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The Sustainable Development Goals: Roadmaps to Progress

E. William Colglazier

The seventeen Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda have been called a gift to humanity.[1] While much worthwhile effort has occurred since the world's political leadership arrived at this consensus in 2015, much work remains to be done.

The SDGs represent an aspirational and practical definition of sustainable development applying to all countries. This broad set of interdependent social, economic, and environmental goals reflects value judgments made specific through the establishment of an array of targets and indicators.

The 2030 Agenda aims for synergistic progress by focusing on all the SDGs together. It seeks to mobilize funding and ensure that no one is left behind. To help achieve the goals, it promotes multi-stakeholder engagement, national action plans, and public-private partnerships. And it strives to harness science, technology, and innovation (STI) to accelerate progress.[2]

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Challenges

The challenges to making progress on the SDGs cover many issues. Aspirational rhetoric is nice, but effective policies, real action, and adequate funding are hard to implement and sustain. Just to begin with three prime examples, current targets do not cover all the essential elements. Many key indicators are either missing or lack adequate data. The voluntary national reviews submitted by member states to the UN High-Level Political Forum are useful, but not real action plans.[3]

Furthermore, stakeholder engagement is weak in most countries, including in many with top-down national plans. Not every government is paying attention, which is especially true of the United States. With a few notable exceptions, the STI community in most countries is not much involved.

As for the deficiencies in the targets and indicators, not only do targets for a number of goals fail to encompass all aspects required for developing realistic action plans, many indicators do not provide what is needed to adequately guide action and judge progress.

The deficiencies in the 232 indicators, which are classified into three tiers by the world's statistical agencies, include variable quality of methodology and data.[4] Tier 1 includes indicators with known methodology and regular reliable data collection. Tier 2 has indicators with known methodology, but data are not very well collected. Tier 3 includes indicators for which the methodology is not well defined and the data are hard to collect or uncollected. About one third of the indicators currently fall in each of the three categories.

Role of Science, Technology, and Innovation

The STI community can, in my view, help drive progress on the SDGs in multiple ways:

- Advising on challenges
- Providing indicators for monitoring progress
- Advising on policies and actions
- Searching for innovative solutions
- Ensuring every country and the UN have a robust science-policy interface.

Harnessing science, technology, and innovation for the SDGs requires the policy community, the STI community, and other stakeholders to engage on all five elements. The top two are incorporated in the 2030 Agenda. The bottom three are likewise crucial, but engaging on them has received much less attention. STI

helps to accelerate progress by promoting better use of evidence in policy making and by addressing knowledge and implementation gaps. Meaningful interaction of science advice across the different levels of governance – from local to global – increases the likelihood of significant impact.

STI is moving incredibly fast in our hyperconnected, competitive world, and advances have the potential to leapfrog political and diplomatic obstacles and create new pathways for progress. Advances can also produce disruptions and challenges. Most countries have recognized that for their own prosperity and national security, they must upgrade their STI capabilities. Fortunately, these are the same capabilities needed to make progress on the 2030 Agenda.

Multi-stakeholder STI Forum

The 2030 Agenda includes an initiative called the Technology Facilitation Mechanism (TFM), responsible for an annual Multi-stakeholder Forum at the UN focused on STI for the SDGs.[5] Recognizing the ways STI can help achieve progress, the 2017 STI Forum highlighted several general areas requiring increased attention by member states and the worldwide STI community,[6] encouraging these five actions in particular:

1. Utilize holistic approaches and systems analysis to help maximize synergies and minimize tradeoffs among the interdependent SDGs.

2. Emphasize STI capacity building in each country, including building human capacity and strengthening the science advisory ecosystem and the STI policy framework.

3. Create action plans and roadmaps that incorporate STI into national planning efforts addressing the SDGs.

4. Expand involvement through public-private partnerships and efforts that help create business opportunities in pursuing SDG solutions.

