Supporting Innovation in Digital Urban Services

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The GSMA represents the interests of mobile operators worldwide, uniting more than 750 operators with nearly 400 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and internet companies, as well as organisations in adjacent industry sectors. The GSMA also produces the industry-leading MWC events held annually in Barcelona, Los Angeles and Shanghai, as well as the Mobile 360 Series of regional conferences.

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GSMA ClimateTech

The GSMA ClimateTech programme unlocks the power of digital technology in low- and middle-income countries to enable their transition towards a low-carbon and climate-resilient future. We do this with the collective support of the mobile industry, as well as public and private actors. Through our research and in-market expertise, we catalyse strong partnerships, facilitating innovative digital solutions that address key challenges. Our work spans climate mitigation, adaptation and resilience strategies in low- and middle-income countries, across the globe.

The programme is supported by the UK Foreign, Commonwealth & Development Office (FCDO).

For more information, please visit www.gsma.com/ClimateTech

GSMA Digital Utilities

Utility services such as energy, water, sanitation, waste management, and transport are essential to life. The Digital Utilities programme enables access to affordable, reliable, safe, and sustainable urban utility services for low-income populations through digital solutions and innovative partnerships. In doing so, we also seek to support cities in low- and middle-income countries in their transition to a low-carbon, climate-resilient future.

The programme is supported by the UK Foreign, Commonwealth & Development Office (FCDO).

For more information, please visit www.gsma.com/mobilefordevelopment/digitalutilities/

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The views expressed do not necessarily reflect the UK government's official policies.

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FOREWORD

The 30 fastest growing cities in the world are all in Africa and Asia with 90 per cent of urban growth from now until 2050 projected to be concentrated in these two regions.[1] In many low- and middle-income countries (LMICs), rapid urbanisation is generally not accompanied by inclusive growth. Rather, it is linked to the growth of informal settlements where the majority of the urban population in LMICs already resides. For city authorities and utilities providing basic public services, this poses unique challenges as many are struggling to respond to the growing demands of rapidly expanding and increasingly unequal cities.

Climate change is intensifying these challenges. There is an urgent need for cities to be resilient to sudden shocks, to adapt to rapidly changing circumstances and be responsive to risks and vulnerabilities. Without innovative pathways, water shortages, unsanitary conditions, unreliable power provision and insufficient waste management will remain a defining reality for many, especially low-income communities.

The UK Foreign, Commonwealth & Development Office (FCDO) and GSMA Mobile for Development have been proudly working together since 2013 to drive digital innovations that reduce inequalities in our world. Through our strategic partnership, we have demonstrated the impact that digital tools can have in addressing urban service challenges. We have helped unlock multiple promising new models that make essential urban services, such as water, sanitation and cooking gas, more accessible, reliable, sustainable and affordable. We conduct research and broker partnerships to support the transition to resilient, equitable and decarbonised societies in LMICs. We bring the mobile industry and private and public actors together to unlock the power of digital technology in LMICs and enable essential services that underpin climate-resilient economies.

The work of Mobile for Development has produced important evidence of the essential role of digital tools in improving urban services and protecting our environment. However, it is clear that this immense challenge needs continued investment. This is why we are launching the GSMA Innovation Fund for Digital Urban Services. This initiative, funded by FCDO, will support innovations that provide essential plastic and waste management, energy, water, and sanitation solutions that improve the lives of low-income urban populations in LMICs in the face of climate change and urbanisation.

By leveraging digital technology and partnering with the mobile industry, cities and innovators can develop novel business models that make essential urban services more accessible, reliable, sustainable and affordable. We are committed to supporting transformative digital innovations that will help make cities work for everyone, while also supporting vital climate action.

Max Cuvellier,
Head of Mobile for Development, GSMA

Magdalena Banasiak,
Head of Technology and Innovation Cluster, Senior Innovation Adviser,
UK Foreign, Commonwealth and Development Office (FCDO)

1. UN DESA. (2018). *2018 Revision of World Urbanization Prospects.*

ARE YOU A **START-UP, SME** or **SOCIAL ENTERPRISE?**

ARE YOU IN **AFRICA, SOUTH** OR **SOUTH EAST ASIA?**

Are you **leveraging digital technology to deliver urban services with socio-economic, commercial and environmental impact in:**

- **PLASTIC AND WASTE MANAGEMENT**
- **ENERGY**
- **WATER**
- **SANITATION**

If yes, you can find out more information and apply to the fund at:

gsma.com/digitalurbanservices

Applications open until 2 July 2021

1 The GSMA Innovation Fund for Digital Urban Services

Urban services such as plastics and waste management, energy, water, and sanitation are essential to well-being and the creation of more circular economies. While there has been a historic rise in mobile connectivity in low- and middle-income countries (LMICs), billions of people lack access to basic services. With rapidly expanding informal settlements across Africa and Asia, where 90 per cent of global urban growth from now until 2050 will be concentrated,[2] water shortages, unsanitary conditions, unreliable power provision, and inadequate waste management could remain a defining reality for many.

Providing basic urban services to rapidly expanding informal settlements poses unique challenges to municipalities and state-owned utilities. For instance, extending piped networks and sewer infrastructure to informal settlements faces a range of financial, technical, and political barriers. The result is often highly disproportionate distribution of basic services between richer neighborhoods and poorer informal settlements, with preference given to the socio-economic core.

Experts warn that instead of benefiting from pathways to greater prosperity, many people living in informal settlements risk being locked into "poverty traps" given that they often settle in areas deprived of public and private investment.[3] Innovative solutions that can make cities work for low-income populations, provide sustainable urban services, and allow cities to become true engines of upward mobility need to be tested and scaled.

There is growing evidence that innovative digital solutions can help address this challenge. Digital solutions can unlock business models with the capacity of extending service provision to low-income urban populations. For example, prepaid smart meters in the water sector can make safe water sources more affordable to low-income populations who otherwise rely on variably priced, unsafe sources. There is also growing recognition that 'downstream' innovations in plastic supply chains will help ensure that global and domestic brands have a consistent supply of high-quality recycled plastic, and enable 'upstream' innovation where products use less virgin plastic and are designed to be reused or recycled. However, these solutions require strong partnerships between the public and private sector, as well as mobile operators and other technology providers. Innovators bring new approaches and solutions, mobile operators provide the digital platforms and underlying connectivity infrastructure to reach and communicate with customers, while municipalities and utilities have crucial service mandates to fulfil. Together, these partners can leverage the power of digital technology to create innovative service models to enable access to more reliable, affordable, and sustainable urban services.

In support of this opportunity, and the broader need to drive digital innovation to reduce inequalities in our world, the GSMA Innovation Fund supports innovative digital solutions in emerging markets. With 10 years of experience running innovation funds on a multitude of Mobile for Development topics, our approach has been to fund projects that drive innovation, have a clear socio-economic impact, are commercially sustainable and have the potential to reach end users at scale.

Building on the impact and insights from this work, and remaining evidence gaps, in 2021, the GSMA will launch the GSMA Innovation Fund for Digital Urban Services. The fund will support digital innovations that provide essential services for low-income, urban households. It will target four sectors:

PLASTIC AND WASTE MANAGEMENT

ENERGY

WATER

SANITATION

2. UN DESA. (2018). *2018 Revision of World Urbanization Prospects.*
3. Marx, Stocker and Suri. (2013). *The Economics of Slums in the Developing World.*

The aim of this upcoming Innovation Fund round is to improve the lives of those living in urban areas with digital solutions that make essential services accessible, reliable, sustainable and affordable. To achieve this, we will support digital innovators who bring the ingenuity, technical expertise and customer-centric focus to work alongside mobile operators, urban services providers and municipalities to address these pressing challenges. Funding will be allocated through grants of £100,000 to £250,000 and projects will run for 15 to 18 months.

The GSMA Innovation Fund for Digital Urban Services will be supported by the GSMA Digital Utilities and ClimateTech programmes. The Digital Utilities programme enables affordable and reliable access to sustainable utility services for low-income populations, particularly in urban and peri-urban areas, through digital solutions and innovative partnerships. The ClimateTech programme works to bring together the mobile industry and public and private actors to unlock the power of digital technology in LMICs as an enabler towards their transition to a low-carbon and climate-resilient future.

This report first describes the opportunity to leverage a powerful digital ecosystem for improving lives, and the role that GSMA plays to catalyse these solutions through our GSMA Innovation Fund. It then discusses the specific kinds of innovations the upcoming GSMA Innovation Fund for Digital Urban Services will target based on insights from our work, and areas where more evidence is needed, with a final focus on the need for these solutions for a low-carbon and climate-resilient future. Lastly, we showcase the impact of our work to date driving digital solutions for energy, water and sanitation services through the Digital Utilities programme.

To find out more about the upcoming Innovation Fund for Digital Urban Services, please visit our website.

2 Leveraging digital technology to build impactful innovations

GSMA Mobile for Development drives digital innovations to reduce inequalities in the context of rapidly expanding mobile ecosystems across LMICs. Our GSMA Innovation Fund provides a key platform for achieving this with catalytic funding, facilitation of partnerships between mobile operators and innovators, as well as broader technical assistance. We then build evidence from this work, and the broader industry to share insights and advocate for action across industries and stakeholders.

