Financing for Sustainable Development Report 2022

Inter-agency Task Force on Financing for Development

Bridging the Finance Divide

United Nations

Report of the Inter-agency Task Force on Financing for Development

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The online annex of the Task Force (http://developmentfinance.un.org) provides additional data and analysis on progress in implementation of the Financing for Development outcomes, including the Addis Ababa Action Agenda and relevant means of implementation targets of the Sustainable Development Goals.

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Science, technology, innovation and capacity building



Chapter III.G

Science, technology, innovation and capacity building

1. Key messages and recommendations

Two major technology transitions are under way that together will shape a post-COVID-19 world: (i) the digitalization of the economy; and (ii) the progress in science, technology and innovation (STI) that can support a sustainable energy transition. Both trends are creating new opportunities for more resource-efficient, resilient and sustainable development, underpinning transitions in all other areas of the Sustainable Development Agenda and Addis Ababa Action Agenda. They are closely interlinked, as digital technology can help to accelerate the energy transition while also being a potential source of growing energy demand. Both technology transitions may also create new risks and worsen inequalities, effects which are already visible in the digital economy and which could possibly be expected as a result of the energy transition, if not carefully managed. Greater efforts are needed at the national and international levels to harness these technologies and mobilize the financing and capacity building required for just and inclusive transitions.

Increased digitalization has helped to mitigate the COVID-19 crisis for some population groups but has exacerbated the cost of digital exclusion and created new risks. Affordable and universal access to the Internet and digital skills have become a precondition for participating in the digitalized economy. This has exposed and exacerbated digital gaps between countries—with least developed countries (LDCs) continuing to lag behind. It has also highlighted the digital gaps between men and women, companies, workers and vulnerable groups, each with different capacities to benefit from the digital transition. The growth of digital financial services has provided an opportunity to strengthen financial inclusion, while also exposing persistent gender gaps and creating new risks, including new forms of exclusion, cyber incidents and digital fraud. The growing role of big technology platforms has raised concerns about market power and data governance.

- *To close digital divides, policymakers need to ensure universal and affordable Internet access, digital skills training and targeted policies for specific groups, including women and girls;*
- *Regulators and supervisors can build on financial technology to support financial inclusion while addressing growing risks from cyber incidents and digital fraud by strengthening consumer protection and holding financial service providers accountable for safeguarding data;*
- *Well-managed and transparent universal service and access funds can help to mobilize the necessary resources to achieve universal broadband Internet access, based on private-sector contributions, which can be pooled with public funds where necessary;*
- *Regulatory frameworks should be reviewed and strengthened, where appropriate, to address issues of data governance (including to avoid concentration of market power), content accountability, discrimination and human rights. International coordination will be needed to ensure coherent global standards.*

As a sustainable energy transition becomes increasingly urgent, STI solutions are opening up new opportunities. There is little time left to achieve the Paris Agreement and greenhouse gas (GHG) emissions will need to be cut sharply by 2030 and to net zero by 2050. While political commitments have strengthened, investments in sustainable energy sources are still insufficient. Energy investments have fallen in developing countries (excluding China) and there has been a reduction in clean technology transfer. Yet, recent technology innovations have made the energy transition achievable, with improvements in sustainable energy production and end use, including through digital consumer technologies.

- *Policymakers must further increase climate ambitions and support their pledges through appropriate budget measures,* *including by building on fiscal stimulus measures for a sustainable recovery from the COVID-19 crisis;*

- *Private investment can be a large source of funding for energy infrastructure, while the public sector can set incentives and help to ensure universal and affordable energy access for remote and underserved communities. International cooperation will be needed to support the transition in many developing countries, including through capacity building and technology transfer;*
- *Efforts to increase energy efficiency, including through digital technologies, can lower overall investment needs and help to reduce the reliance on unproven technological solutions for the reduction and abatement of GHG emissions.*

The United Nations system is working to strengthen countries' STI capacity, complementing bilateral and other multilateral efforts. The Technology Facilitation Mechanism (TFM) and the United Nations Technology Bank for the Least Developed Countries (Technology Bank) are facilitating policy dialogue and technology transfer, including to harness digital technologies for development and to address the COVID-19 pandemic. United Nations entities have joined forces with other partners through the Access to COVID-19 Tools Accelerator (ACT-A) that has delivered over 1 billion vaccine doses to developing countries but remains underfunded. Collaboration at different levels also aims to support country efforts to align finance, investment and technology to recover better from the current crisis.

- *Member States are called upon to step up their contributions to ACT-A and consider sharing know-how and intellectual property to support the fight against COVID-19 and strengthen resilience to future pandemics;*
- *Continued support for the TFM and Technology Bank is needed to help them deliver on their mandates and further strengthen developing countries' capacity to harness STI—for instance, through STI for SDGs roadmaps.*

The next section of this chapter analyses opportunities and risks from digital trends that have been accelerated by the pandemic and puts forward recommendations for enabling a just and inclusive digital transition; section 3 lays out the challenges of a sustainable energy transition and reviews investment needs and technological opportunities to make it happen; and section 4 takes stock of United Nations system actions to help countries to harness STI for sustainable development.

2. Enabling a just and inclusive digital transition

Digital information and communications technologies are transforming every aspect of life, including all areas of financing for development highlighted in the Addis Ababa Action Agenda. The COVID-19 pandemic has further accelerated these trends. Yet, while digital technologies can increase efficiencies, strengthen resilience and enable inclusion, they can also deepen inequities between and within countries and create new risks. With affordable Internet access and digital skills being basic requirements to benefit from technology and related services, rapid digitalization has greatly increased the cost of exclusion for those who do not have access or cannot use these technologies (often the most vulnerable groups of society). Many developing countries, especially LDCs, are also at risk of falling behind and becoming mainly users and data providers rather than inserting themselves productively into the global digital value chain. Other risks at the individual and institutional levels include the growing threat of cyber incidents and digital fraud, as well as new forms of exclusion, for example, through biases in algorithmic decision-making. At the market level, digitalization has been associated with increased concentration of market power due to the rise of large international tech platforms. The growth in digital financial services has also raised concerns about financial stability and integrity (see chapter III.F).

2.1 Acceleration of digital trends

Increased Internet usage, with persistent gaps

The COVID-19 pandemic has boosted Internet usage worldwide. This has helped mitigate the social and economic impact for some but not all population groups, thereby exacerbating the cost of digital exclusion. According to the latest data from the International Telecommunication Union (ITU), in 2021, 4.9 billion people, or 63 per cent of the world population, were using the Internet—up from 4.6 billion (59 per cent) in 2020 and 4.1 billion (54 per cent) in 2019. Most of this increase was driven by new Internet users in middle-income countries (MICs). In LDCs, the share of individuals using the Internet remained low, at 27 per cent, compared to 57 per cent in developing countries overall, and 90 per cent in developed countries (figure III.G.1).

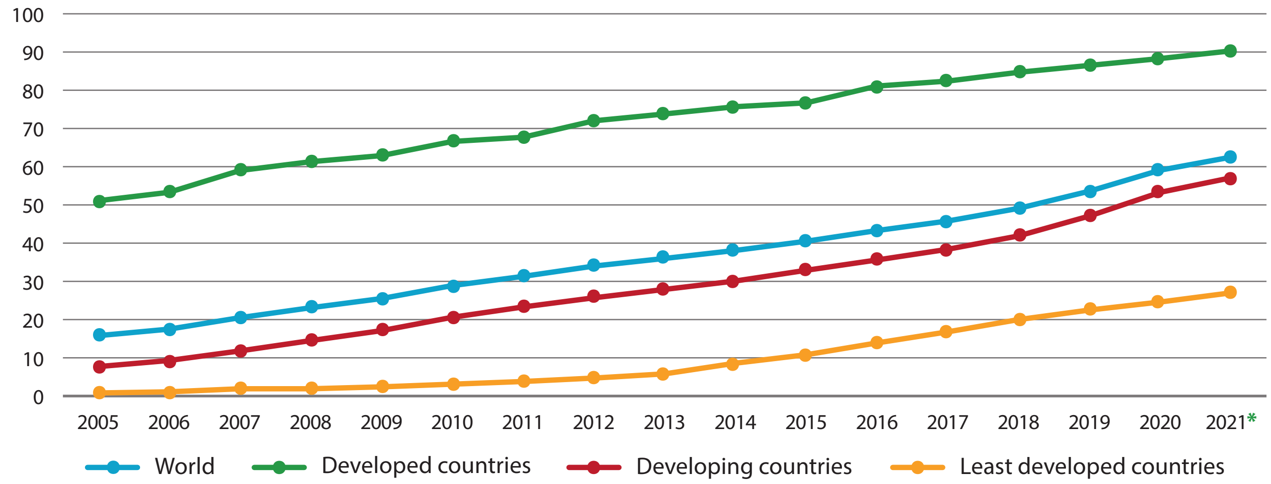
Global data flows—as measured by the global use of Internet bandwidth—have continued to increase at an accelerated pace. Global data flows increased by 35 per cent in 2020 to reach 230 Exabytes per month. They are expected to more than triple by 2026, to reach 780 Exabytes.[1] This increased reliance on digital connectivity underscores the inequalities between and within countries and regions in terms of access to digital opportunity and creates new policy challenges.