5. Conduct "deep dives" on every SDG, because only a comprehensive approach can yield realistic roadmaps for each SDG and for many existing and yet-to-be-developed targets—at the global, regional, national, local, and institutional levels—and thereby enable countries to achieve what is intended by the 2030 Agenda.

STI Roadmaps for the SDGs

The high-tech sector is among the fields to use roadmaps as a planning device toward achieving concrete goals. Roadmaps come in many different forms, but they usually encompass detailed action plans that are regularly updated based on new information and rigorous evaluation. Feedback loops to assess what is and is not working can help create a real learning environment.

Progress on the SDGs will be facilitated if we can build and implement detailed roadmaps at levels that range from local to global. They will be most effective if developed with stakeholder engagement, have integrated the plans of multiple government agencies, and have aimed at helping government become smarter in utilizing evidence.

The STI component of roadmaps is complicated in its own right, considering the need to address STI's role in facilitating and informing needed policies, actions, investments, and partnerships. The "STI for SDG" roadmaps are thus more than national plans for upgrading STI to address research needs, accelerate innovation, and spur economic growth. They necessarily incorporate the ability of science to advise on and evaluate the effectiveness of policies and actions, as well as produce innovations that overcome roadblocks and accelerate progress on all the SDGs.

STI for SDG roadmaps are useful at the global level for communication and motivation, but most actions for addressing the 2030 Agenda must occur at the national and subnational levels. The TFM can, however, be key in stimulating member states to take seriously the task of preparing STI for SDG roadmaps as part of their national plans and their own priority-setting agenda. A working group of member states, UN agencies, and the World Bank is now collaborating to provide guidance.[7]

If enough member states commit to preparing STI for SDG roadmaps over the next two years, this outcome would contribute substantially to the evaluation of the 2030 Agenda at the UN High-Level Political Forum with heads of state in 2019. The TFM would become a significant mechanism for technology facilitating progress.

The complexity of goals, targets, and indicators implies that STI for SDG roadmaps will be needed at many levels of detail and many levels of governance. Numerous individual targets will require detailed roadmaps at the global, regional, national, subnational, local, and institutional levels. And these roadmaps will have to take into consideration their implications for all the other SDGs and targets.

In helping to prepare STI for SDG roadmaps, the STI community will need to engage not only knowledgeable individuals and institutions but also a broad array of stakeholders, including individuals and communities most affected by the issues of concern. An example of what can be very helpful in focusing STI roadmaps is illustrated by a recent workshop addressing the issue of providing electricity to underserved regions.[8] The underserved populations mostly live in rural communities and villages where the national electric grids have not reached and incomes are low. This includes sizeable populations in Africa, Asia, and other parts of the world.

Recognizing that an overall objective of the 2030 Agenda is to leave no one behind, this workshop brought together experts from electrical utilities serving customers; government agencies implementing plans for national grids; development banks and development aid agencies providing funding and assistance; scientists and technologists from universities and research institutions investigating options; and foundations, private companies, and not-for-profit organizations developing off-grid solutions. But it also included individuals representing rural communities and young scientists driven by idealism to apply their expertise to societal problems.

The workshop focused on the first of five targets, along with two indicators, for SDG 7—to "ensure access to affordable, reliable, sustainable, and modern energy for all"—with a specific emphasis on the underserved population:

- Target 7.1: "by 2020, ensure universal access to affordable, reliable, and modern energy services"
  - Indicator 7.1.1: "proportion of population with access to electricity" (Tier 1)
  - Indicator 7.1.2: "proportion of population with primary reliance on clean fuels and technology" (Tier 1)

At the workshop, bringing together knowledgeable individuals with diverse expertise and experience and stakeholders representing interests of the rural poor from several regions resulted in a number of key insights on Target 7.1. These observations can ultimately benefit the lives and livelihoods of the rural poor and focus the relevant roadmaps. They may, conversely, help illustrate the limitations of the two indicators and help to improve communication back to the global level on the real aims of Target 7.1.1.

