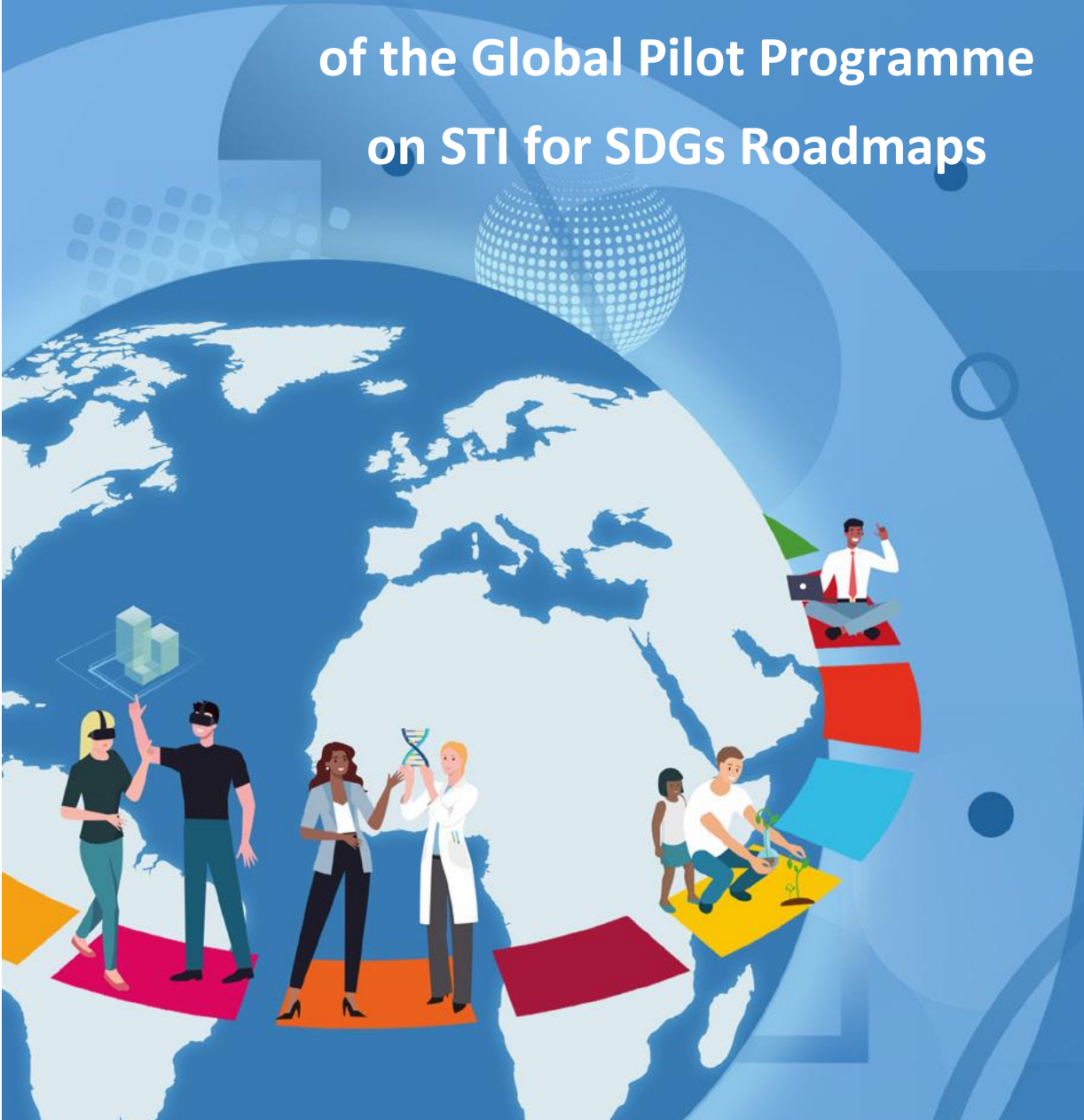


# PROGRESS REPORT

of the Global Pilot Programme  
on STI for SDGs Roadmaps



Department of  
Economic and  
Social Affairs



UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION

## Foreword

Attaining the 17 Sustainable Development Goals (SDGs) is the most important global agenda for 2030. Recent analyses made by the United Nations and other international organizations point out that it is very difficult to achieve the SDGs if we continue business as usual. Efforts have been further hindered by the recent COVID-19 pandemic. Getting the SDGs agenda back on track is an urgent priority.

STI for SDGs roadmaps stimulate collective and coherent actions and strict progress evaluation so that STI contributes greatly to attaining the SDGs. Indeed, roadmaps are essential for the effective integration of STI into national and sub-national development plans addressing the SDGs. In the early STI Forums convened by the United Nations Economic and Social Council, implementing STI for SDGs roadmaps was points of intense discussion, and the “Global Pilot Programme on STI for SDGs Roadmaps” was launched at the High-Level Political Forum in 2019.

While taking account of local circumstances and priorities, each of the six countries (Ghana, Ethiopia, Kenya, India, Serbia and Ukraine) participating in the first phase of the Programme has been working on implementing concrete roadmaps in line with the “Guidebook for the Preparation of STI for SDGs Roadmaps” published by the UN Inter-Agency Task Team. The potential of STI for SDGs roadmaps for innovating national ecosystems of each country is well recognized from the first stage experiences.

What is needed today for harnessing STI for SDGs is dynamic roadmapping which encompasses a series of enhanced actions according to new circumstances. I hope that this report contributes to expanding the Global Pilot Programme and paving the way for the SDGs.

**Michiharu Nakamura**  
**UN 10-Member Group (2018-2020)**

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# Executive Summary

## Background

The 2030 Agenda, adopted at the United Nations Sustainable Development Summit in September 2015, positioned Science, Technology, and Innovation (STI) as key means of implementation of the SDGs, and launched the UN Technology Facilitation Mechanism (TFM). The Annual Multi-Stakeholder Forum for Science, Technology, and Innovation (STI Forum), supported by the Inter-Agency Task Team on Science, Technology and Innovation for the SDGs (IATT), has been the main fora for TFM to discuss topics of common interests of Member States and STI stakeholders in the context of the 2030 Agenda.

As STI roadmaps and action plans to help realize the SDGs have been among the central topics through the first three STI Forum<sup>1</sup>, IATT established a sub-working group on Roadmaps<sup>2</sup> for taking forward the discussions and initiatives on STI Roadmaps.<sup>3</sup> Consequently, the IATT sub-working group together with 10-Member Group<sup>4</sup> have launched the Guidebook for the preparation of STI for SDGs Roadmaps.

As a mean to engage countries in piloting the approach and methodology elaborated in the Guidebook, the IATT sub-working group has also launched a Global Pilot Programme on STI for SDGs roadmaps. **Since the last High Level Political Forum (HLPF) in July 2019, five pilot countries, Ethiopia, Ghana, India, Kenya and Serbia, together with two international partners, Japan and the European Union, have been participating in the first phase of the Programme. Ukraine joined the Programme in 2021.** As more countries are interested in joining the Pilot Programme<sup>5</sup>, new efforts are also **underway to initiate a support mechanism for the second wave of countries to join the Pilot Programme** through a new joint initiative called “Partnership in Action,” concept in which is described in a draft outreach note.

Meanwhile, **IATT has developed two background papers, one on International Cooperation and another on methodologies, which, together with the Guidebook, inform IATT’s continuous dialogues with national authorities leading roadmap pilots, and prepared grounds for solidifying respective pilot design as well as peer learning.**

This Progress report of the Global Pilot Programme is designed to take stock of the state of country pilots, to draw out lessons and implications from the current implementation and to suggest ideas for the way forward. The longer, full version of the progress report will also be available on TFM website.

## Current State of Country Pilots

This progress report uses SDG index to provide comparative information on where pilot countries have started with respect to STI and SDGs<sup>6</sup> (Figures 1 and 2). The two indexes show a positive co-relation but with large variance. A key observation is that **more effort needs to be dedicated to improving STI capability, particularly in developing countries**, as Goal 9 (which has been structured primarily around

<sup>1</sup> In the Addis Ababa Action Agenda, Member States had committed to “adopt science, technology and innovation strategies as integral elements of our national sustainable development strategies” (para 119). In the 2017 STI Forum, participants highlighted that the STI roadmaps and action plans are needed at the subnational, national and global levels, and should include measures for tracking progress. These roadmaps incorporate processes that require feedback loops, evaluate what is working and not working, and produce continual revisions that create a real learning environment.

<sup>2</sup> IATT is coordinated by DESA and UNCTAD, and the co-leads for its sub working group on STI for SDGs Roadmaps, which also include the World Bank and UNESCO; Outside of the UN, EU-JRC and OECD actively participate and contribute to the activities.

<sup>3</sup> The objective of the sub-working group is to devise and implement, with the help IATT partners and other stakeholders, an inter-sessional work program that will enrich STI Forum discussions on STI Roadmaps, through delivering tangible impact to be achieved over 2018-2019.

<sup>4</sup> 10 Member Group is a group of 10 high-level representatives from civil society, the private sector and the scientific community.

<sup>5</sup> In total (including the countries in the first phase of the pilot programme), more than 20 countries, including a number of Asian and African countries, including Cambodia, China, Indonesia (Oman and Republic of Korea), Botswana, Chad, Rwanda, South Africa, and Tunisia, have expressed interest in joining the programme to implement the roadmaps along the guidelines of the Guidebook.

<sup>6</sup> Note: We are fully aware that data for indicators is missing and indicators for some important dimensions are lacking, particularly in developing countries. Our intention is to contextualize where the countries started their pilot projects to help monitoring and evaluation processes to follow.

STI) appears to be one of the weakest. Another important point to note is that **there is a large room for improvement in harnessing STI for SDGs**, as some of the pilot countries do worse on the SDG index.

### **Lessons Learned In pilots (following steps specified in the Guidebook)**

All six pilot countries have taken the first step of STI for SDGs Road-mapping exercise, *objective setting of pilot projects*; they have done so within the context of their national development plans and their economic and social conditions. All of them have **chosen a narrow set of SDGs** because of the difficulty of tackling all the SDGs simultaneously. As most countries are low income or lower middle-income countries with high poverty rates and the largest share of employment in agriculture, it is not surprising that **SDGs 1, 4, and 2 are the most commonly chosen goals**.

As the second step, *assessment of the current situation* of both SDG gaps and STI supply/capability, requires a lot of data and expertise, the depth of the assessment has varied across the pilot countries. In the third step of *developing a vision, goals and targets*, what seems to matter is institutional set-ups through which they have engaged in the pilot exercise, especially in **involving the highest level of government in the process**.

The fourth step of *assessing alternative pathways* is perhaps the most complex and expensive one, requiring the engagement of representatives from different groups in the innovation chain, including not just the technology, but the agents involved in the value chain to diffusion and use as well as the provision of complementary inputs including finance and infrastructure. None of the pilot countries have yet fully *developed detailed roadmaps* or have reached the *execution or implementation phase*. But during these steps, **monitoring and evaluation is a critical element as it will enable countries to learn from the implementation experience and to adjust as well as to take into account the impact of changes in the context, i.e., the current COVID-19 crisis**. The *use of data and expertise* has varied widely across pilot countries, depending in large part on what information is readily available as well as how much effort they have put into developing and collecting relevant data. There has also been a lot of variation in the extent to which domestic and international expertise has been tapped to help develop the roadmap, as well as the nature and depth of stakeholder consultations.

**The most common challenge**, experienced by all countries, **has been getting stakeholder involvement and active participation**. Pilot countries doing relatively well, have succeeded in involving several ministries and agencies, creating platforms for getting effective coordination and collaboration among government and between government and other stakeholders. **A related challenge has been getting a focus on SDGs into the development of national plans and the STI for SDGs roadmap**. The second **major challenge has been the availability of updated data and relevant expertise** to do the assessment to develop priorities. Besides the COVID-19, another common problem which has slowed the preparation of the roadmaps is **the lack of specific budget to develop and more importantly to implement the STI for SDG roadmap**.

Table 1 presents a review of progress on the development of the STI for SDG roadmaps by each of the pilot countries.

### **Moving Forward**

Building on the progress and success made thus far, collective actions are needed to expand and strengthen the Global Pilot Programme on STI for SDGs roadmaps. Setting up a community of practice of countries developing and implementing roadmaps would be an enormous help, for example. The UN IATT and its Member countries with relevant stakeholders need to **draw more on existing national and international information, technical as well as financial resources and take a full advantage of**

the opportunities offered by new and existing technologies<sup>7</sup> through the afore-mentioned “Partnership in Action.”

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<sup>7</sup> There is a great opportunity to harness new digital technologies and take advantage of the convergence between digital, physical and biological technologies, while addressing the potential negative effects of these disruptive technologies such as tendency for increasing inequality, risk that as more personal data becomes digitized there are serious issues of privacy, security, and autonomy.

**Table 1: Six Countries Participating in the Global Pilot Program for STI for SDGs Roadmaps**

	Kenya	Ghana	Ethiopia	India	Serbia	Ukraine
<b>Lead and other institutions involved</b>	<ul style="list-style-type: none"> <li>- Treasury, Dept. of Planning</li> <li>- NACOSTI, ACTS</li> <li>- Line ministries (Edu S&amp;T, Foreign, ICT, Agri, Industry)</li> </ul>	<ul style="list-style-type: none"> <li>- Min of Env &amp; STI</li> <li>- CSIR-STEPRI</li> </ul>	<ul style="list-style-type: none"> <li>- Ministry of Innovation &amp; Technology</li> <li>- Ministry of Science and Higher Education</li> </ul>	<ul style="list-style-type: none"> <li>- PSA Office</li> <li>- Niti Aayog, Min of ext. affairs, RIS</li> <li>- National Coordination Committee</li> </ul>	<ul style="list-style-type: none"> <li>- Lead: Min of Edu, S&amp;T; coordinating Inter-ministerial Working Group and cooperation with national Agenda 2030 Group. Other actors: Working groups for Smart Specialization (4S) priority domains led by business and academia, National Statistics office, National Patent Office; National Analytics team (academia-led)</li> </ul>	<ul style="list-style-type: none"> <li>- Lead: Vice Prime Minister's Office</li> <li>- Ministry of Education and Science</li> <li>- Ministry of Economy</li> <li>- National Smart Specialization Team</li> </ul>
<b>Underlying policy frameworks</b>	<ul style="list-style-type: none"> <li>- Kenya Vision 2030</li> <li>- MTP III 2018-22, Big Four</li> <li>- STI Policy, Research Priorities</li> <li>- Digital Economy Blueprint</li> <li>- Agricultural Sector Transformation and Growth Strategy (2019-2029)</li> </ul>	<ul style="list-style-type: none"> <li>- Agenda for Jobs 2017-2021</li> <li>- CPESDP 2017-24</li> <li>- National STI Policy 2017</li> </ul>	<ul style="list-style-type: none"> <li>- GTP III 2015-20</li> <li>- STI Policy 2012</li> </ul>	<ul style="list-style-type: none"> <li>- Strategy for New India@75</li> <li>- STI Policy 2013</li> </ul>	<ul style="list-style-type: none"> <li>- EU Accession Process and 4S</li> <li>- New STI and industrial policy under Prime Minister</li> <li>- Agenda 2030</li> </ul>	<ul style="list-style-type: none"> <li>- EU Integration Process and Smart Specialization Agenda 2030</li> </ul>
<b>Scope and objectives of roadmap</b>	<ul style="list-style-type: none"> <li>- Big Four (agri, health, manufacturing, housing)</li> <li>- Agro-processing and ICT as an initial focus</li> <li>-SDG2 and those closed linked to it</li> </ul>	<ul style="list-style-type: none"> <li>Focusing on SDGs 1, 2, 3, 4, 6, 8 and 9. The roadmap discussed these SDGs and the strategies, programmes and activities to ensure STI accelerate the</li> </ul>	<ul style="list-style-type: none"> <li>SDG 8 (Job creation)</li> </ul>	<ul style="list-style-type: none"> <li>- Agri, energy, water, health; align with key initiatives (e.g. Doubling Farmers Income, JAM Trinity)</li> <li>- Strong international focus – Africa and Far East</li> </ul>	<ul style="list-style-type: none"> <li>-Develop the implementation plan to guide work on the four defined smart specialization priority domains and horizontal actions</li> <li>-Priorities include: creative industries; food for the</li> </ul>	<ul style="list-style-type: none"> <li>- Identify National SDG priorities</li> <li>- Coordinate national and regional (subnational) priorities</li> <li>- Identify STI potential and key actions</li> <li>Develop a detailed Action Plan</li> </ul>



	(SDG1, SDG8 and SDG 9)	achievement of these prioritized SDGs			future; machines and production processes of the future; ICT	
<b>Approach to pilot</b>	<ul style="list-style-type: none"> <li>- Sectoral deep-dive, target-driven (100% food and nutrition security by 2022)</li> <li>- R&amp;D &amp; adoption/diffusion</li> <li>- Aiming for an East Africa regional model</li> </ul>	<ul style="list-style-type: none"> <li>- Build on technology incubation centers</li> <li>- Aim for investment proposals and institutional strengthening</li> </ul>	- Sectoral: build on 24 technology roadmaps	<ul style="list-style-type: none"> <li>- International national and subnational levels (Lighthouse India, cooperative federalism)</li> <li>- Data/Dashboard to be substantiated through STI-PER inputs</li> </ul>	<ul style="list-style-type: none"> <li>-Leverage on ongoing work underpinning the production of a 4S, taking into consideration the national, subnational and international dimensions</li> <li>- mix of deep dives and horizontal activities building on existing stakeholder mechanisms and working groups contributing to 4S methodology</li> </ul>	<ul style="list-style-type: none"> <li>-Leverage on ongoing work underpinning the production of a Smart Specialization Strategy, taking into consideration the national, subnational and international dimensions</li> <li>- mix of deep dives and horizontal activities building on existing stakeholder mechanisms and working groups</li> </ul>
<b>Timeframe and key milestones</b>	To be updated	<ul style="list-style-type: none"> <li>-Dec 2019: deliberation of the objective of the roadmap and development of tentative workplan</li> <li>-June 2020: Inauguration of Technical task team</li> <li>- July 2020: Technical Task meeting validating the situational analysis report and discussing the Roadmap outline (composition of drafting working teams)</li> </ul>		<ul style="list-style-type: none"> <li>- First 6 months (in India)</li> <li>- End 1<sup>st</sup> year (AfDB AMs?)</li> <li>- End 2<sup>nd</sup> year (in NY)</li> </ul>	<ul style="list-style-type: none"> <li>- adoption of Smart Specialization Strategy (February 2020) and a detailed roadmap: October 2020</li> <li>- adoption of the Action Plan (STI for SDGs Roadmap) in March 2021</li> </ul>	<ul style="list-style-type: none"> <li>- adoption of first regional Smart Specialization Strategies: December 2021</li> <li>- National level Roadmap: to be decided</li> </ul>



			-Sep 2020 Finalization of the situational analysis report - Feb 2021: presentation by Ghana focal person of the STI for SDGs pilot at the African STI Forum -March 2021 Submission and review of the 1 <sup>st</sup> draft of the Roadmap - March 2021: Task team meeting to discuss 1 <sup>st</sup> draft of the Roadmap and provide comments and feedback -April 20201 Expected finalization of the Roadmap				
<b>Partners (DESA: The Secretariat)</b>	IATT focal	- WB (STI PER) - UNESCO (Saga, Go-SPIN)	- UNESCO - WB	- UNCTAD (STIP Review) - WB, UNESCO	- WB (STI PER) - ESCAP	- EU/JRC - UNIDO	- EU/JRC - UNIDO
	UN, Others	- Priv. partnership (Toyota)	- OECD	- UNDP, UNIDO	- OECD - UNDP		
		Possible EU/ACP, AUC, RECs, Japan-India-Africa cooperation					

\* Key abbreviations: [Kenya] National Commission on Science, Technology and Innovation; African Center for Technology Studies; Mid Term Plan III. [Ghana] Council for Scientific and Industrial Research – Science and Technology Policy Research Institute; Coordinated Programme of Economic and Social Development Policies. [Ethiopia] Growth and Transformation Plan III. [India] National Institution for Transforming India; Research and Information System for Developing Countries; electronic National Agricultural Marketing; Mission Indradhanush; Swachh Bharat Mission Gramin; National Innovation Foundation. [Serbia] Research and Innovation Strategies for Smart Specialization.

# Chapter 1. Introduction

## Background

The 2030 Agenda, adopted at the United Nations Sustainable Development Summit in September 2015, positioned Science, Technology and Innovation (STI) as key means of implementation of the SDGs, and launched the UN Technology Facilitation Mechanism (TFM). The Annual Multi-stakeholder Forum for Science, Technology and Innovation (STI Forum), supported by the Inter-Agency Task Team on Science, Technology and Innovation for the SDGs (IATT), has been the main fora for TFM to discuss topics of common interests of Member States and STI stakeholders in the context of the 2030 Agenda.

STI roadmaps and action plans to help realize the SDGs have been among the central topics through the first three STI Forums. In the Addis Ababa Action Agenda, Member States had committed to “adopt science, technology and innovation strategies as integral elements of our national sustainable development strategies” (para 119). In the 2017 STI Forum, participants highlighted that the STI roadmaps and action plans are needed at the subnational, national and global levels, and should include measures for tracking progress. These roadmaps incorporate processes that require feedback loops, evaluate what is working and not working, and produce continual revisions that create a real learning environment.

With a view to translate these objectives into concrete outcomes, the IATT established a sub-working group for taking forward the discussions and initiatives on STI Roadmaps. The objective of the sub-working group on STI for SDGs Roadmaps is to devise and implement, with the help of IATT partners and other stakeholders, an inter-sessional work program that will enrich STI Forum discussions on STI Roadmaps, through delivering tangible impact to be achieved over 2018-2019.

Consequently, the IATT sub-working group together with 10-Member Group has launched the Guidebook for the preparation of STI for SDGs Roadmaps. The Guidebook is currently being translated into eight languages, including the six UN official languages. As a mean to engage countries in piloting the approach and methodology elaborated in the Guidebook, the IATT sub-working group has launched a Global Pilot Programme on STI for SDGs roadmaps, and since the last in July 2019, five pilot countries, Ethiopia, Ghana, India, Kenya and Serbia, together with two international partners, Japan and the European Union, have been participating in the first phase of the Programme. Ukraine joined the Programme in 2021.

As more countries are interested in joining the Pilot Programme, new efforts are also underway to initiate a support mechanism for the second wave of countries to join the Pilot Programme through a new joint initiative called “Partnership in Action,” concept in which is described in a draft outreach note.

At the same time, IATT has developed two background papers, one on international STI collaboration and investment for the SDGs and another providing an overview of methodologies for STI for SDGs roadmapping, which, together with the Guidebook, inform IATT’s continuous dialogues with national authorities leading roadmap pilots, and prepared grounds for solidifying respective pilot design as well as peer learning.

## Objectives

This objective of this progress report of the Global Pilot Programme is to:

- Summarize the current state of the programme in the six pilot countries through country write-ups prepared by the IATT focal points working on each country in coordination with the country teams developing the roadmaps (Chapter 3)
- Summarize the lessons and implications from the current implementation experience in the six countries as well as from the three country case studies of successful national examples submitted as of May 2020 and implications for international STI collaboration (Chapter 4)

- Draw out some of the implications of these lessons (Chapter 4) for
  - Future revisions and sharpening of the Guidebook
  - Further work in the pilot countries
  - For countries that may join the pilot programme in the future and
  - For moving forward

To put what in context what is being done in each pilot country, chapter 2 provides a broad snapshot of the STI gaps in the first six countries, as well as their relative positions on the SDG gap index and their innovation capability.

The three country case studies that have been received as of May 2020 are in the Annex.

## Chapter 2. Current State of Countries and of Country Pilots

### Contextualization of where countries are with respect to STI for SDGs

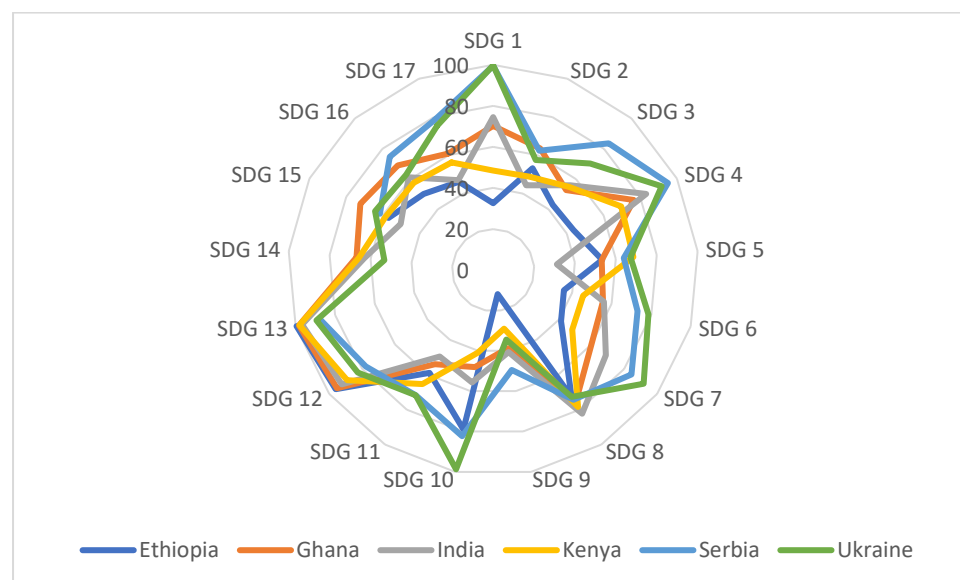
While each country has to do a detailed assessment of its SDG gaps and its goals depending on its situation and ambition, it is useful to look at broad indicators of where countries stand in order to provide some context for understanding their STI for SDG roadmaps. This is done in this section by using two indicators that are available for most countries in the world. In addition, Appendix A.1 presents data on the six countries' relative size, economic structure, social and environmental indicators.