Affordable Internet access and the cost of devices remain a challenge in many developing countries and for vulnerable populations everywhere (figure III.G.2). Even where broadband coverage exists, the cost of access continues to be an obstacle, especially in LDCs. The median monthly price of the cheapest broadband subscription with at least 5 GB of data in LDCs is $22.3, or just over 20 per cent of gross national income (GNI) per capita. This compares to a global median of $22.8, or 2.8 per cent of global GNI per capita.[2] The cost of digital devices is also prohibitive for significant segments of the population in lower-income groups in many developing countries. Nearly 2.5 billion people live in countries where the cost of the cheapest available smartphone equals 25 per cent or more of the average monthly income.[3] This lack of affordability is one of the main drivers of the mobile Internet usage gap, with 3.4 billion people not using mobile Internet despite living in areas with mobile coverage.[4]

The gender digital gap remains sizeable, especially in poorer countries

The gender digital divide has narrowed substantially but remains sizeable in some developing countries, particularly LDCs and landlocked developing countries (LLDCs). In 2020, 57 per cent of all women used the Internet, 5 percentage points below the level for men. This represents a slight reduction of the gap (by 1 percentage point) from

Figure III.G.1
Individuals using the Internet, by country groups, 2005–2021
(Percentages)



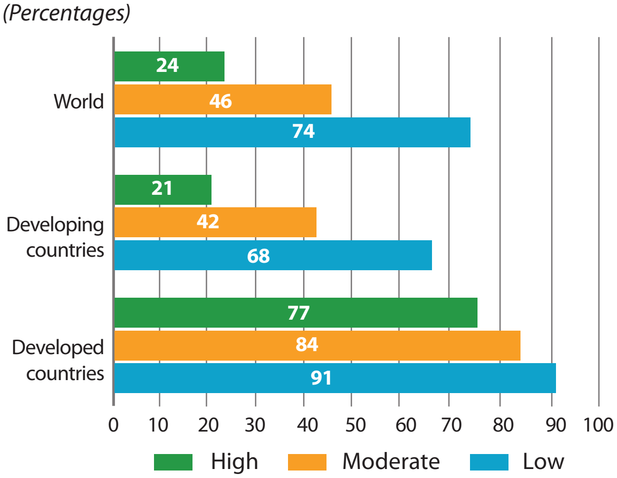
Source: ITU World Telecommunication/ICT Indicators database.
Note: *Data for 2021 are estimates.

2018. While gender parity in Internet use has been more or less achieved in developed countries and in small island developing States (SIDS), larger gaps, of over 10 percentage points, remain in some LDCs and LLDCs (figure III.G.3). Among geographic regions, the largest gaps are in Africa (11 percentage points) and in the Arab States (12 percentage points).[5]

Globally, women and girls are more likely to experience gender-based online harassment, which may further cement the digital divide. For instance, in a 2017 United States survey, women were about twice as likely as men to say they have been targeted because of their gender. In the same year, a study in Pakistan found that 40 per cent of women had faced online harassment. Across countries, female politicians, journalists, human rights activists and women who are members of ethnic minorities and other vulnerable groups tend to be particularly targeted. Affected women often reduce their online presence and withdraw from debates and online discussions, which may result in reduced access to online services and the cementing of the digital divide.[6]

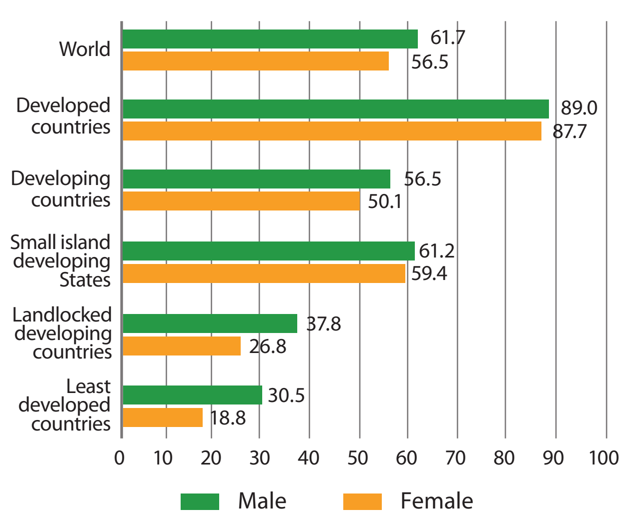
Closing the gender gap will require more affordable access and devices and targeted policies to support and protect women in the digital space. Policies to reduce the gender divide—and digital divides in general—include the promotion of affordable Internet access,

Figure III.G.2
Internet access, by vulnerability, 2019
(Percentages)



Source: Gallup.
Note: Percentage of people with access to the Internet based on economic vulnerability, as measured by times in the past year when people could/could not afford food or shelter and did/did not have help from friends or family.

Figure III.G.3
Percentage of female and male population using the Internet, 2020
(Percentages)



Source: ITU World Telecommunication/ICT Indicators database.

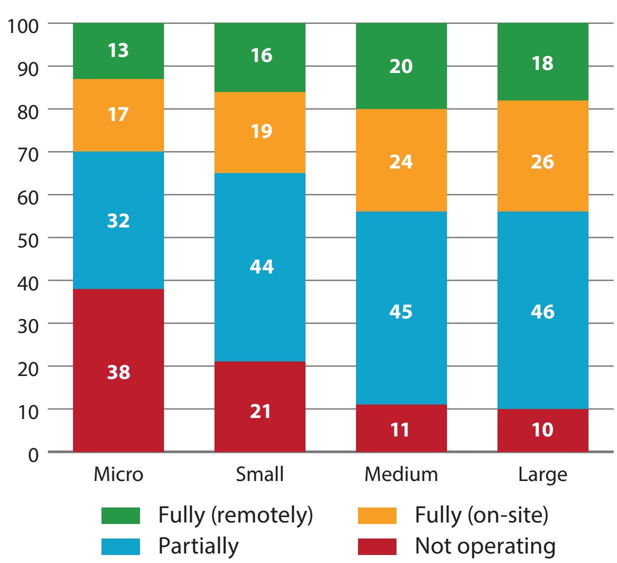
universal access to official identity systems and ownership of digital devices. Protecting the right to privacy, strengthening the responsible use of artificial intelligence (AI) and combating cybercrimes could also contribute to a safer digital space for all. More targeted policies can include the promotion of digital skills development among women and girls and support for their increased participation in technology development and content creation.

Digitally enabled new forms of work and doing business benefited some but excluded many others

Teleworking allowed more people to work from home during lockdowns but exacerbated inequalities between and within countries. During the second quarter of 2020, around 17 per cent of the global workforce worked from home, compared to just 8 per cent in 2019.[7] The extent of the increase differed between countries, depending on their digital infrastructure and sectoral employment patterns, which are closely related to income levels. According to estimates, around 27 per cent of the workforce could, on average, work from home on a permanent basis in high-income countries, compared to 17 per cent in MICs and 13 per cent in LICs. Within countries, smaller businesses were generally less prepared to transition to teleworking arrangements than larger companies (figure III.G.4). At the individual level, higher-skilled, and therefore higher-paid, workers are more likely to have jobs that can be carried out from home and to have the necessary digital skills.[8]

The medium-term outlook depends on countries' preparedness, and the balance of benefits and challenges for employers and workers. While telework has the potential to increase productivity and improve work-life balance through reduced commutes and more flexible working hours, the change in intra-company communication styles could also have negative impacts on creativity and innovation. An increase in telework by women during the pandemic has been linked to an increased burden of unpaid care work (including home schooling). More broadly, increased teleworking also has the potential to shift the territorial distribution of economic activity, affecting the demand for housing and other services. Based on surveys in several high-income countries, some hybrid arrangements are expected in the medium term. For example, the share of remote work in the United States could remain at around 20 per cent after the pandemic. In the United Kingdom, over 60 per cent of surveyed employers planned to introduce or expand hybrid working. In Japan, over 50 per cent of teleworkers reportedly want to continue to telework at least part time.[9]

Figure III.G.4
Operational status of enterprises during the COVID-19 crisis, by size, 2020
(Percentages)



Source: ILO.
Note: Based on an ILO survey carried out during the second quarter of 2020 with over 4,500 enterprises in 45 countries. Respondents were asked whether, and how, their enterprise was currently operating.

