

“Building Back Better” Requires Building In Digital

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Any national infrastructure package should include 21st century digital infrastructure—not only investments in core digital infrastructure, such as broadband and government IT systems, but also hybrid-digital upgrades to existing physical infrastructure to improve its performance.

KEY TAKEAWAYS

- Putting digital at the center of an infrastructure plan will create jobs. Compared to traditional infrastructure, it will also generate superior longer-term economic growth, competitiveness, national security, and environmental benefits.
- China has announced a massive infrastructure package to invest in “innovation infrastructures” of the future, including digital infrastructure such as 5G and 6G networks, industrial Internet, smart grid, and smart cities.
- A U.S. infrastructure package should include significant funding for digital infrastructure, including wireline and wireless broadband and funding for local, state, and national government agencies to significantly upgrade legacy IT systems.
- The package also should ensure funds go to upgrading and digitizing the electricity grid, along with physical infrastructure such as water, waste, and road systems, and supporting smart cities, farms, factories, and other sectors.

INTRODUCTION

Joe Biden ran for president on the theme of “build back better.” With his proposed \$2 trillion infrastructure plan, the president is certainly seeking to build back.¹ Indeed, this is a once-in-a-generation opportunity to make a big, bold investment to move America forward. But unless this plan fully embraces digital infrastructure, and not just asphalt and pipes, it will have built back, but not “better.”

As such, as the administration and Congress negotiate the size, composition, and funding of a major national infrastructure plan, they need to ensure that it includes a focus on 21st century digital infrastructure. This means not only investments in core digital infrastructure, such as wireless and wireline broadband and government IT systems, but also hybrid digital infrastructure wherein existing physical infrastructure—such as road and bridges, electric grids, water systems, and even cities—are upgraded with digital technologies to dramatically improve performance, address cybersecurity needs, and promote economic opportunity. (The Information Technology and Innovation Foundation (ITIF) has written elsewhere about the importance of supporting research and development in the infrastructure package as well.²)

America will lose a critical opportunity if the infrastructure package focuses on 20th century infrastructure while China leapfrogs ahead with 21st century infrastructure.

A commitment to digital is the path China is following as it makes massive investments (\$1.4 trillion to \$2.5 trillion over the next five years) in “innovative infrastructure” of the future, including in digital infrastructure such as 5G and 6G networks, industrial Internet (including “Internet of things”), smart grid, and next generation Internet architecture.³ In addition, 25 Chinese provinces have launched their own digital infrastructure projects, adding even more to that investment. America will lose a critical opportunity if the infrastructure package focuses on 20th century infrastructure while China leapfrogs ahead with 21st century infrastructure.

Putting digital (and not just broadband) at the center of the infrastructure plan will create jobs (just as traditional infrastructure will), but unlike traditional infrastructure it will generate superior longer-term economic growth, competitiveness, national security, and environmental benefits. And just as building highways and water systems can bring economic opportunities to more parts of the country, so too can investing in digital infrastructure ensure that all Americans have an opportunity to participate in the digital economy. And a more-robust digital infrastructure would make America more resilient, should we once again be forced to engage in widespread social distancing, with digital technologies playing a key role.

As such, the infrastructure package should include significant funding for wireline and wireless broadband; upgrading and digitizing the nation’s electric grid; upgrading physical infrastructure, such as water, waste, and road systems, with digital technologies; support smart cities, buildings, farms, factories, and other sectors; and funding local, state, and national government agencies to significantly upgrade legacy IT systems with more secure, modern, and efficient alternatives.

INFRASTRUCTURE FUNDING GOALS

Any national infrastructure package should have three principal goals:

1. **Improve infrastructure:** The main goal should be to improve the nation's infrastructure, which is the basis for economic activity and quality of life. But if that can be accomplished in ways that at the same time achieve other goals, such as competitiveness or productivity, policymakers should take advantage of those opportunities.
2. **Spur productivity growth:** The widely accepted view that infrastructure spending is an investment is no longer true. If infrastructure investment does not boost productivity growth, then it is just spending, not investment. Only infrastructure projects that yield net-present-value economic benefits greater than the cost of spending are investments. Some kinds of infrastructure, such as repaving roads or building transit, are spending, as in many cases they do not yield economic benefits in excess of costs. In contrast, other infrastructure, particularly digital infrastructure, has significantly positive benefit-cost ratios because, compared with some "cement and steel" infrastructure projects, the costs are lower and benefits higher.
3. **Enhance U.S. competitiveness:** Certain kinds of infrastructure can make the U.S. economy more competitive, either by helping exporting firms become more competitive or helping firms developing infrastructure to sell more overseas. Europe and many Asian nations are making big bets on an array of infrastructure technologies—including digital infrastructure, such as 5G wireless, and Internet of Things (IoT) technologies, including smart cities—not only to reap the economic and social benefits, but also to improve the productivity of companies using infrastructure and help companies that produce these systems to gain global market share. If the United States limits investment in digital infrastructure, it risks ceding the future to foreign companies, especially Chinese.

What about jobs? Shouldn't getting Americans back to work be the main goal? To be sure, the president and most supporters of a large infrastructure package sell it on the basis of job creation; indeed, the president's plan is called the "American Jobs Plan."⁴ Framing it around short-term job creation might elicit political support for the plan, but it is misleading.

Many studies of the economic benefits of spending on physical infrastructure find large benefits only because they assume that without the spending, the workers building infrastructure would otherwise be unemployed.⁵ But that is not likely to be the case now. With the natural course of the economic recovery, coupled with the massive stimulus packages of 2020 and 2021, there is no reason to think that the U.S. economy will not reach full employment within a couple years—certainly before the job impacts of an infrastructure package would manifest. Second, any deficit-financed spending would create jobs as the money got spent. The government could create jobs, to paraphrase Keynes, even if it put \$100 bills in old wine bottles and buried them in abandoned mines.

So, while short-term job creation will continue to be a key political selling point for infrastructure spending, and policymakers are right to consider how investments in digital infrastructure will enable American workers to succeed in the jobs of the future, policymakers should not make reducing short-term unemployment the principal goal because doing so would make it easier to support infrastructure spending that yields few long-term economic-growth benefits.

What Is Digital Infrastructure?

“Infrastructure” can refer to a wide array of physical assets. One definition is “essential facilities, services, and organizational structures for cities and communities,” which includes not only roads and rails, but also fire stations, prisons, dams, schools, etc.⁶ But this definition, while inclusive, is too broad for well-considered policy deliberations. “Infrastructure” refers to systems societies use to transport and process goods, people, or information.

“Digital” refers to information technology systems that electronically collect, process, and transmit information. Therefore, “digital infrastructure” is where at least a portion contains information technology. As such, there are two kinds of digital infrastructure: hybrid and dedicated.

Dedicated digital infrastructure is by its very nature digital. Broadband cables to transfer digital Internet packets would be an example. Supercomputing data centers or quantum computing facilities to provide access to advanced computing would be another. E-government services to provide front-office or back-office services are dedicated digital infrastructure as well. Open data portals provide communities, including businesses and individuals, with access to government data.

Digital infrastructure is where at least a portion contains information technology.

Hybrid infrastructure is traditional physical infrastructure that includes added digital components in order to improve performance. For example, water mains that are embedded with sensors to detect and transmit information on leaks become hybrid infrastructure.⁷ A digitally enabled electrical grid that uses smart meters, advanced control systems, and communication networks to gather, distribute, and respond to information regarding the behavior of suppliers, consumers, and the grid itself is hybrid.⁸ Intelligent transportation systems, such as traffic lights that respond dynamically to traffic conditions, are hybrid systems.⁹ Bridges that contain digital sensors to monitor stresses are also hybrid systems.¹⁰

THE CASE FOR DIGITAL INFRASTRUCTURE

Many argue that spending on physical infrastructure (roads, bridges, water systems, etc.) drives long-term economic growth. The World Economic Forum believes “infrastructure creates economic growth.”¹¹ Paul Krugman argued that “if the investment is productive, it will expand the economy’s productive capacity in the long run. This is obviously true for physical infrastructure.”¹² Investment manager Steve Rattner wrote, “An infrastructure initiative would not provide quick relief, but it would support stronger growth in the future.”¹³

