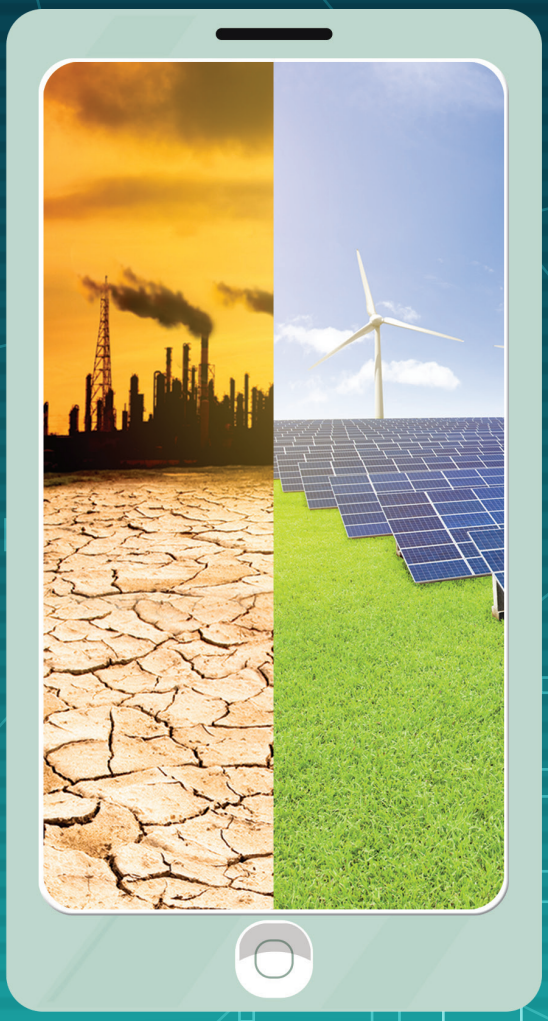
TECHNOLOGY FOR CLIMATE ACTION IN LATIN AMERICA AND THE CARIBBEAN



How ICT and Mobile Solutions Contribute to a Sustainable, Low-Carbon Future

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Foreword (GSMA)

The mobile industry is fully committed to contributing to a sustainable future. In 2016, the sector became the first to support—as a group—the United Nations Sustainable Development Goals (SDGs). Indeed, mobile operators and players across the ecosystem are delivering a vast range of programs and initiatives that contribute to the achievement of the SDGs, including helping to combat climate change and its impacts.

In fact, the recently published report, *2017 Mobile Industry Impact Report: Sustainable Development Goals*, established that in 2016, the mobile industry had increased its impact across all 17 SDGs. The greatest improvements were in Goal 3 (Good Health and Well-Being), Goal 11 (Sustainable Cities and Communities) and, more importantly, in Goal 13 (Climate Action). Goal 13 is one of the SDGs to which operators are making the strongest contribution.

Mobile operators play an increasingly important role in building resilience to climate-related and natural disasters by way of early warning systems and emergency communication and broadcasting. The use of Big Data also is able to provide critical information to track population movements before and during emergencies, thus enabling governments to better focus disaster planning and relief strategies.

While still in the early stages of development, Internet of Things solutions are beginning to reflect an impact on Goal 13. As such, governments are now able to collect data that are critical to the adaptation to and management of climate

change; for example, by providing real-time climate and weather information, as well as early warning systems.

Other smart apps in areas such as energy, transportation, buildings, manufacturing, and agriculture are able to assist in tackling climate change. Innovations in smart logistics, for instance, can contribute to more efficient traffic flows, easing congestion and avoiding the need for new transport infrastructure. Smart metering and smart grids can reduce household and business energy consumption while increasing energy efficiency and reducing carbon emissions.

To ensure a better environment for the region's citizens, operators across Latin America and the Caribbean are creating initiatives to address the impacts of climate change. These range from the delivery of smart metering solutions to manage water networks in Chile, to providing apps for farmers to make climate-smart decisions in Colombia and Honduras, to managing e-waste in Mexico.

Addressing climate change is one of the most urgent concerns that faces everyone today. It is one that cannot be ignored, since we have only one planet. This report provides valuable insight into the role of information and communication technology, as well as mobile solutions, in tackling the environmental agenda. I hope it inspires you to consider joining us in this most foremost struggle.

Mats Granryd
Director General
GSMA

Foreword (South Pole)

Information and communication technology (ICT), in its various forms, will prove to be a true catalyst of the low-carbon revolution in the twenty-first century. Within the next decade, it is expected that ICT will reduce our global carbon emissions by up to 20 percent, paving the way for companies and consumers alike to make more intelligent use of the world's resources. This is good news for our climate, our industries and our economies.

In 2015, global consensus on the severity of climate change found expression in international support for the Paris Agreement. By the end of 2017, every Latin American country had signed this landmark climate accord. Today, the challenge is to achieve its core goals; to limit global warming to below 2 degrees Celsius and to deliver on the ambitious Sustainable Development Goals.

ICT can—and will—contribute by providing advantages across the triple bottom line: from reducing emissions, to driving additional cost savings and generating revenues and wider societal benefits. The ability of ICT to deliver will depend on its smart application in the field of energy efficiency in the transport, energy, agriculture, and real estate sectors, among others. The increased information flow made possible by ICT solutions will reveal the hidden impacts and emissions, further optimizing existing systems.

In a world where resources are scarce, new technology will be able to help preserve ecosystems (e.g., smart meters to save water, real-time meteorological information

to secure agricultural yields, and Global Positioning System technology to track deforestation and biodiversity loss).

The transition to smart cities through integrated ICT infrastructure will result in the creation of better systems to deliver energy and water, and improve transport facilities. This will represent a major improvement for 80 percent of Latin America's population already today living in Latin America's cities.

ICT and mobile solutions are in the process of addressing the challenges of climate mitigation and adaptation. In light of the increasingly intense natural disasters resulting from climate change, advanced sensoring technologies and better access to information have improved weather predictions and alarm systems; enhanced the coordination of emergency services in response to disasters; improved the efficiency and effectiveness of disaster relief measures; and, ultimately, saved human lives. In a region that continues to rely heavily on agriculture, climate smart agriculture solutions have enabled Latin American and Caribbean farmers to make better informed decisions. The high and steadily increasing subscription rates to such services are driving real and meaningful changes in the field of climate-resilient agriculture.

As business paradigms change, the issues of climate change and resource efficiency also become increasingly relevant to the ICT industry itself. There is evidence of strong investment in new and upgraded infrastructure, further contributing to the decrease of emissions per byte. Data centers are becoming smart and are applying such technologies as ambient cooling to reduce energy consumption. The opening of Latin American energy markets offers exciting opportunities to source the remaining energy from renewable sources—a win-win situation that benefits commerce and climate alike.

Forward-thinking companies that integrate such areas as fossil fuels, emission reductions, renewable energy and alignment with the Sustainable Developoment Goals into their business planning will benefit from lower risks, increased savings, and stronger brand value. This also applies to those firms that develop solutions for other sectors in collaboration with the public sector, other industries, and civil society organizations. This is the way to make headway.

Renat Heuberger
CEO
South Pole

Foreword
(Inter-American Development Bank)

Countries in the Latin American and Caribbean region are particularly vulnerable to the impacts of climate change. By 2050, rising sea levels, increasing temperatures, and changes in rainfall patterns could result in an estimated annual cost of 2–4 percent of the region's gross domestic product.

To prevent these effects from occurring, entrepreneurs are working collaboratively with policymakers, financial institutions, and civil society organizations to leverage the use of new digital technologies. Thanks to this endeavor, it is now feasible to design more efficient transport networks, provide more resilient infrastructure, improve resource management, implement smart energy grids, and enable precision agriculture.

The new era of connected devices (Internet of Things) brings about an up-to-date set of solutions that are based on the use of sensors to collect real-time information. Such a wealth of data can be processed and analyzed through the use of artificial intelligence, offering policymakers, financial institutions, and firms an entire set of new tools to manage the impacts of climate change on their operations and to reduce the generation of greenhouse gas emissions as a result of their production processes.

Unless there is connectivity to networks and services that are of high quality, however, this scenario will not eventuate. Sadly, there is a lag in the transformation process in Latin American and Caribbean countries, on average. Severe challenges

in terms of infrastructure availability remain, and there is little access to reliable and affordable connectivity services and digital technologies. Such inadequacies are especially acute in rural areas where the population is far more vulnerable to the effects of climate change.

The Inter-American Development Bank is strongly committed to assisting countries in their search to resolve such issues. It aims to encourage the deployment of the infrastructure necessary to enable the development of robust digital ecosystems. In this way, it expects not only to help fight climate change but also to overcome the many other challenges that countries continue to face.

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Christina is a Consultant with South Pole, working on the implementation of projects with a focus on cities and sustainable supply chains. She has been involved in the preparation and implementation of monitoring frameworks for sustainable firewood and water risks in agricultural supply chains and on several projects translating climate smart agriculture solutions into practice. Prior to joining South Pole, Christina gained valuable experience in the cleantech sector, focusing on technology adoption, during a stay at the Netherlands Consulate-General in Toronto. She also was a member of the Contaminated Site Management team of a major environmental consultancy in the Netherlands. She holds a MSc in Environmental Sciences from Wageningen University, the Netherllands, specializing in environmental technology, with a minor in management of contaminated land.

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Introduction

About the Inter-American Development Bank

The aim of the Inter-American Development Bank (IDB) is to improve lives in Latin America and the Caribbean. Through financial and technical support, it help improve health and education, as well as advance infrastructure in those countries that are working to reduce poverty and inequality. Its objective is to achieve development in a sustainable, climate-friendly manner. With a history that dates back to 1959, the IDB is now the leading source of development finance for Latin America and the Caribbean. It not only provides loans, grants, and technical assistance; it also conducts extensive research. The IDB maintains a strong commitment to the achievement of measurable results and the highest standards of increased integrity, transparency, and accountability.

The IDB´s current focus areas include three development challenges: social inclusion and inequality; productivity and innovation; and economic integration. It also incorporates three cross-cutting issues: gender equality and diversity; climate change and environmental sustainability; and institutional capacity and the rule of law. Further information on the IDB's current institutional strategy can be accessed at www.iadb.org.

About GSMA

The GSMA represents the interests of mobile operators worldwide, uniting nearly 800 operators with more than 300 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 industry-leading events such as Mobile World Congress, Mobile World Congress Shanghai, Mobile World Congress Americas and the Mobile 360 Series of conferences.

For more information, please visit the GSMA corporate website at www.gsma.com. Follow the GSMA on Twitter: @GSMA.

About South Pole

South Pole is a global sustainability solutions provider. South Pole works with clients in the public and private space to build solutions for a sustainable society and economy. South Pole's vision is to positively impact our climate, ecosystems, and communities. South Pole's team of over 200 experts in 13 global offices focus on key sustainability topics such as climate change, renewable energy, water, and forests and land use, as well as sustainable cities and buildings.

For more information, please visit South Pole's website at www.southpole.com. Follow South Pole on Twitter @southpoleglobal.

Abbreviations

°C	degree Celsius
App	application
BAU	business as usual
CCFLA	Cities Climate Finance Leadership Association
CO_2	carbon dioxide
CO_2eq	carbon dioxide equivalent
COP	Conference of the Parties
e-waste	electronic waste
EEE	electric and electronic equipment
EPR	extended producer responsibility
GHG	greenhouse gas
GHGP	Greenhouse Gas Protocol
GPS	Global Positioning System
GRI	Global Reporting Initiative
ICT	information and communication technology
IDB	Inter-American Development Bank
IoT	Internet of Things
ITU	International Telecommunications Union
kg	kilogram
kt	kiloton
LAC	Latin America and the Caribbean
M2M	machine to machine
NDC	nationally determined contribution
NGO	nongovernmental organization
RE100	100 percent renewable energy
REC	renewable energy certificate

SBT	Science-Based Target
SDG	Sustainable Development Goal
t	ton
UN	United Nations
UNU	United Nations University
UNFCCC	United Nations Framework Convention on Climate Change

Executive Summary

Climate Change and Its Relevance for Countries in Latin America and the Caribbean

Climate change is a global issue that is in evidence at the local level. Research shows that countries in the Latin America and the Caribbean (LAC) region will face severe challenges as a result of changing precipitation patterns and increasing extreme weather events while, at the same time, having limited resources and knowledge to be able to adapt to such impacts. Climate change affects the lives of people in this region, and will do more so within the next few decades. Projected increases in extreme events, such as flash floods and hurricanes, also will affect the information and communication technology (ICT) sector and its infrastructure within the region.

The Role of ICT and Mobile Solutions in Addressing Climate Change and Protecting the Environment

ICT will prove to be the true catalyst of the low-carbon revolution in the twenty-first century. Within the next decade, ICT will contribute to slashing up to 20 percent of the world's carbon emissions in ways that will enable companies and consumers to use and save energy more intelligently. Within a fluid and ever-changing ecosystem, ICT and mobile technologies affect nearly every industry sector, providing solutions that are innovative, personalized, and efficient. This digital revolution also will form the basis of a collaborative and sustainable global economy, in line with the United Nations Sustainable Development Goals. Harnessing the potential

to develop new products, services, and business models that will contribute to a low-carbon economy will require, nevertheless, the active engagement of the ICT industry and the public and private sectors.

The ICT industry not only enables climate-friendly solutions for the greening of other sectors; it also tackles its own ecological footprint. Mobile operators are setting goals to exploit their share of renewable energy within the next few years as they focus on initiatives to reduce energy consumption and contribute to environmental protection initiatives, such as campaigns to reduce deforestation and the development of services to protect wildlife. To connect all Latin Americans and Caribbeans to a fourth industrial revolution—the digital revolution—while effectively decoupling economic growth from that of emissions will be the industry's principal goal.

Leveraging Big Data and the Internet of Things to Resolve Climate Change and Other Environmental Issues

Big Data and the Internet of Things (IoT) have the potential to be the drivers for climate change solutions. Their application will assist the transport, manufacturing, agriculture, building, and energy sectors, to name a few, in reducing their greenhouse gas (GHG) emissions and increasing the efficient use of resources while protecting the environment. While there are many provisions in the LAC region that make cities more connected, sustainable, and livable, they also focus on rural areas with a view to more efficient agricultural supply chains and wildlife protection.

An estimated 70 percent of global GHG emissions are associated with cities. In Latin America, 80 percent of the population lives in cities, making it one of the most urbanized regions in the world. The cities are spearheading the application of ICT and mobile solutions to fight climate change, given that they are struggling to provide services to the growing number of people who need access to clean air, water, transportation, electricity, waste management, and sanitation. Climate change is exacerbating the issues as cities from Medellín (Colombia) to Buenos Aires (Argentina) to Curitiba (Brazil) seek smart solutions. Such solutions, particularly those of IoT, remain largely untapped.

From an economic, environmental, and social perspective, reducing as soon as possible rather than increasing emissions—at the same time, improving access to services—is in the interest of all cities. There are many opportunities for climate

change action in cities; these can be separated into four main groups: (i) decarbonization of the electricity grid, (ii) optimization of energy efficiency in buildings, (iii) next generation mobility, and (iv) better waste management. ICT and mobile solutions are essential in these areas. Their application is promoted by mobile operators and they range from smart water metering, real-time monitoring of air pollution, and optimization of transport systems to the application of smart grids and the efficient integration of renewable energy sources in existing networks.

A Sustainable Approach to e-Waste Management

Electronic waste (e-waste) generated in Latin America in 2017 amounted to an estimated 4,400 kilotons (kt), and it is expected to grow annually by 10 percent until 2020. Approximately 9 percent of total global e-waste (about 46,000 kt in 2017) is generated in Latin America. The regional ICT industry is taking measures to ensure a sustainable production of devices and network infrastructure, as well a move to prevent negative impacts on the environment as a result of the disposal of e-products. Recycling and reusage decrease the demand on energy, thus resulting in reduced GHG emissions, given that there is less e-waste going to landfills.

In 2017, from a total of 4,400 kt of e-waste in Latin America, an estimated 46 kt was directly associated to mobile phones. The uptake of mobile phones continues to rise as they have become ubiquitous, yet they represent only 1 percent of total e-waste generated in the region.

The average amount of e-waste per capita in Latin American countries in 2017 is estimated at 6 kilograms (kg). This amount is in the range of the global average of 7 kg per capita, far less than in other regions, such as Europe or Oceania where e-waste is in the range of 17 kg per capita. Nevertheless, LAC governments should improve recycling and reuse incentives for electric and electronic equipment. To move even further toward a circular economy, it is essential for LAC countries to implement additional policies directed at the ICT sector, an example of which is the extended producer responsibility approach.

Strategies for the ICT Sector to Become a Climate Leader

The ICT sector should take the necessary steps to become a climate leader. The effects from ICT-based opportunities will only materialize when the sector and

its players put time and effort into moving in this direction. The key topics at the boardroom, research and development, and marketing levels should include sustainability and the mitigation of climate change, a practice that is not yet commonplace. The gains of active, corporate engagement are threefold: new business, effective risk mitigation, and assured legitimacy.

From a climate change perspective of the ICT landscape, smart companies should keep abreast of economic trends that point to an acceleration in the growth of renewable energy sources. This also applies to the potential benefits to business and society from the embracement of sustainability.

For the ICT industry to take action, it first must comprehend the environmental impacts and risks associated with its operations, as well as the potential to become private sector leaders with regard to Goal 13 of the Sustainable Development Goals (climate action). Corporations will then be able to set their own environmental targets, as well as comply with those of the industry, in their efforts to develop sound climate strategies and associated roadmaps. The following step should be a plan to action, reflecting the most time-consuming phase on the journey toward climate leadership. Areas where the ICT sector can take action include digital infrastructure, energy efficiency, and renewable energy, as well as the enabling of clients to support a low-carbon economy by, for example, making the default option climate friendly.

How the Digital Industry Can Reach its Full Potential to Address Climate Change

A strong commitment to energy efficiency and renewable energy is the way forward for the digital industry to align itself with the Paris Agreement and to maintain global warming well below 2 degrees Celsius (°C). The ICT sector, moreover, should build on existing and future collaboration with clean technology startups, the public sector, civil society, and academia to develop new digital and mobile solutions in relation to climate change.

ICT companies have the potential to become the problem solvers and thought leaders of smart and sustainable solutions. In a reach toward millions of people in the LAC region and beyond, they are ideally placed to nudge the world economy toward a more sustainable future. A first step for the digital industry is to ask “How can the industry leverage smart climate solutions to ensure the fulfillment of its mission? How can the industry ensure resiliency at 2°C?”

Overview of Climate Change and Sustainable Development, and Their Context in the ICT Industry

This section provides an overview of climate change in the LAC region and its relevant policies and impacts on a global as well as regional level. Since climate change is a cross-cutting topic and is strongly intertwined with sustainable development, a specific section is dedicated to the Sustainable Development Goals (SDG). Both dimensions are put into the context of the ICT industry, with an initial overview of the industry's efforts and the cross-industrial potential to achieve the targets of the SDGs and the Paris Agreement.

1.1 Global Consensus and the Call to Action

Over the past decades, greenhouse gas (GHG) emissions have been rising exponentially. Human-induced climate change, according to the Intergovernmental Panel on Climate Change, is a 99 percent probability. Given its complexity and the global debate, so too will be the impact on the various regions and communities on our planet.

Global consensus on the severity of the issue was achieved, leading to the creation of the Paris Agreement during the 21st session of the Conference of the Parties (COP21) in 2015 under the United Nations (UN) Framework Convention on Climate Change (UNFCCC), as well as its ratification within the subsequent year. The accord aims to limit global warming to well below the 2 degrees Celsius (°C) mark—ideally below 1.5°C—compared to pre-industrial levels. By the end of 2017, all LAC countries had become signatories to the Paris Agreement, with Nicaragua the last to do so in October 2017, having held back on the grounds that the agreement was insufficiently strong and unambitious. At the same time, the process for

ratification was significantly advanced, with only Colombia, Suriname, and Trinidad and Tobago yet to come forward (UNFCCC, 2018).

The objective of the Paris Agreement is to hold nations accountable, whereby their responsibility must be shared with subnational and nonstate actors. The measures under the agreement to limit global GHG emissions are referred to as nationally determined contributions (NDC). Each country determines its own GHG emission reduction target, and reports it to the UNFCCC, with objectives increasing every five years. LAC countries, in large part, have ratified the agreement and established their respective NDCs. Despite this groundbreaking development, the most recent NDCs fall short of achieving the goal under the Paris Agreement. In short, a more earnest ambition is required.

While the targets are determined at the national level, implementation, policies, initiatives, and projects are increasingly observed at the regional, urban, and nonstate levels. Many initiatives at the subnational level have been launched in the wake of the Paris Agreement, and there is a commitment at the city level of each country to achieve its climate target. The private sector also is doing its fair share by committing to science-based targets (SBT), the principles for responsible investing, the Task Force on Climate-Related Financial Disclosures, and the 100 percent renewable power initiative (RE100), among many others. It is evident, therefore, that there is a clear move toward a low-carbon economy that is driven by actors across continents, sectors, and jurisdictions. The ICT and mobile sectors, for example, are taking initiative by reducing their own carbon footprint and, more importantly, enabling other sectors to do so.

ICT and mobile-based solutions, such as distributed ledger technology (also known as blockchain technology), are able to strengthen governance mechanisms and enable urgently needed transparency under the Paris Agreement. They can do so by influencing an essential part of the equation; that is, enabling trust and decentralizing collaboration in their drive toward renewable energy and energy efficiency project implementation. The International Emissions Trading Association has launched a project that focuses on applying market instruments in some countries in Latin America and the Caribbean (Puhl, 2017).

To simultaneously achieve GHG emission reductions and economic growth, it is essential to shift toward a low-carbon economy by decoupling both, given the now available low-carbon technologies and smart use of natural resources and energy. At an international level, the 2030 Agenda for Sustainable Development—specifically

Box 1

What Is the Meaning of Climate Resilience? What Target Must the Latin American and Caribbean Region Achieve?

"To be resilient means people and their economies need to have three things:

1. to be able to understand and anticipate climate risks and hazards (both extreme events such as hurricanes and changes such as hotter temperatures and sea level rise);
2. to be able to absorb and cope with the impact of shocks and stresses when they occur; and,
3. in the long term a transformation of development and what they do to reduce these risks."

Source: UNFCCC (2017).

the SDGs adopted in 2015—is steering public and private sector initiatives. ICT and mobile solutions can contribute to a low-carbon future for the LAC region. This report underlines the way in which this can be done; that is, by showcasing examples while taking into account future developments.