Mobile connectivity and mobile-enabled innovations have expanded throughout Africa and Asia, paving the way for more circular economies and digital solutions that make vital services, such as energy, water, sanitation, plastic and waste management more accessible and affordable. In Sub-Saharan Africa and Asia Pacific, the unique mobile connections now exceed 456 million[4] and 2.8 billion,[5] respectively. An additional 500 million subscribers are projected in both regions by 2025.

The spread of mobile money throughout Sub-Saharan Africa, and increasingly Asia, has been a key enabler of digital payments and financial inclusion. As of 2020, globally there were over 300 million active mobile money accounts making transactions worth $2 billion a day.[6] The design of mobile money makes it far more accessible to remote and low-income households, as compared to traditional banking, opening to them convenient and safe remittances, payments, lending, saving, and insurance services.

Mobile money has played a particularly key role enabling essential services in both urban and rural contexts. At a fundamental level, it streamlines regular payments and billing and reduces cash losses, benefiting both service providers and consumers.

Through "pay-as-you-go" (PAYG) models, it allows service providers to remotely collect smaller payments from their customers, which can make new services affordable to low-income populations, and assure revenue collection for providers. PAYG solar home system (SHS) models have accelerated off-grid energy access, and also paved the way for replication in more urban contexts, expanding to clean cooking, water and sanitation (see section 4 for more information).

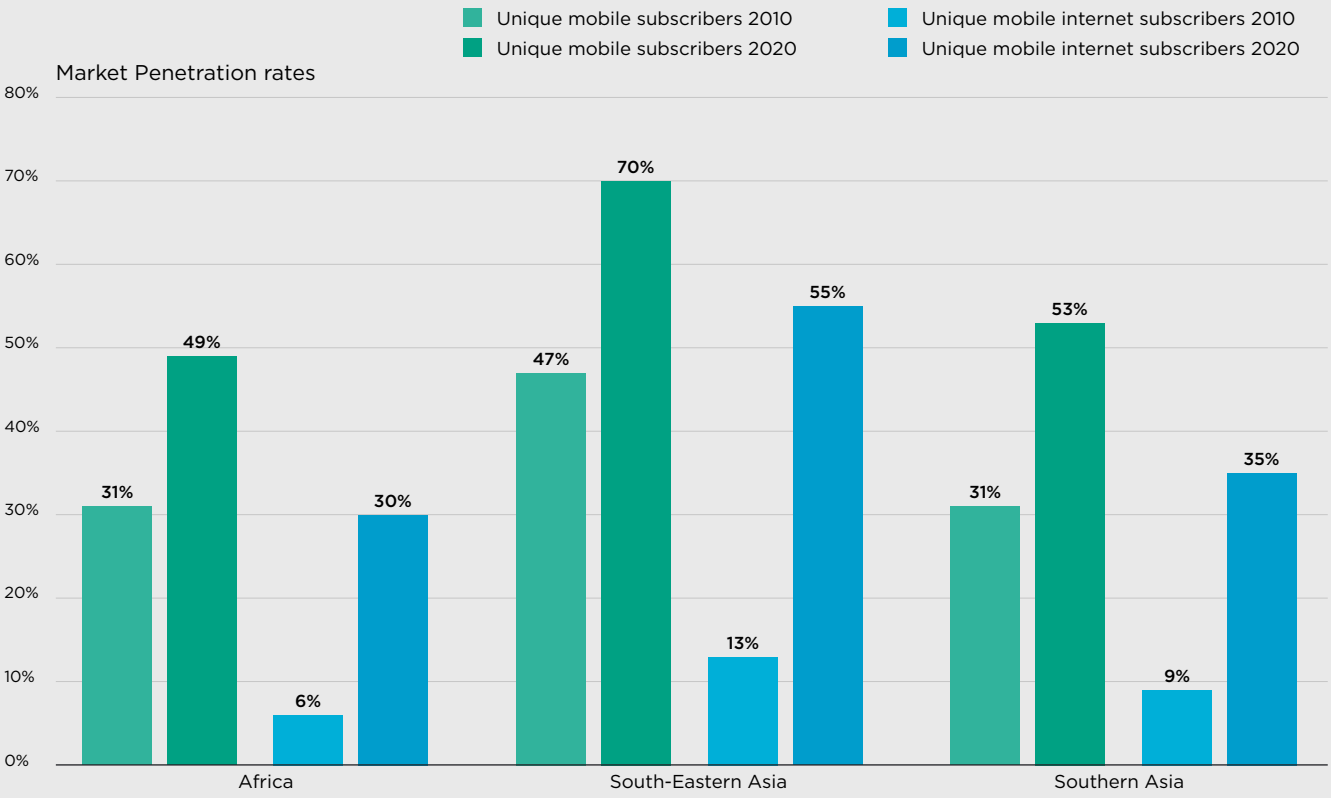
The expansion of mobile internet in LMICs is another key enabling factor for innovations, particularly in urban contexts. According to the GSMA report, *The State of Mobile Internet Connectivity 2020*, urban populations in LMICs are 40 per cent more likely than their rural counterparts to use mobile internet. This is due, in part, to smartphones becoming more affordable, particularly in Sub-Saharan Africa and South Asia, as well as rising digital literacy, especially in urban areas. Between 2017 and 2019 the penetration of smartphone connections in Sub-Saharan Africa increased from 26 per cent of total connections to 38 per cent. In South Asia smartphone penetration increased from 36 per cent to 47 per cent over the same time frame.[7]

The growth of the mobile ecosystem means that digital tools, such as mobile applications, mobile payments, geographic information systems (GIS), smart metering, big data analytics and mobile-enabled Internet of Things (IoT) devices, offer unique opportunities to improve coordination and transactions across a range of public, private and civic stakeholders. Through partnerships, these stakeholders can use these solutions to deliver essential urban services in tailored, cost-effective ways.

4. GSMA. (2020). *The Mobile Economy Sub-Saharan Africa 2019.*
5. GSMA. (2019). *The Mobile Economy Asia Pacific 2019.*
6. GSMA. (2021). *State of the Industry Report on Mobile Money.*
7. GSMA. (2020). *State Of Mobile Internet Connectivity Report.*

FIGURE 1

The Growth of Mobile Technology



Source: GSMA Intelligence

TABLE 1

How digital solutions can help address essential service gaps

	SERVICE GAPS	MOBILE SOLUTIONS
	Unaffordable	• Pay-as-you-go models can make services affordable for low-income consumers by enabling micropayments. • For service providers, mobile money can reduce operating costs and improve revenue collection.
	Unconnected	• GIS can generate granular data to assess needs and coordinate service delivery in complex value chains. • Digital tools provide the ability to identify hotspots and better match supply and demand for essential services.
	Unreliable and unaccountable	• Smart monitoring and smart metering can improve operational efficiency. • IoT can improve management of service delivery and consumption. • Digital tools have the ability to establish an auditable trail of financial transactions and to measure environmental and social impact.
	Unplanned	• Data and large data sets can inform plans for the provision of urban services. • Big data can support evidence-based policymaking.
	Unsafe	• IoT sensors can be used to monitor service quality and prevent faults. • Digital solutions and platforms can drive accountability in the informal sector, making service provision safer for workers and customers.

CREATING MEANINGFUL PARTNERSHIPS WITH MOBILE OPERATORS

The opportunity for innovators supporting essential urban services to collaborate with mobile operators is driven by their natural synergies. The specific nature of these services is that they are essential for healthy and productive communities, so households and governments demand regular, reliable access for all. Achieving this in today's context depends on digital tools as explained above. At the same time, mobile operators are hungry to deliver more value to their customers' lives, far beyond basic communication. This means mobile operators see essential services as a key strategic business area.

More broadly speaking, start-ups and mobile operators bring important synergies to one another. While start-ups in emerging markets have the potential to excel in both the innovation ecosystem and the wider economy, many start-ups struggle to reach scale due to:

1. Insufficient investment capital;
2. Lack of payment infrastructure;
3. Difficulty reaching new users as a less-known company; and
4. A shortage of market insights and limited government support.

While mobile operators have reached scale across many population segments, they also face challenges in retaining subscribers and increasing service revenue as:

1. Achieving high profit margins in the telecommunications sector is becoming increasingly difficult and maintaining customer loyalty remains a constant challenge;
2. Digital disruption has made it challenging for mobile operators to keep up with the accelerating pace of innovation; and
3. There are still market segments with limited adoption of key services like mobile money and mobile internet.

As operating costs for network services rise, and the price of basic mobile services fall, mobile operators seek to grow revenue by increasing usage of existing services through new and attractive use cases, and new services. While mobile operators have reached the scale that start-ups seek, start-ups have the capacity to dynamically innovate in adjacent areas that mobile operators may lack. Mobile operators are also seen as trusted entities with the potential capacity to facilitate public-private partnerships between start-ups and governments. Increasingly mobile operators see partnerships with innovators as key to their growth, and many operate their own accelerator programs, with some investing significant venture capital in start-ups. Figure 2 depicts the "haves" and "needs" of mobile operators and start-ups that reveal potential opportunities for collaboration.[8] Although this framework applies more broadly, examples from past GSMA grantees are featured.

