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High-level segment on accelerating the recovery from the coronavirus disease (COVID-19) and the full implementation of the 2030 Agenda for Sustainable Development at all levels: high-level policy dialogue, including future trends and scenarios related to the Council theme and the long-term impacts of current trends

Long-term future trends and scenarios: impacts on the realization of the Sustainable Development Goals

Report of the Secretary General*

Summary

The present report serves to inform the discussions of the high-level segment of the Economic and Social Council in July 2023, pursuant to General Assembly resolution 72/305. It complements the report of the Secretary-General on the theme of the 2023 session of the Council (E/2023/78) and the report of the Secretary-General entitled "Progress towards the Sustainable Development Goals: towards a rescue plan for people and planet" (A/78/80-E/2023/64). It looks beyond current crises and emergencies to reflect on long-term trends and scenarios with a view to achieving the Sustainable Development Goals and climate change objectives while leaving no one behind.

Despite some positive developments, in a business-as-usual scenario, none of the Sustainable Development Goals would be achieved and development would be decisively unsustainable by 2050. Recent scientific and technological breakthroughs could become game-changers, but unprecedented levels of global cooperation and support would be required to make these new possibilities work for everyone. Recent Sustainable Development Goal pathways and sustainable development scenarios illustrate what would be needed in terms of globally coordinated policies and high-impact actions.

* The present report was submitted after the deadline so as to include the most recent information.

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I. Introduction

1. The present report serves to inform the discussions of the Economic and Social Council's high-level policy dialogue in 2023 on future trends and scenarios and the long-term impact of such trends and new technologies on the realization of the 2030 Agenda for Sustainable Development.[1] It looks beyond the current crises and emergencies and takes a long-term futures perspective towards 2030 and beyond, all the way to 2050. It thus complements the report of the Secretary-General on the theme of the 2023 session of the Council (E/2023/78), which discusses recent efforts to recover from the coronavirus disease (COVID-19) pandemic, the present crises and their immediate implications, as well as the report of the Secretary-General on "Progress towards the Sustainable Development Goals: towards a rescue plan for people and planet" (A/78/80-E/2023/64).

2. The 2030 Agenda sets out a broad, aspirational vision "for people, planet and prosperity".[2] Its Sustainable Development Goals provide a quantitative and qualitative snapshot of what the world aspires to achieve by 2030.[3] It also outlines policy recommendations and actions, but does not offer precise guidance on how coordinated actions could feasibly be undertaken over time to achieve the Goals. That is what scenarios are designed to explore.

3. Scenarios are internally consistent and plausible paths describing developments into the future. They bring together scientific and technical knowledge from all relevant disciplines and sources in a coherent manner to improve understanding of possible future developments and support decision-making. Policymakers often refer to scenarios as pathways, a term that is used synonymously in the present report. However, scenarios are not predictions. Instead, scenario analysts make assumptions about an inherently uncertain future and ask "if/then" questions. Scenarios focus our thinking on identifying solutions that do not breach physical, technical, economic or sociopolitical boundaries but that truly add up and reflect the best available science and evidence.

4. As the world prepares for the Sustainable Development Goals Summit and the Summit of the Future, insights from sustainable development scenarios are an important means of identifying possible pathways, prioritizing actions and understanding the longer-term implications of policies. They provide a best guess of what is possible. It should be noted, however, that they are based on scenario models that are limited in terms of capturing all the complex aspects of systems, especially at the local and national level.

5. In his previous reports in this series (E/2020/60, E/2021/61 and E/2022/58), the Secretary-General presented the "low energy demand (LED) better futures scenario" as a global best-case scenario for achievement of the Sustainable Development Goals by 2030 and broader sustainable development by 2050. The reports also considered the potential long-term consequences of near-term decisions in responses to the COVID-19 pandemic and to artificial intelligence technologies, as well as the potential of myriad digital consumer innovations for transforming end-use

[1] In accordance with General Assembly resolution 72/305, the final day of the high-level segment of the Council will focus on "future trends and scenarios related to the Council theme, the long-term impact of current trends, such as the contribution of new technologies, in the economic, social and environmental areas on the realization of the Sustainable Development Goals, based on the work of the United Nations and other regional and international organizations and bodies as well as other stakeholders. It should aim at enhancing knowledge-sharing and regional and international cooperation".

[2] See General Assembly resolution 70/1.

[3] With selective targets for other years.

efficiencies in transportation, buildings, food and energy. Among other findings, the reports concluded that the world was not on track to achieve its long-term goals and that it had largely not taken actions that would have been in line with the global best-case scenario, despite several positive developments.

6. This year's report builds on those earlier reports. It takes stock of long-term trends across all Sustainable Development Goal areas, describes the scenario of a business-as-usual future (section II), discusses the potential of rapidly emerging technologies to act as game changers to accelerate progress towards sustainability (section III), reports on the latest findings and policy implications of sustainable development scenarios and futures for the Sustainable Development Goals and beyond (section IV) and concludes with a brief summary of the way forward (section V).

II. Long-term trends and the scenario of a business-as-usual future

7. The report of the Secretary-General entitled "Progress towards the Sustainable Development Goals: towards a rescue plan for people and planet" (A/78/80-E/2023/64) provides a comprehensive picture of recent progress towards the Goals since 2015 and provides an extensive list of policy recommendations. The present section looks at longer-term historical trends and what they might mean for 2030 and even 2050, if the world continues along its current path without a significant course correction in the form of globally coordinated action from Governments, businesses, and individuals alike.

8. The business-as-usual future reported in the present section is primarily based on the "middle of the road" shared socioeconomic pathway-nationally determined contributions (SSP2-NDC) scenario of the Intergovernmental Panel on Climate Change, in which trends broadly follow their historical patterns and implementation of the nationally determined contributions under the Paris Agreement is assumed. It is important to note that trends are closely interconnected, hence this scenario differs in important ways from simple extrapolations of individual trends.

9. Science and technology have driven human development over the past half century, in what has been termed the "great acceleration". In relative terms, many improvements have been made, including reductions in the shares of the global population suffering from poverty and lacking access to electricity, as well as increased access to clean cooking fuel, drinking water, education and health. In absolute terms, science and technology have helped lift billions out of poverty and provided them with a better life, even as billions have been left behind.

10. Overall, the world has made significant progress in most of the Sustainable Development Goal areas over the past three decades, but that progress has largely been too slow compared with the aspirations embodied in the Goals and for the achievement of sustainable development. In fact, if current trends continue, the resulting business-as-usual future will be starkly unsustainable in most dimensions of the Goals. The table provides a selective overview of historical trends, the current situation and a business-as-usual future to 2050.