#### The SDG Index

Although full and robust indicators of SDG gaps are not available at a global level<sup>8</sup>, a rough idea of each country's position can be obtained from the SDG Index produced by Bertelsmann and Sustainable Development Solutions Network every year. The report is not an official monitoring of SDGs but rather uses publicly available data published by official data providers (World Bank, WHO, ILO, others) and other organizations including research centers and non-governmental organizations. The SDG Index scores countries on the 17 SDG goals. The score indicates a country's position between the worst (0) and the best or target (100) outcomes on each of the 17 SDG goals.<sup>9</sup> Although there is some variation, in general, there is a positive relationship between a country's overall SDG Index and its per capita GDP (Figure A.2).

The position of each of the pilot countries with respect to the 17 SDGs is presented on Figure 2.1 where the outer part of the circle represents being on target.

Figure 2.1 Position of the Six Pilot Countries on the SDG Index Score.



Source: Bertelsmann and Sustainable Development Solutions Network (2018). *SDG Index*

<sup>8</sup> There is ongoing work to improve SDG indicators. The UNESCO Statistical Institute, in particular, is working on a broader and more detailed set of STI and SDG indicators. There are also various methodologies for STI roadmapping. The IATT Background paper on Overview of the existing STI for SDGs roadmapping methodologies (2020) provides a summary of various such methodologies.

<sup>9</sup> While data for indicators is missing in many countries, and there are lack of indicators for some dimensions of important components of SDG goals, particularly for developing countries, the SDG index does provide some useful information that can be compared at the global level.

## Observations

### SDG gaps

One of weakest areas is the SDG 9 index. Although the goal is supposed to cover industry, infrastructure and innovation, the actual indicators used in the index are structured primarily around STI capability. This is the SDG on which all the pilot countries scored the lowest. Similarly, all developing countries score the lowest on SDG 9 relative to the other SDG goals. This implies that much more effort needs to be dedicated to improving STI capability in the pilot countries as well as among developing countries more generally.

One of best performing SDGs for developing countries is environmental. However, developing countries are ranked favorably here due to their low level of development. But it should be noted that developing countries do poorly on natural resource depletion as indicated in comparative ESE basic indicators.

### The assessment of current state of STI for SDGs roadmaps

The assessment of the current state of STI for SDGs roadmaps is based on the updated achievements reported by the IATT focal points in the six pilot countries outlined in the Guidebook, their collected data, expertise and stakeholder consultations, as well as their self-reporting challenges and lessons learned.

Table 2.1. presents a review of progress on the development of the STI for SDGs roadmaps by each of the pilot countries, including the key agencies leading the process, other expected stakeholders and timeline, challenges and lessons learned.

Chapter 3 summarizes what has been achieved so far in developing the STI for SDG roadmaps in the pilot countries.

Chapter 4 draws the lessons and implications from their experience to date, as well as from the case studies of the effective use of STI to accelerate development goals in three pilot countries.

**Table 2.1: Summary of Pilot Countries Approach and Progress in Developing Their STI for SDGs Roadmaps (based on reports from Chapter 3)**

	<b>Ethiopia</b>	<b>Ghana</b>	<b>India</b>	<b>Kenya</b>	<b>Serbia</b>	<b>Ukraine</b>
<b>Leading Ministry(ies)</b>	Ministry of Innovation and Technology (MINT) is lead agency, Ministry of Science and Higher Education (MOSHE) interesting in joining. Working on modalities of collaboration	Min. of Environment, Science, Technology, and Innovation (MESTI) & CSIR-STEPRI (policy research institute). Technical oversight committee co-chaired by President's SDG Advisory Unit and MESTI. Involves Ministries of Finance, Planning, etc.	Office of Principal Scientific Advisor (PSA) of Prime Minister and NITI Aayog (main policy think-tank of the government).	State Department of Planning in National Treasury and National Commission for Science, Technology, and Innovation (NACOSTI) in Ministry of Education; in partnership with Ministries of ICT, Foreign Affairs, Agriculture, and Industry, and is supported by African Center for Technology Studies (ACT)	STI for SDGs roadmap being developed from Serbia's Smart Specialization Strategy (4S), announced February 2020 lead by Prime Minister's Inter-Ministerial Working group and operationalized by Ministry of Education, Science and Technology. Participation of multiple ministries, private sector, and academic community	The office of the Deputy Prime Minister for European and Euro-Atlantic Integration of Ukraine, Ministry of Education and Science, Ministry of Economy, Interministerial National Smart Specialisation Team
<b>Objectives &amp; Scope</b>	Effort so far has been based on Science Technology and Innovation Policy (STEP) Review concluded in 2019. Key STGS that appear to be planned targets are 1, 2, 3, and 10.	Focusing on SDGs 1, 2, 3, 4, 6, 8 and 9. The roadmap discussed these SDGs and the strategies, programmes and activities to ensure STI accelerate the achievement of these prioritized SDGs	Focusing on SDGs 1, 3, 6, 7, and 17 (because of India's strong STI capability and interest in partnering with developing countries.	Main objective is plan for implementation of STI policy and support for delivery of President's Big Four Agenda, which focusses on agriculture, manufacturing, health, and housing and therefore includes SDGs 1,2,8, and 9. Gender in STI (SDG5) has also been included for the roadmap development.	4S agenda is to foster socio- economic development and transformation based on 6 knowledge-intensive priority sectors (food, creative industries, manufacturing, ICT, key enabling technologies, energy. STI for SDGs roadmap is to be detailed action plan of the 4S. SDGs include: 2, 7, 8	National and subnational Smart Specialisation priority domains and priority SDGs implemented via detailed Action Plan: STI for SDGs Roadmap
<b>Assessment of Current Situation</b>	Has been done as part of the STEP Review. Included collection of data and knowledge on development	Largely based on STI Eco survey SDG baseline report 2018 A STI situational analysis was conducted and validated by the Technical Task team, with inputs	Detailed R&D assessment at subnational and national level (2019).	Used indicators from various international and national databases on SDG gaps and country situation.	4S plan involved detailed assessment of economic, innovation, and research potential of Serbia. EC JC financed mapping SDGs	Preparatory stage (Ukraine joined the Global Pilot Programme in February 2020) –

	situation of country, status of national innovation system including 22 sectoral technology roadmaps.	and contribution from various STI stakeholders.	NITI Aayog constructed SDG India Index for 13 of 17 SDGs on set of 62 priority indicators. Mapping of some key sectors completed.	Is undertaking STI Public Expenditure Review aiming to promote R&D and technology adoption and diffusion with increased efficiency and effectiveness	prioritized in the 4S plan, statistical baseline analysis and identification of STI inputs focused on specific SDG goals (May 2)	establishing the governance structure
<b>Vision, Goals and Targets</b>	In process, part of drafting a New National STI Policy. Roadmap is to follow preparation of the new STI policy. Linked to strong employment focus in National Development Plans. Focus on job creation, SDG 8 (decent work and economic growth) which feeds indirectly into improving other SDGs such as 1, 2, 3 and 10.	Build strong STI capacity to support social and economic development for sustainable development.  The ultimate goal is to fast-track the achievement of the prioritized SDGs (1, 2, 3, 4, 6, 8 and 9) using STI. The prioritized SDGs and targets for the Roadmap is elaborated in chapter 3.	Overall framework in Strategy for a new India@75. Vision, goals, and targets still under preparation. Some of main initiatives revolve around use of digital technologies to facilitate coordination and implementation of plan.	Guided by Vision 2030 which aims to transform Kenya into a newly industrialized middle-income country with high quality of life in a clean and secure environment by 2030, and President's Big Four Agenda (agriculture, manufacturing, health, and housing). Within Big Four Agenda it is focusing on SDG 2 (end hunger) and those closely related to it such as SDGs 1, 8, and 9.	Vision is "Serbia Creates Innovation." Goals include 5 objectives: 1) R&D focused on 4S priorities, 2) economic growth supported through R&D, 3) education focused on innovation and entrepreneurship, 4) improved business environment through digitalization in 4S areas, and 5) internationalization through regional and global value chains in 4S areas	Under development
<b>Alternative Technology Pathways</b>	Discussion so far has focused on preparing an implementation plan covering several of 22 sectoral technology maps prepared for Ethiopia.	Focusing on university- based technology incubators working on emerging technologies	Analysis of alternative technologies being done as part of developing roadmap.	Within SDG 2, focused on increasing productivity and income for smallholders and technologies for maize, rice, and potatoes. Methodology being tested for maize.	Entrepreneurial discovery process framed the discussion of alternative targets and solution. This is documented in separate workshop reports.	Under development
<b>Detailed roadmap</b>	Under preparation: So far implementation plans have only been prepared for 3 of the	The first draft was submitted and discussed in a national technical task team in March 2021. Ghana team will continue collecting inputs in order to finalize the roadmap	Under preparation but various interventions ongoing in agriculture, digital	Under preparation, but team has identified needs and gaps along six agricultural value chains, and current gaps	Under preparation. Detailed STI for SDGs roadmap will be the action plan for S4. Will focus on specific actions	Under development First subnational Smart Specialisation Strategies are



	22 technology roadmaps	before the sixth annual STI forum in 2021.	connectivity, health, energy, e-governance, tinkering labs, digital ID, digital banking, health insurance. Plus, PM has announced 8 major innovation missions.	in STI system. Activities to effectively implement the Kenya Country pilot project on STI for SDGs Roadmap was proposed	to achieve the prioritized SDGs. Inter-ministerial Working Group for Agenda 2030 led by PM joined the work of S TI4SDGs	expected to be finalized in December 2021
<b>Timeframe and Key Milestones</b>	COVID-19 delayed process of preparation.	<ol style="list-style-type: none"> <li>1) Finalization of the STI Roadmap for the SDGs; March-April. 2021</li> <li>2) Mobilization of Resources, Implementation of programs/projects/activities, Monitoring and Evaluation; May 2021- Dec 2030</li> <li>3) Implementation of programmes/projects/activities developed in the plan; May 2021-Dec 2030</li> <li>4) Monitoring and Evaluation; May 2021-Dec 2030</li> <li>5) Review of STI Roadmap for the SDGs; Jan 2031</li> </ol>	Deep dives into specific programs is next step. Monitoring and evaluation platforms planned. Workshop with Japan planned 6/2020	Team will expand scope to and hold consultations to identify what technologies can be delivered, mobilize resources, and incentivize private sector participation	Detailed STI for SDGs roadmap will have detailed indicators and timeframes. Expected to be completed by end 2020. Progress has been slowed due to the COVID -19 crisis	The process has been launched in 2021 and is expected to take 1-2 years.
<b>Execute, Monitor Evaluate, Update Plan</b>	Not yet applicable	The specific strategies and programmes for each of the prioritized SDGs their respective targets, the expected outputs and the responsibilities of the lead and collaborating institutions were elaborated in the Roadmap. The monitoring will be anchored on the existing national and sub-national monitoring arrangement. A mid-term evaluation is proposed by for 2024. The feedback will be used to inform the medium-term	Not yet applicable, but planning includes strong monitoring and evaluation and strategic decision system	Not yet applicable as plan is still under preparation	Not yet applicable, but the S4 Strategy will have monitoring and evaluation system based on input, output, and outcome indicators.	STI for SDGs Roadmap will have a monitoring and evaluation system based on input, output, and outcome indicators aligned with Smart Specialization Strategy

		development plans for 2025 to 2028. A terminal evaluation is scheduled for 2030 to examine the overall impact of the STI Roadmap in contributing to the achievement of the SDGs				
<b>Inputs/ Data/ Consultation</b>	STIP Review involved stakeholders in the national innovation system, including government, academia, research centers, private sector, and civil society. Potential new stakeholders include the Development Planning Commission and possibly the line ministries	Multiple consultations, including on-line consultations, online survey, interview and quantitative data collection.  partnership with academia (UCL)	Extensive domestic data inputs and consultations with multiple stakeholders at central government, state and local levels, including with private sector and civil society	Extensive use of data and expertise from national and international sources, including India and Japan. ACTS working with counterparts in Ethiopia, Mauritius, Rwanda, Tanzania, Uganda for developing STI for SDG roadmaps	Extensive use of national and international data including creation of own Analytical Team. EU-JRC financed study by Fraunhofer Institute. Extensive consultations across government, private sector, academics, and broader society. Creation of working groups for each priority	Extensive use of national and international data for identification of economic, innovation, scientific and technological potential and SDG priorities.
<b>IATT Focal point</b>	UNCTAD	UNESCO	World Bank	World Bank	EU-JRC, UNIDO	EU-JRC, UNIDO
<b>Challenges/ Problems/ Lessons</b>	Challenges: 1) lack of specific budget for the implementation of the STI for SDGs roadmap (UNCTAD has been able to mobilize some support for the preparation), 2) establishing a smooth mechanism for collaboration across stakeholders that ideally would be involved in the preparation of the roadmap	Challenges: 1) Involving broad range of stakeholders for definition of priorities 2) Ensuring shared responsibility and commitment at the highest level 3) Better alignment of STI policies to sectoral priorities and national development plans 4) Inter-ministerial cooperation key to avoid duplications 5) Identifying a team of resource persons involving STI experts	Challenges: 1) Obtaining updated data 2) Coordination among agencies 2) COVID-19 crisis has slowed down progress	Challenges: Inadequate data for baseline of SDG targets or to link government programs to SDG targets Lessons: 1) Importance of Technical Committee to provide guidance, 2) need for external support to develop STI for SDGs roadmaps because of limited skills and funding 3) Need for increased stakeholder consultation	Challenges: lack of sufficiently disaggregated data, building trust and involving stakeholders, overcoming government silos, and getting focus on SDGs. balance between setting strategy and actual implementation. Successes: mobilizing own funding for implementation of 4S with additional EU funding, formation of permanent public private dialogue platform for	Challenges: 1) interministerial and multi-level coordination 2) COVID restrictions hampering meetings and stakeholder dialogue

	3) COVID-19 crisis has slowed the whole process			4) Most difficult and expensive step is assessing alternative technology pathways	involvement of high-level stakeholders. Winning approval of PM.	
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## Chapter 3: Review of Progress [Inputs from Focal Points of Each Pilot Country]

### Ethiopia – inputs from UNCTAD

#### 1. Leading Agencies and National Counterparts

Ethiopia's roadmap is being coordinated by its national counterpart, the Ministry of Innovation and Technology (MINT). The Ministry of Science and Higher Education (MOSHE) has participated in several recent IATT events and is interested to participate in the preparation of the roadmap. MINT and MOSHE are the prime institutions responsible for planning related specifically to innovation and technology, and to science, respectively. MINT and MOSHE are discussing bilaterally their modalities for collaboration.

#### 2. Achievements so far, Expected Outcome and Key Activities

The process for the development of STI for SDGs roadmap is on-going with 2 steps out of six completed as part of the preparation of the STIP Review of Ethiopia concluded in 2019. The two steps are 1). The definition of objectives and 2). Assessment of the current situation.

The STIP Review process included the mobilization of the three core inputs for the STI for SDGs roadmap process. First, it mobilized stakeholder's engagement among the main actors of the national innovation system, including government, private sector (sector leaders and business associations), academia and research centers, and civil society, through interviews, workshops and capacity building activities. Second, it engaged senior policymakers in Ethiopia as well as international and national consultants to identify challenges and opportunities for using STI for development in Ethiopia. Third, it collected data and knowledge on the development situation in the country, the status of the national innovation system, and the critical issues on promoting STI for job creation and inclusive and sustainable development. The STIP Review of Ethiopia presents the findings and recommendations to strengthen the national system of innovation of the country. It also serves as the report of the two initial steps of the STI for SDGs roadmap in Ethiopia.

The development of the roadmap is now at step three (develop vision, goals and targets), which corresponds to work on drafting a new national STI policy. The key activity so far is the discussion of the objectives and scope of the roadmap, and modalities for collaboration across MINT and MOSHE as the most relevant STI-related ministries in Ethiopia. Discussions so far have centered on preparing an implementation plan covering several of the 22 sectoral technology roadmaps that have been prepared in Ethiopia. To date, Implementation Protocols (or plans) have only been prepared for three of these technology roadmaps.

The expected outcome is an STI roadmap that covers important aspects of the current high priority areas of Ethiopia's evolving development plans and the SDGs. This might focus on job creation (most closely aligned with SDG 8 (decent work and economic growth), but which feeds indirectly into improving several other SDGs such as 1 (no poverty), 2 (zero hunger), 3 (good health and well-being) and 10 (reduced inequalities)) as a unifying theme. National development plans and priorities have been evolving rapidly in the country in recent months. The employment focus recognizes the serious challenges created by the high unemployment rate in the country and the high priority placed on creating jobs highlighted in the recent National Job Creation Agenda in Ethiopia.

#### 3. Other Expected Stakeholders, Milestones and Timeline

Other relevant stakeholders include the Development Planning Commission and possibly key line ministries. Representatives of the private sector and academia should also play a role in the steps involved in preparing the roadmap.

So far, UNCTAD has provided support to as part of its project on implementing a STI policy review for Ethiopia. The roadmap is to be sequenced as a follow-up to the preparation of the STIP review (which has now been completed) and the drafting of a new national STI policy. Ethiopia is currently engaged in the process of drafting a new national STI policy, with UNCTAD supporting this process. The roadmap preparation should follow directly the preparation of the new STI policy. Currently, the timeline is being revised due to delays emanating from the outbreak and rapid evolution of the COVID-19 crisis in Ethiopia and other countries around the world. The original timeline was for activities related to drafting a new national STI policy to start in late April, but a new timeline has to be agreed that corresponds to what is possible given the restrictions on travel to and from Ethiopia and other countries. This likewise implies a delay in starting the roadmap.

#### 4. Lessons Learned, Challenges/Problems Encountered So Far (if applicable)

A key challenge encountered is the lack of a specific budget for the implementation of the roadmap. This has slowed the process of planning activities due to the need to provide financing to support planned activities. UNCTAD was able to mobilize some limited resources as part of the follow up to the development of the STIP Review of Ethiopia.

An additional challenge is establishing a smooth mechanism for generating collaboration across stakeholders that would ideally be involved in preparation of the roadmap. The lack of regular meetings by the National STI Council means that getting approval from this cross-governmental body on coordination is not easily achievable.

## Ghana – inputs from UNESCO

### 1. Leading Agencies and National Counterparts

The process for development of STI for SDGs Roadmap in Ghana is part of Ghana's current effort to align the national STI priorities and the National STI policy (2017) towards achieving the SDGs.

Launched in late 2019, the pilot exercise in Ghana is coordinated by the Ministry of Environment, Science, Technology and Innovation (MESTI) and the Science and Technology Policy Research Institute (CSIR-STEPRI). Additionally, it involves also other ministries such as the Ministry of Finance, and Ministry of Planning, Ministry of Trade and Industry, Ministry of Health etc.

The Technical Task Team with oversight responsibility over the process of developing the STI for SDGs roadmap is co-chaired by the representative from the Office of the President SDGs Advisory Unit and MESTI. UNESCO is the IATT focal point agency for the implementation of the pilot road-mapping exercise.

### 2. Achievements so far, Expected Outcome and Key Activities

#### Scope and objectives

The country has the current national development plan frameworks “**Agenda for Job-Creating Prosperity and Equal Opportunity for All** (2017-2021) and the **Coordinated Program for Economic and Social Development Policies** (2017-2024) which set out the **national priorities** in all sectors of the economy. The objective of the development of the STI for SDGs roadmap is to align and implement STI priorities towards contributing to the achievement of the SDGs. Developing an action oriented STI for SDGs roadmap is expected also to accelerate developing new or adapting existing solutions to meet the SDGs target by 2030, while ensuring sustainability.

The thrust of the STI for SDGs Roadmap is the elaboration of strategies and programmes to use STI to accelerate the achievement of the SDGs. In this regard, the roadmap has been formulated within the broad domain of STI. The national context of Ghana in terms of its natural resource endowments, the social and economic attributes and the political and cultural conditions have been analyzed as part of the situational report and have guided the formulation of the roadmap. In the course of the work on the roadmap, certain SDGs were prioritized taking account of the present development goals of the nation. These are SDGs 1, 2, 3, 4, 6, 8 and 9. The roadmap has been limited to discussions of these SDGs and the strategies, programmes and activities, to ensure STI accelerate the achievement of these prioritized SDGs.

The specific objectives of the STI for SDG Roadmap report are to:

- (i) Define the vision, goals and targets for the STI for SDGs Roadmap;
- (ii) Detail the strategies, programmes, projects and activities necessary for STI to fast-track the achievement of the prioritized SDGs
- (iii) Elaborate on the budget, funding and coordination arrangement for the implementation of the STI for SDGs Roadmap
- (iv) Formulate the partnership and communication strategy to sustain stakeholder involvement and ensure an inclusive governance of the roadmap.
- (v) Design the Monitoring and Evaluation system to track progress on the roadmap implementation.

#### Assessment of the current situation

As part of the processes leading to the development of the STI for SDGs Roadmap, UNESCO supported CSIR-STEPRI to conduct a situational analysis in Ghana. The study reviewed the current STI Policy, SDGs

and Development Plans and the inter-linkages, assessed the current status of the prioritized SDGs 1, 2, 3, 4, 6, 8 & 9, assessed capacity needs in terms of STI human resources needs, examined institutional capabilities and STI infrastructural needs for achieving the SDGs, and analyzed the country-specific challenges and solutions in achieving the SDGs.

**The STI situational analysis highlighted the need for Ghana to make necessary effort from both public and private sectors to boost research and development, enhance the skills based of the current and future workforce, develop new infrastructure and create capacities in new technologies to establish the Launchpad for accelerating the achievement of the SDGs.** For effective human capital formation to drive the STI agenda especially for the accelerated achievement of the SDGs, there must be a rejuvenation of the educational system with emphasis on stimulating curiosity and creativity and enhancing competence-building. At the tertiary level in particular, STI human resources must be equipped for the tertiary institutions to effectively deliver teaching and learning in STEM. Research and development in the established institutions must be enhanced with adequate human resources and infrastructures.

The STI Situational Analysis study provides the important inputs for the formulation of the STI for SDGs Roadmap.

Other advancements include:

- i) The adoption of Ghana's Science Agenda for Agriculture in Africa (S3A) promoted by the Forum for Agricultural Research in Africa (FARA)
- ii) The establishment of the Presidential Advisory Commission on STI and a Research Fund for scientists and researchers
- iii) The inter-institutional framework for working towards the achievement of the SDGs through the development plans of Ministries, Departments and Agencies (MDAs), and Metropolitan, Municipal and District Assemblies (MMDAs). Ghana has processed a STI ecosystem survey and an R & D survey which its results and data provide key baseline indicators for STI and for the STI-SDGs roadmap exercise. In addition, the National SDG baseline Report of 2018 serves as well as a baseline for the work.

### **Activity: Develop vision, goals, and targets**

The vision of Ghana is to build a strong STI capacity to support the social and economic development for the sustainable transformation of the economy.

The Coordinated Programme of Economic and Social Policies (CPESDP 2017-2024) states the vision as: *"An optimistic, self-confident and prosperous nation, through the creative exploitation of our human and natural resources, and operating within a democratic, open and fair society in which mutual trust and economic opportunities exist for all."*

For the purposes of the STI for SDGs Roadmap, the critical part of the vision statement is the "creative exploitation of our human and natural resources".

The national vision is further elaborated by other important national documents including the Ghana Beyond Aid policy. The overall goal is to achieve a "W.I.S.E.R" Ghana:

- W - Wealthy Ghana;
- I - Inclusive Ghana;
- S - Sustainable Ghana;
- E - Empowered Ghana; and
- R - Resilient Ghana.



### Activity: Assess alternative targets

The current STI development trends in the country show that technology incubation hubs are making a great impact that contributes significantly to socio-economic development of Ghana, complementing to the efforts by actors in the formal R & D system. These hubs are centered on students and young graduates in tertiary institutions. The STI roadmap in Ghana should emphasize promoting these systems. While the formal institutions continue to work on existing and emerging technologies, some of these incubation hubs focus their energies mainly on emerging technologies such as Artificial Intelligence and Robotics.