8. GSMA. (2017). Building Synergies: How Mobile Operators and Start-ups Can Partner for Impact in Emerging Markets.

FIGURE 2

"Needs and Haves" framework between start-ups and mobile operators

MOBILE OPERATORS HAVE	LARGE CUSTOMER BASE	CAPACITY TO INVEST	TRACKING AND COORDINATION TOOLS	MOBILE MONEY	WIDE SALES AND DISTRIBUTION NETWORK	MARKET EXPERTISE	BRAND RECOGNITION AND TRUST
SYNERGIES	◦ Wonderkid provides software solutions to water utilities in Kenya and across Africa. ◦ Wonderkid's solution paired with high mobile money adoption has enabled some utilities to operate cashless, and others to increase revenue collection by 25%.	◦ Circle Gas, acquired KOPAGAS' technology that provides PAYG LPG cooking gas with smart meters that also optimise operations. ◦ Through the $25 million acquisition, the mobile operator Safaricom owns 18.9% of Circle Gas and is supporting their expansion in Kenya.	◦ The Container Based Sanitation Alliance (CBSA) developed a tool for container-based sanitation providers to track waste collection processes, collect payments with mobile money and communicate better with customers.	◦ Sehat Kahani provides affordable healthcare to populations in rural areas and urban slums across Pakistan. ◦ Sehat Kahani is integrated with mobile money so patients can pay for various services. ◦ The mobile operator Jazz also provides Sehat Kahani with subsidized data rates for e-Hubs across Pakistan. ◦ Sehat Kahani has benefitted over 3.1 million users.	◦ Lumos designs and manufactures mobile-enabled SHS. ◦ Lumos partnered with MTN Nigeria to use mobile credit for payments and distribute and sell its PAYG SHS through hundreds of MTN stores.	◦ Jazz Pakistan partnered with a start-up spun out from a research institution (CISNR) and grid distributor (PESCO) to build intelligent systems to digitalise electricity infrastructure and distribution. ◦ After just three months of implementation, PESCO's line losses dropped, creating savings of $78,980 in one quarter.	◦ In Côte d'Ivoire, recycling start-up Coliba incentivizes households to recycle plastic bottles through their mobile app with MTN data credits. ◦ Coliba and MTN co-brand and cross-sell through a commercial partnership, and Coliba uses MTN's open SMS and mobile money APIs to communicate with and pay its recycling collectors. ◦ Coliba received support from MTN's Y'ello Start-up incubator programme. ◦ Coliba has recycled over 700 tonnes of waste.
START-UPS NEED	BUSINESS PLANNING SUPPORT	FINANCIAL SUPPORT	EFFICIENT OPERATIONS	EFFICIENT REVENUE COLLECTION	ACCESS TO CUSTOMER TOUCHPOINTS	ADVISORY AND MENTORING	BRAND EXPOSURE AND TRUST

START-UPS HAVE

SYNERGIES

MOBILE OPERATORS NEED

NEW AND INNOVATIVE BUSINESS MODELS

- VITALITE provides PAYG SHS, smartphones and cookstoves in rural Zambia.
- 41% of VITALITE's PAYG smartphone customers and 48% of smartphone add-on customers were first-time smartphone buyers.
- 29% of PAYG customers were first-time mobile money subscribers.
- Approximately half of all smartphone adopters are women.

NEW INNOVATIONS AND REVENUE SOURCES

NEW CUSTOMER SEGMENTS

- CityTaps provides PAYG digital metering solutions to utilities.
- The solution allows low-income households to pay for water incrementally using mobile money.
- 16% of subscribers became new mobile money customers to use the PAYG meters.
- 96% of customers who used mobile money before subscribing to CityTaps claim to have increased their mobile money usage as a result of the CityTaps solution.

DRIVE MOBILE PENETRATION IN NEW MARKETS

NEW REVENUE STREAMS

- eFishery partnered with Telkomsel, to develop narrowband IoT devices for the aquaculture sector.
- The solution, Smart Feeder, uses sensors to detect appetite and automatically feed the optimal amount.
- Farmers can then access and track these insights.
- eFishery is now active in over 120 cities across Indonesia.
- Fish farmers using the eFishery solution have increased profits by over 20%.

INCREASED AND MORE EFFICIENT NETWORK USE CASES

CUSTOMER RELATIONSHIPS

- Twiga Foods is a mobile-based supply platform for small- and medium-sized fruit and vegetable vendors.
- Twiga Foods' distribution infrastructure is managed through a digital platform that enables real-time, end-to-end data collection. The platform is also integrated with mobile money to provide cashless payments throughout the value chain.
- Through mobile money, Twiga Foods makes about 1,000 payments to farmers a week.
- Twiga foods is now working with over 4000 suppliers.

CUSTOMER ACQUISITION AND CUSTOMER RETENTION

TANGIBLE SOCIO-ECONOMIC IMPACT

- Drinkwell developed a sensor-based water treatment solution for purifying water and distributing it through water ATMs in Bangladesh where 41% of all improved water sources are contaminated with E. coli bacteria.
- Drinkwell has deployed over 400 systems across India and Bangladesh, providing over 10 million litres per month to city dwellers, and creating 340 jobs for locals.

STRONGER MARKET REPUTATION AND BRAND PERCEPTION

MOBILE-CENTRIC APPROACH

- Safe Water Network operates water treatment and distribution stations in peri-urban Ghana and uses digital meters on kiosk and household connections along with mobile payments.
- Safe Water Network partnered with MTN Ghana to educate users through interactive group workshops, one-to-one sessions and a promotional campaign that offered prizes for mobile money users.
- This led to 98% of Safe Water Network's customers making their monthly payments for household connections with mobile money.

HIGHER CORE REVENUE AND GREATER DIGITAL LITERACY AMONG CUSTOMERS

MAXIMIZING THE IMPACT OF GSMA GRANTS THROUGH ADDITIONAL SUPPORT

A key aim of the of the GSMA has been to support start-ups with early-stage risk capital (in the form of grant funding), in order to crowd-in follow-on funding and drive commercial sustainability. These start-ups often pioneer market-creating innovations that transform complicated and expensive products or services into ones that are more affordable and accessible, allowing many more people to buy and use them.[9]

While grant funding can be an important catalyst for start-ups seeking to validate, refine and scale their business models, start-ups that operate in sectors that deliver both social and commercial value, experience unique barriers to scale and funding. Start-ups face trade-offs between turning a profit to sustain operations, serving low-income populations and providing high-quality service. There are also context- and sector-specific challenges, such as willingness to pay, financial and digital exclusion, the high costs of customer acquisition and the lack of an enabling environment.

To support start-ups, ensure that grant funding provided is as impactful as possible, and contribute to the maturity of business models and the wider sectors in which they operate, other support mechanisms such as partnership facilitation, technical assistance and advocacy are critical. Grant funding can improve the supply of innovations by allowing piloted ideas to be refined, by enabling more evidence on impact to be collected and by improving understanding of how technology can optimise business models. However, even the most brilliant innovations can fail to take hold if demand is not there as the UK Innovation Agency NESTA points out.[10] When it comes to social innovation, particularly in the context of essential urban services, innovators may need to invest heavily in marketing and customer education to generate demand. This often requires partnerships with stakeholders that have the marketing and distribution networks to reach a mass audience.

The needs of innovators may differ depending on their business model. An innovator that helps government improve services to end users may have to persuade key decision makers in government to reallocate resources to scale a solution. This requires advocacy efforts and hard evidence of how the innovation addresses their challenges. A venture that directly serves end users may need to develop a better understanding of customers' ability to pay and tailor the product design to the local context.

This is why grant funding alone cannot catalyse impact, scale and follow-on funding. The GSMA supports grantees to deliver impactful results by also providing:

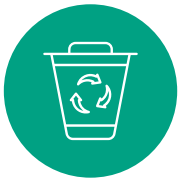
- Technical assistance to support innovators to identify and address these challenges;
- Partnerships facilitation, particularly with mobile operators, but also with corporates and public sector stakeholders;
- Visibility through world-class GSMA events, such as Mobile World Congress, which provide innovators with exposure to investors and other key partners; and
- Research and insights to demonstrate impact of digital innovations to future funders, mobile operators, government and other partners, paired with advocacy and technical advisory to these stakeholders.

This approach has demonstrated significant impact across Mobile for Development topics. Section 4 reflects directly on our impact in energy, water and sanitation through the previous eight years of innovation funding through the Digital Utilities programme, while the next section outlines the key focus areas for the upcoming Fund.

9. Christensen, Ojomo and Dillon. (2018). *The Prosperity Paradox: How Innovation Can Lift Nations Out of Poverty.*
10. Nesta. (2018). *Funding Innovation: A Practice Guide.*

3 GSMA Innovation Fund for Digital Urban Services – Key Focus Areas

This section focuses on four sub-sectors in urban service provision: plastic and waste management, energy, water, and sanitation. It highlights how challenges in urban service provision continue to manifest across these sectors, which innovations have proven impactful at responding to these challenges, how GSMA support has helped innovators in these sectors in the past, and where additional GSMA innovation funding is needed. It lastly demonstrates the importance of these topics for climate resilience.



