Global Future Council on the Future of Technology

WORLD ECONOMIC FORUM

Technology Policy: Responsible Design for a Flourishing World

WHITE PAPER

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Contents

Executive summary

Technology brings risks as well as opportunity – risks that threaten to undermine potential positive outcomes. Policy is needed that drives responsible technology design.

What is a flourishing world?

It is one in which sustainable economic development does not leave nature behind, in which individual gain and collective societal progress are mutually reinforcing, in which freedom, equity and human rights are undisputable principles, and in which governments facilitate, convene and empower other stakeholders to shape the future.

Technology contributes to this flourishing world. It can:

- Improve safety, well-being and quality of life
- Enhance economic opportunities and productivity
- Increase connectivity and close geographical distances
- Empower freedoms and accessibility
- Enable creative expression and amplify innovation

But technology is also full of contradictions – where there is opportunity, there is risk. These risks include threats to privacy, security, democracy and trust.

Responsible design shaped by anticipatory governance is needed to ensure that technological advances are aligned with ethical principles, sustainability goals and societal values and not just economic or individual advances. Effective governance, in this mould, will make technology more trustworthy. Without responsible design, technology can easily be used – intentionally or not – to constrain, minimize and threaten the flourishing world envisaged above.

Policy is a critical mechanism for ensuring that technology is designed responsibly. Technology policy establishes the appropriate systems and guardrails that shape how technologies are developed and adopted. When technology policy is effective and inclusive, it not only delivers positive outcomes for society but also builds and preserves public trust in democratic values, processes and institutions.

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How to read this report

The Global Future Council on the Future of Technology Policy advocates for policy design that creates the foundations for technology to contribute to a flourishing world. This report provides a non-exhaustive overview and action list for improvements to technology policy design. Based on the Council's experiences and expertise, the report investigates a series of outcomes that technology policy should aim to influence, and enablers that can improve the process of technology policy development.

The report is structured as follows:

- Section 1, "Technology policy guideposts", introduces the fundamental considerations for policy design that are recommended to drive positive outcomes in managing the potential risks and harms of technology.
- Sections 2–5 focus on recommendations to improve policy as it relates to the objectives of safety and security; the resilience of citizens; the quality of public markets and infrastructure; and communities and the natural environment.
- Sections 6–7 share proposals that better enable governments and associated stakeholders to deliver on responsible technology policy design, by building specifically on the required capabilities for government and the structures required for effective multistakeholder collaboration.

Each section is based on evolving best practice in policy-making – providing background on the main challenges and gaps for each focus area, and a high-level overview of concrete solutions or actions that can improve policy's capacity to drive responsible technology design. The solutions deliberately span the multistakeholder ecosystem, with suggestions for public-, private- and civil-sector actors. Each section also includes case studies from different jurisdictions and recommendations for stakeholders to better inform how proposed solutions can be put into operation in different geographies, cultures and policy environments.

The ideas and recommendations provided in this report do not represent a complete list of topic areas or actions required to ensure that all aspects of policy achieve responsible technology design. They are intended to encourage the adoption of new practices that incrementally improve the effectiveness of policy; collectively, they can facilitate significant advances. Further, the report does not generally provide specific policy recommendations for a given technology, and instead focuses on items that improve the broader policy-making process.

Many suggestions are embedded in the principles of agile governance, defined as *adaptive, human-centred, inclusive and sustainable policy-making*, which acknowledges that policy development is no longer limited to governments but is increasingly a multistakeholder effort.[1] It is imperative to maintain a position of learning and openness, to be ready to revise strategies in light of new insights and emerging challenges. This approach will enable policy-makers in government and business not just to respond to the current landscape but also to proactively shape a resilient and equitable future as technologies evolve. Further guidance on agile governance shared by previous iterations of this Council examine this approach: *Agile Governance: Reimagining Policy-making in the Fourth Industrial Revolution*; *Agile Regulation for the Fourth Industrial Revolution: A Toolkit for Regulators*; and *Regulatory Technology for the 21st Century*.

The Global Future Council on the Future of Technology Policy aims to use this report to advance select recommendations through deeper discussions, both online and in-person. This will provide an opportunity to examine the recommendations in greater detail and will offer insights into the execution of technology policy to further advance the realization of responsible design for a flourishing world.

FIGURE 1 **Case studies, countries and topics**

Safety and security

Association of Southeast Asian Nations (ASEAN) and EU alignment on data protections and standards
Standards/policies: (data) | ASEAN/EU

Coordination to advance aligned transatlantic cyber-incident reporting
Partnership: (cybersecurity) | US/EU

Advancing professional responsibility through codes of ethics
Education and training: (general) | Global

Markets and infrastructure

Legislating framework for digital public infrastructure (DPI) in the EU
Standards/policies: (DPI) | EU

Developing self-sustaining DPI funding in Ukraine
Enabling technology: (general) | Ukraine

"India Stack" – aligning development and growth incentives
Enabling technology: (DPI) | India

Dynamic capabilities for government

The United Arab Emirates' journey of dynamic capability-building in innovation
Education and training: (general) | UAE

Nigeria's Devs in Government project
Education and training: (general) | Nigeria

Building capacity and connections to enable GovTech solutions in Serbia
Education and training: (govtech) | Serbia

Resilient citizens

Empowering women through digital literacy: A case study from India
Education and training: (general) | India

Global initiatives and collaborations: Pioneering privacy-enhancing technologies for data protection
Enabling technology: (data) | Global

Empowering the future workforce: Innovative upskilling and reskilling initiatives across industries
Education and training: (general) | Private sector (mostly US)

Leading by example: Businesses' strategic pathways to artificial intelligence (AI) ethics
Standards/policies: (AI) | Private sector (mostly US)

Environment and community

The United States' National Artificial Intelligence Research Resource pilot
Enabling technology (AI) | US

India's Digital Personal Data Protection Act[2] and new E-Waste Management Rules
Standards/policies: (data) | India

The Brookings Institution's New AI Equity Lab
Partnership: (AI) | US

Extended Multistakeholderism

Setting policy for multistakeholder action towards transparency and fairness
Standards/policies: (general) | Japan

The Global Partnership on AI (GPAI)
Partnership: (AI) | Global

The Institutional Arrangement for Partnership (IAP)
Partnership: (data) | Global

Territories mentioned

ASEAN | Global | Japan | Serbia | Ukraine
EU | India | Nigeria | UAE | US

1 Technology policy guideposts

Technological advances are an indispensable driver of economic growth, job creation and societal progress.

From the printing press to the internet, from semiconductors to artificial intelligence (AI) and biotech, technology has enabled an increasingly interconnected and then digitalized world – a world, however, in which traditional mechanisms to protect consumers, safeguard privacy and maintain security can be challenged.

Good technology policy navigates this delicate equilibrium to codify an enabling environment that propels responsible technological advances. While technology policy is likely to vary significantly depending on the problem to be addressed or the programme to be advanced, the Council has identified eight "technology policy guideposts" to consider in the design, development and implementation of any policies and regulations applicable to emerging technologies. These guideposts align with the World Economic Forum's goals for trustworthy technology, including security and reliability, effective accountability and oversight, and inclusive, ethical and responsible use, as described in the report *Earning Digital Trust*.[3]

The guideposts should be informative to the regulator, the regulated and the public as they embark on this journey. Some paths will be shorter (quicker) but more strenuous (more risky), while others will be longer (slower) with more ease and less risk. That is why there is a need to carefully appraise the relevance of each guidepost and the inherent trade-offs associated with it.

This Council encourages all three groups – regulators, regulated and members of the public – to consider these guideposts as "readiness" or "fitness" reminders for those paths based on existing policies, national economic and social priorities and a nation's particular interests in terms of specific technology such as AI, blockchain, cloud, agritech, 5G, advanced energy solutions and quantum.

By studying these guideposts and making informed decisions together on the best path forward, regulators and those they govern can create a thriving environment that encourages innovation and growth while minimizing risks and harms. The examples under the guideposts provide a flavour of how to approach each element, while acknowledging that all of the guideposts are connected.

> Good technology policy navigates a delicate equilibrium to codify an enabling environment that propels responsible technological advances.

Eight guideposts

1. **Innovation and economic growth.** Mechanisms can be employed to seed nascent or critical technology industries – such as semiconductors, quantum or 5G – or to create incentives for good practices; for example, to embed cybersecurity features or post-quantum encryption. These mechanisms can include, among others: direct investments, tax incentives, research and development (R&D) funding, public–private partnerships and challenge grants.

   Example: The United States has historically invested heavily in semiconductor research and development through programmes such as the CHIPS and Science Act of 2022, while Japan has also implemented initiatives to bolster its semiconductor industry. Similarly, many countries such as Brazil, Japan, Singapore and the US have made significant investments in the development and deployment of open and interoperable 5G technology.[4,5]

2. **Shared values, consumer protection and harm mitigation.** Just as society has recognized the need for regulations such as prohibiting smoking on aircraft to safeguard public health (a shared value), there are technological instances in which similar prohibitions are necessary for the well-being and safety of individuals. The aim is to mitigate potential harms associated with technologies, ensuring that they meet safety standards and commonly agreed ethical guidelines before being deployed in real-world settings.

   Example: The EU AI Act establishes universal use limitations for certain high-risk AI systems such as biometrics, critical infrastructure, education systems, employment and law enforcement. It also subjects certain AI systems to specific transparency requirements, especially where there is a clear risk of manipulation, such as through chatbots.

3 **Choice and competition.** When setting technology policy, careful consideration of its impact on producers, users and members of the general public is required. Policy can constrain design and use choices for both technology developers and consumers, but if designed well, it can improve the options and choices of technology. While absence of policy can also yield more options, such absence increases the possibility of poor decision-making on the part of developers, leading to, for example, a proliferation of unsafe options for consumers. At the same time, a policy vacuum can allow consolidation of market power and other restraints on competition harmful to consumers and innovation. Thus, a delicate policy balance must be struck to ensure sufficient choice and create incentives for appropriate standards.

Example: The EU Digital Markets Act is intended to create a level playing field online and reduce or prevent competition-distorting hoarding of data. It creates new obligations for big technology platforms acting as "gatekeepers providing core platform services" to create a fairer environment for business users that rely on gatekeepers, and to ensure consumers have access to better services and can easily switch providers. Similarly, India and the Kingdom of Saudi Arabia (KSA) are also introducing competition rules to advance growth and investment in the country while promoting fair and vibrant competition.

4 **National security and global competitiveness.** Policies should support the development and deployment of cutting-edge technologies while safeguarding against potential risks to national security, such as cyberthreats. National security can often be in tension with international collaboration and information-sharing – important components that enhance global competitiveness. Approaches to separate critical and non-critical infrastructure and compartmentalize data are examples of how nations try to maintain both security and competitiveness.