Based on the current STI situation, the following policy recommendations were made:

- Develop strategies to take advantage of innovations in agri-food system, health and education delivery systems, and regulate Ghana's technological space;
- Invest in Advance Digital Production (ADP) technologies and strengthen uptake of R&D;
- Address infrastructural gaps in irrigation, low adoption rates of climate smart technologies and inadequate human resources;
- Invest in STEM education, scientific equipment and e-learning facilities at all levels;
- Build local capacity and workforce in industrial equipment maintenance to reduce over-reliance on foreign expertise, and initiate equity law to protect local industries;
- Invest in water quality monitoring and management systems as well as behavioral initiatives on sanitation and good hygiene practices.

### Activity: Develop detailed STI for SDG roadmap

Working teams comprised of members of the Technical Task Team were established to draft the different chapters of the Roadmap, based on the findings and information in the situational analysis report on STI in Ghana. Each chapter was presented by the lead team during the Technical Task Team meeting in March 2021, which aimed to collect additional feedback from the Task team members. The results of the discussion will be submitted to CSIR-STEPRI- the lead Technical Institution for the preparation of the STI for SDGs Roadmap, to finalize the document for onward submission to UNESCO before the sixth annual STI forum in 2021.

### Activity: Execute, monitor and evaluate, and update plan

Ghana's plan is to implement during the years 2021-2030 up to 50 programs, projects and activities by **mobilizing resources** through GoG budgetary supports/donors with the assistance of the Ministry of Finance, President of Ghana. In parallel to constitute an Apex level **Inter-Ministerial Implementation Team** to oversee the implementation of the STI for SDG Roadmap. Also, the Ministry of Monitoring and Evaluation with the support of the UN, will request regular reports for each program/project/activity. The monitoring methods below will allow to review and evaluate the STIs Roadmap for the SDGs by 2030.

**Implementation:** The specific strategies and programmes for each of the prioritized SDGs and their respective targets, the activities envisaged to address the respective targets, the expected outputs and the responsibilities of the lead and collaborating institutions were elaborated in the Roadmap.

**Monitoring:** Monitoring of the STI Roadmap will be anchored on the existing national and sub-national monitoring arrangement. MESTI, with support from National Development Planning Commission (NDPC) will liaise with relevant Ministries, Departments and Agencies (MDAs) and Metropolitan, Municipal and District Assemblies (MMDAs) to include indicators for tracking the implementation of the STI Roadmap in their respective M&E plans. This will ensure that the annual progress reports (APRs) contain information on the agreed set of indicators for tracking the implementation of the Roadmap. In addition, private sector organizations, academia and other non-state actors that play

important roles in the implementation of the Roadmap will be supported to generate data and report on the relevant STI Roadmap indicators.

The sector and district APRs, together with reports from relevant non-state actors will constitute the primary source of data for preparing annual reports to track the implementation the STI Roadmap. The data will be complemented with information from key informant interviews, focus group discussion, and field visits as appropriate. The annual progress reports on the implementation of the Roadmap will be discussed at stakeholder fora and lessons therein will form the basis of revising the roadmap, where necessary.

***Evaluation and Revision of the roadmap:*** The purpose of the evaluation process is to answer more in-depth questions about how and why interventions are achieving or not the expected results. It will also identify changes in internal and external conditions (social, political, technology, economic and environmental) that may affect the successful achievement of the targets in the STI Roadmap. The evaluations will be based on five criteria; relevance, effectiveness, efficiency, impact and sustainability. A mid-term evaluation is proposed by for 2024. The feedback will be used to inform the medium-term development plans for 2025 to 2028. Lessons from this evaluation will influence the revision of the Roadmap to ensure the achievement of the targets and objectives. A terminal evaluation is scheduled for 2030 to examine the overall impact of the STI Roadmap in contributing to the achievement of the SDGs. It is anticipated that the findings from the terminal evaluation will significantly shape the use of STI in Ghana's development pursuit.

***Budget:*** The key to effective implementation of the roadmap is funding. Although the government of Ghana will definitely be investing in the implementation of the envisaged activities, funding from development partners and other stakeholders are crucial. Implementation activities and corresponding budget for each prioritized SDG were elaborated in the Roadmap.

#### **Inputs: Data, stakeholder consultations and expertise**

***Data:*** The approach to data collection was the use of four main methods – desk research, interviews, Expert Group Discussion and online survey.

#### ***Consultations and expertise:***

The 1st national consultation was held in Accra, in December 2019, including key national partners and UNESCO, who reflected on the process and the way forward.

The first Technical Task Team consultation workshop was held in Accra, Ghana in June 2020 to inaugurate the Technical Task Team and finalize the work plans for the Roadmap. The second consultation workshop was held in September 2020 to review the situational analysis report, attended by the task team, UNESCO and UNDP representatives. The third Technical Task Team consultation was held in March 2021 to review the first draft of the STI for SDG Roadmap in Ghana.

Meanwhile, UNESCO as the IATT focal point for the Ghana Pilot has been developing a partnership with academics. A team of students at the University College of London (UCL) - Department of Science, Technology, Engineering and Public Policy (STeAPP) contributed to the pilot roadmap project in Ghana under Dr. Jean-Christophe Mauduit as a mentor. The UCL team mainly contributed with desktop research and analysis on STI for SDGs in key priority sectors in Ghana and on-line survey. The research resulted in the report, reframing STI for SDGs: insights and recommendations for Roadmaps as successful policy tools in Ghana and beyond, which was submitted in October 2020. The report identified four key enablers of successful STI for SDG Roadmaps and for the IATT to consider in its future work. Additionally, it investigated the implications of the COVID-19 pandemic on the pilot programme countries' progress towards the SDGs.

## Other achievements

### *Development of five policy briefs*

Ghana has developed five policy briefs, based on the findings of the situational analysis report and the preliminary work on the drafting of the STI for SDGs roadmap, which also contributed to UN IATT's policy briefs. The titles of the policy briefs are:

- Conceptualizing STI for SDGs Roadmaps: An Actionable Strategy aimed at accelerating the achievement Of SDGs using STI in Ghana
- Review of the current STI Policy, SDGs and Development Plans and the Inter-linkages
- Assessment of STI Capabilities to meet prioritized SDGs
- Harnessing Innovation potential of the Ghanaian Youth for the attainment of the SDGs
- Fact Sheet on current situation with prioritized SDGs

*Ghana has also presented their progress and achievement of the STI for SDGs Roadmap process in major in UN IATT related event, including the STI Forum in Africa, held in February 2021.*

### 3. Other Expected Stakeholders, Milestones and Timeline

The current work plan for the development of Ghana's STI Roadmap for the SDGs involves:

1. Finalization of the STI Roadmap for the SDGs by the Technical Task Team with support by a consultant; March-April. 2021
2. Mobilization of Resources, Implementation of programs/projects/activities, Monitoring and Evaluation; May 2021- Dec 2030
3. Implementation of programmes/projects/activities developed in the plan; May 2021-Dec 2030
4. Monitoring and Evaluation; May 2021-Dec 2030
5. Review of STI Roadmap for the SDGs; Jan 2031

### 4. Lessons Learned, Challenges/Problems Encountered So Far (if applicable)

- 1) The main challenge is involving a broad range of STI stakeholders for the definition of priorities of STI policies and strategies.
- 2) It was of great importance to ensure shared responsibility and commitment at the highest level – MESTI's Strategic role and guidance in the development of STI4SDGs Roadmap and intensive engagement with stakeholders – expert group discussions, validation workshop and virtual debriefing meeting with Technical Task Team. Inter-ministerial coordination and cooperation, including with STI agencies in the country, is key to avoid **duplication of programs** and activities. And it is important to identify a team of STI experts and Development Practitioners and have effective targeting of sectors to focus on, based on developmental trajectory.
- 3) Dissemination of information and consultations are key aspect of the process.
- 4) Better alignment of the STI policies to the sectoral policies and national development plans is essential.
- 5) Strong cutting edge of STI and expected developmental outcomes is indispensable.

## India – inputs and updates by WB

### 1. Leading Agencies and National Counterparts

As part of India's commitment to achieve the Sustainable Development Goals, India is very keen to develop a framework to capture SDGs as outcomes of Science, Technology and Innovation (STI) interventions. In this direction Government of India has launched a major initiative to formulate STI roadmaps for SDGs being led by Office of Principal Scientific Adviser to the Government of India (PSA). In this regard, India is also one of the 5 pilot countries of the Global Pilot Programme for STI for SDGs Roadmaps of the UN, an initiative under the Technology Facilitation Mechanism (TFM) launched as part of the Agenda 2030 for implementation of the SDGs.

The Office of the PSA has entrusted the Research and Information System for Developing Countries (RIS), New Delhi as the knowledge partner in this initiative, with the primary responsibility towards formulating India's STI for SDGs roadmaps. India's strong innovation capabilities, wider expertise in people-centric affordable technology solutions and more recent ICT enabled development transformations offers robust foundations towards undertaking this exercise.

The STI for SDGs Roadmaps in India, as decided, would initially focus on 4 interrelated SDGs viz. SDG 2 (Agriculture/nutrition); SDG 3 (Health and wellbeing), SDG 6 (Water and Sanitation) and SDG 7 (Affordable and Clean Energy). India's national STI for SDGs Roadmaps shall be achieved through close consultations with all relevant line ministries that implement welfare programmes, formulates policies and determines the regulatory architecture. All key scientific ministries and departments play major role in providing direction to India's STI efforts and are therefore preeminent stakeholders in the process. All subnational governments particularly, the State Governments also form vital pillars for supporting formulation of India's national STI for SDGs Roadmaps. In this initiative relevant private sector bodies, companies, start-ups, social enterprises as well as other development partners would be consulted.

### 2. Achievements so far, Expected Outcome and Key Activities

#### a. National Workshops with Line Ministries and other Stakeholders

To formulate India's STI for SDGs Roadmaps thematic workshops on each of the four SDGs are being conducted to supplement and inform analytical studies and detail technical assessments. These consultations shall be led by the Office of the PSA and shall bring on board the line ministries, the scientific ministries, the NITI Aayog, other implementing agencies and stakeholders including the private sector. The consultations are being organised by the Research and Information System for Developing Countries (RIS), New Delhi. The thematic workshops shall lead to drawing on insights from India's flagship initiatives that have relevance with regard to Science, Technology and Innovation for the selected SDGs.

The thematic workshops are being organized to explore the following dimensions:

- If technologies are available, what could be the appropriate roadmap on deployment after evaluation of existing ownership status (public/private) and operational and feasible models of technology transfer and diffusion?
- At the next level, technology availability status would be highlighted and a roadmap on development and deployment shall be considered. This would also necessitate careful assessment of existing innovation capacities as well as resources and timelines.
- In all areas with promise of indigenous technology development and that are available for technology transfer, in line with the aspirations of the Global Pilot Programme on STI for SDGs Roadmaps, detailed mechanisms may be suggested for sharing of STI solutions with other developing countries/LDCs, particularly in Africa.

All information related to India's STI for SDGs Roadmap exercise is being documented as part of a newly launched web portal <https://www.ris.org.in/sti-4-sdgs>.

## b. Formulation of STI for SDGs Roadmaps – The Indian Template

The Global Pilot Programme for STI for SDGs Roadmaps is expected to evolve into a very useful tool to strengthen national efforts on STI for SDGs mapping. And also, promote international cooperation on knowledge, technology transfer, capacity, networks and finance for operationalization of the TFM. India has proposed to formulate STI for SDGs roadmaps on four closely interconnected goals (SDGs 2, 3, 6 and 7) under the Global Pilot Programme. It may be noted that STI interventions are desired in areas that are helpful in achieving the defined objective of the SDG/Target determined through global/national indicator based assessments.

Tentative templates for STI for SDGs Roadmaps, covering all the four SDGs is being developed, keeping in view India's national development objectives and STI for SDGs indicator-based assessment (UN Indicators vis-à-vis India's National Indicators)<sup>10</sup> as well as through incorporating relevant STI indicators that are not part of SDG indicators. This would be followed by mapping and assessment of technologies for achieving the SDG targets (with innovation and deployment parameters), and finally assessment of institutional preparedness and technology availability/readiness levels. Relevant reference to UN Guidebook on STI for SDGs Roadmaps has also been made. The base line indicator mapping alongside available and emerging technology mapping shall be used as an input for the process (Appendix 3 and Appendix 4).

The identification of the developmental challenge and decomposition into specific product and process components is crucial for initiating a STI for SDGs roadmap. The same can be undertaken for each target and the underlying indicators. For example, based on the scientific and technological challenges the associated targets under SDG 2 can be further classified into three principal areas: i) Production and Nutrition; ii) Conservation; and iii) Food Processing. Similarly for SDG 6 – specifically with regard to water use technologies the broad classification could be: i) Quality of water (filtration/treatment of water sources); ii) Access to water (development of distribution systems); and iii) Water-use efficiency (reduction of overexploitation).

## 3. Other Expected Stakeholders, Milestones and Timeline

### a. Stakeholders and Activities

As elaborated above, as part of the STI for SDGs Roadmaps dialogues have been initiated with relevant line ministries/departments including the NITI Aayog, the New Emerging and Strategic Technologies division of the MEA, DST, CSIR, ICMR and the TIFAC for deeper insights and leveraging the significant work undertaken by these agencies/ departments.

Under the STI for SDGs Roadmaps initiative a suggested key deliverable would also be to work towards formulating a decision support system for mapping resource flows on R&D for greater effectiveness in the Indian context. Scoping study in this regard has been initiated.

One of the very first milestones under the India pilot towards initiating strong foundations of international partnership has been the co-organisation of the Workshop on Developing STI Partnerships for Sustainable Development on June 29, 2020 by the Office of the Principal Scientific Advisor to the Government of India (PSA) jointly with the Research and Information System for Developing Countries (RIS), Cabinet Office of the Government of Japan (CAO) and the United Nations

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<sup>10</sup> In 2018, NITI Aayog developed the first SDG India Index based on 62 indicators covering 13 out of 17 SDGs (excepting Goals 12, 13, 14 and 17). While the second edition in the 2019, SDG India Index was more comprehensive with 100 indicators, covering all the 17 Goals, largely drawn from the National Indicator Framework (NIF). Out of the 100 indicators, 40 were adopted from the 2018 version and the remaining 60 were sourced from NIF or were suitable refinements.

Interagency Task Team on Science, Technology and Innovation (STI) for the Sustainable Development Goals (UN-IATT).

The main theme of the workshop was “Accelerating International Cooperation and Actions through the Global Pilot Programme on STI for SDGs Roadmaps”. The meeting was joined by high level representatives of the pilot countries and UN-IATT partner agencies participating in the Global Pilot Program, and other interested stakeholders. The workshop saw participation by senior policy makers and experts from the pilot countries including India, and Japan and other partner agencies.

The workshop deliberated on the following themes

- Formulation of STI for SDGs Roadmaps
- Current initiatives on STI for SDGs in Pilot Countries and Key Partners
- STI for SDG Partnership in the Multilateral Arena
- COVID-19 Pandemic and STI for SDGs
- Building Partnerships and Networks for Acceleration and Expansion of the Pilot Programme: Role of Think Tanks/ Academia, Foundations and Private Sector

The workshop was preceded by very successful preparatory dialogues between India and Japan. Based on the existing close partnership in science and technology between India and Japan, both sides have expressed strong interest in extending their collaboration in STI for SDGs, particularly in cooperating in formulating STI for SDGs Roadmaps on 4 specific goals (SDG 2, 3, 6 and 7) through the Global Pilot Programme. The two countries are deepening their collaboration in applying frontier technologies in the above mentioned areas and in collaborating with the UN-IATT in supporting pilot countries from Africa in particular, and other LDCs in formulating and implementing their STI for SDGs Roadmaps by sharing of experience, knowledge and capacities with them, in the spirit of South-South and Triangular Cooperation as mandated under the TFM.

***b. Key Actors for the India Pilot and International Collaboration***

- Knowledge partnerships in India
  - Office of the Principal Scientific Advisor
  - Various line ministries of the Government of India, NITI Aayog, Sub-national agencies
  - Department of Science and Technology
  - Indian Council for Medical Research
  - Indian Council for Agricultural Research
  - Think Tanks/Research Organisations
  - Private Sector/ Start-Ups
- UN Agencies and International Organisations
  - UN-IATT (DESA, UNDP, ESCAP etc.)
  - World Bank
  - International Solar Alliance

During the formulation of STI for SDGs Roadmaps for India, special attention is being paid to technological opportunities across the border and experiences of other countries in deploying STI solutions for achieving the SDGs.

**4. Lessons Learned, Challenges/Problems Encountered So Far (if applicable)**

Under the India pilot for the Global Pilot Programme for STI for SDGs Roadmaps, extensive consultations with all stakeholders are underway to arrive at most effective templates for SDG specific technological interventions in relevant domains. This is expected to further help in identification of broader scientific challenges and shape the technology deployment roadmap for India under the STI for SDGs roadmaps. At all levels where there is scope for technology transfer and capacity building in

adoption/adaptation (based on indigenous capabilities), India expects to develop future knowledge sharing partnerships with developing countries for fulfilling the aspiration of STI for SDGs in the spirit of South-South Cooperation.

One important lesson is that, STI interventions must be tallied with the scientific challenge emerging out of the nature of the development gap and the complexity of the problem (with considerations for access, equity and inclusion as well as sustainability). There should be prima facie reasons to argue that with use/availability of existing or potential STI solutions the development/sustainability indicator would achieve desired values at a much accelerated pace. It could also be the case that diffusion of already available STI solutions would be a key determinant in achievement of the indicator and fulfilling the SDG target. In certain cases, it is obvious that given the enormity or the complexity of the challenge, existing STI solutions may be grossly inadequate and all countries may not be in a position to develop, acquire or access STI solutions. While ICT tools are increasingly ubiquitous as enabling technologies, the same may not be accessible to all implementing agencies across countries. This is certainly an area that needs to be considered for developing robust STI for SDGs roadmaps.

However, the specific challenges that need to be taken into account for generating generic templates for STI for SDGs Roadmaps include the following:

- At the first level, there are perceived challenges in terms of mainstreaming SDGs as a development tool and thereafter finding/ twinning appropriate technological solutions for implementation and accelerated action
- Secondly, there are challenges in terms creating right absorptive capacities for technologies
- Thirdly, there are methodological difficulties in defining the base to formulate strategies for technology deployment for specific SDGs and associated targets
- Fourth, there has to be a sense of ownership by all implementing agencies on the larger STI for SDGs roadmaps and enable tracking of progress in that direction
- Finally, the Covid-19 pandemic has caused significant derailment of the developmental process adversely impacting action on the ground and coordinated approaches and deploying STI for SDGs.



## Kenya – inputs and updates by WB<sup>11</sup>

### 1. Leading Agencies and National Counterparts

Kenya's STI for SDGs roadmap is being led by the State Department for Planning, SDP, (which hosts SDGs Secretariat) in the National Treasury and National Commission for Science, Technology and Innovation (NACOSTI) under Ministry of Education (MoE), in partnerships with line ministries for ICT, Foreign Affairs, Agriculture and Industry. The process is supported by the African Centre for Technology Studies, as a technical and knowledge carrier. A small technical team was established to spearhead the pilot project and prepare draft documents to be used for engagement with wider stakeholders. The World Bank and UNESCO were assigned as the IATT Member Agencies Focal Points for Kenya's participation in the Programme.

### 2. Achievements so far, Expected Outcome and Key Activities

#### Activity: Define objectives and scope

**Objectives:** In formulating the objectives and the scope of the STI roadmap, the Kenyan Technical Team has been guided by several national and sectorial development policies and strategies. These includes the Vision 18-2030, the Third Medium Term Plan 2018-22 (MTP III)<sup>12</sup>, as well as the President's Big Four Agenda, which covers Agriculture, Manufacturing, Health and Housing. The STI roadmap for the SDGs project has selected to pursue two sectors of the Big Four – manufacturing and agriculture with ICT as cross cutting. Based on the experience from piloting, the project will later be expanded to cover all the four sectors. In addition, the pilot project has also been guided by the draft STI policy and the recently launched National Research Priorities (2018-2020). The main objective of the Kenyan STI roadmap is to provide a medium term timebound and resourced plan for the implementation of the STI policy and to support the delivery of the president's Big Four Agenda.

**Focus:** Accordingly, the STI for the SDGs roadmap focusses on SDG 2 (End Hunger) as well as those SDGs closely linked to it, such as SDG 1 (No Poverty), SDG 8 (Decent Work and Economic Growth) and SDG 9 (Industry, Innovation, and Infrastructure).

The specific objects of the STI for SDGs Roadmaps in Kenya were to:

- a. Evaluate the current SDG situation and identify gaps in achieving SDGs;
- b. Develop the STI for SDGs Roadmap to address the gaps identified;
- c. Develop a comprehensive STI Strategy to implement the SDGs Roadmap;
- d. Implement the STI Plan for SDGs Roadmap;
- e. Monitor and evaluate the implementation of the STI plan for SDGs Roadmap; and
- f. Use the STI for SDGs Roadmap to support the four areas identified in the Big Four Agenda.

#### Activity: Assess current situation

**Analyzing the gaps and further prioritization of the SDGs:** The roadmap technical team used indicators from the SDG Index, the African SDG Dashboard 2019 report, the Kenya Department of Planning Status Report 2019, National Statistics, the Food Insecurity Index as well as a Kenyan SDGs Policy Gaps Analysis (2018). The team so far undertook a detailed assessment of SDG 2, covering all the five sub-objectives (2.1, 2.2., 2.3, 2.4. and 2.5). The analysis showed that Kenya was lagging behind in most of the SDG 2 targets REFERENCE, the team prioritized SDG 2.3 (increasing productivity and income of smallholder farmers) which, if addressed, would bring the highest impact to all the other sub-objectives of SDG2 and also contribute towards realization of SDG 1, SDG 8 and SDG 9. SDG 2.3 also synchronizes well with the aspiration of the Big Four Agenda for Agriculture and Food Security.

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<sup>11</sup> This summary is based on a progress report on the pilot program in Kenya (ACTS, 2019), supplemented by the Kenya focal points discussion with the Kenya team leader.

<sup>12</sup> The Vision 2030 is implemented through tranches of five-year Medium-Term Plans.

*Identifying the STI needs and Gaps:* The team identified the following six areas along agricultural value chains that require STI inputs: improved seed varieties; access to quality inputs; irrigation and mechanization; reducing postharvest losses; agro-processing; and marketing; with ICT as cutting across the value chain. The team has also identified the current gaps in the STI systems, which may hinder effective deployment of the required STI. In addition, supported by the World Bank, the team is analyzing, through STI Public Expenditure Review, existing and planned relevant programs/projects funded by the government and international partners, aiming to promote R&D and technology adoption and diffusion with increased efficiency and effectiveness.

#### **Activity: Develop vision, goals, and targets**

This STI Roadmap for the SDGs is based on: Vision 2030 and its third Medium Term Plan (2019-2022); Big Four Initiative (2018-2022); STI Policy 2019; National Research Priorities (2019-2022); and Agricultural Sector Transformation and Growth Strategy (2019-2029)

The broad vision of the STI for SDGs was framed within Vision 2030, which lays out the long-term priorities of transforming Kenya into a newly industrialized middle-income country with high quality of life in a clean and secure environment for all citizens by 2030. The STI for SDG pilot roadmap initially focusses on two of the President's Big Four agenda—manufacturing and agriculture—because of the strong interlinkages between them. Accordingly, it focusses on increasing agricultural productivity and increasing the incomes of small farmers since at the 2019 STI Forum, it was determined that such focus would have the greatest positive impact on livelihoods. The roadmap aims to mainstream the application of STI for the realization of SDGs in Kenya. The goal is set to “Realize 100% food and nutrition security by 2022 through the application of science, technology, and innovation in increasing agricultural productivity, increasing income of small holder farms, and reducing the cost of food.”

#### **Activity: Assess alternative technologies**

With the prioritization on agriculture in SDG 2, the roadmap process has started by focusing on three crops: maize, rice and potatoes. To test the methodology, the STI team is focusing on maize with the short-term goal of achieving self-sufficiency in maize by 2022. To achieve this, the team is identifying technologies in new plant varieties; production and blending of fertilizer; control of pests and diseases, mechanization; reduction of postharvest losses, processing technologies, and STI for enhanced market access. Improved seed varieties was prioritized, and various conventional as well as alternative existing technologies were assessed. It was determined to go ahead and develop a roadmap using an existing conventional variety available domestically.

#### **Activity: Develop detailed STI for SDG roadmap**

To develop the detailed plan, the team will map and hold consultations with various stakeholders; identify programs through which the technologies can be delivered and agree on what need to be done by different stakeholders. This will include different government agencies, the private sector, and the small holding farmers. The team will also document how to mobilize the resources required for the deployment of the technologies to scale and to incentivize the private sector's participation in technology uptake and deployment. The next steps will be to expand the scope of the STI for SDGs roadmap to the other priority interventions identified, to do further consultations with relevant stakeholders and to scale up and harmonize the roadmap, and to plan a communication strategy for the government to announce the roadmap. The Kenyan Roadmap draft was presented at a side event during the Tokyo Conference on Africa's Development (TICAD) in Yokohama, Japan in August 2019.