PLASTIC AND WASTE MANAGEMENT

The amount of waste produced globally is increasing rapidly, especially in Africa and South and Southeast Asia where formal waste management systems are underdeveloped or non-existent. The total amount of waste generated is expected to triple in Africa and double in Asia by 2050.[11] The World Bank predicts that global annual waste will increase to 3.4 billion tons by 2050, a third of which will be disposed of in unregulated dumps or burned in the open. This waste will mainly pile up in the environment, as 70 per cent of the waste in Africa and Asia is estimated to be mismanaged.[12]

Over 400 million tons of plastic are currently produced every year, and this is expected to double over the next 10 to 15 years.[13] It is estimated that 75 per cent of the plastic ever produced has now reached the end of its life, and less than a tenth of it has been recycled. Another 12 per cent has been incinerated and 79 per cent has accumulated in landfills or in the environment.[14] Between 5.3 and 14 million tons of plastic flow into the ocean every year, mostly from coastal regions in Asia.

The life cycle of plastic is also considered a "planetary boundary threat", meaning that high levels of plastic pollution could eventually pass a critical threshold and have an irreversible global impact on vital climate processes, biodiversity levels and ecosystem functions.[15] At current rates, the greenhouse gas emissions from the plastic value chain threaten the ability of the global community to meet carbon emissions targets. If these trends continue, the plastic industry could account for 20 per cent of the world's total oil consumption by 2050.[16]

Mismanaged waste poses health and safety risks for low-income populations, who are most likely to live close to dump sites and/or earn their living as informal waste workers. In LMICs, where city authorities struggle with policy priorities in the context of scarce public resources, waste management practices remain highly unregulated. Budgets for solid waste management are primarily allocated for collection rather than processing or recycling. Without an accountable management system, improperly controlled collection sites are often left abandoned and create a public health hazard. Meanwhile, most cities have not seized the potential opportunities of circular value chains, which use solid waste for waste-to-energy and waste-to-fertiliser use cases, or turn recyclable materials such as plastic into new products.

Waste pollution also affects the economic development of LMICs by damaging livelihoods and curtailing growth in tourism. The United Nations Environment Programme (UNEP) estimates that the economic costs (e.g. revenue losses to fisheries, aquaculture and marine tourism industries) associated with ocean-based consumer plastic pollution alone amounts to $13 billion every year.[17]

Waste management remains a labour-intensive practice. Dominated by informal pickers who work in hazardous conditions on unsafe open dumps and landfills, they run the daily risk of being killed by collapses or fires. In addition to the implicit risks of the job, informal waste pickers also lack social protections, such as health insurance, pensions, and access to credit, even though this work is their main source of employment and removing waste provides significant social benefits. A study by the African Clean Cities Platform reports that between 2016 and 2019, over 250 deaths in Ethiopia, Benin, Guinea-Conakry and Mozambique were due to landfill fires or collapses.[18]

11. World Bank. (2018). What a Waste 2.0.
12. Ibid.
13. UNEP. (2018). *Single-use plastics: a roadmap for sustainability.*
14. National Geographic. (June 2018). *We Made Plastic. We Depend on It. Now We're Drowning in It.*
15. Villarrubia-Gómez, Cornell and Fabres. (2017). "Marine plastic pollution as a planetary boundary threat – The drifting piece in the sustainability puzzle", *Marine Policy.* Volume 96. pp. 213–220.
16. UNEP. (2018). *Banning single-use plastic: lessons and experiences from countries.*
17. National Geographic. (June 2018). *We Made Plastic. We Depend on It. Now We're Drowning in It.*
18. African Clean Cities Platform. (2019). *Africa Solid Waste Management Data Book 2019.*

Waste management is a complex sector, and systemic change will require various actors to collaborate. In countries where few consumers and municipalities are willing to prioritise or pay for waste management solutions, many innovators struggle to scale circular models (i.e. waste collection and recycling) that yield sustainable profits from waste. Many initiatives still need to be cross-subsidised.

Given these challenges, digital tools can be used to identify waste hotspots and connect innovators to both local and international buyers of recycled goods. Mobile connectivity could allow data to be collected on vehicles and collectors in real time, which could then be used for planning routes and optimising loads. It could also allow waste pickers to digitally log their waste collection in real time or relay their locations back to customers, social enterprises or cooperatives to help manage logistics. This data can be analysed to inform waste management decisions, provide traceability to the plastic supply chain and ultimately lead to more sustainable collection and recycling practices.

Digital services that enable more efficient and cost-effective plastic recycling processes will also unlock opportunities for upstream innovation that prevents problematic and unnecessary plastic from ever entering (or re-entering) the supply chain. Upstream innovators might design new products that use recycled plastic in place of virgin materials, or find new ways to ensure that the plastics they use are reusable, recyclable, or compostable. Ultimately, upstream innovations will create an environment where more of the plastic items used in LMICs are part of a circular economy, and kept out of the environment.

TABLE 2

Digital technology use cases for waste management

TECHNOLOGY	DESCRIPTION	USE CASE
Voice, SMS and USSD functions	Mobile platforms enable communication between providers and customers.	Waste management platforms can incentivise, facilitate and optimise the collection, transport, sorting and recycling of waste. These can also play an important role in formalising the informal sector and enable upstream innovation in the plastics supply chain.
IoT/M2M connectivity and GIS mapping	Smart monitoring of system performance can improve logistics, traceability, and profitability.	Digital traceability tools will be vital for innovators to create an auditable trail of recovered waste, prove compliance to Extended Producer Responsibility (EPR) policies, gain valuable market insights (e.g. where waste is located in the supply chain and where leakage is occurring or is likely to occur) and to monitor the social and environmental impacts of waste management practices.
Digital payments	Digital payments enable transparency and can be used to provide customer incentives.	Mobile money services, including those linked to blockchain payment platforms, could provide a more convenient, cost-effective and transparent way for organisations to transfer entitlements to beneficiaries.

BOX 1

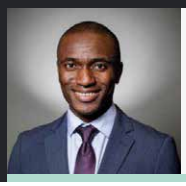
Catching up with our past grantees: Coliba

Coliba is a waste management company that provides off-grid recycling and recovery of plastic waste and transforms it into productive use. Coliba's solution provides a web, mobile and SMS platform that allows customers to schedule waste pickers for plastic collection in return for points for mobile data or other supported products. Coliba received a grant from the GSMA to deploy a large-scale, mobile-supported plastic recycling value chain in Abidjan to collect, recycle and resell plastic waste from households and businesses.

The grant from the GSMA allowed us to create an application for collection which enables us to better manage logistics for plastic waste collection.

Working with MTN has been great for Coliba in terms of credibility and visibility. It was really thanks to the partnership with MTN that we were able to obtain a grant from the GSMA and meet other partners because we're more credible. Right from the beginning of our project we were looking for more innovative ways to get the population involved in the process of waste collection, we knew mobile operators already have access to the market and a large number of subscribers. So, we worked on an API that allowed households to be able to convert points from collected plastic waste into airtime.

Genesis Ehimegbe, CFO and co-founder, Coliba



The GSMA Innovation Fund for Digital Urban Services will aim to support the following digital plastic and waste management solutions. This applies to solutions across the value chain from recycling, to upstream solutions to reduce the use of non-virgin plastics, or ensure that plastic products are reusable, recyclable, or compostable.

1. **Digital payment platforms:** More efforts are needed to develop payment systems for waste collection, which remain fragmented and largely untested since payments are often not transparent and access to fair market prices is not widespread. The GSMA will seek to test how mobile operators and other technology organisations can use their digital platforms, services and expertise to support new recycling and waste management models.
2. **Platforms for data collection, data analysis, traceability, logistics management and marketplaces:** Coordination and digitisation in the waste management value chain remain low. The GSMA will seek to understand how improved traceability can increase the commercial and social impact of plastic for all stakeholders in the value chain; and how to develop, pilot or scale digital tools and business models that support transparent, traceable, sustainable and profitable plastic and/or broader waste management services.
3. **Awareness and education:** While awareness of the environmental, economic and public health risks associated with mismanaged waste is still low, mobile technology is particularly well placed to raise awareness of environmental issues and influence positive behaviour change through information sharing, incentives or gamification.

ENERGY

According to the World Bank, over 600 million people are expected to still be without electricity in 2030. Due to rapid urbanisation and the growth of informal settlements, which are often cut off from the national electricity grid, low-income households are particularly affected by unreliable energy access. A recent report by the Baker Institute proposes a new way to estimate "reasonably reliable" power, which they report 3.5 billion people currently live without.[19] Many of those without reliable electricity still use kerosene and diesel generators, at least as back-up systems during power outages. Prolific use of small gasoline generators in Africa and Asia has wide-ranging negative impacts on the environment, public health and government budgets.

Since urban access to energy in least-developed countries (at 79 per cent) significantly exceeds access levels in rural areas (at 37 per cent),[20] many donors and policies aiming to achieve SDG 7 (Access to Affordable and Clean Energy for All) focus on extending access to electricity to rural off-grid communities only. However, due to rising energy demand in cities across LMICs, additional attention needs to be placed on urban energy provision. Without plans for affordable and reliable urban energy provision, several countries are at risk of not only failing to meet SDG 7, but also depressing the economic potential of several emerging cities.

IRENA revealed that the share of the global population with access to clean cooking solutions has increased slowly, from 56 per cent in 2010 to just 63 per cent in 2018, leaving approximately 2.8 billion people without access.[21] Sustainable Energy for All estimates $4 billion is required annually to ensure universal access to cleaner cooking options by 2020.[22] Household pollution generated from diesel generators, as well as polluting cooking materials like charcoal, are major causes of death and have profound adverse implications for long-term health outcomes and economic growth.