Example: Governments worldwide are increasingly concerned about the national security risks posed by increasing digitalization. For example, when critical infrastructure such as water and electricity is connected to the internet, allowing for increased efficiencies in service delivery, this exposes the infrastructure to the risk of cyberthreats. In the event of a cyberattack on critical infrastructure, the everyday lives of citizens will be affected. Australia, for example, has developed the Critical Infrastructure Resilience Strategy 2023 to manage such risks, intended to work in tandem with its Critical Infrastructure Resilience Plan 2023 and Security Legislation Amendment (Critical Infrastructure) Act 2021.[6]

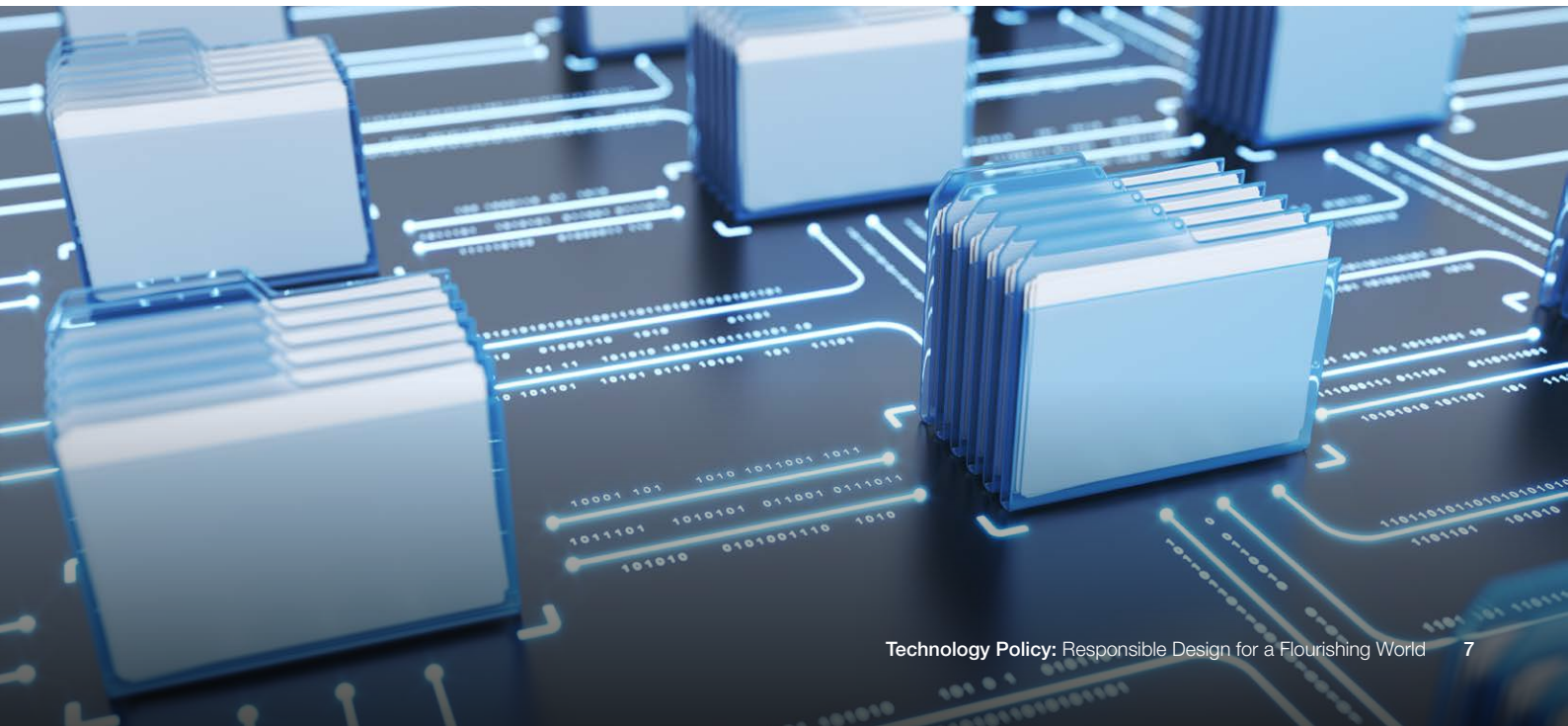
> A risk-based approach promotes innovation by providing clear guidelines and incentives for responsible technology development.

5 **Policy interoperability.** Given that technology knows no jurisdictional borders, avoiding duplication and conflict with policies in other jurisdictions is essential to create a cohesive regulatory environment in an internationally connected world. Policy-makers should strive to create a baseline of common requirements and streamline regulatory processes to promote consistency and clarity for technology companies operating across different jurisdictions, with an emphasis on interoperability. This in turn can help better protect consumers and citizens from being exposed to potential harms beyond national borders. Complete alignment is not necessarily the goal here, as there are, for instance, cultural and structural variations, as well as differences in values, that are embedded in technology policy, the importance of which should not be diminished.

Example: The African Union Data Policy Framework, published after extensive multistakeholder engagements, provides a blueprint for how the African Union (AU) will accomplish its goals for Africa's digital economy. Its aim is to bolster intra-African digital trade, entrepreneurship and digital innovation while safeguarding against risks and harms of the digital economy in a manner that aligns with international approaches to data protection, such as the need to root data policy in the rule of law, protect fundamental rights and strike an appropriate balance between innovation and privacy. It dissuades member states from adopting broad data localization requirements, instead taking a precision approach in which certain categories of data may be in scope to ensure a broad flow of data in line with policies such as the African Continental Free Trade Area Agreement. The AU has adopted a similar policy approach on cross-border data flows within the context of trade through the Continental Digital Trade Protocol endorsed by heads of states in February 2024. The foundation of policy interoperability, including for the AU's Interoperability Framework for Digital ID, is the Africa Digital Transformation Strategy of 2020.

6 **Risk-based approach.** By assessing risks based on factors such as the nature of the technology, its intended use, the degree of dependency by the end user, the potential impact it will have on individuals and society, and so forth, policy-makers can focus regulatory efforts where they are most needed. Acknowledging that there are no one-size-fits-all rules, this approach enables proactive identification and mitigation of high-risk scenarios, such as cybersecurity vulnerabilities or ethical concerns in AI systems, while avoiding unnecessary burdens on low-risk technologies. Additionally, a risk-based approach promotes innovation by providing clear guidelines and incentives for responsible technology development, encouraging companies to invest in robust risk-management practices and compliance measures.

Example: The recently adopted EU AI Act also takes a risk-based approach to regulating AI by identifying specific sectors and use cases in which high-risk applications may pose significant risks to individuals' rights and freedoms. These sectors include healthcare, education, employment, credit-scoring and criminal justice. Under the Act, high-risk AI systems must meet strict requirements regarding data quality, documentation, explanation and impact assessment. Also, the US government via the National Institute of Standards and Technology (NIST) worked with stakeholders to create its AI Risk Management Framework, which, like its cousin documents the Cybersecurity Framework and Privacy Framework, is designed to evolve as new risks, technologies and needs emerge.



> A 'by design' and 'future-focused' approach emphasizes the proactive integration of core principles, strategic intelligence and forward-looking technological assessments.

7 **Built-in by design and future-focused.** Embedding core principles such as accountability, ethics and privacy – as well as appropriate incentive structures – into technology policy from the outset is crucial to ensuring that innovation aligns with societal values and ethical standards.[7] A "by design" and "future-focused" approach emphasizes the proactive integration of core principles, strategic intelligence and forward-looking technological assessments, for example, directly into the design and development of technology. This approach ensures that ethical, legal and societal implications are addressed at the foundational level, rather than being treated as an afterthought or addressed reactively once issues arise – supporting a more holistic approach to tech governance and policy.

Example: The US Cybersecurity and Infrastructure Security Agency (CISA) has outlined key secure by design principles – along with its international partners (the cybersecurity authorities of Australia, Canada, the United Kingdom, Germany, the Netherlands and New Zealand, which co-sealed the initial version, and the cybersecurity agencies of the Czech Republic, Israel, Singapore, Korea, Norway and Japan, its global partners on the updated version) – such as usage of a software bill of materials (SBOM) and guidance for software developers worldwide.[8,9,10] These help software manufacturers take the urgent steps necessary to design, develop and deliver products that are secure by design. Another example is the UK Regulatory Horizon Council (RHC), an independent expert committee that advises the UK government on regulatory reform and the future of technology, through detailed reports on specific areas of technological innovation and cross-cutting topics on regulation and innovation. As an example of its work, the RHC produced recommendations on fusion energy that were accepted by the Department for Business, Energy and Industrial Strategy.[11]

8 **Evidence-based.** Given the challenges brought about by technology development, evidence-based policy is all the more important to inform decision-making in the policy-making process. Digital tools can help by complementing existing regulatory tools and increasing regulatory capacity. Using data, analytics and AI, policy-makers can make informed decisions that drive positive outcomes for society.

Example: The absence of evidence – in this case on AI models and potential safety – led the US, the UK and Japan to launch AI safety institutes to specifically develop "science-based and empirically backed guidelines and standards for AI measurement and policy, laying the foundation for AI safety across the world".[12] Until this science is more mature and such guidelines actually exist, regulatory decisions about how to address potential risks will necessarily be under-informed. Where there is evidence driven by AI, governments are making more informed policies. As detailed by the Boston Consulting Group (BCG), the economic development unit in Quebec used AI tools to improve its economic developing policies, a government in the Middle East improved its balance of payment and trade policies through applying "pattern-sensing tools" and the UK government used AI to help understand the impact of carbon tax and how best to set tax policies that would "both curb emissions and maintain productivity".[13]

2 Design for: Safety and security

Threats ranging from privacy breaches that expose sensitive personal information to cyberattacks that target critical infrastructure mean there is a growing need for effective policies to safeguard individuals, organizations and societies.

As the physical and digital worlds increasingly converge, interactions with technology pose new concerns for human safety and security. Increased connectivity of systems and devices creates vulnerabilities that can compromise personal safety, financial security and even national defence.

The concepts of privacy and security-by-default-and-design have been the north star of privacy and cybersecurity regulators and industry professionals alike. As referenced in Guidepost 7, these concepts underscore the importance of integrating privacy and security measures into the design and implementation of technology from the outset, rather than as an afterthought. This ultimately promotes greater trust and confidence in the digital ecosystem.

2.1 Analysis of problems and gaps

For the purpose of this section, safety and security risks are broadly categorized into personal data protection, cybersecurity and online safety.