The following initiatives can be supported as a way of completing the process that was started.

1. **STI roadmap for SDG 2:** This process had reached the stage of stakeholders' engagement for the purpose of prioritization. The technical team had identified the following key entry points for STI: improved plant varieties, fertilizer production and blending, pest, disease and weed control; postharvest reduction; and smart agriculture. NACOSTI through technical support from ACTS can coordinate and guide Agriculture stakeholders to formulate STI roadmaps for at least three of these prioritize areas.
2. **STI for SDG 9:** For manufacturing, the team identified and prioritized the following areas as potential entry points for STI: fish value chain, textile value chain, leather value chain, circular economy and digital economy. NACOSTI through technical support from ACTS can work with the Ministry of Trade and Industry and Kenya Industrial Research and Development Institute to coordinate and guide the relevant manufacturing stakeholders to formulate STI roadmaps for at least three of these prioritize areas.
3. **STI for SDG 4:** In 2019, the Ministry of Education initiated the process of development an STI roadmap for Education. This process, which was started before the UN Global STI roadmap project, was being spearheaded by the directorates responsible for planning and research in the ministry of education. The process has not been completed. This can be a good entry point for the STI for digital education.

#### **Activity: Execute, monitor and evaluate, and update plan**

As the plan is still under preparation, and no explicit mechanisms for monitoring, evaluating, and updating the full roadmap seem to have been put in place yet. However, the pilot exercise focused on improved maize varieties has helped to identify the importance of the technical committees giving broad guidance and the need for increased stakeholder consultation.

#### **Inputs: Data, stakeholder consultations and expertise**

The STI for SDG team has made extensive use of existing national and international data. It has also held some consultations with stakeholders, including various parts of government, the private sector, civil society and farmers. Technical input has involved domestic and some foreign experts and international institutions. However, from the conclusions of the pilot test, an important lesson is the need for a more proactive stakeholder engagement strategy.

The team has made significant progress in terms of forging international stakeholder involvement. The NACOSTI as the lead agency and Toyota Tsusho Corporation forged an agreement, which was announced during TICAD7 in July 2019, that the Japanese firm would support Kenya's roadmaps e.g., in skills development for the Big Four agenda, initially in agro-processing and value addition as well as improving SMEs' managerial and technology adoption capabilities through the corporation's educational/vocational training platform (Toyota Kenya Academy). The Kenyan team has been active in bilateral/trilateral cooperation with Japan and India to tap into their expertise. The three countries have been discussing concrete ways to forging coordination/cooperation, i.e., through think tank network among ACTS, Research and Information System for Developing Countries (RIS) (India) and National Graduate Institute for Policy Studies (GRIPS) (Japan), and to share good practices and lessons-learned in supporting national roadmaps related activities at planned events, including India-Japan 2-day Workshop on STI for SDGs Roadmaps. The governments of Kenya and Japan have been encouraging research partnerships among their research institutions, i.e. combating parasitic plant (Striga) affecting maize production. Additionally, ACTS has been working with Japan International Corporation Agency by identifying and coordinating at least 16 ongoing/pipeline projects with high relevance to Kenyan Pilot project.

### 3. Other Expected Stakeholders, Milestones and Timeline

The original plan was that the process would be rolled out as follows from January 2020.

- a. Generation of a work plan for the whole process
- b. Mapping of the actors and stakeholders who are relevant to the various focus areas.
- c. Validation of the SDG gaps (SDG focal points)
- d. Defining and prioritizing in collaboration with (relevant) stakeholders' entry points of STI for SDGs roadmap. Prioritization will be done at this stage
- e. Create area-specific technical team to develop the STI for SDGs roadmap for their area.
- f. Reviewing the drafts generated by the area specific technical committees by the core technical team
- g. Validation by the relevant stakeholder
- h. Consolidation (involves harmonization) of the various drafts
- i. Strategic communication to relevant authorities (Cabinet Secretaries and Principal Secretaries)

Currently the timelines are being revised due to delays emanating from covid-19 and changes in personnel, both at the department of planning and NACOSTI. The main contact person at Planning has retired whereas there is a new Director General at NACOSTI.

### 4. Lessons Learned, Challenges/Problems Encountered So Far (if applicable)

- a. The process of developing an STI roadmap for the SDGs is a unique opportunity that has brought together government agency responsible for SDGs (Department of Planning) to work closely with the NACOSTI, the Agency responsible for STI. In the past such coordinated efforts between the two had never taken place. Such situation of limited coordination between SDGs and STI may also be found in other pilot countries.
- b. The process of developing the STI roadmap is complex, requires expertise and various stakeholders.
- c. The presence of clear government prioritized sectors (like the big four agenda) may make the processing of defining the scope easier.
- d. Data is a challenge. There is inadequate data to provide the baseline for all the targets. There are no direct SDGs targets. They can only be inferred from sectoral plans and strategies. Therefore, the gaps were determined using SDG Index and Dashboard
- e. Most of government departments are implementing programs and projects that contributes to SDGs but have not linked their targets to SDG objectives. As relevant documents of government funded STI programs/projects rarely mention which SDGs are relevant, it has been difficult for the team to track down and list up existing work.
- f. Developing of the STI roadmap for the SDGs is new and requires skills and capabilities to make use of country diagnostic methodologies and tools for gaps and needs assessment. Such skills and capabilities may not be readily available in the government, the private sector and the NGO. When Kenya initiated its analytical work with the WB, the Kenyan technical team members needed a hands-on support and guidance from the Bank in collecting domestic data to be collated in a table, for example. Capacity building is required, and attentive technical support of relevant international partner agencies is essential.
- g. Assess Alternative Pathways is perhaps the most complex and expensive step in this process. It requires active participation of carefully selected stakeholders, not only from the government and research institutions but also from the private sector and civil societies, for each of the identified areas of interventions. As mentioned in 2.3, the team has assessed various technologies for achieve self-efficiency in maize by 2022. In doing so, nearly a dozen of workshops have been held to cover a wide range of sub-topics, e.g., new plant varieties and production/blending of fertilizer. Knowledge and networks of Agricultural experts in the team were crucial in mapping out issues and stakeholders, put together a series of workshops and come up with priorities.

## Serbia – inputs and updates by EC/JRC with UNIDO<sup>13</sup>

Serbia has developed its STI for SDGs Roadmap based on the Smart Specialization Strategy adopted by the government in February 2020, following Action Plan (Roadmap) in March 2021. This makes Serbia the first country to finalize the roadmap development. The preparations for the implementation phase have now started.

### 1. Leading Agencies and National Counterparts

Serbian Interministerial Smart Specialization Team has led the process of development of the Strategy and the Roadmap from the beginning of Serbian participation in the Global Pilot Programme, with the operational leadership by Ministry of Education, Science and Technological Development (MESTD). A new government was formed on 28 October 2020, with the appointment of H.E. Ana Brnabic as Prime Minister. While recent changes in the government has led to a process of reorganization of leadership and mandates and the need to reintroduce pertinent links between different ministries, the inter-ministerial working group lead by the Prime Minister Cabinet office, remains in place with a mandate to oversee Smart Specialization Strategy of Serbia (4S) and the implementation of Agenda 2030.<sup>14</sup>

At operational level, MESTD continues leading the S4 implementation and head the National 4S Team. The latter team includes staff from MESTD, from Public Policy Secretariat (PPS), and representatives from a public research institution. Additional members might be joining the team in the near future. During the strategy development process the following stakeholders were involved: Ministry of Economy, Ministry of Finance, Ministry of Labour, Employment, Veteran and Social Policy, Ministry of Trade, Tourism and Telecommunications, Ministry of Agriculture, Forestry and Water Management and Environmental Protection, Ministry of Culture and Information, Provincial Secretariat for Economy and Tourism of AP Vojvodina, Serbian Chamber of Commerce and Industry and Serbian Academy of Sciences and Arts - SASA). National Statistical Office, Intellectual Property Office, and the University of Belgrade were also involved at different stages in the strategy development process. EC-JRC provided financial and methodological support for the strategy and roadmap development process and the analytical work leading to the identification of priorities among the 17 SDGs<sup>15</sup> while UNIDO has accompanied the process by providing in kind support to the development of the STI for SDGs Roadmap.

### 2. Achievements so far, Expected Outcome and Key Activities

Serbia decided to leverage on 4S development process to elaborate the STI for SDGs Roadmap. **Following the adoption of 4S by the Government of Serbia on 27 February 2020, the STI for SDGs (STI4SDGs) Roadmap adopted in March 2021 became the strategy's implementation plan.** It aims to inform and guide public and private investment in a number of STI priorities with highest potential impact on socio-economic development. Thus, a first achievement is that the STI4SDGs Roadmap for Serbia will become a first exercise in extending the scope of traditional Research and innovation Strategies for Smart Specialization by introducing a new directionality, which is the alignment of national development and STI efforts to the country's commitment towards the 2030 Sustainable Development Agenda, and associated SDGs. Because 4S stands at the crossroad between research and development and technological innovation (RDTI) and economic/industry and other policy

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<sup>13</sup> This case builds, among other sources, on the Serbian presentation at Session 10 of the UN-China Ministry of Science and Technology Joint Capacity Building Workshop in Guilin, China, December 9-17, see Knezevic and Nedović, 2019, the following presentation in Vienna (February 2020), the official Smart Specialisation Strategy text and progress reports by an EU/JRC consultant engaged to support finalization of the STI4SDGs Roadmap document. The text was prepared by Monika Matusiak (EC JRC) and Fernando Santiago Rodriguez (UNIDO), and reviewed by Viktor Nedović and Tijana Knezevic (MEDST).

<sup>14</sup> The inter-ministerial working group includes Ministries in charge of different development strategies, including inter alia industrial development.

<sup>15</sup> <https://s3platform.jrc.ec.europa.eu/pilot-methodology>

domains of relevance for Serbia, particularly agriculture, close cooperation by the various Ministries and Agencies in charge of these policy domains is required for smooth S4 implementation.

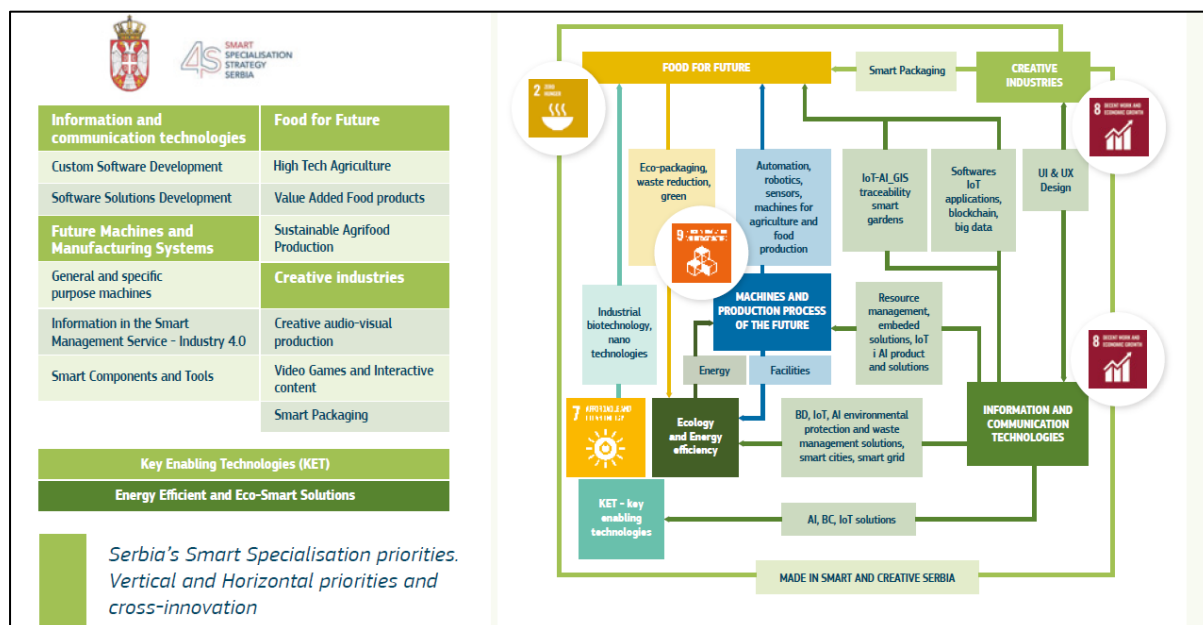
The Serbian government is leveraging from the established processes underpinning the 4S to produce a STI4SDGs Roadmap, which as already indicated became the detailed Action Plan of the 4S. In line with the methodology elaborated in the STI for SDGs Roadmaps Guidebook, 4S includes:

- Wide policy framework and synergies,
- Analysis of economic, innovative and scientific potential,
- Selection of policy priorities and targets,
- Vision for the future,
- Policy measures,
- Monitoring and financial framework,
- Operational framework for implementation

The pandemic of COVID-19 and changes in government slowed down the process of developing the STI4SDGs Roadmap, which was finally adopted in March 2021. Throughout 2020, EU/JRC and UNIDO worked, with support by an EU/JRC consultant, in guiding the Roadmap development activities.

### Activities: Define objectives and scope

4S is an interdisciplinary research and innovation agenda to foster the socio-economic development and transformation based on knowledge-intensive activities. It focuses on the following priorities and SDGs:



The following STI for SDGs Roadmap was based on the support provided by EC/JRC and UNIDO, which focused on:

1. Analysis and methodological advice for moving towards the implementation phase of S4. In particular, guidance on how to develop the three elements below further:
  - Policy mix definition and implementation;
  - Establishment of a monitoring and evaluation system;
  - Governance for the implementation stage of S4



2. Review of successive versions of the draft STI4SDGS Roadmap, unofficially translated in English. Focus of the discussion on the more detailed components of the three elements above, for example, individual policy measures and associated performance indicators, or the analysis of such same instruments in context of more comprehensive policy mixes, with examples of types of instruments from other countries (e.g., Industrial PhDs) and on the choice of indicators for the monitoring system.

### Assess current situation

Development of the STI4SDGS Roadmap slowed down due to the pandemic and by the change of Government that took place towards the end of 2020. However, to the extent possible technical work could still be performed during this period. Members of the National 4S Team stayed in function after the change in Ministers, thereby ensuring continuity of the work on the Roadmap. The STI4SDG Roadmap has been produced, including the following types of policy instruments:

- Instruments from R&D policy sphere such as Innovation Fund and Science Fund;
- Instruments from economic/industrial policy sphere such as Transformation of industry from linear to circular model with reduced CO2 emissions or Increased contribution of scientific and research solutions in the process of development and digitalization of the domestic industry;
- Instruments from other policy spheres: agriculture and food industry R&D incentives or for Development of Information Technology the Development of Artificial Intelligence.

### Develop vision, goals, and targets

The vision for the future has been developed in a wide participatory process as described in the section Stakeholder consultations. Over half of the participants represented private sector. The accepted vision is:

**Serbia Creates Innovations** - Serbia country of smart and creative people, highly competitive in the world, recognized by its knowledge-based innovations, partnerships of the domestic ecosystem and creativity of individuals in areas of:

- *Sustainable high-tech production of high value-added food for the future.*
- *Sophisticated software solutions for the global market.*
- *Inter-sectoral-based industrial innovations with a high degree of inter-sectoral integrated industrial and business solutions and innovations.*

Overall goal aims to achieve the vision “Serbia Creates Innovation”: Development of the Republic of Serbia towards a highly competitive economy through research, development, innovations, and entrepreneurial initiatives in the 4S areas. The goal includes 5 objectives:

1. *Research and development focused on 4S priorities.*
2. *Economic growth supported through R&D and collaboration among the quadruple helix participants.*
3. *Education focused on innovations and entrepreneurship.*
4. *Improved business environment through optimization and digitalization of procedures in 4S areas.*
5. *Internationalization of the economy through involvement in regional and global value chains in the 4S areas*

and a set of priority-specific targets to be achieved by 2027.



### Activity: Assess alternative targets

The entrepreneurial discovery process framed the discussion of alternative targets and solutions. This is documented in separate workshop reports.

### Activity: Develop detailed STI for SDG roadmap

The detailed roadmap became the Action Plan for 4S, as indicated in the government-approved Strategy. It will focus on specific actions to achieve the prioritized SDGs, with detailed indicators and timeframes for the achievement of the targets.

### Activity: Execute, monitor and evaluate, and update plan

Smart Specialization Strategy includes monitoring and evaluation system, based on the input, output and outcome indicators. It has been further developed in the Roadmap document for specific actions.

### Inputs: Data, stakeholder consultations and expertise

*Data and expertise:* The Serbian approach is fully evidence informed. It includes a mix of quantitative and qualitative indicators disaggregated for specific purpose of the analysis, sourced from the National Statistical Office, Intellectual Property Office, Public Policy Secretariat, Ministry of Education, Science and Technological Development, Ministry of Economy, Serbian Chamber of Commerce and Industry and the University of Belgrade. The country has mobilized its own Analytical Team and used external expertise of JRC and Fraunhofer Institute (financed by JRC). Additional support of JRC covered the study on mapping of SDGs, including the identification of SDGs prioritized in the national strategic framework, the statistical baseline analysis and the identification of the STI inputs focused on specific SDGs.

*Stakeholder consultations:* Serbia has run a wide participatory process (entrepreneurial discovery), with over 700 stakeholders, 178 interviews, 17 workshops and 2 conferences were organized to develop the consensus on the joint vision and priorities. Over half of the participants represented private sector. The entrepreneurial discovery working groups for each priority have been formalized and will be actively involved in the implementation and monitoring process. Each working group is run by the representatives of business and academia, with the government providing a platform for discussions and joint work.

## 3. Expected Other Stakeholders, Milestones and Timeline

The Inter-ministerial Working Group for Agenda 2030 joined the work on STI for SDGs Roadmap, adopted in March 2021. The Group proposed to create a subcommittee on STI for SDGs. An area of interest is localization of SDGs. UNIDO joined the Roadmapping work in partnership with JRC.

The foreseen next steps after the Roadmap development include support for implementation, the continued stakeholders' dialogue on STI for SDGs and piloting of the SDG budgeting for Roadmap implementation.

## 4. Lessons Learned, Challenges/Problems Encountered So Far (if applicable)

The development of an interdisciplinary, multi-ministerial document in a transparent and participative way brings several challenges. They include:

- Dependence on external financing at the beginning of the process,
- Lack of sufficiently disaggregated data for the analysis of the current state,
- Building trust of stakeholders and convincing them to participate in the government-led dialogue,
- Overcoming the governmental silos, and launching a real inter-ministerial cooperation,
- Insufficient familiarity with SDGs and the overall 2030 Development Agenda, which may seem overwhelming for both policy makers and individual practitioners,

- Difficulties to operationalize a complex set of targets at a macro level, and to link them to concrete policy interventions intended to tackle focused micro-level challenges, need to balance between time and effort invested in strategy setting and actual implementation to avoid stakeholder fatigue.

**Due to these challenges the process encountered some delays, but the successes include:** mobilization of Serbian own funding for the implementation of 4S, accompanied by additional EU-funding; developing a permanent cooperation with the Statistical office and IPR office that delivered necessary information; launching a permanent public-private dialogue platform with high involvement of stakeholders and winning the approval of the Prime Minister who took leadership of the Inter-ministerial Working Group. These achievements show increased institutional capacity that bears well for the later implementation.

## Ukraine – inputs and updates by EC/JRC with UNIDO<sup>16</sup>

### 1. Leading Agencies and National Counterparts

Ukraine will participate in the Global Pilot Programme in partnership with the Joint Research Centre (JRC) of the European Commission that will support the development and implementation of the STI for SDGs Roadmap based on Smart Specialization approach, as well as with UNIDO that will provide support based on their experience on green industrial transformation.

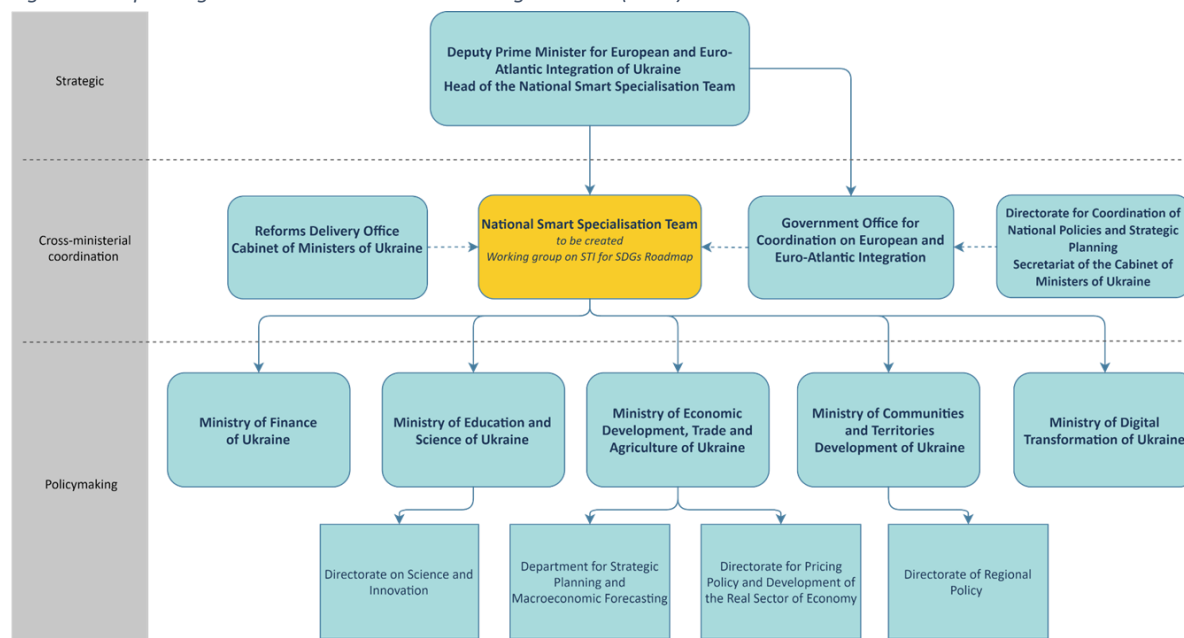
The office of the Deputy Prime Minister for European and Euro-Atlantic Integration of Ukraine will ensure its leadership in the Global Pilot Programme providing strategic coordination of SDGs and European Integration policies.

The Deputy Prime Minister office will be assisted in this task by the National Smart Specialization Team, which will ensure the governance of the STI for SDGs Roadmap process and enhance cross-ministerial coordination. A ministerial decree will officially establish the Smart Specialization Team as an advisory body to the Cabinet of Ministers and the necessary policy mandate will be ensured.

The Government Office for Coordination on European and Euro-Atlantic Integration (EU Integration Office) will also be involved for the Roadmap development. Two resources will be added in the organigram of the Reforms Delivery Office of the Cabinet of Ministers of Ukraine to enhance the EU Integration Office capacity to provide needed support of the STI for SDGs policy coordination. These two resources will work in close cooperation with the EU Integration Office and support organizational work of the National Smart Specialization Team on cross-ministerial efforts coordination.

The Ministry of Education and Science of Ukraine (MES), responsible for the STI policy, will lead at the operational level the STI for SDGs Roadmap development, in close cooperation with the Ministry of Economic Development, Trade and Agriculture of Ukraine (MEDTA), responsible for the SDGs, innovation in real economy, IPR and regional Smart Specialization policies, as well as with the Ministry of Digital Transformation of Ukraine, responsible for the digitalization and business development policy to the stakeholder framework, to be included into the development process.

Figure 1. Proposed governance structure. Source: Olga Bolibok (2021).



<sup>16</sup> This chapter builds, among other sources, on the report “Support for the development of Science, Technology and Innovation for SDGs Roadmap in Ukraine” prepared by Olga Bolibok, expert for the Joint Research Centre of the European Commission and on consultations held with national authorities. The text was prepared by Angela Sarcina (EC JRC), Monika Matusiak (EC JRC) and Fernando Santiago Rodriguez (UNIDO).

## 2. Achievements so far, Expected Outcome and Key Activities

Having joined the Global Pilot Programme in February 2021, Ukraine's activities for the development of the STI for SDGs roadmap are at a very preliminary stage of design and still under discussion by and with the national counterparts. A preliminary list of the proposed activities to be performed includes the following:

- Ensuring coordination with the ongoing smart specialization process at regional level and upcoming local initiatives;
- Establishing a governance structure able to manage the process and implement the results;
- Identifying synergies with other policies: Assessment of national SDG framework in Serbia;
- Using the results of Ukraine's Voluntary National Review for SDG prioritisation;
- Stakeholder validation of challenges;
- Identification of existing STI potential for SDGs;
- Identification of collaboration networks to deliver change;
- Stakeholder dialogue: entrepreneurial discovery for sustainable innovation: discovery for recovery;
- National Smart Specialization priorities and Action plan included in the STI for SDGs Roadmap.