Historical trends and business-as-usual future in key Sustainable Development Goal areas, 1990–2050

2030 Agenda areas	*Goal*	*Related indicator*	*Historical trend*			*Today*	*Business-as-usual future (continuation of historical trends)*			*Unit*
			1990	*2000*	*2012*	*2022*	*2030*	*2040*	*2050*	*Year*
People	Population	World population (United Nations medium variant)	5.3	6.1	7.1	7.9	8.5	9.2	9.7	Billions of people
		Above 65 years of age	0.32	0.42	0.56	0.78	1.01	1.33	1.6	Billions of people
		Urban residents	2.29	2.87	3.63	4.5	5.17	5.94	..	Billions of people
	1	People in absolute poverty	1.95	1.78	1.17	0.69	0.57	0.28	0.19	Billions of people (latest projection)
			..	..	..	..	0.44	..	0.12	Billions of people (SSP2 scenario)
	3	Under-5 deaths	12.8	9.9	6.7	4.9	3.8	2.6	1.4	Millions of children
		Disability-adjusted life years lost from fine particulate matter (PM2.5)	..	..	200	200	214	224	227	Million disability-adjusted life years per year
	4	Share of adults without education	..	..	15	12	10	8	6	Percentage
	5	Secondary education gender gap	..	6.8	3.4	2.6	2.4	1.8	1.3	Percentage points
Provision of material needs and sustainable resources	2	People underweight	..	0.75	0.73	0.66	0.61	0.57	0.52	Billions of people
	6	Agricultural water withdrawal	..	2.8	3.0	3.2	3.5	3.9	4.4	1,000 km^3 per year
	7	People without electricity access	2.0	1.6	1.2	0.7	0.7	0.6	0.5	Billions of people
		Useful energy per capita in buildings and mobility	..	12	13	15	17	20	23	Gigajoules per capita per year
	12	Food waste	..	440	580	650	700	740	780	Kilocalories per capita per day
Prosperity	8	Global economy size	35	47	73	104	142	184	230	Trillions of US dollars (2005 PPP)
	9	Industry clean energy share	..	18	19	21	25	31	41	Percentage (final energy)
	10	Relative poverty rate	..	..	18.4	19.0	19.1	18.9	18.6	Percentage (with regard to median income)
		Global income convergence	..	26	32	37	40	44	47	PPP per capita ratio to OECD (Percentage)
		Global middle class ($11 to $110 a day (2011 PPP))	1.2	1.8	2.5	3.5	4.8	6.0	6.5	Billions of people
	11	Urban residents	2.29	2.87	3.63	4.5	5.17	5.94	..	Billions of people
		Megacity residents (> 10 million)	0.15	0.23	0.35	0.53	0.73	1.0	..	Billions of people
		Slum dwellers	0.67	0.78	0.87	1.01	1.6	2.0	..	Billions of people

2030 Agenda areas	*Goal*	*Related indicator*	*Historical trend*			*Today*	*Business-as-usual future (continuation of historical trends)*			*Unit*
			1990	*2000*	*2012*	*2022*	*2030*	*2040*	*2050*	*Year*
		Urban concentration of fine particulate matter (PM2.5)	..	..	34	31	31.6	30.8	28.7	Micrograms per cubic metre of air
		Premature deaths from ambient air pollution (fine particulate matter, PM2.5)	2.9	3.1	3.3	3.3	3.6	3.9	4.2	Millions of people
Planetary integrity	13	Greenhouse gas emissions	38	41	52	54	54	48	43	Billions of tons of carbon dioxide equivalent per year
		Global mean temperature increase	..	..	0.9	1.2	1.4	1.6	1.8	Kelvin
	14	Aragonite saturation state (oceans)	..	..	2.94	2.85	2.77	2.71	2.66	–
		Nitrogen fixation	..	..	151	190	219	248	268	Millions of tons of nitrogen per year
	15	Biodiversity intactness	..	0.798	0.794	0.792	0.7911	0.7893	0.7878	–
Institutions and partnerships	16	Rule of law and civil liberties	..	..	0.60	0.61	0.64	0.68	0.71	Index
		Peace (conflict/battle-related deaths)	..	..	..	0.3	2	8	26	Probability of < 20,000 fatalities
	17	Internet users	0.003	0.36	2.4	4.9	7.5	8.7	9.5	Billions of people

Sources: Data based on "A sustainable development pathway for climate action within the UN 2030 Agenda" in *Nature Climate Change* and related data repository, available at https://zenodo.org/record/4787613; "Defining a sustainable development target space for 2030 and 2050" in *One Earth; Prototype Global Sustainable Development Report; World Population Prospects 2022 Revision*; World Bank; United Nations statistics database; and estimates by the United Nations Secretariat.

Notes: Business-as-usual future primarily based on the "middle of the road" shared socioeconomic pathway-nationally determined contributions (SSP2-NDC) scenario of the Intergovernmental Panel on Climate Change. Absolute poverty is defined as below the international poverty line of less than $2.15 per day (2017 PPP).

Abbreviations: OECD, Organisation for Economic Cooperation and Development; PPP, purchasing power parity.

People (Goals 1, 3, 4 and 5)

11. The world population has increased by an average of almost 1 billion people in each of the past three decades and reached about 8 billion in 2023. It is expected to continue to grow, albeit at a slower rate, and to reach 8.5 billion in 2030 and 9.7 billion in 2050.[4] The majority of this growth will be in Africa and South Asia, where fertility rates remain relatively high. A number of developing countries in Africa have entered the early phase of a demographic dividend whereby the working-age population is rapidly rising as a share of the total population.[5] Overall, however, the global population is ageing, with the number of people aged 65 and over expected to double from 0.76 billion in 2022 to 1.6 billion in 2050,[6] and the number of those aged 80 and over expected to triple from 0.16 billion to 0.46 billion. Most developed and many developing countries will see their populations peak and then shrink after 2040. The world's economic old-age dependency ratio will increase from 20 per cent in 2020 to 27 per cent in 2030.[7]

12. In a business-as-usual future, progress will be too slow to achieve the moral imperative of eradicating absolute poverty in the near future. Despite population growth, the total number of people in absolute poverty[8] decreased by around 600 million in the 2000s and by 500 million in the 2010s, but rose for the first time in three decades in 2020, by 70 million. It has since continued to decline, standing at about 670 million at the end of 2022. In the long run, it is expected to drop further, but at a slower rate. According to simple projections, it will drop to 575 million by 2030, which means that only one third of countries would have halved their national poverty rates from 2015 to 2030. Even in a slightly more optimistic business-as-usual scenario, there would still be 440 million people in absolute poverty in 2030 and 120 million in 2050 – absolute poverty would not be eradicated even by mid-century.

13. The under-5 mortality rate declined from 93 deaths per 1,000 live births in 1990 to 38 deaths per 1,000 live births in 2021. However, this also means that about 267 million under-5 deaths occurred during that period. If current trends continue, another 48 million under-5 deaths will occur in the 2020s, the majority from preventable or treatable causes. Even in 2040 and 2050, millions of children would die every year.

14. Over the past decade, a roughly constant 200 million disability-adjusted life years were lost every year, a number that is expected to rise further in the future, owing to the continued health impacts of air pollution that is expected to remain above the target levels established by the World Health Organization (WHO) for almost everyone.

