

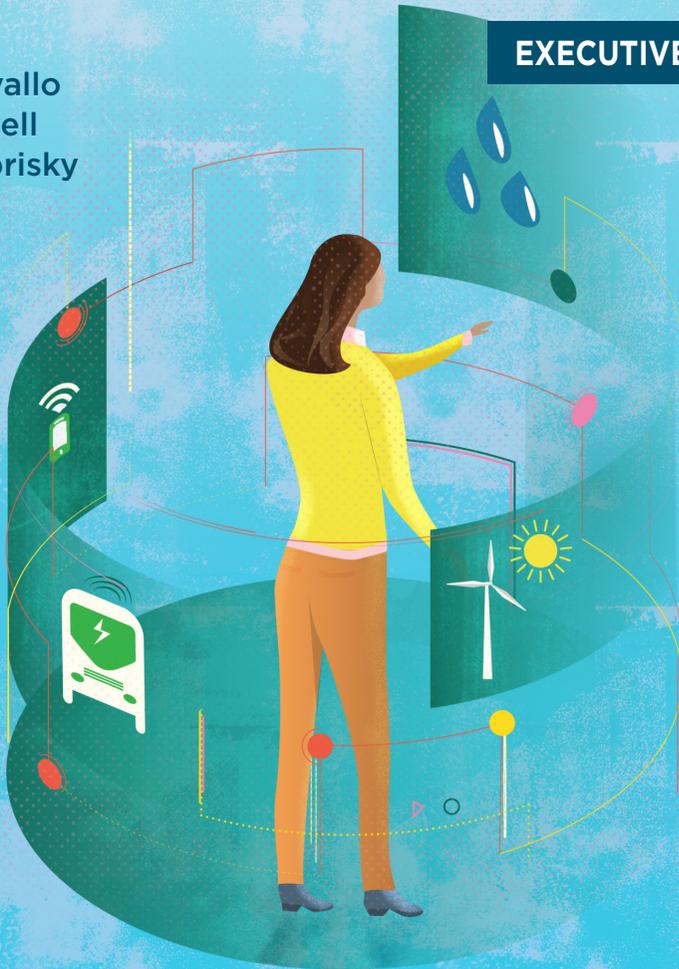
DEVELOPMENT IN THE AMERICAS

FROM STRUCTURES TO SERVICES

The Path to Better Infrastructure
in Latin America and the Caribbean

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EXECUTIVE SUMMARY



To close its infrastructure gap, Latin America and the Caribbean needs more than investment in new structures. It needs to become more efficient at investing in infrastructure and regulating a new range of services that have the potential to disrupt the energy, transport, and water sectors. The technological revolution makes a future with quality services possible, but not inevitable. This year's *Development in the Americas* (DIA) report offers policy options for countries to improve the access, quality, and affordability of services today, to ensure that they will be sustainable in the future, and to harness emerging technological advances for the benefit of all. This book aims to provoke discussion and further research on those many important issues and mark a path that helps the region move from structures to services and improve infrastructure for all.

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One Morning in a Not-too-Distant Future in Latin America and the Caribbean

Today is María Fernanda's birthday. At 7 a.m. her alarm clock rings with a soft instrumental version of "Happy Birthday." Her home's artificial intelligence system has programmed the water temperature at 24 degrees—María Fernanda's preferred temperature for her shower. Yesterday was a sunny day in Quito and her home's solar panels charged the battery that stores electricity, allowing all the appliances in her home to run for several hours without power from the grid.

After breakfast, and before leaving for work, María Fernanda spends a few minutes on one of her favorite pastimes: working in the community organic garden. Fertilizer comes from composting organic matter and recycled water provides irrigation, a mandatory practice in all homes in her neighborhood.

At 8:15 a.m., María Fernanda and her partner set off on electric bikes for the recently opened station to catch one of the autonomous electric buses. The journey to downtown Quito, where they work, takes just 20 minutes. Just a few short years ago, it took over an hour to make the same journey, in a rickety, overcrowded, unsafe bus.

María Fernanda's story could become reality for millions across Latin America and the Caribbean in the not too distant future. Imagining the daily life of an individual illustrates that the future of infrastructure is the future of the services provided to real people. For this reason, when researching and analyzing infrastructure and planning for the future, the focus should be on the needs of actual people and businesses that consume electricity, water, transport, and connectivity services. The customer service experience is key. And that is intimately related to the quality, quantity, and cost of the

service supplied. This focus has fundamental implications for the structure and governance of the relevant sectors; governance and industry structure determine incentives and incentives explain the majority of what might be described as the good, the bad, and the ugly of current service provision.

Frequently, the word “infrastructure” is associated with concrete and cement, with building physical assets such as roads, dams, airports, and water treatment plants. Service provision, despite its importance in the day-to-day lives of citizens and businesses, ranks lower on the public policy agenda. As detailed in this flagship report, too little is invested in infrastructure assets—around 3 percent of GDP. Still, around 10 percent of Gross Domestic Product is derived from the value added in water and sanitation, energy, and transport services. The analysis in this book focuses on this 10 percent and how it can be improved by better utilizing existing assets and by building better assets in the future.

Physical assets and services are, in practice, inseparable. Structures are the indispensable starting point for providing a service, but not enough to ensure adequate quality. Service providers, public regulations, and user behavior must also be well-managed. For example, a country can build a road with the best engineering standards to stimulate trade between cities A and B. But if transport companies provide unreliable service because their truck fleets are old or because they agree among themselves to divvy up the market and charge excessive prices, then trade will most likely not increase and the investment in the road will not have the expected impacts. In other words, understanding investment in structures and service provision as two watertight compartments is equivalent to ignoring the symbiotic relationship between computer hardware and software.

The Starting Point

María Fernanda's story describes a scenario that is both desirable and attainable for all of Latin America and the Caribbean's 650 million inhabitants, regardless of their socioeconomic status.

María Fernanda's situation today, however, is probably very different.

She likely lives in a low-income neighborhood on the outskirts of a city in Latin America and the Caribbean with a very different reality. In 2020, María Fernanda has electricity service in her home, but power cuts are frequent. And although she has access to drinking water in her home, she does not

have quality sanitation; consequently, when storms occur, her neighborhood is often flooded with sewage. Her journey from home to work is uncomfortable and slow, and the pollution affects her breathing and that of many of her neighbors. Apart from the poor quality of the services they receive, María Fernanda and her parents struggle to pay the electricity and water bills and the cost of transportation, often forcing them to cut back on other necessities. Their efforts to pay for these services are made more difficult by the high cost of internet and mobile phone service.