A Data protection

Data protection is quickly becoming one of the more fragmented areas of technology policy, creating regulatory uncertainty and exacerbating the risks of doing business in multiple jurisdictions.[14,15] In a global online ecosystem, this fragmentation weakens consumer control and increases compliance costs for business.[16]

Cross-border data transfers (CBDT) are a critical mechanism to reduce fragmentation among jurisdictions. However, as the majority of jurisdictions have their own privacy legislation and data protection laws, it is extremely difficult to compare privacy protections and determine the compatibility of these protections before a data transfer is permitted. This limits the extent to which the digital economy can flourish in a safe and responsible manner. A global approach to CBDT needs to evolve to become an integral design feature of privacy legislation.

B Cybersecurity

With digital transformation and the addition of sensors and meters to systems, physical infrastructure and equipment (e.g. lighting, security, factories) are increasingly integrated with the digital. As information technology (IT) and operational technology (OT) converge, policy-makers are increasingly aware of cybersecurity risks to national security, and have been developing national strategies to manage these risks. However, such activities undermine the cohesion of global cybersecurity management. For example, some jurisdictions require the reporting of all data breaches, regardless of severity, while others set thresholds for reporting based on the inflicted harm.[17] This creates difficulties in responding to cybersecurity incidents, particularly in cases where a breach spans multiple jurisdictions.

C Online safety

Developments in AI technologies, including deep learning (DL), generative artificial intelligence (GAI) and large language models (LLMs), have led to the emergence of “deepfakes” and concerns

“The World Economic Forum’s *Global Risks Report 2024* ranked disinformation as the top risk over the next two years.

surrounding their use and abuse.[18] Deepfakes use AI technologies to create new – but fake – images, videos and/or audio material from existing material, depicting real (and often influential) individuals saying or doing things they never said or did, resulting in misleading content that can have a profound impact on their safety online.

In Hong Kong, a finance worker at a multinational corporation fell prey to an elaborate deepfake phishing scam in which senior management personnel “instructed” him via a video conferencing call to transfer HKD200 million (around $25 million) to fraudsters.[19] In Singapore, scams and cybercrime continue to be an important concern, with cases increasing by 69.4% during January–June 2023 compared to the same period in 2022. Young adults aged 20–39 made up more than 50% of the total number of scam victims.[20] And in Africa, cybercrime has been growing, with the continent experiencing the highest average number of cyberattacks per week per organization globally in the second quarter of 2023 – an increase of 23% compared to 2022.[21] Cybercrime can cost these countries an average of 10% of their GDP.[22]

With AI tools becoming increasingly powerful and accessible, the low cost, ease and scale at which deepfakes can be created exacerbates online safety issues, such as social engineering and promotion of misinformation and disinformation. The World Economic Forum’s *Global Risks Report 2024* ranked disinformation as the top risk over the next two years.[23]

TABLE 1 **Proposed solutions and action**

	Solution/action	Expected impact	Potential roadblocks	Enablers
A **Data protection**	**Building consensus around a set of core CBDT principles to develop CBDT-by-default-and-design regimes**	Reducing data policy fragmentation among jurisdictions, increasing the strength of consumer protections and minimizing administrative burdens	Data protection frameworks differ in their principles and core standards, often due to differences in ideology that are difficult to bridge	Developing mechanisms for CBDT at global and regional levels to avoid bilateral agreements Embedding core principles for CBDT into global digital trade standards Focus on developing interoperable, not identical, CBDT regimes
B **Cybersecurity**	**Global interoperability of cybersecurity regimes**	Ensures mutually compatible cybersecurity practices, enabling companies operating in multiple regions to adhere to consistent standards, reducing complexity and confusion, simplifying compliance efforts Promotes enhanced collaboration and information-sharing among various entities globally for a more secure digital and physical environment	Resistance to change, limiting the interoperability of data protection and privacy regulations and the continued prioritization of compliance over cybersecurity best practices	Global commitment to: adopting a common and efficient international incident-reporting taxonomy and requirements; establishing sector-specific basic cyber hygiene principles; applying a consistent risk assessment methodology across IT and OT environments; securing and embracing an ecosystem-wide resilience across the supply chain; and adopting mature existing international standards (such as the ISO/IEC 62443 and ISO 27k series)

TABLE 1 | **Proposed solutions and action** (Continued)

	Solution/action	Expected impact	Potential roadblocks	Enablers
C **Online safety**	**Required disclosure for when a user is interacting with or ingesting the output of GAI systems, for example on social media**[24]	Create a level of accountability and trust in the AI value system by signalling to other users the authenticity or otherwise of the content	Malicious actors can circumvent legal requirements by jailbreaking the GAI or LLM, or by creating their own non-compliant tools and making them available to others on the dark web Potential patchwork of inconsistent standards for provenance tracking globally	Adopting industry standards for watermarking; for example, C2PA, with global interoperability[25]
	Education and skills-building in "zero trust" – an approach to designing and implementing secure systems, built upon the maxim of "never trust, always verify".[26] **It requires the system to question everything – every credential, every prompt, every action – to protect itself against intrusion**	Building societal capacity to be mindful of content authenticity to help minimize the subversive impact of deepfakes and other misleading content for individuals	Complacency to cyber risks due to perceived non-exposure, and assuming protection against deepfakes and other online scams	A multifaceted approach to online safety, incorporating technology, policy and, most importantly, a mindset shift
General	**Develop a computer science "code of ethics" to ensure that safety and security are taught as the fundamentals of technology design**	Technologies are built with safety and security inherent to their design, complementing by-design policy regimes	Adoption and buy-in from the computer science industry Agreement on a collective set of standards	New generation of computer scientists Increased knowledge and research on the impact of technology Increased responsibility put on developers by society

CASE STUDY 1

Association of Southeast Asian Nations (ASEAN) and EU alignment on data protections and standards

The Association of Southeast Asian Nations model contractual clauses (ASEAN MCCs) and the European Union standard contractual clauses (EU SCCs) are frameworks designed to facilitate the secure and legal cross-border transfer of personal data. The ASEAN MCCs, tailored to the legal and regulatory environment of the ASEAN, aim to establish a common set of standards and protections that mirror the robust privacy principles found in European legislation. Similarly, the EU SCCs are contractual tools used within and outside the European Union to ensure that personal data leaving the EU or European Economic Area (EEA) will continue to benefit from adequate protection in line with the General Data Protection Regulation (GDPR).[27,28]

Both sets of clauses include provisions on data protection standards, the obligations of data controllers and processors, and the rights of data subjects, thus aligning in their core purpose of safeguarding personal data during transfers. This alignment not only simplifies compliance efforts for multinational corporations operating across these regions but also enhances trust in international data exchanges by ensuring consistent data protection measures. While there are differences in approach and specific requirements, the fundamental principles of both the ASEAN MCCs and EU SCCs support a cohesive framework that promotes the legal and secure international flow of information, accommodating both regional and global data protection standards.

CASE STUDY 2

Coordination to advance aligned transatlantic cyber-incident reporting

The US Department of Homeland Security (DHS) and the European Commission's Directorate General for Communications Networks, Content and Technology (DG CONNECT) announced an initiative to compare cyber-incident reporting elements.[29] The report identifies six main areas for comparative analysis: (1) definitions and reporting thresholds; (2) timelines, triggers and types of cyber-incident reporting; (3) content of cyber-incident reports; (4) reporting mechanisms; (5) aggregation of incident data; and (6) public disclosure of cyber-incident information. This represents a good first step towards aligning and potentially coordinating transatlantic cyber-incident reporting.

CASE STUDY 3

Advancing professional responsibility through codes of ethics

The Association for Computing Machinery (ACM) developed a code of ethics in 2018 that emphasizes responsible behaviour by computing professionals to support the public good.[30] The code guides them in ethical conduct through principles that prioritize societal and environmental well-being. It underscores the importance of preventing harm, being honest, respecting privacy and maintaining confidentiality. These ethical guidelines contribute to safety and security by design, promoting a framework in which technological developments are aligned with ethical standards to minimize risks and protect users. Similar codes, or the wide acceptance of a single code, can be broadly taught and adopted by the computer science industry to ensure that technology does not endanger or violate human rights. As with other codes of ethics, such as those used in medicine, the code should be a living document that keeps pace with changes in technology in society.[31]

3

Design for: Resilient citizens

By focusing on empowering “resilient citizens”, design can shift from a technology-centric to a human-centric paradigm.

Technology policy and individual empowerment are increasingly connected in the ever-changing digital age. Technological advances not only drive economic growth and innovation but can also support people in adapting to such rapid change. For example, the advent of social media transformed communication and information access while simultaneously presenting challenges such as misinformation and digital addiction.

It is critical to ensure that citizens are resilient to such technological disruptions and transformations – increasing the ability of individuals and communities to adapt, recover and prosper in these conditions. A prime example is how communities have used digital platforms for disaster response and recovery, turning potential vulnerabilities into strengths.[32]

A resilient perspective ensures that technology enhances rather than detracts from human capabilities and well-being. The development of user-friendly privacy settings can empower users to control their data security simply, rather than overwhelming them with technical and legal specifications. The integration of AI in healthcare, a market projected to be worth $188 billion by 2030, can revolutionize the ease and accessibility of personalized treatment plans.[33] This exemplifies technology’s role in augmenting human health and longevity – aligning technological progress with human values.

3.1 Analysis of problems and gaps

> Addressing these issues is not just about bridging gaps or enhancing individual protections; it is about redefining the relationship between technology, society and the individual.

The primary challenges to creating resilient citizens relate to the accessibility and understanding of key digital technologies, the potential violation of personal privacy and the impact of technologies on employment markets. Each carries profound implications for social equity, personal freedoms and economic stability. Addressing these issues is not just about bridging gaps or enhancing individual protections; it is about redefining the relationship between technology, society and the individual so it is mutually reinforcing and supportive.

A Digital divide

The digital divide represents a significant barrier to information access and equal opportunities in education and employment. For instance, in rural and low-income urban areas, limited access to high-speed internet can drastically reduce the opportunities for online learning and remote work. According to a report by the International Telecommunication Union (ITU), as of 2023 about 33% of the world's population (approximately 2.6 billion people) had never used the internet, with the majority of these living in developing countries.[34] Yet even within developed countries, access to stable, high-speed internet is not universal. In the US, 22.3% of Americans in rural areas lack coverage from fixed terrestrial broadband.[35]

This divide extends beyond internet access; it also includes disparities in digital literacy, where certain populations lack the necessary skills to navigate and use digital tools effectively. For instance, older generations often find themselves at a disadvantage in a world increasingly reliant on digital interfaces, from online banking to telehealth services. A Pew Research study found that roughly 10% of American adults are digitally illiterate, lacking basic skills in using computers and the internet. The divide often coincides with intersectional identities, with disproportionate effects on historically excluded communities (e.g. women, poor people, ethnic minorities, rural dwellers and people with disabilities).

