create sustainable and high growth industries, the addition of inclusiveness into the design principles of technology will ensure that the ensuring economic growth is inclusive and equitably distributed.

Against the above backdrop, developing nations - supported with multilateral institutions - develop policy frameworks to create new markets and attract solution owners, and they rapidly build the capacities required for the innovations above to be implemented. In this world the future is embraced, and the global community is largely aligned, creating lower risk and more inclusive growth and development. In this scenario, a spirit of global partnership prevails, and stakeholders work together to build a safer, more prosperous, and sustainable future for all.

3. Extended Transition: War and Conflict, Breakdown of Global Order

At the other end of the spectrum, states compete for the future in a far more winner takes all model, a “country first” approach, and one that is far more predatory. In the background to the competition for the future, in this scenario, the world fails to rise to the challenges created by the global polycrisis, since some countries feel they are less affected and can afford to play in their own narrow interests. As a result, countries are effectively overwhelmed by cumulative impacts of the Polycrisis. In this scenario, states both by means democratic and otherwise succumb to isolationist agendas that prioritize narrowly defined national interests over multilateral engagement and coordinated action. This in turn leads to increasing regional rivalries that negatively impact security, rising trade barriers and protectionist policies that negatively impact prosperity and limited global efforts to tackle challenges, which will continue to be source of rising risk for the world.

Such a world would diverge sharply from principles like the rule of law, multilateral action, and over time, the sanctity of fundamental human rights, which lie at the core of the current global order, whose demise will be all but certain. Without this order, its norms and its institutions to underwrite global security, the world is much more susceptible to finding itself on a path of internecine conflict ranging from fighting over trading and commercial interests to actual wars over territory, in a throwback to a pre-World War II era. This deregulated world is one which is not

too distant from one not run on rule of law, the big get bigger and they swallow the smaller companies, markets and occasionally countries.
The technology priorities of such a world would be focused on parochial issues facing countries engaged in zero-sum competition with each other. Six key considerations stand out in this regard:

1. Owning Attractive Markets. The military-technology machine, the equivalent of the military-industrial complex for tech, would involve governments and their trade negotiators, intelligence agencies, and other arms of government having the job of securing advantage for their largest technology companies.
2. Escalating Technology Arms Races. Countries around the world would compete to develop and control the key technologies critical to national security triggering a series of arms races across strategic technologies as states invest heavily in R&D and control of supply chains for these technologies to outpace rivals.
3. Focus on Strategic Technologies, Not Solving Global Problems. Countries would continue to focus on the disruptive and exponential technologies such as AI, fusion, and quantum technologies, given the disproportionate impact that these technologies can have on the future, and the power they provide to those that that control them. Conversely, countries would likely deemphasize technologies whose benefits cannot be narrowly captured by the user, like carbon capture technologies or renewables.
4. Technology Deployment Priorities, Security Concerns Prevail. Disruptive technologies have overlapping civilian and military applications, amplifying their strategic importance. In a resource constrained extended transition, countries will need to make choices around technology deployment, which would likely lead to prioritizing security and defense applications for technologies like AI, cyber, autonomous vehicles, among others.
5. Rising Rivalries Slow Progress on Key Breakthroughs. While competition between states has been a key driver of technological progress in history,[84] much of this progress has been on applied technologies, rather than on fundamental research, which relies of open knowledge sharing. The large hadron collider at CERN, for example, (focused on particle physics), is the product of collaboration among over 100 countries. A lack of international coordination on fundamental R&D will risk dragging down the global rate of progress on key longer-term breakthroughs, with states prioritizing research providing near-term advantages.
6. Access to Technologies Remains Highly Uneven. With escalating costs of R&D and many countries unwilling to share technologies that they consider strategic, poorer nations struggle to access critical resources and technologies, further exacerbating inequality between nations. This has the potential to create multiple classes of technology-defined countries, with the most advanced having the benefits of AI enhanced individual and collective performance and the least included not yet having basic computing power.