Here are three of the broad key insights that I learned from comments of participants:

1. The roadmaps for this target should "emphasize the services which people can access, rather than simply aggregate the energy they consume."[9] The range

of energy services should include "heating, cooling, cooking, lighting, mobility, mechanical power, communications, entertainment, etc., of adequate quality, reliability, affordability, efficiency, and environmental sustainability," with "each service having a metric to track progress and credible mechanisms for gathering relevant data."[10]

2. "There is a tendency to prioritize easy solutions over people's actual needs, and initiatives targeting those at the bottom of the energy ladder cannot be sustainable if they do not increase household income and support enterprise."[11]

3. "Of special importance is the need to better integrate plans for national electrical grid expansion and improvement with the infrastructure of off-grid energy services being implemented in rural areas where grid extension is years away."[12]

Such insights show how targeted workshops like this one can help illuminate the key factors on which STI for SDG roadmaps can focus.

Searching for Innovative Solutions

Innovative solutions are often seen as coming primarily from technological advances. Certainly, the world is counting on innovations in clean energy technologies to reduce costs and accelerate displacement of fossil fuels, with the goal of mitigating anthropogenic climate change. But important advances can also come from innovations in our policies, financing, and thinking, as well as from enhanced understanding of consumer needs and creative deployment of existing technologies.

This kind of creativity is exemplified in the experience of a private-sector company, Godrej, that has developed a new market in rural India, focused on addressing the widespread problem of keeping foods cool.[13] Recognizing that 80 percent of India's rural population lacks refrigeration capacity, and cannot afford modern refrigerators, Godrej turned to an existing technology, solid-state electronic cooling, that had been innovatively applied. These factors, along with persistence in developing the technology, and creative marketing and deployment, allowed the company to cost-effectively address a critical need of the rural poor.

The product, Chotukool, is marketed as "India's first mobile food & beverage cooler…open to all."[14] Small, portable, and affordable, it runs on intelligent solid-state cooling with no compressors, refrigerants, or moving parts—similar to how laptop computers are kept from overheating. Sheetak, a company based in Austin, Texas, developed and manufactures the efficient, environmentally friendly, solid-state electronic cooling engines.[15] Chotukool remains cool for three hours without electricity, and the power requirement is equivalent to one sixty-watt light bulb.

It can also be powered by batteries, such as a portable car inverter, and is sold through post offices to be available to rural India.

Innovative applications and deployment of existing technologies to meet the needs of consumers in developing countries will be highlighted at the Global Solutions Summit to be held at the UN on June 4, 2018, in advance of the third Multi-stakeholder STI Forum on June 5–6.[16]

What Else Is Needed

The following seven tasks also deserve high priority for governments and the worldwide scientific community:

1. Conducting Systems Analysis and Data Analytics

Maximizing synergies and minimizing tradeoffs among the interdependent SDGs requires sophisticated systems analysis, integrated assessments, and data analytics. Promising efforts by the world's scientific communities include: exploring future pathways through The World in 2050 initiative; advancing sustainability science through the Future Earth collaboration; examining SDG interactions and interdependencies through the investigations of the International Council for Science and the International Network for Government Science Advice; and developing analytical approaches for drawing insights from massive amounts of new data through the explorations of the Science and Technology for Sustainability Program of the U.S. National Academies.[17] Insights can come from many creative approaches and innovative analyses. A recent example is an examination of the detailed connections between the health SDG and other SDGs combined with an emphasis on the central importance of the universal health coverage target.[18] This thoughtful approach can be replicated for other SDGs.

2. Building Online Platforms for Mutual Learning and Technology Deployment

A second task for the TFM, alongside running the Multi-stakeholder Forum, is to help create an online platform that will channel the power of the internet and the information and communication technology revolution to facilitate mutual learning among societies, institutions, and individuals, as well as help connect seekers of technological solutions with potential providers.[19] This is a complicated undertaking given the large number of platforms of various types already in existence, not all of them useful or used. Helping develop the right global platform remains a high priority for the TFM.