1.2 The Latin American and Caribbean Regulatory Context

From a global viewpoint, LAC accounts for approximately 3.9 gigatons (12 percent) of the 47 gigatons of global GHG emissions between 1990 and 2014 (WRI, 2017). Within LAC, Mexico and Brazil are among the top 10 GHG emitters (Ibid.). Achieving the targets set by the Paris Agreement, therefore, is critical. LAC countries each have submitted their NDCs, demonstrating their intention to play their part in a timely manner. The Paris Agreement itself was ratified in record time, entering into force on November 4, 2016. Nearly all countries in the region have set their GHG reduction targets in one way or another (Figure 1).

GHG reduction targets determine the amount of carbon dioxide (CO_2) a country is permitted to emit, based on a comparative historical level within a certain period. Mexico, for example, has committed to reducing GHG emissions by 25 percent by 2030 in comparison to its business as usual (BAU) scenario. Mexico's BAU scenario is based on the increase of emissions that relate to economic growth in the absence of climate change policies since 2013, which is when the country's General Law on Climate Change came into force. Brazil aims to reduce its emissions by 37 percent below its 2005 levels by 2025 (WRI, 2017). In addition, as countries

FIGURE 1: TYPE OF TARGET, BASED ON NATIONALLY DETERMINED CONTRIBUTIONS, LATIN AMERICA AND THE CARIBBEAN

Source: WRI (2017), accessed November 25,.2017.

determine the mechanisms necessary to reach NDC targets, Mexico announced in 2017 that it will create a mandatory pilot carbon market in August 2018, with full rollout in 2021. Argentina, conversely, has set an absolute emissions reduction target, limiting emissions to 483 metric tons of CO_2 equivalent (CO_2eq) by 2030,

Box 2

Paris Agreement and Nationally Determined Contributions[a]

"The agreement seeks to limit the mean global temperature increase to well below 2 degrees Celsius and to pursue efforts to limit global mean temperatures to 1.5 degrees Celsius. Countries have a legally binding obligation to submit national climate change plans—called Nationally Determined Contributions (NDCs)—every five years, outlining progressively ambitious actions to reduce emissions and adapt to climate change impacts. To implement them, developed countries (must provide developing countries with the finance and support for capacity building and the transfer of technology." (Amal-Lee Amin)[b]

[a] NDC Registry. Available at http://unfccc.int/focus/ndc_registry/items/9433.php.

[b] Ms Amin is head of the Climate Change Division at the Inter-American Development Bank, where she manages a wide portfolio of adaptation and mitigation projects in Latin America and the Caribbean. See https://blogs.worldbank.org/team/amal-lee-amin.

Source: Amal-Lee Amin (2016).

with focus on the energy, industrial processes, agriculture, cattle, land use change, forestry, and waste sectors (Ibid.).

To meet these ambitious targets, public and private actors alike must act to significantly reduce their emissions within a short period of time. ICT and mobile solutions are able to assist other industries, across sectors, to do so (Ericsson, 2015).

1.3 Impact of Climate Change on Latin America and the Caribbean

The Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (Marin et al., 2014) includes a vulnerability assessment of each region. With regard to Central and South America, it states that countries are experiencing severe climate variability and extreme weather events (Magrin et al., 2014). Rainfall is increasing in the south of the continent, while it is decreasing in Central America, and temperatures have risen throughout the region between 0.7°C to 1°C since the mid-1970s at the exclusion of Chile's coastal area, where a cooling of about 1°C has

been detected. According to the UN, water is the primary medium through which the effects of climate change have occurred and which will be most felt. More frequent and extreme rainfall events increasingly are occurring in the form of flash floods, among other effects. Changes in stream flow and water availability are observed and are projected to continue. The report concludes that communities that have a persistently high level of poverty are significantly vulnerable to the risks of climate variability and change in the LAC region (Magrin et al., 2014).

The results of climate change are directly impacting society and migration. The UN High Commissioner for Refugees has concluded that 21.5 million people a year, worldwide, were forcibly displaced between 2008 and 2016 due to the sudden onset of weather-related disasters, such as floods, storms, wildfires, and extreme temperatures (UNHCR, 2015). Understanding the drivers that lead to migration, the number of people who will migrate in the near future—and their likely routes—should be assessed in anticipation to allow for preparation. An increased number of low-cost housing options and access to services to limit human suffering should be immediately available. A comprehension of the drivers relies on a combination of climate models to identify the areas that will be less attractive to live in and their demographics, both largely based on Big Data. In parallel to taking the necessary actions to reduce GHG emissions—mitigation and adaption—there should be a move to increase resilience and, therefore, adaptation to climate change in these areas is critical.

Reducing emissions to mitigate climate change is a necessity in terms of the LAC region. As previously outlined, research indicates that climate change will have severe negative impact in this area. Due to its geographic, climatic, socioeconomic, and demographic attributes, LAC is highly vulnerable to climate change and the region is experiencing temperature and precipitation pattern changes. Extreme weather events, such as hurricanes, prolonged drought, severe flooding, more intense storms, and the loss of biodiversity are taking place more frequently. Their severity differs depending on the geography of the area and the ability of the local population and ecosystem to adapt (ECLAC/UN, 2015).

1.3.1 Cities and rural areas: equally set to suffer...or profit

Cities and rural areas will be affected by climate change in different ways. In LAC, especially, the direct impacts include a higher risk of heat waves due to increasing temperatures and the urban heat island effect, as well as flash and surface floods with associated landslides due to changing precipitation patterns. Such impacts pose a

threat to cities, making it imperative to consider climate change in the decision-making process from public health management to transport infrastructure. For cities to be at the ready to cope with these risks, funding must be earmarked for low-carbon and climate-resilient infrastructure, as well as telecommunication networks. In this context, long-term projects, in particular, such as transport infrastructure, will help to secure investments more feasibly. Overall, significant investment in urban low-carbon and climate-resilient infrastructure in LAC is necessary to meet the needs of growing populations (Amin, 2017). To assist decision makers in their efforts to improve their plans and reactions to climate change impacts, ICT solutions offer opportunities to access up-to-date and highly accurate data.

"Investing in climate-friendly development is where the smart money is headed."

Source: Guterres (2017).

Although LAC is considerably urbanized (see Section 2.3), agriculture continues to play a major role in most economies, accounting for 20 percent of gross national product in Paraguay, 13.5 percent in Nicaragua, 7.6 percent in Argentina, 7.1 percent in Colombia, and 5.5 percent in Brazil in 2016 (World Bank, 2017a). Changing temperatures and precipitation patterns have devastating effects on crop yields (World Bank, 2014). Acting in ways such as adapting climate-smart agriculture solutions, will be effective only if farmers have access to relevant information to enable them to make informed decisions in a timely manner. In rural Latin America, agriculture and livestock production are important sources of income for most of the population (FAO, 2013) with traditionally little access to information. The unique subscriber penetration rate of mobile usage on a per-person basis reached 70 percent of the population in LAC in 2016, with several countries (namely, Argentina, Chile, and Uruguay) having reached over 90 percent of the population. Combining access to mobile phones with improved network coverage and initiatives that focus on small farmers implies that access to information can drive real change in rural areas (GSMA, 2017b).

1.3.2 Sustainable development and the ICT industry's contribution to achieving the SDGs

On January 1, 2016, the 17 SDGs of the 2030 Agenda for Sustainable Development—adopted by world leaders in September 2015—officially came into force. Later, in 2016, the UN Secretary-General and President of the General Assembly advocated for the explicit linking of the goals and processes to the 2030 Agenda for Sustainable Development and the Paris Agreement, emphasizing the close connection between sustainable development and climate change. Since the publication of the SDGs in 2015, the private sector has identified opportunities

to contribute to the SDGs and to communicate them. Several partner initiatives, as well as nongovernment organizations (NGO) and platforms, now collaborate with the private sector, showcasing best practices from industry leaders. The World Business Council for Sustainable Development, for example, recommends that industries should specify the SDGs that closely relate to their core business and focus on actions contributing to these. With regard to the ICT industry, the contribution covers all SDGs, as indicated in a recent industry mapping by GSMA (2017a). It is essential to understand that the SDGs represent a holistic approach to foster sustainable development across various dimensions. It is not surprising, therefore, that the 17 SDGs are closely interconnected. For example, Goal 13 on climate change relates directly to Goal 7 on affordable clean energy and Goal 9 on infrastructure, industry, and innovation. Several SDGs have a clear focus on climate change and the environment, as per the following:


Affordable and Clean Energy


Industry, Innovation, and Infrastructure


Sustainable Cities and Communities


Responsible Consumption and Production


Climate Action

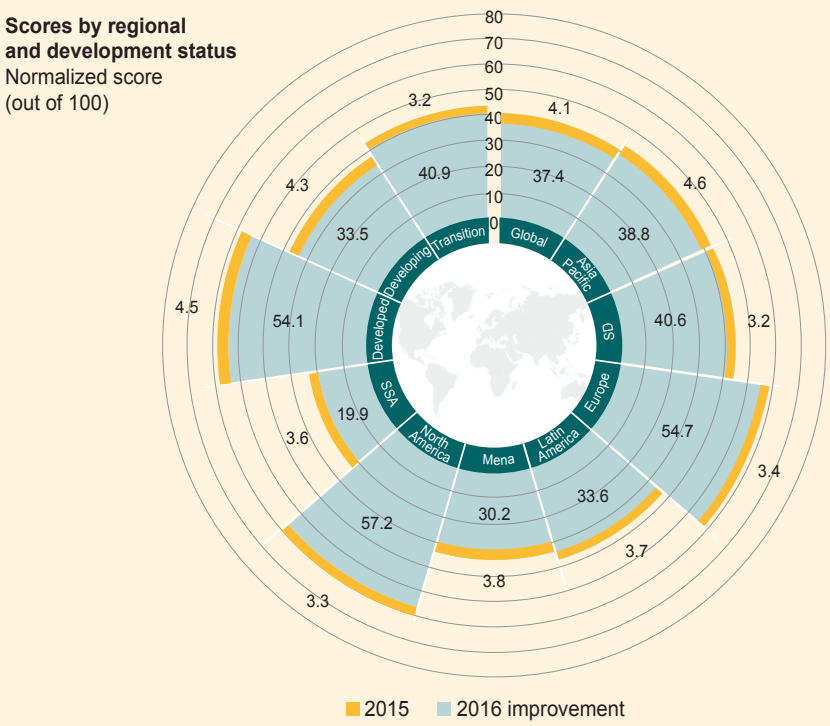

Life below Water


Life on Land


Partnerships for the Goals

The manner in which specific solutions will contribute to the SDGs are outlined in the following sections. The mobile ecosystem is one of the few areas that could contribute to each of the 17 SDGs (GSMA, 2017b) and is increasingly doing so. In the second year of its impact scoring, the sector scored 45 out of 100 points, with obvious improvements in every category (GSMA, 2017a). As attention focuses on the SDGs, impact is likely to grow further, the strongest at present relating to SDG 9 (Industry, Innovation, and Infrastructure), SDG 13 (Climate Action), and SDG 11 (Sustainable Cities and Communities). The high global impact score on SDG 13 is based on several factors, among which is an increase in network coverage, quality, and take-up of mobile services. The ICT sector can play a vital role in building resilience in cities and rural areas affected by climate change, particularly in terms of the application of IoT solutions. IoT solutions enable the collection of critical data to adapt to and manage the impact of climate change, such as real-time weather and transport data (Ibid.).

FIGURE 2: CLIMATE ACTION (SUSTAINABLE DEVELOPMENT GOAL 13): TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE AND ITS IMPACTS



Source: GSMA (2017a).

The score on SDG 13 (Climate Action) is shown in Figure 2. It highlights the fact that ICT and mobile technology can resolve climate change issues across the globe as well as contribute to a country's economic development. For this particular SDG, the score—which will be tracked every year—has reached 33.6 points in Latin America out of 100 points. Compared with other parts of the world, where Europe, North America, and Oceania each scored well over 50 points, this score is relatively low.

1.4 A Closer Look at Latin America and the Caribbean

GSMA impact scoring takes into account global results and provides an overview of each region. Regarding LAC, the SDG with the highest impact score

Box 3

Sustainable Development Goal 7

"Affordable and clean energy will require the update and implementation of technologies by the public and private sector at an unprecedented speed."

Source: International Resource Panel (2017).

and most significant improvement from 2015 to 2016 is SDG 16 (Peace, Justice and Strong Institutions). The reason for this lies in the commitment of operators to SDG 16 pursuits, such as becoming signatories to the Ten Principles of the UN Global Compact and ensuring high social media penetration, the latter of which ranks highest in the world. The Ten Principles relate to the issues of Human Rights, Labour, Environment, and Anti-Corruption. Impact scores were also high for SDG 9 (Industry, Innovation and Infrastructure), fuelled by initiatives such as Telefónica's Internet para todos initiative, currently being piloted in Peru, which connects rural and remote areas of Latin America to high-speed Internet. In addition, SDG 4 (Quality Education) was highly ranked. The SDG with the lowest impact score, however, is SDG 14 (Life below Water), which has room for significant improvement. One of the ICT-related developments with positive impact on a number of the SDGs is the increasing uptake of mobile money in LAC. Mobile money provides large segments of the population with access to low-cost remittance and financial services, thus supporting economic financial inclusion.

Box 4

Sustainable Development Goals

The 17 Sustainable Development Goals (SDG) (Figure 3) and their 169 targets represent a followup of effort to the Millennium Development Goals that were in place from 2000 to 2015. The SDGs will focus the public and private sector activities on sustainable development until 2030. In comparison to the Millenium Development Goals, SDGs are applicable to developing and developed countries alike. It is a national government's responsibility to achieve the SDGs, with the private sector increasingly expected to share the burden. Many of the goals are interconnected. SDG 13 (Climate Action) relates directly to SDG 7 (Affordable and Clean Energy) and SDG 9 (Infrastructure, Industry and Innovation). The private sector is specifically encouraged to support the efforts of SDG 17 (Partnerships for the Goals). Across industries, companies have begun to report their contributions to the SDGs in their effort to demonstrate commitment.

FIGURE 3: OVERVIEW OF THE SUSTAINABLE DEVELOPMENT GOALS

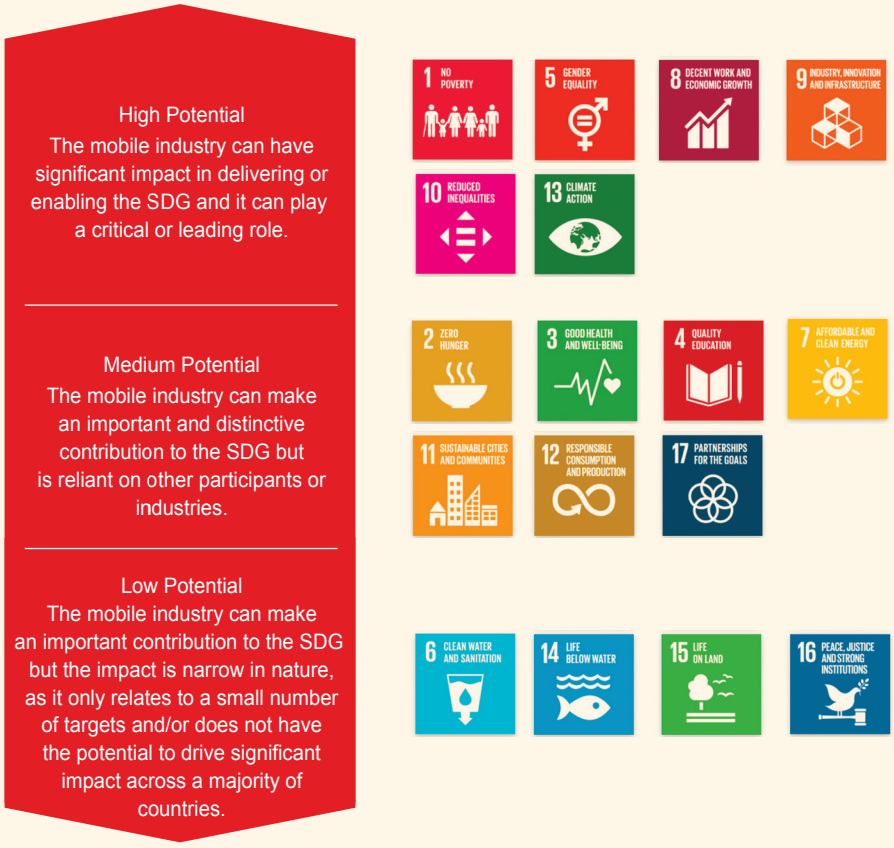
Source: UNDP (2017).

1.4.1 Contributing to every goal

The mobile industry is one of the few industries that is capable of contributing to each and every one of the 17 SDGs. In doing so, the three main factors are improving networks, increasing connectivity, and expanding mobile services. More efficient networks give access to mobile services and are vital to emergency responses in cases such as natural disasters. As network coverage spreads, people in remote areas will gain access to these services and will benefit from social and economic opportunities. New possibilities will be available by extending the range of activities and further refining the apps for mobile devices, such as financial planning, access to better health services, and education (GSMA, 2017a).

The potential for contribution varies across the 17 SDGs and is dependent on the involvement of the mobile ecosystem beyond BAU practices. In an effort to assess the impact on each goal, the drivers were identified as was the impact of

FIGURE 4: POTENTIAL OF THE MOBILE INDUSTRY TO CONTRIBUTE TO EACH OF THE 17 SUSTAINABLE DEVELOPMENT GOALS



Source: GSMA (2017a).

the mobile sector on the driver determined. Based on a global scoring, there is significant potential for the SDGs that address poverty reduction; gender equality; economic growth; activities relating to industry, innovation, and infrastructure; reduction of inequalities; and actions to address climate change. This is summarized in Figure 4.

The opportunities to apply IoT and Big Data to address the challenges of this century and meet SDG targets are immense. Section 2 showcases ongoing initiatives that have transformed and improved the nature of city transport, agricultural

practices, disaster response, and energy production, with some initiatives directly aligned with the SDGs or being driven by their targets. The Big Data for Social Good (GSMA, 2018) initiative of the GSMA is an example. It aims to ensure that Big Data responds effectively and efficiently to tackle the spread of infectious diseases, pollution, earthquakes, and other disasters. The program is supported by 20 operators in over 100 countries, accounting for over 2 billion connections. Participating mobile operators aim to provide data in a format that is consistent to, as well as an ecosystem for, timely planning and response for public agencies and NGOs, thus enabling them to carry out informed decisions. A further industry-wide initiative is the UN Global Pulse (UN, 2018) which aims to harness Big Data for development and humanitarian action. Ongoing projects include Using Twitter Data to Analyse Public Sentiment on Fuel Subsidy Policy Reform in El Salvador and Using Mobile Phone Activity For Disaster Management During Floods. Among the winning solutions of the UN Global Pulse Data for Climate Action challenge in 2017 was a project using electro-mobility, the Clean Mexico City's Air With Big Data and Climate Policy. A team of researchers from the University of California (Berkley) and the National Institute of Ecology and Climate Change (Instituto Nacional de Ecología y Cambio Climático) analyzed the data on traffic patterns as a result of using the driving app, Waze, to evaluate the potential of various transportation electrification policies in efforts to reduce air pollution and GHG emissions (UN, 2018b).

1.4.2 Harnessing smart, emerging technologies to fight climate change

When considering solutions to tackle climate change, the ICT industry is not the first sector to come to mind. It could soon be, however, given that it is a fast-paced industry with constant change. Recent advancements have led to the development of high- speed and reliable networks, the backbone of mobile solutions. This increased capacity enables these technologies to be used for tasks that were inconceivable a few years ago. The application of mobile technology solutions is being captured by the private and public sectors. There is barely an industry that would not profit from this development, whether it be the optimization of work flows, increase in transparency, risk mitigation, or GHG reduction.

An indication of this rising capability is the development of network capacity. While 2G networks are able to transfer sufficient data for voice calls, the new 5G network will be capable of handling the flow of Big Data, IoT, and ICT solutions in the gigabyte range**.** Today, the most common networks are 3G and 4G, allowing

5G: What Is About to Come

Ultra-reliable, very low latency. Application in remote health care, traffic safety. Enhanced mobile broadband, expected in 2020. Will need the support of governments (timely release of spectrums).

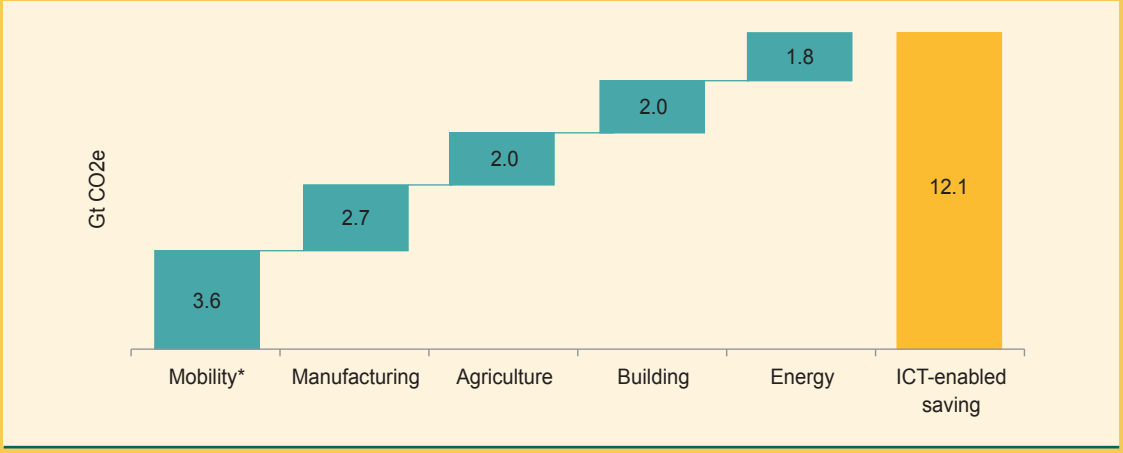
Source: Ericsson (2016).

the transfer of data in the range of one megabyte to hundreds of megabytes, respectively, with Internet access via portable devices. Trials for 5G are in process, standards are being developed, and network providers are determining the implications relating to the 5G network, the rollout of which will take place in urban densely populated areas. To be successful, major investments will be necessary.

1.4.3 How ICT and mobile solutions change the way we do anything—really

The way in which we call a cab, buy a coffee, organize events, listen to music, or monitor our finances has transformed radically in the twenty-first century. The digital revolution is creating a better future, step by step. Many things in everyday life have become easier, faster, and more accessible due to changing technology. The ICT industry is well aware of its potential while the general public, as well as the public and private sectors, continue to process their understanding of such change in the long term. Projects that appeared too large or too time consuming have suddenly become feasible. As shown in Figure 5, the ability of the ICT and mobile sectors to help reduce GHG emissions across sectors is deemed highly likely across industry sectors, with especially large shares contributed by the transport sector.