This world will have a fundamental impact on the priorities of technology companies. Like all private sector companies, technology companies respond to the realities of market opportunities

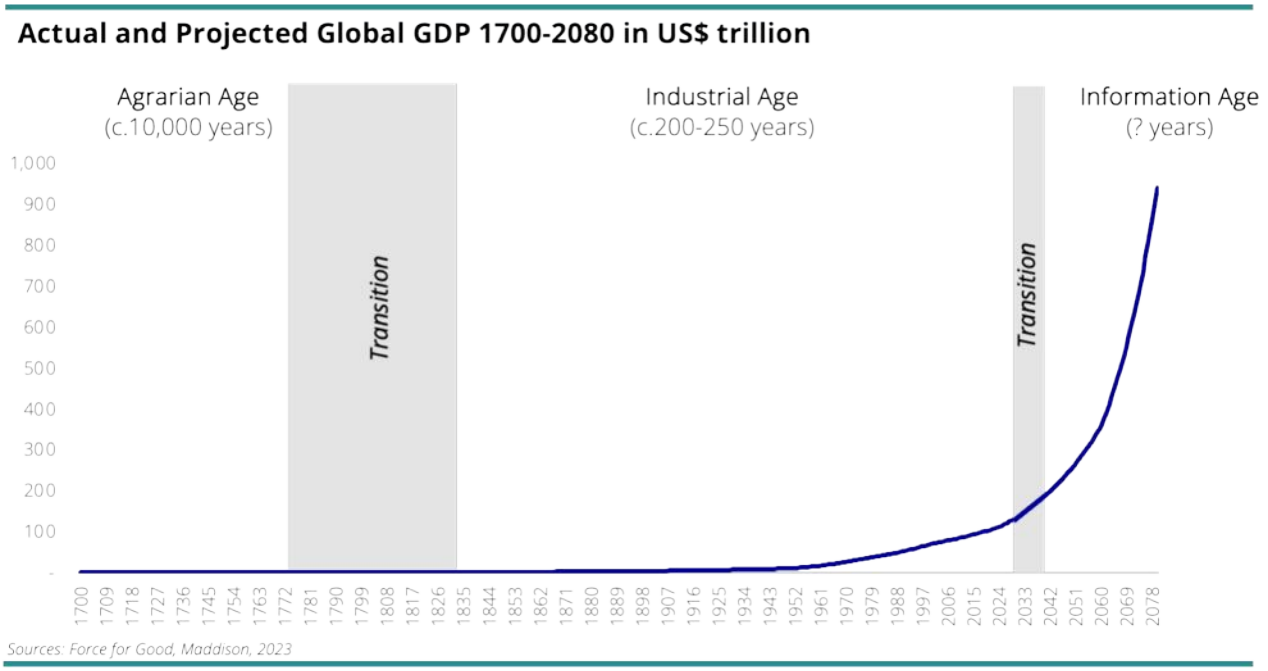
and risks. If the biggest market for nanotechnology is in military applications, then this is where corporate R&D and investments will most likely be applied. And in the absence of large multilateral programs to solve global challenges like ocean acidification, or carbon emissions, tech companies will lack the funding to develop solutions for these areas (and lack the customers to buy them too). In such a world, technology's role as a force for good will be greatly diminished and its potential to underpin human security for all will remain unfulfilled.

The world that this dynamic creates risks being less safe, less prosperous and less sustainable than the world we live in today, with significant degradation of ecosystems, pollution, and resource depletion. Economic development will remain uneven, with very few countries creating growth, some regions experiencing stagnation while others face growing inequality. These dynamics will exacerbate vulnerabilities, particularly for countries that depend on natural resources for their economies and livelihoods, which in turn will lead to more migration and conflict. However, it may be a world that suits certain countries as a path to realizing their geopolitical power ambitions, and so cannot be written off as irrational.

4. Conclusion: The Rewards of the Future

The prospects of a world that underwrites secure, sustainable development to manage the present while continuing to invest in the future is an optimistic one. This approach not only minimizes the risks and but also shortens the transition period to the future. The transition between the Agrarian Age and Industrial Age in the late 18th and early 19th centuries played out over several generations, even in the most technologically advanced region of the world (Northern Europe). The accelerating nature of technological progress implies that the coming transition to the future of the Information Age can be a shorter transition to the Information Age and given the right execution path could be completed in the coming decade or so. However, political considerations can change this progress. More importantly though, the short path if embraced paves the way for unprecedented, accelerating long-term growth for humanity.