B Privacy concerns

In an era in which data is the new currency, privacy concerns are more pronounced than ever. As highlighted in the safety and security section, personal data protection is a major challenge to maintaining safety and security across borders. From a citizen's perspective, there is growing unease about how personal information is collected, used and protected. For example, users of social media and smart devices often unknowingly consent to extensive data collection, which can be used for targeted advertising or other more intrusive purposes.

The misuse or exploitation of data by companies or governments for targeted advertising, surveillance or discriminatory practices can further erode trust in digital systems and exacerbate concerns about privacy infringement. For example, the advent of technologies such as facial recognition software raises questions about consent and the potential for misuse in surveillance and data profiling. The implementation of privacy regulations across the globe built upon the EU GDPR (but modified for suitability in local contexts) reflects a global shift towards imposing more stringent data privacy regulations and giving consumers more control over the use of their data, but further action is needed to embed privacy protection and improve citizen protection.

C Impact of AI and automation on employment

AI and automation are a double-edged sword. On one hand, they drive workplace efficiency and innovation; on the other, they pose significant risks to job security and workforce dynamics. Sectors such as manufacturing and retail have already seen substantial automation, leading to job displacement. It is not only manual labour that is at risk; advances in AI threaten white-collar professions, such as legal and accounting services, where algorithms can increasingly perform tasks traditionally done by humans. The International Monetary Fund (IMF) notes that 40% of global employment is vulnerable to AI disruptions, with advanced economies facing a higher risk (60%) but also greater potential benefits than emerging markets.[36]

However, there is also potential for positive employment change because of AI. The World Economic Forum finds that AI will not only reshape existing jobs but create new positions, such as AI developers, interface and interaction designers, AI content creators, data curators and AI ethics and governance specialists.[37] For this transition to happen, there need to be policies that embed the appropriate safeguards for citizens. Without these, shifts in working arrangements could exacerbate vulnerabilities among employees rather than support worker welfare in the evolving digital economy.

TABLE 2 | **Proposed solutions and action**

	Solution/action	Expected impact	Potential roadblocks	Enablers
A **Digital divide**	**Implement widespread and affordable internet access programmes**	Enhanced access to digital resources for underserved communities	Funding, infrastructure development in remote areas	Government subsidies, multistakeholder partnerships
	Digital literacy education programmes: focus not just on providing internet access but also on equipping individuals with the skills to use digital tools effectively	Improved skills in using digital tools, bridging the gap for older generations and other disadvantaged groups	Resource allocation, programme outreach	Collaboration with educational institutions, community organizations and technology companies
B **Privacy concerns**	**Harmonization and interoperability of data regulations empower citizens across regulatory systems and build resilience**	Increased security and control over personal data for users	Resistance from technology companies, enforcement challenges	International cooperation, public education, literacy and awareness campaigns
	Promote the development of privacy-enhancing technologies: in addition to regulatory measures, technological solutions that give users more control over their data can be pivotal	Empowering users to control their data, reducing the risk of breaches	Technological complexity, adoption rates	Innovation in cybersecurity, consumer demand for privacy
C **Impact of AI and automation on employment**	**Upskilling and reskilling programmes to equip workers with the skills needed to adapt to technological changes and transition to new job opportunities**	Mitigation of job displacement, creation of new job opportunities	Funding, identifying relevant skills for the future workforce	Government initiatives, corporate responsibility programmes
	Development of AI ethics guidelines, and encouraging businesses to adopt practices to mitigate potential harm to employees	Ensuring AI is used responsibly, protecting jobs and public interests	Balancing innovation with regulation, global standardization	Multistakeholder engagement, including ethicists, technologists and policy-makers

CASE STUDY 4

Empowering women through digital literacy: A case study from India

A notable case study of efforts to achieve digital literacy, specifically aimed at empowering women in India, was undertaken by Oxford University Press (OUP) in partnership with Literacy India.[38] In October 2020, OUP and Literacy India established an education and skills development centre in Noida to support women's financial independence through upskilling. The centre offers a variety of courses, including basic computer literacy, and provides remedial education for children, especially girls, who missed schooling due to the lack of digital resources. This initiative not only focuses on enhancing digital literacy but also aims to enable women to find employment or become entrepreneurs. Furthering their commitment, OUP and Literacy India have supported several education and skill-development projects across the Delhi National Capital Region and Kolkata, including the Karigari programme, which offers skill-based certification courses in technology learning, and the set-up of two digital learning centres during the COVID-19 pandemic to facilitate continued education.

CASE STUDY 5

Global initiatives and collaborations: Pioneering privacy-enhancing technologies for data protection

The promotion of privacy-enhancing technologies (PETs) is an important focus in global privacy and data protection efforts, involving diverse initiatives across the world. The United Nations, for instance, has created a PETs case study repository to showcase real-world applications and inspire data-rich organizations to adopt privacy-preserving technologies.[39] Singapore and South Korea are actively supporting the development and adoption of PETs through programmes such as sandbox testing and strategic international collaborations, for example between the US and the UK.[40] In the US, the White House Office of Science and Technology Policy is pushing for PETs integration into national data strategies to enhance privacy while harnessing data for societal benefits.[41] These efforts collectively aim to blend technological innovation with regulatory frameworks to secure a privacy-respecting global data ecosystem.

CASE STUDY 6

Empowering the future workforce: Innovative upskilling and reskilling initiatives across industries

Several organizations are actively engaged in upskilling and reskilling their workforces to adapt to rapid technological advances and shifting job markets, emphasizing the importance of continuous learning. For instance, PepsiCo has launched a comprehensive programme providing free educational opportunities, from high-school diplomas to advanced degrees, to enhance career mobility.[42] Similarly, Henkel, in collaboration with Accenture, has initiated a global digital upskilling programme aimed at fostering innovation and addressing changing market dynamics.[43] Other companies such as Walmart, Verizon and Google have also invested in various educational initiatives to enhance their employees' skill sets and promote internal talent development. IBM has been reskilling its employees in AI since 2017 to support the internal adoption of the technology, starting with human resources. Furthermore, IBM uses AI for training through an internal learning platform, YourLearning, that recommends personalized learning to employees according to job roles and skills. National governments such as Singapore[44] have also undertaken systematic skilling programmes to ensure workforce preparedness in the face of digital developments.

CASE STUDY 7

Leading by example: Businesses' strategic pathways to AI ethics

Companies are leading by example by developing and implementing AI ethics guidelines to mitigate potential harms to employees and society. For example, Unilever and IBM are leading the way in integrating AI ethics within their operations, emphasizing transparency, fairness and accountability. Unilever has implemented a comprehensive programme to review AI applications rigorously, ensuring ethical use and human oversight.[45] Similarly, IBM has established an AI ethics board to promote ethical AI practices guided by principles of trust and transparency, augmenting human intelligence while ensuring that ownership of data remains with creators.[46] Hewlett Packard is also committed to AI ethics, conducting audits and forming partnerships to align AI use with human rights and ethical sourcing. Its global strategy involves crafting and implementing responsible AI ethics principles that reflect its corporate ethos and engineering legacy, focusing on decentralizing decision-making and educating teams on ethical practices and local regulations.[47]

4 Design for: Markets and infrastructure

Markets and infrastructure play pivotal roles in shaping the trajectory of technology policy due to their fundamental influence on economic growth, innovation and societal well-being.

Markets serve as dynamic ecosystems in which technology companies compete, innovate and drive economic activity. Effective technology policy must navigate the complexities of market dynamics – for both existing and new markets – to ensure fair competition, protect consumer interests and promote innovation. Core infrastructure, including digital networks, telecommunications systems and cloud storage, forms the foundation for technological advance and digital transformation. With an estimated 60% of global GDP reliant on digital communications technologies in 2022, effective management and investment in technology infrastructure will only become more important.[48]

Policy has an important role in ensuring markets and infrastructure are set up for long-term success. This includes influencing investment, ownership, governance, competition and intellectual property rights, among other important factors. Effective policy design is critical to ensure that the functioning of markets and infrastructure aligns with overarching policy objectives.

4.1 Analysis of problems and gaps

> As technology advances, infrastructure and markets also need to evolve to support continued holistic development effectively.

Ensuring high-quality infrastructure and well-functioning markets is extremely complex. Both are increasingly connected, as digital infrastructure supports more and more economic and social activity. As technology advances, infrastructure and markets also need to evolve to support continued holistic development effectively.

A Investment in public infrastructure

Traditionally, governments and large public entities were responsible for developing and maintaining the infrastructure that enables digital ecosystems. However, there has been a shift of ownership towards the private sector as new digital infrastructure emerges. For example, the shift to cloud-based solutions has concentrated critical data assets in a few large private-sector entities. This means major technology firms and private entities now play a significant role in building and controlling important digital infrastructure. When private entities own the infrastructure, they can dictate the terms of access, prioritize their own services and potentially stifle competition. Such control can lead to market distortions and reduce the competitiveness of tech markets. Private companies may also prioritize profit over the public good, potentially leading to disparities in critical service access and quality. Greater efforts to improve digital public infrastructure (DPI) – infrastructure that has a public purpose regardless of whether it has public ownership or management – are needed, including higher levels of investment and greater international coordination.

B Flexibility of infrastructure

Technology's rapid evolution necessitates infrastructure that can support emerging technologies. Flexible frameworks allow for quicker adaptation and integration of emerging technologies, giving societies and economies a competitive edge. Further emphasis on infrastructure that is "distributed by design" – infrastructure that is built as a network of independent components as opposed to a single or small number of critical hubs – can yield stronger, more scalable infrastructure that is capable of more successfully managing critical applications, data operations and connectivity demands, while improving accessibility to important digital capacity for individuals and SMEs. It is also critical that this flexibility is grounded in values-driven, high-quality and sustainable infrastructure development.

C Adapting to new market dynamics

Technologies are changing market behaviour, such as competition, consumer preferences and supply and demand, while also creating new markets enabled by technology. For example, the emergence of digital platforms and the sharing economy has transformed traditional industries, including transportation and accommodation, enabling peer-to-peer transactions at scale, facilitated by digital platforms such as Uber and Airbnb. Generative AI is revolutionizing the content creation and design industries, and biotechnology is reshaping healthcare markets by using genetic data and advanced analytics to deliver tailored medical treatments and interventions.

It is important to establish favourable market environments that nurture innovation, competition and investment; for example, by promoting entrepreneurial endeavours and creating incentives for R&D. This can be supported by designing policies that anticipate technological developments rather than react to them, and governance mechanisms that create the incentives for more efficient and sustainable outcomes. Traditional governance strategies may not adequately cover emerging technologies because they can be inflexible, prescribing specific technologies or methods without considering the unique circumstances or innovative potential. The Organisation for Economic Co-operation and Development (OECD) Framework for Anticipatory Governance of Emerging Technologies[49] identifies five interdependent elements that can shape effective anticipatory governance, as referenced in the table below.