Indeed, it has been an article of faith that traditional physical infrastructure (concrete and steel) boosts long-term growth. But evidence suggests that these growth benefits have declined over the last 40 years and are limited when compared with other areas, especially 21st century digital infrastructure. A widely cited 1989 paper finds that increasing traditional infrastructure investments in projects such as roads, transmission lines, and bridges by 1 percent increases productivity by 0.23 percent.¹⁴ But as the U.S. interstate system has become built out, the efficiency of these investments has declined. One study finds that U.S. highway investments generated annual total economic returns of 18 percent in the 1970s, 5 percent in the 1980s,

and just 1 percent in the 1990s.¹⁵ One meta-analysis of the studies on transportation infrastructure finds that “an increase of 10% in public investment in transport infrastructure is associated with an increase in output of about 0.5%. This puts forward a rather modest productivity effect of transport infrastructure.”¹⁶

Moreover, because of the strident opposition to cars and highways by many progressives, it is likely that the vast majority of any spending on roads in an infrastructure bill will be for repairs of roads and construction of transit, rather than expansion of lanes—and the former will do less to spur productivity growth and competitiveness.¹⁷

In contrast, investments in digital infrastructure are likely to generate significantly greater overall economic returns.¹⁸ These include both dedicated digital infrastructure and hybrid infrastructure. For example, researchers estimated that if the rest of the European Union built out its digital infrastructure to the level Norway achieved in 2011, it would increase gross domestic product (GDP) by \$315 billion.¹⁹ Likewise, a study of broadband adoption by European firms finds that broadband adoption has significant positive impact on labor productivity.²⁰ Mandel estimated that full rollout of 5G networks would boost U.S. productivity by 11 percent.²¹ The Electric Power Research Institute estimated that dynamic pricing and other smart-grid capabilities have the potential to deliver average annual economic benefits of \$31 billion to \$50 billion due to improved efficiency over the next 20 years.²²

Moreover, although some traditional infrastructure already has some digital components, these components are outdated and vulnerable to cyberattacks. Vulnerable physical infrastructure, especially the industrial control systems running dams to wastewater systems to the electric grid, exposes the United States to potential attacks from adversaries that could cause considerable economic and physical damage.²³ Investing in digital infrastructure creates opportunities to modernize these systems and address urgent vulnerabilities.

At the same time, physical infrastructure should not be ignored. There are potential projects that could have big payoffs—especially by adding more road capacity in congested areas—but any congressional infrastructure package should make sure there are significant investments in 21st century digital infrastructure.

DIGITAL INFRASTRUCTURE INVESTMENT

There is an array of areas any infrastructure bill should target to ensure digital infrastructure deployment.

- **Broadband infrastructure** in rural areas is critical and the investment should focus first and foremost on unserved areas.²⁴ This should include support for both fixed and mobile broadband.
- With the need for increased resiliency of the **electric grid**, any package should include significant investments to modernize, expand, secure, and digitize it. This should include well-funded pilot programs to integrate and test IT technologies on the grid in particular locations.
- Because the U.S. lags behind other nations in the development of **smart cities**, any package should include a nationwide smart cities program to help cities and towns use digital technologies to improve operations and quality of life.²⁵ In addition, it should fund

pilot programs to support smart farms, smart factories, smart health care, smart buildings (especially federal buildings), and other systems upgraded by connected sensors and analytics.

- The initiative should include funding for states to upgrade **physical infrastructure**, such as water, waste systems, and roads and bridges. It should ensure that funding can be spent on hybrid digital technology solutions, including using funds to upgrade cybersecurity measures.
- Funds should be allocated to ensure all communities, no matter their race or zip code, have access to **next-generation supercomputing and quantum computing**.²⁶
- Any package should include significant funding to help local, state, and national government agencies **upgrade legacy and outdated IT systems**, including but not limited to investing in cloud-based IT systems that offer both secure, mobile-friendly online services to government customers, and remote work capabilities for employees and contractors.

CONCLUSION

Information technology is creating a smart world—from smart enterprises to smart schools to smart cities. With the proposed infrastructure package there is a once-in-a-generation opportunity for the United States to modernize its infrastructure by embracing 21st century digital infrastructure. Doing so will generate an array of economic and social benefits.

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