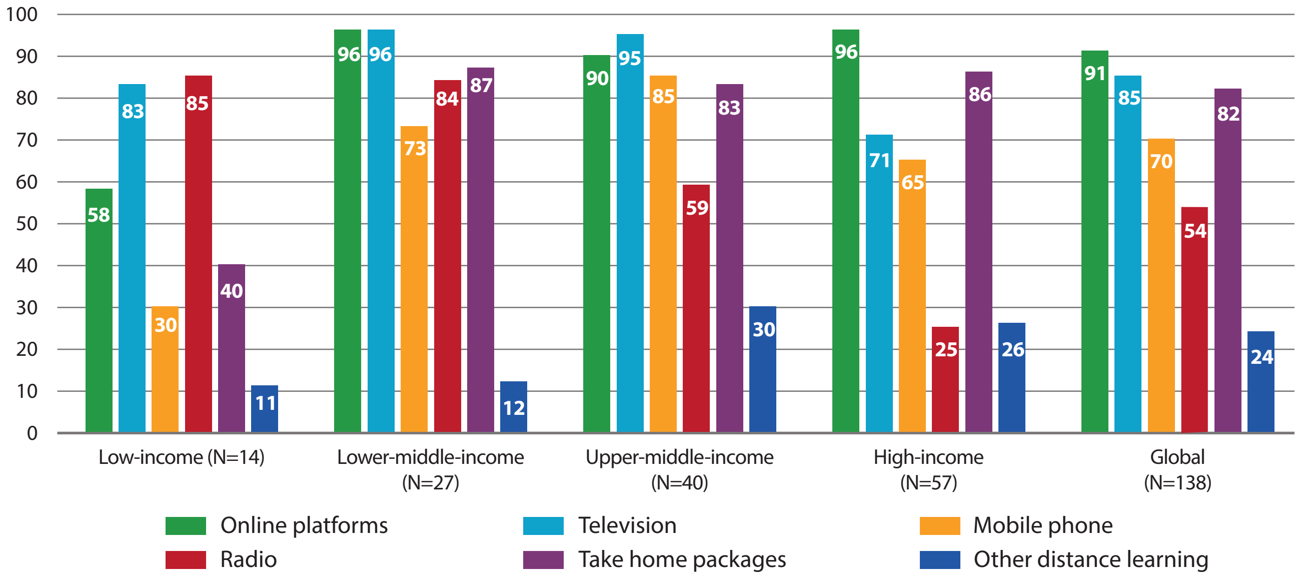
Experiments with e-learning showed mixed results

COVID-19 has disrupted education worldwide, and vast differences in remote learning opportunities have further exacerbated inequalities. At the peak of the crisis, school closures affected over 1.6 billion students in 188 countries. While schools reopened quickly in some countries, they remained fully or partially closed in many others, leading to an estimated global learning loss of 0.9 learning-adjusted years of schooling. Almost all countries implemented remote learning programmes during school closures, with a majority relying on online learning platforms (91 per cent), educational television programmes and take-home packages, with large differences across income groups (figure III.G.5). Yet, in many countries, remote education has not effectively mitigated learning losses, and children from lower-income households and/or in poorer countries have been more likely to fall behind.[10]

Online learning platforms are gaining more attention, but many students have been left behind. While online education helped to somewhat mitigate the academic and social impacts of school closures during the pandemic in most developed countries, it also exacerbated existing inequalities. More than 700 million students worldwide do not have Internet access at home, around 800 million do not have a household computer and 56 million students live in areas not covered by mobile service.[11] As a result, 850 million children and young adults — half of those enrolled in schools, colleges and universities worldwide — were not in education or training at some point during 2020 and 2021.

To make online education more inclusive, public educational institutions must ensure that more learners can benefit from new technologies. While there should be an emphasis on keeping schools open where possible, access to and the quality of remote learning tools need to be improved. This can be done through prioritizing access to broadband Internet, smartphones and laptops, and by including all students in remote learning strategies. Some Governments have reported progress in these areas, for example, by providing specific support to those with disabilities (56 per cent), designing learning materials in minority languages (21 per cent) and making a special effort to ensure that remote and online learning becomes more accessible to migrant and displaced children (16 per cent).[12] In addition, teachers need specialized digital skills training and technical support to effectively implement—and evaluate the impact of—remote and online learning.[13]

Figure III.G.5
Share of survey respondent countries offering a remote learning modality across at least one education level, by income group
(Percentages)



Source: UNESCO, UNICEF and World Bank.
Note: Percentage of respondent countries in a particular income group that reported using a particular modality for at least one of the education levels (pre-primary, primary, lower secondary, and upper secondary).

2.2 Digital financial services and financial inclusion

Financial technology (fintech) has supported strong growth in financial inclusion in recent years. Digital financial innovations have reduced market frictions and lowered transaction costs, making it profitable to provide financial services to previously excluded or underserved individuals and micro-, small and medium-sized enterprises (MSMEs). Fintech services, and particularly mobile money services, have contributed to a rapid increase in account ownership, including by women. This trend was accelerated by the COVID-19 pandemic, as digital financial services provided a lifeline to many individuals and businesses. Governments also used digital financial services to deploy broad-based government-to-person transfers.[14]

New types of digital payments, such as instant payments and e-money, continued to grow rapidly during the COVID-19 pandemic. According to a recent report on the global payments industry, overall non-cash payments increased by 7.8 per cent in 2020. While this was less than the annual compound growth rate of 14.3 from 2016 to 2019, the share of "new payments" (instant payments and e-money payments) continued to rise, to the detriment of traditional non-cash payment methods such as checks, direct debits, credit transfers and cards.[15] Similarly, registered mobile money accounts worldwide increased by 13 per cent in 2020, to 1.2 billion, with a 22 per cent increase in the value of transactions, to $767 billion.[16]

Fintech lending continued to outgrow traditional lending in 2020, but the share of non-performing assets of non-bank fintech companies outside the regulatory umbrella rose. Lending by fintech banks (that is, regulated online banks) and non-banks (such as consumer lending platforms) increased by 21 per cent and 8 per cent, respectively, in 2020, following steady growth of 60 per cent and 125 per cent, between 2013 and 2019. In comparison, lending by traditional banks increased by a more modest 16 per cent in 2020 and lending by traditional non-banks (such as credit card issuers and sales finance companies) grew by 2 per cent. While the share of non-performing assets of both fintech and traditional regulated banks remained relatively constant, at around 0.5 per cent to 0.7 per cent, non-performing assets of fintech non-banks rose to almost 8 per cent in the first half of 2020, almost four times that of traditional non-banks. This suggests that a further increase in non-bank fintech lending could become a greater risk to financial stability in future downturns and highlights the importance of regulation for all fintech companies involved in lending.[17]

Investment in fintech recovered in 2021, driven by strong increases in venture capital (VC) and private equity (PE) investments. Global fintech investment totalled $210.1 billion in 2021, marking a strong recovery after the sharp decline in 2020 but remaining below the record of $213.8 billion in 2019 (figure III.G.6). Investments began to rebound in the fourth quarter of 2020 and remained above average throughout 2021. The main drivers were VC and, to some extent, PE investments, while mergers and acquisitions (M&A) grew more slowly. Investments picked up in all major regions, but especially in the combined Europe, Western Asia and Africa region, where they reached a new record high after the significant drop in 2020—owing to a sharp increase in VC investments and a strong recovery in M&A. Fintech investment in Asia and the Pacific nearly doubled from 2020, while growing by a more moderate 26 per cent in the Americas. Investments in the cryptoassets and blockchain space recorded the fastest growth, increasing almost six-fold to $30.2 billion in 2021. Investments in cybersecurity almost doubled amid growing concerns about cyber threats (see chapter III.F).

Government support, regulatory responses and initiatives by digital financial service providers helped some MSMEs to navigate the challenges of the COVID-19 crisis. Governments in both developed and developing countries have taken measures to provide financial support to MSMEs (see chapter III.B). In several countries, this included support for greater digitalization of MSMEs, such as the implementation of digital payment and financing systems.[18] Policies in support of mobile payments, such as transaction fee waivers, increased transaction limits and the flexibilization of Know Your Customer and on-boarding requirements (figure III.G.7), also benefited many MSMEs—although in some cases, these measures affected the revenues of mobile money providers. Many traditional financial intermediaries also strengthened their digital service channels to better support MSMEs remotely. Fintech and big tech companies stepped up their services too, including by participating in government relief schemes and launching new digital payment mechanisms.[19]

Strengthening digital financial inclusion

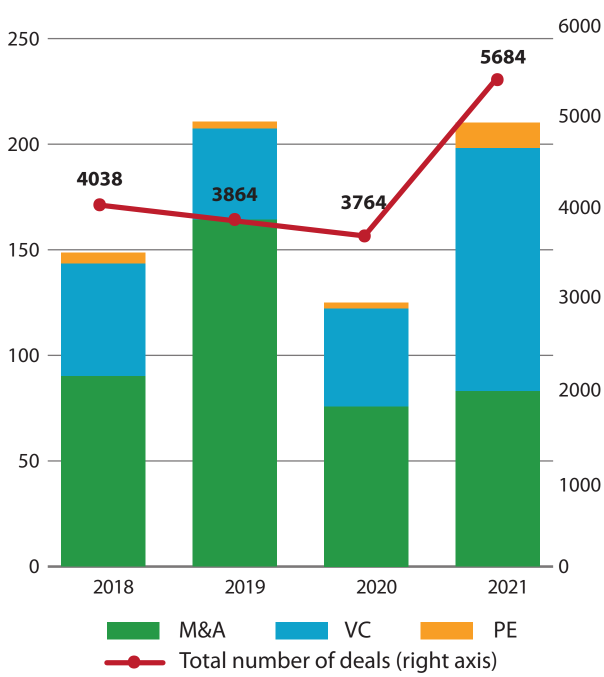
Despite improvements in women's Internet use and targeted policies for women's financial inclusion, the gender gap in financial access remains high. Deposits by women and loans to women remained broadly stable during 2020.[20] Nonetheless, women in low- and middle-income countries are still 33 per cent less likely than men to own mobile money accounts (although gender-disaggregated data is not always available and reliable). To increase the share of women account holders, several operators have taken targeted measures, such as recruiting female agents, developing products tailored to women's needs and redesigning mobile apps.[21]