Figure 34: Global GDP Growth 1700-2080



Some estimates suggest that by 2060, global GDP could more than triple to reach approximately $350 trillion. This would mean that, on average, the wealth per capita for the world's projected 10 billion people could align with the standard currently enjoyed by South Koreans. Beyond 2060, however, global growth has the potential to accelerate even further, with GDP approaching US$1 trillion by 2080, driven by further technological breakthroughs driving substantial increases in productivity and output across both developed and the then remaining emerging economies, supported by significant policy reforms.

Critical Choices and Decision Makers

The choices facing the world therefore are fundamental ones. Practically speaking however, the number of people whose choices matter for the world has never been smaller. Just two countries generate over 40% of the world's gross domestic product and are home to nine out of the ten largest technology companies in the world (and 14 out of the top 20), giving their leaders unprecedented power to shape the world's trajectory. Similarly, approximately half a dozen Big Tech companies have achieved oligopolies (e.g. in cloud computing or semiconductor manufacturing) and monopolies (e.g., mobile operating systems or internet search), in critical technologies, with a small number of companies effectively dominating six of the 19 technologies today (across AI, Big Data, IoT, Autonomous Systems, Quantum Technologies, and AR/VR/XR), and one individual alone, Elon Musk, controlling companies that leading two of these technologies (Electric Vehicles and Space Tech) and are competitive in a third (Autonomous Systems). While the "Great Man Theory of History" has fallen out of favor of more structuralist explanations of world events, this concentration of power means that the decisions of a very small number of people really matter. The American president and his key insiders, with a technologist in that core group,

have enormous influence over US government policy, and the regulatory environment facing businesses.

Technology and technologists have a key role to play in shaping the future for the world, the security of the future for all, whether existential threats are addressed, and the inclusion or exclusion of the two-thirds of the world that are currently not meaningfully electronically connected.

In summary

- The transition to the future will be a period of economic upheaval, social fragmentation, and political power shifts, with technological advances initially creating widespread disruption alongside their longer-term transformative benefits.
- This transition phase will be shaped by rivalry between powers, between companies, and between technologies as rising and innovative challengers compete with established incumbents across political economic, financial, and industrial systems.
- The world needs to choose between two alternative paths to the future, with the power to choose more closely concentrated in a handful of individuals across politics and technology than ever before.
- The rewards of a short transition path to a secure, sustainable and secure future are enormous, with the global economy potentially growing more than ten-fold well before the end of this century.

VI. Conclusion

The world stands at a pivotal moment in history, marked by an unprecedented convergence of crises and a profound global transition to the future. This era of transformation is driven by technology, a force reshaping the dynamics of power, wealth, and society itself. As nations grapple with interconnected challenges, the potential of technology to serve as both a disruptor and a unifier is becoming increasingly clear.

A World in Crisis and Transition

The liberal international order is under strain, from the global challenges of the Polycrisis. Economic instability, environmental degradation, social upheaval, and political discord are intertwined, creating existential threats that demand coordinated responses. At the same time, the capacity of states to act collectively is diminishing, undermining the structures that have historically preserved global stability. Amid this turmoil, the world is moving beyond the point of no return in its transition from an Industrial Age powered by fossil fuels to an Information Age future defined by renewable energy and advanced information technologies. This seismic shift is generating conflicts between those driving innovation, those resisting change, and opportunists exploiting the chaos. Technology, particularly digital advancements, is at the heart of this transformation, offering unprecedented opportunities for power and wealth creation. This

promise is driving increasingly fierce competition among both states and corporations striving to dominate key technology domains. The future of war is also evolving. Artificial intelligence is enabling new dimensions of conflict, including physical and cyber wars. These wars may take various forms: asymmetric power struggles characterized by ruthless efficiency and reminiscent of history's empires, balanced power dynamics resulting in proxy wars with no limits to casualties, and superpower rivalries potentially leading to prolonged stalemates. Conversely, the future of peace depends on strengthening institutions of stability and rule of law, promoting mutual self-interest to create shared prosperity, and resisting mercenary self-interest that prioritizes short-term gains over sustainable solutions.