15. The share of adults without an education will continue to decline slowly, decreasing from 12 per cent today to 10 per cent in 2030. Similarly, the secondary education gender gap will continue to decrease slowly, but would still stand at around 1 per cent even in 2050.

[4] United Nations, "Standard projections: most used", *World Population Prospects 2022 Revision*, online ed. Available at https://population.un.org/wpp/Download/Standard/MostUsed/.

[5] *World Social Report 2023: Leaving No One Behind in an Ageing World* (United Nations publication, 2023).

[6] United Nations, "Standard projections: population", *World Population Prospects 2022 Revision*, online ed. Available at https://population.un.org/wpp/Download/Standard/Population/.

[7] *World Social Report 2023: Leaving No One Behind in an Ageing World* (United Nations publication, 2023).

[8] Defined as those living on less than $2.15 per day (2017 purchasing power parity (PPP)).

Provision of material needs and sustainable resources (Goals 2, 6, 7 and 12)

16. Over the past few decades, the number of hungry people and the number of underweight people has slowly decreased despite the growing population. However, hunger still affects more than half a billion people and numbers are expected to remain stubbornly high in a business-as-usual future.

17. Rapid progress has been made in providing people with access to electricity, but that progress has significantly slowed. By mid-century, there might still be half a billion people without access, which will exclude them from all the benefits of an increasingly electrified information society. The per capita use of useful energy in buildings and mobility will rise at accelerated rates to 23 gigajoules by 2050. As a whole, global energy demand has continued to rise and is projected to increase by another 50 per cent by 2040, driven by population growth, urbanization and industrialization. Over the same time frame, agricultural water withdrawals will increase by another 22 per cent. Competition for scarce resources, such as water and minerals, will intensify and might lead to increased risks of geopolitical tensions and potential conflicts.

18. Food waste has increased, albeit at slower rates, and might reach as much as 700 kilocalories per capita per day by 2030, which is theoretically enough to feed an additional 3 billion people, an unimaginable waste in the face of hunger.

Prosperity (Goals 8, 9, 10 and 11)

19. The world economy has continued to expand at a long-term average rate of around 3 per cent per year. Global gross domestic product (GDP) reached $104 trillion[9] at the end of 2022, and is expected to continue to expand, increasing by 40 per cent by 2030 alone.

20. The global middle class[10] has doubled since 2000 to 3.5 billion people in 2022, and it is expected to further increase to 4.8 billion people by 2030[11] (primarily owing to expansion in Asia) and to 6.5 billion by 2050. Yet economic inequality will persist both within and between countries, potentially bringing higher risks of social unrest, political instability and reduced economic growth.

21. The within-country relative poverty rate has remained stubbornly high at around 19 per cent and is expected to remain at that level. However, that average masks huge differences between countries, with rapidly increasing relative poverty in some countries. At the global level, income convergence is expected to continue, driven by rapid economic growth in some populous developing countries, but by 2050, average purchasing power parity (PPP) per capita in the Organisation for Economic Cooperation and Development region would still be twice that of the rest of the world, and major regional disparities would persist.

22. Today, some 4.5 billion people (or 56 per cent of the world's population) live in cities – 900 million more than just 10 years ago.[12] By 2030, the urban population will have increased by another 700 million, to 5.2 billion. Building the necessary energy, transportation, communications, water and sanitation infrastructure, as well intercity infrastructure, for an additional 100 million urban residents a year will be a major sustainability challenge. Another challenge is the decreasing overall density of urban

[9] In 2005 PPP terms.

[10] Defined as people with an income per day of between $11 and $110 (2011 PPP).

[11] Wolfgang Fengler and Homi Kharas, "A long-term view of COVID-19's impact on the rise of the global consumer class", Brookings Institution, 20 May 2021.

[12] United Nations, *World Urbanization Prospects 2018 Revision*, online ed. Available at https://population.un.org/wup/Download/.

areas since 1990. If this trend continues, the global urban land area will have almost tripled from 2000 to 2030,[13] leading to major loss of natural habitats.[14]

23. Cities with more than 1 million residents have grown at twice the rate of the overall population. Half a billion people now live in megacities, each with more than 10 million inhabitants; by 2040, that figure might be around 1 billion, primarily in Asia and Africa. However, most urban growth will occur in medium-sized cities with 1 to 5 million inhabitants. It is projected that 660 such cities will house 1.6 billion people by 2030. There will also be progressively more slum dwellers, as their number is expected to double from 1 to 2 billion between 2022 and 2040.

24. While the clean energy share in industry is expected to grow at an accelerated rate, doubling from 21 per cent today to 41 per cent in 2050, urban air pollution (fine particulate matter, PM2.5) concentrations would stay stubbornly high and far above WHO standards in most cities and would continue to cause millions of premature deaths every year for decades to come.

Planetary integrity (Goals 13, 14 and 15)

25. Despite the many policy measures taken, in the twenty-first century, global greenhouse gas emissions have continued to increase every year (except in the pandemic year of 2020) and reached 54 billion tons of carbon dioxide equivalent in 2022. Assuming that all nationally determined contributions are implemented, greenhouse gas emissions would peak before 2030 and remain at very high levels, reaching 43 billion tons of carbon dioxide equivalent even in 2050. As a result, global mean temperatures will continue rising, breaching 1.5°C around 2030 and 2.5°C by 2100. By contrast, staying within the 1.5°C goal of the Paris Agreement would require global greenhouse gas emissions to fall by 43 per cent by 2030 compared with 2019 levels, fall to net zero by 2050 and then turn net-negative for some years.

26. Large-scale planetary changes on land, in the ocean and in the atmosphere are already happening. Ocean acidification continues to increase and has reached levels not seen for at least 26,000 years, endangering marine organisms. The melting of glaciers and sea level rise, which reached record levels in 2022, will continue for thousands of years. Some 3.4 billion people live in areas that are highly vulnerable to climate change, and that number might rise to 5 billion by 2040, reinforcing the need for climate adaptation.

27. Human-induced nitrogen fixation has become a major concern and is expected to rise further, from 190 millions of tons of nitrogen today to 270 millions of tons of nitrogen by 2050. One of the consequences is continued biodiversity degradation.

Institutions and partnerships (Goals 16 and 17)

28. Despite regional disparities, the global long-term trend towards improved rule of law and civil liberties is expected to continue. Furthermore, for the “middle of the road” shared socioeconomic pathway-nationally determined contributions (SSP2-NDC) scenario, the probability of the world seeing less than 20,000 conflict/battle-related fatalities per year was estimated to increase from 0.3 per cent in 2022 to 26 per cent in 2050.

29. There are now 4.9 billion Internet users in the world, and by 2030 there may be 7.5 billion users, representing almost 90 per cent of the global population. This will

[13] If current trends in population density continue and all areas with high probabilities of urban expansion undergo change.

