



# INFRA TECH POLICY TOOLKIT

**WORLD BANK**  
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## 1. Context and Overview

### 1.1 Background

The 2020 G20 Presidency mandated the Infrastructure Working Group (IWG) to develop an agenda to accelerate the adoption and application of technology-enabled infrastructure (InfraTech). This agenda supports two existing IWG initiatives—the Roadmap to Infrastructure as an Asset Class, and the G20 Principles for Quality Infrastructure Investment (QII). Technology supports the roadmap by providing enhanced data, tools, and transparency for investors. In addition, it creates new investment opportunities by creating new markets, business models and potential for enhanced revenues. InfraTech also supports QII, as many technologies maximize the positive impact of infrastructure by enhancing sustainability, inclusivity, and resilience. The potential economic efficiencies that new technologies offer also help attain value for money across the project lifecycle and potentially reduce upfront or recurring public financial outlays. InfraTech also provides valuable tools for governments to respond to the COVID-19 health and economic crisis.

This is one of three Reference Notes supporting the agenda: Value Drivers of InfraTech; InfraTech Stock Take of Use Cases; and InfraTech Policy Toolkit.

### 1.2 Objective

This Reference Note supports the InfraTech Agenda by outlining priority areas and tools for policymakers to implement the agenda. This paper focuses on the transport, energy, water, and digital infrastructure sectors.

## 2. Cross-Cutting Policy Priorities

At its broadest definition, InfraTech can be considered any technology that significantly impacts the development, delivery and ongoing operation of infrastructure (for a more detailed definition, please see the accompanying Reference Note “Value Drivers of InfraTech”). InfraTech is creating new opportunities for governments, infrastructure users, and providers. These include greater efficiencies in the development and operation of assets, greater citizen engagement and utilization, and new models for infrastructure financing and asset optimization. However, the rapid change enabled by InfraTech is also bringing new uncertainties, given its potential to disrupt traditional delivery models and to increase risks that assets and investments will become obsolete. This impact is magnified by the infrastructure sector’s relatively poor reputation for dealing with disruption.<sup>1</sup>

Governments wishing to adopt InfraTech will need to introduce policies, regulations, and legislation that strike the right balance between fostering innovation and safeguarding the public good. To do so, they should seek to implement the following cross-cutting priorities into their decision making:

- **Priority 1: Play an active role in leading and enabling an inclusive InfraTech agenda, including responding to natural disasters and pandemics.**
- **Priority 2: Put data at the center across all infrastructure sectors.**

## 2.1 Priority 1: Play an Active Role in Leading and Enabling an Inclusive InfraTech Agenda, Including Responding to Natural Disasters and Pandemics

Governments should carefully assess the benefits and costs of InfraTech adoption in fostering sustainable, inclusive national growth. For those technologies that have high potential given the technology's maturity, implementation costs, risks, and country context, policymakers should act both as leaders and as enablers. Governments will need to adopt new skills, capabilities, and mindsets to implement effective policies.

### 2.1a Response to Natural Disasters and Pandemics

Countries that have invested in InfraTech adoption, particularly in data and analytics, have leveraged these investments to implement successful responses to COVID-19.

#### **InfraTech Policy Levers for an Effective COVID-19 Public Health and Economic Response**

- **Improve the enabling environment for digital connectivity.** Digital connectivity is key to maintaining economic and social activities during social distancing. Removing regulatory restrictions can spur investment in innovative last-mile connectivity solutions and help promote economic recovery. Governments can also improve access and affordability of essential digital connectivity through relief of taxes and deployment of universal service funds. Given the potential of COVID-19 to exacerbate existing inequalities, governments should also ensure inclusive access to digital services, including across gender and spatial lines.
- **Employ data-driven solutions and build the data ecosystem.** Data and advanced analytical tools have helped countries such as China, Korea, Singapore, and Australia track the spread of the pandemic, identify high-priority cases, and respond quickly. Governments can work with the private sector to adopt solutions using partnership or innovative procurement models. The private sector can also provide data from non-traditional sources, such as from geospatial technologies or social media, to give policymakers real-time updates. Governments can also upgrade the data collected by infrastructure services to monitor food and production supply chains to target economic recovery interventions. In parallel, governments can build the data ecosystem necessary to support the robust applications of data across the public and private sectors. Adequate privacy and data protection safeguards need to be updated alongside the application of new tools.
- **Procure solutions that safeguard critical infrastructure services.** Remote and automated methods (e.g., drones, Internet of Things [IoT], robots) can increase the frequency of physical inspection to ensure critical infrastructure services are not interrupted. Upgrading the safety of transport lines, using solutions such as AI-powered temperature screening or contactless ticketing, can help rebuild confidence in public transport. Data collected from contactless ticketing on public transit has also allowed agencies in Australia to create targeted transport responses for high risk areas. Technologies that minimize physical contact at borders or ports (e.g., automation) can also help ensure continuity of road or shipping logistics.
- **Foster new business models that mitigate economic and social impacts.** Long-haul e-logistics platforms, such as Nigeria's Kobo360, are helping optimize private logistics assets and maintain supply chains. Governments can also use public or private demand responsive transport options to support social distancing and still maintain mobility.<sup>ii</sup>

## 2.1b Governments Acting as Leaders

A national or coordinated sub-national approach to InfraTech will help support cross-sectoral solutions and a favorable InfraTech investment climate. Government leadership is key in areas such as addressing trust and transparency concerns in data. Data security and trust will either be a critical roadblock or an industry accelerator depending on the level of government involvement in resolving key challenges. In addition, governments can play a catalytic role in fostering important sectors by becoming early adopters in areas such as electric vehicles or green energy. Depending on the country context, the level of technology maturity, the cost of implementation, and the number of industrial applications will be essential factors in prioritizing sectors or technologies.

## 2.1c Governments Acting as Enablers

Governments should establish a level playing field for all potential InfraTech solutions. Regulation, legislation, and procurement guidelines should be flexible and focused on outcomes rather than specific technologies. An appropriate agile regulatory approach will ensure that new technological solutions don't fall outside of existing regulations or laws. Supporting open, accessible, and integrated data standards will help drive innovation and collaboration across industry. Implementing policies aimed at spurring InfraTech research and development (R&D) and collaborating with the private sector will also grow new and emerging InfraTech markets, particularly those that have strong environmental and social benefits. Governments also have to build the foundational technologies of high-speed connectivity, cloud computing, sensors, and fintech that support the acceleration of both the adoption and application of InfraTech.

## 2.1d Governments Putting in Place Safeguards

InfraTech brings existing and new implementation, social, economic, and environmental risks. Policymakers need to develop new risk-management systems that take a forward-looking approach to all InfraTech projects. Cybersecurity, and environmental and social issues, including job displacement, loss of citizen privacy, and widening inequalities, must be central to any new risk-management frameworks.