FIGURE 5: HOW THE ICT AND MOBILE SECTORS WILL DELIVER SUBSTANTIAL CARBON DIOXIDE REDUCTIONS UNTIL 2030



Source: GeSI (2015).
* Mobility solutions consider ICT-enabled improvements to private and commercial mobility and additionally consider the reduced need to travel from various sectors, including health, learning, commerce, etc.

The strength of ICT and mobile solutions lies in their flexibility. These are not solutions in themselves; rather, they are tools to carry out almost any task, the base in which lie the speedy transfer of data and the ability to transform this data into valuable information to support decision making, optimize processes, and propose options for solutions while considering more variables than any one person would be aware of at any given time.

ICT and mobile technologies currently provide data that are moderated by someone who will use them to determine a decision as a first step. Following this is the development of communication between devices to enable the decisions to be carried out at an optimal point in time. This includes further improving the performance of everyday appliances such as sun blinds that close and open, based on weather conditions; washing machines that communicate with the electricity grid and know when there is an oversupply of power; and alarm systems that differentiate between a cat and a threat by alerting either the person by phone or the police.

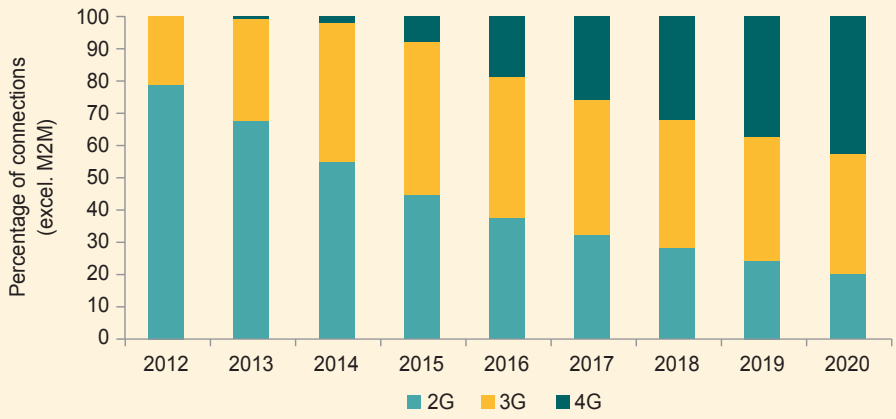
1.4.4 Unwrapping the potential of the Internet of Things

This next step is exemplified by IoT. Machine-to-machine (M2M) communication is expected to improve the efficiency and productivity of people at the same as decrease GHG emissions. The rollout and application of these technologies will be smooth and secure only if network capacity is able to handle the amount of data traffic. Mobile operators are aware that their contribution will be essential.

Network capacities vary across the LAC region and are mostly made up of 3G, gradually increasing to 4G. Mobile operators plan to invest a total of US$68 billion during the 2017–20 period in LAC networks so as to increase access to better service. Illustrated in Figure 6, expected connections via 3G or 4G networks will be more than 70 percent by 2020 (GSMA, 2017b). Across LAC, focus is shifting away from providing access to networks to the improvement of services and network capacity. Investments into the upgrade of networks will improve consumer experience and enable them to take advantage of ICT and mobile solutions, at the same time becoming more energy efficient by using less energy per transmission byte.

Companies—from car manufacturers to providers of household appliances—architects, health professionals, and city planners are taking note and beginning to develop products, services, buildings, and cities that rely on connectivity, and the market for these products and services is exponentially developing. Research

FIGURE 6: ACCESS DEVELOPMENT TO VARIOUS NETWORKS IN LATIN AMERICA AND THE CARIBBEAN



Source: GSMA (2017b).

from Ericsson ConsumerLab shows that IoT solutions are largely accepted and favored in LAC. For example, a recent study shows that 46 percent of Colombian consumers would like their home alarms to be connected to the Internet, with similar results in Brazil and Chile (Ericsson, 2016).

The share of smartphones in overall mobile subscriptions in the region in 2016 is rising, having reached close to 55 percent, with broadband connections at 62 percent. Both are expected to continue escalating significantly until 2020—to 71 percent and 79 percent, respectively. This spiral in the use of digital services will lead to additional data traffic, calling for increased network capacity (GSMA, 2017b). It is anticipated that 5G networks will be rolled out in the mid-2020s in the region, enabling gains in efficiency and, thus, IoT solutions on a large scale (Ericsson, 2017).

1.4.5 Existing commitments

Telecommunication providers calculate their carbon footprint, mainly by following the Greenhouse Gas Protocol (GHGP), which sets industry standards. Firms are required to report their emissions according to the Global Reporting Initiative (GRI), CDP, and the SBT Manual, as well as demonstrate their contribution to the SDGs in their annual sustainability reviews. Telefónica, for example, is recognized as a climate

1. Committed to 100 percent renewable energy by 2030
2. Joined the international initiative, RE100, in 2017
3. Has approved Science-Based Targets
4. Has 44 percent share in global renewable energy
5. Operations in Costa Rica, Germany, Spain, the United Kingdom, and Uruguay have reached over 90 percent renewable energy consumption
6. Power purchasing agreements either signed or proposed in Argentina, Chile, Colombia, and Mexico.

Box 5

Targets of the Information Communication Technology Industry: Telefónica

leader, having been on the "A" list of CDP for four years in a row. Its global use of renewable energy now stands at 44 percent. Globally, 130 ongoing energy efficiency projects have resulted in savings of EUR 22 million in 2016 (Telefónica, 2017).

Most operators have set their share of renewable energy objectives for the next few years, focusing on initiatives to reduce energy consumption. In addition to measures relating to the core business of providing telecommunication facilities, such as energy consumption and waste management, several providers contribute to initiatives that protect the environment; these may be campaigns to reduce de-forestation or the development of services to protect wildlife.

An industry initiative that directs and combines efforts on several fronts is the WeCare campaign in LAC, led by GSMA. It includes projects relating to digital inclusion, child online protection, environmental care, disaster response, contribution to public safety, and combating handset theft. The environmental care component focuses on the responsible management of e-waste, a topic that is discussed in depth in Section 3.

Globally, corporations are highlighting their commitments by setting SBTs, as has Telefónica. SBTs assure that a firm's targets align with the level of decarbonization needed to reach those of the Paris Agreement. Currently, only a limited number of companies with headquarters in Latin America have committed to the SBTs; in fact, four from a total of 355. Of the 355 businesses, 16 represent the telecommunications sector, showing that there is ample room for improvement and action not only at the global level but also in the LAC region. A similar portrayal emerges for the signatories of RE100, whereby of the 128 companies committed to source 100 percent renewable energy, only five are telecommunication providers mostly headquartered in Europe.

FIGURE 7: COUNTRIES THAT HAVE LAUNCHED WECARE CAMPAIGNS AND INITIATIVES RELATING TO THE SUSTAINABLE DEVELOPMENT GOALS

Source: GSMA (2017b).

Box 6

Disaster Response and the Human Connectivity Charter

In emergency situations, including climate-related events, mobile network connectivity is a crucial lifeline, providing access to information and assistance from a government, NGOs, and international humanitarian associations. The shared principles developed and summarized in the GSMA Humanitarian Connectivity Charter of 2015 outline the ways in which mobile network providers are able to assist in the preparation for and response to emergency situations. Its three principles are:

- to enhance coordination within and among mobile network operators before, during, and after a disaster;
- to scale and standardize preparedness and response activities across the industry to enable a more predictable reaction; and
- to strengthen partnerships between the mobile industry, government, and the humanitarian sector.

Mobile network operators covering 106 countries amount to 146 that have signed the charter. Examples of activities that relate to the charter include responses to Hurricane Irma and Hurricane Maria which reached the Caribbean within a short time in 2017. Both events caused the displacement of thousands of people, left without access to clean drinking water and power due to considerable damage to existing infrastructure. The following services were provided by mobile network operators, coordinated by GSMA:

- Zero-rate SMS and calls were facilitated in the region by mobile network operators to allow affected populations and their loved ones to connect.
- Key facilities, including hospitals and coordination centers, were prioritized to ensure immediate restoration of network connectivity.
- Charging facilities were provided at key locations to enable those without power to charge their devices.
- WiFi hotspots and Cell on Wheels were rolled out to provide emergency connectivity in shelters and key locations.
- Zero-rating of mobile internet took place to enable access to information services.
- Messaging systems were launched to support the reconnection of family/friends with those in areas where connectivity was down.

In addition to corporate commitments, the mobile sector is serious about contributing to a low-carbon economy. In 2010, the Guadalajara ICT Declaration for Transformative Low-Carbon Solutions, created in preparation for the 16th session of the Conference of the Parties (COP), urged governments to consider ICT solutions to address climate change (GeSI, 2010). The Connect 2020 Agenda (ITU, 2018), adopted by the International Telecommunications Union (ITU) in 2014, shows the commitment of the sector to four goals relating to e-waste and the GHG emission of the sector. This includes (i) Growth—enabling and fostering access to and increased use of telecommunication/ICT; (ii) Inclusiveness—bridging the digital divide and providing broadband for all; (iii) Sustainability—managing challenges resulting from telecommunication/ICT development; and (iv) Innovation and Partnership—leading, improving, and adapting to the changing telecommunication/ICT environment. Recently, at the UN Momentum for Change Awards in 2017 (UNFCCC, 2014), an easy-to-use ICT tool to assist farmers in making climate-smart choices in Colombia and Honduras was among the winning innovations, underlying an increasing traction and the relevance of the sector to tackle climate change and its impact.

Leveraging the Internet of Things and Big Data Solutions

Climate change and other environmental issues, such as air and water pollution, are complex challenges. The relationship between cause and action is often not evident or is delayed in time. While scientists have long been ringing alarm bells, public and private sector actors have been slow to react. The first manifestation of the "new climate normal" is reflected in a recent increase in the intensity of extreme weather events. Understanding this and the societal cost of air and water pollution have helped to create a momentum that has culminated with the Paris Agreement and the SDGs.

As briefly pointed out in the previous section, the private and public sectors are now actively seeking solutions. Numerous initiatives have been emerging in the business, financial, agriculture, energy, and transport sectors. The World Business Council for Sustainable Development, UN Global Compact, Task Force on Climate-Related Financial Disclosures, Sustainable Agriculture Initiative Platform, RE100, and C40 Cities Climate Leadership Group are only a few initiatives that focus on the task. Recent advancements in ICT and IoT solutions are already helping to address these issues. Many options to provide solutions and support the move toward a low-carbon economy and sustainable development, however, have yet to be explored—not least due to a limited understanding by and awareness in the public and private sectors.

Advancements that have been implemented and exclude compliance with clear reporting guidelines (e.g., RE100 commitments and progress tracking) often lack a thorough monitoring approach and publicly available quantitative information on outcomes. As a result, there is little information on the actual climate impact of

these projects, such as the amount of CO_2eq reduction, and the co-benefits available. As will be pointed out in Section 4, a robust and reliable monitoring system is essential. It allows to track progress, impact, and cost effectiveness, and is an ideal tool to convince doubting parties to take a step further toward climate action. The application of ICT solutions can play an important part in gathering information on the impact of climate action, if this need is recognized and viewed as an opportunity by the ICT sector.

2.1 Big Data

What is driving the ICT sector is data—vast amounts of it. ICTs make it possible to handle the large amount of data as well as access and understand the hidden information in them, from improving weather forecasts, analyzing traffic flows to monitoring financial data. Mobile network operators are also tapping into their own data resources to help find solutions for climate change and project the environment (e.g., to monitor nitrogen oxide emissions in Sao Paolo, Brazil). The application of these approaches also can assist other sectors, such as transport, manufacturing, agriculture, construction, and energy—to name a few—to reduce their GHG emissions and increase the efficient use of resources, at the same time protecting the environment. Big Data can provide the public and private sectors with insights and information at an incredible degree of detail and accuracy at considerable cost, leading to better decision making. Many existing applications of Big Data solutions in LAC are already doing so.

Box 7

Case Study: Contribution to Sustainable Development Goal 13 (Climate Action) by World Meteorological Organization

Weather, climate and water information is available from multiple sources. Institutions, such as the World Meteorological Organization, have for decades struggled to combine data with different degrees of availability, quality, and consistency. Information and communication technology solutions help to aggregate this information and convert data points into information that can be used directly in agriculture, by utility operators, and for emergency services. The generated high-quality, reliable, and consistent information can protect lives and property, as well as build resilience to high-impact weather and climate events in all sectors and countries alike in different parts of the world.

Source: ITU (2018b).

Box 8

What Is the Internet of Things About?

> "...a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies." (ITU, 2018c)
>
> "The Internet of Things (IoT) refers to the use of intelligently connected devices and systems to leverage data gathered by embedded sensors and actuators in machines and other physical objects." (GSMA, 2014)

The IoT allows devices to connect with each other, analyze information, and take action based on this information, largely independent of human interaction. This opens a new field of opportunities that consumers and businesses will greatly benefit from.

2.2 Untapped Potential

Potential is largely untapped in LAC. Globally, Europe and Asia lead the way in the use of advanced technologies. Sweden has rolled out smart meters in 100 percent of its electricity networks and is currently upgrading the system. India, among others, has launched the 100 Smart Cities Mission, while Singapore is ensuring new buildings provide space for infrastructure such as base stations to improve connectivity. In Africa, the application of mobile solutions is often related to providing access to the most basic needs, such as safe drinking water. Sensors provide information on the availability of water at a certain location and inform water providers on the state of the equipment and water quality. This allows for targeted maintenance trips, resulting in significant cost savings in remote areas.

Chapter 2 outlines the issues that current Big Data and IoT solutions are addressing, drawing on examples from across sectors and locations in LAC. It also shows that while the potential is large, there are still obstacles that need to be overcome to address the challenges of climate change mitigation and adaptation and other environmental issues.

Box 9

Protecting Data

These developments are based on one assumption: the secure transfer of data. This is a challenge the information and communication technology sector is prioritizing. As more devices are connected and Internet of Things solutions are becoming a reality, the security of networks and individual devices are a key requirement.

2.3 Cities

"A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve the quality of life, efficiency of urban operation and services and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental, as well as cultural, aspects."

Source: ITU (2017).

Cities of all sizes around the globe are taking climate action, not only to reduce their carbon footprint and contribute to the Paris Agreement but also to increase the quality of life of their inhabitants and support a sustainable development strategy. Cities such as Bogota (Colombia), Lima (Peru), Mexico City, and Sao Paulo (Brazil) are now under pressure to provide services to the growing number of people living in and around their jurisdictions, who need access to clean air, water, transportation, electricity, waste management, and sanitation. Climate change is exacerbating these issues.

While cities themselves are forced to adapt to the changing climate, they also can expect increasing migration due to climate change. As rural areas and regions close to the sea offer less opportunities and higher risks, migration toward cities is only set to increase (Warn and Adamo, 2014).

Most Latin Americans live in cities, making up 80 percent of the population across the region. Several countries exceed this percentage; in Argentina, 92 percent of the population was living in urban areas in 2016 and, in Uruguay, this was 95 percent (World Bank, 2017). This percentage is expected to continue growing. Cities provide income and education opportunities that many rural areas lack. As the population living in cities increases, so too will their GHG emissions in a BAU scenario. This will have a considerable impact on the total amount of GHG emissions. Cities, globally, already account for 70 percent of GHG emissions.

Today, cities are increasingly connected and are learning from each other. Although specific situations between cities may differ, many face similar problems. ICT solutions developed and shown to function in one city can find applications in cities across the world, making significant use of the lessons learned in the development process.

2.3.1 Talking to each other; sharing insights

Networks, such as the Covenant of Mayors, C40 Cities Climate Leadership Group, International Council for Local Environmental Initiatives, Cities Climate Finance Leadership Alliance, and Global Fund for Cities Development, are spreading best practices and encouraging direct contact between city officials. This exchange focuses on a wide range of topics, specific technologies, administration, and access

Box 10

C40 Deadline 2020: Why 86 of the Largest Cities Worldwide Are Taking Climate Action

Globally, cities will suffer the results of inaction on climate change. In LAC, in particular, the consequences are a higher risk of heat waves, flash and surface floods, and landslides. Cities are recognizing that rapid and dramatic cuts in greenhouse gas (GHG) emissions are necessary to achieve the 1.5 degrees Celsius (°C) target of the Paris Agreement. The C40 Cities Climate Leadership Group (C40), an organization that supports cities in their ambition to reduce GHG emissions and increase the quality of life of their inhabitants, determined in a recent study of what a realistic scenario for cities may look like. The emissions, largely from the stationary, transport, and waste sectors, are expected to rise in a business-as-usual scenario. The research concluded that major actions to set cities on a 1.5°C or 2°C path need to be taken within the next 15 years.

Reducing rather than increasing emissions as soon as possible is in the interest of all cities from an economic and social perspective. Some cities are now moving in the right direction. The number of actions relating to climate change, reported by the C40 cities increased from 4,734 in 2011 to 10,945 in 2016. In the interest of efficiency, C40 encourages cities to focus on actions with the highest impact and energy is one of these areas. Actions relating to building large-scale clean energy deployment, by far, have the largest impact on the overall GHG emission of a city. The effect of measures taken in this area would be felt throughout a city's operation.

Reliable and clean energy ensures not only the operation of the transport system, water supplies, waste services, hospitals, schools, and public buildings; it also ensures the heating and cooling for residential and commercial properties as well as general economic activity. A focus on more local- or district-scale energy production also increases the energy resilience of urban areas.

Cities can achieve great results. To truly advance, however, they need partners. The amount of power and control city governments have varies by country. In many cases, cities require partners to take action. Partnerships with other cities, national governments, private businesses, investors, and civil society are critical in driving action. These partnerships will, among others, facilitate the access to much needed finance.

The financial investment needed for each C40 city in Latin America until 2050 in a 1.5°C scenario (see the list of eight cities above), on average, is over US$10 billion. These large sums signify that cities must have the capacity to manage pipelines of investment in order to leverage funding from various sources and establish innovative financing mechanisms.

C40's research concludes that cities should reduce per capita emission across the 86 C40 cities from today's 5 metric tons of carbon dioxide equivalent (tCO_{2eq}) to around 2.9 tCO_{2eq} by 2030 to remain on a 1.5°C track. This is a massive task indeed.

Source: C40 and Arup (2016).

12 Latin American cities: Bogotá, Buenos Aires, Caracas, Ciudad de México, Curitiba, Lima, Medellín, Quito, Rio de Janeiro, Salvador (BR), Santiago (Chile) Sao Paulo. in 8 countries: Argentina, Brazil, Chile, Colombia, Ecuador, Peru, Mexico, Venezuela, are part of C40.
Source: ITU (2017).

to finance. Infrastructure projects in cities require large amounts of financial resources over extended periods of time; thus cities are exploring innovative ways to access finance through different mechanisms.

Green bonds are one such mechanism that explicitly focuses on "green" or sustainable projects. The green bond market has been gaining a lot of traction since 2013, when the cities of Massachusetts (United States) and Gothenburg (Sweden) issued their first green municipal bonds. The market reached a total size of well over US$100 billion in 2017. Many cities, utilities, and regions have followed suit, mainly in Africa, Asia, Europe, and the United States. The number of green bond issuances in LAC is still limited, with the count standing at seven transactions between 2014 and 2016, although it is projected to increase (Weinman, 2017). Cities in LAC are currently looking at how Mexico City issued a municipal green bond (US$50 million, five years, and 2.5 times oversubscribed) in 2016, the first to finance climate-resilient infrastructure and mobility projects across the region (Patzdorf, 2016).

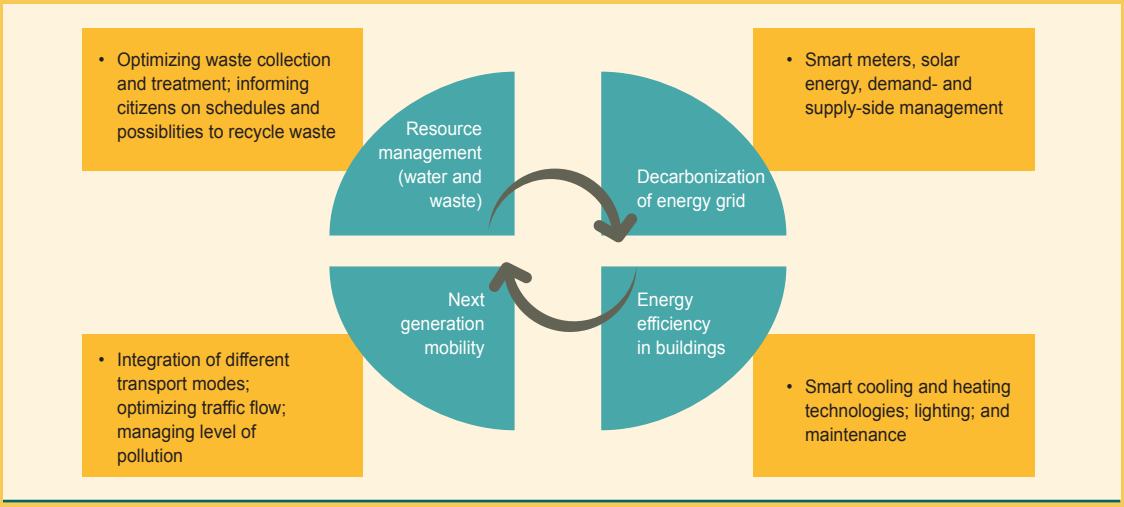
Cities understand the impact they can have on the climate and the environment, and they are showing their commitment to combat climate change. At the COP23 session in Bonn, Germany, in 2017, 25 cities representing 150 million people—all part of the C40 city network—committed to take climate action before 2020. Among them are seven Latin American cities: Buenos Aires (Argentina), Caracas (Venezuela), Mexico City, Quito (Ecuador), Rio de Janeiro Brazil), San Salvador (El Salvador), and Santiago (Chile).

The international community, in turn, has also recognized the potential of cities. In 2017 at the COP23 session, cities and regions had a dedicated pavilion for the first time. Several international agreements consider sustainable developments in cities: the New Urban Agenda of Habitat III, the Paris Agreement, and the UN 2030 Agenda for Sustainable Development (ITU, 2017).

2.3.2 Steps in the right direction

The challenge for cities to reduce their GHG emissions, attract finance, and build a sustainable future is daunting, despite the posiive developments that are taking place. Solutions that now are and will be available will be transformed into practice through public-private partnerships. Such partnerships are crucial to leverage their full potential.

FIGURE 8: HIGH POTENTIAL AREAS FOR INFORMATION COMMUNICATION TECHNOLOGY AND MOBILE SOLUTIONS IN CITIES



Source: South Pole, 2018 adapted from McKinsey and C40 Cities, 2017

Opportunities for climate action are many. These can be classified into four main categories, based on a recent report relating to cities vis-à-vis climate change (McKinsey and C40 Cities, 2017). These are decarbonization of the electricity grid, optimization of energy efficiency in buildings, next generation mobility, and better waste management. Climate action in these areas would lead to a rapid shift toward sustainable and low-carbon cities (Figure 8). Cities, unable to push these measures on their own, are in need of sound partners. Decarbonization of the electricity grid, for example, will require collaboration between the utilities, regulators, and cities, and is directly related to the use of energy in buildings. All stand to benefit (Ibid.). These four dimensions are described in more detail in the following subsections.