[14] Karen C. Seto, Burak Güneralp and Lucy R. Hutyra, “Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools”, *PNAS*, vol. 109, No. 40 (October 2012).

facilitate the exchange of information, ideas and resources, driving further innovation and economic growth.

30. The growth of global trade is expected to continue, driven by the expansion of the digital economy, the proliferation of global value chains and the increasing integration of developing economies into the world market.

31. The world's scientific and technological knowledge base and overall data volumes will continue to expand greatly. The annual number of peer-reviewed articles in the fields of science and engineering published every year grew from 1.5 million in 2015 to 2.1 million in 2022 and is expected to double to 3 million by 2030. As many scientific and technological papers will be added in the next seven years to 2030 as in the entire human history to date. Disciplines have further specialized and narrowed. Artificial intelligence is increasingly needed to obtain a comprehensive picture of scientific knowledge across disciplines to inform policy and actions.

32. The amount of data created and shared almost instantly across the globe has increased even faster. By 2022, the world had accumulated an estimated 100 zettabytes of data, which is 10 times the amount of 10 zettabytes in 2015. In 2022 alone, the world added 15 zettabytes of new data, which was about as much as it had accumulated throughout human history until 2017. Deep learning and big data business strategies mean that this growth will likely continue, if not accelerate further. By 2030, data volumes may be 400 or more zettabytes, with at least 40 zettabytes of data being added per year.

III. Rapidly emerging technology: a game changer?

33. Section II painted a picture of a business-as-usual future that is highly unsustainable and is the result of a continuation of long-term historical trends. However, these are times of rapidly emerging new technologies, with important implications for sustainable development. The present section briefly discusses selected trends in science and technology and whether they could become game changers for sustainability.[15] This provides important background for understanding technological change as a major ingredient of the sustainable development pathways described in section IV.

A. Scientific and technological advances: a means to accelerate progress towards the Sustainable Development Goals but also an enormous challenge

34. Rapidly emerging scientific breakthroughs and technologies are upending old development models and offering new opportunities, but they also present enormous institutional challenges in all countries, especially in many developing countries. Rapid changes can be seen in technology development, demonstration and diffusion, with increasingly significant impacts on countries at all levels of development. Almost all countries that are not at the technology frontier with respect to these new technology clusters face increasing disadvantages, with the export-oriented development model based on technological upgrading, which has been extremely

[15] See also, 10-Member-Group of High-level Representatives of Scientific Community, Private Sector and Civil Society in Support of the Technology Facilitation Mechanism, "Science, technology and innovation for the SDGs: progress, future vision and recommendations", 1 May 2023.

successful in recent decades, becoming increasingly difficult to follow. A related phenomenon is premature deindustrialization in developing countries.

35. A growing disparity in science, technology and innovation capabilities between countries and within societies could lead to a rapid increase in socioeconomic disparities and significantly reduce equal opportunities for all. At the same time, science, technology and innovation communities are undergoing major institutional and organizational changes, as their societal and economic roles are shifting. Just one example is the emergence of sustainability science as a fully integrated, practical kind of science that is linked with many different disciplines across natural and social sciences.

36. The level and distribution of current research and development expenditures provide an insight into future capabilities. Global research and development spending continued to increase and reached $2.5 trillion from all sources in 2022. However, investments remain highly concentrated in a few developed countries and in China, with limited resources going to the Global South (low-income countries account for only 0.3 per cent). The public and private sectors both play a vital role in research and development. Current governmental research and development funding amounts to around $200 billion to $300 billion a year. Private research and development funding remains crucial for translating research findings into marketable products and services.

37. In other words, unless developing countries and disadvantaged communities are fully integrated into the new world economy driven by research and development, modern science, technology and innovation will fall far short of making a positive difference for the Sustainable Development Goals, and will cause the gaps to widen further.

B. Environmentally compatible technologies and the emerging green economy

38. The green economy has emerged very rapidly since 2018, driven by a technological revolution in advanced digital production technologies, green and low-carbon technologies, electric vehicles, solar photovoltaics, hydrogen, smart grids and digital consumer technologies. Globally, the green economy has become the fifth largest industrial sector by market value at $7.2 trillion, larger than the retail, financial services, and oil and gas sectors.[16]

39. Global investments in the energy transition alone rose to a new record of $1.1 trillion in 2022, especially due to electric transportation and solar photovoltaics. In fact, for the first time in history, energy transition investments surpassed fossil fuel investments in 2022. China alone accounted for 49 per cent of this total and for 91 per cent of global investments in clean energy manufacturing. Many other developing countries, however, face serious challenges in raising the necessary resources for sustainable energy investments.

40. Targeted policy strategies are driving this technology adoption. For example, zero-emissions vehicle targets already cover 40 per cent of the global automobile market. These technologies will increase productivity and energy efficiency and provide solutions to major sustainability challenges. With the right policy choices, they could also lead to more jobs and development. However, they may also increase the risk of widening income gaps between and within countries.

[16] *Financing for Sustainable Development Report 2023: Financing for Sustainable Transformations* (United Nations publication, 2023), chap. III.G.

41. According to the *Technology and Innovation Report 2023*, these trends may offer green windows of opportunity for developing countries, based on an empirical analysis of trade data and the identification of potential future technology trajectories. The extent to which developing countries will be able to reap the benefits will also depend on the degree of openness of trade and science, technology and innovation systems in the coming years. Advances might also raise the bar for firms in developing countries and close off traditional development pathways. Without major capacity-building efforts, green windows of opportunity might remain a mirage for many developing countries.

C. Digitalization

42. Digitalization has become a pervasive force across all sectors and countries, promising new opportunities for leapfrogging. For example, financial technology has the potential to greatly increase financial inclusion, including in underdeveloped parts of the world. Yet 3 billion people remain excluded from these benefits owing to a lack of basic Internet connectivity, technology skills and access. While considerable progress has been made in closing digital gaps in terms of simple Internet and web access in many parts of the world, new digital gaps have continuously opened up as new technology infrastructure has been built on top of basic connectivity infrastructure. In particular, the usefulness of artificial intelligence technology applications for the Sustainable Development Goals is significantly constrained by infrastructure and skill gaps.

43. Digitalization is also reshaping production processes. By 2021, there were 3.5 million industrial robots installed worldwide, and installations have surged at rates of over 30 per cent per year. While the current boom in industrial robots remains highly concentrated in a few countries and in the electronics and vehicle sectors, the projected cost advantages will greatly challenge the labour cost advantage of developing countries in one sector after another in the years to 2030. Service robots with increasingly powerful artificial intelligence capabilities are being deployed and have the potential to transform health care, transportation and ultimately all sectors. This presents unprecedented challenges for developing countries, which will be left even further behind by such trends unless global responses address their needs.