## 2.2 Priority 2: Put Data at the Center Across All Infrastructure Sectors

InfraTech relies strongly on data and information obtained from supporting technologies. The following elements will help governments build a trusted data sharing ecosystem that protects people and includes both enablers and safeguards to maximize the value of data to achieve development outcomes in infrastructure:

- *Policies, laws and regulations:* Governments can clearly define rights and obligations over data, including the rights of people to determine when and how personal data is collected, shared and used.
- *Data Governance:* Governments require strong coordinating bodies that can harmonize approaches to data protection and data sharing, as well as implement a whole-of-government approach to implementing data governance. This requires robust and resourced institutions within the government.
- *Trusted Technical Architecture:* Governments can ensure that gathering and capturing data is a priority for all infrastructure services through the use of sensors and platforms that facilitate appropriate sharing of data between public sector, private sector, civil society and people. Technology platforms should be used that foster interoperability, accountability and transparency while maintaining strong cybersecurity standards.

### 3. Policy Tools and Levers

The successful adoption of InfraTech will require governments to use effective levers in the following areas:

1. Legislation and regulation;
2. Procurement and contract management;
3. Funding and financing;
4. Effective institutions; and
5. A future-enabled workforce.

#### 3.1 Legislation and Regulation Tools and Levers

There are often a number of roadblocks that hinder the adoption of InfraTech that can be addressed with appropriate interventions by policymakers. These include the following:

- **Regulations are not keeping up with the pace of technological change.** The innovation lifecycle is counted in months and sometimes even days, but infrastructure assets are often in use for decades. Governments and infrastructure authorities often need to provide strong regulatory oversight to ensure that what customers demand is developed and maintained. Traditional regulatory models are often unable to respond to the current pace of technological change.
- **Regulations are typically risk averse and may inhibit the adoption of InfraTech.** The challenge for policymakers is that innovation, by its very nature, is agile and involves risks and mistakes, which regulators typically want to avoid.<sup>iii</sup> Because InfraTech involves new technologies that bring with them risks and uncertainty, governments are likely to have difficulties in striking the right regulatory balance and responding in a timely fashion. This has been demonstrated by the way governments are grappling with how to regulate ride-hailing platforms such as Uber, which has seen its ability to operate in regions across the world either suspended or removed in a number of locations.<sup>iv</sup>
- **Technology is increasing the risk of information asymmetry with the private sector.** In countries with a strong private sector, much of the knowledge and expertise related to infrastructure technologies lies within those companies, creating information asymmetries between the public and private sectors. This results in a knowledge gap in infrastructure development and planning.
- **Regulatory approaches are typically siloed and not cross-sectoral.** Governments will also need to think from a broader InfraTech ecosystem perspective and work toward removing institutional silos that are often reinforced by the structure of digital systems and data. There is currently no efficient way to leverage data across institutions or an InfraTech ecosystem. Moving in the direction of common data standards and terms can also help systems to work together, as well as enable international collaboration and investment.
- **Local, national and international approaches are not aligned and lack international standards.** While regulatory challenges typically vary by locality, all levels of government need to be aligned from a regulatory perspective for InfraTech to thrive in a locality. Given that infrastructure and construction both have national and local impacts, legislation and regulation must reflect cooperation between national and local approaches. This is amplified by the complexity of private sector delivery, technology diversity, and the requirement to manage across the whole of the asset lifecycle. The importance of local governments will be further enhanced by their role in developing smart city schemes. The key for the successful adoption of InfraTech will involve developing country-level regulations with a local focus (regional or municipal).

### 3.1a National and Sub-national Strategic Multisector and Sector Planning

National and sub-national plans should focus on strategic multisector and sector planning. This is fundamental for envisioning the entrance of new technologies, understanding the economic impact of a potential industry disruption, analyzing potential benefits of sector coupling, or assessing the economic impact of different technology paths. Scenario planning can help policymakers best manage risk given uncertainty of technological progress. Strategic multisector planning will also ensure appropriate attention to investments that benefit multiple infrastructure sectors including foundational technologies (e.g. connectivity), fostering a trusted data sharing ecosystem, and building a local InfraTech entrepreneurship ecosystem.

- Developing a national approach.** A national approach should include a vision for the application of technology in the strategy, design, and conceptualization of infrastructure assets and services, and guidance on future impact. It should also outline how the government will support transitions and transformations necessitated by the rapidly evolving technology landscape. The national approach can be suited to each country’s context and national goals, while also ensuring that all segments of society, including across gender and economic lines, benefit from InfraTech and are not left behind. Adopting a “whole of system” approach can help governments focus their efforts on creating cohesive regulatory systems that enable InfraTech growth. The plan can also help identify opportunities for regulatory change and reduce bureaucratic obstacles. Because InfraTech is not limited to national borders, the plan should consider international standards.

**Canada’s Digital Charter.** Canada launched a Digital Charter in 2019. The charter focuses on preparing the workforce for future needs; supporting the growth and competitiveness of Canadian companies; and ensuring data and trust in the digital age.<sup>v</sup>

**U.K. Digital Twin.** Following the recommendations of the National Infrastructure Commission 2017 *Data for the Public Good* report, the United Kingdom is planning to adopt a national digital twin program to integrate all aspects of its infrastructure system across regions and sectors. The United Kingdom expects the program to generate £7 billion a year from cost savings and efficiency gains.<sup>vi</sup>

- Developing regional and city-level approaches.** The focus of efforts to enact reforms and to strengthen regulatory and legislative tools extends beyond the national government level. Models/frameworks require attention at both centralized and decentralized levels of government. Within the sub-national context, cities are often at the forefront of innovation from a policy perspective, and governments can take advantage of this by coordinating feedback loops between different levels of government. This is partly due to the fact that technology-enabled infrastructure will be critical to fast-growing cities, allowing them to operate more effectively and efficiently and therefore cope with higher usage. However doing so means successfully integrating different technologies, sectors, and user sophistication levels, to ensure services are provided in a cohesive and seamless fashion across a number of platforms.

**India Smart Cities Mission.** India’s Smart Cities Mission is an urban renewal and retrofitting program to develop smart cities across the country, making them citizen friendly and sustainable. Each smart city will create a special purpose vehicle (SPV) with both public and private funding to implement the mission. India selected participating cities based on a countrywide competition. The competitive selection also ruled out the possibility of political patronage.<sup>vii</sup>

**ASEAN.** Members of the Association of Southeast Asian Nations (ASEAN) have at least 26 smart cities in development, including Jakarta, Bangkok, and Manila. While they vary in their stages of development, the vast majority are seeing significant value beginning to flow from their investments. Some governments, including Singapore's, are exploring how they can expand the digitization and smart city infrastructure to much wider populations.<sup>viii</sup>

**City of Ipswich intelligent transport.** In Australia, the City of Ipswich is running sensor-based data gathering and bringing together sub-national departments of transport and the city to run Australia's largest cooperative intelligent transport system programs. This smart infrastructure and IoT initiative gathers important insights for national level policies.<sup>ix</sup>

**Virtual Singapore.** Singapore's National Research Foundation created the authoritative 3D digital platform for use by the public, private, people, and research sectors. This model is being used to improve accessibility, plan for new infrastructure projects, simulate emergencies, and provide real-time monitoring.<sup>x</sup>

### 3.1b Promote a Trusted Data Sharing Ecosystem

- **Adopt data privacy and protection policies, laws and regulation.** Data privacy, protection, and citizen trust are critical to the successful adoption of InfraTech, meaning that governments need to ensure that citizens' information is protected and safeguarded against potential threats. Technology and the data it generates can make infrastructure more responsive to citizens' needs, but in order for InfraTech to be successful, trust and transparency concerns must be addressed. This means taking due care of individuals' privacy, both through legal compliance but also through transparency-enhancing measures such as independent advisory panels that can represent citizens' interests. Government institutions must be appropriately resourced to develop and enforce these policies. New tools and regulatory structures are being developed among early public-sector adopters. For example, following a series of high-profile data breaches, legislators in Japan overhauled its Privacy Protection Law in 2015, and again in 2017. This led to the introduction of laws requiring organizations to obtain individual consent before using or sharing personal data with third parties and to notify the public of any data sharing.