EXAMPLE: FORTALEZA, BRAZIL

Innovative waste management strategies based on an online system to devolve municipal responsibilities.

EXAMPLE: BUENOS AIRES, ARGENTINA

A water and weather monitoring system consisting of a network of interconnected sensors that gather data on rainfall, temperature, humidity, wind direction and speed, and stream water levels to help manage the overall system. It also operates as the basis on which emergency decisions are made.

Smart LED street lights increase visibility and lead to significant energy savings by an estimated 50 percent. They can be controlled individually, switched on gradually as it gets darker, and efficiently maintained.

EXAMPLE: CURITIBA, BRAZIL

Ericsson and Telefónica in Brazil partnered on a smart transport solutions project based on mobile broadband. It has enabled electronic ticketing and fleet management systems through the application of machine-to-machine technology, making life simpler and more secure for Curitiba's 3.2 million metropolitan inhabitants and reducing the cost of fuel as well as greenhouse gas emissions.

EXAMPLE: MEDELLIN, COLOMBIA

The harnessing of information and communication technology (ICT) and mobile solutions in Medellin by a public entity, dedicated to improving the services for citizens, includes transport, early warning systems, and outreach programs to provide inhabitants of cities access to ICT infrastructure. The huge progress made led to Medellin becoming internationally recognized in 2013, when the Urban Land Institute named it Innovative City of the Year.

The success of initiatives was based on a strong focus on the inclusion of local inhabitants, and was achieved through strong public support. Measures included investment in integrated transport solutions, including Bus Rapid Transit, a metro cable car system, and escalators on steep hills. These are monitored online.

2.3.3 Resource management: water and waste

Water is essential for human consumption, ecosystems, and agriculture,as well as for many industrial processes. Freshwater is a finite resource, however, and only accounts for a share of 2.5 percent of global water reserves. Furthermore, its occurrence and reserves vary over periods of time and across geographies. While the importance of freshwater for economic development has shifted to the top of the World Economic Forum agenda, the occurrence of water crises on the planet over the next 10 years has been ranked as a global risk. Access to water is challenging, not only in densely populated areas such as Mexico City but also in rural areas that require large amounts, of water for irrigation purposes. In cities, water infrastructure is often poorly maintained, leading to losses of up to 40 percent as in Mexico City. The impacts of climate change will further aggravate stress on utilities to supply water in adequate amounts,

Box 11

Google and the Ellen MacArthur Foundation on a Development Approach for a Circular Economy for Cities

Google's effort to democratize information relies on connectivity as well as stable, reliable networks to enable access to knowledge for all. Google is of the opinion that a circular economy should be powered by digital technology to be able to build a regenerating and restoring urban system. The adaptation of a circular economy approach for cities will require the awareness and collaboration of designers, planners, policymakers, and businesses alike to preserve, restore, and regenerate natural, social, and financial capital in their efforts. The elements that shape a circular city are as follows:

- built environment;
- energy that is resilient, localized, and distributed; and
- mobility that is multi-modal and is based on the integration of public transport and last-mile solutions, electric-powered, shared, and automated.

Relevant digital technologies are asset tagging, and offer geo-spatial information, Big Data management, and connectivity. Furthermore, they provide real-time information at the level of detail to enable a manufacturer or user to react to an issue before it occurs, as well as to improve management to extents that were unimaginable not so long ago. Several Google applications and technological solutions are available, such as Project Sunroof, Nest Learning Thermostat, Waze, Flow, Project Air View, and LeanPath.

Ongoing developments that form the economy of the twenty-first century include the digital revolution, circular economy transition, and urbanization. Combining the first two will do much to resolve the issues of the third.

"Powering the circular economy by providing digital solutions and closing the information gap is probably the best investment that technology companies of our time can make."

Source: Sukhdev et al. (2017).

with appropriate quality and location. Flooding and droughts are estimated to increase in frequency in LAC.

Utilities often lack the information to plan ahead and respond to such extreme events. Adaptation mechanisms, therefore, need to rely strongly on mobile solutions. Smart meters, for example, are able to measure the exact amount of water used, determine leakages, and optimize maintenance schedules that will result in improved service and lower costs for consumer and operator alike (GSMA, 2016).

Box 12

Smart Water Metering in Chile

Telefónica and Huawei are partnering with Essbio, the Chilean water utility, and Kamstrup, a Danish metering company, on a smart meter project. Essbio services the Libertador Bernardo O'Higgins, Bío Bío, and Maule regions of Chile. The aim of the project is to increase network efficiency, reduce freshwater loss, and improve the quality of service for the end user. The group has tested various systems in an effort to improve the connectivity of devices so that customers can monitor their daily use of water; estimates can be replaced by accurate invoicing; and leaks and abnormal conditions can be detected, while allowing the water network operator to learn the needs of its customers. Essbio uses the data to improve the design of its intelligent water network (GSMA, 2017b).

Six thousand ultrasonic water meters were installed in diverse urban and rural areas across the three regions to determine the rate of flow to an accuracy of two liters an hour. A narrowband IoT network, developed by Telefónica, Huawei, and the Government of Chile, is used by utility companies and regions to provide a two-way communication for the IoT devices, which include smart meters and smart water applications (app) (Metering and Smart Energy International, 2017). Collaboration between the various actors should lead to service improvements for the end customer as well as the utility operator. This project showcases the viable business opportunities the ICT sector can benefit from when project revenue is scaled up nationally.

One step further is the water sensor that will measure a certain parameter and trigger an action to correct an issue, whether or not it is using an additive or opening gates to release excess water during heavy rains (Pretz, 2016). This development could considerably support utilities facing aging and inadequate infrastructure or those operating under poor management.

The same holds true for waste management, another large source of GHG emissions. System integrators, network operators, and technology providers each have a role to play in working with government to facilitate the application of smart solutions.

2.3.4 Next generation mobility

Transport, at a global level and in the LAC region, is a major issue. Poor traffic management will increase air pollution and challenge economic development as a result of the lower mobility of city inhabitants and the time lost to traffic. Measures taken to improve the environmental performance of transport (e.g., reducing GHG

emissions) also will lower the incidence of accidents and improve public health. Such illnesses as stroke, heart disease, lung cancer, chronic and acute respiratory diseases including asthma, have been linked to poor air quality. Measures taken also will reduce travel time and stimulate economic activity. Cities around the globe use ICT solutions to improve traffic flows and pollution levels while optimizing fleet management and saving costs.

The decision-making process to secure investments depends on taking into account the impacts of climate change, especially with regard to long-term projects such as large-scale transport infrastructure. The New Climate Economy estimates that low-carbon urban actions, including transport, will present a global economic opportunity of US$17 trillion by 2050 (The New Climate Economy, 2017). This suggests that significant investment in infrastructure is necessary in LAC countries to meet the needs of growing populations (IDB, 2017).

2.3.5 Why travel at all?

ICT and mobile solutions have contributed to the reduction of transport-related emissions by eliminating the need to travel. Modern ICT solutions have brought virtual meetings closer to a face-to-face experience. The rising use of virtual meetings has become a corporate strategy to reduce emissions across all sectors. This is especially relevant when taking into account the emissions of automobile and plane travel, and the fact that the energy used to power ICT equipment is sourced from renewables. The prevention of emissions through holding virtual meetings saves time, is inexpensive, and ensures that employees are content (Borggren et al., 2013; Harrison, 2016).

2.3.6 Changing transport behavior

ICT can make mass transit, walking and cycling safer, more attractive, and more effective if combined with initiatives such as targeted densification, thus reducing the average distance between points of travel. To fully integrate various transport modes, a door-to-door experience should be considered. Public transport often leaves people at a distance from their final destination, making it less attractive as transportation solution. Bike sharing is a sustainable and healthy option, if conveniently feasible, safe, and affordable. Such an option, however, can be limited to a particular number of stations and the distance between each. IoT-enabled bike sharing systems further increase the attractiveness to travel sustainably. It allows

commuters to drop off the shared bike at a given location and lock it by way of an app. The app also shows the location of bikes within the area—a further step toward the full integration of transport services based on IoT solutions to support the adoption of sustainable transport options (Guldbrand, 2017).

EXAMPLE: TELEFÓNICA'S AIR QUALITY PROJECT: SAO PAULO, BRAZIL

Telefónica launched a pilot in Summer 2017 to assess the impact of traffic and human mobility on the quality of air and to gauge the health and wellbeing of Sao Paulo's inhabitants. The project applies a combination of mobile indicators for population volume and movement, in addition to the use of data sources and models, such as pollution levels, weather data, wind speed, temperature, and direct sunlight. The outcome of this approach will inform the policy decisions of the city in terms of public health, the environment and transport, enhancing the well-being and health of residents. A similar approach was implemented by Telefónica NEXT in Nuremberg, Germany, in collaboration with South Pole and Teralytics.

EXAMPLE: ERICSSON'S APPROACH: GOIANA, BRAZIL

Ericsson's approach is to connect city buses to a mobile broadband network to improve public transport while reducing carbon emissions. The project was implemented jointly with Volvo and a consortium of public transport agencies, led by the city's Mayor. The system manages 1,300 buses and 6,000 stops, as well as mobilizes 600,000 people on a daily basis. Base operators track the fleet in real time and are able to access precise information on travel time and punctuality on each route. Carbon emissions are reduced with the high efficiency of the fleet and passengers have access to real-time information regarding their transport options.

EXAMPLE: MOBILE TECHNOLOGY: MEXICO

AT&T and Current, the latter powered by GE, use mobile technology to enhance public infrastructure in Mexico. Collaboration with local authorities aims to equip streetlights with cameras, microphones, and sensors, transforming them into IoT-enabled streetlights. These sensors, with real-time data, will assist the authorities in estimating crowd sizes and checking vehicle speeds (GSMA, 2014).

2.3.7 Decarbonizing the energy sector and energy efficiency in buildings

The quote above refers to the fact that energy production is the largest contributor to GHG emissions, not only on a global scale but also on at the regional level,

such as in LAC (WRI, 2017). Energy consumption continues to increase, despite the use of ICT and IoT solutions, and a key factor is the energy efficiency in city buildings. The energy sector, however, is among those that could considerably benefit from ICT solutions by playing a major role in optimizing the use of energy. Furthermore, it could integrate renewable energy sources into existing electricity networks, especially the energy generated by roof-top solar panels in urban environments. Solar energy can be fed directly into the grid, thus creating a new energy player, the prosumer. Prosumer buildings switch between producing and consuming energy, and use smart meters for accurate billing.

For remote and rural populations, off-grid solutions provide access to energy through the deployment of small off-grid networks. Currently, there are 1.3 billion people worldwide who have no access to electricity, thus constituting a business opportunity for the ICT sector. Mobile money provides an alternative to traditional financial services, making payments affordable in remote areas. At the same time, connectivity enables direct communication with costumers and the ability to remotely monitor the distributed networks.

Design reflects intention. Networks are designed to address peak loads which they run efficiently; however, efficiency decreases when the load on a network is low. A more targeted approach would be to add smaller cells, the number of which can be easily increased in high-traffic locations so as to decrease energy consumption, byte by byte, thus reducing transmission distance and providing improved service. These cells also can be incorporated into existing infrastructure to manage visual impact, such as smart street lamps.

There is strong economic incentive to further develop smart grids. The cost savings associated with smart grids would reflect on the following three stakeholders:

- Grid operators: Investing in grids and their maintenance will decrease costs. As operational efficiency improves, the cost of labor, associated mechanisms, fuel, and maintenance will decrease.
- Energy providers: The effectiveness of energy demand and supply management increases.
- Consumers: By being better able to understand their consumption, they will adapt their behavior (consumption) accordingly. This will reduce the amount of energy used, resulting in lower costs (ITU, 2017).

"...the only way to keep below 2 degrees and as close as possible to 1.5 degrees is to mobilize the private sector to move on an energy transformation." (Antonio Guterres, UN Secretary at the 23rd Conference of the Parties, 2017)

Source: Guterres (2017).

"ICT has the potential to enable a 20 percent reduction of global CO_2eq emissions by 2030, hold emissions at 2015 levels and effectively decouple economic growth from emissions growth."

Source: GeSI (2015).

Energy efficiency in buildings largely relates to the type of building materials used and the design to improve insulation by relying, where possible, on natural light and energy-saving bulbs. LED lighting, for example, has been successfully introduced in many countries over the years. Intelligent systems that regulate and optimize the energy use of a building, such as smart meters for direct feedback, are worth considering for energy efficiency. Smart heating and air conditioners, among many other appliances, reduce GHG emissions and will increase the wellbeing of those living and working in buildings.

EXAMPLE: ON ITS WAY TO BEING A SMART CITY: SANTIAGO, CHILE

Santiago has implemented various smart technology apps since its initiative, Smartcity Santiago, was launched in 2012. The drivers behind these developments are Chilectra and Entel Group. One hundred smart meters were deployed in three city districts and an office park. Santiago's Ciudad Empresarial is aligned with several smart technologies that improve management and optimize energy use, thus decreasing GHG emissions.

EXAMPLE: END-TO-END SMART ENERGY BUILDING SOLUTIONS: SAO PAOLO, BRAZIL

Telefónica developed a pilot project of end-to-end smart energy building solutions in collaboration with the Melía hotel chain, the latter among the market leaders in LAC. Their aim is to decrease costs and GHG emissions by measuring energy consumption in real time and remotely controlling lighting and air conditioning systems in common areas. The outcome in the first year (2016) of the project was a decrease in energy consumption by 12 percent compared to previous records. This resulted in an approximate return on investment in only 1.3 years, with an associated reduction in GHG emission of about 485 kilotons (kt) of CO_2 per annum.

2.3.8 Cities and mobile solutions: the way ahead

There are numerous ways in which cities are able to benefit from ICT and mobile solutions. As described in this section, many are now in place, although their potential is far from reached, given the different planning and operating perspectives of cities and the ICT industry. Innovative approaches remain scarce, although one could be to adapt, with the aid of the ICT sector, to what is becoming an attractive business model that is partially driven by a circular economy and sustainability; that is, the service economy approach. In its adapted form, this approach would take into account the scale of change in the ICT industry while meeting

Box 13

State of the Art Technology to Resolve City Challenges

Cities continue to seek new solutions from each other. In particular is the procurement process, using information and communication technology platforms such as Citymart, a social enterprise that since 2011 has supported cities with state-of-the-art technology to address urgent issues. In the LAC region, the cities of Sao Paolo and Buenos Aires and the Government of Chile are among those that have taken advantage.

The platform facilitates communication between civil servants around the world facing similar issues. It aids large-scale problem solving, not in the least by widening the procurement process and offering a city the opportunity to select from among a higher number of partners to work with. While the approach remains the same, the challenges to address are diverse, relating to such topics as urban lighting, traffic safety, energy, education, and public health.

Source: Citymart (2017).

the long-term requirements of public operators. With such a service-oriented approach, a city would not be required to buy a particular number of water meters, sensors, or software packages; rather, a provider would be able to offer services by contracting them out over a paticular period of time. This approach not only would offer the provider the freedom to opt on how to extend this service, it also would incentivize the provider to regularly increase and update the technology, thus pushing innovation further. Exploring new approaches is essential and will require flexibility and transparency, as well as the willingness of all parties to think outside the box.

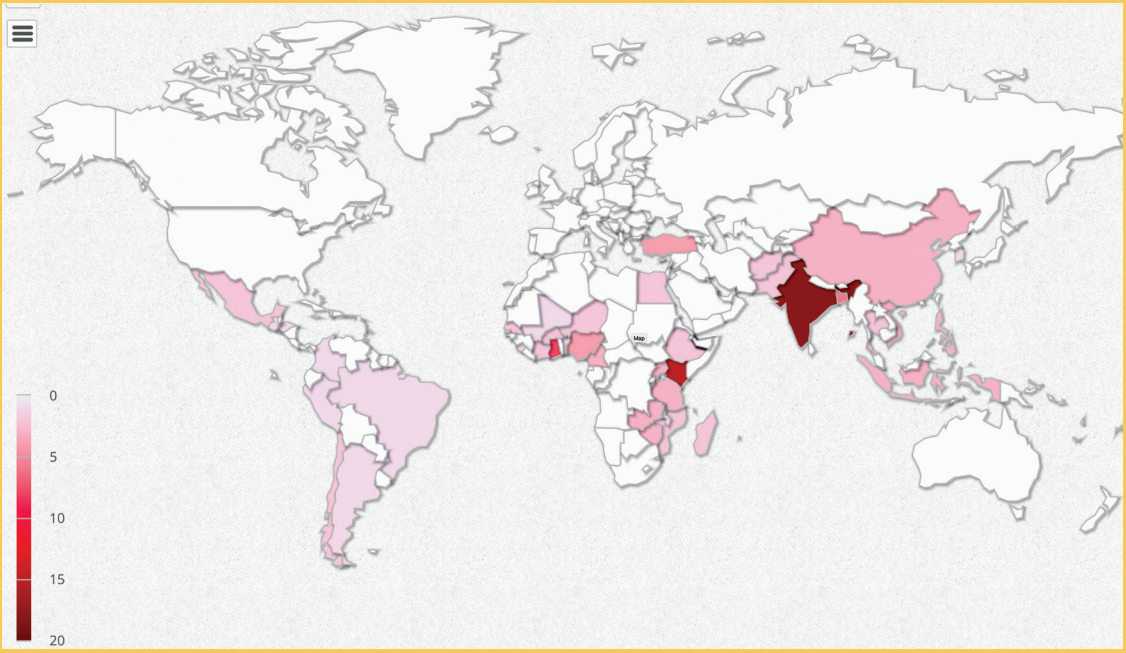
2.4 Rural Areas

While those Latin Americans and Caribbeans who reside in urban areas have access to electricity through the grid (99 percent), one in five people in rural areas lacks access. Their methods for light and energy is through the use of kerosene lamps, candles, and diesel generators, all of which negatively impact the environment and people's health. To extend the grid to these areas often is not viable, given their remoteness and inaccessibility (e.g. the Andes). Off-grid power solutions, such as solar energy, are alternatives not only to reduce environmental and health impacts, but also to lower costs in the long term. These include energy to light homes, charge mobile phones, listen to radios, and cook (World Bank, 2016).

The focus of off-grid solution providers has been on Africa and Southeast Asia, according to GOGLA, the international organization tasked with supporting the use of solar solutions for remote locations. Several of its providers, however, are operating in the LAC region, particularly Central America, with the likelihood of their share in the market increasing. A key factor when developing and deploying solar powered systems is repair and maintenance. Technical support in remote areas can be expensive and challenging. Mobile technology, in this case, would enable operators to remotely monitor systems and provide precisely targeted services at reasonable cost.

The untapped opportunities in LAC for ICT and mobile solutions in agriculture is significant. An overview of these solutions at the global level provides evidence of this. Throughout LAC, GSMA's mAgri Deployment Tracker lists only one to five solutions in each country (Figure 9). The highest number of apps by country are in Asia.

FIGURE 9: GSMA mAGRI DEPLOYMENT TRACKER: NUMBER OF PRODUCTS AND SERVICES USING MOBILES IN AGRICULTURE ACROSS THE DEVELOPING WORLD



Source: GSMA mAgri Deployment Tracker, available at https://www.gsma.com/mobilefordevelopment/m4d-tracker/magri-deployment-tracker/.

The initiative also examines projects that further improve the independence and sustainability of smallholder farmers in LAC, such as the digitalization of agricultural payments by mobile phone. This is an example of an interesting business opportunity in the ICT sector; annual revenue by 2020 is estimated at close to US$2 billion for the business-to-person sector alone (GSMA Intelligence, 2016).

Apps now often are dominated by initiatives that are supported by development aid. In the course of their implementation, however, it has become evident that these technologies drive efficiency and transparency, contribute to SDG achievement, and become established new services. For example, a project on transparency and efficiency in agricultural supply chains led to the development of the Farmforce platform, initially supported in El Salvador, Honduras, Haiti, and Guatemala with a grant from the Syngenta Foundation, Switzerland. The platform software is now marketed as a service to NGOs, food production companies, auditors, outgrower schemes, and exporters around the world (Syngenta, 2017). The next phase of this service is likely to include the environmental aspect of the industry.

2.4.1 Sustainable agriculture

Agriculture, particularly the transformation of agricultural land as a result of deforestation, has a large GHG footprint. Following energy, agriculture is the largest single contributor to GHG emissions in LAC countries such as Argentina, Brazil,

Box 14

Big Data and CGIAR

"Data is much more than simply information: in expert hands, it is intelligence. The rapid growth in processing power and global connectivity means we can now quickly collect, share and analyse enormous amounts of data and turn it into recommendations that can be of use to farmers and policymakers. Applying these Big Data approaches to agriculture promises to find new ways to reduce hunger and poverty, and to develop robust responses to challenges such as climate change, pest and disease outbreaks, and land degradation. It could help reduce some of the daily risks farmers in developing countries face, enabling them to thrive."

Source: CGIAR (2018).

and Mexico (Global Forest Watch, 2018). It also is affected directly by, and vulnerable to, the impacts of climate change, such as precipitation patterns and temperature.

2.4.2 Smart and resilient smallholder farmers

In the food and agriculture sectors, digital technologies such as sensors, IoT, Big Data, and robotics contribute to the empowering of small-scale farmers by optimizing value chains; reducing resource usage and food waste; allowing smart resource allocation and food traceability; building climate-resilient agriculture; and creating resilient crops. Basic technologies, such as communication through SMS, also assist farmers to access information on weather and climate impacts.

These developments lead to a reduction of GHG emissions in the sector and protect the environment. Advanced modelling of changing environmental patterns due to climate change is the basis for building resilient systems. Mobile technologies make this information available to a large audience such as small-scale farmers in countries vulnerable to climate change. The use of robotics, Big Data, IoT, smart equipment, and farm management software generates efficiency gains in food production for a growing population facing resource constraints without damaging the environment (SustainAbility, 2017).

Agriculture is especially sensitive to changes in precipitation patterns. Therefore, irrigation systems are an option to increase resilience. Solutions are based on sensors and communication, intelligent watering systems, and highly efficient delivery mechanisms for water and nutrients. Technologies, such as moisture and canopy sensors, allow farmers to provide irrigation when it is needed and adopt other good agricultural practices such as conservation tillage. Other benefits are reduced energy needs in comparison to conventional systems. These technologies alone, however, cannot lead to benefits for the environment, farmer, and society. The adoption of technologies should be accompanied by extensive capacity-building measures, given that a smart solution used in an inadequate way can be as or more wasteful than a conventional method (Levidow et al., 2014).