TABLE 3 | Proposed solutions and action

	Solution/action	Expected impact	Potential roadblocks	Enablers
A **Investment in public infrastructure**	**Identify new, shared financing and ownership models to support digital public infrastructure**	Facilitate broader access and ensure sufficient scale of critical digital infrastructure	Resistance from traditional financing institutions Legal complexities surrounding shared ownership models The need for consensus among stakeholders on governance and decision-making structures	Standardized legal frameworks and contractual agreements Financial incentives, such as tax breaks or subsidies, for investment in public-serving infrastructure Rapidly developing use cases (e.g. in India, Estonia and Thailand) that can be a base for standards development and identification of future success factors
	Systematic processes for evaluating current DPI, and measuring investment impacts capturing DPI as a high-impact area for scale	Stronger business case for DPI, while also optimizing resource allocation, improving decision-making and maximizing the impact of investments	Data constraints Alignment and agreement on standard metrics	
B **Flexibility of Infrastructure**	**Build greater awareness of implementing infrastructure systems that are "distributed by design"– with a focus on modular, interoperable and open-source foundations**	Technology infrastructure that is adaptable – able to connect to both open and private systems – as well as being easier to update as the technology itself progresses. Avoids infrastructure "lock-in"	Interoperability issues between different systems Concerns about data security and privacy	Promoting open-source communities, modular development models and collaboration platforms
C **Adapting to new market dynamics**	**Diffusion-based incentive system (DBIS), under which two policy objectives of generation and diffusion are integrated and synchronized, as a system of national technology policy formulation and implementation**	A holistic approach to policy that minimizes the gap between technology development and scale. Creating a clearer path for emerging technologies to grow	Coordinating across multiple government agencies and stakeholders. Balancing competing policy objectives	Multistakeholder task forces and advisory boards (encompassing actors from the public and private sectors) can facilitate coordination and collaboration in policy formulation and implementation
	An anticipatory governance system grounded in a set of common values. Anticipatory engagement with stakeholders and the public at large	A holistic governance system that seeks to apply innovative forms of governance in earlier stages of tech development, both in the downstream phase but also operating upstream	Lack of long-term governance capabilities (e.g. lack of tools for strategic intelligence and tech assessment); no collaboration across agencies, transboundary governance issues; trust in government impeding engagement	Establishing a clear strategy, encompassing: guiding values, strategic intelligence, stakeholder engagement, agile regulation and international cooperation
	Identification of the various types of infrastructure that are essential to research and innovation, mapping the range of policy instruments to be used in infrastructure development policies (governance, financial support, incentives, etc.)	Better informed, more effective infrastructure development policies, with insights established for quicker policy responses to emerging technologies and market disruptions	Complexity and contextual range in mapping diverse infrastructure needs	Cross-jurisdictional insights and use cases, focused on identifying transferable success factors

CASE STUDY 8

Legislating framework for DPI in the EU

The EU digital public infrastructure (DPI) legislation, enacted in February 2024, ensures that the use of DPI is inclusive, and does not exclude those who opt out, while participation remains free and voluntary.[50] It mandates that systems be open-source to allow public scrutiny and incorporate a privacy-by-design framework. This approach promotes minimal resistance from civil society and vulnerable groups, enhances accountability for DPI providers and facilitates public–private partnerships. Recognized as the first of its kind globally, this legislation aligns with the criteria for DPI developed by DPI-focused global non-profit Co-Develop, emphasizing essential digital capabilities that enable broad societal and market participation.[51]

CASE STUDY 9

Developing self-sustaining DPI funding in Ukraine

ProZorro is a public procurement platform in Ukraine designed to enhance transparency by enabling electronic procurement transactions and public access to contract tenders. It began with modest funding from local businesses eager to address procurement corruption that was costing Ukraine more than €2 billion ($2.2 billion) annually. As the platform proved its potential to reduce corruption and improve competition, larger philanthropies and bilateral funders came on board, providing significant resources through non-profit intermediaries. This initial funding was crucial for getting ProZorro off the ground, allowing it to develop into a self-sustaining model that charges transaction fees to cover its operational costs. This transition from donor support to a financially independent framework highlights the importance of strategic funding in launching and scaling innovative e-government solutions such as ProZorro, and illustrates how a sustainable funding model for DPI can be developed.[52,53]

CASE STUDY 10

“India Stack” – aligning development and growth incentives

A diffusion-based incentive system refers to strategies designed to encourage the widespread adoption and integration of technological innovations through the alignment of incentives among key stakeholders. With DPI, there is often a gap between the generation and scaling of technological solutions. This can be overcome through various funding, design and policy incentives, among others. India’s DPI stack development has been a success story for building and scaling technology. The country established three foundational layers, “India stack”, on top of which public- and private-sector solutions can be built. These include a digital identification layer called Aadhar, a payments system running as a unified payment interface, and a data exchange layer in its account aggregator, among other services.[54] The stack encourages private innovation through open access, but also includes clear principles such as accountability, interoperability, collaboration and transparency, which gives entrepreneurs clear guidance on how technology solutions should be developed and adopted responsibly. It also creates flexibility, as each level addresses a specific need, while in combination they can create even more powerful and unique applications.

5 Design for: Environment and community

Technology policy must seek to encourage sustainable growth that protects the environment while taking account of the needs of vulnerable communities.

With the rapid proliferation of advanced technologies affecting every facet of both individual lives and society as a whole, it has never been more critical to establish, promote and ensure the long-term success of technology design that balances supporting technological innovation with sustainability. This balance becomes even more pressing when vulnerable environments and historically underserved populations are affected.

The challenge for both the policy-maker and the innovator is to look unflinchingly at the two fundamental constraints that apply to every human endeavour. The first is that some processes are irreversible. The appearance of terms such as "tipping point" and "forever chemicals" into policy discourse and discussions of, for example, the potential loss of access to space due to self-entombment in orbital debris are both an acknowledgement of the second law of thermodynamics: some decisions cannot be undone. The second constraint is that some resources are finite. All supply chains, energy or material can be traced back to either the Sun or the Earth, and every energy resource that can be exploited ultimately derives from either the accumulation of solar radiation or from the radioactive decay of elements forged in the supernovae of suns long gone. Until and unless humanity expands to extraterrestrial mining, Earth remains the sole resource for material supply chains – illuminating the pronounced priorities that must be faced when it comes to protecting local communities and the people living in them.

Sustainability is the design of systems that permit us to achieve societal goals in perpetuity and universally by simultaneously acknowledging these fundamental constraints and extending the limits of integration expansively over all critical dimensions: time, space and populations.[55] Sustainable growth is growth that does not preclude future growth. Equitable sustainability extends these considerations by demanding that people, while striving to live within their means on average, do not continue to permit such marked disparity among levels of income and quality of life – and, instead, strive for systems that can allow universal access.

From a sustainability standpoint, it is important to design technology development policies that codify consideration, transparency and accountability on these two critical constraints: (1) issues of energy consumption, carbon footprint, recyclability and repairability impact that accompany technology innovation and scaling; and (2) sustainable growth. Meanwhile, technology use policy must work hard and intentionally to minimize discrimination and access challenges for marginalized communities and protect communities whose localities are being used by technology firms as a part of their growth strategies.

5.1 Analysis of problems and gaps

As highlighted at the start of this report, technology can present both opportunities and challenges, in this case to the delicate balance of environment and communities.

A Sustainability of technology

In 2022, energy use by industry was 26.6% of global usage and resulted in 21% of the corresponding greenhouse gas (GHG) emissions. While what is usually considered the global high-tech industry accounted for only 2–3% of those emissions, the anticipated pervasive application of energy-intensive applications such as generative AI is yet to be fully taken into account.[56] Just as other industries have experienced a significant growth in emissions, such as a doubling of emissions from cement production since the turn of the century, it is expected that technology-induced demand for energy and thus production of emissions will

> There is real potential for emerging technologies such as AI to help optimize energy consumption further and drive efforts towards net zero.

continue to grow.[57] Even for those enterprises that have pledged carbon neutrality, the fact remains that consumption of sustainable energy resources in one sector necessitates consumption of non-sustainable energy in other sectors, until such time as the entire energy economy has a sustainable basis.

The challenge is not just in energy consumption and related emissions, but in waste as well. Only 17.4% of electronic waste is recycled globally.[58] This leads to heightened environmental and health issues, particularly in economically developing countries. Additionally, e-waste results in a loss of at least $57 billion annually through the disposal of key raw materials, such as iron, copper and gold, hitting communities with limited recycling infrastructure (e.g. India) particularly hard. Concerns about waste are emerging even beyond Earth's boundaries. Millions of pieces of space junk are floating around in low Earth orbit (LEO), with more than 34,000 pieces of junk more than 10 cm in size and a total weight of more than 5,500 tonnes.[59,60,61] As private organizations push into space with minimal regulation, the need for sharp policy that demands accountability is very clear.

B Enabling green technology

While presenting a challenge to sustainability, technologies also offer many opportunities to minimize the negative impact human activities have on sustainability. The global green technology and sustainability market was valued at $13.76 billion in 2022 and is projected to grow at a compound annual growth rate (CAGR) of 20.8% between 2023 and 2030.[62] Accelerating this trend will help to create better environmental futures and overall human outcomes, particularly with smart policy to power its trajectory.

Agile technologies – from AI to cloud computing to DevOps – are already playing a role in achieving more sustainable futures. A recent report by BCG and Google states that AI has the potential to mitigate 5–10% of global GHG emissions by providing helpful and previously unseen information, predicting climate-related events and optimizing climate action.[63] There is real potential for emerging technologies such as AI to help optimize energy consumption further and drive efforts towards net zero – even in energy-intensive operations such as data centres.

C Societal and ethical concerns

Technologies can create social disruptions that have a negative impact on core values and the rights of individuals. For example, certain technological advances are illustrating race-based bias as they get smarter – an effect dubbed techno-racism. A study by NIST of more than 100 facial recognition algorithms found that they falsely identified African American and Asian faces 10 to 100 times more frequently than Caucasian faces.[64] Similarly, while some technologies are being used for good purposes, such as supporting humanitarian action, they are potentially bringing unintended negative consequences.[65]

As described in Section 3, the rise of platform-based work arrangements introduces new challenges for workers, often characterized by precarious employment conditions and a lack of traditional labour protections. As large, digitally based organizations continue to extend their reach across the commercial landscape, the pressing questions around platform workers' rights will grow more urgent, in parallel.[66] The key implication is that policy must also stretch to include the human resources behind the proliferation of these powerful technology platforms.