#### Key Questions for Policies on Data Protection, Legislation, and Regulation

- Why is data being collected?
  - How is data collected?
  - How is this data corrected, such as through quality checks?
  - How is data curated to make it useful for the public, government or businesses?
  - How is data computed—what kinds of data analytics work is carried out, such as involving artificial intelligence?
  - How is data communicated between parties?
  - How are conclusions reached with data, and how do governments and other organizations act on the insights generated?
- **Foster trusted technology architecture systems and standards:** Governments can encourage appropriate data sharing across public and private sectors by encouraging the development of trusted technology architecture systems and standards. In addition to setting standards that encourage interoperability, appropriate storage, security and sharing measures can be encouraged as well:



- **Establish cloud storage legislation and regulation.** Much of the regulation covering cloud computing concerns data protection and security, focusing on how and where data is processed. InfraTech will generate significant amounts of data that will rely on cloud storage, including information on asset performance and user behavior, making this a key issue for regulators and policymakers to consider. It will be particularly important given that this information could include personal identifiers and might be stored outside of the country of origin. Governments and operators will need to consider if an organization using a cloud service retains responsibility for how data is handled, even when the work is done by the supplier. Regulators will need to consider the tensions between data sovereignty and protection on the one hand and allowing for global innovation, free trade in cloud computing services, and access to cheaper markets on the other.<sup>xi</sup>
- **Adopt cybersecurity measures.** To ensure the reliability and safety of InfraTech systems, public and private-sector organizations need to work together on implementing physical and virtual security measures, including the use of virtual private networks, firewalls, and rerouting of unwanted remote traffic. For example, water supply and wastewater processing rely heavily on automated technologies to track and manage treatment work. Automated information and communication technology (ICT) systems have improved the reliability and quality of water, but have also raised the possibility of cyberattacks that threaten supply and waste processing. These could include chemical or biological contamination, physical disruption, or interference with computer systems controlling water assets, with potential consequences including long periods of operational downtime, financial losses and threats to public safety.

**Cybersecurity Capacity Maturity Model for Nations (CMM).** The CMM, hosted at the Global Cybersecurity Capacity Centre at Oxford, has been deployed in more than 80 countries through multilateral partners including the World Bank.<sup>xii</sup> It has five dimensions critical to building a country's cybersecurity capacity that are also necessary to safeguard critical infrastructure services: cybersecurity policy and strategy; cyber culture and society; cybersecurity skills; legal and regulatory frameworks; and standards.

- **Address and reduce information asymmetry.** There are often information asymmetries between the public and the private sectors in areas including capabilities, access to data sets, quality of data, and application. These asymmetries can lead to inadequate oversight and poorly designed regulation. Governments should seek to gather information from stakeholders, industry providers, and academics to help understand the landscape so that legislation and regulation remains relevant as InfraTech develops.

**U.K. National Infrastructure Commission Gemini Principles.** These principles provide a standard and common definition for information management that industry and government can follow to ensure that data is not mistreated.<sup>xiii</sup> The three governing principles for the creation of digital twins under the Gemini Principles are:

- Purpose—Data collection and use must have a clear purpose.
- Trust—Data must be secure, transparent, and of reputable quality.
- Function—Digital twins must be based on a connected environment, have clear ownership, governance, and regulation, and must be able to adapt to technology as society evolves.

**Building data collaboratives in Malawi and the Democratic Republic of Congo.** In Malawi and in the Democratic Republic of Congo, 30 percent and 56 percent of the population, respectively, don't have access to safe drinking water. Due to fragmented data ecosystems, it is difficult for the governments to integrate different data sources in order to best target interventions. Pilot projects in Malawi and the

Democratic Republic of Congo developed and evaluated an innovative framework to build a data ecosystem by bringing together sociological and technical aspects along five dimensions: data actors, data governance, data supply, data demand, and data infrastructure. One innovative aspect of the project was to use drones to gather aerial imagery for water point detection, and combining this with other sources of geospatial data. The framework also enabled local communities to determine transportation time needed to reach health centers to better design infrastructure interventions. Key lessons from the project included the importance of open standards and appropriate technology solutions.<sup>xiv</sup>

### 3.1c Enabling Environment

Enabling the development of a local InfraTech industry will not only contribute to a more dynamic economy but also will develop skills and capabilities within the public and private sectors. Policymakers can adopt the following elements:

- **Establish a level playing field.** Governments should ensure relevant policies, legislation, and regulation are technology agnostic to encourage competition and innovation.
- **Clear and credible policies.** Governments need to ensure that legislation and regulation are credible, which means clearly defining “where and how to act, as well as where not to act” and making policies “subject to a regular revision and an adjustment within a predictable range.”<sup>xv</sup> Governments should also seek to develop holistic regulation and legislation that looks at the whole ecosystem to address the issue of bypass, a problem in which some areas are regulated and others aren’t.

**Creating drone markets in Africa.** Rwanda has encouraged the use of medical delivery drones supported by an open regulatory approach. Rwanda implemented a performance-based regulation approach that granted airspace to drone companies to test technology if they can prove it meets safety requirements. This gave innovators faster access to airspace compared to developed countries and expanded the range of possible applications. In February 2020, Rwanda partnered with the World Bank, the World Economic Forum, and the U.K. Department for International Development (DIFD) to host the Africa Drone Forum,<sup>xvi</sup> which included a regulatory summit to move toward regional drone regulation solutions to help face the challenge of limited ground infrastructure in Africa. Rwanda is also supporting local African innovators to encourage homegrown drone technology companies.

**Adapting drone regulations in the Pacific.** Some developing countries have aligned their UAV regulations with those of countries where the regulatory aspects are more developed. For example, member countries of the Pacific Aviation Safety Office are mostly adopting the UAV regulations of New Zealand or Australia. To best adapt regulations, countries can use the Global Drone Regulations Database, a collaborative and voluntary resource providing links to known UAV regulations.