Technology as a Force for Good

While technology has the potential to exacerbate divisions, it also holds great promise as a force for good, underpinning human security for all. Unlocking this potential requires a collaborative effort among policymakers, tech companies, and end-users. Together, they must establish ethical frameworks to guide the development, deployment, and oversight of technology. Central to this vision is the imperative to bring digital access to the 4.4 billion people still excluded from the benefits of connectivity. Critically this needs to include economically and socially marginalized in rich countries as well. Indeed, without their goodwill and positive vote for global progress, the world's future is jeopardized as electorates prioritize domestic issues. Achieving universal access will require a comprehensive "solutions stack" – policies, infrastructure, hardware, software, and cultural adaptations – to bridge the digital divide and empower individuals worldwide. Ensuring that technology serves humanity requires smart regulation that fosters innovation and scales transformative solutions, avoiding the pitfalls of over-regulation that stifles creativity and preserves outdated monoliths.

Technology Accelerating the SDGs

The SDGs represent a blueprint for global progress, but efforts to achieve them are faltering. None of the 17 goals are on track for full realization by 2030, and the annual funding gap of US$14–17 trillion highlights the need for transformative solutions. Nine tech-driven and enabled "Big Ideas" have the potential to achieve 88% of the SDGs, offering scalable and impactful innovations that could reshape global development. Technology companies playing a leading role in deploying these solutions is essential to their success. The future of consumer capitalism and its markets aligns with this vision, envisioning one global market with local characteristics enabling the seamless flow of goods, services, and ideas. The future of money is also poised to transform, becoming democratized, distributed, and predominantly electronic, while enterprise evolves into a landscape where every individual is a trader in something.

Creating New Markets and Opportunities

The path to achieving the SDGs also represents immense economic potential. Meeting the goals

can create US$15 trillion in market opportunities globally, with significant opportunities in food systems, climate change mitigation, gender equality, and digital inclusion. Transformative policies and capacity-building measures that remove barriers for private sector engagement are critical catalysts for converting development needs into commercial opportunities, creating new markets that attract innovation and investment. AI powered machines will play an increasingly central role in this evolution, not just as educators, workers, and arbiters of facts, but as friends, managers, and collaborators who partner with humans to drive progress.

The Future Beyond Sustainable Development

A subset of 19 critical technologies is poised to define the longer-term future. Over the near-term, four technologies, AI, IoT, robotics, and renewable energy stand out, collectively contributing $35 trillion annually to the global economy by 2030. Over the longer-term, a series of additional technologies such as nanotechnology, fusion energy, quantum technologies, and gene editing are awaiting further breakthroughs to deliver exponential growth which will drive the next wave of transformation. The United States currently leads in nine of the ten most critical technologies, yet China is making significant strides, particularly in early-stage research. The global tech rivalry between U.S. hyper-monopolies and Chinese state capitalism will likely determine the future balance of power between these two rival superpowers. The EU with the largest market and a rules-based platform is an important stakeholder, and India is likely to join it in moderating the rivalry. This competition underscores the strategic importance of breakthroughs in AI, quantum technologies, and fusion energy, which could reshape military, economic, and governance systems on a global scale.

Navigating the Transition to the Information Age

The shift from an industrial to an information-based economy heralds profound changes in geopolitical, economic, and social structures. This transition is marked by upheaval, as rising powers challenge established norms, and existing systems struggle to adapt. The rivalry between the U.S. and China, centered on technological dominance, lies at the heart of this transformation, with the winner potentially shaping the future global order. The world faces two possible paths to the future: one characterized by collaboration, innovation and mass inclusion, and another marked by rivalry, conflict, and exclusion. The former offers a vision of shared prosperity, leveraging technology to address global challenges and unlock economic potential. The latter risks prolonged strife, as nations prioritize competition over cooperation, leading to a breakdown of the global order and heightened existential threats, including climate disasters and potentially global conflicts. Choosing a peaceful transition requires a commitment to collaboration, prioritizing innovation for mutual benefit rather than domination. A managed, short-term transition could raise global GDP to US$350 trillion by 2060, lifting all of humanity in the process. However, this depends on the willingness of wealth creators to share the fruits of progress and the capacity of leaders to act with foresight and responsibility.