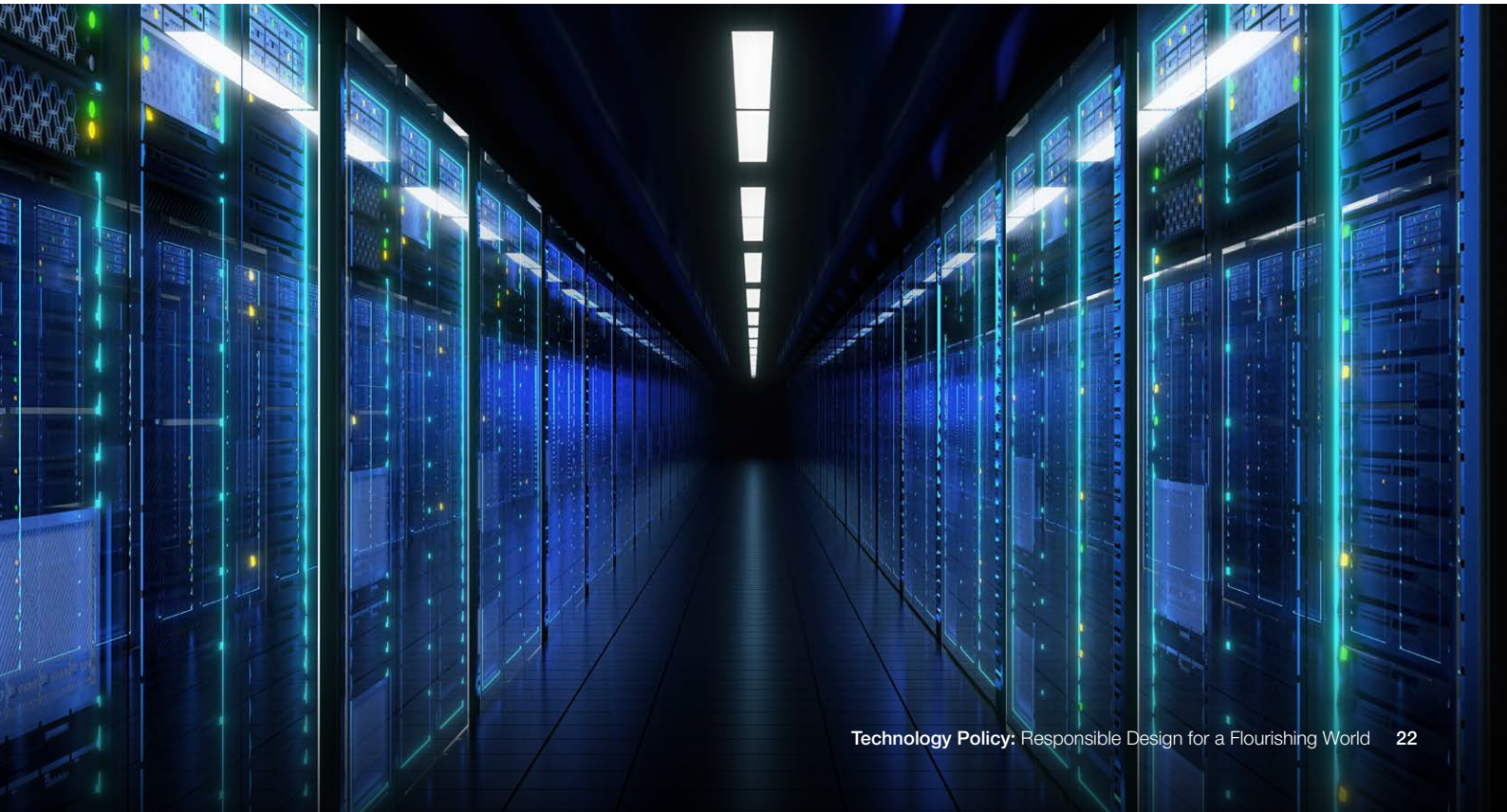


TABLE 4 | **Proposed solutions and action**

	Solution/action	Expected impact	Potential roadblocks	Enablers
A **Sustainability of technology**	**Align technology policy with broader environmental, sustainability and governance (ESG) priorities, frameworks and desired outcomes**	Promote responsible technology development and deployment, aligning with private-sector incentives and accountability mechanisms	Resistance from industry stakeholders, lack of standardized metrics, ESG push-back Competitive forces from cheaper, less sustainable options that deliver on consumer and customer price sensitivities	Strengthening regulatory oversight mechanisms, coupled with improvements in policy design by investing in education and capacity-building
B **Enabling green technology**	**Create processes for a whole-of-value-chain approach to designing policy incentives for green technology, from developers, producers, retailers and consumers**	Increased innovation, development and uptake of green technologies through aligned demand and supply-side incentives throughout the entire life cycle of a product	Trust in emerging technologies, resistance to change, too much complexity in policy systems and competing regulations, coordination across markets	Strong leadership and effective governance structures, multistakeholder collaboration platforms for effective design
	Develop organizational standards to guide investment in operational elements such as clean energy sources, energy-efficient facilities and other factors in decision-making	Align broader corporate decisions that have an impact on technology development with sustainability priorities and create more sustainable long-term business practices	Shareholder push-back against larger short-term costs; traditional partners might create roadblocks if they are supplanted for greener partners and suppliers	Build new relationships with facilities, partners and energy-supplier networks to create a more sustainable ecosystem around technology development
C **Societal and ethical concerns**	**Develop mechanisms to better connect technology innovations and solutions to the populations they must/should serve**	Efficiency, focused human impact, increased effectiveness	Closed tech/data systems, community-specific nuance, current regulations, market forces	Local community leaders, local organizations, non-governmental organizations (NGOs) with ground-level knowledge, networks and expertise
	Develop assessment tools beyond environmental impact assessments, with human-centricity as a core and cross-solution design principle	New measurement tools and capabilities to increase the effectiveness of policy to address social and ethical concerns	Inaccessible data or data gaps, market forces Complexity of assessing subjective human experiences and values Competing interests and properties by different countries and individual stakeholders	Engaging with diverse stakeholders, removing layers of bias from the system

CASE STUDY 11

The United States' National Artificial Intelligence Research Resource pilot

In January 2024 the US National Science Foundation launched the pilot programme of the National Artificial Intelligence Research Resource (NAIRR).[67] As stated in the launch announcement, "The pilot will broadly support fundamental, translational and use-inspired AI-related research with particular emphasis on societal challenges. Initial priority topics include safe, secure and trustworthy AI; human health; and environment and infrastructure. A broader array of priority areas will be supported as the pilot progresses. The pilot will also support educators to train students on responsible use and development of AI technologies by providing access to infrastructure and training resources." This pilot will provide researchers with the computational, data, software, model, training and user-support services necessary to participate in AI research.

Given the increasingly substantial capital and operational costs of developing AI models, as documented in the trends maps available at epocai.org,[68] the leading LLM computation cost is estimated at $5x10^{25}$ AI floating point operations, which is the equivalent of more than eight weeks of continuous usage of the fastest general-purpose supercomputer, the US Department of Energy Oak Ridge National Laboratory's Frontier system, or more than 264 years of continuous usage of an eight-GPU commercially available AI training server or cloud compute instance. By providing holistic research resources, the NAIRR will enable groups outside of highly capitalized enterprises and those seeking to demonstrate the benefits of AI for language, culture and experience to access the means of innovation, whether or not the models created have potential future profitability.

CASE STUDY 12

India's Digital Personal Data Protection Act and new E-Waste Management Rules

Amid rapid digitalization and increased security and privacy risks, and as policy-makers around the world grapple with taking the right action, India passed its Digital Personal Data Protection Act (DPDPA) in August 2023. This new legislation provides a framework for handling personal digital data that codifies individuals' rights to safeguard their information as well as the need to process such data for legitimate purposes, and was a course correction from the country's Personal Data Protection Bill 2019 (PDPB)[69] – which was seen as problematic. This new law and the GDPR in the European Union are being lauded as "paramount pillars in the global mission to ensure the security of personal data"[70] for all. The DPDPA's consent requirements, children's data protection measures, data-breach notification and other elements seem engineered to provide individuals and communities with the tools to protect both themselves and their data, while not imposing onerous demands on potential business innovations.

When it comes to prioritizing environmental protection in the context of accelerating innovation and technology adoption in India, e-waste is a challenge. In this context, India has introduced its new E-Waste Management Rules of 2022,[71] effective from 1 April 2023, which replace its old 2016 rule and represent a big step forward in the country's efforts to regulate and increase efficiency within the e-waste ecosystem. Only about 5%[72] of India's total electronic rubbish is recycled officially every year, and more than 95% is managed by scrap dealers who dismantle items instead of recycling them and as a result cause long-lasting environmental damage due to mishandling of waste. The new rules have dramatically expanded the scope of controls, establishing clear registration requirements and offering a refined approach to extended producer responsibility (EPR) – focusing on creating more accountability and stimulating a more environmentally conscious national mindset.

CASE STUDY 13

The Brookings Institution's New AI Equity Lab

In February 2024, the Brookings Institution launched its new AI Equity Lab,[73] a focused effort to realize a future of more inclusive technology. It calls itself a "convening platform for a full view of the socio-technical design contexts and outcomes of evolving and emerging technologies in a manner that promotes increased interdisciplinary and diverse cooperation and collaboration". Minority communities face challenges when it comes to the proliferation of AI – from errors in facial recognition tech used by law enforcement when it comes to darker complexions, leading to misidentification, to biases in criminal databases whereby some minority communities might feature more often and skew predictive decision-making. This brand-new effort aims to ensure that traditionally marginalized communities are not negatively affected by technology innovation and provide a convening environment for policy-makers, academics and others who have a role to play in ensuring equitable technology innovation for communities of all types.

6

Enable with: Dynamic capabilities for government

Government and the public sector must be alert and agile to act at the right time and in the right way to direct technology policy.