There is also a tremendous need to develop the potential of electric mobility (e-mobility) across Africa and Asia. Road traffic is one of the primary causes of air pollution in cities such as Lagos or Mumbai. In 2018, air pollution caused an estimated 11,200 premature deaths in Lagos State, the highest in West Africa.[23] According to the World Bank, there are only an estimated 3.1 million electric passenger vehicles currently on the road globally.[24] LMICs stand to benefit significantly from cost-effective innovative solutions, such as e-bikes. However, governments need to facilitate e-mobility solutions through policies, regulations, standards for charging, and basic consumer protection frameworks with low fiscal costs.[25]

Since 2013, GSMA funding has been instrumental in trialing new business models to bridge the gap in energy access in LMICs. The most significant are PAYG solar models, which have primarily played a role in rural energy access, but are applicable in some urban contexts as well. In addition to relying on mobile money, some PAYG solar models also make use of M2M connectivity to monitor systems remotely and halt usage if customers default. Mobile operators have seen strong synergy with these business models from the start and in some cases leveraged their brands, and in some their distribution networks, to support PAYG solar products. Some have even trailed and launched their own PAYG solar businesses.

For on-grid urban utilities in emerging markets, we have observed that shifting to smart metering to monitor energy use in near real time can cut costs and help to balance supply and demand. For mini-grids, our pilots have demonstrated that smart meters enable mini-grid operators to make decisions that will increase usage and reliability, including whether to connect new customers, increase or decrease consumption at certain times of the day or add new generation or energy storage.

19. Ayaburi et al. (2020). "Measuring 'Reasonably Reliable' Access to Electricity Services", *The Electricity Journal*. 33(7).
20. World Bank Development Indicators.
21. IRENA. (2020). *The Energy Progress Report.*
22. Sustainable Energy for All. (2018). *Energizing Finance: Understanding the Landscape 2020.*
23. Kemper and Chaudhuri. (2020). "Air pollution: A silent killer in Lagos", *World Bank Blogs.*
24. World Bank and International Association of Public Transport. (2018). *Electric Mobility and Development.*
25. World Bank. (2018). *Leveraging Electric Mobility for Development and Climate.*

TABLE 3

Digital energy solutions previously supported by the GSMA

TECHNOLOGY	DESCRIPTION	USE CASE
Pay-as-you-go (PAYG)	PAYG services enable low-income customers to make micropayments and guarantee revenue collection for providers.	Fenix, now part of Engie Energy Access, designs, manufactures and distributes PAYG SHS supported by financing and mobile payments. Systems provide solar panels, a smart battery system and appliances such as LED lighting, radio and mobile phone chargers, which empower off-grid residents with convenient, affordable access to clean electricity.
IoT/M2M connectivity	IoT technology and machine learning have the potential to optimise operations and improve performance.	Circle Cas, through their acquisition of KOPAGAS, offers a PAYG LPG clean cooking model that uses an IoT-enabled smart meter. Customers can pay via mobile money and consume small amounts of gas at a time, while also providing timely and granular usage and payment information.
Smart on-the-grid metering	Smart metering can minimise electricity theft and line losses.	Jazz received a grant from the GSMA to develop and implement a mobile-enabled theft prevention and loss reduction solution for an urban electricity grid distributor. Jazz, along with their technology partner, Company of Intelligent Systems and Networks Research (CISNR) and grid distributor Peshawar Electric Supply Company (PESCO), implemented this solution to address Pakistan's growing line losses and electricity theft.

BOX 2

Catching up with our past grantees: Lumos Global

In December 2013, the GSMA awarded Lumos a grant to trial PAYG solar services with MTN Nigeria. Since then, Lumos has expanded to Côte d'Ivoire in partnership with MTN and has raised £122.22 million in additional funding.

> The GSMA grant was instrumental early on in our scaling journey, not just for its financial support (which is critical for any early stage company), but also and maybe more importantly for the stamp of approval it signaled the market about our offering to mobile operators. Having the GSMA network and industry knowledge to our benefit played a key role in securing our first mobile operators partnership agreements.

> Securing a partnership with a leading mobile operator in any market we operate is at the very core of our business as our business model relies heavily on PAYG. Without it, we can't scale and reach our targeted customer base as fast and efficiently as we would like.

Ron Margalit
Principal of Blended Impact Investments, Lumos Global

The GSMA Innovation Fund for Digital Urban Services will aim to support the following digital energy solutions:

1. **Replication of business models that leverage digital solutions for clean cooking (PAYG LPG, electric cooking):** While smart metering, mobile connectivity and mobile payments can support promising solutions in the clean cooking sector, scale has not yet been achieved due to lack of financing, awareness and innovation. The Innovation Fund will aim to support the scale and replication of existing business models, the digitisation of value chains, and innovative business models that reduce technology costs and create value propositions and partnership opportunities for mobile operators.

2. **Test and scale generation/storage solutions for urban MSMEs:** Digital tools and new business models will play a key role in the decarbonisation of unsustainable power supply chains. Digital tools will encourage generator replacement by reducing the cost of renewable energy solutions for businesses. Furthermore, digital solutions in the sector can be an important tool for more effective and inclusive incentives and subsidies, such as low-interest loans, results-based financing and carbon credits.

3. **Digital Solutions for e-mobility:** Digital solutions can offer payment platforms, data management solutions for consumers, companies and energy providers, and more affordable energy storage/management and battery solutions to support the emergence of electric vehicles.

WATER

Globally, 2.2 billion people rely on non-piped water sources, and 144 million still rely on surface water.[26,27] In many countries, access to safe water is extremely inequitable, with wealth and location often determining access. The price of water can vary enormously depending on where one lives and where they get their water. Households that are not connected to a formal utility supplier are reliant on private market providers, which can be considerably more expensive. A World Resources Institute study of 15 cities found that private water providers charge as much as 52 times more than municipally supplied water.[28] Water shortages will likely cause these costs to rise even more, as it is predicted that water scarcity could displace 700 million people by 2050.[29] When Cape Town approached "day zero" in 2018, water prices increased 390 per cent.[30] Similar tariff increases are common in other contexts in times of scarcity.[31]

Over the past seven years, the GSMA has supported innovative PAYG metered solutions, PAYG water ATM models, and the adoption of digital payments in the water sector. Mobile or digital payments for water services are becoming more ubiquitous. Digital payments have been a core aspect of nearly all past GSMA grants, which have supported the development of new use cases for digital payments in order to overcome barriers to adoption. For water service providers, mobile payments enable regular revenue collection, reduce administrative costs (usually by eliminating cash management costs) and human error associated with traditional payment methods, and eliminate the risks of handling and keeping cash safe until it can be deposited in a bank. For consumers, mobile money saves time and money by providing a secure and remote channel to pay for water at a set price. Furthermore, PAYG solutions enabled by mobile money, make it affordable for low-income households to access water as they can pay for water incrementally. This gives them more control over their budget while also removing the burden of risk from the utility, which can now get paid in advance.

26. Water retrieved from surfaces that is often contaminated, and therefore not considered a reliable and safe source of drinking water.
27. WHO and UNICEF. (2017). *Progress on Drinking Water, Sanitation and Hygiene: Joint Monitoring Programme 2017 Update and SDG Baselines.*
28. World Resources Institute. (2019). *Unaffordable and Undrinkable: Rethinking Urban Water Access in the Global South.*
29. Global Water Institute. (2013). *Future Water (In)security: Facts, Figures, and Predictions.*
30. Global Water Intelligence. (2019). *What Does the World Pay for Water?.*
31. Global Water Intelligence. (2020). *The Global Water Tariff Survey: The Global Value of Water.*

Digital tools can also support the exchange of valuable real-time data to monitor and deliver water more efficiently, from the functionality of water delivery points to water consumption patterns, leaks, broken meters and regular or on-demand user feedback. In this context, digital solutions have a central role in enabling more efficient utility operations and supporting new service delivery models that reach low-income populations. Our recent report, Scaling Digital Solutions in the Water Sector, details some of the critical use cases and benefits of digital solutions in improving services.

TABLE 4

Digital water solutions previously supported by the GSMA

TECHNOLOGY	DESCRIPTION	USE CASE
Pay-as-you-go (PAYG)	PAYG services enable low-income customers to make micropayments and guarantee revenue collection for providers.	Safe Water Network provides reliable and accessible water for consumers in rural areas via "pay-as-you-drink" water ATMs and smart prepaid meters for household connections. Users can top up their prepaid meter via mobile payments and machine-to-machine connectivity means that water can be automatically dispensed without the need for manual operation.
IoT/M2M connectivity	Smart monitoring of system performance can minimise technical losses and improve operational efficiency.	eWaterPay has designed a tap that is connected to their cloud-based dashboard using M2M technology. It generates real-time data on water usage and enables remote assessment of the functioning of the taps.
Voice, SMS and USSD functions	Mobile services enable communication between providers and customers.	Wonderkid provides software solutions to 40 water utilities across Africa. Their solution allows customers to effectively communicate complaints to the utility and allows utilities to inform customers of maintenance work or send disconnection notices.
Smart metering	Smart metering can help make operations and billing more efficient.	CityTaps provides PAYG digital metering solutions to utilities. CityTaps has developed a water utility subscriber management solution that combines a smart, prepaid water meter with an integrated software management system to process payments through mobile money.