- **Focus on outcomes.** Policies should take a user-centric view, so that rather than focusing on outputs such as the number of vehicles a bridge can carry each day, they consider outcomes such as shorter journey times, lower pollution and carbon emissions, and better access to employment. Focusing on users and related outcomes can facilitate the use of new, innovative InfraTech solutions to generate environmental and social benefits.
- **Innovation sandboxes.** One approach to encouraging innovation is the adoption of regulation “sandboxes.” This will help address the disconnect between the pace of technological change and

the evolution of regulatory frameworks. Barcelona has adopted such an approach by designating a specific area where technology firms can test out their innovative products, which is intended to inform the regulations the city adopts.<sup>xvii</sup>

**Sweden’s innovation sandbox.** In order to encourage the use of dynamic pricing for roadways and parking, Sweden conducted a congestion pricing pilot program that proved the economic, social, and environmental benefits of the technology.<sup>xviii</sup> Given the success of the scheme, it was later upgraded to a dynamic pricing system (which increased the highest fee). The upfront costs of implementing the system were recouped in less than five years.

**Regulatory sandbox for the energy sector.** Singapore’s Energy Market Authority (EMA) launched a framework for testing innovative products and services in electricity and gas while providing safeguards for consumers and the energy market.<sup>xix</sup> The framework supports companies before market introduction of innovative solutions through a sandbox that helped EMA review its frameworks and provide appropriate regulatory support.

- **Fostering a market for local technology startups.** In order to foster local InfraTech-focused startups, public support to accelerators or incubators that promote InfraTech solutions can be considered. Israel has supported a vibrant entrepreneurship ecosystem by providing support to private accelerators and incubators in select fields such as AI, cybersecurity, agri-tech, and food tech. Early-stage funding can help to scale up businesses and attract institutional investor capital to support a long-term vision.

**5G Barcelona.** 5G Barcelona is a public-private partnership approach that aims to transform the city’s metropolitan area into an open and neutral urban laboratory for validation and adoption of 5G technologies and applications.<sup>xx</sup> This culture of innovation combined with the ease of doing business with the city is materially increasing the quantity and the quality of both tech and InfraTech investments going into the city.

**Australia’s Future Transport Digital Accelerator.** Australia created the first government transport accelerator model of its kind, which facilitates direct collaboration between the public and private sectors<sup>xxi</sup>. They launched a mobility as a service (MaaS) innovation challenge that provides seed funding, incubation support, and mentoring to pilot innovative MaaS solutions.

- **Explore decentralized solutions.** InfraTech now enables a new generation of solutions to shift infrastructure from a top-down, centralized approach, to a bottom-up, citizen-led, decentralized model that not only leads to agility, efficiencies, and lower costs, but improves ease of use, affordability, and accessibility based on resilience at a local level. These solutions offer the potential to unpackage large infrastructure, so they are delivered as a number of smaller, more flexible future-enabled projects that are more nimble to react to technology changes. However, decentralized services may not offer the same volume and quality of service, and require significant operational and regulatory complexity. Adoption of decentralized solutions will depend on factors such as the sector, type of service, local circumstances, and market structure.

**Creating markets for off-grid solar solutions.** Advances in solar, battery storage, and financial technologies have continued to drive down costs of off-grid solar solutions, offering the opportunity to bring electricity to rural areas at much lower upfront and ongoing costs than traditional solutions. The World Bank’s *Off-Grid Solar Market Trends Report 2020* notes that 420 million users are now served by off-grid solar technology and this number is projected to rise. The World Bank’s Lighting Global program works with governments to remove policy and regulatory market entry barriers in

order to increase access to clean energy, and to foster a vibrant competitive market for off-grid energy products. In addition, Lighting Africa works with governments to integrate modern off-grid energy products into rural electrification programs. Decentralized microgrids also offer the opportunity for peer-to-peer energy trading, potentially reducing the cost of energy for participants.

### 3.2 Tools for Procurement and Contract Management

Traditionally, infrastructure has been limited in its flexibility to respond to changes in external conditions after delivery. For example, a standard stretch of road cannot alter its capacity based on dynamic changes in traffic flow. InfraTech can provide such flexibility, but doing so means overcoming rigid procurement practices. To mitigate the risk of stranded assets, governments should take a view across the entire life of a project and view procurement as an ongoing process throughout the project's lifecycle. Existing procurement systems and contracts are typically designed for long-lived assets with minimal changes assumed in construction, operations or maintenance systems, or technologies. At the same time, emerging technologies are evolving and changing at a faster rate when compared to existing technologies, leading to dramatically shifting cost structures, risk profiles, and delivery models over the life of the project. These changes make it more challenging for governments to scope and assess proposals during the procurement process. The nature of existing procurement systems exacerbates this issue as they can be risk-averse and therefore favor incumbent rather than innovative solutions. They also create a lack of incentives for innovation in either enhanced service delivery or lower costs.

While procurement can be a significant lever to accelerate adoption of InfraTech, successful adoption of innovative solutions will depend on a combination of factors: (i) how planning is designed, (ii) market structures, (iii) regulatory design, (iv) operational rules, and (v) how risk is allocated and priced. Within this local context, the following tools may be helpful in designing a successful procurement approach for InfraTech solutions.

#### 3.2a Collaborative Procurement and Contracting Approaches

To ensure appropriate InfraTech procurement that takes into account value for money principles, governments can employ collaborative procurement and contracting approaches such as competitive dialogue models for procurement, which allow bidders to prepare alternative proposals; the two envelope system, which separates technical and pricing aspects of bids; and new clauses to allow for innovation while defining issues surrounding liability and risks. The aim of these models would be to minimize the use of lowest-cost procurement or competitive bidding, which do not fit InfraTech projects and the costs associated with effectively implementing these projects.

Governments should consider alternative options if neither public-private partnerships (PPPs) nor alliancing—where participants work to collaborate closely on cost savings and enhanced performance—fit a project. A direct contracting model can work in developing countries where market interest and maturity might be low and local capacity might not exist to deliver complex procurement models. More generally, governments might benefit from building a process that allows them to review unsolicited proposals, as this can help ensure that the use of innovative technology is not inadvertently barred by rigid procurement structures.

**Helix Nebula Science Cloud.** Ten leading European public research organizations used a pre-commercial procurement process to jointly procure a hybrid cloud solution with an innovative infrastructure as a service model. The process included open market consultation, where technology companies, experts and research organizations progressively refined the focus of the procurement. A survey was also undertaken among the known technology market players to allow the procurers to detect the capabilities and the

willingness of the market to participate in the tender. The procurement was done in three phases, with selected companies building a prototype for the second phase. Based on the prototypes developed, two winners were chosen to develop the hybrid cloud solution<sup>xxii</sup>.

**Unsolicited proposals and the Office of Extraordinary Innovation.** Los Angeles Metro established an Office of Extraordinary Innovation (OEI) to identify, evaluate, develop, and implement new opportunities.<sup>xxiii</sup> OEI created an unsolicited proposal policy (UPP) designed to catalyze ideas and accelerate the adoption of new financing strategies, unconventional or alternative approaches, and superior technical concepts.<sup>xxiv</sup> In defining the UPP, the OEI was intentionally vague, and the bar for submission was set low so that all ideas with potential would be included and explored. The UPP process allows the OEI to identify and prioritize projects and overcome early stage challenges through internal and external co-development. To date, the OEI has received a steady pipeline of proposals from external entities supporting continuous innovation. New mobility projects, such as the Microtransit Pilot, Mobile Tolling, and Los Angeles Aerial Rapid Transit, are spurring adoption and exploration of InfraTech in transportation.