3. Building STI Capacity and Knowledge-Based Societies

The overriding importance of pursuing actions and policies to strengthen STI and human capacity has been emphasized in every STI Forum. Indeed, creating knowledge-based, innovative societies may be one of the most significant legacies of the 2030 Agenda. To this end, building STI capacity and science advisory ecosystems in every country as well as at the UN should be a key objective of the STI for SDG roadmaps. To date, several UN and international agencies have conducted reviews of STI capacity for a range of countries with the goal of advancing economic development and dealing with specific challenges such anthropogenic climate change.[20] The lessons learned from these specific national assessments can help inform the task of preparing STI for SDG roadmaps addressing broad agendas. Building capabilities to conduct high-quality research is also essential in these action plans, including in fundamental basic research as well as in mission-directed applied research and development. The Global Development Network, a nongovernmental institution that focuses on building social science research capacity in emerging countries, has emphasized the importance of conducting social science research on development challenges.[21] Just as the International Network for Government Science Advice is strengthening the role of science advice in the science policy of many countries, the Foreign Ministries Science and Technology Advisors Network is doing that in diplomacy.[22]

4. Providing Financing from Multiple Sources

The largest funding sources for advancing the SDGs will be expenditures and investments by governments and the private sector. Government expenditures need to be directed wisely in order to achieve intended outcomes and to avoid corruption, mismanagement, and inefficiencies. When it comes to private-sector investment, motivation will be enhanced by policies and partnerships that align the interests of large and small companies with progress on the SDGs and associated business opportunities.[23] Although at a lower level than government and private-sector investment, the financial resources made available by development aid, philanthropy, and specialized global funds enable important initiatives and programs addressing the SDGs that otherwise would not happen.

5. Contributing to the Global Commons

SDGs addressing climate, oceans, and terrestrial ecosystems that transcend national borders are among the concerns requiring significant motivation and inspiration on the global level to stimulate national-level actions. The Paris Agreement has been a significant step forward with its voluntary Intended Nationally Determined Contributions, prepared and updated by countries, and the

annual Conference of Parties with discussion of additional measures. For protecting the oceans and their biological and physical resources, progress has been made in developing voluntary commitments, sustainable fisheries management plans, implementation of international law, and increased coverage of marine protected areas. The mandate of the Antarctic Treaty and the work of the Arctic Council help inspire protection of the global commons in other regions.

6. Dealing with Technological Disruptions and Challenges

The technological disruptions and challenges emerging from rapid advances and adoption of technologies such as artificial intelligence, robotics, gene editing, synthetic biology, blockchain, and social media have received much attention. All these technologies present opportunities as well as significant challenges. The negative implications range from potentially significant job loss in certain sectors without new employment opportunities, to societal disruption through the spread of false news and loss of privacy, to the creation of new technological capabilities that threaten national and personal security. As much effort should be directed at anticipating and mitigating these consequences as to taking advantage of corresponding business and development opportunities.

7. Contributing to Peace and Security

SDG 16, interpreted in the broadest context of UN responsibilities, may be the most important goal of all. Wars and conflicts can quickly upset the universal aspirations represented by the 2030 Agenda. As was emphasized by the great scientist-humanist Jacob Bronowski, the values that come from doing science reinforce fundamental values of humanity.[24] This year is the seventieth anniversary of the Universal Declaration of Human Rights—another great gift for the world from the United Nations. **SD**

Endnotes

1. The UN Sustainable Development Knowledge Platform contains much useful information on the SDGs, along with targets and indicators, and is regularly updated with the many UN and other efforts to address the 2030 Agenda. See https://sustainabledevelopment.un.org. I heard the description of the 2030 Agenda as a gift to the world from Peter Bakker, president and CEO of the World Business Council for Sustainable Development. He and I served on the 10-Member Group appointed for 2016 and 2017 by the UN secretary-general to advise on the role of STI for the SDGs, as part of the Technology Facilitation Mechanism of the 2030 Agenda.