In 2017, CGIAR—a global research partnership for a food-secure future—launched the Platform for Big Data in Agriculture to drive the adoption of new technologies and build capacity. It aims to facilitate the development of new approaches for agriculture in developing countries by seeking solutions for challenges such as

climate change, pests, disease, and water and land degradation. The solutions will find their way onto the field only if actors across the supply chain cooperate and drive the adoption of new practices. CGIAR will use its existing vast reach and resources to drive the initiative by collaborating with small local players and national institutions alike.

2.4.3 Challenges in the livestock sector

One sector within agriculture that is associated with large and increasing shares of GHG emissions is the livestock sector; especially in less developed countries, the amount of GHG emitted per unit of output is staggeringly high. On a well-managed farm, GHG emissions per liter of milk can be three to four times lower than on a poorly managed one. As more people are able to afford and wish to consume animal products, reigning in GHG emissions from this sector is vital to addressing climate change.

2.4.4 Agriculture systems of tomorrow

Increasing the productivity of agricultural systems largely relates to the knowledge and level of education of local farmers. With strong mobile coverage across LAC, farmers are able to be remotely reached, trained, and supported at scale.

At the same time, traditional farming practices should adapt to changes in climate patterns, such as droughts and floods. This is a challenge for farmers, one that ultimately threatens food security. Crops and yields are negatively affected by unpredictable, shifting weather patterns and extreme weather events. Smallholder farmers have little access to information on this topic unless it is provided via mobile devices, due to their location and general lack of resources. This situation also highlights the fact that information must be targeted to and relevant for those receiving it. Initiatives that generally demonstrate a high success rate follow a “nothing for me without me” approach that assures the involvement of farmers and, in turn, ensures that the information provided fulfills its purpose.

EXAMPLE: UNILEVER’S DIGITAL STRATEGY

Unilever’s digital strategy for sustainable agriculture centers on the delivery of information, as well as transactional and advisory services through mobile technology.

It is aligned with the vision to increase rural incomes of the Food and Agriculture Organization of the United Nations.

EXAMPLE: COLLABORATING TO PROVIDE SMALL-SCALE FARMERS WITH PRECISE INFORMATION: COLOMBIA AND HONDURAS

In these two countries, several organizations are collaborating to provide small-scale farmers with information that is precise and adapted to the local environment so that they can make climate-smart decisions. The project is a result of the co-operation between the International Center for Tropical Agriculture, the CGIAR Research Program on Climate, Agriculture and Food Security, and more than 10 other partners including the Colombian Ministry of Agriculture and Rural Development and the Honduran Secretariat of Agriculture and Livestock. Approximately 300,000 farmers—growing mostly maize, beans, rice, fruit trees, and coffee—are benefitting from the project. It was one of the winners of the Momentum for Change Award by the UNFCCC in 2017 (UNFCCC, 2017). In one case in Cordoba, Colombia, the information was used to adjust rice planting times. The adaptation of practices based on available data is estimated to have assisted 170 farmers in avoiding crop loss in 1,800 hectares of irrigated rice. This decision alone has saved US$3.5 million in input costs (CIAT, 2017).

EXAMPLE: MEXICO'S TECHNOLOGY TRANSFORMATION PROGRAM

The technology transformation program, MasAgro, in Mexico uses satellite imagery in a tool to calculate nitrogen requirements of farmer fields. The program is managed by the Government of Mexico, in collaboration with CIMMYT of Mexico. Industry partners, such as Grupo Bimbo, a major brand in LAC, are vital in the implementation of the program.

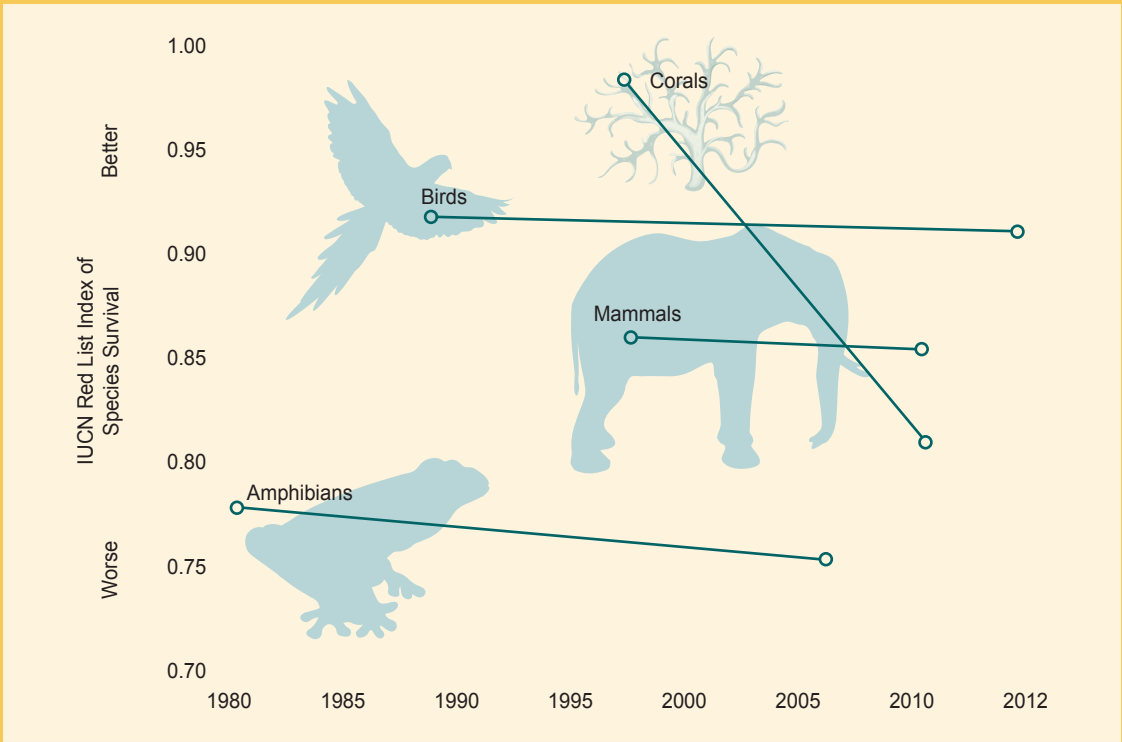
EXAMPLE: USING MOBILE PHONES TO EMPOWER FARMERS IN MEXICO

The social enterprise, Extensio, in Mexico provides a platform for smallholder farmers to access the information necessary to make informed decisions and be able to lead the life they value. The information varies from weather to market prices and sustainable farming practices. It mainly utilizes simple messaging technologies, such as SMS, that are available in rural areas. In 2017, the company's services reached 8,000 farmers (Extensio, 2018). As Diana Popa, Co-Founder and Chief Executive Officer, points out, "The scalability of communication technologies facilitates the access to information relevant to climate change. Not only large corporations but also small holder farmers can now consider accessing the necessary information to determine adaptation and mitigation actions such as sustainable farming practices or in the future even GHG emission related to transport."

2.5 Smart Environmental Protection Based on Mobile Solutions

A rising global population and the increasing use of land for agricultural production have driven land-use change over the past century. Along with leading to a stark increase in atmospheric CO_2 emissions, it also has led to the decrease and destruction of habitat for wildlife. The International Union for the Conservation of Nature's Red List of Threatened Species™ is becoming longer, and the Red List Index for the four major taxonomic groups (Figure 10) indicates that their status is clearly declining. Once a species has reached a certain threshold, recovery is challenging and, in some cases, nearly impossible. Taking preventative action based on a clear understanding of the status is key. The sections below highlight how mobile solutions can build understanding and lead to real impact on the ground to protect wildlife and prevent deforestation.

FIGURE 10: INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE



Source: IUCN (2017).

2.5.1 Protecting wildlife

Human-induced climate change is likely to be a major cause for extinction in the twenty-first century. In LAC, there is a large number of species especially vulnerable to climate change due to their characteristics, such as specialized habitat needs, narrow environmental tolerances, or poor ability to disperse (IUCN, 2015). In order to understand the magnitude of the problem and determine potential actions that can protect threatened species, policymakers and conservationists alike should improve their understanding of the behavior of wildlife and their habitats. Sensors, cameras, and remote sensing apps have increased significantly the understanding and, subsequently, measures to protect threatened species.

The digital industry can collaborate with NGOs and the public sector to use ICT and IoT to protect the environment. América Móvil, for example, is cooperating with NGOs— mainly the World Wildlife Fund—on conservation projects in LAC.

EXAMPLE: ALLIANCE OF WORLD WILDLIFE FUND, TELMEX, AND TELCEL FOUNDATION: MEXICO

Since 2003, the alliance of World Wildlife Foundation, Telmex, and Telcel Foundation has worked to preserve natural heritage and foster sustainable development in Mexico. Species that have benefited from this cooperation are the jaguar, monarch butterfly, and marine species that inhabit the Sea of Cortez, such as the sea turtle. Part of the effort includes raising awareness and, in 2016, 15,000 students were encouraged to consider the beauty and richness of Mexico's natural fauna and flora as well as how these can be preserved.

EXAMPLE: TRACKING SEALS

To increase understanding and take measures to respond to the declining populations, seals and other marine mammals were equipped with the latest marine smart tags, using M2M technology. Connected to Vodafone's global M2M platform, it provides scientists at the United Kingdom's Sea Mammal Research Unit at St Andrews University with a continuous flow of information on a seal's location, its dive behavior, and its oceanic environment for analyses. The tracker is fixed to the fur of the seal with a harmless adhesive, and it drops off during the seal's annual molt. The output of the data analyses and similar projects can lead to effective management and protective measures for wildlife on land and in the water in a way that is compatible with other land-use forms, such as locating off-shore wind farms. Detailed information on animal behavior in real time is only now beginning to show its true potential.

EXAMPLE: GLOBAL POSITIONING SYSTEM TRACKERS AGAINST POACHERS: NICARAGUA

Poaching of sea turtle egg nests is a big issue in Central America. In Nicaragua, the NGO, Paso Pacífico, has developed a global positioning system (GPS) tracker to identify the poaching transit routes of sea turtle eggs, the InvestEGGator. The GPS tracker is hidden in a three-dimensional printed container that looks and feels like an actual sea turtle egg and enables the identification of poachers as well as those buying the eggs (Paso Pacífico, 2018).

EXAMPLE: WORLD WILDLIFE FUND: SEA TURTLE TRACKING

The World Wildlife Foundation is tracking several sea turtles from different species across the Caribbean to understand better their habitat and situation. The live feed is available on their website to raise awareness (WWF, 2018).

2.5.2 Preventing deforestation

Forests convert harmful CO_2 emissions into fresh, lifesaving air and they provide habitats for an innumerable amount of species. Like wildlife, forests are under threat from several pressures, including the expansion of agricultural activities and climate change. The Amazon alone has lost one-fifth of its area over the last four decades. Climate change can lead to significant degeneration and, hence, reduce the capacity of a forest to photosynthesize (i.e. produce clean, liveable air). Sustainably managing and protecting forests is a major contribution to addressing climate change and ensuring the preservation of ecosystems, water resources, and endangered species. The world's largest and most biodiverse forests (e.g, the Amazon) cover vast areas that are challenging to monitor, manage, or protect without the application of technologies such as satellite imaging and the aggregation of real-time information from various sources. Once information of ongoing activities in forests, such as illegal logging, is available to the public and policymakers alike, action can be accelerated to potentially save large areas of vital primary forest.

EXAMPLE: MOBILE APPS TO STRENGTHEN FOREST AND LAND RIGHTS

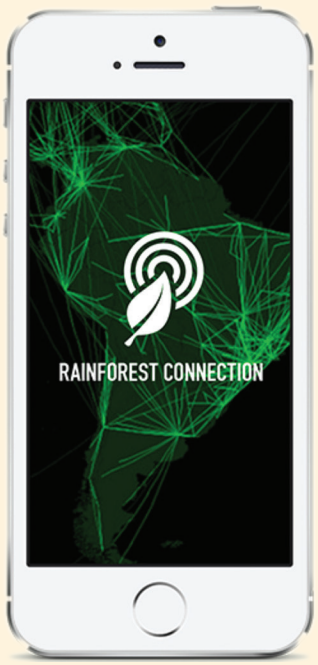
Mobile apps use real-time satellite data to strengthen forest and land rights. Once deforestation is visible on satellite images, it is often too late to act. Rainforest Connection, an NGO, is decreasing the response time by using old mobile phones (Figure 11) mounted in tree canopies and powered by solar energy to alert forest managers to illegal logging activity. The phones record sounds 24 hours a day

and, upon further analysis, can locate noise associated to illegal logging, chain saws, and trucks. Applications over the last two years have included forests in Brazil, Ecuador, and Peru. The project fails to stop there, however; the sound that is recorded also can be used by scientists to study animals, such as rare birds, and allows the general public to listen to the sounds of the forest at any time by using the Rainforest Connection app. The app can send alerts if something is happening on a specific forest site and it provides information to increase understanding and raise awareness (Nunez, 2017).

EXAMPLE: THE GLOBAL FOREST WATCH APPLICATION

Operated by the World Resources Institute since 2014, this app aims to provide information freely for a large number of stakeholders, NGOs, conservationists, scientists, journalists, and policymakers, enabling them to take informed decisions. By aggregating data from various sources and on a broad range of forest-related topics, Global Forest Watch enables the development of strategies and measures that are holistic in their approach and can profit from identifying synergies. The output is provided in form of maps, as Figure 12 shows.

FIGURE 11: THE RAINFOREST CONNECTION APPLICATION: AVAILABLE FOR ANYONE INTERESTED IN LISTENING TO THE RAIN FOREST

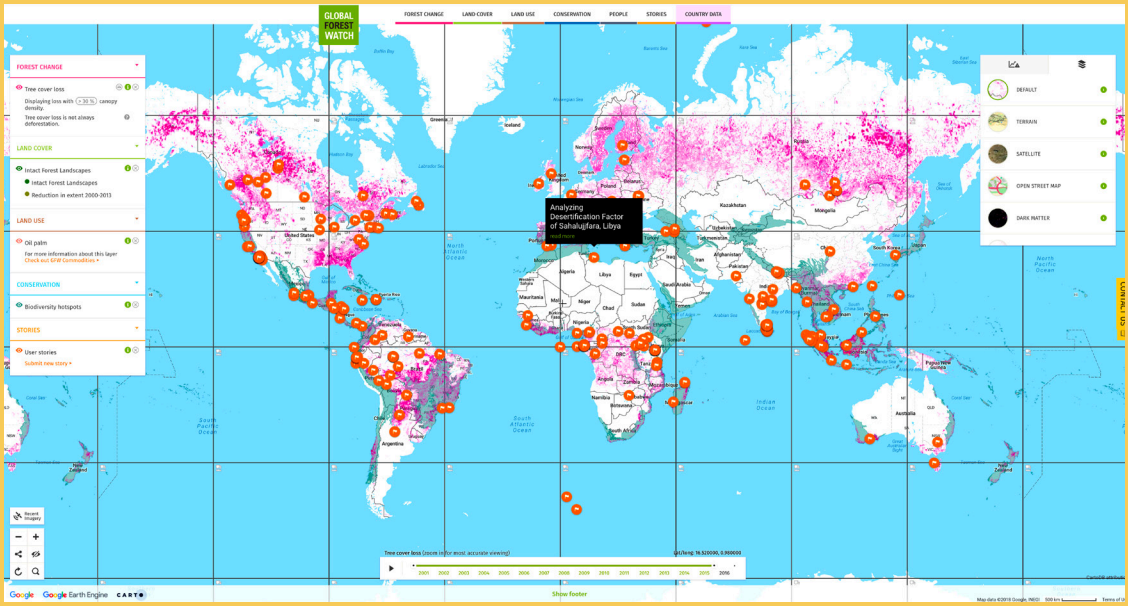


Source: Rainforest Connection (2017).

2.5.3 How information and communication technology solutions decrease greenhouse gas emissions

ICT solutions alone will not reduce carbon emissions and energy consumption, drive yields, decrease travel times, ensure safe water, or reduce deforestation. Solutions need to be applied and integrated and, for this to occur, the digital ecosystem requires partners in the public and private sectors. Finding and collaborating with

FIGURE 12: GLOBAL FOREST WATCH INTERFACE AND INFORMATION FOR BRAZIL



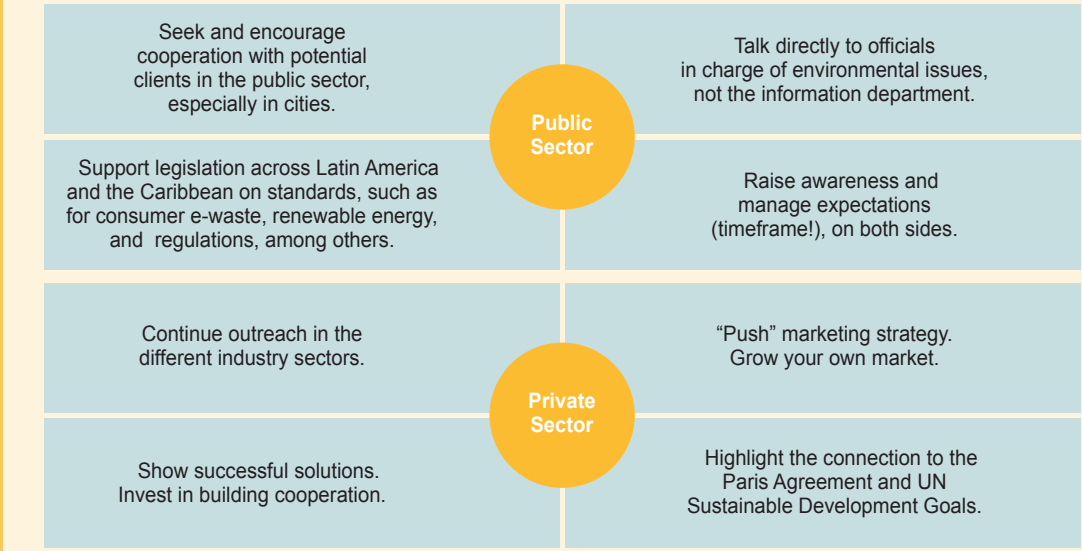
Source: WRI (2017).

these partners differs by sector and topic. An overview of the main points is given in Figure 13.

2.5.4 From technology to solution

The magnitude of the impact the ICT sector can have on climate change mitigation and adaptation will strongly depend on its ability to overcome barriers in collaborating with private and public sector partners. These two sectors have challenges in common, namely, a lack of awareness of the potential and breadth of application of ICT solutions and, consequently, their current reluctance to approach and interact with the ICT sector. The ICT sector must actively engage and build understanding and awareness while supporting the adoption of harmonized legislation and standards across LAC, an important factor. It can lead to higher efficiency and the scale up of solutions across the region. Providing examples of case studies and best practices that are based on robust data through a state-of-the-art monitoring approach is another factor that can significantly contribute to the scale up of solutions in the public and private sectors.

FIGURE 13: FROM TECHNOLOGY TO SOLUTION



Source: South Pole (2018).
Note: SDG = Sustainable Development Goals of the United Nations.

2.6 Current Obstacles in the Public and Private Sectors

This section highlights the magnitude of potential. Actual impact is yet far from reached due to various reasons, among which are aspects of the public and private sectors. Despite the great number and diversity of solutions available in the ICT industry to address climate change mitigation, adaptation, and other environmental issues, it is now possible to accelerate the dissemination of these solutions, as well as the uptake of newer solutions, across the LAC region and globally. Crucial, however, are the lack of policies to address issues at the national and international levels. The lack of appropriate policies hinders companies in the ICT sector to take uniform action and scale up the positive impacts that ICT solutions can offer on the environment.

2.6.1 Public sector

To address these obstacles, national governments—or public entities and departments—should implement policies that contribute to the scale up of ICT solutions

for the mitigation of climate change and other environmental challenges. Legislation, for example, has been implemented in seven LAC countries to reduce e-waste. In countries where pro-environmental legislation remains obscure, NGOs and stakeholders should create awareness and inform civil society, as well as the public and private sectors, to create new ways toward a low-carbon economy.

The ICT sector is advancing rapidly, and it is inevitably a challenge for policymakers to keep abreast of technology. The ICT sector, therefore, must play an active and clear role to engage them to speed up private sector initiatives and comply with new legislations. Such efforts are vital especially in LAC where climate change and environmentally friendly policies must be acknowledged. Depending on their level of inclusiveness, policies can take time from the design stage to implementation, and they are meaningless in the absence of effective enforcement. Taking into account the turbulent history of many countries in the region, the fact that governments may change during the course of policy development remains a challenge. This can reverse significantly the adoption of legislation, thus setting a country behind.

2.6.2 Private sector

The many initiatives and solutions that are present today are randomly spread in terms of geography, approach, and target. A more uniform approach to address the key challenges is required. A step in the right direction is the signing of internationally recognized agreements, pledges, and treaties, such as the SBTs, RE100, and Task Force on Climate-Related Financial Disclosures, together with monitoring and reporting requirements. Nevertheless, more sector-specific initiatives are necessary by pooling together the most prominent players and committing them to reduction targets that take into account the ICT sector. This will pressure the entire sector toward more low-carbon operations and leverage the capacity of their solutions to contribute to tackling climate change and its impacts. The commitment of the ICT sector to the SDGs will be a first step. More concrete and targeted action, however, must follow.

E-Waste Management in Latin America and the Caribbean: Update on Statistics and Sustainable Management Approaches

In order for the ICT industry to reach its full potential in supporting a sustainable economy and society—as previously stated in earlier sections—it is essential that a large quantity of devices be produced, together with adequate network infrastructure and, at the end of their life cycle, disposed of. The way in which this process is managed will have a significant impact on the environment, particularly in the method in which raw materials are extracted as well as the environment in which such materials will be recycled or disposed of.

The management of e-waste partly addresses SDG 6, SDG 11, SDG 12, and SDG 14, which relate to environmental impacts, as well as SDG 13 on heath impacts and SDG 8 on employment and economic growth (Baldé et al., 2017). This section focuses on approaches that contribute to the sustainable management of e-waste, highlighting the situation in LAC as it is today, exemplified by the Dominican Republic. Data presented in this section are based on those representing 2014 to 2016 and those extrapolated for the period 2017–20. Previously mentioned data and the data and figures in this section are based on an analysis conducted in 2017 by the UNU Vice Rectorate which hosts the Sustainable Cycles (SCYCLE) Programme. The underlying dataset was published in Baldé et al. (2017).