The expansion of digital financial services during the COVID-19 crisis has provided an opportunity to reach vulnerable populations, but has also created growing risks that policymakers need to address—including new forms of exclusion, cyber incidents and digital fraud. Authorities should work with all relevant stakeholders to enhance the digital financial skills of vulnerable groups, including the poor, women, rural dwellers and MSMEs. They should strengthen consumer protection requirements—including by addressing new forms of exclusion, e.g., through biases in AI decision-making—and hold financial service providers accountable for safeguarding their customers' financial information and personal data, and protecting their systems against possible outages.[22] Together with financial service providers, experts and community representatives, authorities can develop and implement strategies to support the overall financial health of the most vulnerable and underserved populations and help them to detect and avoid digital fraud. Such strategies can build on the G20 Menu of Policy Options for Digital Financial Literacy and Financial Consumer and MSME Protection, which include crisis support for vulnerable individuals and MSMEs; enhanced customer protection and financial education; awareness-raising about fraud; and strengthening redress mechanisms.[23]

2.3 Fostering a just and inclusive digital transition

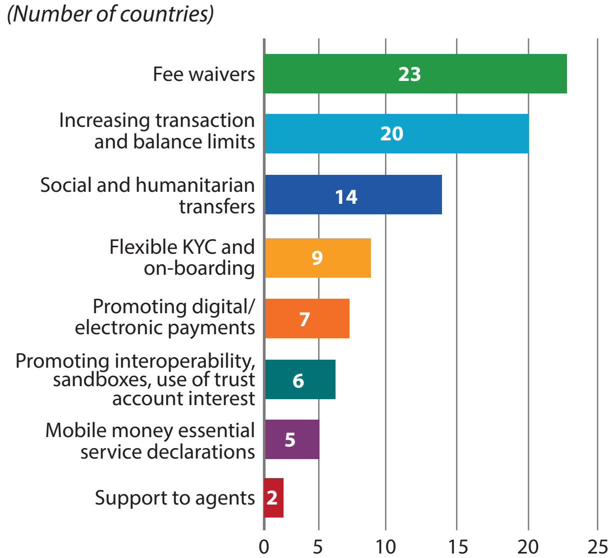
Overcoming divides and ensuring universal and inclusive participation in the digital economy will require significant additional investment and enabling policies and regulations. Global investments of around $428 billion will be needed between 2020

Figure III.G.6
Global fintech investment activity, 2018–2021
(Billions of United States dollars)



Source: KPMG. 2021. "The Pulse of Fintech".
Note: Mergers and Acquisitions (M&A), Venture Capital (VC), and Private Equity (PE).

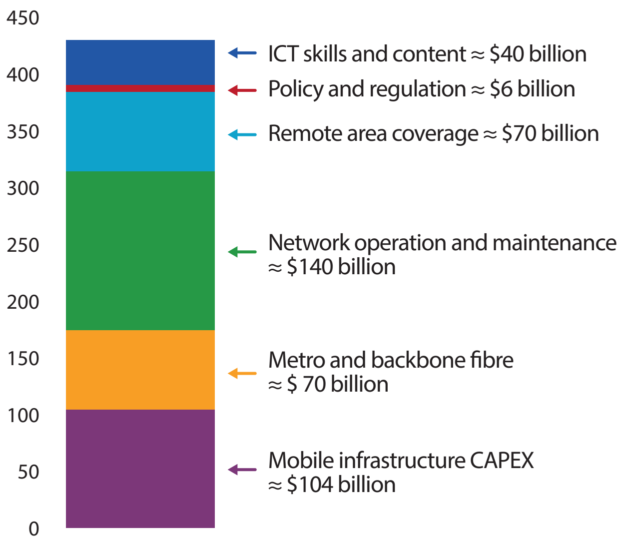
Figure III.G.7
Mobile money policy response
(Number of countries)



Source: GSMA. 2021. State of the Industry Report on Mobile Money.
Note: Based on data from 32 countries in sub-Saharan Africa (17), East Asia and the Pacific (7), South Asia (4), Middle East and North Africa (3), and Latin America and the Caribbean (1). A country may have introduced one or several of these policies.

and 2030 to connect the over 3 billion people who are currently unconnected to the Internet. This includes around US$40 billion for information and communication technology (ICT) skills and content, with the rest primarily for infrastructure development and operations (figure III.G.8).

Figure III.G.8
Connecting humanity to broadband – investment requirements by category, 2020–2030
(Billions of United States dollars)



Source: ITU.

ICT infrastructure has relied on private-sector funding, traditionally from network operators and tower companies, although the expansion of the digital economy has extended the pool of possible contributors. Digital platforms, data centre providers and digital content providers benefit directly from the digital economy. Therefore, they could be encouraged to co-fund network upgrades and expanded coverage. Funds from other sources—including public finance, multilateral, regional and national development banks and private philanthropic investors—can play an important role in supporting infrastructure for remote areas and underserved populations. Direct levies on service providers can also help to finance universal service and access funds (see below).[24]

Further support for the demand side—to foster the broader adoption and use of broadband Internet—can come from both private and public sources. Private companies and individuals will be the main drivers of content and applications or "use cases"—such as data analytics, AI applications or media content—that make the use of broadband Internet attractive. The public sector can also support demand (e.g., by providing digital public services), and policymakers can support local innovation and content creation, for instance, through incubators and innovation hubs. Public support will also be needed to strengthen digital skills and could help to facilitate a stronger participation of MSMEs in the digital economy (box III.G.1 showcases select digital skills programmes).

Box III.G.1
Promoting digital skills in South-East Asia

To support an inclusive digital transition of their economies and societies, several countries in South-East Asia have implemented a range of policy measures to enhance the digital literacy of their citizens and digital skills of their workforce. For example:

Indonesia has prioritized digital skills and literacy as a key agenda for the country's G20 Presidency in 2022. At the national level, the Government is implementing a National Movement for Digital Cyber-Skills Literacy programme that aims to instil basic digital skills in 12.5 million participants, and a Digital Talent Scholarship programme for mid-level digital skills (100,000 participants) and advanced digital skills (300 participants).[a]

In ***Thailand***, the Ministry of Labour launched the Digital Skill Development Academy in early 2021. The Academy oversees digital skills development for the workforce and provides digital skills training programmes and courses for youth.[b]

Cambodia is aiming to overcome low digital literacy levels that have prevented women micro-entrepreneurs from accessing finance and growing and scaling their business. The United Nations Economic and Social Commission for Asia and the Pacific (UN/ESCAP), United Nations Capital Development Fund (UNCDF) and SHE Investments recently launched the KOTRA-Riel bookkeeping app that creates a simple, user-friendly experience to support Cambodian micro-entrepreneurs plan, manage cash flows and access formal financial services.[c]

Source: UN/ESCAP.

a Hani, Aineena. 2021. "Indonesia Strengthens Digital Literacy to Improve Digital Economy." September 15, 2021. https://opengovasia.com/indonesia-strengthens-digital-literacy-to-improve-digital-economy/.
b Bangkok Post. 2021. "MOL Launches DISDA to Enhance Digital Workforce." February 22, 2021.
c UN ESCAP. 2021. "United Nations and SHE Investments launch a mobile bookkeeping app for women entrepreneurs." February 12, 2021.

Updated universal service and access funds (USAFs) could help to pool funds and provide expertise to achieve universal and inclusive broadband coverage and use. Since the early 2000s, USAFs have been adopted by over 100 countries to promote universal access to telecommunication services. The main funding source of most USAFs are mandatory contributions from telecommunications service providers, which are sometimes complemented with public funds. These resources are typically used to incentivize private-sector investments in areas that would otherwise not be commercially viable. The past performance of USAFs has been mixed, with some funds achieving coverage goals and operating in a transparent and accountable manner, while others have been criticized for a lack of transparency and the underutilization of funds. To address shortcomings and harness USAFs for the transition to universal broadband coverage, they should be reviewed to determine what updates are necessary and feasible (while some may have to be discontinued). Updates can include the following:

- Include a broader range of contributors (e.g., only 7 per cent of funds currently require Internet service providers to contribute);

- Pool resources and use public funds (e.g., from development banks) to leverage additional resources when necessary;
- Impose developmental conditions on funding, such as infrastructure sharing, universal access, digital inclusion and the prioritization of local development needs; and
- Implement good governance principles, such as accountability and transparency, and avoid over-collecting/underspending of resources (addressing problems with some first-generation USAFs).[25]

Enabling policies and regulatory frameworks

Policymakers and regulators can establish supportive frameworks and requirements for universal and inclusive broadband coverage, while enabling innovation. Universal-service obligations (USOs) have long been used to oblige network operators to extend telecommunications coverage to hard-to-reach and vulnerable populations. While they have become less common in recent years, they could play a role in the universal roll-out of 4G and 5G broadband, in return for access to high-demand spectrum, especially where operators hold significant market power. Other regulatory requirements could include open access regimes and infrastructure sharing, among others. Authorities can also establish non-financial incentives for private investment, such as streamlining of procedures and approval processes; access to local infrastructure mapping and geographic information; and electronic transaction, cybersecurity, copyright and privacy frameworks. Regulatory sandboxes can help to spur innovation by providing a safe space for companies to develop and test new concepts and products at limited scale.[26]