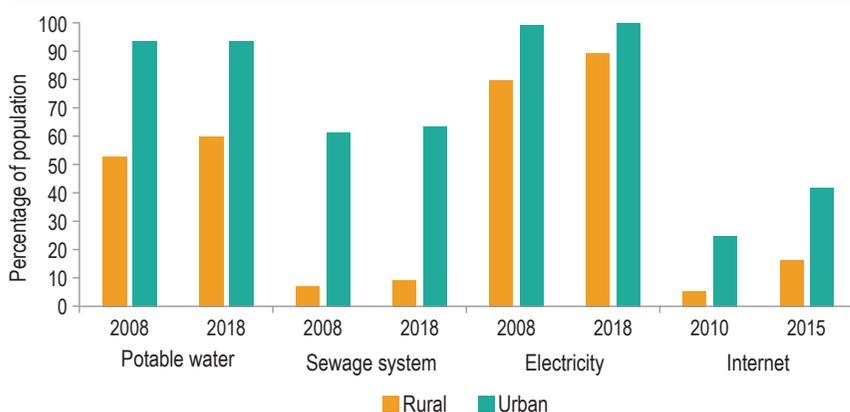
Access is the first step to consuming a service, and luckily Latin America and the Caribbean has improved access to infrastructure services. Significant progress has been made toward universal coverage, especially of electricity (Figure 1). But access statistics are often misleading because the definition of access is often far from the minimum standards needed for an acceptable quality of life. The example of water and sanitation is illustrative. In Latin America and the Caribbean, 86 percent of the rural population had access to a "safe" water source in 2019,



In recent decades, access to services in Latin America and the Caribbean has increased, but quality and affordability are remaining challenges.

according to a definition that assumes a household has access if its water source is within a 15-minute walk from home. However, according to higher standards, such as having piped water in the home itself, the proportion of the rural population with access falls to 55 percent. Similarly, if access to sanitation is defined as having a sewage connection or septic tank, 45 million people in Latin America still lack access.

Figure 1
Access to Infrastructure Services, 2008 and 2018



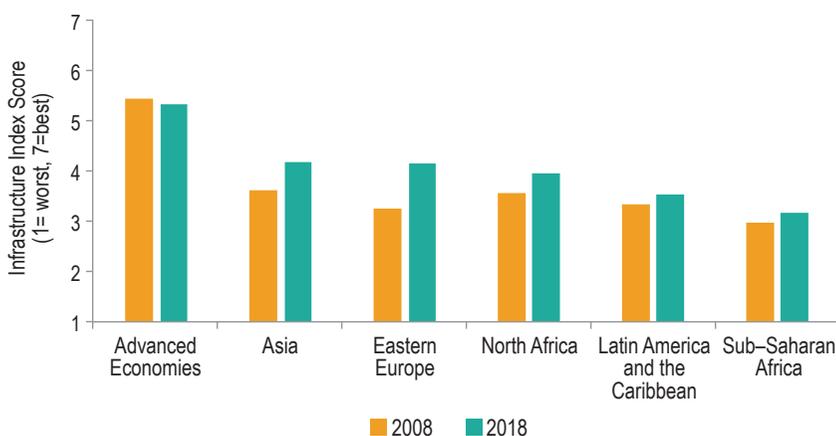
Source: Chapter 1 of the full report.

Notes: Data on access to drinking water, sewerage, and electricity are based on country household surveys and drawn from SEDLAC. The data express the share of households with access to the respective service. Internet data are from the International Telecommunications Union and refer to the percentage of the population with access to the Internet.

Once access is available, the focus shifts to quality. For María Fernanda, for example, service quality means receiving electricity without power cuts, having potable water in her home, and having access to frequent public transport services within a short distance of her home. For companies, power outages or unreliable logistical services directly impact their competitiveness because their products deteriorate or do not reach the market in time, generating unforeseen financial costs that ultimately translate into higher prices for consumers or

fewer job opportunities for workers. While the vast majority of countries in the region have improved the quality of services, progress has been much less than in other developing regions. Figure 2 highlights the growing quality gap with other regions, which in many cases compete directly with Latin America and the Caribbean as exporters of goods.

Figure 2
Quality of Infrastructure by Regions, 2008 and 2018



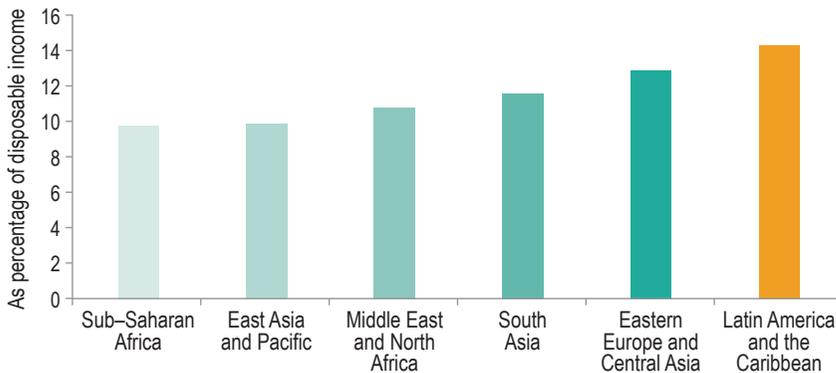
Source: Chapter 1 of the full report.

Notes: The information in this figure is based on the “overall infrastructure quality” indicator in the WEF’s *Global Competitiveness Report*. This indicator ranges from 1 (worst) to 7 (best), based on stakeholders’ answers to the following question: “How do you assess the general state of infrastructure (e.g. transport, communications, and energy) in your country? [1 = extremely underdeveloped—among the worst in the world; 7 = extensive and efficient—among the best in the world].”

Finally, the possibility of accessing quality services is of little use if people cannot afford them. People in Latin America and the Caribbean, particularly the lowest income groups, spend more on electricity, water, transport, and communications than in other regions (Figure 3). While it is difficult to reduce or stop consuming these essential services, this is, in fact, happening in Latin America and the Caribbean every day. Some 40 percent of the poor in the region make the main journey of their day on

foot, while only 10 percent of the wealthiest do so. That would not be bad if the decision to walk was a choice; however, often the poor walk more because they lack access to public transport or simply cannot afford it. Electricity consumption shows a similar pattern of repressed consumption. Households in Latin America and the Caribbean consume an annual average of 2,000 kWh, while European households consume almost twice that amount at 3,700 kWh. Often, consumption of services is lower because users do not have the wherewithal to buy the equipment required to consume the service. Such is the case in Latin America and the Caribbean with household appliances such as refrigerators and air conditioning equipment.

Figure 3
Share of Income Spent on Infrastructure Services by Relative Position on Global Income Distribution



Source: Chapter 1 of the full report.

Note: Infrastructure services in this figure include water and sanitation, public transportation, energy, and communications.

Governments in Latin America and the Caribbean, aware of the impact that service prices have on household spending, grant subsidies. In 2018, subsidies to cover the operating costs of service providers averaged 0.7 percent of GDP. However, just how

much they improve the payment capacity of the most vulnerable is unclear. Information on company costs is limited since it is impossible to distinguish the fraction of subsidies intended to cover production costs, which are too high because management is inefficient, from subsidies provided because service prices are too low to recover costs. Although supply subsidies in the region are significant, direct subsidies on the demand side, especially those targeted at the poorest population, are not frequent. The region still needs to define how and to whom subsidies should be given. The objective should be to provide subsidies only to those who need them, which is becoming easier thanks to technologies that enable targeting through electronic payments, as in the case of public transport in several cities in the region.

Investing More and Better

It is simply impossible to meet the demand for water and sanitation, electricity, and transport without investing in creating and maintaining the structures needed to provide these services.

Latin America and the Caribbean invests much less than other developing regions. Infrastructure investment in Latin America and the Caribbean (including both public and private sources) averaged just 2.8 percent per year between 2008 and 2017, well below other emerging economies: 5.7 percent in East Asia and the Pacific, 4.8 percent in the Middle East and North Africa, and 4.3 percent in South Asia. Using absolute numbers can help put these differences into perspective.