### Activity: Define objectives and scope

The development of the STI for SDGs roadmap in Ukraine will build on the regional (subnational) experience on Smart Specialization. Since 2016, Ukraine is working on the development of regional smart specialization strategies with JRC support. Coordinated by the National Smart Specialization Team, the Ministry of Economic Development, Trade and Agriculture of Ukraine is leading the process in cooperation with the Ministry of Communities and Territories Development and the Ministry of Education and Science, State Statistics Service of Ukraine and other stakeholders.

In 2018, Smart Specialization methodology was identified as the main tool for achieving the objectives included in the "Regional industrial development" strategy of the National industrial policy developed by the Ministry of Economic Development, Trade and Agriculture, but not yet adopted. In addition, the Cabinet of Ministers adopted a resolution according to which Ukrainian regions have to define at least one goal within the framework of the Regional Development Strategy based on the Smart Specialization approach that would allow regions to apply for funding by the Regional Development Fund. In addition, the National Smart Specialization team launched simultaneous training processes in 25 Ukrainian regions. To enhance institutional capacity, JRC launched expert support in 11 regions in 2019 and in 8 regions at the end of 2020.

Taking into account the ongoing process at the regional level, Ukraine will develop the national STI for SDGs roadmap based on Smart Specialization approach and supplemented by UNIDO's approach on green industrial transformation using a multi-level approach.

In order to ensure efficient interconnection among the different levels, a corresponding institutional set-up is now under discussion by relevant ministries and directorates. The proposal under discussion is to set up two working groups within the National Smart Specialization Team, one in charge of the Regional Smart Specialization strategies and the other one for STI for SDGs Roadmap based on National Smart Specialization. This mechanism would aim at ensuring coordination between levels and projects.

### Activity: Assess current situation

As a preparatory work to define the positioning of the STI for SDGs Roadmap within the national policy context, an analysis of the strategic policy frameworks has been performed.

It has been assessed that Ukraine has a national SDGs indicators system, which consists of 17 goals and 86 targets, included in the report “Sustainable Development Goals Ukraine 2020<sup>17</sup>. The report provides a good basis for future monitoring, as well as for the analysis needed for the STI for SDGs Roadmap development. In addition, the President of Ukraine issued a decree “On Sustainable Development Goals of Ukraine for the period till 2030” to promote the achievement of the SDGs. An Inter-Agency Working Group on Achieving Sustainable Development Goals, a temporary advisory body of the Cabinet of Ministers of Ukraine, was established to ensure coordination of efforts. The Voluntary National Review on Sustainable Development Goals was presented online at the High-Level Political Forum on Sustainable Development in July 2020.

At the STI level, since 2016, reforms on science and innovation have been developed and launched. A complex reform of the state system of support to the innovation ecosystem was launched in 2017 and it is still not fully implemented. A process of reforms of the national science and technology system was launched in 2015 defining the modern legal, organizational and financial basis of functioning and development of the scientific and technological scopes in Ukraine. In this framework, the National Research Foundation of Ukraine was established.

To improve policy coherence between science and innovation components, Directorate of Science and Directorate of Innovation in the Ministry of Education and Science were merged into the newly established Directorate on Science and Innovation.

### Inputs: Data, stakeholder consultations and expertise

The main data source for the National Smart Specialization Strategy is a State Statistics Service of Ukraine that may provide economic data and innovation survey data

Other data sources for the STI for SDGs Roadmap may include (but are not limited to) the following:

- UN Global SDG Indicators Database for the statistical assessment of the key challenges resulting from SDGs;
- European Commission’s CORDIS database (Horizon 2020 projects), Elsevier’s Scopus (Scientific publications);
- Databases of the National Research Foundation of Ukraine, Ukrainian Startup Fund and Inventors Fund;
- European and Ukrainian patents, PATSTAT database (patents) for the identification of the scientific, technological and innovative potential of Ukraine.

### 3. Other Expected Stakeholders, Milestones and Timeline

On the initial stage of the programme, stakeholders’ information and consultations are being realized, in the form of individual online meetings carried out by the JRC expert.

On 26 March 2021, the official kick-off meeting on the Global Pilot Programme was held online at the presence of Ms. Yulia Bezvershenko, Director General of the Directorate on Science and Innovation of the Ministry of Education and Science of Ukraine and Ms. Daria Gaidai, Advisor to the Deputy Prime

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<sup>17</sup> For further information, see the documents: Sustainable Development Goals Ukraine 2020 Monitoring Report [\[Eng\]](#) [\[Ukr\]](#); Sustainable Development Goals Ukraine 2020 Factsheet [\[Eng\]](#) [\[Ukr\]](#); Sustainable Development Goals Ukraine 2020 Data One-pager [\[Eng\]](#) [\[Ukr\]](#).

Minister of European and Euro-Atlantic Integration of Ukraine, as well as other representatives from other relevant ministries and government offices.

Ukraine is expected to define the next steps and timeline by mid-April.

## Chapter 4: Lessons and Implications from Experience to Date

This chapter draws lessons and implication from the six country pilots undertaken to date. The first section summarizes the progress on the six steps of the roadmap as well as what they report as challenges and lessons learned. The second section reports on the lessons learned from three country case studies - India, Kenya and Serbia. The third section draws some of the preliminary lessons and implications for moving forward from progress to date.

### From Country Pilots

Following is the summary of progress of the country pilots on the six steps of the roadmap as well as what they report as challenges and lessons learned.

#### 1. Objectives and scope

The objectives have been framed within the context of the country's national development plan and their economic and social conditions. All countries have chosen a narrow set of SDGs (from three to seven) because of the difficulty of tackling all the SDGs simultaneously.

The most common SDGs, chosen by four countries each, have been SDG 1 (No Poverty) and SDG 8 (Decent Work and Economic Growth) with a strong focus on jobs. The third most common, chosen by three countries each, have been SDG 2 (Zero Hunger). The next most common, chosen by two countries each, have been SDG 3 (Good Health and Wellbeing), SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), and SDG 10 (Reduced Inequality). Another four have been chosen by one country each. They are SDG 4 (Quality Education), SDG 9 (Industry, Infrastructure and Innovation), SDG 13 (Climate Action), and SDG 17 (International Partnerships).

As all but Serbia are low income or lower middle-income countries with high poverty rates and have the largest share of employment in agriculture (see Appendix Table A.1), it is not surprising that SDGs 1, 4, and 2 are the most commonly chosen. Serbia, the highest per capita income country, has focused most on using STI to increase its growth and competitiveness.

India stands out in having included SDG 17 on international partnerships for the goals even though it is a lower middle-income country. That, in part, is because of its strong technological capability and its commitment to the TFM to help other developing countries use STI to accelerate their development.

Ukraine, as a new country in the Global Pilot Program has an opportunity to draw from the lessons learnt so far. In the case of this country, an interesting challenge will be the coordinated national and subnational level efforts for the development of STI for SDGs Roadmap.

#### 2. Assessment of current situation

The assessment of the current situation of both SDG gaps and STI supply/capability requires a lot of data and expertise. The depth of the assessment has varied across the pilot countries. In Ghana, India, Kenya and Serbia, they have been done based on assessments of both STI capabilities and SDG gaps, although the data available in each country has varied. In India, a detailed analysis of the technological STI system disaggregated to the state level has been done. In Serbia, the target-level statistical analysis has been prepared showing the distance from the best performers in the European Union (see Appendix Figure A.4 for the aggregated results of the analysis and Appendix Figure A.5, for a detailed example for one of the SDGs). In Ghana, the assessment has focused mostly on a Science Technology and Innovation Policy Review and detailed technology roadmaps for 22 sectors, but not yet on SDG gaps and goals.

#### 3. Vision

Developing a vision, goals and targets has varied widely across the pilot countries because of the different institutional set-ups through which they have engaged in the pilot exercise. The most

developed visions have been done in Serbia, India and Kenya where there has been more involvement of the highest level of government in the process. In Ghana, the vision is still being developed and is mostly driven by the Ministry of Environment Science and Technology. In Ethiopia, a clear vision for STI for SDG roadmaps is still in the process of development because the work so far has been undertaken only by the Ministry of Innovation and Technology and will be articulated after drafting a New National STI Policy. In Ukraine, from the application stage, the Vice-Prime Minister's office has taken the lead of the process, which is expected to facilitate the development of the Roadmap and later implementation.

#### 4. Assessment of alternative technological pathways

Assessing alternative pathways is perhaps the most complex and expensive step, requiring the engagement of representatives from different parts in the innovation chain, including not just the technology, but the agents involved in the value chain to diffusion and use as well as the provision of complementary inputs, including finance and infrastructure. This has not been very fully developed in most of the pilot countries except perhaps for Kenya, where the methodology for considering alternative technologies was tested for the case of maize.

#### 5. Development of detailed STI for SDGs roadmaps,

Serbia has adopted its STI for SDGs Roadmap in March 2021. Other pilot countries have not yet fully developed detailed roadmaps, which are at different stages of advancement. In some cases, such as Serbia and India, they are more comprehensive and involve the actions of many stakeholders. In others, so far, they are more narrowly focused (technology roadmaps in various sectors in Ethiopia, technology incubators in Ghana, the agricultural value chain for three crops in Kenya) and are still in the process of expanding the coverage and developing the details of the policies and implementation actions.

#### 6. Execution, Implementation, monitoring and evaluation

As the detailed STI for SDGs roadmaps have not yet been finalized in most of the pilot countries, they have not reached the execution or implementation phase. Serbia has launched the first calls for implementation, connected with mobilizing STI for COVID already in 2020. In 2021, a full-scale implementation is expected. Moreover, some implementation actions have already started in India. In addition, India is putting a strong emphasis on monitoring and evaluation for strategic decision making for the execution and adjustment of the plan. Serbia has also prepared for the implementation with dedicated actions planned, among others, with the Science and Innovation Funds. As noted in the Guidebook, monitoring and evaluation is a critical element because the implementation of the roadmap is essentially a learning exercise. It will be important to learn from the implementation experience and to make adjustments as well as to take into account the impact of changes in the context, such as the current COVID-19 crisis.

#### 7. Data, expertise and stakeholder consultation

The use of data and expertise has varied widely across countries, depending in large part on what information is readily available as well as how much effort they have put into developing and collecting relevant data. There has also been a lot of variation in the extent to which domestic and international expertise has been tapped to help develop the roadmap, as well as the nature and depth of stakeholder consultations. The most extensive appear to have been in India, Serbia, and Kenya which are developing broader and more detailed roadmaps. In Ethiopia and Ghana, the consultations have been more limited to stakeholders in the national innovation system. Ghana project has initiated a new partnership with academic institution for data collection and analysis.

#### 8. Challenges, Problems, Lessons

The most common challenge, mentioned by all the six countries, has been getting stakeholder involvement and active participation. In countries involving several ministries and agencies, this has



included getting effective coordination. In the case of Serbia, the development of the roadmap has allowed a great mobilization of not only public but also private stakeholders and civic society. In addition, though not always explicitly mentioned in the country write-ups, except in the Serbia progress report, a related challenge has been getting a focus different parts of government that are involved in STI or general development planning to focus on SDGs. In many cases the plans are still just STI roadmaps, or parts of national development plans, not necessarily STI for SDGs roadmap. The second major challenge has been the availability of updated data to do the assessment to develop priorities.

Another major challenge which has slowed the preparation of the roadmaps has been the COVID – 19 crisis which has diverted the attention of government officials to addressing the crisis. In addition, another critical challenge has been the lack of specific budget to develop, and more importantly to implement the STI for SDG roadmap.

Some of the key lessons are the importance of creating platforms for coordination and collaboration among government and between government and other stakeholders. Other lessons are the importance of getting relevant expertise and secure funding.

## Lessons learned from pilot country case studies

This section draws the lessons from three Pilot country case studies: M-PESA from Kenya; The Ayushman Bharat PM-JAY Health Insurance System from India; and the Innovation Fund from Serbia.

### Key elements of success

**1. Strong collaboration among multiple stakeholders with effective coordination:** Multi-stakeholder engagement with effective coordination is seen in all the case studies. The three cases also demonstrate the importance of involving relevant stakeholders from different parts of government, the private sectors, technical experts, and civil society. Although the process of involving stakeholders may be lengthy and complex, it is critical for the successful development and implementation of the project.

**2. Developing a good deployment system is crucial.** All three cases had an emphasis on the development of deployment system.

- **In India**, for both health systems and Aadhaar (the unique ID system), the key requirement were considerable buy-in from state government, plus multiple providers of IT and of health providers, in case of health system.
- **In Kenya for M-Pesa**, it was critical to have participation of vendor networks.
- **In Serbia**, a lot of effort was put into developing the capacity of the staff in charge of the innovation fund, including foreign study trips, hands on training and advice from renowned foreign experts. The case study also shows that often it is necessary to enact new laws and create specialized institutions in order to be able to operationalize the plan.

**3. The ability to adjust to changes is a key for success.** All three cases had to adjust as they were being implemented. In order to adjust to unexpected changes, putting effective monitoring and evaluation system is critical.

**4. Involvement and partnership with private sector.** The private sector can play a very important role. This point was seen clearest in the Kenya M-Pesa case study, where the main driver was Vodafone/Safaricom (International and domestic private sector). This was also the case in India, as the health insurance system required the participation of the private sector to develop the digital platforms to integrate the system. The India system also needed the active participation of private doctors, health care facilities, and hospitals part of the system. In Serbia, the establishment of the Innovation Fund helped reorient public research towards the needs of the private sector in order to

increase Serbia's industrial competitiveness, and the private sector was the donor as well as the recipient of new funds.

**5. Adequate financing.** Securing adequate financing was also critical, particularly for social programs provided by the government such as in India. But it is important to note that public (DFID) financing was instrumental even in the case of Vodafone (a large multinational) in the initial development stage. Also, it is important to recognize that M-Pesa seems to have been privately financed once its viability was demonstrated. Also, its focus changed, and it seems to be privately financed by users who find value in this application. In Serbia, the innovation fund required international funding from the EU and the WB as well as from the Serbian government, and co-funding from the private sector for approved projects.

### Role of assessment of alternative pathways

Minimal assessment of alternative pathways was evident in the three case studies, although there appears to have been some in the India case. Also, there was a significant effort to learn from best practices from other countries in setting up the Serbia Innovation Fund.

It should be noted that assessing alternative pathways is generally difficult for any country to do, as there is not easily and readily available system of technological alternative information.

### Replicability

Replicability varies, depending on many contextual factors including capacity of local agents. M-Pesa has had some limited replicability. The case study highlighted the importance of the regulatory regime as well as the deployment system. But it should be noted that M-Pesa was not so replicable in India because of the regulatory system of the banking sector.

Aadhaar-potentially has a large replicability, although there are issues of technical capacity in other countries, as well as important issues of trust, privacy and security.

India Universal Health is in fact still being expanded in India. Potentially, it has replicability to other developing countries. But some preconditions need to be met, such as vertical and horizontal coordination, multiple healthcare providers and finance.

Serbia's Innovation Fund has some elements of replicability. However, the case study clearly shows how a program has to be adapted to the specifics of the country. It also requires strong support from the highest level, the creation of a strong independent institutions, strong, and extensive stakeholder consultation, changing or passing new legislation, and lots of external technical and financial support and involvement from the private sector.

### Lessons related to International Partnerships on STI for SDGs Roadmaps

The progress reports from the six pilot countries as well as the country case studies present the following lessons for international partnerships, which resonate with the recommendations of the IATT Background Paper on International Cooperation. **The overall lesson is that greater technical and financial assistance from international partnerships for SDG Roadmaps will be very helpful to help countries develop effective STI for SDG roadmaps.** More specifically this includes:

- Building the national STI capabilities of developing countries, to address challenges underpinning the SDGs; and helping to connect national innovation systems in developing countries internationally
- Undertaking concentrated analytical efforts to improve methodologies for assessing synergies and trade-offs among the SDG goals in the challenging context of developing countries, and providing technical expertise and finance to help them design and implement their plans

- Boosting international flows of relevant knowledge and technology across countries and on supporting cross-country STI collaborations, addressing the SDGs
- Brokering international collective STI actions with an ambition to tackle global challenges, notably the Global Public Goods as technological advances can help developing countries more effectively tackle their SDG challenge

## Implications and recommendations for moving forward

The following is a list of lessons learned from current state of pilots as well as from country case studies, for further strengthening of the Guidebook and the Pilot countries as well as for expanding the pilot activities to other countries.

### 1. For the Guidebook

- Countries can't tackle all the goals and follow all the steps at once. The Guidebook should be more explicit that should start where there is enough political support and capability and then expand as experience is acquired.
- Beyond what is the country progress reports, it should be noted that in no country, but Serbia does it appear that an explicit effort was made to assess trade-offs and synergies between or among different SDGs in the particular country context. In Serbia, the synergies between different priority domains and related SDGs have been discussed during the entrepreneurial discovery process and included in the Smart Specialization Strategy and later addressed in the dedicated analytical exercise. Methodologies for helping countries assess such trade-offs and synergies could help countries decide which are the key SDGs they may find it most effective to pursue, and to organize their objectives and scope accordingly.
- The case studies do not strictly follow the six steps. They developed more organically by trial and error rather than as part of a planned project. However, following the steps can help to speed the process.
- It is important to take stock of the strategic framework and existing policies in order to avoid duplications of policy processes and fill the gaps. This has been done in most pilot countries. The six steps can then serve to understand what has been sufficiently developed and where there are areas for improvement.
- More guidance would be useful on how to get more international assistance on:
  - a. Existing technology and innovation that can be harnessed
  - b. Expert advice and technical assistance on how more effective use of technology and innovation can help to accelerate the goals
  - c. Where to find finance for the development of the roadmaps, but more importantly for the implementation of the roadmap
  - d. International efforts to build, boost and broker STI collaboration for the SDGs
- Provide more guidance on how to set up the roadmap as a learning experience to be adjusted and updated as experience is gained
- Provide more on concrete examples on how more effective use of technology and innovate can help achieve the goals in order to stimulate excitement and commitment to developing STI for SDG roadmaps as well as to illustrate what is required. The illustrative case studies from India, Kenya, and Serbia included in this progress report which provide concrete examples of how STI can contribute to achieving SDG goals and what is required in terms of getting stakeholder involvement, expertise, planning, implementation, monitoring and evaluation and adjustment as experience is acquired helpful in this respect. Such concrete successful experiences should be reflected in a future version of the Guidebook.

- Provide more guidance on how to create high level interest, buy-in, and commitment to implementation and improvement
- Set up a community of practice of countries developing and implementing roadmaps
- Update the Guidebook as more experience is accumulated

## 2. For current pilot countries

This is not directed at any specific country but rather provides general suggestions that countries may wish to consider as they move forward with fleshing out their STI for SDG roadmaps and begin to implement them.

- Draw more on existing national and international information, technical and financial resources
- Get greater stakeholder participation and ownership
- Improve coordination across relevant ministries/government agencies and other stakeholders in the private sector and civil society
- Consider potential synergies and complementarities as well as trade-offs among the SDGs targeted in the STI4SDG roadmaps, in order to make the most effective use of limited financial and human resources
- Take advantage of the many opportunities offered by new digital technologies and the convergence between digital, physical and biological technologies, but also address the potential negative effects of these disruptive technologies such as tendency for increasing inequality, risk that as more personal data becomes digitized there are serious issues of privacy, security, and autonomy that need to be addressed
- Move to developing strong implementation plans with clear assignment of responsibilities for the different agents and stakeholders
- Build monitoring and evaluation systems into the roadmaps, as it is certain that there will need to be adaptations and change in the implementation of the roadmaps in light of the implementation experience as well as major changes in the global and local context (for example the disruption caused by the COVID-19 pandemic, and other expected climate related shocks such as extreme weather, flooding, droughts; as well as unknown and unexpected shocks)
- Partner with academia for adding academic robustness on the STI metrics and enhancing M&E in general
- Participate in community of practice among countries that are developing STI for SDGs roadmaps which is likely to be set up to share experiences.
- Do more to take advantage of positive synergies across SDGs and targets
- Country specific observations implementation [For IATT discussions and modification / refinement if necessary]
  - a. [Ethiopia](#). A big challenge is expanding the scope beyond STI to STI for SDGs. This requires more active involvement of ministries beyond MINT and MOSHE and ideally should include the Ministries of Finance, Planning, Agriculture, Industry and other key sectorial ministries, as well as involvement from the Presidents or Prime Minister's Office.
  - b. [Ghana](#). A big challenge is to expand objectives and scope beyond STI and current focus on university-based technology incubators to develop more comprehensive STI4 SDG roadmaps for the SDGs chosen.

- c. [India](#). There is great potential to use its considerable digital skills to improve the coordination, monitoring and evaluation of STI and STI for SDGs. India also has many compelling examples of using STI to accelerate the achievement of many SDG goals which have potential applications in other developing countries.
- d. [Kenya](#). Kenya has taken a deep dive into developing a plan for improving maize technology to increase the income of poor farmers. Now that it has acquired some experience with assessing alternative technologies it needs to broaden its scope and for that it will need to mobilize more stakeholders and expertise and to make concrete implementation plans.
- e. [Serbia](#). Serbia first developed an ambitious 4S strategy with initial focus on priority SDGs and is now moving to incorporate SDG goals into its implementation plan. Based on the additional SDG mapping, other important SDG goals have been discussed and, to be addressed within the STI for SDGs roadmap.
- f. [Ukraine](#). Ukraine should use the lessons learnt from the experience of other pilot countries. The country seems well prepared for this effort and has already requested a peer learning exercise, with a particular focus on Serbia.

### 3. For expanding to other countries

- Disseminate compelling examples of how effective use of STI can speed the achievement of SDGs. This should include examples such as those from the country case studies in the Annex, which although they were not developed explicitly as STI for SDG roadmaps, are good examples of what can be accomplished by focusing STI on attaining SDG development goals.
- Organize another call for pilots
  - a. Ask for high level commitment
  - b. Require a strong high-level coordinating body
- Build a community of practice to share experiences in developing STI for SDG roadmaps and invite potential member countries to join
- Boost more active involvement of UN IATT, other international and national agencies and private sector to help developing countries develop their STI for SDGs roadmaps
- Broker more technical and financial support from the international system

### 4. For the international community,

In light of relative slow progress to date:

- Raise alarm that goals are not going to be met and that we are entering critical tipping points.
- Undertake greater advocacy of the benefits of STI for SDGs roadmaps
- Provide more concrete compelling examples
- Create and participate in the upcoming community of practice
- Strengthen the STI online platform of available technologies
- Create platform of technical and financial assistance
- Build more STI for SDG roadmaps in developing countries, but be careful not to just support STI for its own sake, but to contribute to the SDGs
- Involve the private sector more. Refer to case studies such as M-Pesa and other examples and build on efforts such as the WEFs “Frontier 2030—a New Fourth Industrial Revolution Platform for Global Goals Platform (see WEF 2020)
- Broker more international coalitions to create Technology and Innovation relevant for the goals (see the IATT background paper on International STI Collaboration and Investment for Sustainable Development Goals)
- Above includes the need to manage the downsides of technology (see GSDR 2019).