As digital services continue to expand, authorities should also review regulatory frameworks for data governance to protect users and ensure a level playing field. The cross-border nature of data flows calls for greater global coordination. Global digital platforms—most of which are located in a small number of countries—are currently in a privileged position to collect and process data at large scale (including from cross-border data flows), while many developing countries risk being locked into a position of raw data providers. This has raised concerns about data security, ownership and the accrual of value, creating a strong rationale for a global data governance framework. Such a framework should seek to enable gains from data flows to be equitably distributed within and between countries, while addressing emerging risks and concerns. Policymakers also need to ensure the full realization of the social value of data for the whole economy, beyond the accrual of private value to the platforms who collect and control the data.[27]

Continued work towards a global digital governance framework should complement national and regional efforts. Regulatory efforts are progressing at different speeds across jurisdictions. For example, the European Union is expected to advance legislation on digital competition and content moderation in the course of 2022 (the Digital Markets Act aims to limit the market power of large “gate-keeper” platforms, while the Digital Services Act sets out accountability and transparency standards for online content and the functioning of algorithms). While such regulations have the potential to become legislative benchmarks, global standards should be flexible to allow countries with different levels of readiness and capacities to benefit from the digital economy. As proposed by the Secretary-General in his report on Our Common Agenda, a public-private Global Digital Compact could address questions of universal connectivity; data governance; accountability criteria for content and regarding discrimination; and the protection of human rights.[28]

Progress in the digital transition is closely linked with the need for a sustainable energy transition. Digital technologies can enhance resource and energy efficiency, although the growing use of digital devices and services could also cause net increases in energy use if not carefully managed.[29] For instance, there are growing concerns about the energy intensity of some types of distributed ledger technology that underpin digital assets such as Bitcoin (see chapter III.F).

3. STI for a sustainable energy transition towards net-zero GHG emissions

Recent technological and political trends hold promise for accelerating the global sustainable energy transition. While the challenge to achieve a sustainable energy transition towards net-zero GHG emissions remains enormous, especially in terms of globally coordinated investments, increasing political will and very promising recent technological developments show a way forward. This includes progress in digital consumer technologies that can help to accelerate the energy transition by “doing more with less”.

3.1 Increasing consensus on the extraordinary challenges and opportunities ahead

The global sustainable energy transition is essential for sustainable development progress in all other areas. Since the Brundtland report in 1987,[30] a series of United Nations reports have pointed out that the energy transition is one of the most important sustainability transitions for achieving sustainable development, as it will be essential for all other sustainability transitions. This includes a comprehensive transformation of the entire energy system—from extraction of primary energy to end-use and energy services, such as heating, cooling and mobility—that requires complementary actions beyond the energy sector, in transport, housing, industry and agriculture, and digitalization.[31]

For several decades, Governments have pursued various policy mixes to build a sustainable energy system to support economic, social and environmental goals, including the SDGs. At the global level, a sustainable energy system should be more integrated, highly efficient, affordable, reliable and cleaner, with rapidly increasing modern renewables capacities and other low-carbon options. While the specific characteristics of such a system at the local or national level depend greatly on local conditions, one common factor is the quest for higher energy densities,[32] especially in places with high population densities.

However, the share of fossil fuels in the global energy system has barely changed since 1995, requiring an ever faster global energy transition to achieve climate goals. Despite global agreement on climate goals—particularly SDG 13 and the Paris Agreement target of limiting global warming to 1.5°C above pre-industrial levels—fossil fuels accounted for just below 85 per cent of global primary energy consumption in 2020, compared to 86 per cent in 1995.[33] Driven by growing global energy demand, GHG emissions increased rapidly until 2010, and thereafter at slower rates, reaching an all-time high of 52.5 Gt carbon dioxide equivalent (CO_2-eq) by 2020 (figure III.G.9). While the impact of the COVID-19 pandemic reduced CO_2 emissions from fossil fuels by an estimated 5.8 per cent in 2020, emissions are estimated to have reached new record levels by the end of 2021.[34] To achieve temperature goals of either 1.5°C or 2°C, global GHG emissions would need to be cut by half by 2030 and reduced to net zero by 2050. To achieve the 1.5°C target, GHG emissions would need to be reduced by 7.6 per cent per year until 2030.[35] The technical feasibility of such a rapid energy transition has been demonstrated in a multitude of studies, but time is running out, and the challenge grows with every year without decisive action.

Governments have significantly increased their ambitions for clean energy transitions since 2016. Under the Paris Agreement, Governments specify planned GHG mitigation actions, most of which are centred on the energy sector. Figure III.G.9 shows the resulting global GHG emissions under the assumption that all plans and commitments are fully implemented until 2030. The fan lines depict progressively increased ambitions for GHG reductions: as of April 2016, commitments would have implied continued emissions increases, whereas by October 2021 (around the time of the United Nations Climate Change Conference (COP26)), for the first time ever, government plans envisaged a peaking of emissions by 2025. Yet, much more ambitious action will be needed to meet the 1.5°C target.

Fiscal support for a "green" recovery from COVID-19

Fiscal stimulus packages related to COVID-19 were more focused on a sustainable recovery in 2021. Recent data on public spending policies in the world's 50 largest economies shows that of a total of $18.2 trillion committed to address the COVID-19 crisis by the end of 2021, only $3.1 trillion was directed to longer-term recovery measures. Of that amount, 31 per cent ($970 billion) was for "green" or environmentally compatible spending (table III.G.1). On the one hand, this means that only 5 per cent of the total stimulus has been committed for green recovery packages, raising concerns that public investments may lock in a "business-as-usual" pathway. On the other hand, the share of "green" funding in recovery measures greatly increased from 18 per cent in 2020 to 51 per cent in 2021, as new initiatives with longer lead times were incorporated into public budgets.[36]

Table III.G.1
Fiscal stimulus packages in response to the COVID-19 pandemic in 2020 and 2021, worldwide
(Billions of United States dollars)

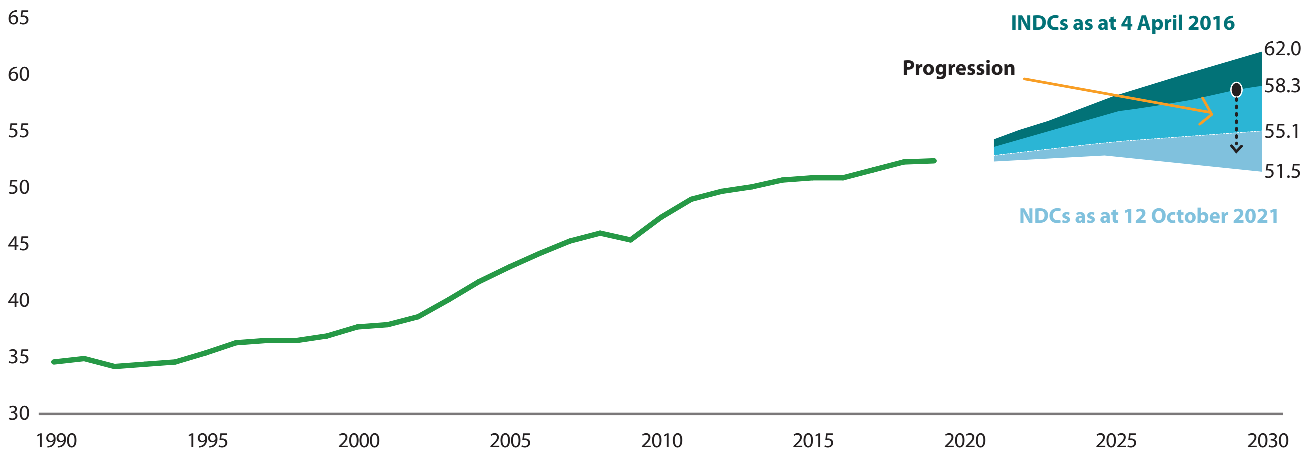
	Rescue efforts	*Recovery measures*		*Total*
		Green	*Not green*	
2020	11,100	341	1,553	14,594
2021	3,931	629	606	5,166
Both years total	15,031	970	2,159	18,160

Source: Global Recovery Observatory (UNEP and University of Oxford).

Green recovery spending was concentrated in a few countries, with a focus on sustainable energy. Countries that committed at least 1 per cent of GDP and spent at least 30 per cent of recovery funding in an environmentally compatible manner include primarily European countries, as well as Canada and the Dominican Republic.[37] In 2020, most green recovery spending was committed to new electric and hydrogen-fuelled transport and infrastructures, public transport, low-carbon energy supply and infrastructure, energy-efficient building upgrades, and green research and development for decarbonizing aviation, plastics, agriculture and carbon sequestration (figure III.G.10).