This report provides the second overview of data ever published on e-waste in the LAC region, the first report of which was published in 2015. As this section describes, it is necessary to address e-waste in the region. At this point, however, it also should be stated that the most seriously negative impacts of e-waste at the global level apply to Africa and Asia, which receive a vast amount of discarded electronics from Europe and the United States. These are then processed under conditions that expose people and the environment to toxic substances, leading to lasting health and environmental damage.

Box 15

E-Waste and Climate Change

E-waste, if not managed responsibly, can harm the environment. It releases uncontrolled substances, such as dioxin and furan, into the environment and increases greenhouse gas (GHG) emissions. The disposal of material in landfills is a practice that will contribute to higher GHG in comparison to a recycling process with various mechanisms in place. For example, instead of using material that is readily available, raw materials are sourced, thus intensifying energy and GHG emissions. Furthermore, the mining of materials historically relates to the transformation of land use, deforestation, and the negative social impacts on local communities.

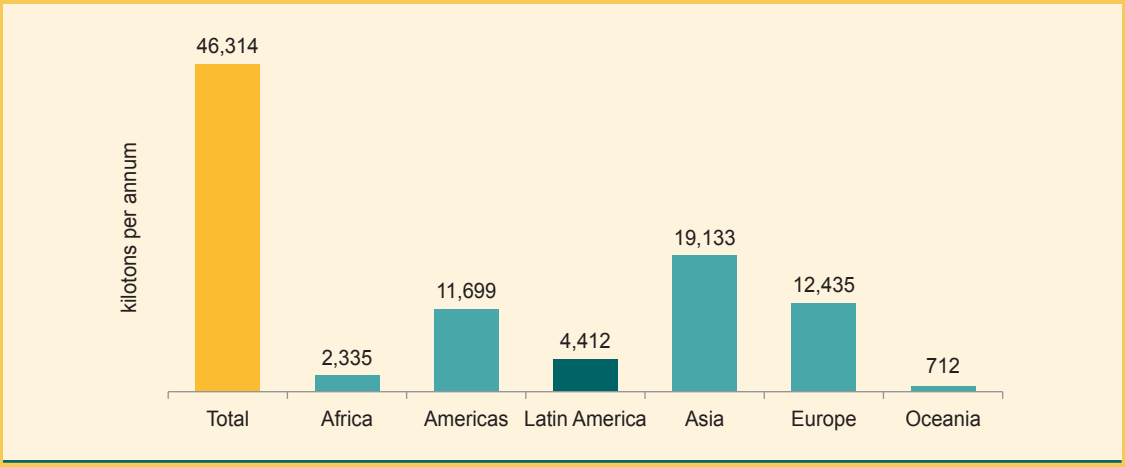
The number of people who rely on the daily use of electric and electronic equipment (EEE) is rising. While the total amount of e-waste relating to EEE is low in comparison to other sources of e-waste (e.g., small and large household appliances), it is crucial for the sustainability of the ICT sector. What happens to EEE once it is of no further use is a question that is becoming increasingly critical. So-called e-waste is a complex mixture of materials and components that contain hazardous elements. Modern electronics use scarce and expensive resources (e.g., approximately 10 percent of total gold worldwide is used in producing EEE). If not properly managed, e-waste can cause major environmental and health challenges. A mobile phone, for example, consists of a large number of elements in the periodic table, including many precious metals and a 45 percent weight composition of plastics.

The ICT industry is moving toward a circular economy approach to address the issue of e-waste. In a circular economy model, no compound goes to waste but is instead reintroduced in the overall cycle, as will be elaborated more in detail in Section 3.1. This reduces the need to mine for virgin materials and, therefore, reduces the amount of wasted material deposited in landfills and incineration. Such a model requires a high level of organization and coordination as well as awareness by the consumer. Section 3.1 presents the current e-waste statistics and management strategies of the ICT industry in Latin America and provides recommendations on how to adopt a circular economy model.

3.1 The Current Landscape of e-Waste in Latin America and the Caribbean

E-waste is set to remain a reoccurring theme in the twenty-first century. With an increasing number of items, from watches to fridges and alarm systems, it is set to

FIGURE 14: ESTIMATED TOTAL E-WASTE GENERATED BY ALL WORLD REGIONS, 2017



Source: Baldé et al. (2017).

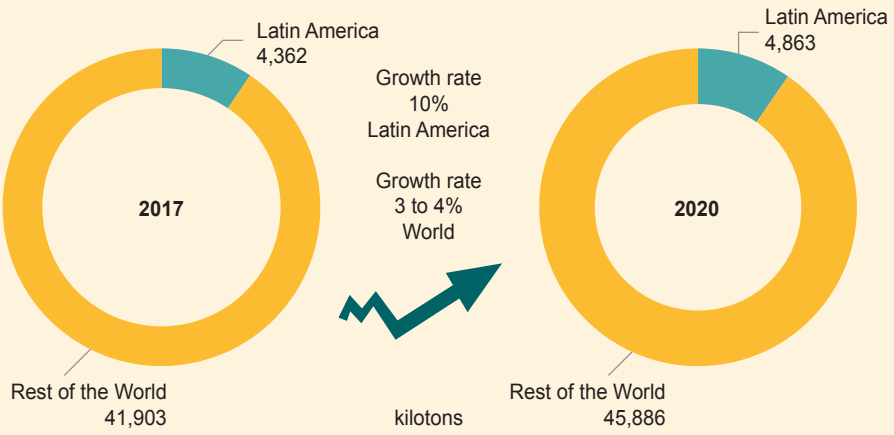
become smart and connected, and the use of electric/electronic equipment and its associated waste is bound to swell. According to a UNU estimate, the amount of e-waste generated will rise by close to 10 percent per annum from 2017 to 2020 in LAC.

It also is reflected in global statistics of e-waste, which is growing steadily and reaching an estimated 46,000 kt in 2017. Approximately 9 percent—close to 4,400 kt— of e-waste is generated in LAC (Figure 14 and Figure 20). The total global amount is estimated to grow an average of 4 percent per annum (Baldé et al., 2017). The growth rate expected for LAC is more than twice as high, at 10 percent per annum, and expected to further increase (Figure 15 and Figure 20) (Ibid.).

While mobile phones have become ubiquitous and their uptake continues to expand, only a small percentage of total e-waste generated in LAC, by weight, is associated with mobile phones, reflecting an estimated 46 kt (or 1 percent) in 2017 (Baldé et al., 2017).

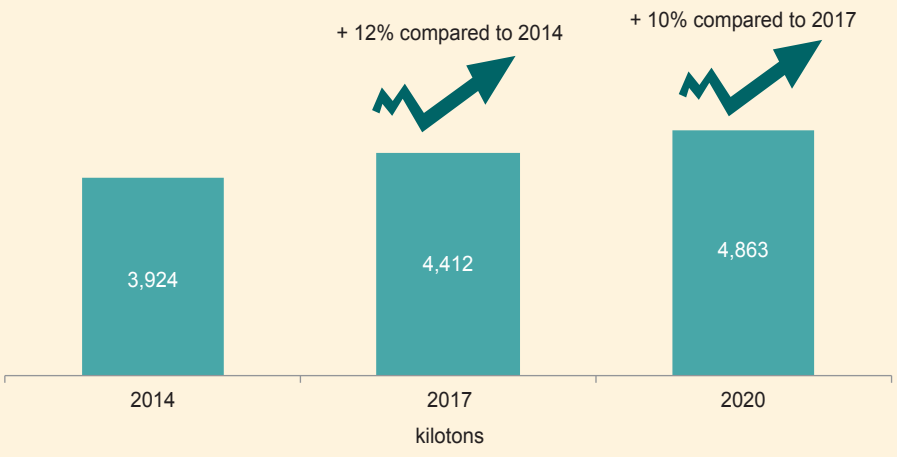
The amount of e-waste from electric and electronic equipment use per capita per annum varies across LAC. The highest per capital amount in 2017 was generated in Uruguay at an estimated 11 kilograms (kg), while it was considerably lower in

FIGURE 15: ESTIMATED AMOUNTS OF TOTAL E-WASTE AND GROWTH RATES FOR LATIN AMERICA AND THE WORLD



Source: Baldé et al. (2017).

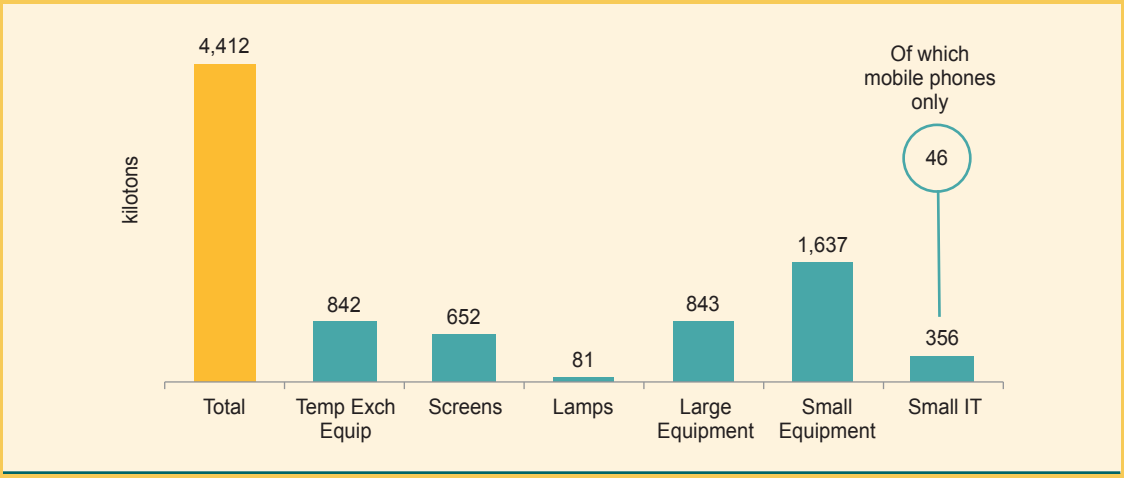
FIGURE 16: TOTAL E-WASTE GENERATED IN LATIN AMERICA*



Source: Baldé et al. (2017).
*Data for 2017 and 2020 are estimates.

Nicaragua at approximately 2 kg (Figure 18). The regional average amounted to an estimated 7 kg per capita in 2017, close to the global average of 6 kg per capita, although it was significantly lower than, for example, in Europe at 16 kg (Baldé et

FIGURE 17: ESTIMATED TOTAL AND MOBILE PHONE E-WASTE GENERATED IN LATIN AMERICA, 2017



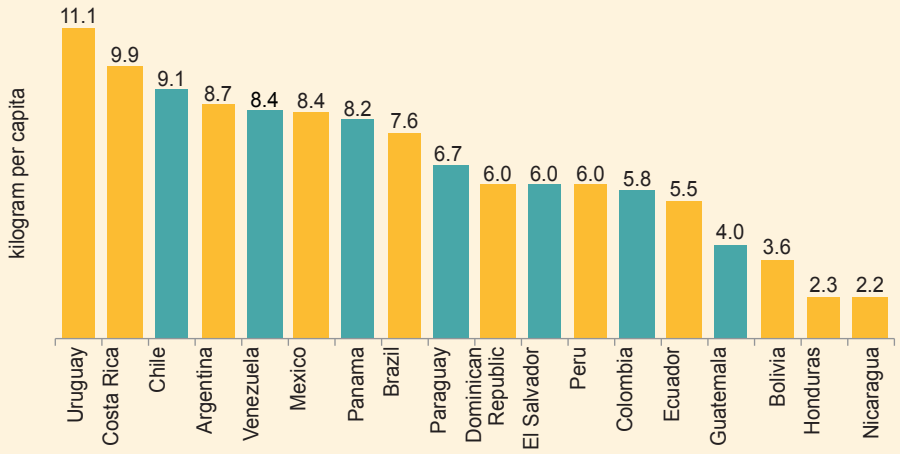
Source: Baldé et al. (2017).

al., 2017). A likely factor contributing to this is that the re-use of mobile devices in Latin America is rather high. Devices are often handed down to relatives or sold instead of being discarded, thus raising their life cycle. In parallel, old devices often are stored at home due to the lack of recycle infrastructure and incentives.

In the absence of major policy initiatives, e-waste is projected to grow across LAC from 2017 to 2020 by an estimated 10 percent per annum. At present, initiatives and policies in LAC to address the issue are at random. Countries such as Chile are advocating the extended producer responsibility (EPR) approach as an option to tackle the matter, while others barely take action. Legislation at the national level is enforced in seven countries across the region, namely, Bolivia, Chile, Colombia, Costa Rica, Ecuador, Mexico, and Peru. Next to those without, the implementation of initiatives and policies remains a challenge (Baldé et al., 2017).

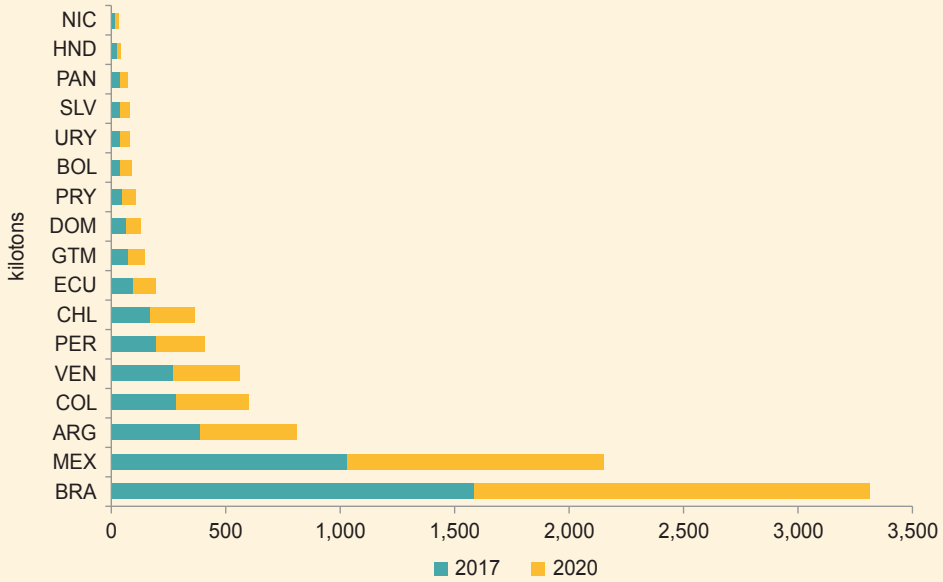
The largest absolute amount of e-waste in Latin America is produced by Brazil followed by Mexico and Colombia (Figure 21).The average amount of e-waste from mobile phones per capita in LAC in 2017 was 81 grams. The range is broad for the region, reflecting Uruguay at 142 grams per capita down to Hondoras at 30 grams (Figure 22).

FIGURE 18: ESTIMATED TOTAL E-WASTE IN LATIN AMERICA



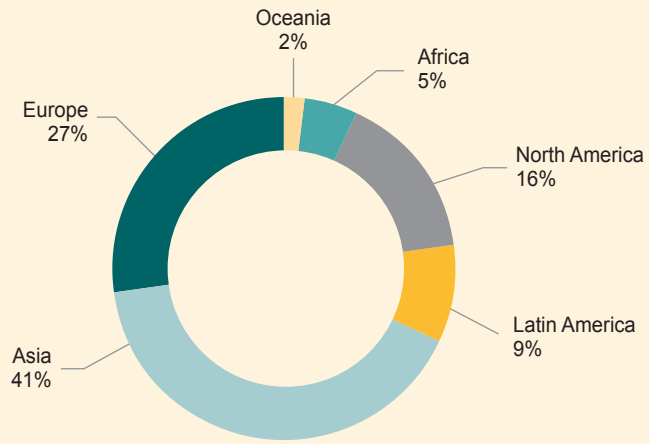
Source: Baldé et al. (2017).

FIGURE 19: ESTIMATED E-WASTE IN LATIN AMERICAN MARKETS, 2017–20



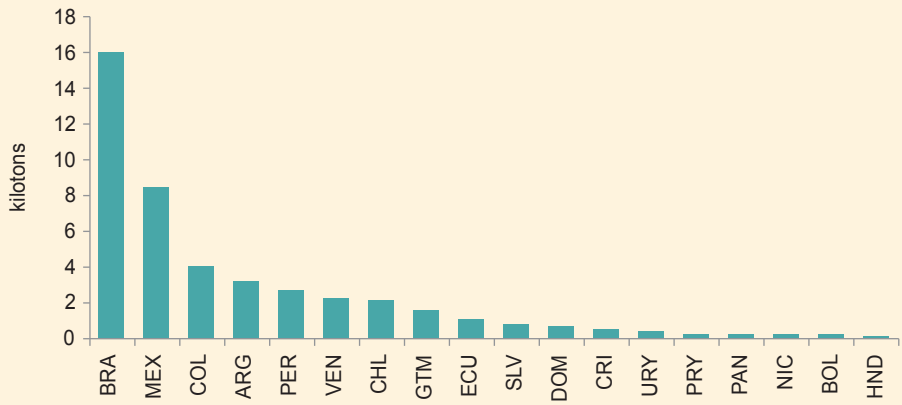
Source: Baldé et al. (2017).

FIGURE 20: PERCENTAGE OF E-WASTE GENERATED GLOBALLY, 2017



Source: Baldé et al. (2017).

FIGURE 21: ESTIMATED MOBILE PHONE E-WASTE FOR LATIN AMERICA, 2017



Source: Baldé et al. (2017).

FIGURE 22: MOBILE PHONE E-WASTE GENERATED IN LATIN AMERICA, 2017

Source: Baldé et al. (2017).

3.2 A Sustainable Approach to e-Waste Management

The circular economy centers on the adaptation of approaches to eliminate the notion of waste. The output of any production process, therefore, is an ingredient that can be applied to another process such as a natural process, exemplified by falling leaves that decay and provide nutrients for the following season. A circular economy takes into account the technical nutrients, such as metals that are able to be recycled and reused with or without a minimal reduction in function

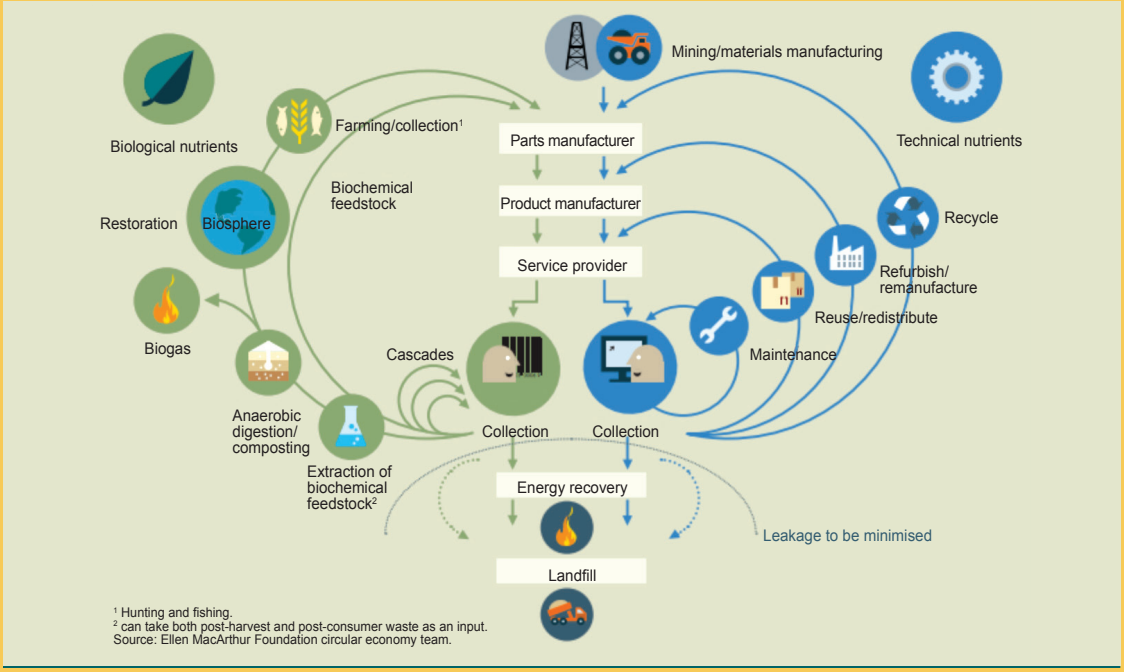
Box 16

A Circular Economy

"A circular economy is characterized as an economy that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times, whilst distinguishing between technical and biological cycles."

Sources: Ellen McArthur Foundation (2013); Sukhdev et al. (2017).

FIGURE 23: THE CIRCULAR ECONOMY: AN INDUSTRIAL SYSTEM THAT IS RESTORATIVE BY DESIGN



Source: Ellen McArthur Foundation (2013).

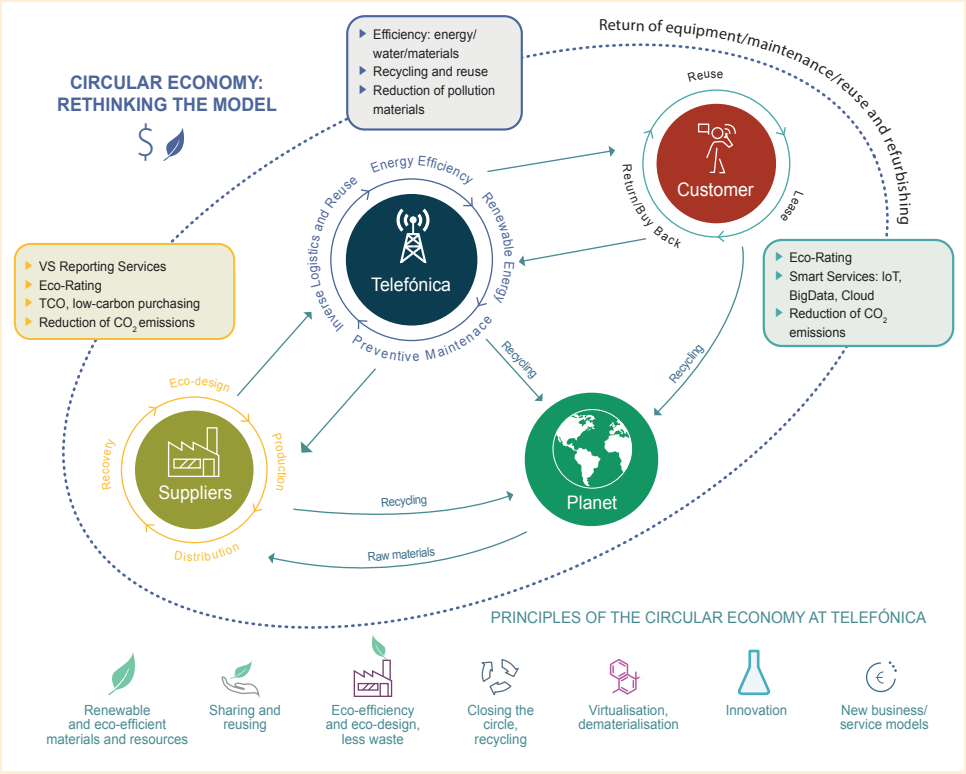
or capability. The two cycles of biological and technical nutrients are described in Figure 23. The individual steps leading to the function of this technical nutrient cycle require the cooperation of relevant actors along the cycle, from the user dropping the old device at a dedicated waste collection point to the industry providing services (e.g., refurbishments and maintenance) to increase the life span of the device. Ideally, this reuse should be examined during the design phase.