2. E. William Colglazier, "Diplomacy for Science and Science for Sustainable Development," *Science & Diplomacy* 5, no. 1 (March 2016): 6–11, http://www.sciencediplomacy.org/editorial/2016/diplomacy-for-science-and-science-for-sustainable-development.
3. "Voluntary National Reviews Database," Sustainable Development Knowledge Platform, https://sustainabledevelopment.un.org/vnrs/. The VNRs are sometimes used to report current actions repackaged to address the goals.
4. "Indicators," Sustainable Development Knowledge Platform, https://sustainabledevelopment.un.org/topics/indicators.
5. "Technology Facilitation Mechanism," Sustainable Development Knowledge Platform, https://sustainabledevelopment.un.org/tfm.
6. See "Multi-stakeholder forum on science, technology, and innovation for the Sustainable Development Goals: summary by the Co-Chairs," June 24, 2016, http://www.un.org/ga/search/view_doc.asp?symbol=E/HLPF/2016/6&Lang=E; "Co-Chairs' summary of the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals," May 31, 2017, http://www.un.org/ga/search/view_doc.asp?symbol=E/HLPF/2017/4&Lang=E; and "Statement by: 10-Member Group to Support Technology Facilitation Mechanism," June 4, 2016, https://sustainabledevelopment.un.org/index.php?page=view&type=255&nr=21201&menu=35.
7. A working group that includes representatives of the government of Japan, the World Bank, several UN agencies, and the UN Department of Economic and Social Affairs met with interested observers, including myself, at the UN on March 26–27, 2018; it will meet again on May 8–9, in Tokyo, with representatives of several member states. Japan has been instrumental in pushing this initiative forward.
8. National Academies of Sciences, Engineering, and Medicine, *Providing Reliable and Affordable Electricity in Countries with Energy Deficits* (Washington, DC: National Academies Press, forthcoming 2018).
9. Ibid. Participants' comments were made under Chatham House Rule not permitting attribution.
10. Ibid.
11. Ibid.
12. Ibid.
13. See the Chotukool webpage, https://www.chotukool.com.
14. Ibid.
15. See the Sheetak website, http://www.sheetak.com/.
16. Details available at Global Solutions Summit, http://www.globalsolutionssummit.com/. The goal is to ensure that new and existing solutions are deployed on a scale commensurate with local, national, and global challenges.
17. See "The World in 2050," International Institute for Applied Systems Analysis, http://www.iiasa.ac.at/web/home/research/twi/TWI2050.html; Future Earth, http://www.futureearth.org/home; International Council for Science, https://icsu.org; International Network for18 Government Science Advice, http://www.ingsa.org; and "Science and Technology for Sustainability Program," National Academies of Sciences, Engineering, and Medicine, http://sites.nationalacademies.org/PGA/sustainability/index.htm.
18. Christopher Dye, "Expanded Health Systems for Sustainable Development," Science 359, no. 6382 (March 23, 2018): 1337–39, http://science.sciencemag.org/content/359/6382/1337.full.
19. "Technology Facilitation Mechanism," https://sustainabledevelopment.un.org/tfm.
20. Informative country analyses and reviews related to STI are carried out by the UN Conference on Trade and Development, through its Science, Technology, and Innovation Policy (STIP) reviews; the World Bank; the UN Environmental Programme; the World Intellectual Property Organization; the Organisation for Economic Co-operation and Development; and other international agencies.
21. Global Development Network, http://www.gdn.int.
22. Foreign Ministries Science and Technology Advisors Network, http://www.ingsa.org/chapters/fmstan/
23. The World Business Council for Sustainable Development has five innovative programs for achieving systems transformation; see https://www.wbcsd.org.
24. Jacob Bronowski, *Science and Human Values*, rev. ed. (New York: Harper & Row, 1965).