The large-scale financial stimulus packages show the feasibility of closing the remaining gap on the unfulfilled promise of $100 billion per year in climate finance for developing countries. The stimulus packages in the sample in 2020 accounted for 23 per cent of the

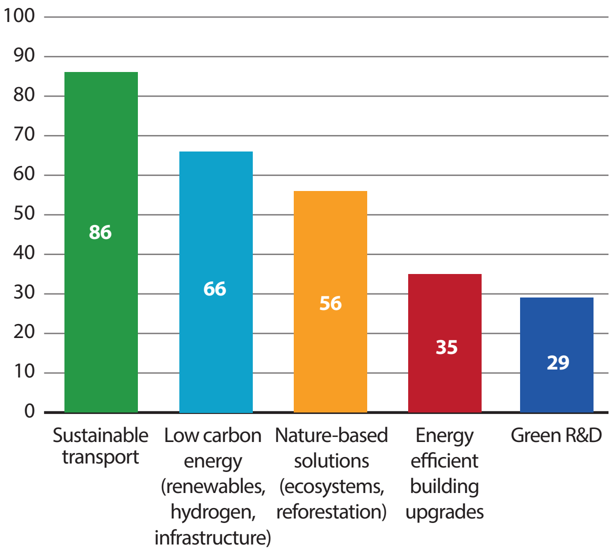
Figure III.G.9
Global GHG emissions, 1990–2020 and projected until 2030
(Gt CO_2 equivalent)



Source: UNFCCC.
Note: Projections assume full implementation of all the Nationally Determined Contributions (NDCs) to which Governments have committed under the Paris Agreement.

GDP of advanced economies and 11 per cent of the GDP of emerging market and developing countries. This shows the possibility of raising trillions of dollars on short notice, provided there is political will.

Figure III.G.10
Green recovery spending in response to COVID-19, 2020
(Billions of United States dollars)



Source: Global Recovery Observatory (UNEP and University of Oxford).
Note: An additional $68 billion of green investments fall into a range of categories that are not shown, including conditional liquidity support, electronic appliance incentives, green worker retraining and job creation, green market creation and unspecified.

Total investment in the sustainable energy transition keeps growing

In 2021, the public and private sector together invested an estimated US$755 billion in the global energy transition. Most of it, around $360 billion, was invested in modern renewable energy—a level that has stayed roughly constant since 2015 after rapid increases in the previous ten years. Falling costs, however, imply continued growth in annual installed capacities of renewables (see below). More than half of the modern renewable investments were in solar photovoltaic (PV) energy. From 2016, most of the increase has been in electrified transport and electrified heat, with smaller investments in nuclear energy and, most recently, sustainable materials. Much less was invested in energy storage, carbon capture and storage (CCS) and hydrogen (figure III.G.11).[38]

Private-sector interest in the sustainable energy transition is also reflected in the market capitalizations of various technology companies. For example, the market capitalization of electric vehicle specialists increased more than five-fold from January 2020 to January 2021, when their value reached that of all traditional automakers combined.

3.2 New opportunities from recent energy technology and systems innovations

Recent energy technology and systems innovations have opened up new opportunities. A peak in GHG emissions by mid-decade, as envisioned by political commitments, is technologically feasible. Technological change and innovations have reached critical levels, especially in modern renewables (e.g., solar PV energy), electric and hydrogen-fuelled transportation and digital consumer innovations.

Solar photovoltaic cells

A third generation of solar PV cells is emerging that can overcome the efficiency limit of conventional single bandgap solar cells.[39] Current solar PV is already the modern renewable option with by far the highest power density[40] and the only currently available renewable option that could in principle fully support our modern, highly energy-intensive civilization. While their power densities would still be 10 to 100 times less than fossil fuels, they represent a feasible option at global scale, with multiple environmental advantages beyond GHG emissions. Greater efforts in research and development and knowledge exchange could facilitate a larger-scale deployment of higher-efficiency solar PV technology in developing countries as a fundamental ingredient of a menu of energy sources for a stable and reliable electricity supply.

Production costs of conventional solar PV have fallen rapidly. Levelized costs declined from an average of 38 cents per kWh in 2010 to less than 6 cents in 2020. This is also reflected in auction prices which are a mere 4 cents per kWh, making solar PV increasingly cost-competitive, especially when combined with the emerging managed-charging systems for electric vehicles (see below). The cost reduction for solar PV has been much faster than for any other modern renewable. For example, the cost of onshore wind power—previously the most competitive modern renewable option—only halved from 8 cents to 4 cents per kWh over the same time frame, and auction prices for 2022 are higher than for commercial solar PV parks. As of 2020, solar PV and onshore wind power achieved levelized costs of less than half that of concentrated solar power and offshore wind power (figure III.G.12).

Electrified transport

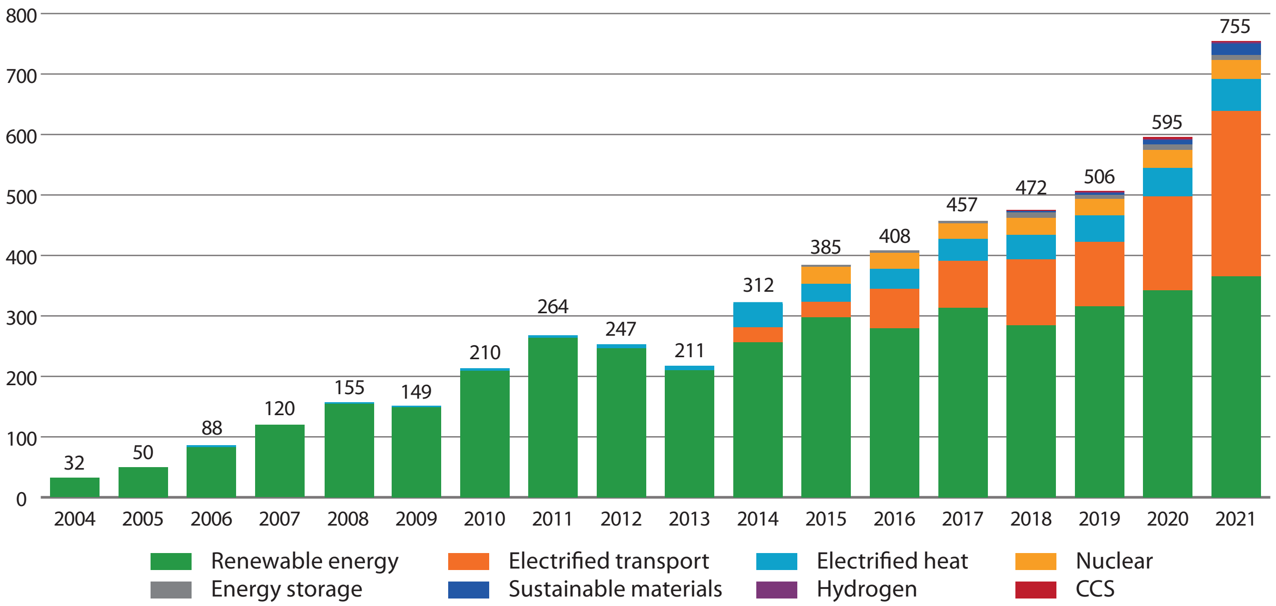
While a sizeable share of rail transport has benefited from electrification for many decades, recent technological progress has enabled increasing electrification of passenger road vehicles. State-of-the-art batteries in fully battery-driven passenger vehicles reached 40 to 100 kWh at the beginning of 2021,[41] making them a viable option for a wide range of applications. Meanwhile, the cost of lithium-ion batteries has decreased from US$10,000 per kWh at the time of their commercial market entry in 1991 to around US$200 per kWh today.[42] Yet, while today's leading lithium-ion batteries have much higher power densities than just a few years ago, they remain rather heavy and bulky (easily increasing the weight of a car by half), which continues to limit the environmental benefits of electric vehicles.

Managed electric charging systems—in which the system rather than the user decides when a vehicle is charged or used as a power source for the grid—hold great promise to balance the grid, solve the intermittency issue of solar and wind power and improve grid stability. Installed capacity of automobiles is very large compared to power plants—for example, in the United States in 2000, it was almost ten times as large. Digital technologies are key in building smart charging infrastructures (see below). Without making full use of such digital opportunities, the introduction of fully electric vehicle fleets would require a significant expansion of electricity generation capacities.