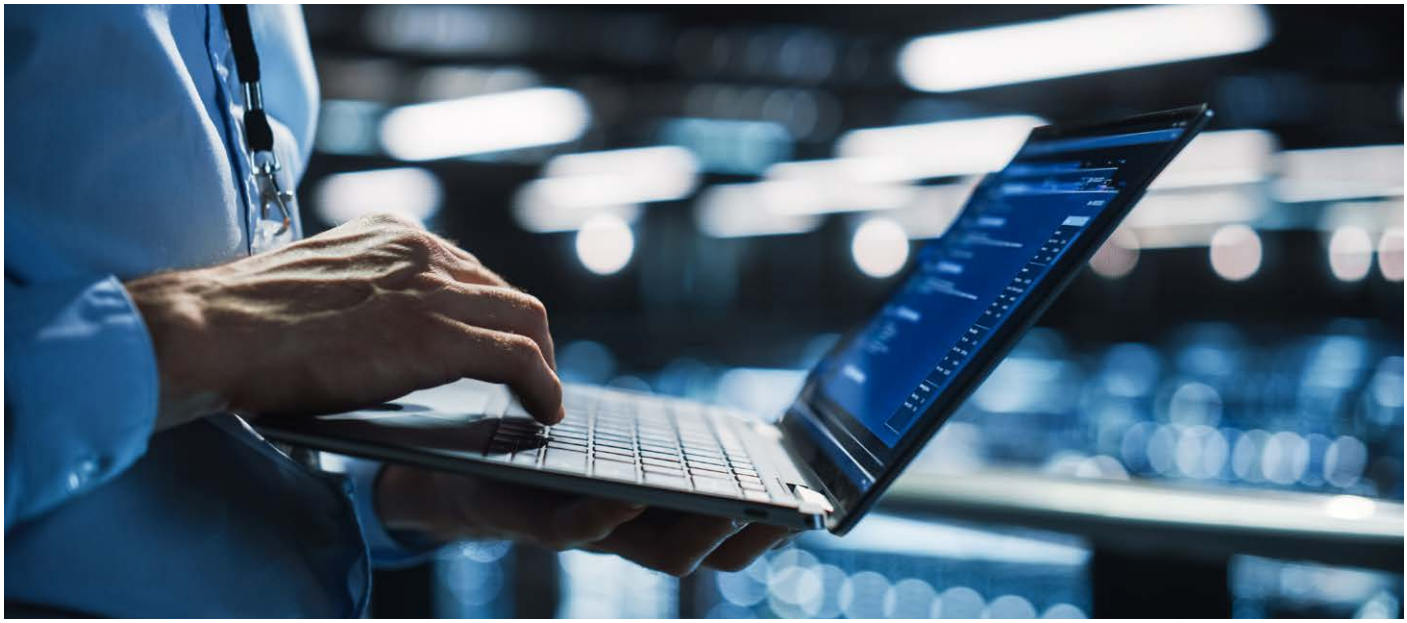
The speed of technological advance makes it extremely challenging for governments globally to keep abreast of constantly evolving trends and to regularly update or iterate their approach to policy-making and regulation. With technology developing so quickly, some policy is obsolete before it is even finalized (what has been called the pacing challenge),[74] and governments face a challenge in deciding when to intervene – early, with potentially incomplete information, or with more information but potentially too late to meaningfully shape developments (the so-called Collingridge dilemma).

Governments are starting to acknowledge their limitations when it comes to regulating rapidly evolving technology. Equally importantly, a public sector that does not have the required dynamic capabilities to continuously lead and adapt cannot procure technology effectively, nor direct technology policy towards positive societal outcomes. Direction is as important as speed, especially in a context characterized by the complexity involved in the policy-making process.

The United Kingdom and Singapore are two jurisdictions with traditionally strong policy-making capacities contending with the reality that even their policy-making capacities are increasingly challenged. In an interim report dated March 2023, the UK House of Commons Science, Innovation and Technology Committee expressed uncertainty at current levels of regulatory capacity to facilitate AI governance, and recommending a gap analysis of regulatory capacity to implement and enforce the principles outlined in the government's pro-innovation AI white paper.[75,76] In June 2023, Singapore's Infocomm Media Development Authority (IMDA) highlighted the need to build greater capacity within the AI ecosystem before AI regulation can be effective.[77]

In response, both jurisdictions opted for agile governance, turning to international cooperation and multistakeholder efforts for policy solutions to AI governance. It is crucial to develop new capabilities and rethink the policy-to-implementation cycle to equip the public sector with the tools to craft technology policy that can safeguard the rights and well-being of citizens while at the same time promoting responsible innovation.

“ It is crucial to develop new capabilities and rethink the policy-to-implementation cycle to equip the public sector with the tools to craft technology policy.



6.1 Analysis of problems and gaps

The challenges and the need for progress are best addressed by way of two questions: (1) which capabilities are needed to understand and create policies around emerging technologies?; (2) how can these capabilities be built most effectively?

A Articulating the dynamic capabilities needed for technology policy formulation and successful implementation/delivery

The global debate about technological risks to society – for example, in the application of AI to neuro- and biotechnology and recent high-profile scandals of technological misuse or misapplication (e.g. Robodebt in Australia, children's benefits in the Netherlands, the Horizon Post Office affair in the UK) – have brought to the fore the need for governments to improve their performance with respect to understanding and regulating emerging technologies and steering their use towards public value.[78]

Governments need to invest in dynamic capabilities to respond in a timely and agile manner to technological breakthroughs. These capabilities include skills (technical and leadership expertise), competencies (attitudes and behaviour) and, critically, the ability to adapt them as the technological context changes.

Failure to do so can bring unintended societal outcomes, as reflected in the results of the latest global Edelman Trust Barometer. The survey found that 59% of government regulators lack adequate understanding of emerging technologies to regulate them effectively, and that when institutions mismanage innovation, the population is more likely to believe that technology is advancing in ways that do not benefit (27% more likely) or are not good for (22% more likely) individuals like themselves.[79]

The latest OECD survey of schools of government provides a snapshot of the lag in the provision of relevant courses to public-sector workers, with AI and automation still poorly represented in existing curricula.[80] The capabilities gap is also reflected in the divide between the Global North and the Global South, as captured, for example, in Oxford Insights' *Government AI Readiness Index 2023* report and the UN's *State of Science, Technology and Innovation in the Least Developed Countries*.[81,82]

Progress has been made recently in articulating some of the dynamic capabilities needed for technology policy.[83] For example, the United Nations Educational, Scientific and Cultural Organization (UNESCO) proposed a competencies framework for civil servants for AI and digital transformation (see below);[84] the Teaching Public Service in the Digital Era academic initiative put forward an eight-competencies framework for digital-era public service;[85] and the Brookings Institution published a blueprint for technology governance, introducing an innovation-enabling approach to regulation in government.[86] But much more needs to be done, in a consistent and sustained way, given the rapidity of technological evolution.

B Process for effective government capability-building

Documenting concrete examples of effective government capability-building programmes from around the world that relate to technology policy will help governments design the most effective programmes for public and civil servant capability-building. Much can be learned from emerging examples of governments taking a proactive role in addressing the capabilities gap – from the United Arab Emirates to Australia, from India to the US.[87]

At the same time, a recent review of "how governments learn" makes the case for reimagining the way in which the public sector understands and regulates scientific and technological advances.[88] Important questions still remain on this "how", with further attention needed on areas such as:

- How to build capabilities fast and at scale across the public sector, while avoiding falling into the trap of following the latest technology fads
- How to build capabilities to tackle coordination challenges between different levels of government (national/local) and between departments/ministries
- How to work effectively with multistakeholder partners to anticipate trends
- How to build capabilities both at the tactical (vertical) and strategic/systemic level (horizontal)
- How the policy and regulation cycle needs to change for effective technology policy
- How to take into account variations in, for example, contexts, geographies and values to improve context-sensitivity

TABLE 5 | **Proposed solutions and actions**

	Solution/action	Expected impact	Potential roadblocks	Enablers
A **Articulating the dynamic capabilities**	**Develop a framework for dynamic capabilities for technology policy**	A common understanding of what capabilities are needed A tool for governments to assess where they stand and measure their progress	The pacing challenge, given the velocity of tech development	Several foundational frameworks are publicly available (e.g. UNESCO, see above)
	Map current skills taught by public policy schools and other efforts to build dynamic capabilities in government	Highlight existing gaps Improve the understanding of the balance between classroom vs. on-the-job, just-in-time learning and experimentation	Lack of data availability Poor incentives for research-driven academics to engage in public-sector skilling efforts	Using AI or a dedicated survey to produce a real-time map of skills taught
B **Process for effective capability-building**	**Document the upskilling/dynamic capabilities journey of selected governments**	Inspiration and practical insights on how to build dynamic capabilities and improve execution	The complexity and multiplicity of stakeholders may limit efforts for systematic and comprehensive documentation	Using the networks of the World Economic Forum and other multistakeholder entities to build a collection of case studies

CASE STUDY 14

The United Arab Emirates' journey of dynamic capability-building in innovation

The UAE government has followed an approach to dynamic capability-building that deliberately pursues a mix of on-the-job and classroom-based learning opportunities. The government's approach is based on the premise that new capabilities need to be spread, in different forms, throughout the public sector, and it has built dynamic capabilities at three levels:

1. **Creating a culture and an enabling environment for everyone to learn.** This is achieved via recognition of successful innovation efforts, by means of the UAE Innovation Month and the UAE Innovates awards, which showcase public-sector innovations, and by launching platforms that support the public sector. Such platforms include: the Ibtekr platform, which to date has serviced more than 300,000 learners and includes five massive open online courses (MOOCs) and 450 publications on public-sector innovation;[89] the Edge of Government, a matchmaking platform that encourages prototyping of new services based on inspiring practices from across the world;[90] and initiatives such as the Artificial Intelligence Program, the National Program for Coders and the Dubai Future Academy.[91]
2. **Cultivating champions and public-sector "intrapreneurs".** To create a cadre of key champions empowered to drive change, every entity in government has appointed a chief innovation officer. These officers form a community that meets on a regular basis to cultivate a culture of intrapreneurship. A dedicated programme, the Public Sector Innovation Diploma, was established to ensure that innovation champions have the necessary capabilities, and a Regulations Lab was created that allows for rapid testing (through "regulatory sprints") and a streamlined process to licensing, among other things.
3. **Agile leadership.** The UAE government has designed dedicated platforms to facilitate open learning and experimentation, including Pitch@Gov, a platform that gives start-ups the opportunity to interact directly with government entities' leadership.[92] The UAE's "Government Accelerators" are cooperation programmes specifically designed to allow front-line staff across the public and private sectors to take the lead in developing solutions through 100-day challenges, which are then presented to leadership to streamline implementation.[93] The Mohammed Bin Rashid School of Government also offers a Master's in Innovation Management, as well as executive education courses on innovation.

CASE STUDY 15

Nigeria's Devs in Government project

Nigeria is developing a civil servant software developers upskilling programme that allows government staff who run technology projects to collaborate, share constraints, access resources and build solutions. This is in a bid to uplift technical capacity, build community as a peer-to-peer learning measure, and improve access to e-government services with a broader goal of affecting citizens.[94] This project, announced in February 2024, will help champion Nigeria's Digital Public Infrastructure initiative aimed at transforming public services.[95]

CASE STUDY 16

Building capacity and connections to enable GovTech solutions in Serbia

Serbia's new GovTech programme aims to bridge the gap between the creation of innovation solutions and practical implementation within public services. The first phase of the programme focuses on creating demand in the public sector through training and capacity-building. The government has designed tailor-made, interactive training to enable more than 100,000 public servants to better understand and formulate policies on emerging technologies such as AI, blockchain, the internet of things (IoT), robots, drones, 3D printing, virtual reality (VR) and augmented reality (AR), the platform economy and generally on digital transformation and innovation in the public sector.[96] With a deep understanding of these technologies, the public sector is better equipped to review, assess and implement important GovTech solutions that can transform how governments and citizens interact.