The World Technology Will Shape

As humanity stands at the threshold of a new era, the choices made today will determine the trajectory of our shared future. Technology offers the tools to bridge divides, create new markets, and foster peace and prosperity, but this requires the world to make choices that deliver these outcomes. The choices made by leaders, nations, and individuals are critical at this juncture where both adversity and collaboration are on offer, each creating very different future trajectories for our civilization which will determine the legacy of this pivotal moment in history. The rational and humane path forward is clear: a commitment to collaboration, innovation, and shared progress. Human security for all requires this to be complimented by the timely avoidance of existential threats, leadership that prioritizes a unified world, and constraints on abuses of power by unregulated capitalism. There are many paths that can create the future, and the last year saw the public make choices that may lead to far greater tension and rivalry. The hope is that it will unlock innovation, create wealth that can be distributed, and renew the energy to solve big problems.

Whether technology plays a greater role as a force for good as the future unfolds or merely a greater role as a force for exercising power is yet to be decided. Also, whether it unlocks value for all of humanity or only a few will emerge during this transition. Science fiction is turning rapidly into reality as greater and greater breakthroughs in AI and other technologies are rolled out. Technology provides the key to a far better future for all, and that requires individuals at every level of society to choose for it to do so.

APPENDIX

1. Complete List of SDG Market Value by Country

Rank	Country	Total Value of Addressing the SDGs (US$ billion)
1	India	2,933.3
2	China	2,051.8
3	Pakistan	636.9
4	Nigeria	615.2
5	Indonesia	501.3
6	United States	430.0
7	Bangladesh	361.9
8	Ethiopia	330.6
9	Congo, Dem. Rep.	314.7
10	Brazil	314.5
11	Russian Federation	235.1
12	Mexico	226.7
13	Philippines	223.8
14	Egypt, Arab Rep.	221.2
15	Tanzania	176.0
16	Vietnam	173.8
17	Sudan	155.8
18	Iran, Islamic Rep.	153.5
19	Türkiye	144.2
20	Japan	143.3
21	Myanmar	135.5
22	Afghanistan	133.0
23	Kenya	128.0
24	Uganda	118.4
25	Yemen, Rep.	117.9
26	South Africa	117.5
27	Iraq	109.5
28	Angola	108.5
29	Thailand	104.4
30	Mozambique	97.6
31	Madagascar	96.1
32	Colombia	94.2
33	Algeria	91.4
34	Niger	83.9
35	Saudi Arabia	80.9
36	Ghana	76.4
37	Argentina	75.9
38	Cameroon	73.7
39	Germany	72.0
40	Ukraine	67.6
41	Syrian Arab Republic	67.3
42	Morocco	66.9
43	Cote d'Ivoire	66.3
44	Somalia	66.2
45	Burkina Faso	64.5
46	Korea, Rep.	64.1
47	Chad	64.1
48	Italy	63.1
49	Uzbekistan	61.5
50	Mali	61.2
51	France	60.4
52	Venezuela, RB	59.8
53	Malaysia	58.9
54	Korea, Dem. Rep.	58.0
55	Peru	57.6
56	United Kingdom	54.8
57	Malawi	54.2
58	Nepal	54.2
59	Canada	53.2
60	Spain	52.5
61	Zambia	50.8
62	Guatemala	45.8
63	Senegal	43.1
64	Sri Lanka	42.4
65	Guinea	41.7
66	Cambodia	41.3
67	South Sudan	38.9
68	Zimbabwe	37.7
69	Benin	37.2
70	Australia	37.1
71	Poland	36.1
72	Burundi	35.7
73	Kazakhstan	34.1
74	Haiti	33.0
75	Rwanda	31.8
76	Ecuador	31.6
77	Papua New Guinea	31.5
78	Chile	26.0
79	Honduras	24.8
80	Sierra Leone	24.6
81	Romania	24.4
82	Togo	22.8
83	Tunisia	22.5
84	Netherlands	22.0
85	Bolivia	21.4
86	Jordan	20.7
87	Central African Republic	19.8
88	Tajikistan	19.8
89	Congo, Rep.	18.5
90	Dominican Republic	17.7
91	Azerbaijan	17.4
92	Cuba	16.7
93	Lao PDR	16.3
94	Liberia	16.1
95	Nicaragua	15.9
96	Libya	15.4
97	United Arab Emirates	15.1
98	Israel	14.9
99	El Salvador	14.0
100	Mauritania	14.0