Figure III.G.11

Global energy transition investments, 2004–2021

(Billions of United States dollars)

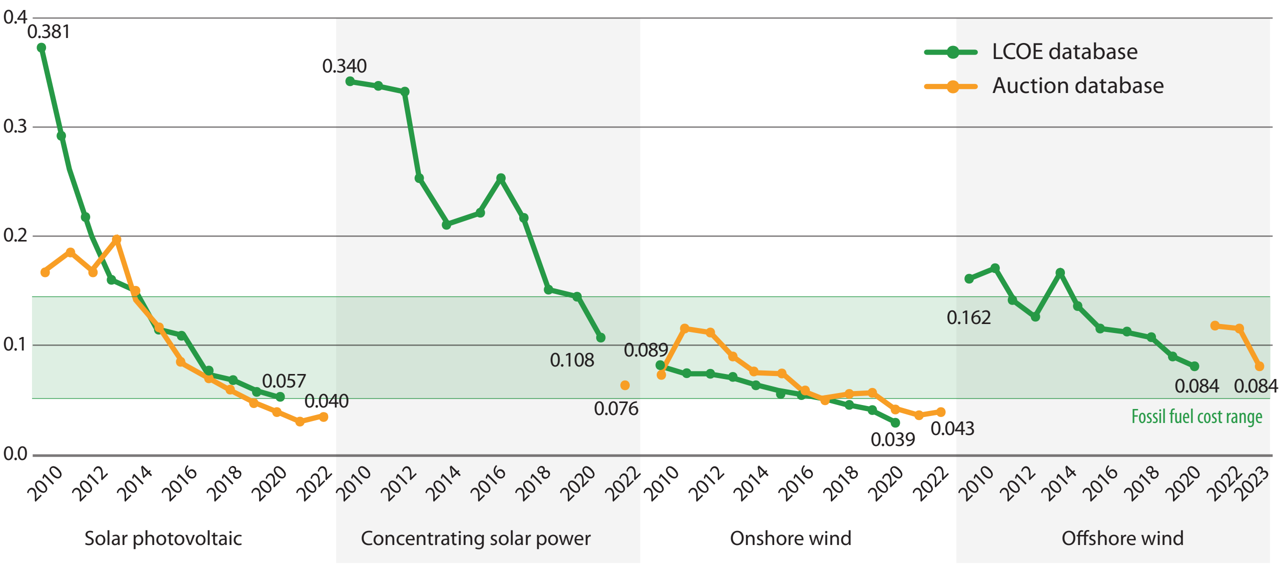


Source: BloombergNEF.
Note: Start-years differ by sector but all sectors are present from 2019 onwards.

Figure III.G.12

Global weighted average levelized cost of electricity and auction prices for solar photovoltaic, onshore wind, offshore wind, and concentrating solar power, 2010–2023

(2020 United States dollars/kWh)



Source: IRENA Renewable Cost Database.
Note: The thick lines are the global weighted average levelized cost of electricity (LCOE, derived from the individual plants commissioned in each year) or auction values, by year. The project-level LCOE is calculated with a real weighted average cost of capital of 7.5 per cent for OECD countries and China in 2010, declining to 5 per cent in 2020; and 10 per cent in 2010 for the rest of the world, declining to 7.5 per cent in 2020. The band that crosses the entire chart represents the cost range of fossil fuel-fired power generation.

Hydrogen

Hydrogen produced from low carbon and renewable sources has become an energy storage option that could replace fossil fuels in most areas. Several countries have launched programmes to investigate how to harness hydrogen production from renewable sources for storing the energy captured from intermittent new renewable sources such as wind power and solar PV.

Hydrogen has power densities that are six times higher than those of even the best lithium-ion batteries, which makes it a better option for long-range transport and heavier vehicles, such as trucks, ships and airplanes.[43] The GHG performance of battery-operated vehicles quickly worsens for longer ranges, compared to fuel cell vehicles running on hydrogen. Fuel cell vehicles weigh much less, cost less, require less "well-to-wheels" energy and take less time to refuel. This makes hydrogen fuel cells the only viable option for achieving very aggressive emissions reduction targets in transport (e.g., beyond 80 per cent below 1990 levels by 2070 in the case of the United States) without fundamental changes in behaviour. However, there remain challenges regarding the handling, storage and safety of hydrogen, leading many Governments to support infrastructure for both electric vehicles and hydrogen fuel cell vehicles. The European Green Deal is a case in point.[44]

The industrial sector is among the most difficult to decarbonize, but hydrogen fuel offers a path forward. Spurred by new technologies, renewable hydrogen production is rapidly expanding for refining, steel, ammonia and chemicals production, mostly combined with on-site electrolysers to avoid the issues of hydrogen storage and transport. Following the adoption of the ambitious European Green Deal targets, many European countries are pursuing more rapid technological development and deployment of hydrogen technologies.[45]

Digital consumer technologies

Digital consumer technologies could greatly reduce primary energy demand, making the global sustainable energy transition easier to achieve. A range of disruptive digital consumer-facing innovations in buildings, mobility, food and energy distribution and use are readily available for local adaptation and deployment across the world. They entail novel application of knowledge that first emerges in market niches before spreading further, typically offering novel product or service attributes to consumers. Some of them appeal to low-end and price-sensitive users, whereas others appeal to high-end market and technophile users.

Estimates of potential energy and GHG savings vary, pointing to the importance of context, local adaptation and user behaviour; in some cases energy demand may increase. For example, digitally enabled home energy systems have led in some cases to energy savings of 91 per cent, while in some outliers they increased energy use by 9 per cent.[46] Consumer innovations that change how energy is supplied to, generated or managed by households can also help to reduce GHG emissions. For instance, third party service providers managing household energy use subject to performance contracts, has led to energy savings of 10-50 per cent in the United States. Fully autonomous vehicles, electric vehicles and e-bikes could lead to large reductions in GHG emissions as well, but they could also increase energy use due to changed behaviours.

3.3 Global cooperation and investment needs for the energy transition

To make use of these opportunities, the energy transition must be a global effort. Greatly enhanced levels of international cooperation in technology, finance, knowledge-sharing and concerted joint action are needed to achieve a global energy transition at the scale required to meet the 1.5°C target. Cooperation also makes economic sense, as mitigation costs in developing countries tend to be much lower than in developed countries. Yet, because of a myriad of other factors, incentives must also be geared to reduce emissions and provide affordable, reliable and clean energy services everywhere.

Some developed countries have achieved reductions in emissions by shifting energy-intensive manufacturing and production to emerging economies, underscoring the importance of global solutions. The global manufacturing share of developed countries fell from over 80 per cent in 1995 to around 50 per cent in 2019, and the vast majority of the world's ammonia, steel, cement and plastics production is now taking place in emerging and developing economies.[47] This has intensified discussions about CO_2 border tax adjustments which would align incentives towards emissions reduction but could potentially constrain the flow of technologies, skills and knowledge that are so essential for making global progress (see chapters III.A and III.D).

Developing economies, excluding China, have seen reductions in energy investments by 20 per cent since 2016 and a reduction in clean technology transfer.[48] While much of this is related to reduced spending on oil and gas supply, this trend also reflects challenges these countries face in mobilizing finance for capital-intensive, lower-carbon energy projects (worsened by the COVID-19 crisis). Without strengthened global cooperation and financial instruments, the world will not benefit from the much lower GHG mitigation costs in these countries.

Sustainable energy investments need to quadruple in developing countries (excluding China), with an increase in private financing. The International Energy Agency (IEA) estimates that annual investments of $600 billion would be needed in developing countries (excluding China) by 2030 to limit the rise in global temperatures to 1.65°C, and over $1 trillion to achieve net-zero GHG emissions by 2050 and limit the global temperature rise to 1.5°C. While public sources of finance are dominant in today's energy investments in these countries, the IEA also estimates that more than 70 per cent of new, sustainable energy investments, primarily renewables and efficiency, would need to be privately financed by the second half of this decade. This should be feasible, given the high average private returns on such investments. State-owned enterprises and development finance institutions can continue to play a role, especially for reaching remote and underserved communities. With renewables, the capital structure of investments is also expected to move towards more debt, with important implications for capacity building and skills requirements.[49]

"Doing more with less": digital consumer innovations for energy efficiency gains

Most of the newer energy transition scenarios rely on yet unproven technologies in the far future to achieve global climate goals. To achieve net-zero GHG emissions by 2050 without curbs on a continuously rising global energy demand, planners and scenario analysts alike have assumed that as yet unproven technological fixes, such as bioenergy with carbon capture and storage, will result in a large-scale decrease in emissions, especially 30 years from now. Even if those technologies were to be implemented at scale, they would likely create new logistical problems (e.g., for the safe storage of billions of tons of carbon dioxide every year) and concerns about food security related to the potentially large-scale use of land for bioenergy crops.

Digital consumer innovations provide a ready alternative to "do more with less" by increasing energy efficiency which would reduce overall investment requirements. A large-scale deployment of technological and behavioural action in areas with untapped potential (such as digital consumer innovations in mobility, food, buildings and energy services) could help to reduce global energy and resource needs despite rapid increases in living standards. This would make it possible to achieve the 1.5°C climate target through the deployment of renewable energy, without relying on as yet unproven negative emission technologies.[50]

Such a shift could reduce overall investment requirements for the sustainable energy transition but increase investments in energy end use. This would require the rapid electrification of energy end use, pervasive digitalization, innovation in granular technologies, together with a shift from ownership of material goods to accessing services, and would need to be supported by strengthened global cooperation on STI. As a result, investment requirements for fuel systems, power plants and networks would need to increase only slightly until 2030. Investments in energy end use and services and related business opportunities would need to initially quadruple, from $0.4 trillion to $1.6 trillion, but much of it would benefit consumers through lower electricity and fuel costs. This pathway would also have important co-benefits in the food and land use system. Compared with current trends, it could double the growth of rural incomes and create an additional 120 million decent jobs. Agricultural productivity could be increased by more than 1 per cent per year and food loss and waste reduced by a quarter.[51]

4. United Nations system actions on STI in the areas of the Addis Ababa Action Agenda

4.1 Actions by the United Nations system

The 2030 Agenda for Sustainable Development recognizes that the world will achieve the SDGs only by mustering the full power of STI. Governments and other decision makers everywhere must have access to the latest science and evidence, disaggregated data, and technology solutions, as well as to the resources needed to build capacity and foster innovation and to bring innovations to scale. In the Addis Ababa Action Agenda, Member States pledged their continued support for developing countries to strengthen their scientific, technological and innovative capacity and enhance international cooperation in these areas, including through official development assistance (ODA).