**The Municipal Innovation Exchange (MIX) Project.** This project is led by the cities of Guelph, London, and Barrie in Ontario, Canada, in association with MaRS, an urban innovation hub in Toronto. Each of the city governments is running an innovation procurement challenge, as well as looking at the potential for multi-city challenges. MIX will share best practice and lessons learned with other municipal governments in Canada.<sup>xxv</sup>

### 3.2b Focus on Outcomes Through a Level Playing Field

While current procurement practices focus on inputs or outputs, to foster InfraTech, procurement evaluations should focus on outcomes, including desired environmental and social outcomes. Procurement approaches should level the playing field for all potential competing solutions in markets. Standardized contracts and approaches can help ensure a level playing field. For large scale infrastructure procurement projects (e.g. energy sector), governments should also focus on fixing the market design and regulation to ensure all technologies can compete in the delivery of specific services on a level playing field.

An evaluation model focused on outcomes might also support the use of alternative financing contracts and also include innovation as part of the scoring of contracts. Governments also need to add more flexibility to procurement practices, bringing together infrastructure owners and planners to make decisions based on real-time data throughout an asset’s lifecycle. For example, the use of activity- and agent-based models could collate hundreds of data sources to produce a minute-by-minute spatial representation of movements within a specific region, allowing authorities to understand the impacts and interdependencies of their decisions.

**Scaling Solar<sup>xxvi</sup>.** Scaling Solar is a “one stop shop” program for governments to rapidly mobilize privately funded grid connected solar projects at competitive tariffs. The program brings together a combination of World Bank Group services, including advise and financing in a standardized process. This has created consistency across countries to create a single, ‘virtual’, large scale market to attract the largest and best global bidders. The focus on standardization creates a level playing field, and has resulted in a 60% tariff reduction achieved in Senegal. Scaling Solar is also exploring technology bundles (“solar plus storage”) as a promising procurement avenue for the deployment of innovative technology arrangements.

### 3.2c Local Procurement Participation

Selecting a procurement option that balances the need for local delivery that is supplemented with global thought leadership is an optimal outcome for emerging markets. While countries should avoid overly protectionist policies that hinder the participation of foreign firms that have the relevant expertise, at the same time countries should ensure that they foster the development of appropriate local capacity and expertise. This balance can be achieved the use of a procurement strategy that requires local and international partnerships to deliver the project. Governments that have a rich understanding of both the local and global availability of talent and the supply chain are better able to select procurement models that balance local strengths with global innovation.

### 3.2d Value for Money and Lifecycle Cost

New technologies can often save significant costs over the lifecycle of an asset, despite having additional upfront costs. For example, the installation of IoT or sensors within transport projects, or digitizing water access data, might incur higher upfront costs but save significant maintenance and operation costs over time. These technologies can also mitigate risks by better targeting interventions or by stopping accidents before they occur. Traditional procurement approaches may focus on upfront costs or mandate particular technologies, creating adverse incentives for operators to include these technologies.

**Canada’s agile procurement pilot.** In order to work with industry using a simplified and less risky competitive bidding process, the Government of Canada is piloting an agile procurement consisting of four collaborative steps: proposal submission, solution presentation, model/prototype development, and assessment/selection. The procurement process encourages industry participation and in turn ensures the government will receive a pool of innovative solutions to choose from. This “challenge-based solicitation” process encourages creativity and emerging technologies, focuses on the outcomes of the required solution, and allows industry to define the solution.<sup>xxvii</sup>

### 3.2e Data Management Guidelines

Standardized data management guidelines should be implemented by governments to facilitate data sharing across public and private service providers. Governments should ensure that data being captured by private providers adheres to the same standards thereby allowing it to be harnessed by the public sector more easily. Projects could also mandate that tools such as digital twins or advanced building information modelling (BIM) be used on a consistent basis to better incorporate real-time data.

**Australia’s water knowledge access platforms.** In Australia, several water utilities used a platform to provide knowledge management and collaboration platforms, including See-What-I-See (SWIS), which reduced the amount of time staff were required in the field. Benefits included 70 percent improved communication and knowledge transfer with error rates and personal safety issues reduced to almost zero, 88 percent lift in first-time fix rates, 70 percent reduction in time, travel, and delays, and 83 percent of knowledge leaving the industry effectively captured, curated, and preserved for future value.

**SOURCE procurement platform.** For the implementation of the QII Principles, the multilateral online platform SOURCE, jointly financed and led by the multilateral development banks, provides a comprehensive map of all aspects to consider for the development of quality and sustainable infrastructure, covering governance, technical, economic, legal, financial, environmental, and social issues. It provides structured project data for reporting to enhance monitoring and evaluation of project outcomes. It is freely accessible for emerging countries and has so far been used in more than 55 countries to date.

### 3.3 Tools to Support Funding and Financing

Projects with a technology component, particularly when it is a new technology, typically have a different risk profile for funders and financiers than traditional infrastructure projects. While the inclusion of technology does not make a project immediately unbankable, it might change the required returns or protections requested by investors and make the pool of financing and funding sources smaller. To promote private investment in InfraTech, new solutions will be needed to create risk-return profiles that match investors' expectations and liability structures. This risk profile has also contributed to a relatively low rate of research and development (R&D) for applications in infrastructure. Governments will need to demonstrate the viability of new InfraTech as a means of easing investor tensions and developing their support. To mitigate the perceived (or actual) higher risk of InfraTech projects, an appropriate governance structure and clear decision-making mechanisms are vital.

#### 3.3a Sector Subsidies

Government subsidies can help spur investment in instances when technological risk is relatively high and hindering investor confidence in the sector. Sectoral subsidies can take the form of tax incentives, concessional finance, or other form of public support (e.g., R&D). Renewable energy subsidies in the United States, Europe, and China have been effective in accelerating national adoption and dramatically bringing down costs. However, the cost-benefit of any subsidy needs to be carefully evaluated, as subsidies are difficult to structure properly, and can have unintended effects by distorting the market and raising costs for consumers.

**Canada electric vehicles.** To accelerate the adoption of electric vehicles, the Government of Canada and the Province of Quebec provided a subsidy of Can\$9.6 million to enable the Laval region to establish its first line of fully electric bus services by 2020. This was part of the overall [“Investing in Canada” infrastructure plan](#), for which the Government of Canada will invest more than Can\$180 billion over 12 years in public transport projects, green infrastructure, social infrastructure, transportation routes, and Canada’s rural and northern communities.<sup>xxviii</sup>

**Kenya solar service providers.** Kenya, through the Kenya Off-Grid Solar Access Project for Underserved Counties,<sup>xxix</sup> is compensating solar service providers for initial, ongoing incremental and opportunity costs associated with an expansion of operations in underserved counties. This will help provide electrification of areas where mini-grids represent the least costly option.

