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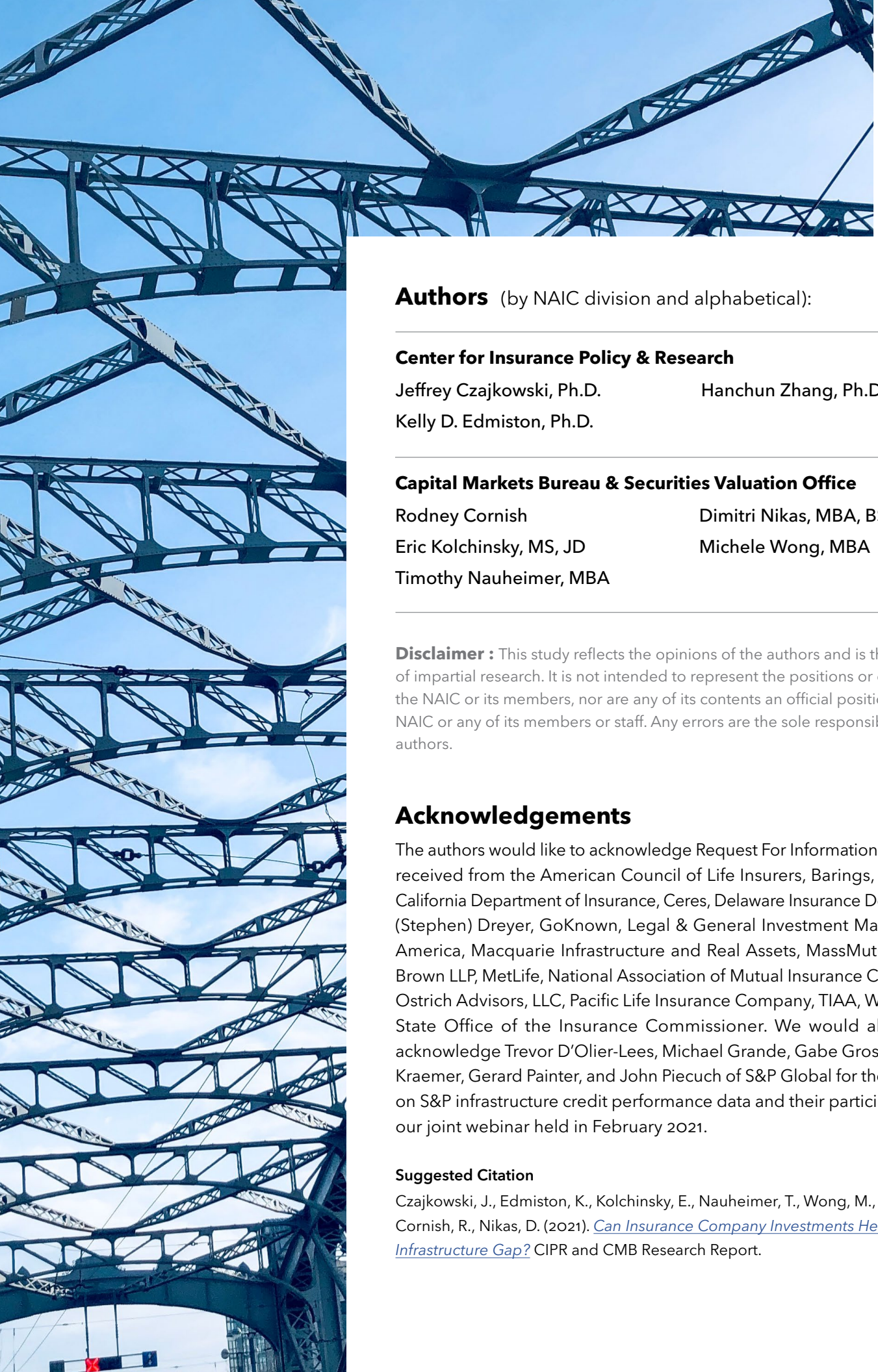
CAPITAL MARKETS BUREAU

Can Insurance Company Investments Help Fill the Infrastructure Gap?