A Swedish case study in 2015, published by the Club of Rome, concluded that by adapting key circular economy policies in terms of renewable energy, energy efficiency, and material efficiency, carbon emissions could be cut by 70 percent by 2030 (Wijkman, 2015). A move toward a circular economy is closely linked to and based on regulatory action. Current regulations across LAC are liberal and do not include principles such as the EPR approach—a common practice in Europe to incentivize the various actors to cooperate around the cycle. Network providers in a system such as this would distribute and support the collection process. Producers, however, should be responsible for the recycling or final disposal of devices.

Box 17

From Theory to Practice: Telefónica's Vision of the Circular Economy

Telefónica has implemented the GReTel, a digital platform for waste management. It addresses various aspects of e-waste, as illustrated in the figure below. The platform provides complete traceability of e-waste, using equipment across countries to assist in setting targets and developing measures. The platform now is employed in Spain and Colombia, and will reach the 15 other countries in which Telefónica operates. It also has simplied Telefónica's compliance with environmental regulation. In addition, Telefónica will continue to leverage its annual purchasing volume by engaging with suppliers of electronic equipment so as to resolve the issues related to e-waste at the beginning of the process.



Source: Telefónica (2018).

3.2.1 A developing sector

The formal recycling sector in LAC is not yet fully developed. Those mobile operators expecting to support the responsible treatment of e-waste are encountering obstacles such as national recycling systems that do not exist or companies unable to support waste collection campaigns at the national level.

EXAMPLE: PROGRAMA VERDE, MEXICO

Programa Verde, under the GSMA WeCare campaign, is a program in Mexico whereby providers such as AT&T, Telcel, Telefónica's Movistar, Huawei, and Samsung, among others, participate in initiatives to raise the amount of e-waste being recycled. Globally, only 15 percent of e-waste is recycled. Despite the program having reached its fifth year of operation, the amount being recycled is seemingly decreasing, possibly as a result of smartphones now being made with longer life cycles. Mobile devices that continue to function often become second-hand items at a high rate in Mexico—a positive outcome from an e-waste perspective. Of the material collected, 80 percent is recycled nationally and 20 percent is exported. To escalate the recycle rate in a country where the development of extensive networks is nascent, regular campaigns to address e-waste management are taking place on social media. Judging from the posts that are most shared, Mexicans are more interested in the numbers and device outcomes in the absence of recycling (Anatel, 2017).

EXAMPLE: SPECIAL CONTAINERS FOR MOBILE DEVICE COLLECTION

The customer service centers of Mexico (i.e., Telcel), Brazil (i.e., Claro), Chile, Colombia, Costa Rica, and Perú offer special containers for the collection of mobile devices and accessories. These items are recycled by certified processors to prevent contamination and reduce emissions throughout the recycling process.

Several facts should be taken into account in terms of responsible e-waste management: e-waste often contains materials that are toxic; recycling often is not cost effective due to the high amount of manual labor required; and only a handful of products are designed for recycling. Furthermore, recycling requires a level of consumer awareness, so that devices can be made to last longer. Based on a global comparison, the life span of a device in LAC is longer, since they often are reused or sold before being discarded. As such, many telecommunication providers are overcomplying with national regulations.

"To move toward a circular economy, we need to understand what is not sustainable and resource friendly about the existing economy." (Cristina Bueti, Advisor of ITU-T Study Group 5)

Source: ITU (2017).

EXAMPLE: ENTEL'S BARRIO FELIZ PROGRAM, CHILE

Chile's Entel promotes the recycle of used mobile phones through its Bario Feliz Program, aiming to support rehabilitation projects in selected neighbourhoods. Customers are able to dispose of their phones at more than 300 Entel collection stations and Entel partner stores (Entel, 2015).

EXAMPLE: OI TROCA FÁCIL PROGRAM, BRAZIL

A buyback program, Oi Troca Fácil, has been implemented by the Brazilian provider Oi S.A., offering customers collection stations for mobile phones. These are recycled or restored and resold to boost 4G migration (Oi, 2017).

3.2.2 A new business model: dematerialization

Significant change relies on product innovation, whose impact often can be intensified in combination with a new business model. A significantly relevant and proven approach for the ICT sector is based on dematerialization. This relates to the purchase of services in place of products. The aim of the model is to ensure that a device, such as a mobile phone, remains the property of the manufacturer. The client pays for the use of the device over a period of time, not unlike a music streaming service. This approach incentivizes the manufacturer to optimize the recycle and reuse of materials, since the profit that would be earned from the sale of another device is made, rather, from the service provided. The shift to such a business model will require a transformation in consumer behavior as well as active commitment by the ICT sector.

3.3 Policy Recommendations for e-Waste Management

From the policy side of e-waste in LAC, there are four key aspects to consider. These are illustrated in Figure 24.

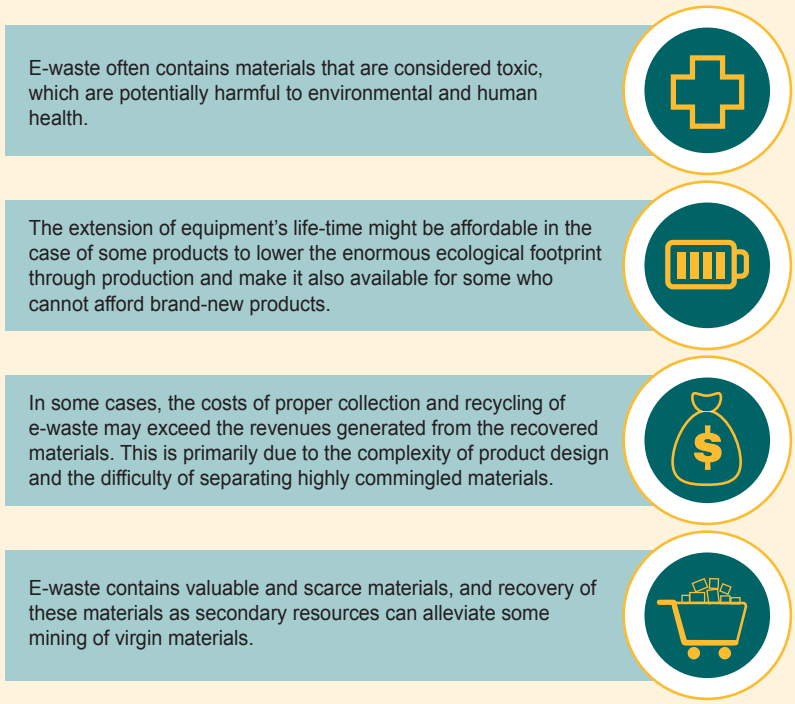
An appropriate financing mechanism that is tailored to the national context should be defined and enforced. While measures along the recycle chain sometimes are remunerated by generated revenue, in the majority of cases this does not occur. It is not possible to decouple these elements from a national or regional assessment of recycling infrastructures for effective collection, pre-processing, and end-processing of e-waste and resulting outcomes.

A suitable financing scheme should be developed to ensure that a nation's e-waste is properly treated and that societal benefits are maximized. Revenues generated by the appropriate recovery of material may not suffice (Magalini, Kuehr, and Baldé, 2015).

3.3.1 A policy approach: the extended producer responsibility

A policy approach that is favored and has been successfully adopted in Europe and has been introduced in various countries in LAC is the EPR method, previously mentioned. This approach aims to incentivize manufacturers to improve the environmental design of their products and their supply-chain environmental

FIGURE 24: FOUR MAIN ELEMENTS TO BE CONSIDERED IN THE CONTEXT OF POLICY DEVELOPMENT



Source: Magalini, Kuehr, and Baldé (2015).

performance. Furthermore, it focuses on ensuring a high rate of utilization in order to preserve materials through effective and environmentally sound collection, treatment, reuse, and recycling processes. To place the responsibility on the manufacturers is based on the fact that most of the environmental impacts of a product are determined at the design stage (Baldé et al., 2017).

3.3.2 E-waste and the sustainable development goals

The management practices of e-waste directly impact six of the 17 SDGs (SDG 3: Good Health and Well-Being; SDG 6: Clean Water and Sanitation; SDG 8: Decent Work and Economic Growth; SDG 11: Sustainable Cities and Communities; SDG 12:

Box 18

Recycling. What Does this Mean?

Ninety-eight percent of products (mainly ferrous and precious metals, as well as plastic) collected from Ericsson's global Ecology Management Product Take-Back Program are recycled. Ericsson has partnered with Chile's leading telecommunications operator, Entel, to implement the program's principles, including the collection, decommissioning, transportation, storage, and disposal of electrical equipment. In 2016, 400 tons of material was collected. While legislation across Latin America and the Caribbean is yet to be harmonized, countries such as Chile are shifting toward an extended producer responsibility approach, with Chile having enacted a law. This approach ensures that electronic equipment manufacturers and companies are responsible for the administrative and financial activities of recovering and managing the waste of their products and derivatives.

Source: Ericsson (2017).

Responsible Consumption and Production; and SDG 14: Life Below Water), recently concluded in a study led by UNU. One of the key aspects is the gathering of data on the generation of and faith in e-waste, given that there are none available at the global level—a further reason why adopting a circular and responsible approach to e-waste management is essential—placing it at the top of the ICT industry agenda.

Box 19

Methodology

In the past, estimates of e-waste generated were mainly obtained from a simple correlation with gross domestic product. For this report, the e-waste data relating to countries in Latin America and the Caribbean were gathered by applying the sales lifespan approach, consistent with internationally accepted definitions of e-waste statistics (Baldé et al., 2015). Likewise, statistical import and export data were derived from the UN Comtrade database and subjected to automated statistical routines, as described in Baldé et al. (2017). This report mostly relies on European-derived lifespans which include the dormant time of the device prior to discard. In other countries, the lifespan of electric and electronic appliances could deviate significantly and lead to error. It was assumed, therefore, that the higher residence times by product in the European Union were approximately applicable for countries in Latin America and the Caribbean. This can lead to an overestimation (products can last longer) or an underestimation (the quality of products is often lower, so they are disposed of in a shorter time). In general, however, it is assumed that this process will lead to estimates that are relatively accurate.

United Nations University

The United Nations University (UNU) is an autonomous organ of the United Nations General Assembly, dedicated to generating and transferring knowledge and strengthening capacities relevant to global issues of human security, development, and welfare. The university operates through a worldwide network of research and training centers and programs, coordinated by the UNU Centre in Tokyo.

The Sustainable Cycles (SCYCLE) Programme, hosted by UNU's Vice Rectorate in Germany, provides world-class research and promotes action on e-waste. SCYCLE aims to enable societies to reduce the environmental burden caused by the production, consumption, and disposal of ubiquitous goods. (See www.unu.edu.)

UNITED NATIONS UNIVERSITY

UNU-VIE SCYCLE

Sustainable Cycles Programme

Climate Leadership: Strategies and Approaches for the Mobile Sector

The first two sections of this report highlight how profuse and diverse are the possibilities for the ICT sector to shift toward a low carbon economy. The impacts from these opportunities, however, can occur if the sector and its players are committed to the time and effort it will take to move in this direction. Sustainability and the tackling of climate change should be key topics for discussion in board rooms, research and development departments, and marketing retreats, yet to be a common occurrence. Political leadership is an essential part of the equation which is yet to be matched by corporate leadership. The private sector must play an active and capital-intensive role to ensure that global warming remains below 1.5°C. The SDGs recognize the significance of the private sector in the form of SDG 17 (Partnerships for the Goals). This begs the question, "What does a mobile company gain by becoming a climate leader?" There are three responses to this, as follows:

i. **Business**. Climate change adaptation and migitation present the business opportunities. The corporate sector is reacting, despite the lack of sufficient publicizing. Solutions, such as improved weather forecasting and optimization of traffic flows, contribute to reducing CO_2 emissions (see Section 2.1 and Section 2.2) and result in paying customers.
ii. **Risk mitigation**. Every sector and industry can expect to experience the impact of climate change. As Martin Stendel, Lead Scientist of the Polar Portal and a senior researcher at the Danish Meteorological Institute, explained,

> "Think of waves on the beach. Some are high, some are low. That's the weather. But in the background the tide is coming in. That's climate change. Even though the waves haven't changed their properties, they come closer and closer to your feet," (Watts, 2018).

As global consensus on climate change has been reached with the adoption of the Paris Agreement in 2016, the discussions on the mitigation of climate change and its consequences are becoming ever more important. Consideration of the climate impact of an operation and the risk associated to the impact of climate change, therefore, are key to mitigate risk in the long term. This is especially true regarding water resources and energy production.

iii. **Legitimacy**. Demonstrating support for the SDGs and a sustainable future is gaining significance. Businesses that disregard their responsibilities are increasingly under pressure from consumers, investors, and civil society alike.

Consequently, as business paradigms change, the issues of climate change and resource efficiency are becoming increasingly significant to the ICT industry. This section summarizes the main characteristics to consider in relation to actors in the mobile ecosystem who wish to improve their performance in terms of the environment and climate change. It highlights proven strategies that work across the ICT industry in LAC, while offering suggestions for firms at any given stage of their climate action journey. This section also outlines strategies and suggestions for climate laggards, climate leaders, and those in between.

4.1 From Climate Laggard to Climate Leader: Advancing the Entire Industry

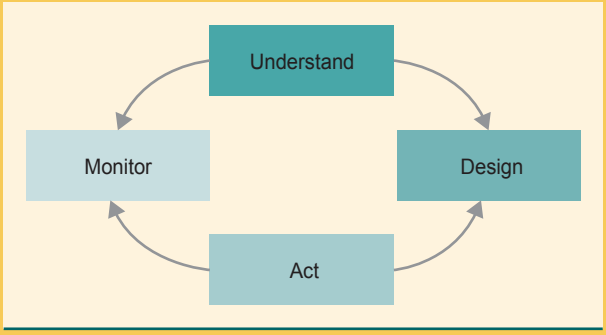
Across the board, industries are increasingly asking themselves—and are being asked—"How can I leverage smart climate solutions to keep fulfilling my mission? How can I ensure the resilience of my operations in a 2°C reality?"

Several companies have embarked on their journey to foster climate action. The first step is for a company to consider its operations so as to set the baseline for its climate strategy decision-making process. The willingness of businesses to integrate sustainable approaches into their core business strategy, beyond their commitment to the SDGs through corporate social responsibility, is crucial. Full integration of sustainability in corporate blueprints will set firms on a path to search for strategies that will reduce their impact on the environment.

This section outlines strategies that take into account the climate laggards and leaders, as well as those in between. They relate to climate-proofing operations

and moving the sector toward lower emissions, thus enabling a low-carbon economy. An overview of the steps toward becoming a climate leader a provided in Figure 25.

FIGURE 25: STEPS TOWARD BECOMING A CLIMATE LEADER



Source: South Pole.

4.2 Understand Your Impact and Risk Exposure

It is essential that the ICT sector have a reliable source of energy in order to function. At present, ICT contributes up to 2.5 percent of global GHG emissions (ITU, 2017). The generation of energy remains largely associated with GHG emissions, as the amount that is used has risen over the last decades and is dependent, to a large extent, on fossil fuels. The energy sector is the largest contributor to GHG emissions on a global scale and the most significant in terms of the ICT industry.

The impact of the mobile ecosystem, therefore, is mostly associated with the energy generated from data centers, base stations, office buildings, and switch sites. To determine the impact, mobile operators need an in-depth understanding of where and how the energy used in their operations is produced. While renewable energy technologies are reaching economic sustainability and relevant policies are being implemented to increase their share, most networks continue to operate mainly on fossil fueled power due to regional variances in the energy mix.

The ICT sector also is responsible for the use of a large quantity of water. The production of energy from fossil and renewable sources requires water (e.g., cooling, among other processes). Understanding the extent to which the operation of an industry is dependent on local water resources is increasingly viewed as a major factor in risk assessments. While the capacity of a power station can be increased, the amount of water available at any given location may limit this increase in capacity. In a report based on questionnaires to industry executives in 2014, the climate change risks cited in the responses most often referred to reputational risk; fuel or energy taxes and regulations; carbon taxes; emission reporting obligations; consumer behavior change; and changes in precipitation extremes and droughts (CDP, 2014).

A first step in solving any problem is to comprehend it. What is your impact and where does it come from? Which part of your operation has the strongest impact on climate change? Questions such as these must be responded to, presenting a challenge for a company that may operate across various countries and continents, as many in the ICT sector do. The sector has large global players that, for years, have been working toward accountability; the smaller ones only now are starting to do so. In recent years, an approach that has emerged as the go-to solution for corporations in responding to these questions is preparing a carbon footprint that is based on the GHGP and feeds into the CDP reporting initiative or that of the GRI. The GHGP provides detailed guidance and specific protocols for various industry sectors. The GRI and those of the CDP aggregate a high number of indicators and topics into one systematic overview that increases understanding and provides a complete scenario. Many industry players are now following this, demonstrated by, among others, the sustainability reports from Telefónica, América Móvil, and Millicom, shown below. Accounting standards have promoted energy efficiency project implementation, especially in networks and data centers. An initial carbon footprint focuses on the so-called Scope 1 emission classification under the GHGP Corporate Standard, the Definition of Scope 1, 2 and 3 are provided in Figure 26.

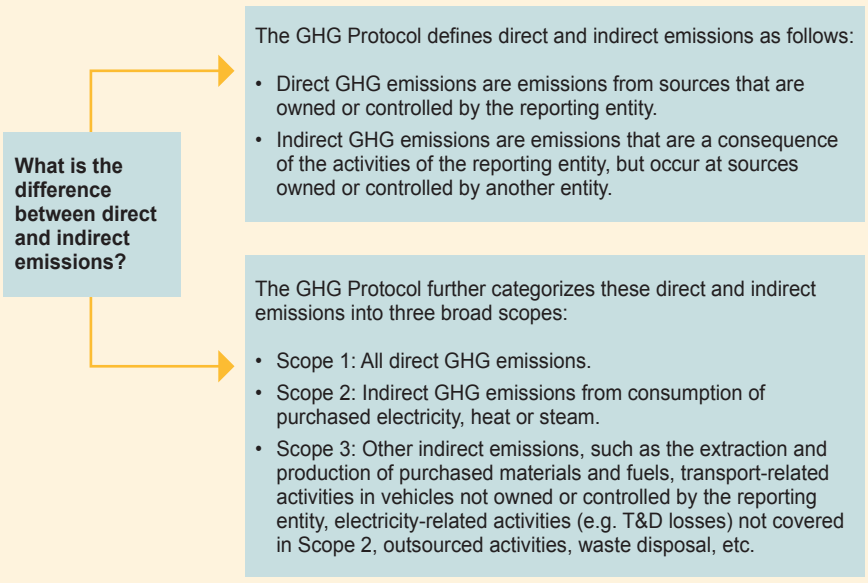
To further increase the understanding of the impact, the GHGP breaks emissions down into three categories: Scope 1, Scope 2, and Scope 3. The definitions are provided in Figure 26. Alongside the different scopes, the variance between direct and indirect GHG emissions is essential. In short, corporates can considerably control direct emissions by focusing on their own actions, while indirect emissions that are out of the direct control of the corporate can only be influenced via communication and cooperation with different actors.

4.3 Design a Strategy that Suits Your Business

4.3.1 Setting targets and developing a strategy

Based on an understanding of impact and risk, corporations should put forward ambitious strategies to determine how to reduce their impact and increase the efficiency of services. These strategies are best aligned with existing sustainability and operational strategies, and are taking internationally recognized targets into account, such as the SBTs, SDGs, and RE100 initiative. Often, announcements of these strategies are aligned with international and national events to highlight the

FIGURE 26: DEFINITION OF SCOPE 1 EMISSIONS ACCORDING TO THE GREENHOUSE GAS PROTOCOL



Source: GHG Protocol (2017).

commitment of the sector (e.g., annual Conference of the Parties; a summit on the topic, such as the One Planet Summit in Paris in December 2017). The high visibility of these events also increases the pressure on companies to deliver on their set targets.

At this point of the journey, choosing a way to monitor and report the positive impact and contribution of companies is key. The most common initiatives the ICT industry participates in are the GRI, CDP, and SBTs. The standards that are most common are the GHGP, ITU-T L1420 of the International Telecommunications Union, and ISO 14064 of the International Organization for Standardization. Using these established standards eliminates the need for the industry to develop its own indicators, as well as enables benchmarking and international recognition. Initiatives such as the SBTs require commitments to reach a goal at a certain point in time and compliance with certification by third parties. Meeting these commitments is best guaranteed by fully integrating them into the overall corporate strategy.

Box 20

TigoUne, Colombia

Operating in Colombia, TigoUne is an example for a telecom provider that has defined clear areas and objectives, as well as clear responsibilities by area regarding environmental performance and sustainable development. The objectives range from the integration of environmental considerations in procurement processes to recycling rates. The responsibilities in many cases do not lie with the environmental or sustainability team; rather, they are spread throughout the organization. Sharing responsibilities is an approach that integrates sustainability into the everyday operation of an organization. As well as accountability, monitoring is implemented based on clear indicators and metrics that are applied throughout the company. This approach allows TigoUne to clearly communicate its contribution to the United Nations Sustainable Development Goals.

4.4 Take Climate Action

Taking action is the most essential and most time- and effort-intensive part of the journey toward climate leadership. For the ICT industry, individual climate actions will be part of one of four categories (Figure 27):

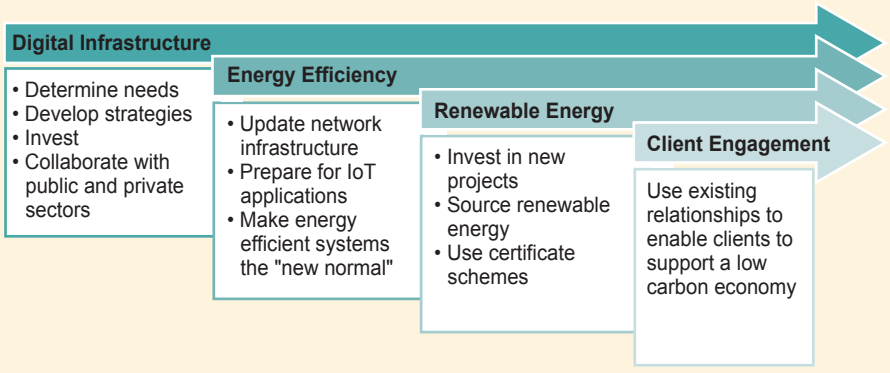
- digital infrastructure
- energy efficiency measures
- renewable energy use
- client engagement.