SDG Commercial Market Opportunity – Top 20 Markets

Social Protection and Decent Jobs (US$1,855 billion

Rank	Country	Market Opportunity US$ trillion
1	India	350
2	China	231
3	Nigeria	94
4	Pakistan	82
5	Indonesia	55
6	Brazil	50
7	United States	49
8	Congo, Dem. Rep.	48
9	Ethiopia	44
10	Bangladesh	42
11	Philippines	30
12	Mexico	25
13	Egypt, Arab Rep.	25
14	Afghanistan	25
15	Tanzania	23
16	Sudan	21
17	South Africa	20
18	Russian Federation	19
19	Iran, Islamic Rep.	19
20	Türkiye	19

Educational Transformation (US$1,672 billion)

Rank	Country	Market Opportunity in US$ billion
1	India	277
2	Pakistan	114
3	Nigeria	104
4	China	86
5	Ethiopia	68
6	Congo, Dem. Rep.	55
7	Bangladesh	53
8	Indonesia	52
9	Egypt, Arab Rep.	30
10	Brazil	30
11	Tanzania	29
12	Philippines	28
13	Sudan	27
14	Afghanistan	24
15	Uganda	23
16	Mexico	21
17	Myanmar	21
18	Yemen, Rep.	20
19	Niger	19
20	Angola	18

Food Systems (US$3,197 billion)

Rank	Country	Market Opportunity in US$ billion
1	India	707
2	China	566
3	United States	127
4	Indonesia	110
5	Pakistan	109
6	Nigeria	82
7	Brazil	80
8	Bangladesh	69
9	Russian Federation	61
10	Mexico	54
11	Vietnam	49
12	Egypt, Arab Rep.	49
13	Japan	46
14	Philippines	41
15	Türkiye	37
16	Congo, Dem. Rep.	35
17	Ethiopia	34
18	Thailand	29
19	Iran, Islamic Rep.	27
20	Myanmar	26

Climate Change (US$2,392 billion)

Rank	Country	Market Opportunity in US$ billion
1	China	501
2	India	489
3	United States	103
4	Indonesia	78
5	Pakistan	77
6	Nigeria	59
7	Bangladesh	50
8	Brazil	50
9	Russian Federation	46
10	Mexico	38
11	Vietnam	36
12	Egypt, Arab Rep.	36
13	Japan	35
14	Ethiopia	32
15	Congo, Dem. Rep.	29
16	Philippines	29
17	Türkiye	27
18	Iran, Islamic Rep.	26
19	Tanzania	21
20	Thailand	20

Energy Transitions (US$1,434 billion)

Rank	Country	Market Opportunity in US$ billion
1	China	276
2	India	197
3	United States	78
4	Nigeria	61
5	Indonesia	41
6	Pakistan	39
7	Russian Federation	34
8	Bangladesh	32
9	Ethiopia	31
10	Congo, Dem. Rep.	27
11	Japan	23
12	Mexico	20
13	Philippines	19
14	Iran, Islamic Rep.	19
15	Tanzania	17
16	Germany	15
17	Egypt, Arab Rep.	14
18	Türkiye	13
19	Saudi Arabia	13
20	Vietnam	12

Inclusive Digitization (US$2,112 billion)

Rank	Country	Market Opportunity in US$ billion
1	India	431
2	China	162
3	Pakistan	101
4	Nigeria	97
5	Indonesia	87
6	Ethiopia	67
7	Congo, Dem. Rep.	62
8	Bangladesh	61
9	Brazil	43
10	Philippines	39
11	Mexico	37
12	Tanzania	32
13	Egypt, Arab Rep.	31
14	Sudan	28
15	Vietnam	26
16	Russian Federation	26
17	Afghanistan	26
18	Myanmar	25
19	Uganda	24
20	Kenya	23

Gender Equality (US$2,372 billion)