BOX 3

Catching up with our past grantees: Safe Water Network

Safe Water Network received grants in 2015 and 2017 from the GSMA to digitialise water services. The aim was to improve monitoring and logistics in water stations across Ghana and integrate mobile money payments, prepaid metering and M2M technology with MTN Ghana. Today, Safe Water Network provides services to over 400,000 people in Ghana every day.

"The GSMA has improved our customer service and user experience by allowing customers to use mobile payments. Internally, it has also helped us track transactions and improve revenue collection which are helpful for building a body of evidence to improve performance and demonstrate financial sustainability."

"Partnerships allow us to bring in new expertise, in addition to technical and financial resources. It also allows us to share and learn from experiences across the sector, and helps to leverage each other's capabilities, footprint, and consumer reach."

Charles Yeboah, Program Manager, Safe Water Network

The GSMA Innovation Fund for Digital Urban Services will aim to support the following digital water solutions:

1. **Testing business and partnership models for digital solutions to improve utility operations:** Given the challenges utilities face managing revenue and expenditure, more testing and evidence is required to strengthen the business models for providing digital tools. This includes tools that enable better customer relationships and enhance operational efficiency; smart metering and digital payment solutions that reach low-income customers and improve revenue collection; and large-scale deployments of digital monitoring tools.
2. **PAYG business models targeting low-income consumers that are not connected:** There are a few established use cases in some contexts however, innovation is still needed to develop innovative business models and partnership models to reach scale. Digital kiosks and tap models are one example of these solutions, along with smart-metering for household connections.
3. **Emerging digital solutions without well-established use cases:** More testing is needed on emerging digital solutions where the use case or business models are still early stage. For example, using unconventional datasets and big data to inform and plan service delivery, and the use of digital tools in regulating services and the informal sector.

SANITATION

According to the WHO, every $1 invested in improved sanitation generates a $5.50 social return in increased societal welfare and productivity. Yet, over half of the world's population, 4.2 billion people, do not have access to a safe toilet or latrine,[32] and only 26 per cent of human excreta is safely managed. The consequences of poor sanitation are far reaching, affecting health, wealth, education and gender equality. Urban population growth continuously outpaces gains in sanitation access. As a result, 100 million urban residents still have to practice open defecation.[33] Providing sewer access to informal settlements is proving particularly challenging given that sanitation service provision is often not a political priority and demands a high level of funding, sophisticated planning and engineering.

One of the main challenges is that, while many households already pay for sanitation services, willingness to pay does not correspond with the costs of providing safely managed services. Commercial sustainability remains a challenge for many safe sanitation providers and innovators. This is due, in part, to a combination of high investment costs, low customer willingness or ability to pay, unknown economies of scale and complex operational models.

Over the past years, we have observed that technologies and business models that either lower the operating costs of providers, or offer more affordable payment plans to households, are most likely to make a substantial contribution to the development of safely managed services. Additionally, models that incorporate digital tools may stand to benefit from the shift to more innovative finance mechanisms in the sector, such as government subsidies, sanitation levies or results-based funding.

Past GSMA grantees have demonstrated that mobile technology has a key role to play in businesses that transform faecal sludge into energy sources, such as fertiliser, black soldier flies for animal feed and briquettes. Mobile technology also provides municipalities and donors with granular data to track and coordinate sanitation services and plan for future growth.

Given the complexity of monitoring and managing waste collection from toilets associated with on-site sanitation, digitising these operations can have significant benefits. While financial sustainability is a critical challenge for these business models, technology has the capacity to enable traceability and optimise operations. Mobile payments can also reduce revenue collection costs and enable service expansion.[34]

32. WHO and UNICEF. (2017). *Progress on Drinking Water, Sanitation and Hygiene: Joint Monitoring Programme 2017 Update and SDG Baselines.*
33. World Bank. (2016). *The Costs of Meeting the 2020 Sustainable Development Goal Targets on Drinking Water, Sanitation, and Hygiene.*
34. Waldron, Sharma and Frank. (2019). *Testing the Waters: Digital Payments for Water and Sanitation.*

TABLE 5

Digital sanitation solutions previously supported by the GSMA

TECHNOLOGY	DESCRIPTION	USE CASE
Voice, SMS and USSD functions	Mobile services enable communication between providers and customers.	The container-based sanitation provider, Sanergy, has developed two mobile applications, one for customers and one for waste collectors. These applications have enabled Sanergy to improve and optimise its customer service and logistics across its operations.
IoT/M2M connectivity and GIS tracking	Smart monitoring of system performance can minimise technical losses and improve operational efficiency.	The Kampala Capital City Authority (KCCA) uses a GIS tracking system and a mobile app to connect customers to pit latrine emptying services and track service delivery, which helps ensure safe disposal and a cleaner and healthier city. KCCA receives pit emptying requests from customers through its call centre and connects them with the nearest pit emptiers.
Pay-as-you-go (PAYG)	PAYG services allow low-income customers to make micropayments and guarantee revenue collection for providers.	Loowatt, a container-based sanitation provider, has developed a mobile app to track their waste collection processes, collect payments with mobile money and communicate better with their customers.

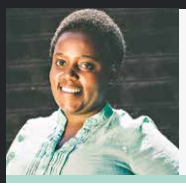
BOX 4

Catching up with our past grantees: Sanergy

In 2015, Sanergy received a grant from the GSMA to test how mobile-enabled sensors (provided by SweetSense Inc.) could optimise the waste collection process. These sensors can provide information on when a toilet is full and needs to be serviced. Sanergy tested different methods of using the sensors and measured different indicators for toilet filling, ultimately settling on one that measured the number of users. Drawing on lessons learned from the grant, Sanergy decided not to continue using the sensors in their day-to-day operations, but did however invest in two mobile apps, as well as mobile money and data collection, to connect with their network and improve their offering.

> *Working with GSMA has helped Sanergy leverage the well-developed mobile networks in Kenya to unlock innovations that have enabled the delivery and scale of safe and cost-effective sanitation services. We have developed mobile tech tools such as Formyoula, a data collection app used by our sales and research teams to collect relevant field data. Another app we have built is used by our 100-person Logistics team to monitor the safe and timely collection of sanitation waste. Running on NFC-enabled smartphones, this app empowers our team to develop schedules for waste collection, optimise routes, and track each of our daily collections. We also use USSD technology to streamline communication with all our customers – those with feature phones as well as smartphones. Our customers use it to remit their monthly payment, report maintenance issues, give feedback on our services and refer their friends interested in joining our network. All of these tools have enhanced efficiency of our operations as well.*

Sheila Kibuthu,
Senior Associate,
External Relations



SANERGY

The GSMA Innovation Fund for Digital Urban Services will aim to support the following digital sanitation solutions:

1. **Technologies that substantially lower the operating costs of sanitation providers:** Reaching financial sustainability remains a challenge for sanitation providers. Examples of digital solutions that could support providers include GIS and remote sensing; IoT technology to optimise waste collection; and digital tools that support effective customer management.

2. **Business models that integrate digital payments:** Digital payments can play an important role in these business models, as they can reduce the cost of cash collection in decentralised models, enable more affordable micropayments for services and facilitate the delivery of targeted subsidies.

3. **Potential synergies between sanitation and other core services:** Digital tools can play a key role in connecting disaggregated value chains. Sanitation and waste management may have some similarities in their value chains, particularly when it comes to circular economy use cases, where digital tools could provide similar value. We seek to explore the synergy between waste management and sanitation models related to digital tools for visibility and logistics, as well as digital payments. We will also look to explore the role of digital technology in supporting circular economy models.

4. **The use of unconventional data sets and big data to support more effective planning and regulation in the sector:** Accurate data on sanitation access and waste flows are scarce in many contexts. Innovative tools and methods that support better regulation have the potential to create a more enabling environment for safe services.

BOX 5

The role of digital solutions in addressing climate change

While the effects of climate change are felt around the world, LMICs will bear a disproportionate number of negative impacts. The challenges low-income households already face will be exacerbated. Power shortages, water scarcity, water contamination, pollution, extreme heat and poor sanitary conditions will affect the lives of those least equipped to cope with and adapt to these changes.

The new GSMA report "The Role of Digital and Mobile-Enabled Solutions in addressing Climate Change" reveals that there is a promising role for digital solutions in enabling the transition to resilient and sustainable communities. The GSMA Innovation Fund for Digital Urban Services seeks to generate more insights and evidence around the following potential pathways to climate mitigation and adaptation:

- Clean energy generation represents a significant opportunity to mitigate greenhouse gas emissions worldwide. Between 2010 and 2020, off-grid solar solutions have avoided 78 million metric tons of CO_2 emissions (equivalent to the energy produced by 20 coal-fired power plants in a single year).[35] Mobile-enabled PAYG solar has been a key catalyst for the growth of off-grid solar in LMICs over the past decade by enabling low-income households to access sustainable energy, battery storage, appliances, and clean cooking solutions. Other innovative PAYG solutions such as PAYG smart meters, can also help communities manage energy consumption. On-grid energy solutions can also benefit from digital tools, such as peer-to-peer electricity trading and smart metering, that can improve energy efficiency.