September 27, 2021

NAIC
NATIONAL ASSOCIATION OF INSURANCE COMMISSIONERS



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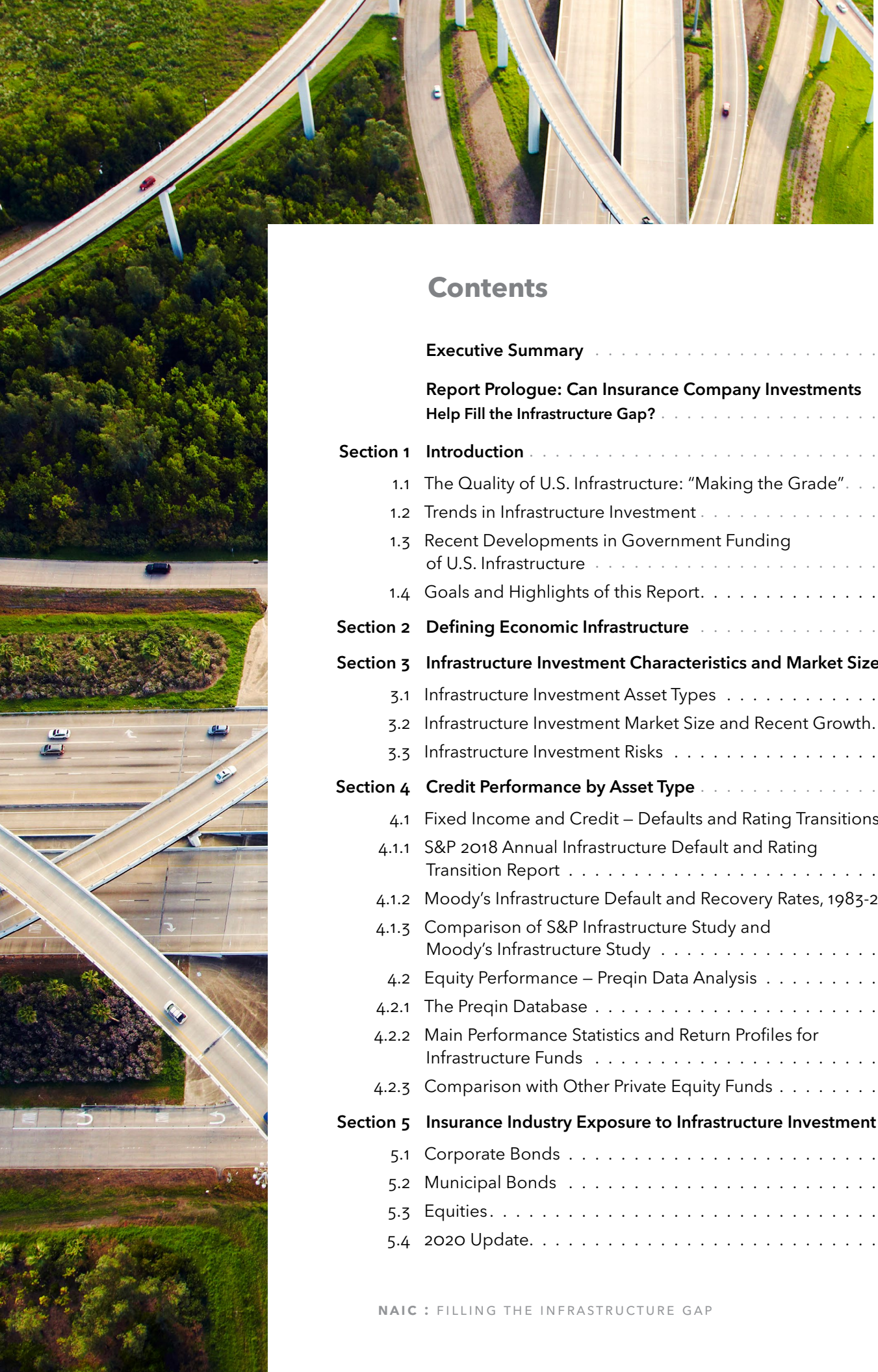

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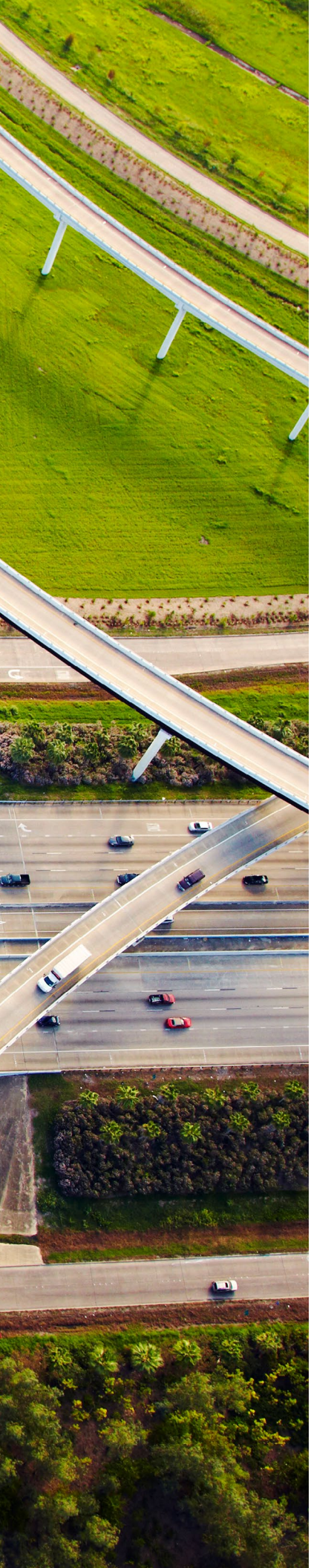