Rank	Country	Market Opportunity in US$ billion
1	India	481
2	China	229
3	Nigeria	119
4	Pakistan	115
5	Indonesia	78
6	United States	58
7	Congo, Dem. Rep.	58
8	Bangladesh	55
9	Ethiopia	53
10	Brazil	52
11	Philippines	37
12	Egypt, Arab Rep.	35
13	Russian Federation	33
14	Mexico	33
15	Afghanistan	30
16	Sudan	29
17	Tanzania	28
18	Iran, Islamic Rep.	25
19	Türkiye	24
20	Yemen, Rep.	23

2. Top 20 Global Technology Companies

Company	Q3 2024 TTM Revenue in US$ billion	Industry Sector
Amazon	US$620	Hyperscaler
Apple Inc	US$391	Hyperscaler
Alphabet Inc.	US$340	Hyperscaler
Microsoft	US$254	Hyperscaler
Samsung	US$220	Diversified electronics
Foxconn	US$208	Diversified electronics
Jingdong Mall	US$157	E-commerce
Meta Platforms	US$156	Hyperscaler
Alibaba Group	US$127	Hyperscaler
NVIDIA	US$113	Semiconductors
Dell Technologies:	US$92	Tech solutions
Sony Corporation	US$89	Diversified electronics
Tencent Holdings	US$86	Hyperscaler
TSMC	US$76	Semiconductors
LG Electronics	US$65	Diversified electronics
IBM	US$62	Hyperscaler
Panasonic	US$58	Diversified electronics
Lenovo	US$57	Tech solutions
Intel Corporation	US$54	Semiconductors
HP Inc.	US$53	Tech solutions

3. Report Leadership and Execution

Project Leadership

Ketan Patel, Chairman, Force for Good, Chair of the Advisory Council, Force for Good, CEO and Founder, Greater Pacific Capital

The Force for Good Advisory Council

Helen Alderson, Independent Board Member; Trustee ODI

Sir Edward Braham, Chairman, M&G plc.

Chantal Line Carpentier, Development Economist, United Nations Conference on Trade and Development (UNCTAD) New York office of the Secretary-General

Nitin Desai, Former Under-Secretary-General for Economic and Social Affairs of the United Nations

Garry Jacobs, President and CEO of the World Academy of Art & Science

Anja Kaspersen, Senior Fellow Carnegie Council; former Director of the UN Office for Disarmament Affairs

Jonathan F. Miller, Former CEO of Digital Media at News Corp, Former chairman and CEO of America Online

Nicky Newton King, former Chief Executive Officer, Johannesburg Stock Exchange; former Director, World Federation of Exchanges.

Sir Alan Parker, Chairman and founder, Brunswick Group

Usha Rao-Monari, Former Under-Secretary General, UN Development Programme; Senior Adviser, Blackstone's Infrastructure Group; Director, Sustainable Business Advisory Group at the International Finance Corporation, World Bank Group

Report Authorship

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

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RESEARCH PROCESS AND METHODOLOGY

1. SDG Market Sizing

This report seeks to determine the total incremental market opportunity (across trade, consumption, and investment) that meeting the SDGs creates on a country-by-country basis. To estimate the total market opportunity, Force for Good has drawn on data from an SDG costing project conducted from UN Trade and Development (UNCTAD) and on SDG performance data drawn from Sustainable Development Report 2024.[85]

The methodology for calculating the incremental market opportunity across the countries are as follows:

1. Estimation of the Initial Market Opportunity Arising from Meeting the SDGs Through the UNCTAD Project.
    a. Description. The report has used the underlying data from the Sustainable Development Goals (SDGs) costing project by the United Nations Trade and Development (UNCTAD) that estimate the spending needed to speed up sustainable development worldwide and achieve the SDGs by 2030. The study focuses on estimating the costs to achieve each of seven transformative categories:

        1. Social protection and decent jobs
        2. Education transformation
        3. Food systems
        4. Climate change
        5. Biodiversity loss and pollution
        6. Energy transition and inclusive digitalization
        7. Gender equality

        The study links these areas to 13 of the 17 SDGs: SDGs 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, and 15.