- In 2018, road travel accounted for 15 per cent of total CO_2 emissions.[36] The International Energy Agency (IEA) predicts that global transport and car ownership rates will increase by 60 per cent by 2070.[37] Digital solutions for shared e-mobility services can support the shift away from private vehicles by making these decarbonising solutions more convenient. Big data, mobile payment services, and digital platforms that offer a bundle of transport services in a single place, can help improve convenience and affordability of these services.

- It is estimated that annually, solid waste accounts for about five per cent of greenhouse gas emissions globally.[38] Landfills also lead to the release of methane, a greenhouse gas that is 34 times more potent than carbon dioxide and has a greater ability to trap heat in the atmosphere.[39] Effective waste management is also important for climate resilience, particularly in mitigating flood risks and water contamination due to waste accumulation. Digital solutions can unlock more effective processes across the waste management value chain, creating more efficient and cost-effective services.

- Digital solutions can enable the development of new innovative business models that make sanitation systems more accessible and efficient. Circular economy models, which are increasingly prevalent in the sanitation and waste management sectors, also present a viable opportunity to mitigate global emissions by as much as 40 per cent by 2050.[40] GIS and tracking tools can support circular economy models that reduce pollution and waste in cities while also making faecal sludge management more efficient.

- If nothing is done to improve water resource management, climate change will have disastrous impact on water security, with a predicted 4.8 billion people and approximately half of global grain production at risk of water stress by 2050.[41] IoT and smart metering solutions can improve efficiency of water systems and reduce water waste, unlock new business models that reduce infrastructure problems and enable system optimisation and operational efficiencies.

35. GOGLA. (2020). *Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data*.
36. International Energy Agency. (2018). *IEA Data Services*.
37. International Energy Agency. (2020). *Energy Technology Perspectives*.
38. World Bank. (2018). *What a Waste 2.0 : A Global Snapshot of Solid Waste Management to 2050*.
39. Global Methane Initiative. (2011). *Landfill Methane: Reducing Emissions, Advancing Recovery and Use Opportunities*.
40. Ellen MacArthur Foundation. (2019). *Completing the Picture: How the Circular Economy Tackles Climate Change*.
41. International Food Policy and Research Institute and Veolia. (2011). *The world's freshwater supply is in demand—and under threat*.

4 Building on the impact of past Digital Utilities Innovation Fund Rounds

Since 2012 the Digital Utilities programme (formerly known as GSMA Mobile for Development Utilities programme) has been working with FCDO to catalyse innovative service delivery models across the energy, sanitation and water sectors. The Digital Utilities programme enables digital solutions and partnerships between innovators, mobile operators, city governments and state-owned utility service providers to make essential utility services more accessible, reliable, sustainable and affordable. The upcoming GSMA Innovation Fund for Digital Urban Services builds in part on the impact and insights from the past eight years of Digital Utilities Innovation Funds and broader programme research and market engagement.

The previous Digital Utilities Innovation Fund rounds have supported 50 organisations with a total of £9.4 million in grant funding, benefitting over 6.5 million people. This has catalysed some of the most promising innovations for improving access to essential life services, and enabled an evolution of digital solutions across sectors. Paired with grant funding, we've provided technical assistance and synthesized key evidence and insights to support the broader industry, drive follow-on funding, and foster more partnerships for the expansion of these solutions.

The programme initially funded some of the first mobile-enabled, PAYG SHS companies — M-KOPA, Fenix, Mobisol and PEG — pioneers in what is now a fast-growing industry delivering energy to the underserved. In 2019, a total of 2.19 million PAYG solar units were sold globally, up from two million in 2018.[42] The model's use of mobile payments, and locking technology, often through GSM modules that also enable remote monitoring and maintenance, has been a key driver for a range of off-grid energy models.

The PAYG solar model has also demonstrated commercial benefits for mobile operators, as captured in the GSMA report, *The Value of Pay-as-you-go Solar for Mobile Operators*, the first multi-country analysis to quantify this. In every country, we observed a substantial increase in the frequency of mobile money transactions right after clients started using PAYG solar services. Additionally, data from multiple mobile operators shows that the increase in mobile money transactions goes beyond payments for just solar energy, and is also reflected across other payment types such as peer-to-peer transactions. This may suggest similar utility models carry similar benefits for mobile operators.

The clear synergy driving mobile-enabled PAYG solar motivated the Digital Utilities Innovation Funding to support the expansion of this model, and the evolution of this model to other services. The programme provided early funding to other pioneers such as SunCulture, providing PAYG solar irrigation, KOPAGAS (now owned by Circle Gas), providing PAYG LPG cooking gas, and CityTaps, providing PAYG smart metering for household water connections.

Beyond mobile payments in PAYG models, the programme has demonstrated the key role of digital tools for optimising the operations of centralized and decentralized essential services. It has supported smart-metering and network monitoring for urban energy grids and rural mini-grids. For decentralized models of sanitation, programme grants have supported cost-saving mobile tools to facilitate complex logistics of faecal sludge collection, transportation and treatment to coordinate between low-income households, entrepreneurs and governments. Additionally, digital monitoring tools combined with mobile payments have proved powerful for improving community water services through kiosk and handpump models, and making household connections affordable and reliable.

The role of Digital Utilities in this evolution of solutions is captured in the timeline below, followed by the impact of this work and a full list of programme grantees and the years of grant support. For more insights from these grants and broader industry research, please see the resources on our website.

42. GOGLA. (2019). *Global Off-grid Solar Market Report*.

Digital Utilities programme timeline

2012–2014

CATALYSING PAYG SOLAR PARTNERSHIPS AND EXPLORING DIGITAL WATER SOLUTIONS

- Launched the first round of the Digital Utilities Innovation Fund to provide £2.6 million to 13 organisations.
- Tested the use of digital tools for manual/automated service monitoring in the water sector.
- Catalysed some of the PAYG solar pioneers (M-KOPA, PEG, and Fenix - now ENGIE Energy Access).

2015–2017

SCALING AND REPLICATING PAYG ACROSS NEW MARKETS AND BUSINESS MODELS

- Developed the Instant Payment Notification (IPN) Hub, an industry tool to support utility providers with real-time notification of payments, with additional support from the Mastercard Foundation, and piloted it in Rwanda.
- Awarded first grant to a PAYG service provider in the water (CityTaps) and clean cooking sectors (Circle Gas).
- Launched expanded Digital Utilities Innovation Fund portfolio that also included sanitation with £3.4 million awarded to 21 organisations.

2017–2020

TRIALING FURTHER VARIATIONS ON PAYG MODELS AND DIGITAL UTILITY SOLUTIONS ACROSS SECTORS TO BUILD TOWARD SCALE

- Re-launched the Digital Utilities Innovation Fund to award £3.3 million to 19 organisations with additional funding from the USAID Scaling Off-Grid Energy (SOGE), Grand Challenge for Development.
- IPN hub processed notifications for over three million unique payments in five markets. In 2019 the IPN Hub was transitioned to Beyonic Inc.
- Provided additional support to start-ups working with water utilities, which allowed them to scale through regional expansion.
- PAYG solar and PAYG cooking grantees reach scale and achieve acquisitions.

HOW THE DIGITAL UTILITIES INNOVATION FUND HAS CROWDED-IN FOLLOW-ON FUNDING

The Digital Utilities Innovation Fund has provided support to innovations that are particularly impactful and scalable, and thus well positioned to attract follow-on funding. These innovations are often "market-creating" in that they transform complicated and expensive products or services into ones that are more affordable and accessible, allowing many more people to buy and use them.[43]

For instance, our programme's early support for off-grid solar providers that pioneered PAYG technology helped make a previously unaffordable product (SHS) accessible to low-income communities through an innovative lease-to-own model. The PAYG business model and technology has been a core feature of the energy start-ups supported by our programme, which have collectively raised over £309 million in follow-on funding after their Digital Utilities Innovation Fund grant. The off-grid energy sector has also been able to attract significant amounts of debt and equity financing from development finance institutions (DFIs) and venture capital providers. Collectively, the off-grid solar sector attracted $312 million in investments in 2019. Most went to PAYG companies, and some have even been able to exit via acquisitions by strategic investors, for example, ENGIE's acquisitions of Fenix and Mobisol.

Given the financing constraints of governments in LMICs, crowding in financing might be even more important in the water and sanitation sectors. According to a World Bank report, achieving SDG 6 will require $114 billion in investment a year until 2030.[44] The amount of follow-on funding raised by our 12 water grantees and six sanitation grantees (£14 million) is smaller in comparison to the funding raised in the energy sector, where innovations, strategic partnerships and product design are significantly more mature. However, some examples from our portfolio highlight that it is possible to make pro-poor innovations in the water sector commercially viable and attractive to investors. For example, CityTaps has attracted significant investment following its pilot with the Société d'Exploitation des Eaux du Niger (SEEN) and Orange Niger, which was supported by two Digital Utilities Innovation Fund grants. Based on the success of its partnership in Niger, CityTaps has received $500,000 from the Global Innovation Fund and raised £1.8 million from several impact investors. CityTaps has also secured £860,000 from various grants to begin projects that will test the PAYG leasing model, including in Mali with Société Malienne de Gestion de l'Eau Potable (SOMAGEP) and in Kenya with Malindi Water & Sewerage Company (MAWASCO).