In the Addis Agenda and the 2030 Agenda, Member States mandated the creation of a Technology Facilitation Mechanism (TFM), to advance development cooperation on STI through multi-stakeholder collaboration and enhanced knowledge-sharing (see section 4.2). The multi-stakeholder TFM complements the United Nations Commission on Science and Technology for Development (CSTD), which has brought together Ministries of Science and Technology since 1992 to deliberate on key issues and share experiences and lessons learned on different policy approaches. Both Agendas also envisaged the establishment of the Technology Bank that would create synergies with the TFM.

The broader United Nations system is supporting Member States' STI capacity through ongoing analytical and capacity building work. This includes joint work by United Nations entities through the Cluster on Finance and Technology that is following up on policy options generated by the Financing for Development in the Era of COVID-19 and Beyond Initiative in 2020. The follow-up involves bringing together and further developing ongoing UN system work, including at the country level.[52] Four pilot countries (Jordan, Samoa, Senegal and Zambia) have been identified for joint action to support Governments and other actors in improving the alignment of finance, investment and technology to recover better from COVID-19 and accelerate the implementation of the SDGs.

Harnessing digital technologies

The Technology Bank continues to support LDCs' efforts to overcome the digital divide as part of its mandate to support their structural transformation and building of productive capacities.[53] In January 2021, the Technology Bank joined the Alliance for Affordable Internet[54] to support the Alliance's mandate to expand access to affordable and equitable Internet in all LDCs through technical assistance, advancing policy and regulatory reform and joint participation in research.

In 2021, the CSTD developed recommendations for the potential use of distributed ledger (blockchain) technology for sustainable development. At its twenty-fourth annual session, the CSTD discussed "Harnessing blockchain for sustainable development: prospects and challenges" as one of its two priority themes (see box III.G.2).

STI for health

Other United Nations entities are continuing to support Member States' capacity in STI, including to combat COVID-19. Despite growing global availability of COVID-19 vaccines, some countries are still struggling to ramp up administration of available supply. As vaccine supplies will continue to increase over the course of 2022, countries need to ensure preparedness, including through microplanning, expanded cold chain equipment, logistics, funding and trained staff. COVAX, the vaccine pillar of the WHO-led ACT-A, is assisting countries through its Country Readiness and Delivery workstream by providing guidance, catalytic financing, technical assistance and enhanced coordination and monitoring at the global, regional and country levels.

Beyond the efficient delivery of vaccine doses, a faster global roll-out will also require the sharing of know-how and intellectual property with developing countries, including through

technology transfer hubs. Under the umbrella of COVAX, WHO and its partners (including the Medicines Patent Pool) have set up a multilateral technology transfer initiative to support the sustainable, regional production of essential health biologicals, including vaccines. Through a network of technology transfer hubs and recipients, the initiative aims to: (i) establish or enhance sustainable biomanufacturing capacity in regions with no significant capacity; and (ii) build human capital for regulation and biomanufacturing in low- and middle-income countries (LMICs). The first hub has been launched in South Africa, aiming to enable the transfer of mRNA vaccine technology to LMIC manufacturers. The first recipients have been identified in South Africa, Brazil and Argentina.[55]

Box III.G.2
Harnessing blockchain for sustainable development

According to some estimates, the market for blockchain applications could grow from $708 million in 2017 to over $60 billion in 2024. Currently, the top use cases are cryptocurrencies and online payments and decentralized finance (see chapter III.F), as well as international trade value chains (including to trace sustainability criteria related to labour conditions and environmental impacts).

Participants at the 2021 session of the United Nations CSTD acknowledged the opportunities of blockchain technology for accelerating progress towards the SDGs, including in areas such as land titles, remittances, identity systems, climate change and financial inclusion. To harness these opportunities while overcoming challenges and constraints (e.g., cost per transaction, interoperability, privacy and confidentiality, and insufficient regulations and infrastructure) they agreed on a set of recommendations:

- Identify short- to medium-term opportunities for blockchain and encourage innovation and create opportunities for skills development through pilot projects to kickstart blockchain diffusion;
- Identify opportunities to share resources, skills and knowledge among various stakeholders to benefit the whole ecosystem;
- Connect various blockchain players to government authorities, for better coordination, guidance and security;
- Create a trusted legitimate body to make sure all agents work together towards widespread use of blockchain.

Source: UNCTAD, based on: United Nations, Report of the Secretary-General on harnessing blockchain for sustainable development: prospects and challenges (E/CN.16/2021/3). Available at https://unctad.org/system/files/official-document/ecn162021d3_en.pdf.

Technology transfer and capacity building can also increase resilience to future pandemics. Increased capacity for local vaccine production in developing countries through the COVAX initiative has the added benefit of strengthening resilience to future disease outbreaks and pandemic threats. A recent initiative by the International Atomic Energy Agency (IAEA) focuses on strengthening countries' outbreak detection and response capacities (see box III.G.3).

Box III.G.3
Zoonotic Disease Integrated Action initiative

The IAEA's Zoonotic Disease Integrated Action (ZODIAC) initiative is designed to help countries prevent future pandemics by strengthening the preparedness and capabilities of Member States to rapidly detect and respond to outbreaks.

Since ZODIAC's launch in June 2020, around 150 Member States have designated ZODIAC National Coordinators, and over 120 ZODIAC National Laboratories have become part of the initiative. To support capacity building, the IAEA has begun to procure equipment for the early detection of pathogens for some of the participating laboratories—initially 25 laboratories in Africa, Asia and the Pacific, Latin America and the Caribbean and Europe.

The IAEA has initiated several activities to support coordinated joint research and is making available training, know-how, expertise and technology packages to enhance pathogen surveillance and disease diagnostics, along with prevention and response actions. ZODIAC also provides access to scientific and diagnostic data that can support timely science- and results-based decision-making using radiation imaging technologies or radiomics.

Source: IAEA.

4.2 The Technology Facilitation Mechanism

The TFM has facilitated collaboration and partnerships on STI for sustainable development through four components: (i) the United Nations interagency task team on STI for the SDGs (IATT); (ii) the United Nations 10-Member-Group of High-level Representatives of Civil Society, Private Sector and Scientific Community to support the TFM (10-Member-Group); (iii) an online platform for the TFM—"2030 Connect"; and (iv) an annual Multi-stakeholder Forum on STI for the Sustainable Development Goals (STI Forum), which also provides formal inputs to the High-level Political Forum on Sustainable Development (HLPF) (see box III.G.4). Two main workstreams of the IATT, "STI for SDGs roadmaps" and "analytical work on emerging science and technologies for the SDGs" are featured below.

STI for SDGs roadmaps

STI4SDGs roadmaps can be applied at the national level to accelerate the adoption and use of STI for sustainable development. Based on multi-stakeholder engagement, the roadmaps provide a framework to envision, plan, communicate and facilitate actions, track progress and foster a learning environment to harness STI to achieve the SDGs. The COVID-19 pandemic has increased the demand for further deployment of STI4SDGs roadmaps, to accelerate efforts to close the digital divide and support the digital inclusion of disadvantaged groups.[56]

The IATT, together with non-United Nations partners and stakeholders from pilot countries, has developed guidance material and is providing capacity building for countries interested in

designing their own STI4SDGs roadmaps. In 2021, the IATT and partners published a *Guidebook for the preparation of Science, Technology and Innovation Roadmaps for the SDGs*,[57] accompanied by an operational note with practical guidance for Governments in pilot countries.[58] The first online course was prepared by the beginning of 2022 and several more are planned in the near future.

Emerging science and technologies for the SDGs

To help decision makers make sense of rapid technological changes, an IATT sub-working group is bringing together analytical expertise from across the United Nations system and a wide range of external experts who volunteer their support. A recent inter-agency report on the impact of the COVID-19 crisis on growing science and technology divides—as well as the broader implications of the acceleration of innovation trends in biotechnology, AI and digitalization—highlights the need to bring together all relevant stakeholders to make sense of these trends and ensure that the way forward is marked by inclusion, equity and sustainability.[59]

Box III.G.4
Multi-stakeholder Forum on Science, Technology and Innovation for the Sustainable Development Goals

To-date, the annual STI Forum has mobilized a growing number of diverse stakeholders to discuss and showcase STI solutions for achieving the SDGs and has led to many new partnerships.

The 2021 STI Forum reviewed lessons from the COVID-19 pandemic for a better science-policy-society interface, a resilient recovery and rapid responses to global challenges. It also discussed the promises and potential risks of emerging science and technologies, as well as technological and capacity divides.

Government representatives reported on the progress of STI for SDGs (STI4SDGs) roadmaps and the related Partnership in Action, which helps to spur coherent STI action towards the SDGs. Key topics were capacity building, gender and next steps for the TFM, including its online platform 2030 Connect.

Source: UN/DESA/DSDG, based on: United Nations, Note by the Secretariat on the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals (E/HLPF/2021/6). Available at https://sdgs.un.org/sites/default/files/2021-10/2021-STI-Forum-summary-final_version.pdf.

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