D. Biotechnology, synthetic biology and health technology

44. Recent developments in biotechnology and synthetic biology have dramatically reduced the cost of DNA sequencing and DNA synthesis, ultimately allowing the "programming" of new organisms. As a result of ever cheaper high technology equipment, "do-it-yourself" biology labs, biohacker spaces, makerspaces and fab labs can now be found in most countries in the world. However, levels of equipment, expertise and biosafety regulation vary greatly. These citizen science movements can be a promising accelerator of progress towards the Sustainable Development Goals, as much of their work is practical and aimed at solving everyday problems. However, this also poses risks if left unregulated. There is a need to develop a regulatory framework that nurtures such innovations while also putting in place all the necessary guardrails to protect against abusive uses of such technologies.

45. In early 2023, the WHO Global Health Foresight function identified the five most promising innovations for global health by 2030:[17] genomics for early diagnosis and pre-diagnosis of diseases; improved vaccine production and global distribution;

[17] World Health Organization, "2023 emerging technologies and scientific innovations: a global public health perspective – preview of horizon scan results", 26 April 2023.

low-cost viral diagnostics; broad-spectrum antimicrobial drugs; and rapid remote diagnostics. To make use of these innovations, technological advancements, skilled health professionals and technicians, leadership and good governance, and a supportive regulatory and policy framework will be needed. There are also inherent risks. Innovations may accentuate health inequity, have reliability and accuracy issues, present access and affordability challenges, or pose threats to data privacy. There may be difficulties in understanding and interpreting results, maintaining manufacturing standards, managing potential toxicity and safety concerns and preventing the misuse of technology. Again, these innovations show great potential for improving the health of billions of people, but they also require major international cooperation and support.

IV. Sustainable development pathways

46. Since the United Nations Conference on Sustainable Development in 2012, many scenario modellers have developed global sustainable development scenarios. Since 2015, they have also developed scenarios relating more specifically to the Sustainable Development Goals. They emphasize economic, technological or political approaches. However, in the past eight years, unabated global increases in the use of energy, materials and land, together with their associated environmental, social and health consequences, have required analysts to make increasingly ambitious scenario assumptions if the Goals are to be achieved in the few remaining years to 2030.

47. To achieve the required ambitious goals, many scenario analysts have long assumed technological fixes, such as bioenergy with carbon capture and storage, to produce negative emissions at a large scale, especially 30 years from now. While mostly theoretical until a few years ago, many demonstration projects have now appeared that indicate their feasibility in principle. However, several issues related to the deployment of these technologies at scale remain unresolved, such as the logistics of safely storing billions of tons of carbon dioxide every year and the potential impacts on ocean and terrestrial ecosystems.

A. A new approach: the low energy demand better futures scenario to achieve the Sustainable Development Goals and decent living standards for all

48. Against this backdrop, in 2018, several eminent scenario analysts and scientists took a different approach and designed an aspirational pathway inspired by the latest technological developments, behavioural change and high-impact business innovations. This scenario is aimed at making exceptional progress on sustainable consumption and production (Goal 12) through rapid transitions to lower energy demand and very high efficiency end-use technology and practices in energy, water, land and materials use.

49. The low energy demand scenario[18] would enable the Sustainable Development Goals and the 1.5°C climate target to be achieved without relying on negative emissions technologies. As a result, hundreds of millions of hectares of cropland could be spared. The scenario was featured in the report of the Intergovernmental Panel on Climate Change entitled *Global Warming of 1.5°C* and is also one of two

[18] Arnulf Gruebler and others, “A low energy demand scenario for meeting the 1.5°C target and sustainable development goals without negative emission technologies”, *Nature Energy*, vol. 3, No. 6 (June 2018).

scenarios highlighted in the Working Group III contribution to the sixth assessment report of the Panel, published in April 2022.[19]

50. On the basis of the original energy scenario, consistent, detailed scenario implementations were developed for land use and food (the "better futures" scenario),[20] water[21] and other Sustainable Development Goal sectors. The resulting combined "low energy demand better futures scenario" translates into important benefits for all Goals.[22] Scenario variants that use different combinations of the design elements of the low energy demand scenario have been developed, which include the scenarios developed by the Netherlands Environmental Assessment Agency[23] and the International Energy Agency,[24] and most recently the sustainable development pathway scenarios of the multi-model scenario project entitled "Sustainable development pathways achieving human well-being while safeguarding the climate and planet Earth" (SHAPE project).[25]

51. The key goal of the low energy demand better futures scenario is to reduce overall global energy, water and land use, despite expanding populations and economic activity and rapidly rising living standards. This is possible thanks to the significant untapped potential for increasing end-use efficiencies through a combination of technological, behavioural and business innovations – a transition fuelled by information and communications technologies.

52. The scenario describes a world that has become increasingly interconnected and focused on education, science and technology. It is a world with rapid global diffusion of technology, in which open science is leveraged for sustainable development. Many digital technologies and artificial intelligence applications would be deployed, vastly increasing service efficiencies. In what becomes a high-technology interconnected world, the Sustainable Development Goals are achieved by 2030, and broader sustainability by 2050.

53. In fact, this scenario outperforms alternative scenarios in terms of progress towards the Goals. It also foresees rapid improvement in living standards in

[19] Valérie Masson-Delmotte and others, eds., *Global Warming of 1.5°C: An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty* (New York, Intergovernmental Panel on Climate Change, 2018).

[20] Food and Land Use Coalition, *Growing Better: Ten Critical Transitions to Transform Food and Land Use* (2019).

[21] Simon Parkinson and others, "Balancing clean water-climate change mitigation trade-offs". Working Paper, No. WP-18-005 (Laxenburg, Austria, International Institute for Applied Systems Analysis, 2018).

[22] International Institute for Applied Systems Analysis, Low Energy Demand database, available at https://db1.ene.iiasa.ac.at/LEDDB, as related to Gruebler and others, "A low energy demand scenario for meeting the 1.5°C target"; and International Institute for Applied Systems Analysis, Shared Socioeconomic Pathways database, version 2.0, available at https://tntcat.iiasa.ac.at/SspDb, as related to Keywan Riahi and others, "The shared socioeconomic pathways and their energy, land use, and greenhouse gas emissions implications: an overview", *Global Environment Change*, vol. 42 (2017).

[23] The Netherlands Environmental Assessment Agency's nexus, 1.5°C and roads from Rio scenarios: Detlef P. Van Vuuren and others, "Integrated scenarios to support analysis of the food-energy-water nexus", *Nature Sustainability*, vol.2, No.12 (December 2019); Detlef P. Van Vuuren and others, "Alternative pathways to the 1.5°C target reduce the need for negative emission technologies", *Nature Climate Change*, vol. 8, No. 5 (May 2018); and Detlef P. van Vuuren and others, "Pathways to achieve a set of ambitious global sustainability objectives by 2050: Explorations using the IMAGE integrated assessment model", *Technological Forecasting and Social Change*, vol. 98 (September 2015).

[24] International Energy Agency sustainable development scenario, contained in the World Energy Model – scenario analysis of future energy trends, World Energy Outlook (November 2019).