Latin America and the Caribbean invested about US\$125 billion per year between 2008 and 2017, while China, which has made infrastructure investment a priority, invested US\$450 billion each year during the same period. On a per capita basis, China invests



Latin America and the Caribbean must invest **more** in infrastructure.

about US\$330 per year, 65 percent more than the US\$200 that Latin America and the Caribbean invests. Moreover, while total investment had been rising in the region, in recent years it has fallen to around 2 percent of GDP, with declines in both public and private investment.

The region needs to invest between 4 percent and 7 percent of its GDP in infrastructure annually. The average figures, of course, hide the differences between countries, which are many in a region as diverse in income, geography, urbanization, and economic structure as Latin America and the Caribbean. Despite the paucity of estimates on investment needs and their questionable results, most Latin American and Caribbean countries clearly do not invest enough to provide their citizens with universal access to high-quality infrastructure.

Low investment in infrastructure in Latin America is not a recent phenomenon. In fact, investment has fallen sharply since the late 1980s, when more than 4 percent of GDP was invested, and has never recovered, particularly in the larger economies (Brazil, Mexico, and Argentina). The result is a significant accumulated infrastructure gap.

Closing the infrastructure gap in Latin America and the Caribbean demands an increase in both public and private investment. The prospects for significant growth in public investment are limited because infrastructure is assigned a lower priority than other spending demands. Public spending in Latin America and the Caribbean is biased against investment, of which infrastructure is a main component. For example, between 2000 and 2016 total primary public spending increased by 5.2 percent of GDP, but 88 percent of the increase was for current spending while only 12 percent was for longer-term investment. Moreover, during recessions, when government revenues contract, infrastructure investment is cut back much more than other spending. Fortunately, this has started to change; many countries in the region have adopted fiscal rules that, in addition to ensuring fiscal solvency, aim to protect investment during periods of fiscal consolidation.

Governments must also create the right conditions for attracting more private investment where it makes economic sense: that is, in projects with high social rates of return and where the private sector can innovate and provide better quality services with greater efficiency. Aside from what can be done on the public investment side, private investment can play a key role in financing infrastructure. Latin America has been a pioneer in attracting private participation in infrastructure management and financing. For example, 70 percent of air passengers (410 million people) use privately managed airports. And 90 percent of container cargo is handled by port terminals operated in public-private partnership schemes. The region had attracted greater financing from private investors and official sources from outside of the region (including state agencies and public banks from other countries), but this has fallen in recent years to about US\$36 billion per annum for the whole region, of which just over US\$20 billion is from truly commercial sources. There is ample room for the growth of investment off public balance sheets by these multiple actors. Given the nature of risks during the construction phase, commercial banks will likely remain important initial financiers but face increasing pressure from tighter prudential regulations to maintain long-term assets on their balance sheets. It also makes sense from a theoretical standpoint to diversify exogenous and project-specific risks among many investors. A recommendation in this report is to seek mechanisms to refinance projects, perhaps through an individual project special purpose vehicle or an aggregator national fund, issuing infrastructure bonds, after the construction phase, to bring in greater financing from investment funds. Multilateral development banks or other players can also assist in this process by guaranteeing project specific risks such as political risks or risks related to contracts with public sector entities allowing such bonds to attract higher ratings.

The potential of such mechanisms to increase funding for investment could be significant. It is estimated that global

investment and sovereign wealth funds that might invest in infrastructure in emerging economies manage around US\$30 trillion. Assuming that 5 percent of that can be attracted to infrastructure in emerging economies, and since Latin America



Latin America and the Caribbean must invest better in infrastructure.

and the Caribbean represents 15 percent of emerging market GDP, the additional boost for financing to the region could amount to over US\$20 billion each year for the next 10 years, doubling current private investment levels.

The low level of infrastructure investment in Latin America and the Caribbean is only part of the problem. The other part is low quality. There is ample room for improvement in the region at all stages of the investment process, from project planning and design through construction (contracting and supervision of works) to maintenance of works in operation.

High quality analysis and the early development of potential projects is essential to know which ones are likely to yield the greatest social benefits for a given level of investment. Decisions can then be made to prioritize and plan effectively. The objective of planning is to ensure that the *right projects are selected* and then to focus the efforts of the investment cycle on the actions needed to *implement the projects in the right way*. The importance of planning goes far beyond choosing projects with the highest economic return. Social and environmental impacts are becoming increasingly relevant; therefore, identifying, measuring, and taking action to mitigate these environmental effects should be key activities from the outset of the planning process.

Projects often have unforeseen delays in the construction phase due to inadequate budget planning, delays in permit authorization, and/or engineering design disputes. Since delays tie up resources, they carry a financial cost, as do cost overruns, which are often the result of unforeseen contingencies. For example, discovering rocks with a more difficult geological formation for drilling in tunnel

construction or underground pipelines in urban areas that are not included in the available maps represent unexpected hurdles. However, cost overruns can be the result of strategic behavior by companies that bid low during the procurement process and then renegotiate bilaterally. In some cases, there may even be corruption involved. In Latin America and the Caribbean, reducing unforeseen delays and cost overruns can generate savings of 35 percent of the amount invested (25 percent for cost overruns and 10 percent for unforeseen delays). Since public investment in infrastructure in the region was 2.3 percent per year between 2008 and 2017, the potential savings or, in other words, the efficiency gains, from addressing delays and cost overruns could reach 0.65 percent of GDP.

Although vital to the infrastructure investment cycle, maintenance is often neglected. New investments usually go to increase capacity (more roads, electricity transmission, and distribution lines or water pipes, to give some examples). However, in many cases, investing in maintaining what already exists is the most cost-effective option for increasing the supply of services. A good maintenance policy makes it possible, for example, to reduce technical losses in electricity distribution or water lost due to broken pipes (which in the region exceeds 40 percent of water produced). By eliminating or reducing the need to invest in new assets, these actions are equivalent to providing more services with existing assets.

Considering the design of contracts carefully and “investing in the investment process” can produce a high return for improving investment efficiency. The search for greater efficiency is a goal shared by many countries, not just those in Latin America and the Caribbean, and a wide variety of ideas are being tried. However, there are still relatively few evaluations of interventions to improve the investment process, making it difficult to provide robust recommendations. Further research is needed in this area. Still, examples such as the recent creation of specialized institutions (*I-bodies*) to improve infrastructure planning such

as those in Australia and the United Kingdom appear to be promising innovations.

Undoubtedly, the region needs to put the issue of impact assessment on the public policy agenda in the infrastructure sector. However, despite limited data and evaluations, policies with consensus among experts in the infrastructure sector include (i) developing and implementing infrastructure plans that recognize the linkages and interdependencies of infrastructure services and create a bank of projects that offer predictability for the construction industry; ii) allocating sufficient resources to pre-investment, that is, prepare projects well in order to reduce the number of unforeseen contingencies, especially those that lead to cost overruns; (iii) stimulating competition and innovation (for example, moving from selection criteria based on inputs, outdated standards, and lower prices to selection based on service quality, so as to create incentives to adopt new technologies); (iv) prioritizing investment in maintenance by implementing contracts, for example, for road rehabilitation and maintenance, in which the region has proven experience and success, and changing the paradigm from reactive to predictive maintenance, which is already possible thanks to technological advances; and (v) fighting corruption in infrastructure, improving compliance with laws, but also innovating with targeted technological solutions; for example, MapalInversiones, a georeferenced platform of projects already implemented in Colombia, Peru, and Costa Rica, allows citizens to identify how resources are spent in their jurisdiction, thereby reducing opportunities for corruption.