## Appendix I: Table A.1: Basic Indicators of Pilot Countries

In 2019 unless otherwise indicated

	Ethiopia	Ghana	India	Kenya	Serbia	Ukraine
<b>GNI/Capita (2019)</b>	17,611	4,857.5	105,444	94,144.6	675,222.3	64,013
<b>GNI (billions) (2019)</b>	94.9	67.5	2,890	91.8	48.8	141.6
<b>GDP growth 2000-2018</b>	9.9	6.6	6.8	5.0	3.2	2.6
<b>Population (millions) (2019)</b>	112.1	30.4	1,366.4	52.6	6.9	44.4
<b>Fertility rate, births/woman (2018)</b>	4.2	3.9	2.2	3.6	1.5	1.3
<b>Agriculture as percent of GDP (2019)</b>	33.5	17.3	16	34.1	6	9
<b>% employment in agriculture male//female (2019)</b>	73.4//58.7	36.3//21.1	39.5//54.9	59.5//59.3	17.7//13.2	15.9//11.4
<b>Agricultural value added/worker in 2010\$, (2019)</b>	588.5	3,301.8	1,972	1,128.3	6,935.8	5,733.3
<b>Access to electricity 2018</b>	45	82.3	95.23	75	89.57	100.00
<b>Access to internet 2017 (%)</b>	18.6	37.9	32.0	17.8	70.3	58.9
<b>Expenditures on R&amp;D/GDP (2017)</b>	0.3	..	0.7	..	0.9	0.4
<b>Life expectancy at birth, (2018)</b>	66	63	69	66	76	71.7
<b>Population below \$1.90//\$3.20, (%) (2015)</b>	30.8//68.9	..	..	37.1//66.5	6.6//11.6	0.0//0.5
<b>Gini coefficient, (latest available 2015-2019)</b>	35.0	43.5	..	40.8	36.2	26.6
<b>Maternal mortality rate/100,000 births, 2017</b>	401	308	145	342	12	19
<b>Under-five mortality rate/ 1,000 live births (2019)</b>	50.7	46.2	34.3	43.2	5.3	8.4
<b>HIV/1000 un-infected population ages 15-49 (2019)</b>	0.2	1.1	..	1.5	0.1	0.6
<b>Adult literacy rate male//female (latest available 2016-2019)</b>	59//44	83//74	82//66	85//78	99//98	..
<b>Primary completion rate male//female (2015)</b>	55//53	99//98	95//100	99//100	101//101	..
<b>Lower secondary completion rate male//female (2015)</b>	30//29	76//72	83//88	79//78	102//102	..
<b>Percent of population using safe drinking water (2017)</b>	11.4	36.4	..	..	74.7	92.0
<b>Natural resource depletion as percentage of GNI, (2019)</b>	3.9	3.5	1.0	0.6	0.5	0.5
<b>Renewable energy consumption as percentage of total (2015)</b>	92.2	41.4	36.0	72.7	21.2	4.1
<b>Ambient air pollution--microgrammes per cubic m (2017)</b>	39.0	34.7	90.9	28.6	24.7	20.3
<b>CO2 emissions, metric tons per capita (2016)</b>	0.1	0.6	1.8	0.3	6.4	4.5
<b>CO2Kgs/2011 PPP\$ GDP (2016)</b>	0.1	0.1	0.3	0.1	0.4	0.4

Source: World Development Indicators 2021

## Appendix II: Figure A.2. Technology Mapping for SDG-2 in India (ongoing with inputs from National Consultations)

**Table 1: Technology Mapping for SDG-2 (ongoing with inputs from National Consultations)**

SDG Target	UN Indicator	MoSPI NIF	NIF Values		Technologies
			2018	2019	
2.1 By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round	2.1.1 Prevalence of undernourishment	2.1.1: Percentage of children aged under 5 years who are underweight.	35.7 (2015-16)		<p><b>POSHAN Atlas</b> is an agro-food database initiative being led by the Ministry of Women and Child Development, Government of India that will link comprehensive information on what foods are traditionally consumed, what crop varieties are currently grown, etc.</p> <p><b>AgNext:</b> AgNext has been using AI, data analytics, internet-of-things and spectral analytics for analysing food quality to ensure effective trade, production, warehousing and consumption.</p>
	2.1.2 Prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale (FIES)	2.1.2: proportion of population (marginalized and vulnerable) with access to food grains at subsidized prices	97.62		
2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land,	2.3.1 Volume of production per labour unit by classes of farming/pastoral/forestry enterprise size				<p><b>MyCrop:</b> MyCrop has developed an ‘agriculture platform as a service’ approach which provisions for the utilisation of algorithms and big data to facilitate informed access to markets for farmers. A ‘<i>farmer mitra</i>’ delivers analytical insights and expertise to farmers for increasing profitability by reducing the cost of cultivation, increasing yield and finding suitable marketplaces.</p>
	2.3.2 Average income of small-scale food producers, by sex and indigenous status	2.3.2: Gross Value Added in agriculture per worker, (in Rs.)	68,531 (2017-18)		

other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment				<b>Agricx:</b> Agricx has developed an AI-enabled software-as-a-service stack for entities across producing, trading, storing, transporting, processing or financing of agricultural commodities. Their services provide an opportunity to digitise the entire procurement process.  <b>Arya:</b> Arya, an integrated agri-tech platform offers storage, warehouse management, embedded finance, and market linkages to agricultural producers and buyers across India through its digital collaboration platform.	
	2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality	2.4.1 Proportion of agricultural area under productive and sustainable agriculture	2.4.1: Proportion of Net Sown Area to Cultivable land	77.04 (2015-16)	<b>AgriStack:</b> AgriStack is a public digital repository of farmers, farms and crops’ data. It aims to enable access to credible data for agricultural entrepreneurs to channel their investments in right locations and for the government to improve service delivery and plugging subsidy leakages.  <b>FASaL App:</b> Fasal, an agritech start-up, captures real-time data on conditions in farms through IoT devices that deliver farm-specific, crop-specific and crop-stage-specific actionable recommendations to farmers through an app. Each such device is equipped with sensors that monitor rainfall, wind speed and direction, solar intensity, and micro-climatic factors such as temperature, humidity, leaf wetness and sub-soil parameters. The system helps in managing irrigation based on specific crops at specific stages, protecting the roots and improving yields. The device keeps an hourly
			2.4.2: Percentage of farmers issued Soil Health Card	91.7 (2015-17)	
			2.4.3: Percentage of net area under organic farming	1.383	



					track of the water tension at the primary root zone, and if the water level exceeds a certain level, the system triggers an action alert through the Fasal app.
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### Appendix III: Figure A.3. Technology Mapping for SDG-6 in India

**Table 2: Technology Mapping for SDG-6 (ongoing with inputs from National Consultations)**

SDG Targets	UN Indicator	MoSPI-NIF	NIF Values		Technologies
			2018	2019	
6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all	Proportion of population using safely managed drinking water services	Percentage of Population getting safe and adequate drinking water within premises through Pipe Water Supply (PWS) (similar to 1.4.1)	37.85 (Rural)	40.50 (Rural)	<b>Grundfos AQpure:</b> This is an easy-to-install ultrafiltration-based water treatment system. It produces drinking water by filtering bacteria, viruses and particles from the raw water source (like ground water, rivers, lakes and ponds). It can be additionally attached with a sedimentation system or a sand filtration system. It is completely solar-powered, requires very little maintenance and has a remote sensing feature that makes it very suitable centralized supply of water in remote, off-grid locations.
		Percentage of population using an improved drinking water source (Rural)	95.81	-	<b>Agua Clara:</b> This organization aims at innovating solutions targeted at improving global access to affordable and safe drinking water. It facilitates construction of a water storage, treatment and distribution system in rural areas through

					<p>community labour/participation and materials/resources available locally. It also trains the local community on operation and maintenance of these simple technologies developed by their researchers for simplicity and affordability. They have partnered with the Tata-Cornell Institute for Agriculture and Nutrition (TCI) and its projects are active in Jharkhand and Odisha in India. They have provided filtered and disinfected tap water in remote areas at one-third of the standard cost. In their latest project in Odisha, the systems are designed to be sustainable for the villages, costing around \$1-2 per household per month.</p> <p><b>JanaJal Water-on-wheels (WOW) Water ATMs:</b> This is a portable, solar powered water kiosk technology. The product itself is a mobile water ATM built on a battery operated e-vehicle enabling last metre delivery to residential areas in both rural and urban areas. So far, however, their projects have only been operating in major cities (Delhi NCR, Mumbai and Surat). Their business model relies mostly on contributors/CSR activities but also allows individuals to rent these water ATMs and run them as their own ventures.</p>
6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in	Proportion of population using (a) safely managed sanitation services and (b) a hand-washing facility with soap and water	Proportion of households having access to toilet facility (Urban & Rural)	50.90% (2015-16) for rural		<p><b>Toilets</b></p> <p><b>Eram Scientific's smart toilets:</b> Along with having self-cleaning automatic washing mechanisms, Eram Scientific has product variants with solar technology and portability features. Their toilets need water supply and can be attached to any septic tank. The prices of their toilets range from Rs. 2 lakh to 20 lakh and maintenance costs between Rs. 3,500 to Rs. 5,100 per month/per unit. The company specializes in making public toilets with useful features like remote sensing, automatic washing and napkin dispensing/destroying technologies being aimed in this direction. As a result, they</p>
		Percentage of Districts achieving	88.13	-	

vulnerable situations		Open Defecation Free (ODF) target			have been installed for public usage in some municipalities in India. However, these toilets have to be maintained regularly in order to remain working. A lot of these public toilets are now out of operation because their Annual Maintenance Contracts (AMC) have not been renewed. ,
		Proportion of schools with separate toilet facility for girls	97.52 (2015-16)		<p><b>Sanitation</b>                      <b>Treatment</b>                      <b>Plant</b></p> <p>• <b>DRDO's Biodigester:</b> A bio-digester is an anaerobic multi-compartment tank with inoculum (anaerobic bacteria) which digests organic material biologically. This system converts faecal waste into usable water and gases in an eco-friendly manner. It can be connected to the toilet or a series of toilets. No power supply is required and it is also cost-effective and maintenance free. Biodigester installation is 50 per cent cheaper than septic tank and gives out natural methane and carbon dioxide (minimal air and water pollution) and requires 25-30 per cent less space, compared to septic tanks. Per unit of biodigester for household costs Rs 30,000-50,000, based on the location. This technology is being used under the Swachh Bharat Mission.</p>
6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and	Proportion of domestic and industrial wastewater flows safely treated	Percentage of sewage treated before discharge into surface water bodies			<p><b>Water Technology Initiative</b> is an ongoing DST programme that aims to promote R&amp;D activities aimed at providing safe drinking water at affordable cost using appropriate S&amp;T interventions evolved through indigenous efforts.</p>
		Percentage of industries (17 category of highly polluting industries/grossly polluting industry/red category of	a) 87.63 (Red Category)		
			b) 86.25 (17 Category)		
			c) 88.99 (GPI Category)		
			(2017-18)		

substantially increasing recycling and safe reuse globally		industries) complying with waste water treatment as per CPCB norms			
6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate	Degree of integrated water resources management	Percentage area of river basins brought under integrated water resources management			<p><b>Groundwater Estimation and Management Software (GEMS)</b> is a tool developed by Central Ground Water Board that digitises groundwater level and quality data for India</p> <p>The <b>National Aquifer Mapping and Management (NAQUIM)</b> Program under the Groundwater Management and Regulation (GWMR) Scheme aims to provide high resolution aquifer maps of the country</p>
	Proportion of transboundary basin area with an operational arrangement for water cooperation				
6.b Support and strengthen the participation of local communities in improving water and sanitation management	Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management	Percentage of developed Irrigated Command Area brought under Water Users Association (WUAs)			<p><b>Agua Clara:</b> This organization aims at innovating solutions targeted at improving global access to affordable and safe drinking water. It facilitates construction of a water storage, treatment and distribution system in rural areas through community labour/participation and materials/resources available locally. It also trains the local community on operation and maintenance of these simple technologies developed by their researchers for simplicity and affordability. They have partnered with the Tata-Cornell Institute for Agriculture and Nutrition (TCI) and its projects are active in Jharkhand and Odisha in India. They have provided filtered and disinfected tap water in remote areas at one-third of the standard cost. In their latest project in Odisha, the systems are designed to be sustainable for the villages, costing around \$1-2 per household per month.</p>
		Proportion of villages with Village Water & Sanitation Committee [VWSC]			

## Appendix IV: Figure A.4. Serbia indicators

The median distance in the statistical indicators of each SDG goal with respect to the EU-27 frontier (top 10% countries).

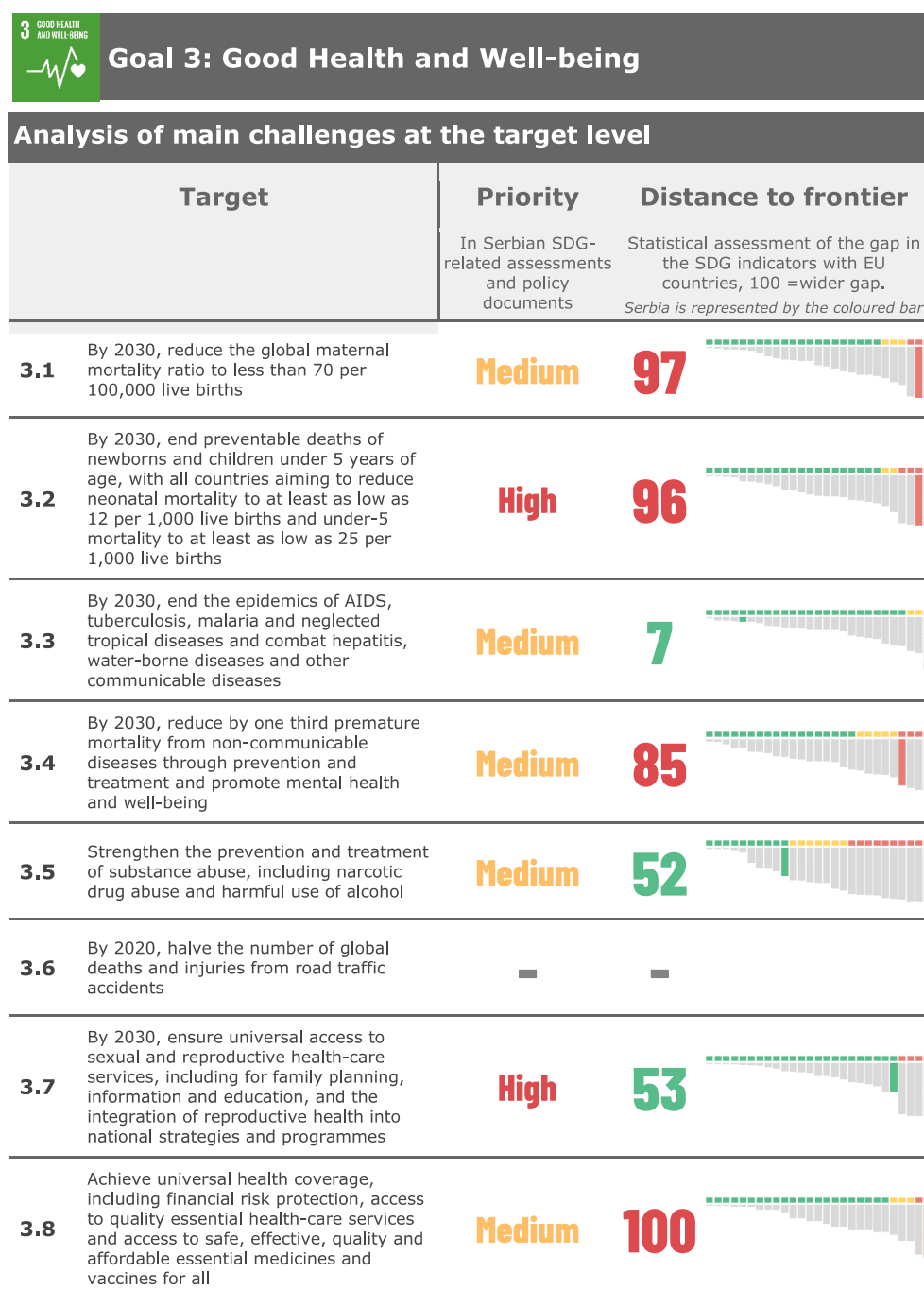
↑ SDGs presenting a wider statistical gap between Serbia and leading EU countries	10. Reduced Inequalities	100
	6. Clean Water and Sanitation	98
	3. Good Health and Well-being	97
	8. Decent Work and Economic Growth	95
	9. Industry, Innovation and Infrastructure	88
	17. Partnerships for the Goals	82
	4. Quality Education	82
	7. Affordable and Clean Energy	79
	1. No Poverty	77
	11. Sustainable Cities and Communities	69
	2. Zero Hunger	52
	16. Peace, Justice and Strong Institutions	51
	5. Gender Equality	39
	15. Life on Land	32
	13. Climate Action	26
	12. Responsible Consumption and Production	21
	14. Life Below Water	Not indicated

*Median distance to the EU-27 frontier (Top 10%) in the statistical indicators*

Source: European Commission, Joint Research Centre

## Appendix V: Figure A.5. Analysis of Serbia Pilot

### Example of the target-level analysis for Serbia – SDG3.



Source: European Commission, Joint Research Centre

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## Annex: Case studies from Pilot Countries

## India: Ayushman Bharat PM-JAY Health Insurance for the Poor

### Introduction

Ayushman Bharat is a federal government initiative in India that seeks to improve access to healthcare for the poorer and more vulnerable households in India. A major novel component of the program seeks to address the issue of catastrophically high out-of-pocket expenses for a largely uninsured population that is estimated to drag down 60 million people into poverty every year. The ambitious program targeting 500 million people (107 million household) was announced by Prime Minister Modi in February 2018 and officially launched in September of the same year, making it particularly notable for the speed of its rollout. The program is reported to have enrolled 680,000 patients in its first 100 days and over 2 million in the first 200 days.

The performance of India's health system has been a source of disappointment, especially in terms of rampant inequities (e.g., income, gender) in access to services. Emblematic of this problem is the country's 1/3<sup>rd</sup> share of global maternal deaths. Although there have been a few visible successes of various initiatives such as eradication of polio, overall, the situation has stubbornly not improved and India remains a laggard as regards SDG3 and until recently the idea of Universal Health Care (UHC) was seen as a pipedream. It is beyond the scope of this brief note to provide an analysis of the historical experience with various National Health Missions or even a rudimentary diagnostic of the Indian health sector that has been extensively studied both within the country and internationally. Rather, our limited objective is to recount the dramatic impact of concerted deployment of technology and innovation to improve healthcare and avoid impoverishment of vulnerable sections of the population in India. Equally important STI has been a game-changer in a profound paradigm shift for government intervention and mobilizing political will for UHC.

### Background & Context: Genesis, Actors, Objectives (political/institutional)

Healthcare in India is a state subject, but the dismal state of the sector led to federal programs being launched over the past decade, such as the National Rural Health Mission (2005) and the National Urban Health Mission (2014). Both of these supply-side interventions sought to expand public health facilities. The Rashtriya Swasthya Bima Yojana (RSBY) was initiated in 2008 as a rare demand-side intervention to provide health insurance for the population below the poverty line. The track record of these has been uneven at best though the RSBY did catalyze similar public insurance schemes at the state level.

The consolidating consensus around healthcare as a development priority in India and its increasing political salience prompted the government to announce the Ayushman Bharat (AB) in the National Budget in February 2018 with the Prime Minister himself soon visibly becoming its champion. Indeed, the timing, a year before the next national elections, was a source of skepticism by some observers who considered it just another electoral gimmick. That was however soon belied by the attention given, speed of critical decisions, appointment of a dynamic CEO and resources provided.

AB actually has two pillars, one on the supply side is an investment program for the central Ministry to set up 150,000 Health & Wellness Centers. Our focus is on the second pillar PM-JAY, a demand-side intervention to provide insurance coverage up to Rs.500,000 (\$7000 approx.) per year each to 107 million eligible households in the country.

The program is funded entirely from tax revenues that is justified partly by the government's commitment to substantially raise the low level of public spending on health in India (around 1% of GDP). Fiscal, economic and administrative considerations prevented universal coverage at this juncture and the benefit is targeted to 40% of the population that is most poor and vulnerable according to the last Socioeconomic and Caste Census conducted in 2011 that has the widest acceptance as a basis for determining key parameters for such assessments and benefit transfers.

While AB-PMJAY is a federal program and combines many of the federal programs before it, healthcare in India remains a state subject; implementation responsibility therefore lies with state governments, which were also free to supplement their existing schemes, if any, with it or fold them into PMJAY. Moreover, states can choose whether to implement the program through a public trust fund, private insurance companies or a mixed model. Financing was arranged to be a 60:40 split between central and state governments, except for the Himalayan and North Eastern states where the federal share is 90%.

A National Health Agency was established to manage the program and upgraded to a National Health Authority with an interministerial governing board chaired by the Union Health Minister. The Chief Executive Officer has the rank of Secretary to the Government of India and has full executive and spending authority required for execution of NHA's responsibilities that include policy decisions, clinical guidelines, benefit packages, operational norms and standards, managing the IT platform, hospital enrolment, and claim management.

Finally, the vast scale of the program and large share of private sector supply in the field of health care made it necessary to extensively consult with a variety of stakeholders, such as private insurances and hospitals, in order to assess the feasibility of the program and develop key parameters. Such consultations also functioned to promote the program among these stakeholders. Not surprisingly, price caps or reimbursable costs that would be accepted generated the most spirited debates, and the controversy lingers even as the program appears to have been largely accepted and a large number of private hospitals have been accredited.

#### STI as a Critical Enabler

As indicated earlier, it is beyond the scope of this note to provide a comprehensive analysis of the overall scheme or the key decisions alluded to above. We confine ourselves to discussing how the unique features that made the AB:PM-JAY program technically feasible, economically viable and operationally workable are critically dependent on effective deployment of Science, Technology & Innovation.

First, the system needed to be able to identify individuals and authenticate their eligibility. Second, the system needed to be able to add and monitor service providers in a decentralized environment. Third, admission, treatment, claims, and financial settlements needed to be processed and tracked again in a vast geographically dispersed context. Fourth, the system needed a dashboard, indeed several at different levels, to pull together relevant information for tracking progress and making corrective actions as well as shared learning across states and stakeholders to maintain momentum. Fifth is the importance of eliminating fraud and abuse and relatedly also monitoring trends related to moral hazard and adverse selection that may need corrective actions.

A Beneficiary Identification System (BIS) developed by the National Informatics Centre, which had previous experience with the RSBY program addressed the first issue aided by the Aadhaar identification system, as well as inclusion of the SECC database.

In order to meet the second and third requirement, the existing systems of 5 states were evaluated for their possible use for AB-PMJAY through in-depth testing of the various systems for compatibility with the requirements of Ayushman Bharat; the Telangana state system was ultimately chosen as the most suitable to build upon further. It is the foundation for modules of the Hospital Empanelment System, which allows for healthcare providers to be added to the system and monitored for quality, and the Hospital Transaction Management System, which allows for the tracking of treatment, claims, and payment for each patient. Together, these sub-systems form the core of the AB-PMJAY system. An important feature is their inter-state nature that allows beneficiaries to use the system anywhere in the country (i.e. not just in their home provinces) yet ensuring that annual benefit limits are not exceeded. Such provision of service across state lines is highly relevant for less affluent workers

migrating across India, e.g. for construction jobs that have provided livelihood to the largest number of entrants to the labor force. The Hospital Empanelment System ensures consistency and transparency of process for the licensing of healthcare services across state lines and is likely to be a key element in maintaining quality of care.

A PM-JAY dashboard was created to address the fourth requirement and uses the existing Application Programming Interfaces (APIs) of the other systems to create a “big picture” view. Even though this module may not be strictly essential to run the insurance program, its ability to show demand for healthcare services, in particular across rural regions and for migrant workers, is a highly important component for the secondary prong of Ayushman Bharat, as the supply of new public and private healthcare centers will be strongly based on the information it aggregates and presents.

Finally, another 10 modules have been created or are in the process of being created in order to give wide ranging access to information to citizens (e.g. mobile app, citizen portal, call center), facilitate operations (e.g. AB-PMJAY portal, grievance management system) and avoid fraud (e.g. data privacy checkpoints, anti-fraud measures, social media monitoring). Some observers believe that PM-JAY can unleash a data revolution in the Indian health sector and more generally promote evidence-based policy in the country. In addition to data analytics to minimize fraud and waste, the information collected can be useful to improve quality of care particularly by detecting inappropriate use as well as positively through identifying local anomalies or geographical specificities. Indeed, real-time monitoring would be invaluable for epidemiological purposes, especially in developing countries such as India.

#### Technological and Other Challenges Going Forward

While the above systems have served to run and scale the scheme for almost a year, the overall scheme has reached a certain level of acceptance, is leaving its proof of concept stage, and moving toward a future as a mainstay of the Indian health system. Consequently, the government is looking toward increasing robustness of the system, allowing for more scalability (potentially up to billions to cover the entire population), and the possibility of innovation with existing or emerging technologies, such as A.I.

At this stage, however, the rapid rollout of the system is starting to catch up with its ambitions. Since none of the current core systems were originally designed specifically for their use in AB-PMJA and are largely licensed from vendors hired by the state governments, improving on the current system could present a major challenge. In particular, the increasing need for interfacing of the various modules and design of overarching functionalities could compromise robustness and data protection, ultimately limiting innovation. Beyond that, the licensing agreements and ownership of intellectual property are limiting the long-term sustainability of the system.

In light of these issues, a full redesign and rebuild of the system from scratch will likely be considered. While this would present a major undertaking, it will indubitably benefit from the existing political momentum behind AB-PMJAY, while being able to benefit from the lessons of the first system on the technological level. The existing interfaces would continue working throughout such a change, making it possible to replace one module at a time with ones that would be both inter-operable with the old system, and designed to have greater functionality with the new one.

Even though a scheme of the size and ambition of AB-PMJAY is bound to run into many challenges, the initial design and the government’s flexibility in adapting to the challenges so far has led the program to being more successful than widely expected by early observers, while still picking up momentum. The Indian parliament has already approved the required allocations for Ayushman Bharat in the latest budget (64 billion rupees (approx. 900 million USD) for 2019-2020), and the government has reiterated its goal of spending 2.5% of GDP on healthcare by 2025. The government has also proposed the National Digital Health Blueprint, a roadmap to create a digital ecosystem to support and extend quality healthcare to all Indians.

## Conclusion

While health care and health insurance considerations, as well as programs to address them exist in most countries, the case of India is unique for its scale and ambition. Having started with very low government spending on healthcare of only 0.93% of GDP, vast out of pocket costs for its citizens, and a medium score on the healthcare related SDG 3 (of 58), the government's commitment to a fully tax-funded insurance scheme for 107 million families presented a dramatic ambition. Nonetheless, rapid deployment of its resources combined with technological prowess and organizational effectiveness allowed the program to be rolled out speedily. While many challenges still remain, its use of technology and organizational innovation has been notable in overcoming many of the hurdles considered insurmountable earlier.