#### 3.3b Project-Level Subsidies

Similar to subsidies at the sectoral level, governments can also provide subsidies aimed at individual projects. The subsidies can include favorable tax treatments, grant programs, and greater encouragement of greenfield development aimed specifically at InfraTech projects. New and innovative InfraTech solutions bring a degree of uncertainty and risk, which can create a barrier for private sector investment. While governments have to be selective about what InfraTech solutions to support based on a careful cost-benefit analysis, including considering economic externalities, they can help provide subsidies to test, pilot, or scale-up technologies—particularly when market maturity or access to capital and financing is low.

**K-City.** The government of the Republic of Korea has invested \$11 million in the building of a virtual city called K-City, which provides the necessary infrastructure and space for the testing of autonomous vehicles and associated technology projects.<sup>xxx</sup>

**SFPark.** SFPark, based in San Francisco, California, was a federally funded demonstration of a new approach to managing parking<sup>xxxii</sup>. It used better information, including real-time data on where parking is available, and demand-responsive parking pricing to help make parking easier to find. As a federally funded demonstration of a new approach to managing parking, SFPark collected an unprecedented data set to enable a thorough evaluation of its effectiveness. The San Francisco Municipal Transportation Agency (SFMTA) evaluated the SFPark pilot project to see how effectively this approach to managing parking delivered the expected benefits. The evaluation showed that after SFPark, San Francisco’s parking availability improved, and greenhouse gas emissions, vehicle miles traveled, and average parking rates all decreased.

**United Arab Emirates Masdar City.** In the government’s effort to rethink sustainable cities, the United Arab Emirates’ Masdar City was established, with most of the seed capital (\$15 billion) provided by the Government of Abu Dhabi.<sup>xxxiii</sup> It is now a green incubator and promotes industry for the development of solutions that encourage the use of renewable energy. The master plan calls for all autonomous rapid transit and no cars. It was the first sustainable city project created as part of the government’s effort to mitigate the impacts of climate change.

### 3.3c PPP and Governance Structures

For InfraTech projects, the risks are less understood, and may be “greenfield” when it is new technology, or technology being used in a new way. Therefore, the allocation of risk for an InfraTech project is far more complex than that of a traditional infrastructure project. For InfraTech there need to be nuanced discussions about which entities will take on which risks. While best practice for risk allocation on large capital projects is to allocate the risk to the party best able to manage them, this is more difficult in many InfraTech projects. Creating governance structures that reflect the experience and expertise of all parties, and provide the appropriate level of risk sharing and collaboration, is vital for InfraTech projects. Technology companies are increasingly part of infrastructure PPP models in order to bring in the necessary expertise and share the risk.

**PPP Best Practices Relevant for InfraTech Adoption.** Successful PPP programs typically start with a *clear legal and institutional framework* which puts forth what is allowed and what is not in terms of types of projects, sectors, terms and conditions of contracts, who provides approvals and times required at each step. There is usually a *center of excellence* called a PPP Unit which provides technical support to governments and serves as a communication channel to the private sector providing necessary information. It is very important that Ministry of Finance is involved in the early stage for the government to make an informed decision on the project related to fiscal risk of PPP projects, and *Inter-Ministerial Committee* is a platform all stakeholders participate in the decision process and ensure of seamless implementation of projects. *Competitive procurement* is norm whenever possible, and even for unsolicited proposals, it is recommended that the project is open for other parties to compete. Proper *risk allocation* is a key for successful PPP projects, and the principle is that risk is borne by a party who can best manage the risk. For more on PPP Best Practice, please refer to PPP Reference Guide 3.0 by World Bank.

### 3.3d Innovative Financing Solutions

Conventional financing sources—such as venture capital, which may be too dilutive or restrictive, or bank loans which are unlikely to offer favorable terms for technologies that are considered speculative—might not be suitable for some InfraTech projects. InfraTech is opening up both new types and new sources of financing.



- **Dynamic pricing mechanisms.** InfraTech is enabling pricing and payment mechanisms that enable better targeting of consumers able and willing to pay for certain infrastructure services. This can improve the financial sustainability of large infrastructure projects. In Stockholm, London, and Singapore, the upfront costs of implementing this system were recouped in less than five years.
- **Pay-as-you-go models.** IoT, fintech, and real-time data are enabling new models of payment and financing that are particularly suited to reach previously unserved areas.

**Using smart metering to improve water access.** Untapped and Mathira Water and Sanitation Company (MAWASCO) ran a proof-of-concept project in Malindi,<sup>xxxiii</sup> a coastal town in Kenya with a population of over 300,000, installing 6,500 pay-as-you-go smart meters on an 18-month capital lease. Over three years, MAWASCO recovered billing arrears and saved operating costs while covering its equipment lease payments. Moreover, the cash flow going through the Untapped digital payments platform was 5.4 times the amount of lease payments. Untapped is expanding the metering service in Kenya to service an additional 550,000 customers by 2021.

**Niger smart pre-paid water meter.** Niger is employing CityTaps, a prepayment service for which beneficiaries use mobile money to prepay for running water with any mobile phone, at any time, for any amount. This system helps utilities become financially independent and invest in infrastructure for at-home water service to even the poorest residents. This system was piloted in 2016, and expects to reach 100,000 people in Niger by the end of 2020<sup>xxxiv</sup>.

- **Technology companies.** Given relatively large balance sheets and an interest in infrastructure, technology companies can also provide new sources of financing for InfraTech projects.

**CSquared.** Google, the World Bank Group, and Mitsui formed CSquared to reduce the costs of broadband in Africa through connectivity investments.<sup>xxxv</sup> CSquared started as a project within Google and then later became independent to expand operations. It currently owns and operates fiber in Uganda, Ghana, and Liberia.

- **User-pays system.** Infrastructure service users can be incentivized to adopt InfraTech solutions through regulation or financial incentives. In these schemes, the system is not fully funded by a government but governments can promote technology development to meet the technical requirements. Users can make their own decisions in terms of purchase and installation, while governments inspect and verify to ensure compliance.

**New South Wales water digitization.** In order to realize the benefits of water access digitization, including promoting sustainability and reducing maintenance costs, New South Wales is requiring users to purchase telemetry devices.<sup>xxxvi</sup> New South Wales used a free market procurement process to ensure devices met cybersecurity and other technical requirements at a reasonable cost to the user.

- **Aggregating projects.** Governments can bundle small-scale InfraTech projects to obtain a scale of interest to investors. Bundling is used for infrastructure projects more broadly (e.g., schools/education projects), but could serve to address challenges associated with scale and risk for InfraTech. Investments in more than one type of technology could also mitigate/dilute the risk of investing in only one that may or may not meet objectives.

- **Microfinancing/crowdfunding:** Microfinancing is an option for financing small-scale InfraTech projects, such as the UN Capital Development Fund’s CleanStart program using this method to support low-income households and micro-entrepreneurs in Africa and Asia in getting access to clean energy.<sup>xxxvii</sup> Crowdfunding, which aggregates small contributions from individuals and private enterprises, provides another possibility for smaller infrastructure projects, particularly projects that local groups/individuals are likely to see as desirable, but that might not fit the investment requirements of a larger financier/funder. “I make Rotterdam” was a crowdfunding campaign for a wooden bridge built as part of the Hofplein neighborhood rejuvenation project, with each person paying at least €25 to have their chosen message inscribed on one of the bridge’s wooden planks.<sup>xxxviii</sup>

### 3.4 Tools for Building Institutional Capacity

Government institutions often lack the appropriate structure to provide effective support to, and oversight of, InfraTech issues. Institutions need to be equipped to change or adapt the regulatory environment to enable adoption of InfraTech. In particular, city governments need to consider the whole ecosystem, and silos typically limit the ability to use and exploit data across institutions. Effective institutions have an important role to play in fostering the adoption of InfraTech.