Innovation, Innovation, and More Innovation

Imagine asking María Fernanda today her opinion of the services she receives; most likely, her response would be unfavorable.

While major challenges remain, the region has certainly tried to innovate and, in many cases, has done so successfully. In urban transport, for example, a bus system with dedicated, separate infrastructure began operating in Curitiba, Brazil, in the mid-1970s.

In 2020, these systems, known as BRT (Bus Rapid Transit), operate in 55 cities in 13 countries in the region and in more than 100 cities outside the region, many of them in developed countries. They have cut average travel times by 7 minutes per trip in Lima and 11 minutes in Cali, but the reductions for lower-income users are far greater because they make longer trips. More recently, the region has begun to develop cable car systems (*teleféricos*); these systems are appropriate given the mountainous geography of many Latin American cities. The systems in Medellín, Caracas, and La Paz-El Alto are the largest by length; Mi Teleférico in La Paz-El Alto carries more passengers than any system in the world (45 million per year).

Wastewater treatment is vital for protecting water sources, public health, and the environment. Latin America and the Caribbean treats only 30 percent of the water it uses. However, Chile implemented a series of policies that expanded coverage to 100 percent, including regulating domestic and industrial effluent standards, strengthening the regulatory capacity of the Superintendency of Sanitary Services, and creating incentives for private companies responsible for wastewater treatment. In 2020, Chile is the only country in the region that treats all its water, and it did so by leaping from 40 percent to 100 percent in just 10 years.

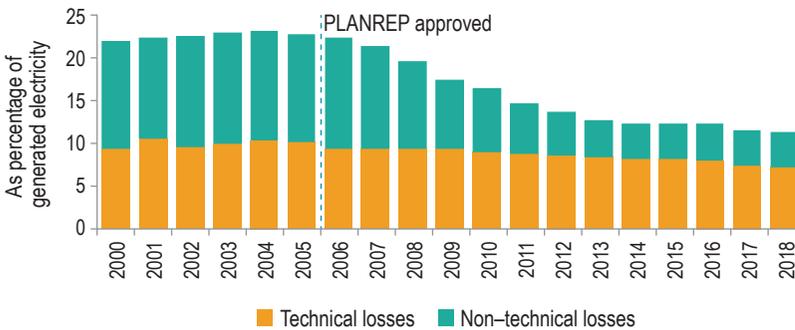
Access to electricity can be considered a success story in Latin America. The investments made to expand the network combined with the off-grid solutions used to reach the most



Innovation in the region has improved services, but more innovation is needed to cut costs and stimulate a leap in the quality of services.

remote locations has brought the region closer to universal access to electricity. But much work remains to be done to improve the quality of services. The key is to establish effective regulatory incentives, as shown by the example of Ecuador. In 2006, Ecuador approved a plan to reduce nontechnical electricity losses (electricity consumed but not paid for) with incentives for companies to improve collectability, install meters, and implement measures to facilitate payment by consumers. From 2006 to 2017, losses fell from 13 percent to 4 percent (Figure 4) and the average annual number of household power cuts fell from 26 to 11.

Figure 4
Electricity Losses in Ecuador Following the Implementation of PLANREP



Source: Chapter 4 of the full report.

These examples show that the region can successfully innovate to improve services. The book documents many more examples, but unfortunately far fewer than are needed to produce quality services at the lowest possible cost.

Improving access, quality, and affordability of services is not just an aspiration of experts. Increasingly, it is a social demand. Latin America and the Caribbean is characterized by high income inequality, especially in comparison to developed

economies. Income inequality is reflected in the provision of services. The quality of water services is lower in poor areas. Transportation services are also highly unequal. Largely poor peri-urban areas tend to receive low-quality formal services forcing many people to depend on informal service providers. In the region's large urban areas, the poor have less access to formal jobs because transport services are inadequate. Apart from access, affordability remains a problem, even for middle-income social sectors. Demand for high-energy appliances, such as air conditioners and washing machines, and for the infrastructure services needed to run them, is far from saturated. However, demand is limited by ability to pay.

Aspirations have been growing in Latin America and the Caribbean as the middle class has expanded. It is not enough to have access to a modern bus if it arrives late, is overcrowded, and the fare over a month is equivalent to 10 percent of the minimum wage. It is not enough to have a tap in the kitchen if the water quality is so dubious that bottled water has to be bought for drinking and cooking. Nor is it enough to be connected to the power grid if power cuts occur every week and threaten to damage appliances. Not surprisingly, price hikes of services can spark protests and social unrest, as they did when transport tariffs were increased in Brazil in 2013 (8 percent in bus fares), and in Chile in 2019 (3 percent in metro fares). Arguably, these protests speak to the growing popular dissatisfaction with the quality and cost of the services people receive from infrastructure. Going forward, reactions to service problems are expected to be more immediate and forceful due to the penetration of social networks. Consumers will also be able to take more active and direct control of service provision through digital devices and will, therefore, demand a more rapid and effective response from regulators and companies to their complaints.

The Times, They Are a-Changing

Digitalization and technological advances, in addition to growing social demands and environmental concerns, will drive dramatic changes for infrastructure services in the coming years. Significant challenges lie ahead, but so do tremendous opportunities.

Digitalization of Services

As the full power of digitalization hits service provision, the changes will be transformational. Electricity markets, particularly the distribution segment, have already begun to change radically. Until now, monopolistic companies have distributed to passive consumers who consume electricity at the price offered. Consumers will play an increasingly important role as they generate their own electricity, becoming consumers and producers at the same time (hence, the term *prosumer*). And electricity companies will have to change their business models to survive.

These changes are driven by two simultaneous trends: decentralized generation and digitalization. Decentralized energy production in households and industries means that a large number of producers are entering the energy market thanks to advances in technology and falling costs. Digitalization, in turn, will allow consumers to exchange electricity on the market, either with the distribution company or, increasingly, with other consumers. But the impact of digitalization will be much broader. Growing digitalization allows distribution companies to use tools (such as machine learning) to optimize use of the electricity grid, reducing maintenance and investment costs. It also allows for consumer demand response mechanisms and cost reduction through smart meters and “Internet of Things” (IoT) applications. For example, consumers will be able to schedule the use of appliances or charge electric vehicles at times of the day

when prices are lower or when the electricity supply in the grid is higher.

Automation and electrification will bring radical changes in the transport sector. The impacts of increased automation will depend largely on digitalization of services. The emergence of ride hailing transport network services such as Uber and Cabify has prompted a decentralization of services in this sector. Together with the availability of electric vehicles, automation is expected to lead to a substantial supply of new autonomous, connected, electric, and shared mobility (ACES) services. Mass transport (metros, trains, and buses) and logistics services will also become increasingly automated, allowing for significant increases in the sector's productivity.

Technological change can also help change the paradigm for organizing and operating water and sanitation services. At present, more water is extracted than needed due to inefficient processes, and only a small fraction of wastewater is treated. Technology can help ensure that water resources are managed in an integrated way by measuring and regulating the amount of water used by each major consumer (agriculture, industry, and households), by reducing the cost of wastewater treatment, and by expanding options for reuse.

Technological disruption will also impact construction and infrastructure maintenance. Digital tools, drones, and satellite data can be used to optimize planning, engineering design, and land acquisition and resettlement. Emerging technologies can cut construction costs by 10 percent to 50 percent. Augmented and virtual reality, for example, can facilitate design and construction. Eventually, new technologies will change the type of infrastructure to be built. In addition,



Implementing technological change in services will boost economic growth and benefit the most vulnerable in particular.