## Kenya: M-Pesa

### Introduction

M-PESA is a mobile money service that was officially launched in March 2007 by Safaricom, the leading mobile phone operator in Kenya and an affiliate of UK telecom giant, Vodafone. Customers do not need to have a bank account and can transact at any of nationwide agent outlets without fees.

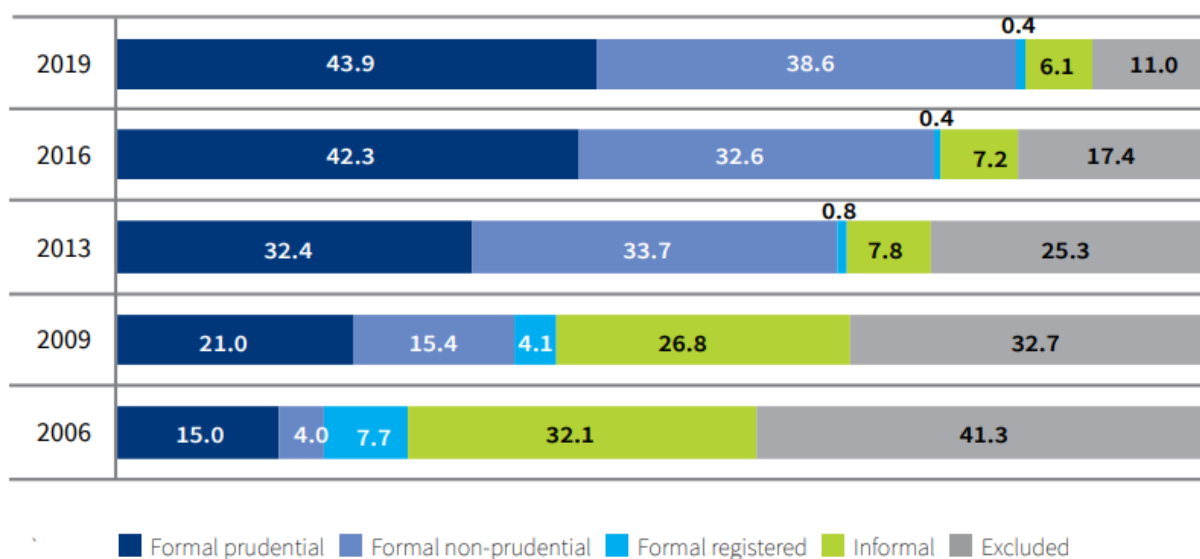
M-PESA was initially developed by Vodafone, and the six-month pilot phase of the project in 2005 was partly funded by the UK DFID with the aim of allowing customers of a micro-finance institution (Faulu) to repay small business loans using their smart phones, generally, by a few dollars a week. However, Safaricom representatives noted that the M-PESA was being put to other uses, including the payment for trading between businesses, purchasing airtime for relations in rural areas and depositing cash to be withdrawn at some other destination. After the pilot phase, Safaricom redesigned the M-PESA services, expanded the agent network and began a massive and culturally compelling “send money home” marketing campaign. Within one month of M-PESA official launch, over 20,000 customers registered the service. In July 2007, about 268,000 people subscribed to M-PESA. One year later, subscription increased by about 30 times to around 7,388,000.

The success of product was phenomenal—between 2016 July and 2017 July, the number of transactions processed over M-PESA was around 1.7 billion and 3.6 trillion Kenyan shillings processed over M-PESA. There are around 120,000 M-PESA agents across Kenya, where people can exchange cash for virtual currency and vice versa. Beyond its role as a money transfer tool, M-PESA now offers services to purchase airtime, withdraw cash from ATM, pay bills online, purchase at partnered outlets, transfer money internationally (through partners like Western Union) and make charity contributions or raise funds.

More recently, new products based on M-PESA like M-Shwari allow users to open interest earning bank deposit accounts and access microcredit loans electronically. Thus M-PESA functions not only as a steppingstone but also as a direct instrument to promote bank account adoption and increase credit access, which contributes significantly to the financial inclusion progress of Kenya. As a result, the overall access to formal financial services and products improved to 82.9% in 2019 from 26.7% in 2006 (see figure 1 below). According to Suri and Jack’s (2010) analysis based on survey data, the implementation of this financial inclusion project is estimated to have lifted as many as 194,000 households – 2% of the Kenyan population – out of poverty (SDG 1), and has been effective in improving the economic lives of poor women and of members of female-headed households (SDG 5).

The impacts appear to be driven by changes in financial behavior—in particular, increased financial resilience and saving—and labor market outcomes, such as occupational choice, especially for women, who moved out of agriculture and into business. Mobile money has therefore increased the efficiency of the allocation of consumption over time while allowing a more efficient allocation of labor and higher-risk but higher return income-earning strategies, resulting in a meaningful reduction of poverty in Kenya. There is also growing evidence that the mobile money impacts the majority of SDGs as a critical enabler.

Figure 1. Access by Categories (%)



Source: The 2019 FinAccess Household Survey

M-PESA has an iconic status in the international community which has actively promoted its virtues to countries around the world. More recently criticism has also emerged such as its role in driving the over-indebtedness of Kenya. Due to the simplicity of accessing funds via M-PESA and rapid development of microcredit and fin-tech institutions, there are more than 15 million M-Schwari accounts in a country of 50 million people. Very few checks and balances exist to restrain M-PESA clients who might wish to misuse funds received via M-PESA for purposes like gambling (Bateman, et al 2019). Many mobile lending companies are also accused of dodging the legal interest rate well below its annualized cost of round 100 percent since the services fell outside of the purview of state regulations

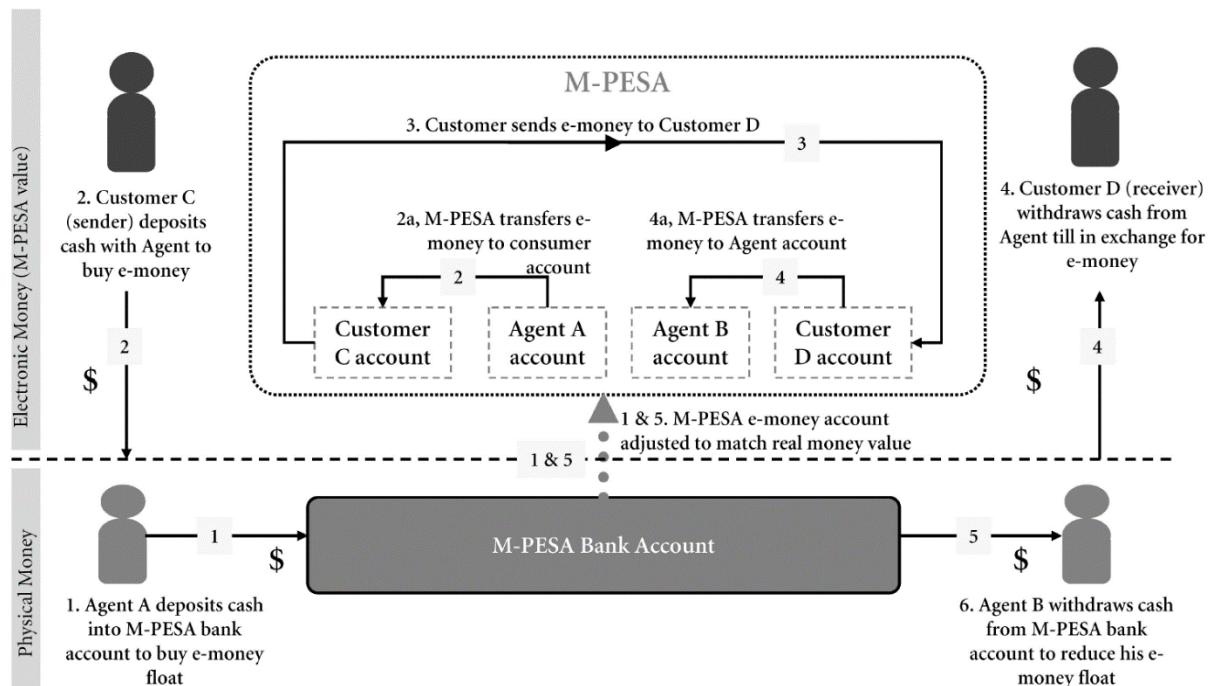
#### What is M-PESA

M-PESA is an electronic money transfer product Vodafone developed originally for Kenya that enables users to store value in the SIM card of their mobile-phone –a mobile account, in the form of electronic currency that can be used for multiple purposes including transfers to other users, payments for goods and services, and conversion to and from cash. The product menu is driven by SIM card toolkit that is standard software on all SIM cards. Consumer interface is very simple and can be used on basic mobile phones. Users use PIN-secured SMS (text messaging) to instruct M-PESA to send balance from their account on SIM cards to the receivers. Users are charged a small fee for sending and withdrawing money using the service. M-PESA is a branchless service so customers need to deposit or withdraw money from a network of Safaricom’s airtime sellers or retail outlets acting as banking agent. All monies (e-float) are held at the M-PESA money transfer trust account at the Commercial Bank of Africa, a private bank. (Figure 2). Customers use their national ID or passport to verify their identity at the agent to send and receive money. In short, SIM card is the ATM card and the agents are the ATMs in the original M-PESA model.

Based on M-PESA’s success, Safaricom partnered with Equity Bank and KCB Group, which are the biggest banks in Kenya by customer base and asset base, to launch M-KESHO and KCB M-PESA. Those products allow customers to deposit, withdraw or transfer money from their existing bank accounts. In partnership with Commercial Bank of Africa, Safaricom also launched M-Shwari which allows customers to save and borrow money through the mobile phone while at the same time earning interest on the money saved. M-PESA agent network has been open to other telecommunications companies and banks since 2014.



Figure 2. M-PESA service flow



Source: <http://www.nixdell.com/classes/Tech-for-the-underserved/m-pesa.pdf>

Who are the major stakeholders

### Safaricom & Vodafone

Safaricom is the leading mobile communications provider in Kenya and it is a publicly traded company registered on the Nairobi Stock Exchange. 40% of company share is owned by Vodafone. The Government of Kenya owns 35% and the retail investors own the 25% (called free float) through Nairobi Stock Exchange. Safaricom is the operator of M-PESA Program. To use M-PESA service, all customers need to do is register at an authorized M-PESA agent by providing their Safaricom mobile number and their identification card.

Vodafone is a world leading telecommunication group based in UK. In 2003, one of its executives, Nick Hughes agreed to use DFID grant to pilot a mobile fund transfer service. After the success story in Kenya, Vodafone has partnered with other operators across the world to expand M-PESA services.

### Government of Kenya (The Central Bank of Kenya)

The Central Bank of Kenya (CBK), and in particular its Payments System group let a mobile operator take the lead in providing payment services to the bulk of the population. In 2006, the CBK had been made aware of the very low levels of bank penetration in the country by the first FinAccess survey, and they were determined to explore all reasonable options for correcting the access imbalance. The CBK worked in close partnership with Vodafone and Safaricom to assess the opportunities and risks involved prior to the launch and as the system developed. They were persuaded that premature regulation might stifle innovation, so they chose to monitor closely and learn, and formalize the regulations later.

### UK Department for International Development (DFID)

In 2002, researchers at Gamos and the Commonwealth Telecommunications Organization, funded by UK DFID, documented that in Uganda, Botswana and Ghana, people were spontaneously using airtime as a proxy for money transfer. DFID introduced the researchers to Vodafone who had been discussing supporting microfinance and back office banking with mobile phones. Furthermore, DFID funded the organizations that made the FinAccess Survey possible – the Financial Sector Deepening Trust in Kenya. At that time, donor agencies like DFID were seeking innovative ways to deliver funds efficiently to those who need it most, so that the capital is productively deployed. DFID believed that if the amount of money necessary for a program's initial investment could be sufficiently reduced, poverty alleviation might become a profitable endeavor that would unleash the creative energies and logistical resources of some of the U.K.'s largest companies, such as Vodafone. Thus DFID granted Vodafone nearly £1m from its Financial Deepening Challenge Fund on a matched basis (50% of total costs) that helped Vodafone put together a pilot in partnership with the Commercial Bank of Africa (CBA) (providing local banking services and interface to the regulatory system) and the local micro-finance company, Faula Kenya (providing local expertise).

### *Key Lessons Learned from Policy Making and Implementation*

According to literature, M-PESA's success was attributed to a number of characteristics of Kenya's population and culture that generated a unique demand for remittance services like great disparity but strong ties between rural and urban households, very limited local remittance services, young but highly literate population, and high mobile phone penetration rate. Traditionally in Kenya many people spend a significant amount of time working in the urban areas away from home and this rural to urban migration creates big demand for domestic remittance services. Prior to M-PESA launch, there were limited options including commercial banks, post offices, forex bureaus, bus companies, and friends and family. Almost all of those options entailed high security and reliability risks

In addition, almost 83 percent of the population who are fifteen years or older have access to a mobile phone in Kenya, which was a critical pre-condition to launch the mobile money program.

### *International partnership*

**International donor engagement played an active role in initiating the M-PESA program.** The original research indicating the potential of mobile payment in African countries was funded by UK DfID. In 2003, it approached a Vodafone executive and proposed funding a small innovation project that was not typical of Vodafone's own R&D portfolio. In 2000, UK DFID had established the Financial Deepening Challenge Fund (FDCF) making available £15m for joint investments with the private sector on projects that help improve access to financial services that was one of the MDGs.

### *Alternative pathways*

**Vodafone developed an innovative product using existing technology to tackle the financial inclusion challenge in a new market with big potential.** Considering ease of usage and a wide coverage, Vodafone chose to build the consumer interface on basic model mobile phone and took SMS (text-messaging) as the main channel to send and receive money. The menu-driven access backed by SIM toolkit available on all mobile phones paved consumers and agents the easiest road to learn and use M-PESA. Internet and smartphone penetration were still low at that time.

### *Institutional arrangements*

**Kenya's regulators enabled the mobile money take-off through a cross-sector collaborative approach.** Safaricom, as a telecommunication company, was an entity licensed by the Kenya telecommunication regulator, the Communications Commission of Kenya (CCK). Yet, according to the Central Bank of Kenya Act, the proposed M-PESA service by Safaricom is a kind of banking service that could only be provided by licensed bank. So the Central Bank of Kenya had the mandate to regulate Safaricom's payment system. This unusual situation required the CBK and the CCK to collaborate to ensure their respective roles and responsibilities were clearly defined when dealing with a mobile money provider, and to avoid unnecessary overlap or arbitrage.

### *Develop vision, goals and/or targets*

**The Central Bank of Kenya (CBK), in particular, played a very progressive role and allowed “regulation to follow innovation”.** In Feb 2007, incentivized by the low financial inclusion rate revealed by 2006 FinAccess survey, the CBK issued Safaricom a letter of no objection authorizing it to launch M-PESA under the oversight of the CBK pending a complete regulatory framework. The non-objection letter acted as a special license that provided a form of certification, legitimated M-PESA in the policy sphere. The CBK had to make sure that Safaricom would not be intermediating M-PESA customer funds. The letter requested all customer funds had to be deposited in a regulated financial institution with interest on deposits going to a not-for-profit trust and the e-float (e-money) could not be invested. As a result, the money in the trust fund was safe from claims by creditors in the event of solvency. Also, there were limits put on transaction size in order to deal with money-laundering concerns.

**Government of Kenya continued to support M-PESA by validating existing business model through passage of new regulations.** In Dec 2009, more stringent regulations were imposed with the passage of the Proceeds of Crime & Anti-Money Laundering Act (AML Act), which explicitly criminalized money laundering, provided enforcement measures to GOK and imposed serve penalties on money launderers. In 2011, in consultation with stakeholders including Safaricom, the CBK issued its Electronic Payment Guidelines of 2011 and Retail Electronic Transfer Guidelines of 2011. In Dec 2011, the National Payment System Act (NPSA) was enacted, which brings all payment services providers, including mobile payment providers like Safaricom into one regulatory framework. The NPSA provides CBK the right to directly oversee the providers to ensure their efficiency and safety.

In 2014, the Cabinet Secretary for the National Treasury issued a Legal Notice officially giving life to the National Payment System Regulations of 2014. The NPS Regulations permit both banks and non-banks, including mobile operators to provide mobile money services. The regulations also provide a stronger compliance and risk mitigation regime and help to drive competition and collaboration within Kenya’s payment market, as well as address some “second generation” issues that have emerged as the mobile money has matured. For example, Anti-Money Laundering regulatory framework for mobile money services was finalized and enacted. A better consumer protection was detailed – service providers needed to have disclosure mechanisms, open channels for consumer redress, and clear terms and conditions for the service, and must maintain the privacy and confidentiality of customer data.

### *International replication experience of M-PESA*

In order to replicate M-PESA’s success in Kenya, many developing countries around the world partnered with development organizations and private companies to launch similar mobile money products. But the results varied: some countries’ mobile money development flourished while in other countries mobile money failed to gain any traction for several year. For example, in India until a few years ago, mobile money transfer was stalled due to a rigid regulatory **environment** whereby only regulated banks can collect deposits and transfer money.

**On the other side, despite a slow start between 2008 and 2012, mobile money has grown fast in Tanzania where conducive regulatory environment played the critical role in the greatest mobile money success story in recent years.** Unlike Kenya, Tanzania has no dominant mobile network operator like Safaricom and within the competitive market, no company holds more than a 30 percent market share. Tanzania’s financial system was far less developed than that of Kenya, with less than half as many bank branches per 1,000 citizens. Moreover, Tanzania is a large country with a dispersed population so quickly reaching dealers in rural areas was difficult. Even with fast growth rate of mobile phone penetration, the mobile phone subscribers’ percentage was relatively low when mobile money launched (around 25%). Although these factors caused the slow initial uptake, the impetus for its turnaround can be traced to the policy changes beginning in 2011-12.

Following Kenya's example, the Government of Tanzania adopted a "Test and Learn" approach and let regulation follow innovation. Lacking of relevant regulations, Tanzania's central bank issued "letters of no objection" that permitted Vodacom and Zantel to offer mobile money (M-PESA and Z-PESA) without being subjected to the Know Your Consumers (KYC) and Anti-Money Laundering (AML) rules that made it impossible for them to reach poorer rural citizens, as well as requiring no official partnership with a bank. In 2011, laws on agent banking were also relaxed, greatly reducing the KYC-AML requirements and moving responsibility for ensuring agents were complying with existing laws from mobile networks to their sponsor banks. In addition, the Central Bank and Tanzania Communications Regulatory Authority have been cooperating on oversight of the mobile financial service (MFS) regulatory framework. Those resulted in an exponential increase of MFS access— from less than 1 percent of the adult population having access in 2008 to 90% having access by 2013

**Another prominent success story in recent years is that Uganda, which also took a "light touch" on mobile money regulations and successfully achieved rapid growth.** Between 2011 and 2013, the Bank of Uganda (BoU) and the Ugandan Communications Committee released a series of guidelines modelled after the enabling policies in Kenya and Tanzania. These guidelines allowed multiple e-money issuers to enter the market, offering basic payment and financial services, and allow banks to partner with Mobile Network Operators (MNO) under significantly simplified KYC-AML laws. The BoU has authorized mobile money services by issuing "no objection letters" to the commercial banks, who partner with the MNOs, and requires the bank to hold the balances recorded in the mobile wallet in an escrow account. Under the condition of the "light touch" regulation, the number of mobile money subscribers in Uganda rose from 2.9 million in 2011 to 22 million by 2018, compared to around 5 million registered accounts in traditional bank. The five largest MNOs in Uganda have partnered with commercial banks and now offer mobile banking accounts. These enabling policies to have resulted in an unprecedented rise in financial inclusion in Uganda.

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#### Annex: Classification of the Access to Finance

Classification	Definition	Institution type	FinAccess survey cycles				
			2006	2009	2013	2016	2019
■ <b>Formal (prudential)</b>	Financial services and products used through prudentially regulated and supervised financial service providers by an independent statutory Government Agency including CBK, CMA, IRA, RBA and SASRA	Commercial banks including mobile phone bank products offered by banks in partnership with MNOs such as KCB M-PESA, MCo-op Cash, M-Shwari, Eazzy loan, Timiza and HF Whizz	✓	✓	✓	✓	✓
		Microfinance banks including mobile banking products offered by microfinance banks			✓	✓	✓
		Insurance service providers	✓	✓	✓	✓	✓
		Deposit Taking SACCOs			✓	✓	✓
		Capital markets intermediaries			✓	✓	✓
■ <b>Formal (non-prudential)</b>	Financial services and products offered through service providers that are subject to non-prudential regulation and supervision (oversight) by Government Ministries/ Departments with focused legislations	Mobile Money		✓	✓	✓	✓
		Postbank	✓	✓	✓	✓	✓
		NSSF	✓	✓	✓	✓	✓
		NHIF		✓	✓	✓	✓
■ <b>Formal (registered)</b>	Financial services and products offered through providers that are legally registered legal persons and/ or operate through direct Government interventions	Credit only microfinance institutions (MFIs)	✓	✓	✓	✓	✓
		Non-deposit taking SACCOs	✓	✓	✓	✓	✓
		Hire purchase companies	✓	✓	✓	✓	✓
		Development financial institutions (DFIs) e.g. AFC, HELB, ICDC & JLB	✓	✓	✓	✓	✓
		Mobile Money Apps/ Digital Apps				✓	✓
■ <b>Informal</b>	Financial services offered through different forms not subject to regulation, but have a relatively well-defined organizational structure	Groups e.g. ASCAs, chamas & ROSCAs	✓	✓	✓	✓	✓
		Shopkeepers/supply chain credit	✓	✓	✓	✓	✓
		Employers	✓	✓	✓	✓	✓
		Moneylenders/shylocks	✓	✓	✓	✓	✓
■ <b>Excluded</b>	Individuals who reported using financial services and products only through family, friends, neighbours or keep money in secret places or not using any form of financial service	Social networks and individual arrangements (e.g. secret hiding place)	✓	✓	✓	✓	✓



## Serbia: Innovation Fund

### Introduction: Critical issues to be addressed

About ten years ago, the industrial capacity of the Republic of Serbia had been severely weakened by the Yugoslav Wars throughout the 1990s and further diminished by the lingering effects of the financial crisis. Although Serbia's R&D spending was higher than other Balkan nation-states (but well below the European Union (EU) average) in 2012, it was dominated by basic research conducted by public institutions, which received funding without going through much of a competitive process.<sup>18</sup> Those publicly funded R&D activities by the research institutions were mostly delinked from industry needs, generating little to no economic value.<sup>19</sup> At the same time, the national innovation system and composition of R&D funding did not support enterprise innovation at any significant level, and the research sector modernization agenda was still in its infancy.<sup>20</sup>

To reorient public research towards the needs of the private sector in order to increase Serbia's industrial competitiveness, the Government of Serbia (GoS), supported by the EU and the World Bank (WB), has been working on renewing its policies and implementing relevant policy measures since 2011. The GoS's Ministry of Education, Science and Technological Development (MoESTD), with support from the two multilateral donors, has been undertaking structural reforms to improve the innovation ecosystem by 1) building up a key institution called the Serbia Innovation Fund (IF), which is an independent national agency under the MoESTD with the mandate to finance enterprise innovation, and 2) formulating new policies and regulations. Although much work remains, Serbia's efforts in pursuing primarily SDG 9: "Industry Innovation and infrastructure" (and simultaneously other goals that are especially relevant to environmental and social management issues<sup>21</sup>) illustrate a number of useful insights in terms of STI for SDG roadmap exercises.

### Institutional setup of Serbia Innovation Fund

#### *The establishment of the IF by strong political leadership*

Serbia's journey to focus more on applied and industry-focused research was spearheaded by a Minister of Science and Technological Development, appointed in 2008.<sup>22</sup> He happened to also hold the position of Serbia's Deputy Prime Minister for EU integration. Unlike most of the previous Science Ministers, who were scientists themselves and therefore interested in promoting basic research,<sup>23</sup> this minister had a strong business and finance background and had served as Minister of Finance and

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<sup>18</sup> MoESTD conducted its last call for proposals in 2010. Although it was a competitive call with independent international evaluators, the success rate was nearly 90%, and the awarded researchers continued to receive yearly payments for these projects for nearly a decade, until a pilot call for grants opened in June 2019. See Mico Tatalovic, "Serbia passes controversial science reforms to modernise research," *Chemistry World*, 13 July 2019 <https://www.chemistryworld.com/news/serbia-passes-controversial-science-reforms-to-modernise-research-/3010733.article> and Nenad Jaric Dauenhauer & Mico Tatalovic, "Serbia is rethinking science — but the reforms could cost hundreds of jobs," *Nature online*, January 11, 2019. <https://www.nature.com/articles/d41586-018-07872-2>

<sup>19</sup> At the time, around 0.9% of GDP was invested in R&D, well below the EU average of 2.03%. R&D spending by the public sector was nearly double that of the business sector. Science infrastructure improvement had been the main focus up to that point, while stimulation of private-sector-led R&D and innovation had been negligible. R&D Institutes were the primary recipients of financing (80% of funds intended for science projects continue to be spent on researcher salaries), with private firms receiving funding only under the technological development component. Few mechanisms were implemented to incentivize private-sector R&D and innovation. Output from the R&D sector was not commensurate with the public resources being invested and did not support modernization of the Serbian economy.