[25] See https://shape-project.org.

developing countries to a level far beyond the basic services described in the Goals, referred to as “decent living standards”, essentially enabling those countries to catch up with the developed world. At the same time, global energy and resource use would decline. Decent standard of living requirements ensure that people have the means to pursue a decent life and include amenities that ensure good health and quality of life and those that enable people to engage with society.[26]

54. All of this is achieved through overall strategies to electrify energy end-use worldwide; to bring homes, appliances and transport modes to the technological efficiency frontier; to support multi-functionality through a convergence of multiple services onto single devices or business models; to promote a generational shift from ownership of material goods to accessing services; to increase utilization rates of goods, infrastructure and vehicles (sharing and circular economy); to promote user-oriented innovation; to ensure decentralization, allowing new roles for end users not just as consumers but also as producers, innovators and traders; and to achieve ubiquitous digitalization and rapid innovation in granular technologies, such as solar photovoltaics and heat pumps.

55. The low energy demand better futures scenario represents a path to a highly desirable sustainable future that has multiple benefits and the potential to prevent various global sustainability crises. With so much at stake, the world should closely assess its current policies and actions against this pathway. While there are important promising new technological and policy developments that have the potential to accelerate the world’s transition towards such an optimal scenario, at the global scale the world has been far off track, in terms of both the required end-use transformations and behavioural changes.

B. Comprehensive sustainable development pathways consistent with the Sustainable Development Goals

56. Alternative sustainable development pathways have been developed by leading scientists in the context of the “Sustainable development pathways achieving human well-being while safeguarding the climate and planet Earth” (SHAPE) project, with results presented in early 2023. The findings offer a pragmatic portfolio of actions that can shift the world onto a track for achieving most of the Sustainable Development Goals, despite recent unsustainable trends.[27] The developers of the sustainable development pathway scenario explored six broad clusters of interventions in the areas of development; resource efficiency and lifestyle changes; climate mitigation; shift in consumption patterns (energy and land use); international climate financing; and national poverty alleviation programmes financed from carbon pricing revenues. They highlight the benefits of synergies between climate change and sustainable development objectives, especially in the long term beyond 2030.

57. These scenarios go further than earlier work and quantify the entire range of Goals, including many social and institutional aspects. This is important and should be useful for translating the findings into specific policies and actions. Key elements of the sustainable development pathway scenario are outlined below.

58. *Planetary integrity*. The sustainable development pathway scenario presents a path towards Goals 13, 14 and 15. Greenhouse gas emissions are reduced to 33 and 10 billion tons equivalent in 2030 and 2050, respectively. Sizeable reductions in agricultural methane and nitrous oxide emissions beyond what is common in other 1.5°C scenarios in the literature allow for a 100-billion-ton higher carbon dioxide

[26] Narasimha D. Rao and Joon Min, “Decent living standards: material prerequisites for human wellbeing”, *Social Indicators Research*, vol. 138, No. 1 (July 2018).

[27] Bjoern Soergel and others, “A sustainable development pathway for climate action within the UN 2030 Agenda”, *Nature Climate Change*, vol.11, No.8 (August 2021).

budget, which limits the scale of the negative emissions that would be needed. Overall warming slightly overshoots 1.5°C by 2050, but stands at 1.3°C by 2100. Importantly, ocean acidification is limited to a level that does not further endanger marine organisms such as corals, clams, oysters and some plankton that use carbonate ions to create their shells and skeletons. The scenario also shows a path towards decreasing human-induced nitrogen fixation to 120 millions of tons of nitrogen per year to conserve primary forests, halt biodiversity loss and reverse some of that loss, all by 2050.

59. *Provision of material needs and sustainable resources* (Goals 2, 6, 7, and 12). Zero hunger is achieved by 2050 and malnourishment is halved by 2030. Food waste and agricultural water use are reduced by a quarter by 2050, which reduces pressures that cause higher food prices. Annual per capita energy use for buildings and mobility in low-income countries almost doubles to 6.4 gigajoules by 2030 and more than triples to 15 gigajoules by 2050 (compared with the world average of 22 gigajoules).

60. *People* (Goals 1, 3, 4, and 5). Extreme poverty could be reduced to 180 million (or about 2 per cent) by 2030, compared with 750 million in 2015, and poverty eradication could be achieved by 2050. It leads to 5 and 25 million fewer (disability adjusted) life years lost by 2030 and 2050, respectively, although air pollution remains above WHO target levels and continues to affect health. Eleven million under-5 deaths would be averted in the 2020s alone. In the scenario, all of the younger generation will have benefited from a school education by 2030.

61. *Prosperity* (Goals 8, 9, 10 and 11). Incomes grow rapidly in the developing world, converging towards those in the developed world, but regional disparities remain. The within-country relative poverty rate decreases from 19 per cent in 2015 to 15 per cent by 2050. The clean energy share in industry grows slowly to 26 per cent by 2030 and more rapidly to 62 per cent by 2050. Urban air pollution (PM2.5) is reduced by 40 per cent by 2050.

62. *Institutions and partnerships* (Goals 16 and 17). The sustainable development pathway scenario assumes a general increase and convergence in institutional quality across the board. International climate financing is increased beyond the current $100 billion target to $350 billion by 2030 and to $910 billion by 2050. The scenario explores the outcomes of using a significant part of these funds to finance poverty alleviation rather merely reinvesting them in new infrastructure and technologies.

International burden-sharing and expanding fiscal space

63. A globally just transition that leaves no one behind needs to recognize various factors, including capacity constraints and differences in capabilities between and within countries. The sustainable development pathway scenario goes a long way in this regard. For example, it foresees all countries successively adopting a carbon price that is determined by income level. Low-income countries would initially have very low carbon prices compared with high-income countries, but a globally uniform carbon price would be achieved by 2050. A fraction of the revenues from carbon pricing in high-income countries would be earmarked for international climate and development financing, including for direct cash transfers to poor households, thus contributing to the reduction of extreme poverty. At the national level, the removal of fossil fuel subsidies, and carbon prices consistent with the 1.5°C target, could create fiscal space of about 20 per cent of the public financing needs for the Sustainable Development Goals (in the median across countries), but with large differences between countries (ranging from close to 0 per cent to 90 per cent). This share would be large in countries with already high infrastructure stocks and relatively low in least developed countries, highlighting the importance of international burden-sharing.[28]

[28] Bjoern Soergel and others, “Joint implementation of the Sustainable Development Goals, climate change mitigation and biosphere protection: policy options for tackling multiple crises simultaneously”, policy paper by the Potsdam Institute for Climate Impact Research, May 2022.