The clean cooking sector has a similarly acute investment gap, which makes crowding in commercial finance imperative for grant financing. According to Sustainable Energy for All, an estimated $4 billion in annual investment is needed to achieve the SDG 7 target for universal access to clean cooking fuel and technology by 2030. However, in 20 countries with some of the world's widest access gaps for clean cooking, only a cumulative $32 million was invested in clean cooking solutions in 2017. In 2015, the GSMA Digital Utilities programme awarded KOPAGAS (now owned by Circle Gas) a grant to design a low-cost meter for Liquefied Petroleum Gas (LPG) cylinders and test a PAYG cooking service in Tanzania. Following a successful pilot, KOPAGAS received another grant from the Digital Utilities Innovation Fund in 2018 to expand its service. By placing digital solutions at the core of their business, the company has efficiently targeted the right customers, achieved high customer satisfaction and excellent market traction, making it an attractive target for strategic investors. In January 2020, Circle Gas Limited acquired KOPAGAS's technology in a transaction worth $25 million. The acquisition, thought to be the largest-ever private equity investments in the clean cooking technology sector, gives Circle Gas access to KOPAGAS's trademarked PAYG LPG technology. The investment will accelerate the scale-up of smart metered LPG and expand their existing business in Tanzania and Kenya in 2020. The project in Kenya will be supported by Safaricom, Kenya's leading mobile operator. Safaricom is also an investor in Circle Gas, which will run the PAYG LPG business in Nairobi through its Kenyan subsidiary, M-Gas.

Despite these achievements, significant funding gaps remain across sectors, and in certain geographies, particularly low-income countries. Crowding in additional funding will continue to be a key objective for the upcoming GSMA Innovation Fund for Digital Urban Services.

43. Christensen, Ojomo, and Dillon. (2019). *The Prosperity Paradox: How Innovation Can Lift Nations Out of Poverty.*
44. World Bank. (2016). *The Costs of Meeting the 2030 Sustainable Development Goal Targets on Drinking Water, Sanitation, and Hygiene.*

FIGURE 3

The most common follow-on investors in Digital Utilities grantees:

DIGITAL UTILITIES PROGRAMME IMPACT 2012-2021

The Digital Utilities Innovation fund

HAS AWARDED

£9.4 million to **50** grantees

OVER

6.5 million

PEOPLE HAVE BENEFITTED FROM THE WORK OF THESE GRANTEES.

MORE THAN

£309 million

HAS BEEN RAISED BY GRANTEES IN FOLLOW-ON FUNDING OR INVESTMENT:

£14 million

HAS BEEN RAISED BY SDG6 GRANTEES

£295 million

HAS BEEN RAISED BY SDG7 GRANTEES

The Digital Utilities programme

THE DIGITAL UTILITIES PROGRAMME HAS CREATED

a pipeline of valuable, innovative partnerships.

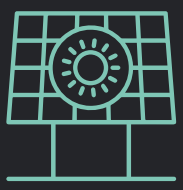
48 direct partnerships

WITH MOBILE OPERATORS HAVE BEEN ESTABLISHED WITH THE SUPPORT OF OUR PROGRAMME.

THE PROGRAMME HAS SUPPORTED THE

evolution of PAYG, remote monitoring and other digital tools for essential services,

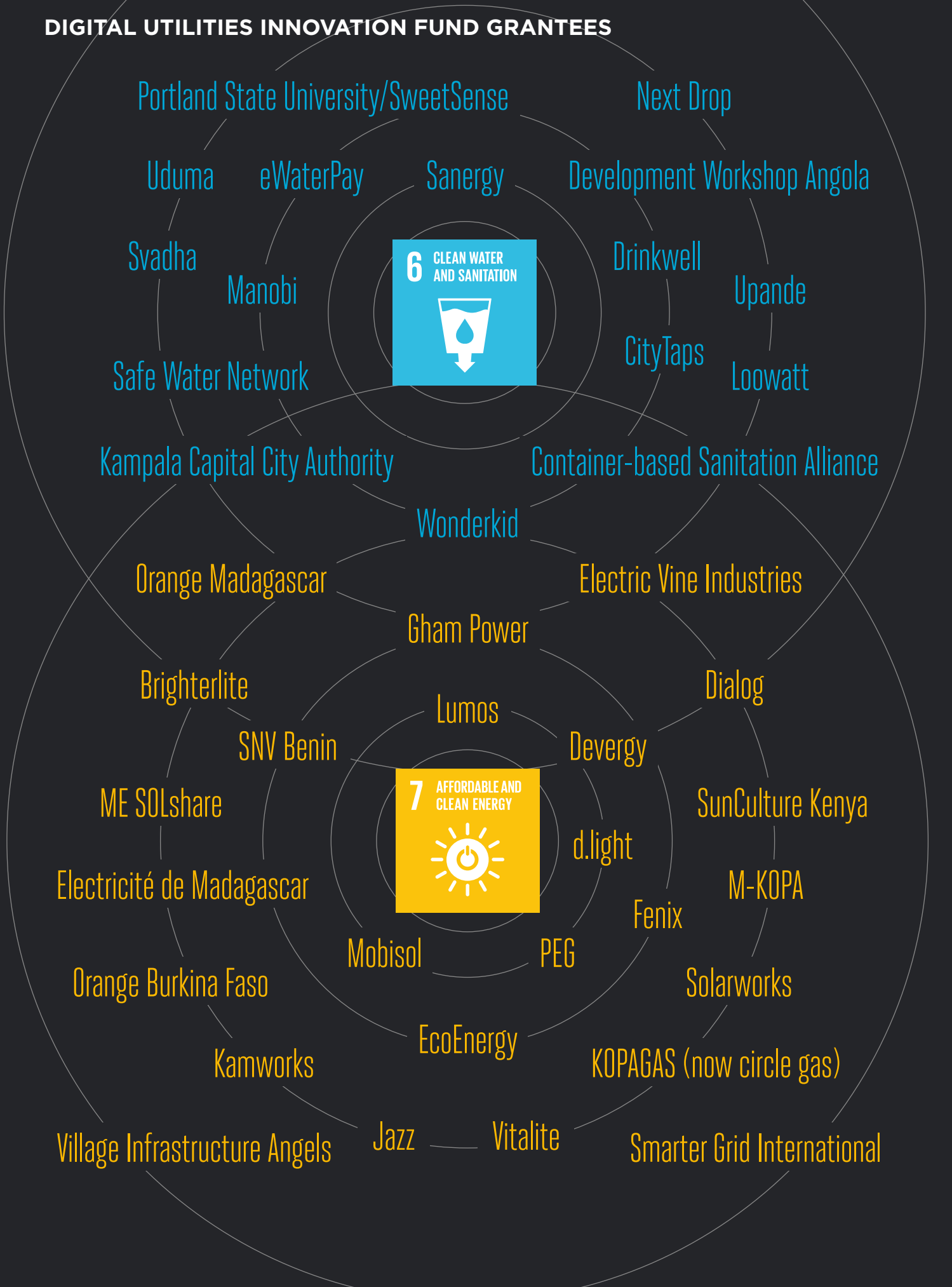
BOTH ON-GRID AND OFF-GRID.



A WIDE RANGE OF DIGITAL UTILITY SOLUTIONS THAT TACKLE THE CHALLENGES OF RAPIDLY GROWING CITIES HAVE DEMONSTRATED THEIR IMPORTANCE FOR

improving lives and achieving the SDGs.

DIGITAL UTILITIES INNOVATION FUND GRANTEES



5 Looking ahead

Digital solutions have demonstrated their value for improving urban services in some LMICs. However, more innovation is needed to develop business models that can be deployed on a wide scale and account for the financial constraints of utilities and municipalities, as well the needs of low-income customers. More work is needed to forge partnerships in new markets and apply digital technologies in new contexts (for example, secondary cities). For more established technologies, further evidence is needed to support the commercial case for adoption, both for utilities as well as prospective investors. The table below summarises some of the key things we hope to learn through this Fund.

To test and scale these solutions, we look forward to supporting innovators to work with mobile operators, government and other key partners to advance the partnerships and business models needed. Our catalytic funding and direct support of these innovators will enhance our broader activities to drive impact. This includes sharing key evidence and insights from the grants and other research with the broader sector, and facilitating more dialogue and cooperation between public and private sector stakeholders engaged in urban service provision. Although the past work of GSMA, and others, has demonstrated great potential for digital urban services, it's clear that there is still tremendous need for scale and further innovation, alongside untapped potential collaboration between innovators, mobile operators and governments.

Find out more about the GSMA Innovation Fund for Digital Urban Services here.

TABLE 6

Learning agendas benefiting from Innovation Fund insights

	TEST THE ROLE OF DIGITAL SOLUTIONS IN:
PLASTIC AND WASTE MANAGEMENT	• Optimising collection logistics; • Enabling circular economy solutions; • Providing greater transparency and traceability; • Deploying payment solutions to formalise models and protect low-income consumers; and • Reducing plastic pollution through upstream innovation.
ENERGY	• Replicating/scaling clean cooking models; • Testing/scaling generation/storage solutions to replace diesel generators across urban MSMEs; and • Trialling e-mobility models that reach the underserved.
WATER	• Providing water to low-income households through PAYG models (for both water connections and water ATMs); and • Improving utility performance through partnerships with digital innovators.
SANITATION	• Optimising and scaling decentralized sanitation services with digital tools to support new financial models, improved accountability and stronger public private partnerships.

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