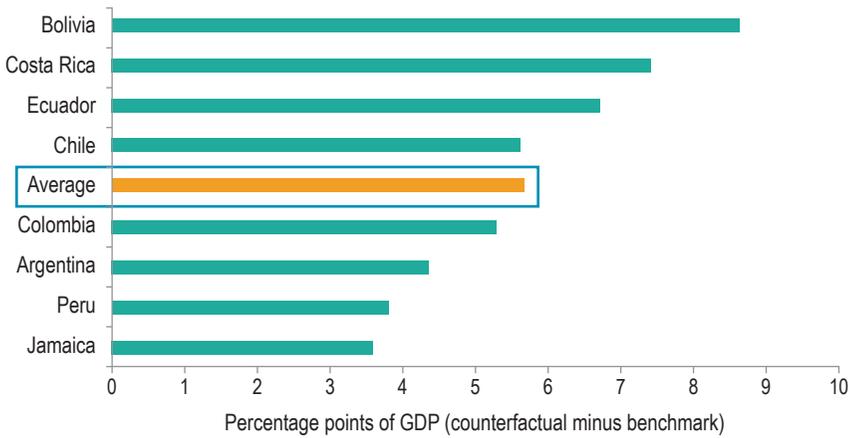
doing more predictive maintenance, along with or complementing corrective maintenance, will create additional cost savings made possible by big data analysis, which will help anticipate maintenance needs and optimize their timing.

María Fernanda's imagined future illustrates how technological disruptions can benefit consumers. In a well-functioning digital world, services will be consumed only as needed, will be less burdensome for consumers and, above all, will be of better quality. Recurrent power cuts will be avoided, every home will have access to quality water, and commuting will be more comfortable, safer, and less time-consuming. As these benefits reach the millions of María Fernandas across Latin America and the Caribbean, economies will become more prosperous and equitable.

The simulations presented in the book show that the digitalization of services will boost economic growth. For example, a 5 percent increase in the efficiency of services through greater productive efficiency (a reasonable assumption given the impact of digitalization on reducing losses, energy efficiency, and process automation) would result in a US\$200 billion increase in GDP over a decade (equivalent to 6 percent of regional GDP). Digitalization of services could, therefore, provide a domestic source of growth for a region that is vulnerable to the vagaries of external factors.

Moreover, digitalization can be a source of inclusive growth: simulations suggest that it would raise the income of all households but help poorer households more than rich households, thereby contributing to greater distributional equity (see Figures 5 and 6). Digitalization would drive down the costs of producing services and, therefore, the price paid for them. Since lower income households spend a higher proportion of their income on services than richer households, they will benefit more from lower prices.

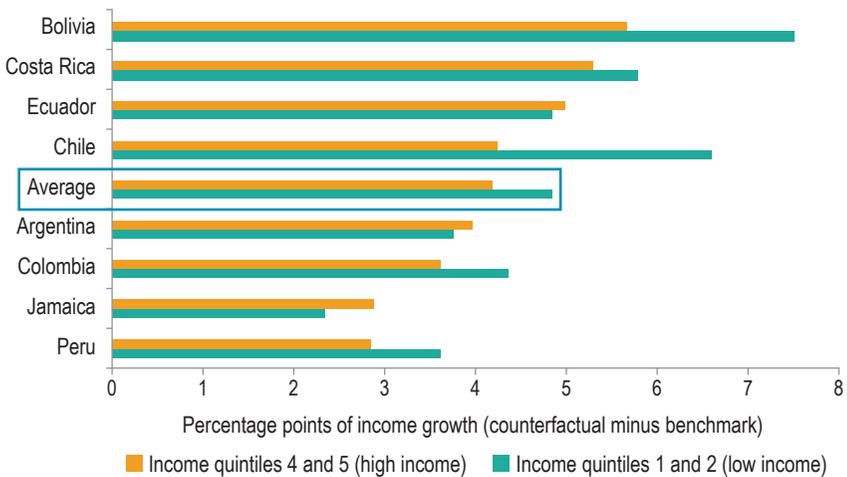
Figure 5
Impact of Digitalization of Infrastructure Services on GDP



Source: Chapter 12 of the full report.

Note: Figure shows the cumulative change, in percentage points of GDP, of the counterfactual (i.e., digitalization) minus the benchmark (i.e., business as usual) growth rates over 10 years.

Figure 6
Impact of Digitalization on Household Income



Source: Chapter 12 of the full report.

Note: Figure shows the cumulative change, in percentage points of real income, of the counterfactual (i.e. higher efficiency) minus the benchmark (i.e. business as usual) growth rates over 10 years.

Is a Dystopian Future Possible?

Tomorrow is right around the corner. For María Fernanda, tomorrow could bring quality water, electricity, and transport services to provide her with a better quality of life. However, that rosy picture of the future is not a given; there are no guarantees. On the contrary, technological change could lead to a dystopian future if the right policies are not adopted.

Urban mobility is a good example. Motorization rates are increasing fast, creating severe congestion in a region that already has 4 of the 10 most congested cities in the world. Under these conditions, autonomous, connected, electric, and shared transport can make the situation worse. Given the expected decline in the price of carpooling, failure to stimulate mass public transport, expand its coverage, and improve the quality of service will encourage many people to stop using public transport. Those who cannot access carpooling will have no choice but to use a public transport system that is less accessible, less affordable, and of poorer quality. Under this scenario, congestion would be greater than today and, without land use regulations, autonomous vehicles could even lead to uncontrolled urban sprawl and displace the poorest residents to areas farther and farther from their jobs.

The organization of the electricity sector could also go in a dystopian direction. Falling prices of self-generation and storage, along with increasing ease of energy exchange, could incite large numbers of users to disconnect from the power grid, which now functions as the backbone of the electricity distribution system. It is not impossible to imagine a future in which consumers living in higher-income areas disconnect from the grid and form small self-sustaining systems, while consumers in lower-income neighborhoods remain dependent on the established networks, which no longer have the resources to maintain them. This scenario would lead to more frequent and longer service interrup-

tions; the progress made in recent decades to increase access and quality of electricity provision would be interrupted or even reversed.

Prepare for Tomorrow, Today: Pillars of the Public Policy Agenda

To access María Fernanda's future and avoid a dystopian one requires governments to play an active part in the design of public policies, willingness to change obsolete institutions, and a commitment to innovate in the use of regulatory instruments.

Digitalization of Quality for All

To take advantage of technological advances in water and sanitation, energy, and transport services, Latin America and the Caribbean will have to develop its own digital connectivity structure. Access indicators show that many countries are lagging far behind in this dimension. Figure 7 shows that only two-fifths of households have Internet access, and only two-thirds of the population have access to mobile broadband.

Ideally, countries should have a dynamic supply and a demand capable of acquiring and using digital services. For this, it is crucial for them to adopt policies to help develop the communications infrastructure needed to achieve universal coverage and promote a competitive and dynamic digital services market.