Decent living standards for all

64. The sustainable development pathway scenario presents a pathway towards ensuring decent living standards for all. The concept of decent living standards goes well beyond basic services and the eradication of poverty, addressing nutrition (food preparation and conservation), shelter (housing and thermal comfort), health (health care, water and sanitation), socialization (education, communication and information), and mobility (motorized transportation). The largest per capita gaps are in sub-Saharan Africa, South Asia and Latin America, but regional differences are sizeable.[29] Decent living gaps are largest in terms of transportation in all regions, but there are also sizeable gaps in clean cooking, cold storage, sanitation and cooling. The cooling gap is especially large in South Asia. In fact, in many parts of the Global South, cooling is among the fastest-growing forms of energy use in buildings, yet it is rarely the focus of sustainability. Heat stress affects the health and productivity of billions of people. According to the Cooling for All initiative, at least 3.4 billion people face cooling access challenges in 2021, including 1.1 billion rural and urban poor and 2.3 million lower-to-middle income people.[30]

65. The sustainable development pathway scenario shows that only about 17 gigajoules of energy per capita per year is needed to provide decent living standards, which is no more than one third of the current global average final energy consumption per capita. In sub-Saharan Africa, final energy use would need to grow from 20 gigajoules to 31 gigajoules per capita to fill the gap. To close cooling gaps with air conditioning and fans in the Global South, about 786 terawatt-hours a year would be required, which could be reduced by half with higher-efficiency systems and better insulation. Passive design strategies for buildings, such as shading, improved natural ventilation and cool roofs can improve thermal comfort and reduce energy demand. Evaporative cooling can be an effective and less energy-intensive technology compared with air conditioning in dry climates.

Innovations in scenario analysis: political institutions[31]

66. The sustainable development pathway scenario process also shows major innovation in terms of modelling the effectiveness of political institutions and thus capturing the implementation dimension. In particular, it includes rule of law projections for 2015–2050 and a comparison with the scenarios of the Intergovernmental Panel on Climate Change.

67. Strong and effective political institutions are essential for implementation of the Sustainable Development Goals. Such institutions formulate sustainability policies and ensure the implementation of policy goals. While the fundamental importance of governance is enshrined in Goal 16, until recently, institutional governance issues have rarely featured explicitly in Sustainable Development Goal scenario analyses. Yet effective institutions and political futures are essential ingredients for the feasibility of scenarios, something also highlighted by the Intergovernmental Panel

[29] Jarmo S. Kikstra, Setu Pelz and Shonali Pachauri, “Eliminating multidimensional poverty by providing decent living standards for all”, science-policy brief for the Multistakeholder Forum on Science, Technology and Innovation for the Sustainable Development Goals, held in May 2022, in the Interagency Task Team on Science, Technology and Innovation for the Sustainable Development Goals (IATT) report 2022.

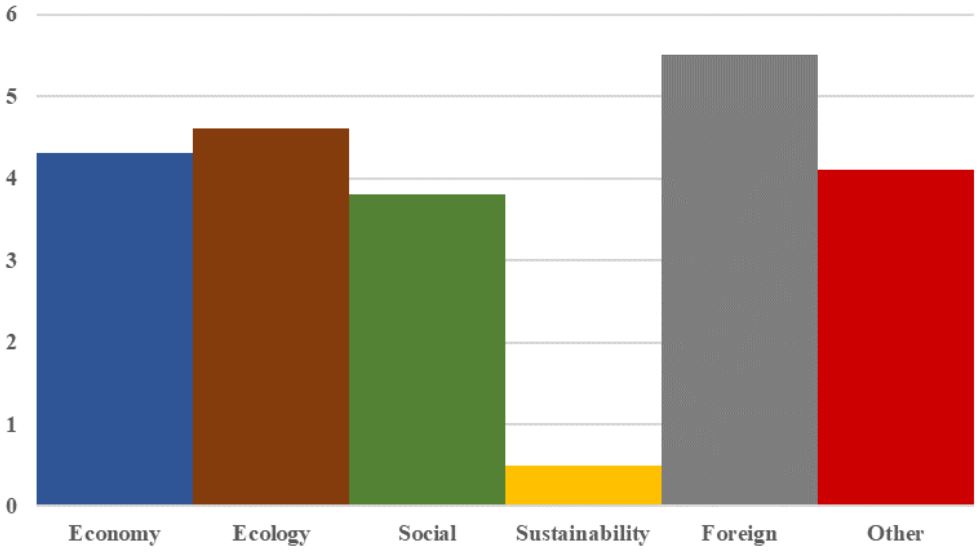
[30] Alessio Mastrucci, Bas van Ruijven and Shonali Pachauri, “Closing cooling gaps in a warming world”, science-policy brief for the Multistakeholder Forum on Science, Technology and Innovation for the Sustainable Development Goals, held in May 2022, in the Interagency Task Team on Science, Technology and Innovation for the Sustainable Development Goals (IATT) report 2022.

[31] Julia Leininger, Christopher Wingens and Anita Breuer, “Political futures – not as rosy as SDG implementation would require”, paper prepared for the German Institute of Development and Sustainability, Bonn, Germany, 2023.

on Climate Change.[32] In fact, the assumptions regarding political institutional futures made in Panel scenarios were far more positive than might be expected from extrapolations of empirical historical trajectories – for rule of law, inclusive institutions and violent conflict.[33]

68. This work has important implications for making institutions fit for implementation of the Sustainable Development Goals. It analysed the institutions responsible for implementation, as described in the voluntary national reviews, and highlighted the importance of effective accountability and governance mechanisms.[34] To create synergies between the Goals and minimize trade-offs, political institutions need to integrate different sectors instead of working in silos.[35] Hence, the participation of line ministries will need to be broadened and deepened in Goal-related planning and implementation, beyond environment and foreign ministries (see figure).

Percentage share of national bodies in the implementation of the Sustainable Development Goals, including each line ministry, 2016–2021



Source: Data based on *Governing the Interlinkages between the SDGs: Approaches, Opportunities and Challenges*, chapter 4.

[32] Ove Hoegh-Guldberg and others, "Impacts of 1.5°C of global warming on natural and human systems", in *Global Warming of 1.5°C: An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*, Valérie Masson-Delmotte and others, eds. (New York, Intergovernmental Panel on Climate Change, 2018).

[33] Bjoern Soergel and others, "A sustainable development pathway for climate action within the UN 2030 Agenda". See also https://zenodo.org/record/4787613.

[34] Anita Breuer and Julia Leininger, "Horizontal accountability for SDG implementation: a comparative cross-national analysis of emerging national accountability regimes", *Sustainability*, vol. 13, article No. 7002 (2021).

[35] Anita Breuer, Julia Leininger and Daniele Malerba, "Governance mechanisms for coherent and effective implementation of the 2030 Agenda: a cross-national comparison of government SDG bodies", in *Governing the Interlinkages between the SDGs: Approaches, Opportunities and Challenges*, Anita Breuer and others, eds. (New York, Routledge, 2023).

C. Policies and actions in the sustainable development pathway

69. The scenario modellers who developed the sustainable development pathway and low energy demand scenarios modelled a package of policies and high-impact actions that would need to be pursued in a globally coordinated way in order to achieve sustainable development and the Sustainable Development Goals. This includes the policies set out below and complements additional near-term actions recommended in the previous reports in this series.