#### 3.4a Upgrading Agency Structures

Institutional structures must be redesigned to embrace the increasing pace of innovation and to operate more effectively in a rapidly changing InfraTech climate. Accountability can also be assigned to new sectors (e.g., drones, AV). In most countries, primarily in Europe and Asia, the use of UAVs (drones) is regulated by the respective aviation authority. While no special entities have emerged in most cases to manage the adoption of UAVs, regulation has been developed to manage their use and operation within each jurisdiction. In some instances, such as in Singapore and Brazil, respective telecommunications authorities are also involved due to the use of radio frequencies in UAVs.

Governments should consider establishing new organizations that focus on innovation and transformation to help disseminate ideas on new InfraTech solutions and to overcome information asymmetries, helping to improve national capacity and capability to execute such projects. Innovation offices are usually established to encourage innovation within the organization (or group of organizations) on efficiencies, cultural change, and the development of innovative ideas; to build on the work of existing departments; or to work on specific projects, policy areas, or partnerships, although many carry out a number of roles. As an alternative to an innovation office, governments can set up advisory panels for specific projects, initiatives, or policy areas. These usually bring together groups of external experts to help guide the government organization in question on a particular topic or problem.

**European Commission Cooperative Intelligent Transport Systems (C-ITS).** In 2010, the European Commission launched a group to internationally standardize C-ITS to promote vehicle-to-vehicle (V2V) technologies. V2V technologies enable communication between vehicles to avoid accidents and enable optimization of traffic flow. As a diverse range of stakeholders need to cooperate, the European Commission created a sub-group to support implementation for common EU-wide cybersecurity infrastructures and processes needed for secure communication<sup>xxxix</sup>.

**Australia Office of Future Transport Technology.** The office was established by the Australian government to develop institutional and government capability on a specific Infratech agenda—automated vehicles. The agency office will manage the enabling of new technology and private sector

innovation, policy leadership at a national level, and it will invest in research and technology deployment and work to drive a supportive regulatory environment.<sup>xi</sup> This clear focus and mandate is a significant change; it redesigned the department of infrastructure, regional development, and cities, and it allows the agency to effectively drive the complex agenda

### 3.4b Empower Infrastructure Financial Institutions

Financial institutions have a key role to play in fostering InfraTech through sector and project level subsidies, and through direct financing of InfraTech projects. Infrastructure banks can set up special programs to catalyze the use of technology within projects they finance, or new institutions can be set up.

**Korea Technology Finance Corporation (KOTEC).** KOTEC is a non-profit quasi-government agency designed to facilitate technology financing to small and medium-sized enterprises (SMEs) that demonstrate strong technological competencies but lack financial resources.<sup>xli</sup>

**EU Horizon 2020 Program.** The European Commission dedicated funding over seven years through this program and the European Structural Investment Funds (ESIF) to encourage the adoption and commercialization of innovations in the market.<sup>xlii</sup> This program also adapted Technology Readiness Levels (TRLs) based on the NASA model to facilitate the evaluation of technology maturity.

## 3.5 Tools to Foster a Future-Enabled Workforce

As digital skills are increasingly critical to addressing the current and emerging needs of technology-enabled infrastructure, skills gaps and capacity constraints hinder the adoption of InfraTech. Both the public and private sectors face skills gaps and capacity constraints in adopting InfraTech.

### 3.5a Assess Skills Gaps

Governments should conduct surveys within the infrastructure sector to assess technology skills gaps. The results of such surveys should help modify education and training based on industry demand, as well as increasing collaboration between educational institutions to meet this demand.

**World Bank Group LinkedIn Digital Data for Development collaboration.**<sup>xliii</sup> This tool uses data generated by LinkedIn's members to identify skills required by specific industries; trends in skills required over time; trends in talent migration between cities and countries; and employment trends. The data can be helpful in InfraTech industries, where sectors and skills are emerging or changing quickly.

### 3.5b Support Inclusive Training

- **Offer grants and incentives for industry.** After identifying what skills are in demand, governments can pay companies grants and incentives to improve workers' skills. Grants and incentives can be based on projects, milestones, or outcomes and can require the company to match them, whether in cash or in-kind. An example is the provincial Government of Ontario's Autonomous Vehicle Innovation Network, which offers funding to companies for fellowship programs to support R&D on connected and autonomous vehicle technologies.<sup>xliiv</sup> Companies are also increasingly using VR/AR technologies to more rapidly upskill their workers.<sup>xliiv</sup> Policymakers should also promote inclusiveness through these programs by ensuring a focus on underrepresented populations in the technology sector, including gender.

- **Enable online learning platforms.** Online education initiatives run by massive open online course providers and traditional universities include “micro degree” and “nanodegree” programs that provide low-cost, targeted training. Many of these offer learners the ability to focus on specific areas or select a variety of topics, based on their needs. Traditional educational institutions (e.g., MIT<sup>xlvi</sup>) or online education platforms (e.g., Coursera) can be engaged to deliver micro certification courses.
- **Establish InfraTech training programs for civil servants.** Governments should also equip their own employees with the skills needed to development InfraTech. To support training of civil servants, governments can help foster an educational system that uses digital solutions to connect industry leaders, educational institutions, and learners in a dynamic and agile manner.

### 3.5c Educational Institutions, Industry, and Government Collaboration

Public-private collaboration will be needed to develop technology skills including programming and data analytics due to the speed of change and the dynamic nature of technology in infrastructure. Training programs will need to be aligned with job market insights to ensure they are providing the right skills for current and future InfraTech projects. Governments can also support the development of talent at academic institutions by offering grants to hire and train students for R&D projects focused on industry needs.

**Japan’s Cross-Ministerial Strategic Innovation Promotion Program.** This program addresses 23 subjects chosen for their societal importance by encouraging cross-disciplinary collaboration in R&D between industry, academia, and government.<sup>xlvii</sup> These collaborations are run continuously so that the curriculums they offer are up-to-date and continue to address industry requirements as technologies evolve.

**UK Research and Innovation.** UK Research and Innovation operates across the United Kingdom and brings together as partners educational institutions and universities, businesses, charities, and various innovation-focused government departments to increase collaboration.<sup>xlviii</sup> The Innovate UK program brings innovation focus areas such as Infratech to the ecosystem, and solutions are developed in collaboration across the various partners. One recent focus area called for rapid sanitizing technology for ambulances; another recent call is to propose solutions that combine digital technologies, artificial intelligence, the application of big data, and engineering solutions with biological, environmental, and/or social science to drive productivity.