Actions may strictly adhere to one of these categories or address all three simultaneously. Considering all three will lead to significantly improving the impact of the ICT sector, while categorizing will help to organize and ease implementation. These should be addressed in unison.

4.4.1 Digital infrastructure

The development of high-quality digital infrastructure is a key element to enabling all the benefits explained in previous sections. LAC countries have a general lack of digital infrastructure. From the point of view of public policy, it is necessary to propose a global strategy. First of all, it is necessary to carry out an exhaustive diagnosis to assess the infrastructure required at all levels. From there, it

FIGURE 27: TAKING CLIMATE ACTION



Source: South Pole.
Note: IoT = Internet of Things.

is necessary to design a plan in collaboration with all the actors of the ecosystem, including the private sector, civil society, local governments, and academia. Governance is a fundamental factor for the success of these plans. Several governments around the world that have been successful in this feat have designated specialized offices, with a chief information officer responsible for the country's digital development.

In addition, a good functioning of the markets is essential so that citizens are able to access quality service at a good price. In some countries in the region, there are considerably uncompetitive markets that do not guarantee service at an adequate price and quality. It is essential to have a modern and strategic regulatory framework that favors investors and competitors alike.

To foster deployment in rural areas, LAC countries must promote a more efficient use of the radio spectrum, a scarce resource managed by governments that is used by different services such as TV, radio, or wireless internet. The emission of the TV signal in digital format—a process known as the digital switchover—is a good opportunity to release spectrum for mobile communications, known as the digital dividend, which is yet to materialize in the region. In a complementary manner, the proliferation of data centers is essential to improve the efficiency of communications, enable IoT apps, promote the development of local industries, and encourage the use of public and private data (open data).

LAC countries are aware of the importance of this opportunity and many are in the process of implementing comprehensive digital plans. Examples are the Digital Agenda 2020, developed in Chile, and the Plan Vive Digital applied in Colombia.

4.4.2 Energy efficiency

The best emissions are those that are never emitted in the first place. Reducing the emission of direct operations is the most environmentally friendly and cost-effective measure a company can take. Several international and multistakeholder research groups have examined more efficient ways to transfer data. One approach focuses on the energy consumption of networks and data centers. The most energy-intensive part in their operation is cooling in base stations and data centers.

For mobile networks, where almost 80 percent of total emissions from mobile network operators occurs, energy efficiency practices should be enhanced. At present, operators implement several measures to reduce their energy consumption based on their corporate strategies and operational plans. Key drivers for this implementation are:

- infrastructure efficiency
- increasing energy costs
- network transformation projects
- attainment of climate goals, among others.

For the specific case of data centers, the approach on the one hand requires developing data centers that use ambient cooling systems and incorporate energy efficiency at the core. This in itself is a shift, as networks and data centers used to focus largely on performance, not on energy efficiency. On the other hand, another option is to move data centers to locations in geographies that offer ambient cooling options due to their low average temperatures, such as Greenland, the global North, or even the ocean. Since 2013, Microsoft's Project Natick has been researching how to move data centers underwater. Moving data centers to locations with favorable meteorological conditions, however, is limited by privacy regulations. Several jurisdictions do not allow the data of their citizens to be transferred across borders.

Moving data centers to remote, cooler locations generally increases the distance to the end-user device. A complementary approach to large, highly efficient data centers are improved networks that consist of small, low-power, radio-access

nodes located at close distances, ranging from 10 to 100 meters from the end-user devices. These small cells could be integrated in existing infrastructure (e.g., smart street lamps, public spaces, and residential buildings). The advantage of these small cells is that they are able to use the radio spectrum more efficiently and provide a better service (Pretz, 2016).

EXAMPLE: SINGLE RADIO ACCESS NETWORK PROJECT: AMERICA MÓVIL

Across its LAC operations, América Móvil has implemented a single radio access network project. It is the single largest energy reduction project the company has ever undertaken. The single radio access network technology allows cellular base stations to conserve between 20 percent and 45 percent of actual energy consumption by installing cell phone transmission technology central processing units in a single multicompatible rack. Over the duration of the project, from 2016 to 2021, the emission of 500,000 t CO_2eq will be prevented.

EXAMPLE: COOLING METHODS: TELEFÓNICA ECUADOR

The energy efficiency targets of Telefónica Ecuador for 2020 and 2030 are aligned with the 2°C target. Energy efficiency efforts focus on the cooling of base stations, building an office headquarters based on smart-building technology (Ekopark), and fleet management projects to optimize fuel consumption. The company is part of the RE100. The additional benefit of more efficient free cooling methods is an increased resilience in the case of natural disasters.

EXAMPLE: IMPROVING INTERFACE OF DEVICES AND SAVINGS: GREEN BTS, COLOMBIA

TigoUne's energy efficiency project, Green Base Transceiver Station, in Colombia focused on the improvement of the radio interface of devices using 2G and 3G technology to decrease their energy use during low traffic. In the course of the project, 3,789 2G stations were updated. The project led to savings in the range of Col$210 million in 2016 alone, as well as a reduction in energy consumption of an estimated 490,151 kilowatt hours, or close to 94 t CO_2eq.

EXAMPLE: AIR CONDITIONING UNITS: TELMEX, TELCEL, AND AMERICA MÓVIL, MEXICO

In Mexico, Telmex and Telcel are upgrading the air conditioning units of their data centers and base stations to models with higher energy efficiency while using refrigerants with lower global warming potential. At the same time, América Móvil is currently developing data centers that can operate at higher temperatures, reducing the consumption of energy for cooling even further.

4.4.3 Renewable energy

As the ICT sector will always rely on energy, energy consumption will never be zero. Energy originating from renewable sources, such as wind, solar, biomass, and hydro, are gaining ground, although they are far from being the norm, neither on a global nor regional level. Additionally, the energy markets in LAC are only gradually opening; at the moment, Mexico is in transition. For the time being, most providers aiming for carbon neutrality will be relying on renewable energy certificates and carbon offsets.

Ambitions to source renewable energy often are challenged by practical issues such as procurement constraints, legislative restrictions, or the unavailability of renewable energy solutions in certain jurisdictions. Sustainability and procurement officers are facing a tough challenge: how to underpin ambitious renewable energy targets with reliable renewable energy solutions.

Rules are in place to assist companies in making credible renewable energy claims. The World Resource Institute's and WBCSD's GHGP's Scope 2 Guidance and its Claims Guidance have become somewhat of a bible for renewable energy practitioners. According to these guidance documents, the fundamental basis for any renewable energy consumption claims are contractual instruments that convey attribute information from generation to end-user. Companies can reduce their carbon footprint by using contractual instruments that meet specified quality criteria. Contractual instruments that are mostly used today are energy attribute certificates, such as renewable energy certificates (REC) in the United States**,** Guarantees of Origin in Europe, and the International RECs in jurisdictions without national renewable energy tracking systems. See Figure 26 below for an overview of countries with existing REC markets.

The clarification of how RECs can be used to lower and account for emissions from the generation of purchased or acquired electricity (also known as Scope 2 Accounting), has furthermore made RECs the number one instrument utilized by RE100 signatory companies to achieve their bold renewable energy consumption targets. In fact, two-thirds of all renewable electricity purchased globally by RE100 signatories in 2015 was sourced through unbundled energy attribute certificates as opposed to the shy 3.3 percent of electricity sourced via power purchase agreements.

The rising popularity of RECs is due to the fact that they are legitimate, reportable, and accessible. Yet, not all renewable energy certificates are equal. A REC only conveys the information that a megawatt hour of renewable electricity was inputted into

the grid and is owned by the end consumer who holds the REC. For corporates that are interested in supporting only recent renewable power plants, or power plants that ensure additional benefits for local communities, eco-labelled RECs have been developed on the market. For example, Guarantees of Origin and the International RECs with the EKOenergy label ensure that the price paid for electricity is reinvested in new renewable energy plants and they help to minimize the impacts of electricity production on ecosystems, habitats, and the biodiversity of species.

Another example is GoldPower, a renewable energy product based on RECs labelled under the Gold Standard. It not only provides the highest quality of renewable energy projects; it also has measurable, positive impacts on communities and the environment in developing countries. It combines robust verification and tracking of renewable electricity generation with additionality, social and environmental safeguards, and transparency through monitoring and third-party audits. In the ICT sector, Microsoft and SAP are among leading companies who have opted to source GoldPower for greening their international operations.

Looking at the ICT landscape through the climate change lens, smart companies are well aware of economic trends that continue to point to an acceleration in growth of renewable energy sources, as well as the business potential of embracing sustainability. SAP, for instance, is providing solutions to its customers in projects relevant to the SDGs. The various IoT and Big Data technologies from SAP are being successfully used in, among others, Buenos Aires to help mitigate flooding during seasonal rains, which are expected to intensify in the future. While such cloud solutions represent a major growth opportunity for SAP, energy-intensive data centers remain one of the main challenges to tackle for the market leader in enterprise app software. SAP's quick growth has also bulked its electricity use and CO_2 emissions, adding to the ~2 percent of global greenhouse gases emitted by the IT sector. Given the significance of its electricity consumption, accounting for one-quarter of total CO_2 emissions, the company has decided to seek a way to power its global operations with 100 percent renewable electricity. By opting for GoldPower, the next generation of RECs, the company has begun leveraging renewables as a powerful differentiator to attract and retain customers, employees, and investors.

Leaders, such as Apple, are pushing renewables into their own supply chains, helping to accelerate the growth of renewable energy worldwide. Apple recently committed to help its suppliers bring 4 gigwatts of renewable electricity online by 2020. Google has bought sufficient renewable energy to offset its nonrenewable energy consumption in 2017, and has become one of the largest buyers of

FIGURE 28: COUNTRIES WITH A RENEWABLE ENERGY CERTIFICATE SCHEME IN PLACE

Source: South Pole (see https://www.southpole.com/sustainability-solutions/renewable-energy).
Note: REC = renewable energy certificate.

renewable energy. At the same time, Google is taking other measures to reduce its carbon footprint, such as employing machine learning to make data centers more energy efficient.

EXAMPLE: A RENEWABLE ENERGY PLAN: ARGENTINA

Telefónica in Argentina has set renewable energy targets. Implementation in Argentina is closely linked to the growth of the renewable energy sector and relevant regulations. Although the sector is growing strongly, the current percentage of energy generated by wind, solar, and bioenergy is low, comprising of 1 percent of the total. This follows the adoption of Argentine Law 27.191 in 2015 that targets an increase to 20 percent by 2025. The law also obliges corporations with an energy consumption of more than 300 kilowatt hours to conform. Telefónica has set targets that go beyond this obligation, committing to 50 percent renewables by 2020 and 100 percent renewables by 2030. Seven percent of Telefónica's global energy consumption is attributed to Argentina. At the moment, energy in Argentina is generated from either nonrenewables or hydropower. At the same time, the capacity will need to double until 2030 to meet increased demand. The largest share of energy consumption is associated with fixed communication infrastructure. The measures defined in the action plan for Argentina are to buy renewable energy with certified Guarantees of Origin; power purchase agreements for long-term energy generation; short-term bilateral agreements, thus directly generating renewable energy and energy efficiency. Following these measures, Telefónica will rely solely on renewable energy in 2030 and subsequently will see a considerable reduction in GHG emissions, especially in terms of Scope 2 due to the reduction of GHG emissions in the generation of energy (Telefónica, 2017).

EXAMPLE: CLARO: CENTRAL AMERICA AND THE CARIBBEAN

The mobile operator, Claro, has been considering a program to switch from diesel generators to solar power for remote and isolated base stations in LAC. The huge drop in solar panel prices, market availability, and increase in local technical knowledge on the installation of such technologies has recently made this project economically viable. Over 15 percent of isolated base towers appear suitable.

EXAMPLE: CARBON NEUTRAILITY: MICROSOFT

Microsoft has signed up to RE100 and has been carbon neutral since 2014. The commitment to this ambitious goal was announced in 2012. Efforts to reduce the carbon footprint of its operations are ongoing and the existing energy needs (4,852,643 megawatt hours in 2016) are either compensated through renewable energy credits or carbon offsets. As is common across the sector, the largest

amount of energy is associated with the operation of data centers. Microsoft is using its expertise to turn these into smart data centers and is pushing for a larger share of the energy consumed in data centers to originate from renewable sources such as wind, solar, and hydro. The commitment stands at 50 percent by 2018. Sourcing renewable energy in the quantities Microsoft needs can be challenging and, in many parts of the world, demand for renewably sourced energy is outstripping supply. The company is engaging with other RE100 companies to encourage utilities to focus on renewable energy production (Telefónica, 2017).

4.4.4 Engage your client on the topic and enable their contribution to a sustainable future

Few industries are in as close contact with their clients on an everyday basis as the ICT industry. The industry already has access to vast amounts of data on their client behaviors, needs, and preferences. Hidden in this data is a wealth of new apps, services, and products that can help people to improve their efficiency when using resources, such as time, water, GHG emissions, and energy.

Alongside the individual user, clients are cities, utilities, and industry. The share of these clients only will increase. Providing them, from the start, with solutions that integrate sustainability at the core is essential. Research has shown, time and again, that the default option, no matter how suitable, is the option most used. Carefully designing default options that have the the best interests of the user and environment at heart belong to the instruments often referred to as nudging. Nudging does not hinder or discourage individuals or businesses to take decisions; rather, it recognizes that many people in their private and professional lives are faced with so many decisions that only a limited time can be used for each of them. A setting that encourages, or nudges, one to an outcome that is beneficial can significantly increase the positive output of decisions. The significance of this approach is highlighted not in the least by the Nobel Laureate of Economics in 2017, Richard Thaler, who was instrumental in developing the field of behavioral economics to which this approach belongs (Sunstein and Thaler, 2008).

With a slowly but steadily increasing awareness of the need for economic growth to be sustainable on an environmental, social and economic level, increasing time and investment into this area is set to provide a future business opportunity. At the same time, this will assist the industry to achieve the commitments made to

meeting the SDGs, not in the least SDG 12 (Ensure sustainable consumption and production patterns).

Furthermore, an awareness of the urgency and severity of climate change is reaching those segments of the population with access to mobile networks. The preferences of millennials are already changing cities, as single car ownership in this segment is lower than in the generations before and aspects of the sharing economy are being embraced. Why not provide these consumers with information that allows them to further improve their footprint in a smart way? From sensors to make food and agricultural supply chains truly transparent to easy options to offset carbon emissions and use new mobility options that integrate several transport modes—all these solutions are based on ICT and mobile infrastructure, offering interesting business opportunities.

In agricultural supply chains, adding the consumer to the equation is taking current social enterprises, focused on informing smallholder farmers, a step further. While these enterprises are social by design, they also are paying costumers, and their number is increasing. Providing information to the end consumer completes the circle. Informing customers on their mobile device energy usage and how their used phone can re-enter the circle are low-hanging fruit with the potential to make a difference.

4.5 Monitor and Continuously Improve Your Performance

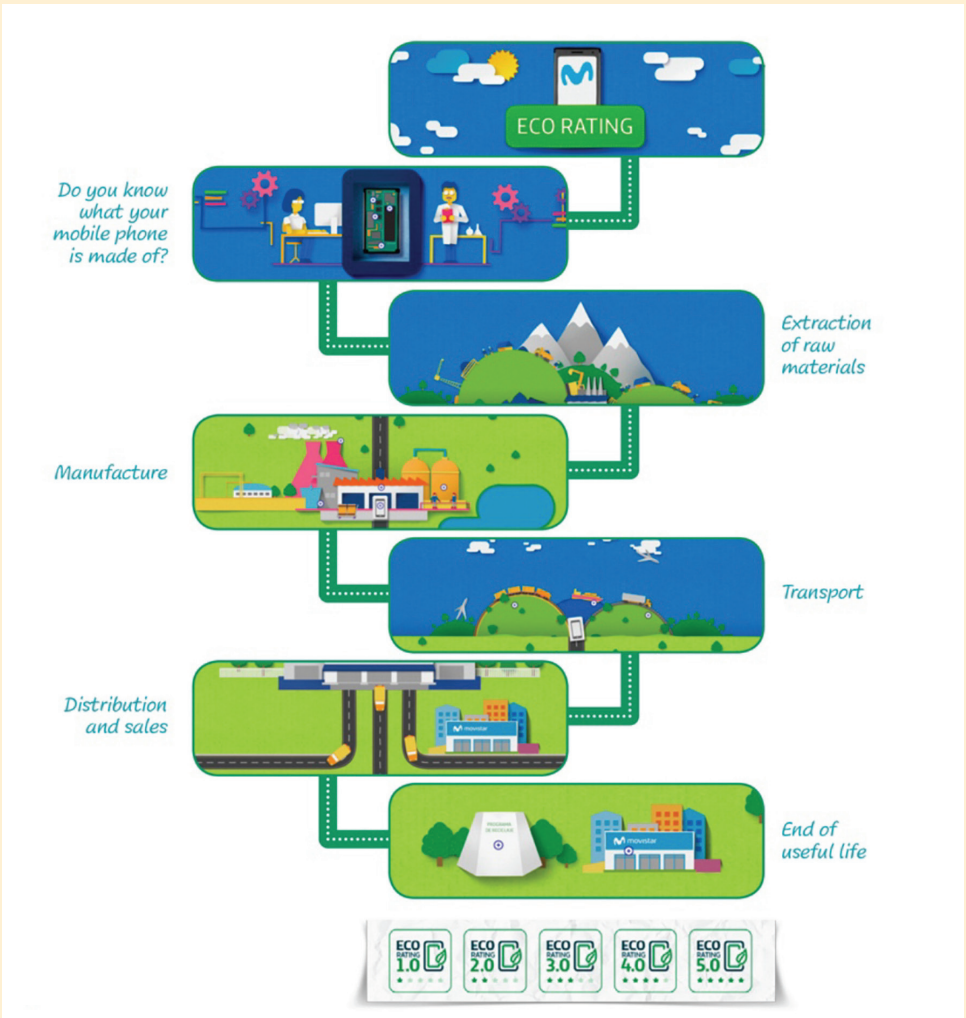
Selecting a monitoring process that will provide robust and reliable data is an integral part of the design step of the process, as previously highlighted. As the monitoring approach is set up and running, the information gathered on the performance of a policy or project implemented by a firm is invaluable to keep track of the effectiveness of such a measure and to foster further improvement and advancement. Especially for companies in the ICT sector or in the use of ICT solutions, the speed in the development of new ICT solutions requires a constant review of current processes and solutions to ensure that the hard-fought position of climate leader is not lost again.

Box 21

Eco Rating for Devices: An Example

The idea is simple: provide clients with easy access to information on the environmental impact of a device when purchasing a new one. Telefónica and its operators in Latin America and the Caribbean, such as Movistar and Vivo, have rolled out eco rating in five countries: Argentina, Brazil, Chile, Ecuador, and Peru. The rest of the region will follow soon. Clients can see the eco rating of the device on the homepage or in the store. The rating provides up to five stars for devices with a lower impact. The methodology the rating is based on was developed by Forum, a nongovernment organization in the United Kingdom, for a better future, and it is used by several operators.

ECO RATING



Source: Telefónica (2017).

How the ICT Industry and Mobile Ecosystem Can Reach their Potential

Build and focus on NEW strong collaboration, guided by SDG 17: Partnerships for the SDGs with corporates, startups, public sector, civil society, and academia, beyond existing circles.

- Take coordinated action to push the entire sector toward a low-carbon economy and help overcome existing obstacles. Actively work toward becoming a climate leader as an industry.
- Adress barriers. While there are several cities pioneering ICT solutions and successfully exploring the potential for climate action, in general, cities and governments are not aware of the potential. They often lack the mindset and willingness to implement solutions.
- Support other industries to reduce emissions by following a “push” marketing strategy, raise awareness, and actively showcase examples. By seeking to listen to and understand other industry challenges, the ICT industry will be able to translate these into potential business cases for ICT and mobile solutions with viable services and products.
- Target awareness building in LAC, which is central. This will require internal capacity building; that is, reaching out to and attracting new talent to develop solutions with a climate change and environmental focus. Being an expert in one field is often not sufficient to solve a problem in the environmental and climate change arena. The knowledge, understanding, and capacity to seek and develop innovative, low-carbon solutions for cities, energy grid, or water utilities is only possible by cooperating between many disciplines. Forming interdisciplinary teams that focus on the environmental, social, business, and technology aspects are the way forward.

- Move sustainability from a focus on philanthropic action to the driver of a core business.
- Push for harmonized regulations. As an operator, push for e-waste regulations that are harmonized across LAC. They can share the load and responsibility with methods such as the EPR approach.

Commit to applying energy efficiency measures across the networks and source energy from renewable energy sources.

- Move toward renewable energy sources. The energy demand of the ICT industry is set to increase significantly with the role of ICT and mobile solutions becoming even more important in the coming years. This implies significant costs and GHG emissions if energy efficiency measures are not implemented across the networks and especially included in any upgrades and new infrastructure projects. The time to recognize this need and incorporate it in planning is immediate.
- Invest in infrastructure. Significant investment in mobile infrastructure and a large-scale expansion of the networks is needed besides moving the current infrastructure toward applying energy efficiency measures and sourcing renewable energy. The expansion and increase in capacity of the network in LAC is a requirement for the development of IoT-based solutions alongside the development of standards and platforms that allow for interoperability. This particularly applies to examining the rollout of 5G from 2020 onward.
- Consider new regulation in the energy market. The energy market is opening in LAC. New regulations that hopefully incentivize renewable energy production should be monitored closely and investment should be directed toward renewable energy projects.
- Ask the public sector to take a lead. The ability of the ICT industry to source energy from renewable sources will depend largely on regulatory incentives, public investment, renewable energy infrastructure, and an integration of different energy sources. While it is crucial that the mobile ecosystem shows its commitment to support the shift to renewable energy sources, the public sector must take the lead.

Engage your clients on the topic and use the access and understanding of their everyday lives to enable them to take smarter, more sustainable decisions

- Facilitate changing of behaviors. Few industries are in such a close relationship and have such a level of access to information on client needs, activities, and

preferences. The ICT industry has the potential to act as a facilitator when it comes to changing behaviors, using existing channels, and building new products and services that target sustainable and environmentally friendly lifestyles.

- Encourage clients to make sustainable decisions in their daily life. The operation of mobile devices contributes to the quality of life of clients and can support the sustainability-related targets of companies, such as increasing energy efficiency and sourcing renewable energy, as well as creating business opportunities. Keep in mind that the most environmentally aware customer segment is, at the same time, very active on ICT and mobile solutions and is likely open to such services.

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