<sup>20</sup> Bank financing was available for SMEs but not for startups with higher risks. No private seed financing or venture capital was available not only in Serbia but also in the Western Balkan region. MoESTD had a grant program with an annual budget of €1 million available to support individuals (not companies) in pursuing their scientific discoveries with disbursement of €1-2,000 per person, which was insufficient to effectively incubate startups. There was one incubator at Belgrade University with some companies, but no funding was available; other than that, there was a minor bilateral donor activity by the Swiss.

<sup>21</sup> The IF financial instruments have generally emphasized merit and commercialization potential and do not specify particular technologies or sectors/issues, but they have been effective in producing products and services that tackle a wide range of social, economic and environmental issues, such as renewable energy, education and waste management. In particular, the most recent EU fund (IPA 2014 Direct Award) to the GoS requires that all implemented projects will be environmentally and socially sound and sustainable. See: <http://www.inovacionifond.rs/cms/files/medunarodni-projekti/20190315-IPA-2014-MiniMatching-ESMF-ENG-draft.pdf>

<sup>22</sup> Minister Božidar Đelić grew up in France, graduated from Harvard Kennedy School and was a partner in McKinsey & Company before he became a politician. [http://www.djelic.net/en/bio\\_long.html](http://www.djelic.net/en/bio_long.html)

<sup>23</sup> One exception was Prof. Dragan Domazet, who served as Minister of Science, Technology and Development in 2001–2004; he tried to change the system to be able to respond to the society's needs.

Economy a few years back, and he vigorously pursued making linkages between science & innovation and Serbia's social economic needs to make firms competitive. Luckily, there was no political opposition to this idea at the time; therefore, his ministry was able to develop and formulate a science strategy, which led to modification of two governing laws: the Law on Research Activity and the Law on Innovation Activity, which operationalized the IF.<sup>24</sup> Meanwhile, the minister secured investment loans for science from the European Investment Bank and the Council of Europe Development Bank, as well as a grant for the IF from the EU Instrument for Pre-Accession Assistance (IPA). This sequence of establishing a strategy, amending laws and securing funds for the activities was done quickly within the three years that the minister was in power.

#### *Independent governmental agency under a ministry*

The IF's success cannot be explained only by this strong leadership demonstrated by a politician, as his other ideas and initiatives did not survive through four successors and the advent of a new administration after he stepped down. Two key elements for the IF's institutional setup seemed to be crucial: 1) keeping a level of independence from its parent ministry and 2) securing strong support from international financial institutions.

Being an independent agency<sup>25</sup> under MoESTD means that the IF receives its operational cost<sup>26</sup> as well as strategic guidance from the ministry. The operational cost is approximately €500,000-700,000 annually to cover expenses like staff salaries, rent and electricity.<sup>27</sup> The ministry's strategic framework for R&D and innovation defines the IF's priorities and activities for a five-year period. Meanwhile, the IF's level of independence from MoESTD is ensured in its institutional setup. First of all, IF was deliberately mandated to co-finance innovation through cooperation with international financial institutions, organizations, donors and the private sector so that the agency would not entirely have to depend on the government and therefore would not be vulnerable to political/domestic turbulence and influence. The IF's Managing Board, which has the authority to approve or reject a list of projects to be funded, is represented by the GoS, but not necessarily MoESTD.

It is important to note that the Managing Board and its government representatives do not have the power to delete or add individual projects in the list, which is submitted as one package by an Independent Investment Committee. In addition to ensuring the independence of the Managing Board, the IF publicizes its financial decisions, monitoring and evaluation (M&E)<sup>28</sup> results and any other information and data needed by its clients and donors, in accordance with international standards. The transparency in those institutional decision-making processes has helped the IF build its reputation among the Serbian research and business communities and has led to the success of launching and managing the financial instruments. Furthermore, the IF is designed to be able to receive input from other ministries besides MoESTD; specifically, the Ministry of Finance and Ministry

<sup>24</sup> The IF was established in 2005 by the Innovation Law (2005), but it was not operational until 2011 after the Law was amended to define form, governance and activities of it so that the organization could encourage entrepreneurship and manage financing for innovation. See for example: Page 2, Aleksandar Caslav Miletic, "Development of Innovations Infrastructure – Benchmarking the Leading Organizational Solutions with Serbia," April 2019. [https://www.researchgate.net/publication/332448072\\_DEVELOPMENT\\_OF\\_INNOVATIONS\\_INFRASTRUCTURE\\_-\\_BENCHMARKING\\_THE\\_LEADING\\_ORGANIZATIONAL\\_SOLUTIONS\\_WITH\\_SERBIA](https://www.researchgate.net/publication/332448072_DEVELOPMENT_OF_INNOVATIONS_INFRASTRUCTURE_-_BENCHMARKING_THE_LEADING_ORGANIZATIONAL_SOLUTIONS_WITH_SERBIA)

<sup>25</sup> When the idea of IF first emerged, Serbia had no choice but to make it semi-public as there was no other real alternative. An ecosystem and market for innovative firms did not exist in the country, as there was no private seed fund that the government could invest public money in. Legally, the GoS was unable to set up an entirely private company with the public funding. Meanwhile, establishing a special window in a Serbian commercial bank was not a feasible option at the time as the banks had no experience and expertise in investing in startups or implementing/managing financial instruments for innovative firms and startups.

<sup>26</sup> A total of 3.86m was provided by the GoS for the period between 2011 and 2015. (P.24, Implementation Completion and Results Report for the Innovation Serbia Project, October 8, 2016.) <http://documents.worldbank.org/curated/en/394131476361888907/Serbia-Innovation-Serbia-Project>

<sup>27</sup> In 2014, the GoS failed to provide an operational budget in time, and as a result, the IF employees were without salary for three months. But in addition to the operational cost, MoESTD began to inject project budgets for grant funding, starting from 2017 with €3m, €5m and €6m. ICR for the Innovation Serbia Project. P.1 on Annex 8

<sup>28</sup> An internal M&E system was designed and built to constantly monitor and report about 50 indicators from all projects and programs (i.e. # of people hired in the beneficiary companies, revenues generated by the companies). Meanwhile, two series of independent evaluation of financial instruments were conducted for two financial instruments. The results are reflected in the IF programs and operations, i.e. resulting changes in the % of match (as other financial options emerged), % of grant required to be allocated to researchers in CGS projects.

of Construction, Transport and Infrastructure represent the government in the aforementioned Managing Board.<sup>29</sup> The Ministry of Finance and Ministry of Economy are involved in the strategic direction and management of the IF's financing instruments and projects as they are represented in the Supervisory Board and Steering Committee, respectively. Lastly, one of the biggest merits of being an independent agency is that the IF is able to set its wages at the level necessary to attract and secure highly eligible staff and experts. In fact, the IF staff generally gets paid approximately double the amount of Serbian public servants. In addition, with internationally competitive salaries, international talent has been recruited and hired as Investment Committee members as well as Strategic and Operational Advisors.

#### *International partnerships and global expertise*

As mentioned earlier, the GoS began its reform in the R&D sector through the establishment of the IF with the help of two international partners: the EU, which provided IPA funding, and the WB, which administered the fund; a Trust Fund Agreement was forged between them. This arrangement was the first of its kind, initiated by the aforementioned Minister, who served as chief negotiator for Serbia's accession to the EU and as chief governor of Serbia in relation to the WB Group at the time. He worked hard to set up this institutional arrangement as he was keen to draw on the WB's extensive networks and expertise in managing projects based on solid data, analysis and international good practices. It was a rather painful process in the beginning as the two international organizations were unfamiliar with the policies and procedures of their counterparts, resulting in some delays during project preparation. It took the highest political effort to resolve an administrative issue,<sup>30</sup> but once they became comfortable with each other as partners, implementation began to progress smoothly.<sup>31</sup>

Once on board, the WB brought global brains into the IF. Most importantly, the Bank was able to convince a prominent international figure in the innovation sphere to serve as IF's Strategic Advisor. He had vast experience and knowledge, including as Chief Scientist of Israel's Ministry of Industry and Trade in the 1990s managing over \$1.5 billion in grant programs to promote R&D activities in the Israeli high-tech industry, which began to grow during his term in the office. The Strategic Advisor was deeply committed and devoted to his responsibilities; in fact, he was in the country for a week at least four times a year. He was in charge of designing and implementing grant instruments, and much of the IF's program design was modeled after Israeli programs and adapted to the needs of the Serbian market.

Another prominent international expert brought into the IF was an Operational Advisor, who dealt with issues related to human resources and operational infrastructure (including ICT and financial management). With rich international connections provided by the WB staff and the advisors, the IF built its system for staff training, including one or two weeks in the leading countries of innovation, such as Israel, Finland and the US, where they had hands-on training in managing funds. Through this training abroad, the IF staff could learn in detail how relevant documents and contracts are formulated and stored, how IT systems are set up to help manage calls for proposals, and how they conduct daily operations in running projects. Out of the nearly €1 million allocated for capacity building,<sup>32</sup> a high-spec IT system was built, including an online portal for applications to be accessible by reviewers, who can log in from anywhere in the world. The Independent Investment Committee, consisting of five international experts, including two Diaspora members, were selected through an international

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<sup>29</sup> IF Managing Board members are listed on the IF website.

<http://www.inovacionifond.rs/fond/our-organization/managing-and-supervisory-board>

<sup>30</sup> There was a heated argument over whose procurement procedure to use. In the end, it required the highest political efforts among the EU commissioner, Bank Vice President and Deputy Prime Minister in resolving this administrative issue, to use the Bank procedure.

<sup>31</sup> Since then, the WB and the European Commission have signed a Trust Fund and Co-financing framework agreement, dealing essentially with the operational aspects of the cooperation between both organizations. [https://ec.europa.eu/europeaid/funding/procedures-beneficiary-countries-and-partners/fafa-world-bank\\_en](https://ec.europa.eu/europeaid/funding/procedures-beneficiary-countries-and-partners/fafa-world-bank_en)

<sup>32</sup> See the figure of the Grant Financing for Component 1 (Capacity building) on the second table for Final Project Cost, p25 of the Implementation Completion and Result Report of Innovation Serbia Project. The figure for Government Financing is the IF operational cost. <http://documents.worldbank.org/curated/en/394131476361888907/pdf/P126229-Serbia-Innovation-Project-ICR-4-Portal-10-0-P126229-2016-10-08-11-25-10112016.pdf>



competitive open solicitation process, and the majority of them had finance/investment backgrounds. Additionally, with help from international experts, the IF built its internal M&E and training system for startups as well as the capacity to hold networking and educational events for enterprises and researchers to interact with each other. The IF capacity-building went well, as by the end of 2015, ten IF managers had gone through training and were applying the acquired skills, 51 startups had benefitted from monitoring, and 22 networking events had been held to promote public-private partnerships.

#### *A series of financial instruments to support innovative firms*

While institutional capacity was being built, the IF launched five programs<sup>33</sup> to support innovative firms under the guidance of the Strategic Advisor. The sequences of the following financial instruments were planned and executed with careful consideration: the first grant program (a Mini Grant) is designed to help innovators in the incubation stage to develop prototypes; the second grant program (a Matching Grant) supports enterprises in the next stage to manufacture and market products; then the IF established a special unit called Tech Transfer Facility (TTF) to stimulate and coordinate technology transfer from public R&D institutions to the private sector with small grant and advisory services; two newer grant programs (Collaborative Grant Scheme and Innovation Voucher) promote business-academia partnerships with different award levels. Having learned from international practice how to weed out “serial grant writers,” these grant programs require entrepreneurs to provide a match in cash. The levels of IF co-financing in these programs were determined by the World Bank’s analysis, drawing from lessons learned in other countries, e.g. in Israel. Generally, the matching contribution level of the beneficiary firms goes up as they get closer to the market. Meanwhile, as the Serbian innovation ecosystem have gradually developed with new investment options by private banks/funds becoming available, the matching levels required for IF-funded enterprises have become higher. Details and characteristics of those financial instruments are summarized below.

**All financial instruments are designed to tackle different stages of technologies to be brought to the market.**

#### **Support for innovative enterprises**

Mini Grants	
Issues to be solved	There was a lack of seed funding to support startups with ideas to develop a prototype
Objective and stage	Proof of concept, prototyping stage (except in high-tech areas like Nano-tech), IP protection, business plan preparation for mobilization of initial capital
Recipient	Incorporated entrepreneurs, innovative startups, spin-offs, micro and SMEs, existing for no longer than three years at the time of application
Grant size	Up to €80k for projects to be completed within 12 months
IF co-financing	Up to 85%
Calls for proposals	7 calls: 2012 (twice), 2013 (twice), 2017, 2018, and 2019 (twice)
# of projects supported	41 (out of 341 applications) in 2016 + 20 (out of 137) in 2017 + 13 (out of 143) in 2018

<sup>33</sup> Most recently, in September 2019, the IF launched its 6<sup>th</sup> program as a new service line of the Technology Transfer Facility: Proof of Concept. The program is designed for researchers who require support to prove that there is a new product, emerging from the research and for which there is a need in the market. It offers financial and mentoring support to existing research efforts to establish the proof of concept of an idea generated during the course of previous R&D efforts.

<b>Matching Grants</b>	
Issue to be solved	Support mechanisms did not exist for the next stage of startups, which already had prototypes but lacked money to manufacture or market products
Objective and stage	R&D (technology development) and commercialization projects for new or improved technologies, products and processes
Recipient	Incorporated entrepreneurs, innovative startups, spin-offs, micro and SMEs
Grant size	Up to €300k for projects to be completed within 24 months
IF co-financing	Up to 70% (company contribution is higher because prototype has been already tested and expectations are higher (the IF receives 20% of sales revenue within the 2 years)
Calls for proposals	6 calls: 2012, 2013 (twice), 2017, 2018, and 2019
# of projects supported	11 (out of 119 applications) in 2016 + 5 (out of 100) in 2017 + 9 (out of 75) in 2018

### **Support for public research organizations to commercialize their research**

<b>Tech Transfer Facility</b>	
Issue to be solved	Serbian research institutions and faculties lacked technology transfer capacity; there was a need to centralize knowledge, expertise and resources in one place to be accessible for researchers who could benefit from receiving help in commercializing their research
Objective and stage	Eliciting invention disclosures from researchers, evaluations (of technologies, markets, teams), last-mile R&D grants (e.g. patent attorneys, prototyping, external expertise, testing), commercialization support, legal support and contract negotiations
Recipient	Public academic R&D organizations; other accredited R&D organizations, including private ones
Grant size	Up to €50k for projects to be completed within 6 months (if commercial partner co-finances, then within 12 months)
IF co-financing	Up to 100% (below €20K), or up to 70% in cases of commercial partnership (for above €20K)
Calls for proposals	Throughout the year
# of projects supported	19 (out of 28 applications)
Outcomes	3 tech transfer deals facilitated (and an additional 2 underway)

### **Support for public-private partnerships**

<b>Collaborative Grant Scheme (CGS)</b>	
Issues to be solved	According to international experience, great innovations often come from research; but in Serbia, there was a big problem with connecting the research community and the private sector as existing ties were destroyed during the wars
Objective and stage	Joint R&D projects between academic R&D and SMEs aiming to create new products, services and technologies
Recipient	Consortium consisting of a lead private sector MSME (lead applicant) with at least one public scientific research organization (co-lead applicant)
Grant size	Up to \$87.2k (€80k) for projects to be completed within 24 months
IF co-financing	Up to 70% for micro/small enterprise; up to 60% for medium-sized enterprise

Calls for proposals	3 calls: 2016, 2018 and 2019
# of projects supported	14 (out of 96 applications) in 2016 + 9 (out of 67 applications) in 2018
Outcomes (from the 1 <sup>st</sup> cycle)	12 new products have been successfully created, 5 advanced prototypes have been developed, 3 new technologies and technological processes have been confirmed and given awards for the production of high-added-value products, while 5 projects have started achieving commercial results by selling their innovations <sup>34</sup>
<b>Innovation Vouchers</b>	
Issues to be solved	As the number of projects receiving CGS awards is limited, there is a demand for more opportunities to help the private sector and researchers to meet and get to know each other in order to generate new ideas for collaboration
Objective and stage	Industrial partners to make service contracts with public research organizations to improve products, processes, skills and services
Recipient	Private micro, small and medium enterprises
Grant size	Up to €6.5k for projects to be completed within 6 months
IF co-financing	Up to 80% (max of 2 vouchers allowed per MSME)
Calls for proposals	4 calls: 2017, 2018, 2019 (twice)
# of projects supported	325 (out of 411 applications)
Outcomes	Over 95% of the beneficiary enterprises indicated satisfaction

Source: author, based on WB and IF documents

### Formulation of new research and innovation policies

#### *Extensive and lengthy stakeholder involvement process led by the ministerial level*

The reform of Serbia's R&D sector has been accelerated in recent years, especially in transitioning its research funding system to a mixture of highly competitive project-based funding and performance-based institutional funding. While the Prime Minister took on the reform as one of his priorities, the EU provided additional IPA money and the WB approved new loan projects. With the WB's technical assistance, the GoS has developed and delivered two sets of policy documents:

- 1) Research for Innovation (R&I) Strategy (2016-2020) (Mach 2016) with accompanying action plans (adopted in 2018), which led the GoS to pass two relevant laws.
- 2) Research Infrastructure Roadmap and corresponding action plans (adopted in December 2018).

The R&I Strategy (2016-2020) called for reform in the public R&D and innovation sector while reinforcing enterprise innovation as well as technology transfer for the economy, including the kinds of support provided by the IF. The government set up a committee to receive domestic experts' input for the R&I Strategy. At the same time, a series of events and roundtables with stakeholders were held to take stock and address the concerns of the research community. However, adoption of the strategy was delayed until March 2016. An accompanying action plan which spelled out the detailed program of reforms was even more controversial and time-consuming. The original plan was to adopt the accompanying plan within a few months after the adoption of the Strategy, and the World Bank experts helped the GoS finalize the draft based on consultations with stakeholders and the government. But for better or worse, the majority of the draft action plan ended up being altered by ministry staff before it was finally adopted two years later. It took that much time because the action plan included technical details of the reform, including detailed steps of how to introduce the new financial mechanism and what would be done during the transition period so that institutions/universities and their researchers would be properly paid with minimal disruption to their life and R&D. What happened was that, to enable full-scale stakeholder involvement, MoESTD top management, including the ministerial level, ended up meeting with all members of Academy of

<sup>34</sup> <http://www.inovacionifond.website/news/ulaganje-u-inovacije-je-ulaganje-u-nasu-buducnost>

Science, faculty deans and directors of research institutes to receive their feedback and to address their concerns. The action plan was finally adopted after being updated to reflect much of the input from these one-on-one conversations with stakeholders.

Since then, two important steps were taken to further advance the reform. The first step in operationalizing the Strategy was the adoption of the Science Fund Law in December 2018. This law established a new independent funding agency (called the Science Fund) for research funding. This sister organization of the IF is crucial for Serbia to improve its research funding model to competitive and performance-based funding. Another law, called the Law on Science and Research, adopted in July 2019, established institutional funding for public R&D institutions while defining all the actors in the national research system so that their researchers would not have to depend, as before, on whether they worked on a project or not.<sup>35</sup> The law also recognized open science as a fundamental principle of science and research, mandating open science for all publicly funded research programs and projects with the intention of making public research output accessible to the private sector. This development made Serbia the first country in the Balkan region to recognize open science in a national law.<sup>36</sup>

#### *Reliance on the expertise of international partners to collect data and analysis*

While MoESTD and its minister spent much time and effort on adopting the R&I Strategy, the accompanying action plan and the two laws, Serbia relied on the expertise of the World Bank in formulating the Research Infrastructure Roadmap, including its action plans. Such a roadmap will be necessary in order for Serbian research communities to have access to EU Structural funds, if and when Serbia becomes an EU member. The original plan was to conduct an extensive bottom-up consultation involving the entire R&D community by launching a call of proposals. However, the formulation of this set of policy documents happened to coincide with the aforementioned highly sensitive time of systematic reforms in the research sector. MoESTD decided not to alert scientists with the call and chose a relatively low-key process to adopt the Roadmap. As a result, the GoS, with technical support from the WB, established a working group consisting of 15 committee members representing the research community with experience in either working on EU research infrastructure projects or managing large facilities in the country. The committee met several times, receiving two rounds of comments during the drafting period of 8 months to reflect these experts' input and data. Meanwhile, to be included in the Research Infrastructure Roadmap, the EU best practices were collected through a series of interviews with European practitioners. The interviews were conducted by the WB team, often accompanied by the ministry officials, who indicated their interest in getting involved in the process as much as possible. The draft text of the Roadmap was closely shared with the MoESTD as the WB team had weekly meetings with top management, often including the Ministerial level, to get comments and feedback. Serbia's Research Infrastructure Roadmap, which was necessary to improve the country's readiness in joining the EU, was adopted in December 2018.

These laws and policy documents have further encouraged Serbian public research institutes to shift to R&D based on excellence and relevance as well as innovation based on partnerships with the private sector.

#### *Ongoing work*

##### *Continued STI reform and STI for SDG roadmap activities*

MoESTD is currently working on operationalizing the aforementioned laws through bylaws, defining, for example, the details of institutional funding and the independent assessment of public R&D institutions. At the same time, with support from EC's Joint Research Centre, MoESTD has been leading the work on formulating Serbia's Research and Innovation Strategy for Specialization (RIS3), which aims to increase the competitiveness of the Serbian national/regional economy in order to contribute to the economic growth and advancement of society by linking research and innovation

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<sup>35</sup> <http://www.nip.rs/en/news/141-the-law-on-science-and-research-has-been-adopted>

<sup>36</sup> <https://www.sciencefordemocracy.org/open-science-included-in-new-serbian-law/>

forces and resources to a number of priority economic areas.<sup>37</sup> So far, Serbia has gone through an extensive bottom-up stakeholder consultation process (called EDP) by holding 17 workshops between March and May 2019, attended by approximately 900 participants and identifying four priority research areas.<sup>38</sup> Meanwhile, the GoS set up a governance structure involving:

- An inter-ministerial National Smart Specialization Team.
- A joint coordination group for smart specialization and industrial policy under the Prime Minister.
- a national analytics team gathering local experts for data analysis; and
- Working groups of stakeholders (business, academia, local and national authorities and civic society) for each of the smart specialization priority domains.

These will be the foundation of Serbia's UN STI for SDGs Pilot Program.<sup>39</sup> In the coming months, the WB are planning to operationalize the sister organization of the IF called the Science Fund while supporting the new Fund's design and the implementation of programs/activities including competitive research grants with incentives to enhance Smart Specialization Strategy and infrastructure support for public research institutions. The support for the new Fund for research funding will be done in a similar manner as the support provided to the Serbia Innovation Fund described earlier. In other words, the new Science Fund will be one of the means to implement the RIS3 Strategy, as the new organization focuses on funding applied research on the four priority sectors already identified.

## Conclusion

Over the years, a lot has been done in Serbia to formulate new laws, policy documents and programs to mobilize STI for achieving SDG 9 in industrial innovation and infrastructure as well as other SDGs related to social and environmental issues. It has taken time and much political leadership, government effort and extensive support from international partners in order to come this far. Serbia has yet to formally reflect the STI reform in formulating its SDGs policy, but so far, the country's experience seems to have generated at least two good practices and lessons learned. First, for a key institution such as the IF, a level of independence and the ability to work with international partners are crucial in building a foundation and core institutional capacity. Secondly, major reform takes years of extensive stakeholder involvement activities, led by a several political leaders. Looking at a decade of Serbia's work, it seems realistic and strategic for countries to start small by building the capacity of core institutions and financing pilot programs under one ministry, but eventually, policy environments need to be enhanced through relevant stakeholders while more government agencies need to be brought into the efforts in order to ensure sustainability and real impact.

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<sup>37</sup> See more details in Serbian RIS3 homepage: <https://pametnaspecijalizacija.mpn.gov.rs/>

<sup>38</sup> Identified research priorities are: 1. ICT (custom software development, software solutions development); 2. machines and production processes of the future (machines for specific purposes, information in smart management service - Industry 4.0, smart components and tools, combustion devices for eco-friendly and sustainable fuels); 3. Food for the future (high-tech agriculture, value-added food products, sustainable food chain); 4. Creative industries (creative audio-visual production, video games and interactive content, smart packaging).

<sup>39</sup> Serbia's pilot is to link its SDG process, STI policy reform and development of EU-supported Smart Specialization Strategy (RIS3), which is based on national or regional priorities that aim to build comparative strengths by linking research and innovation forces to the needs of the economy, as an EU candidate country. Serbia launched its preparation for RIS3 strategy in 2017. The process is led by the MoESTD and the Ministry of Economy, with the support of the Public Policy Secretariat and the technical assistance of EU JRC. The country is currently going through the Entrepreneurial Discovery Process (EDP), which is a bottom-up consultative process among academia, government, private sector and civil society in defining the priorities.