### 3.5d Global Knowledge Exchange

The adoption of InfraTech varies globally, with different regions and countries innovating at different speeds across technologies and types of infrastructure assets. Technology transfer between countries provides a way for governments and institutions to foster greater collaboration and knowledge sharing, thereby bridging knowledge gaps. International partnerships focused on accelerating progress on specific InfraTech areas can also help to promote global knowledge exchange and cooperation.

**EU-Japan Technology Transfer Helpdesk.** This was designed to help bridge the knowledge gap between existing technologies in the European Union and Japan.<sup>xlix</sup> The helpdesk provides services to support companies, academic institutions, research centers, and individuals in their search for technologies. Available and promising technologies are uploaded to a website that offers information on the technology transfer process, intellectual property rights, and other related topics.

**Energy Storage Partnership (ESP).** The ESP is a global partnership convened by the World Bank Group to foster international cooperation to adapt and develop energy storage solutions for developing countries. The partnership includes public and private research institutions to partner on the following activities: technology R&D, system integration and planning tools; policies, regulations, and procurement; and enabling systems for management and sustainability.<sup>1</sup>

## Appendix A: Draft InfraTech Country Readiness Assessment Guidance Note

### I. Context

In order to operationalize the InfraTech Agenda, this note provides guidance on a proposed InfraTech Country Assessment Readiness Assessment. The proposed assessment can be developed through a series of pilots, with the learnings from the pilots used to refine the methodology, framework, areas of focus, questions, and process.

### II. InfraTech Readiness Assessment Objective

The objective of the InfraTech Readiness Assessment is to help countries operationalize the InfraTech Agenda by providing recommendations on short- and medium-term priorities in accelerating InfraTech adoption to support inclusive and sustainable growth, particularly in light of the COVID-19 crisis. The recommendations will focus on cross-sectoral or economywide interventions that can be implemented at the national or sub-national level. The assessment will draw upon the frameworks and case studies presented in the reference notes supporting the InfraTech Agenda.

### III. Areas of Focus

In order to develop recommendations, the assessment will have two main areas of focus:

1. **Current InfraTech adoption in the country.** The assessment will gauge: i) the level of foundational technologies necessary to support a wider set of InfraTech applications; and ii) the prevalence of best practice InfraTech applications and use cases.
2. **Policy and institutional readiness.** The assessment will look at how well the government is utilizing policy tools and levers to accelerate InfraTech adoption including: legislation and regulation; procurement and contract management; funding and financing; establishing effective institutions; and building a future-enabled workforce.

The following provides more detail on how the assessment will be conducted with indicated areas of coverage.

### IV. Assessing Current InfraTech Adoption

1. **COVID-19 response.** This will include the country's adoption of InfraTech that helps ensure an effective public health and economic recovery response to COVID-19 including use of AI and data, promoting cost-effective and remote maintenance, and enhancing safety of transport lines.
2. **Foundational technologies.** The assessment will include the following:
  - a. **Connectivity.** What is the level of broadband coverage in the country? How comprehensive is it? What are current plans to roll out 4G or 5G?
  - b. **Data infrastructure.** What is the level and access to cloud computing services? How is real-time data currently being captured by infrastructure services? How robust are cybersecurity standards within the public and private sector?
  - c. **Fintech.** What is the level of digital payments within the country?
3. **InfraTech applications.** The assessment will check what categories of InfraTech use cases have been adopted, with a focus on cross-sectoral applications. It will also focus on InfraTech use cases that have significant potential financial, economic, social, and environmental benefits combined with relatively easy implementation. This can include the following categories across the lifecycle:

- a. Development and planning.** AI-enabled prediction and demand forecasting, digital twin for goal-based network, AI-enabled construction finance process and monitoring
- b. Design and engineering.** Advanced surveying and object recognition (e.g., using satellite imagery, drones); next-generation BIM, big data-driven procurement and bidding optimization
- c. Construction.** Augmented reality-based site management, autonomous construction equipment and robots; 3D printing and innovative fabrication
- d. Operations and maintenance.** AI monitoring to address disease outbreaks and pandemics; AI predictive maintenance and optimization; dynamic flow/usage optimization and pricing, drone/satellite-based surveying

## V. Assessing Policy and Institutional Readiness

### 1. Legislative and Regulatory Readiness

- a. National or sub-national InfraTech plans.** Do any such plans exist, and if so, how comprehensive are they? Is there a technology-led approach to resilience, including response to pandemics? Is there a risk management framework?
- b. Data ecosystem.** Are there existing data protection and privacy measures? How is data shared between public and private sectors? Is cloud storage legislation and regulation in place? What cybersecurity legislation exists?
- c. Enabling environment for innovation.** Within the core infrastructure sectors, do the relevant policies establish a level playing field for market innovators that is technology agnostic? Are “innovation sandboxes” adopted for key technologies? How vibrant is the market for local technology startups?

### 2. Procurement and Contract Management

- a. Collaborative procurement and contracting approaches.** What are ways in which innovative approaches in procurement are encouraged? Are there distinct guidelines for procurement of technology? Are approaches that take into account value-for-money approaches, such as competitive dialogue models, employed? Do existing procurement approaches typically require local and international partnerships to deliver the project?
- b. Employing data.** Is real-time data used to improve tracking and governance of projects? Are there standardized data management guidelines across projects? What technology is used to monitor projects?

### 3. Funding and Financing

- a. Sector and project level subsidies.** Are there subsidies to encourage development and adoption of InfraTech that helps to achieve economic, social, and sustainable goals, and where a potential market failure exists?
- b. Project structure.** Are PPPs and other partnership structures used in a way to best manage the risks of InfraTech? How active is participation by the private sector, including by technology companies?
- c. Innovative financing.** What other financing mechanisms for InfraTech projects have been used?

### 4. Institutional Capacity

- a.* **Agency structure.** How do infrastructure-related agencies typically manage new technology driven areas (e.g., ride sharing, drones)? Are there any InfraTech-focused institutions, coordinating mechanisms, or advisory panels?
- b.* **Infrastructure finance institutions.** Do infrastructure banks support or incentivize InfraTech within their portfolios?

## 5. Foster a Future-Enabled Workforce

- a.* **InfraTech skills gap.** Have any surveys been undertaken to assess technology skills gaps?
- b.* **Inclusive training.** What online and offline vocational/industry training exists for InfraTech skills in the public and private sectors? Does the government collaborate with, or provide any grants or incentives to, academia and industry to enhance inclusive training programs?
- c.* **Global knowledge exchange.** What international forums or exchange programs in InfraTech does the country engage in?

## VI. Recommendations

Based on the two focus areas, the assessment can provide recommendations in the following categories:

1. **Quick wins—InfraTech use case opportunities.** Based on the level of foundational technologies and country readiness, the assessment can highlight a set of InfraTech use cases that can be implemented relatively quickly with high return. This will include public health and economic responses to the COVID-19 pandemic.
2. **National InfraTech approach.** Future-looking actions to improve and/or develop a comprehensive national InfraTech approach, including necessary long-term investments in foundational technologies. As part of the national approach, the recommendations can include a prioritized list of policy tools that the government can implement in the near and medium term that will have the most impact. This will include adoption of appropriate risk management frameworks.



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