7 Enable with: Extended multistakeholderism

A broad but nimble approach to technology policy-making is needed that takes into account the full – and expanding – range of stakeholders.

Policy-making through public–private cooperation has often been a goal. However, the development of technology policy has become increasingly complex due to the number of different stakeholders involved in the responsible design and management of the technology ecosystem (what has been called the "coordination challenge").[97]

Governments are increasingly recognizing the need to consider how technologies affect various stakeholder groups; they are now operating in an environment in which technology design is influenced by a range of stakeholders beyond just government and businesses, or even civil society. For instance, the data provided by individual citizens significantly influences the decisions made and outcomes produced by AI models. This necessitates a broader engagement strategy in which public feedback and concerns can shape the ethical use and regulatory frameworks of these technologies, ensuring that they serve the wider community effectively.

Multistakeholderism must be the way forward to facilitate governance of increasingly complex technology in a manner that supports innovation, while at the same time protecting the rights and interests of individuals. International and multistakeholder collaboration can deliver a measured and well-thought-out approach to regulating emerging technology that will always be one step ahead.[98]

7.1 Analysis of problems and gaps

More agile governance is needed: adaptive, human-centred policy that is inclusive and sustainable.

With emerging technology, traditional methods of policy-making are failing. Technology's rapid development outpaces policy-makers' capacity to properly grasp its potential benefits and risks and, by extension, what and how to regulate – even before often-lengthy legislative processes are taken into account. More agile governance is needed: adaptive, human-centred policy that is inclusive and sustainable. Policy development can no longer be limited to governments (even if governments must lead and convene such processes), but increasingly must evolve to become an international and multistakeholder effort.

Defining the stakeholders

Multistakeholderism must be redefined as the involvement of the *entire* cross-section of society, from policy-makers to technologists to the private sector to members of civil society and to individual non-affiliated citizens, including the young people who will be the next generation of leaders. By involving diverse stakeholders, each bringing their unique perspectives and expertise to the table, policy-making can become more robust, informed and responsive to the needs and aspirations of society as a whole. This inclusive approach not only fosters greater legitimacy and accountability but also ensures that policies are more reflective of the values and priorities of the communities they aim to serve. The role of governments will have to evolve from public administration and management to public governance: organizing the multistakeholder system, convening relevant actors, facilitating and brokering collective deliberation, aggregating interests and managing trade-offs.

A Incentives for collaboration

Stakeholders often have divergent interests and objectives. For example, governments may prioritize regulatory frameworks that promote public safety and welfare, while businesses may prioritize profit maximization and market competitiveness. Innovators may seek to push the boundaries of technology without being overly constrained by regulations, while civil-society organizations may advocate for policies that prioritize environmental

sustainability, social equity and individual privacy. These differing priorities can create tensions and conflicts when attempting to align incentives. Power imbalances between stakeholders, different time horizons for realizing their goals and varying levels of technological understanding further compound the challenges for collaboration. Aligning the incentives of stakeholders towards common goals requires inclusive and participatory policy processes, building trust among stakeholders and promoting a shared understanding of the benefits and risks of technology innovation. Such processes are far messier than previous policy environments, and both governments and those governed will have to become more accustomed to processes that are contested, non-linear, iterative and lacking in clear blueprints or templated outcomes.

B Effective mechanisms for stakeholder collaboration

Recognizing the limitations of capacity within local borders, particularly in the face of rapidly evolving technologies that transcend jurisdictional boundaries, it becomes imperative to leverage multistakeholder approaches to collaboration among countries. Effective mechanisms for stakeholder collaboration should be established to facilitate multistakeholderism at both the national and international levels. This allows for the combination of policy-making with technical expertise, and for the cross-pollination of expertise from the entire cross-section of society to bridge knowledge, skills and coordination gaps.

TABLE 6 **Proposed solutions and actions**

	Solution/action	Expected impact	Potential roadblocks	Enablers
A **Incentives for collaboration**	**Legislation that promotes a multistakeholder approach (e.g. Act on Improving Transparency and Fairness of Digital Platforms [TFDPA] in Japan)**	Flexible, responsive and agile regulations through collaboration among a broad range of stakeholders	"Regulatory capture" problem	Collaboration among a broad range of stakeholders, including regulators, regulatees, private companies, consumers, civil-society groups and individual citizens
	Encouragement of voluntary collaboration by companies with local communities based on an "agile governance" approach (e.g. ANA Group's trial programme to form a logistics network using drones in remote island areas)[99]	Flexible, responsive and agile problem-solving with soft law tailored to stakeholder needs	Moral hazard by private companies	Collaboration among a broad range of stakeholders, including governmental agencies, employees and technicians of private companies, local government officials and local residents
B **Effective mechanisms for stakeholder collaboration**	**Revolving-door employment policy across sectors**	Transfer of skills across sectors, allowing for cross-pollination	Intellectual property (IP) and other confidentiality concerns, contractualized as non-disclosure agreements (NDAs), particularly in Asia	Discourage use of NDAs, apart from situations in which justifications meet a high threshold (e.g. national security or information with genuine public impact if released)
	Recruitment of expert policy-makers from other jurisdictions	Transfer of skills across jurisdictions, allowing for cross-pollination	National security and official secrets concerns	Cross-regional collaborations between like-minded jurisdictions, e.g. ASEAN, Asia-Pacific Economic Cooperation (APEC), Indo-Pacific Economic Framework for Prosperity (IPEF), Five Eyes (intelligence community of Australia, Canada, New Zealand, the United Kingdom and the United States)
	Clear processes for continuous stakeholder engagement, including post-policy implementation and as general ongoing practice	Remove the "set and forget" tendency of policy design, crowdsourcing feedback and review for continual improvements	Resource-intensive, no associated mechanism for policy adjustment to complement stakeholder engagement	AI to streamline processing of feedback, digital technologies for less burdensome feedback processes

CASE STUDY 17

Setting policy for multistakeholder action towards transparency and fairness

The Act on Improving Transparency and Fairness of Digital Platforms (TFDPA) in Japan dictates that digital-platform providers should voluntarily and proactively undertake initiatives to improve transparency and fairness, and that the government's involvement and regulation should be kept to the minimum necessary.[100] Under this law, Google worked with industry associations and relevant government agencies to create self-regulatory rules that allowed online crane game apps to be offered on the Google Play Store – on the condition that they were reviewed and certified by industry associations. As a result, industry developers formed the Japan Online Crane Game Operators Association, which worked with Google Play to develop, and currently pilot, a certification system for developers, establish certain user-safety standards and implement a monitoring system to ensure effective enforcement of those standards.[101] The policy therefore actively encourages proactive, multistakeholder efforts towards responsible technology development.

CASE STUDY 18

The Global Partnership on AI (GPAI)

The GPAI is a multistakeholder initiative designed to bridge the gap between theory and practice in AI. By bringing together experts from science, industry, civil society, international organizations and government, GPAI promotes collaboration to address AI-related challenges and opportunities. This inclusive approach encourages knowledge exchange and cooperation on AI research and aims to reduce fragmentation through pooled resources. The partnership has focused on promoting the development of ethical, trustworthy and inclusive AI systems, with a particular emphasis on advancing global trust in AI models.[102] In December 2023, 29 member nations of GPAI agreed to jointly develop AI applications, particularly in healthcare and agriculture, with an expanded focus on the Global South.[103]

CASE STUDY 19

The Institutional Arrangement for Partnership (IAP)

The establishment of the IAP was endorsed by G7 leaders in 2023 to operationalize data free flow with trust (DFFT). The IAP brings governments and varied stakeholders together for solutions-oriented cooperation on cross-border flow of data. The structural features of the IAP are:

1. Use existing committees of international organizations to facilitate multilateral policy-making and coordination. The secretariat is established at the OECD, where the IAP is hosted.
2. Establish working groups based on projects consisting of government officials, experts and stakeholders.
3. Collaborate with various international organizations and institutions as participants of the working group projects, with a focus on providing common solutions across countries.

Through these three multistakeholder approaches, the IAP aims to formulate flexible and practical international norms that differ from ordinary multilateral agreements.[104]

8 Three conclusions and one beginning

A willingness to embrace the creative potential of conflicting demands, take a multistakeholder approach and adopt an experimental mindset are crucial for effective governance of technology.

Three principal themes have emerged in the preceding sections – each with profound implications for the future of technology policy.

First, there is potential for tension and trade-offs among different recommendations – and indeed, among the various aspects of the flourishing world envisioned by the paper. For instance, greater emphasis on safety and security – especially if achieved through restrictive regulation – could lead to fewer experiments with use cases, resulting in reduced opportunities to develop markets and infrastructure or the government skills needed in a technology-driven world.

The Global Future Council on the Future of Technology Policy sees this as a potential but not a necessary outcome. An important challenge for policy-makers will be to hold the apparent tensions and trade-offs in their minds while finding creative ways to continue functioning by transcending rather than buckling under the weight of opposing ideas. For instance, safety and security could be achieved through more transparent labelling schemes that enhance public awareness of the different possibilities and pitfalls in different technologies. This could be market-forming rather than market-eroding in its effects, and the ability to articulate rules for such labelling could be part of a new public-sector skill set. Broadening this example, finding ways for apparent tension and trade-offs to be generative, rather than curtailing, will be an essential part of the human flourishing envisioned in this report.

Second, the importance of multistakeholder approaches cannot be overstated. The idea is explored in detail in the final section of this report, but also permeates the recommendations of all of the preceding sections. It is worth emphasizing that the Council does not see multistakeholderism as a purely additive process, with governments simply consulting other sectors and collating different perspectives. Rather, multistakeholderism is a way of being and doing that fundamentally transforms the act of governing: synthesizing different sectoral perspectives so that the whole is far greater than the sum of its parts. This means abandoning traditional, narrowly defined definitions of interests, focusing instead on the collective gains that become possible when governments, businesses, communities and individual citizens row in the same broad direction. Each sector will have to move beyond innate suspicion and mistrust of others and find ways to build new social capital and win-win relationships.

Third, all multistakeholder actors will face the challenges and opportunities of ever-dynamic technological change. The process could potentially be exhausting, given that technology seems to be developing in ever-swifter, ever-shorter evolutionary cycles. Technology will seldom be stable for very long; perennial curiosity and learning mindsets will be ever more critical, as will constant experimentation, iteration, prototyping and beta-testing. The age of governance by blueprints, template and defined plans is clearly over, and an age of governance by agility and adaptation is beginning.

This is why this report is a beginning, not an end – a basis for future conversation, deliberation and exploration, rather than what John Maynard Keynes would have called a “body of settled conclusions”. The ideas here are presented for discussion, debate and refinement.

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