Technology and resource efficiency

70. The scenario shows what would be possible with an unprecedented global effort to ensure the necessary capacity, financing and access to technology for all in order to make sure that no one is left behind – neither countries nor communities.

71. Long-term national plans are adopted and implemented to dynamically ratchet up product efficiency and increase energy efficiency in buildings, transportation and consumer goods to a level that adds up globally to two- to four-fold increases in overall eco-efficiencies by 2050. In particular, the scenario explores the rapid development and deployment of breakthrough innovations – at scale – in electrified transportation, hydrogen industry and transport, and new-generation solar photovoltaics, and unlocks the potential of digital consumer innovations in mobility, food, buildings and energy services.

72. It assumes a much higher level of global cooperation, to make effective use of the world's research and development capacities and to share lessons from demonstration projects in energy, food, climate, biodiversity, health, water and sanitation. One option could be the creation of a global institution, while another might be the creation of a network of strengthened national and regional institutions on sustainability science and technology.[36] In the scenario, global governmental research funders significantly increase research and development spending across the board from fundamental to applied research, which would also include a significant boost to research and development spending for the Sustainable Development Goals (of the order of at least 20 per cent over the next five years).

Climate change and a just transition

73. In the scenario, the world immediately ceases building any new coal-fired electricity generation capacities, and quickly phases out fossil fuel subsidies in all countries. Without these actions or a broad global understanding on minimum direct or indirect carbon dioxide price, the 1.5°C goal of the Paris Agreement is not attainable under reasonable assumption. In the sustainable development pathway scenario, carbon dioxide prices would be adopted in all countries that are differentiated according to average incomes, and would ultimately converge towards a globally uniform price by 2050. In this scenario, a rather moderate carbon dioxide price proves to be a sufficient price signal for a 1.5°C future – by 2030 it would reach about $150 per ton of carbon dioxide in high-income countries and $25 in low-income countries,[37] which is much lower than the projections of other leading climate scenarios.

74. At the global level, the policy costs incurred by developing countries are compensated through a complementary "climate and development" scheme, financed

[36] One possibility in this regard would be the recent proposal of the 10-Member-Group of High-level Representatives for a global sustainability science and technology centre.

[37] For comparison, the carbon price in Sweden increased from about 25 euros in 1991 to 122 euros in 2023.

from a fraction of global carbon pricing revenues. In the sustainable development pathway scenario, this would lead to $350 billion in climate financing by 2030. For sub-Saharan Africa alone, it could mean inflows of $120 billion a year, boosting GDP by almost 4 per cent and lifting 55 million people out of absolute poverty by 2030, while also sending an important long-term price signal to move away from fossil fuels.

75. At the national level, the scenario would require low-income individuals to be compensated for the transition cost through direct cash transfers financed from carbon dioxide pricing revenues. In fact, the sustainable development pathway scenarios show superior sustainable development outcomes for such schemes compared with any other options.[38]

Sustainable energy systems

76. New business models and systemic efforts are pursued, especially on granular end-use technologies, improved efficiencies and renewable energy technology deployment. This necessitates the adoption of long-term strategies to 2050 and investment-ready national plans to 2030 for much improved efficiencies in end-use and upstream sectors in all countries. In the scenario, this includes the adoption of ambitious long-term goals to reduce energy intensities: by 75–86 per cent for thermal comfort through new building standards in developing countries through doubling the retrofit rate in developed countries; by 70 per cent for mobility, and big reductions in lighting and consumer appliances; by 76–90 per cent in terms of energy use per square metre of commercial and public buildings; by 20 per cent for global industrial energy intensity; and by 10–50 per cent in freight transport.

77. No new coal power capacity is built, and by 2030, 90 per cent of coal power capacities are prematurely retired in countries with GDP per capita above $3,000 and 50 per cent of such capacities in lower-income countries. By 2040, traditional biomass for cooking and heating in low-income regions might be almost completely phased out. Global goals for electric vehicle market penetration of at least 25 per cent by 2030 and 40 per cent by 2050 are achieved.

78. Importantly, the employment and social impacts of the energy transition are addressed through just energy transition partnerships, international investment support and regional industrial policies.

Sustainable land and food systems

79. Public sector consumption is leveraged to encourage the acceleration of trends towards healthier, more sustainable and more plant-based nutrition and diets. The remaining forests and carbon-rich ecosystems, such as peatlands, are protected and afforestation considered, in line with local needs and food security. The conversion of remaining intact ecosystems is limited and 20 per cent of working land is conserved as natural or semi-natural habitats to maintain their ecological function. Importantly, the global bioenergy potential is restricted to 100 exajoules per year in the long term.

Global development, equity and cooperation

80. The sustainable development pathway scenario is feasible only with strengthened global cooperation and major international technological and financial support. It assumes international financing on climate alone of the order of $160 billion by 2025, $350 billion by 2030, $480 billion by 2040 and $910 billion by 2050. This is in line with and underlines the feasibility of the Secretary-General’s

[38] This statement is based on academic, peer-reviewed publications and the implied projections of progress towards the Sustainable Development Goals have not been verified by the United Nations.

broader Sustainable Development Goal stimulus plan in the amount of $500 billion per year. In the longer term, this implies boosting broader global public investment in the Goals and suitable options for fair burden-sharing and fiscal space. To strengthen systematic, focused international cooperation, sustainable development strategies, road maps or plans for science, technology and innovation are needed at the global, regional and national level that truly integrate priorities across sectors and achieve decent living standards for all, far beyond basic needs, and that build multi-stakeholder partnerships to support implementation.

V. Conclusion

81. The present report provides options for responding to the Secretary-General's call to deliver "a rescue plan for people and the planet.". In a business-as-usual future, not only would none of the Sustainable Development Goals be achieved, but the scenario paints on the whole a worrisome picture of unsustainable development towards mid-century, despite all the achievements and positive developments in some areas. The present report also highlights that recent scientific and technological breakthroughs could make a decisive positive difference for sustainable development, but an unprecedented level of global cooperation and effort would be required to make those new possibilities work for everyone. Most importantly, the report highlights recent sustainable development scenarios in which the Sustainable Development Goals would be achieved by 2030 and broader sustainable development by 2050. Member States, the United Nations system, decision-makers and other stakeholders are encouraged to consider the globally coordinated policies and high-impact actions that have been explored under the scenario and that will be needed for a sustainable future that leaves no one behind.

82. Lastly, the components of the United Nations system should be encouraged to work together in a one-United Nations model to: (a) support a better understanding, in real time, of overall sustainable development progress and of the latest technology accelerators and green windows of opportunity for achieving the 2030 Agenda; (b) support peer-learning and provide technical support and capacity-building to Governments on scenarios, technology futures, road maps and tools to help make the sustainable development pathway scenario a reality; and (c) convene scenario analysts, government advisors, scientists and frontier technology experts under the Technology Facilitation Mechanism to share experiences and synthesize the latest knowledge on the wider impacts of emerging technologies and the sustainable development model of the 2030 Agenda.