The countries of the region need to create and implement a digital agenda. This includes developing a national broadband

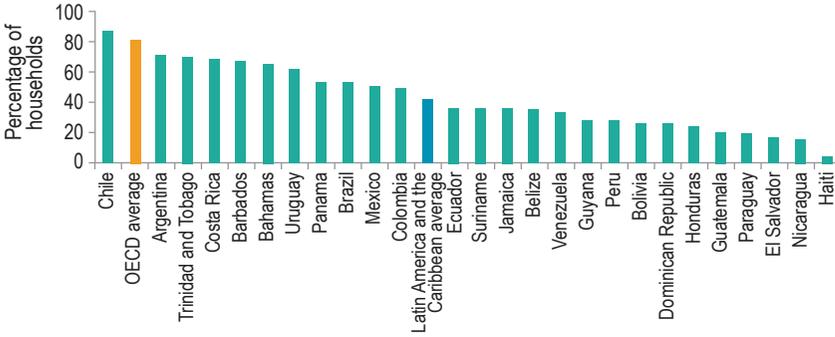


Digitalization of services requires universalization of digital infrastructure and training to use digital services.

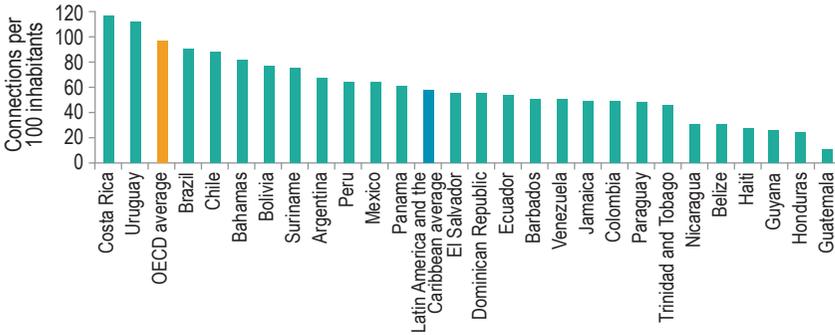
Figure 7

Access to Fixed and Mobile Communication Technologies, Latin America and the Caribbean vs. OECD, 2018

Panel A. Households with access to Internet



Panel B. Mobile broadband penetration



Source: Chapter 5 of the full report.

Note: Both graphs are based on the latest available data (2018).

plan that facilitates open access to infrastructure and promotes competition in segments where feasible. This plan must be accompanied by appropriately targeted subsidies to achieve universal access and promote the use of affordable communication services for the entire population. Finally, it also requires appropriate training so that users can take advantage of the opportunities offered by the technology.

Sustainable Infrastructure: Bridging Generations

The impacts of climate change are significant and their magnitude is evident. The high incidence of natural disasters, such as droughts and floods, negatively affect the quality of life and health of the population and take a high toll on countries' production and economy. Higher temperatures and rising water levels are also threats that put the population at risk and reduce labor productivity.

Natural disasters and climate change also disrupt the provision of infrastructure services. On one hand, the region should be leading part of the solution and join international efforts to mitigate climate change. On the other hand, governments should directly confront these adverse trends by adapting plans for infrastructure to the high level of uncertainty and focusing on the design and provision of resilient infrastructure and services.



Climate change requires immediate action in multiple areas—including infrastructure.

Mitigating Climate Change

Infrastructure unites generations because its life span extends over decades; the generation that produces it bequeaths it to others who will use it later on. Given the commitments made by the countries of the region in signing the Paris Agreement to mitigate climate change, provision of infrastructure and its services must change now. If not, the result is clear: the commitments will not be met.

The targets set in the Paris Agreement are ambitious: limiting the increase in global temperatures to 1.5°C or 2°C means achieving zero net carbon dioxide (CO₂) emissions by 2050 or

2070, respectively. Reaching zero net emissions means reducing emission sources.

As a region, Latin America and the Caribbean accounts for 9 percent of the world's population but generates 12 percent of CO₂ emissions. The two main sources of emissions of CO₂ (and other pollutant gases) are energy generation and food production. As a major agricultural producer and exporter, the region feeds much more than its own population footprint. The burning of fossil fuels for transport and electricity accounts for about 70 percent of total CO₂ emissions in Latin America and the Caribbean. Between 1990 and 2014, these emissions grew 87 percent.

Can this situation be changed? Can adequate and reliable infrastructure services be provided in a zero-carbon economy? The answer is yes; but achieving that goal demands action on the four pillars of decarbonization.

- Zero-carbon electricity generated from renewable sources and supplemented where not available from other low carbon sources.
- Mass electrification of economic activities through the use of electric vehicles as well as electric boilers and heating systems for industrial and residential use. Where this is not possible, fossil fuels will have to be replaced with carbon-free fuels such as hydrogen and sustainably produced biofuels.
- Greater use of public transport and nonmotorized transport, which can be achieved through urban planning geared to mass public transport.
- Reforestation and restoration of ecosystems with high absorption of carbon from the atmosphere.

To make the transition, obstacles must be overcome. The main hurdle is to ensure that planning and business practices break the status quo and adopt decarbonization-compatible technologies. Figure 8 illustrates the size of the challenge: existing power plants in the region already generate more CO₂ emis-

Figure 8

Committed Emissions from the Region's Power Sector vs Average Emissions Consistent with Temperature Targets in IPCC Scenarios



Source: Chapter 7 of the full report.
Note: IPCC Scenarios up to 2050.

sions than the maximum permitted under climate targets. Any increase in electricity generation using natural gas would be incompatible with the CO₂ emissions required to meet the zero net emissions target. Apart from planning, governments in many cases send the wrong signals to the market by setting prices and granting subsidies. Since 2010, the region has subsidized fossil fuels by more than 1 percent of GDP per year, keeping prices artificially low and reducing incentives to adopt clean technologies in energy and transport.

The good news is that providing carbon-neutral energy and transport services by 2050 is technically feasible; moreover, doing so can bring economic benefits. The cost of renewable energy is falling rapidly. At US\$0.03 per kilowatt-hour—which are the values at energy auctions in several countries in the region in 2020—solar and wind power are already the cheapest ways of generating electricity. And if done right, transition to a zero-carbon economy will create jobs and generate more economic growth.

The essential starting point is to design decarbonization plans that: (i) define a roadmap for investments and regulatory reforms compatible with decarbonization targets; (ii) anticipate

and minimize transition costs, and; (iii) give substance to the emission reduction commitments that must be set in the new NDCs (Nationally Determined Contributions, which are the Paris Agreement's instrument that documents countries' explicit commitments to cut emissions).

Adapting to the Effects of Climate Change

To respond to natural disasters and climate change, governments can design resilient infrastructure. Investments in resilience made before a disaster occurs reduce damage to infrastructure assets and minimize disruption to services, thereby avoiding economic losses for individuals and businesses. Many engineering options can increase infrastructure resilience: using earthquake-resistant building material; raising roads or railways, and; increasing redundancy in transmission networks to minimize service disruption if a segment of the network is affected by a natural disaster. To remain resilient, structures also have to be properly maintained.

Making structures resilient could be expected to cost the equivalent of an additional 5 percent in investments. However, evidence shows that the higher costs of building more resilient infrastructure are often more than offset by lower costs of maintaining and repairing those assets over time.

Regulations for infrastructure design must require a comprehensive risk analysis from the outset in the design and planning stage of any new project. This will ensure that decisions with long-term consequences are made while all the options are viable. Taking resilience into account from the start of the project is much more effective in terms of time and money than leaving it until later. Incorporating resilience midstream can require modifications to already approved engineering designs, when many features, such as project location, are already determined, or even worse, rebuilding or modifying works after construction is completed. Even so, it is impossible to eliminate all risks, even

with the best efforts. Consequently, governments should manage residual risk by promoting financial instruments that spread the risk and allow for financing reconstruction and contingency plans.