    b. Assumptions. The UNCTAD project's seven categories focus on 13 out of the 17 SDGs, but assumes that fully funding these seven will allow for the achievement of all the goals with no additional spending required. Further, while the project is focused on estimating the cost of accelerating access towards the goals of the 2030 Agenda for Sustainable Development and has estimates for 90 economies comprising of 72% of the population, it also states these countries will represent the substantial majority of the spend required to fulfill the seven categories, given their size and development needs. This report has taken a conservative assumption that the funding requirement estimated by the UNCTAD project for each category is the total amount of capital required to achieve such category globally. Any additional spend required would represent either additional consumption or investment capital, which would increase the total market opportunity of the goals.

c. Calculations. The report has taken the total estimated cost for each of the seven categories and divided it by the global population. This gives an 'average cost per person' needed to achieve each of seven transformative categories.

Average Cost per Person for Category = (UNCTAD estimated amount to fulfill category) / (Total global population)

2. Calculation of the Gap Towards Achievement of Each SDG for All Countries.
   a. Description. The Sustainable Development Report 2024 measures SDG achievement by country, scoring how close countries are to achieving the goals based on their progress against the goals' underlying targets. Each country is assigned a score between 0 and 100, where 100 means the country has fully achieved the goals, and 0 means no progress. This country SDG score has been used to estimate the 'percentage gap', which provides an estimate of how far the country is from fulfilling each SDG goal.

   b. Assumptions. No additional assumptions used for calculating the percentage gap

   c. Calculation. The following calculations have been conducted:
      i. Find the maximum score achieved by any country and the minimum score achieved by any country for each SDG.
      ii. Subtract a country's SDG score from the maximum score achieved for the SDG to see how much more progress is needed.
      iii. Use this difference to figure out the 'percentage gap' each country needs to close to fully achieve each SDG. For example, the difference between the maximum score and minimum SDG score, the 'percentage gap' will be 100 percentage points and the lower the country's SDG score compared to the maximum score, the higher the 'percentage gap' will be and the further the country is from fulfilling the SDG goal.

      Percentage Gap = (Maximum score achieved by a country in that SDG – Country's SDG score) / (Maximum score achieved by a country in that SDG)

3. Estimation of the Total Gap in the Related SDGs for a Category of the UNCTAD Project.
   a. Description. The UNCTAD project clearly maps the various SDGs that will be impacted by the seven categories. This 'percentage gap' is calculated for every country across each related SDGs for the different categories. An average of the 'percentage gap' across the related SDGs has been used to estimate the gap in amount required per person for each country to fulfill that particular category.
   .
   b. Assumptions. A simple average for the different 'percentage gaps' across the various SDGs is a suitable method to estimate the total gap across the related SDGs for any category.

   c. Calculation.
      i. *Percentage Gaps for Each SDGs with a Category.* For each country, the percentage gap is calculated for all related SDGs within a category. For

example, the category 'Social protection and decent jobs' impacts SDGs 1, 3, 4, 5, 8 and 10. The percentage gap is calculated for every country across each of these 6 SDGs.

ii. *Average Percentage Gap for a Category.* Once the percentage gap calculated for each SDG goal within the related SDGs for a category, a simple average of the different percentage gaps is taken to calculate the total percentage gap to achieve all the related SDGs in a category for a particular country.

4. Quantify Impact of Opportunity for Each Category Across Every Country.
   a. Description. To understand the funding required for each category in every country, the 'average percentage gap' for a category is used to calculate the 'gap amount per person', which is the additional amount that is required per person to fulfil the category in each country. This helps estimate how much more funding is needed for each country to meet the SDG goals under that category.

   b. Assumption. The calculation assumes that:

      Gap Amount Per Person = (Average Percentage Gap for Category) × (Average Cost Per Person for Category)

   c. Calculation.
      i. *Gap Amount Per Person:* Multiply the 'Average Percentage Gap' for a category by the 'Average Cost per Person' for that category.
      ii. *Estimate Total Funding Gap for Category:* Multiply the 'gap amount required per person' by the total population of the country to estimate the total funding gap needed to achieve the SDGs under the category. The funding gap for each of the countries is added to calculate the total funding gap for the category.

This process is repeated for each category to calculate the total funding required for all seven categories across every country.

VII. DISCLAIMER, REFERENCES AND NOTES

Disclaimer

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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.

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