Countries in the region have room to improve their disaster management frameworks. About two-thirds of Latin American and Caribbean countries have formal regulations that require a disaster risk analysis before making an investment, earthquake resistance standards, a definition of critical infrastructure, and standardized technical requirements for critical infrastructure. However, less than one-third of countries in the region have formal regulations that establish risk transfer mechanisms, construction insurance, or continuity plans for services, with water and sanitation being especially critical.

Partnering with Nature

Not all infrastructure is made of concrete. Natural and quasi-natural ecosystems can produce many of the same services as conventional or gray infrastructure. For example, in coastal areas, coral reefs and natural mangroves can provide the same type of protection against storm surges and flooding as dykes, jetties, and bulkheads. In cities, terraces and quasi-natural green spaces can contain storm runoff, considerably alleviating discharge of rainwater into sewage systems. In addition, in both rural and urban areas, natural forests and man-made wetlands can perform the same purification functions as wastewater treatment plants.

In recent years awareness, enthusiasm, and investment in this green infrastructure has increased exponentially in both industrialized and developing countries. What role can green infrastructure play in helping to close the infrastructure gap in Latin America and the Caribbean? In terms of opportunities, considerable evidence shows that, under certain conditions, green infrastructure can provide services as effectively as conventional gray infrastructure, and in some cases at the same cost. Moreover,

green infrastructure provides valuable services that conventional gray infrastructure does not. For example, coral reefs, seagrasses, and mangroves not only help control flooding; they also recycle nutrients, act as a water filter, provide habitat for flora and fauna, and stimulate recreation and ecotourism. Latin America and the Caribbean is well positioned to take advantage of green infrastructure. The region, which is often defined as a biodiversity superpower, contains half the world's remaining tropical forests, a quarter of its mangroves, almost a fifth of its coastal habitats and the second largest coral reef in the world.

The most important problem in adopting natural infrastructure solutions is that evidence of their effectiveness is still very limited and depends very much on the specific location of the intervention. The challenge will be to collect and analyze the data needed to rigorously target, plan, and finance natural infrastructure investments.

All Roads Lead to Regulation

Currently, public services are largely provided by monopolistic companies. In the absence of head-to-head competition, regulation becomes the key instrument to ensure consumers obtain

fair prices and good quality. With rapid technological change, the role of regulation becomes even more important. If new technologies reduce costs, with current market structures, regulation will determine how the benefits are shared between consumers and service providers. The simulations in this book show that if regulation does not push prices down as costs fall (such that margins



Water, energy, and transport services will undergo vast changes due to innovation and climate change. Regulation will have to play a key role in fostering opportunities and mitigating risks.

grow), then technological progress will have less of an impact on growth. Allowing a gap between prices and costs reduces the effect of a positive productivity shock: instead of generating an additional 3.5 percent of GDP growth, it would generate only 1.8 percent of incremental growth. And just as important as the impact on growth is the impact on income distribution. After a technological shock, if cost reductions are fully passed on to prices, all households benefit. However, when there is a margin between prices and costs, lower-income households benefit less. In a region characterized by a high level of income inequality, technological change would improve income distribution if the economic regulator were able to reconcile the way in which efficiency gains are shared between producers and consumers.

Technological progress may also change the market structure of these sectors. Indeed, one of the challenges facing regulators is how, with the benefit of new technologies, the power of competition can be harnessed to sharpen incentives and bring greater benefits to consumers. This will require new ways of thinking, new institutions and a rethinking of regulatory instruments. The starting point may be regulatory frameworks that are, in many cases, obsolete. To change them, governments need to act quickly and flexibly. Undoubtedly, adapting to technological disruptions and other trends such as climate change will require difficult negotiations, as there will be winners and losers. To the extent that aggregate benefits exceed costs, compensatory and coordinating mechanisms can lead to a better future for all.

Adapting Policies

Regulators in the region must invest in their capacity to respond to emerging trends. For example, in 2019, half of electricity regulators lacked tools to issue regulations on the adoption and use of technologies, such as net metering (which is critical for

establishing demand response programs and for developing electricity trading platforms), storage, and electric cars.

The good news is that, despite the gaps, countries are updating their policies in response to technological change (Figure 9). Many countries and multilateral agencies are updating their procurement policies to encourage technological change, moving from policies based on defining inputs or standards to performance-based contracts that offer incentives for service providers to innovate and adopt new technologies.

Figure 9
Timeline of Net Metering Policies' Adoption



Source: Chapter 13 of the full report.

Adapting Instruments

While, pricing, quality standards, and investment obligations will continue to be important regulatory instruments, where technologies allow greater competition over networks, the way in which access to those networks is managed and priced and how those networks are maintained and developed in the future will also become of critical importance. New digital technologies and the opportunities offered by the explosion in data availability, the need to improve coordination with environmental agencies to address climate change concerns, and the need to make regulated services accessible to all, may require the development of new instruments.

The most dramatic changes in instruments are likely to be in pricing regimes. Existing regimes must be changed because

decentralizing services (inspired by the emergence of prosumers, small-scale water treatment systems, or network transport companies such as Uber) will challenge the financing of the networks, which are the backbone of service provision, and this in turn will affect the financial sustainability of service providers.

Current pricing structures may be incompatible with the emerging technological eruptions taking place, especially given decentralization. For example, with greater consumption, electricity prices have been rising in virtually all countries, providing incentives for households to generate their own power. But if more and more small producers consume only their own generation, then the maintenance of a national grid becomes untenable. However, if the national grid becomes untenable then many other consumers, including poorer and more vulnerable families, will suffer. These observations highlight the difficult decisions facing regulators who may have to balance the benefits of adopting new technologies to individuals with overall societal objectives. In electricity, static efficiency suggests pricing at each node of the grid, depending on the conditions at each node today. But such pricing schemes that may be optimal today do not take into account individual incentives and how consumers may then change their behavior with new technologies. Regulators need to consider a holistic approach. Regulation, including pricing structures and policies that grant access to the grid for generation, should aim to provide maximum benefit to the population and in particular to poorer households.

Behavioral economics has been added to the tool-box of regulatory instruments. Its use in Latin America and the Caribbean has so far been limited. However, certain behavioral interventions have ample potential for creating incentives to reduce consumption during high-price hours, to encourage the use of household appliances in lower consumption modes (for example, short-cycle washing machines), and to choose the combination of transport modes with the greatest time savings. For example, an intervention in Costa Rica in 2015 which sent out comparative

consumption information on water bills reduced consumption among the target customers by 3.4 percent. Regulators should create incentives for providers to experiment more with interventions based on behavioral economics.

Adapting instruments to future changes will not be an easy task. It requires detailed technical analysis, based on accurate statistical information, together with strong regulatory institutions with trained human capital and clear mandates.

Adapting Institutions

Regulatory institutions will be critical to guide services toward desirable outcomes. To do this, institutions must adapt to the new reality. Since the reforms of the 1990s, one regulator has overseen each type of service (in smaller countries and states, a single regulator often oversees more than one service). But the exponential increase in data use brought about by digitalization, along with technologies that facilitate decentralized delivery of services, is blurring the regulatory boundaries between sectors. Electricity is becoming increasingly interrelated with transport, water, and telecommunications. For example, electric vehicles are basically batteries on wheels. How electricity storage and flows are regulated (in terms of price and quality) will determine the speed at which electric vehicles are adopted. In turn, this will affect the investment needs of the electricity distribution network. In addition, data are often provided and managed by companies subject to the rules of the telecommunications regulator (think, for example, of Google's entry into transportation with autonomous vehicles); but these data end up being used by other regulators (electricity, transport, or water), so separating the mandates of sectorial regulators becomes impossible, if not counterproductive.

The cross-sector nature of digitalization is why collaboration between regulatory institutions has become more important than ever. It also suggests that sectorial mandates may need to be reassigned. Options include the merging of agencies (a process

already underway in the financial sector), assigning authority over all data handling issues to the competition protection agency, or creating an independent data regulator. The most desirable solution will depend on the country context and should take into account the technical capacity and risks of political reversals of decisions.

In the move to a more uncertain and dynamic area of action, regulators will have to change their procedures. They will need to interact with many more service providers (prosumers, small-scale water treatment providers, mobility platforms) and at the same time implement more frequent and responsive consultation mechanisms because of the greater consumer participation and monitoring allowed by social networks. They will also have to interact more with providers and potential entrants who will continually propose technological innovations. To this end, regulators will have to establish sandboxes (controlled spaces for experimentation) to learn and define new rules rapidly before introducing them to markets. They will also have to address growing cybersecurity challenges that can undermine the reliability of services, at the same time as they protect user privacy. All this requires recruitment and training of professionals able to keep up with the pace of technological innovation in the regulated companies.

An Integrated Approach to the Future

There are moments in history when change happens very quickly. Sometimes it seems that reality overtakes fiction. For example, in 1914, two decades after the president of the British Royal Society declared that it was impossible for heavier-than-air machines to fly, the first commercial airline began carrying passengers. By 1930, only three decades after investors were assured that the automobile was only a passing fad, the United States already had a motorization rate higher than Latin American and Caribbean countries have in 2020 (216 vehicles per 1,000 inhabitants).

Today, the world is likely facing a technological revolution that will change energy and transport services and perhaps water services. It could be a disruption with effects equivalent to the introduction of the steam engine during the industrial revolution of the 19th century.

This is the moment when countries must experiment, redefi- ne policies, and create the best possible institutions. The way forward is to adapt to the realities of each country, but all of them need to take an integrated approach. Perhaps no sector exemplifies this more clearly than urban transport. An efficient (lower-cost, higher-quality services), inclusive (accessible and affordable for all) and sustainable (promoting a safer, cleaner, and more livable urban environment) transport system cannot be achieved through piecemeal policies and fragmented deci- sions. The right policies need to be planned and implemented, assuming the risk of getting it wrong and the political cost, which in many cases could be high. Table 1 provides an example of a transport policy roadmap designed to meet these challenges.

Table 1
Policies for an Efficient, Inclusive, and Sustainable Transport System

	Short term 2020	Medium term	Long term 2030
Improve public transportation	<ul style="list-style-type: none"> ● ACES sandboxes ● Invest in high-quality mass transportation ● Space reallocation from vehicles to public and active modes ● Complementarity of ride-hailing services ● Increased funding for higher quality of mass transport and its feeders 	<ul style="list-style-type: none"> ● Digital gateways for transport services 	

(continued on next page)

Table 1 (continued)

Policies for an Efficient, Inclusive, and Sustainable Transport System

	Short term 2020	Medium term	Long term 2030
Get prices right	<ul style="list-style-type: none"> ● Increased funding for higher quality of mass transport and its feeders 	<ul style="list-style-type: none"> ● Road, congestion, curb and parking pricing 	
Decarbonize transportation	<ul style="list-style-type: none"> ● Availability of EV charging stations ● Preferential lanes/zones for EV 	<ul style="list-style-type: none"> ● No subsidies to fossil fuel 	<ul style="list-style-type: none"> ● Electric public transport fleets ● ICE vehicle sales banned
Address the last-mile logistic conundrum	<ul style="list-style-type: none"> ● Integrated plans for mobility and logistics 	<ul style="list-style-type: none"> ● Updated zoning regulations ● Time windows for deliveries ● Smart management of loading/unloading areas 	
Plan with perspective	<ul style="list-style-type: none"> ● Enhanced telecommunications infrastructure ● Scenario planning/ Strengthen regulatory and institutional capacity ● Enhanced inter-agency and public-private coordination ● Regulatory sandboxes 	<ul style="list-style-type: none"> ● Digital government 	

● National level
 ● Both levels
 ● City level

From Structures to Services: The Path to Better Infrastructure

María Fernanda returns home to celebrate her birthday with family and friends. The everyday trials of her youth such as power outages, the need to buy bottled water because of poor quality drinking water at home, and never-ending delays in public transport, are part of a forgotten past.

Fortunately for María Fernanda and her contemporaries, the positive scenarios for the services envisaged in this book have materialized. It wasn't easy. Nor was it by chance. It required a collective effort in all countries involving governments, private sectors, and consumers themselves. The transformation was not easy and required the design of new institutions and regulations.

In María Fernanda's Latin America and the Caribbean, deficits in infrastructure and lack of investment are problems of the past. Infrastructure services are designed in an integrated way, structures are thought of together with institutions and regulations, prioritizing services and building on the ample knowledge available on how María Fernanda and others like her will use them.

Everyone in Latin America and the Caribbean deserves quality services. That future is possible, but not inevitable. The 2020 Development in the Americas (DIA) report offers policy options for countries to improve the access, quality, and affordability of services today, to ensure that services will be sustainable in the future, and to harness emerging technological advances for the benefit of all. Still, many things are uncertain and remain unknown. This book aims to provoke discussion and further research on those many important issues and mark a path that helps the region move from structures to services and improve infrastructure for all.

“This Development in the Americas (DIA) report has the potential of becoming a landmark publication, it is a veritable goldmine. The long-neglected problem of poor-quality infrastructure services in Latin America is untenable. Grim growth prospects, climate risks, and the post-Covid-19 recovery should catalyze decisive actions. This book provides a timely roadmap on what needs to be done to improve both the *hardware* and the *software* of the sector. Leaders should pay close attention to its recommendations and adopt new standards in planning, procurement, regulation, and management of infrastructure. Social unrest will increase if lack of access to safe water, high traffic congestion, and costly public utilities are not rapidly—and effectively—addressed.”

Mauricio Cárdenas

*Senior Research Scholar, Center on Global Energy Policy, Columbia University
Former Minister of Finance, Energy, and Transportation, Colombia*

“The great contribution of this book is to focus our attention on the services that infrastructure provides rather than on the facilities themselves. This is important because experience cautions that few countries in Latin America and the Caribbean can or will invest as much in infrastructure as development experts recommend. The focus on services, however, reminds us that there are more ways to improve the access, quality and affordability of infrastructure than by simply investing more. And the study is rich with examples of how this might be done.”

José A. Gómez-Ibáñez

*Derek C. Bok Research Professor of Urban Planning and Public Policy,
Harvard University*

“This book strongly calls for an increase in both public and private investment to help close the infrastructure gap in Latin America and the Caribbean. It also highlights the importance of improving access to infrastructure whilst also creating better infrastructure that is more sustainable and resilient. To do this, more innovation is needed to reduce costs and improve the quality of infrastructure. Whilst challenges lie ahead, particularly in a post-Covid-19 world, there is enormous potential to boost economic growth and change lives, particularly the vulnerable.”

Marie Lam-Frendo

Chief Executive Officer, Global Infrastructure Hub