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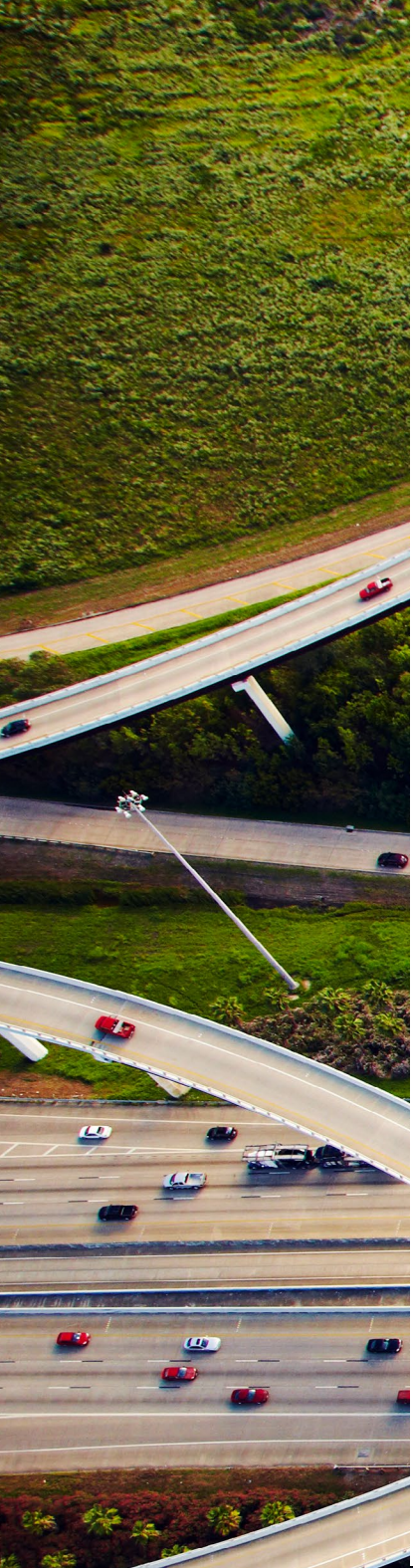

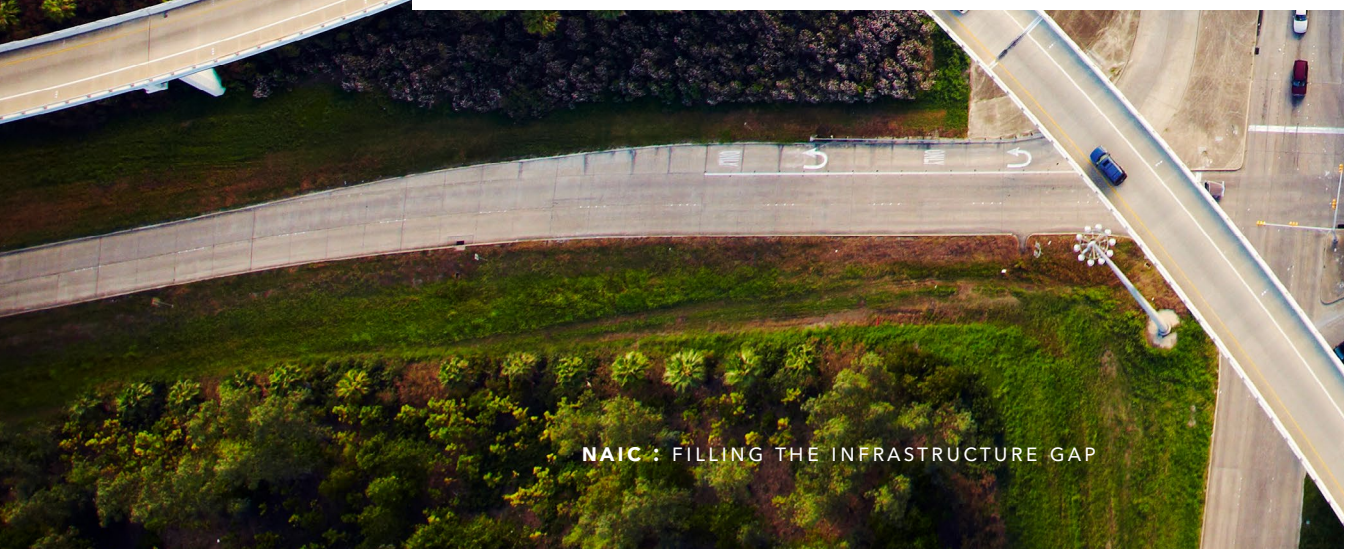

Executive Summary

Infrastructure is the compendium of permanent facilities and structures required to engineer a robust economy that is resilient and growing and for a well-functioning society. The failure to maintain and expand Infrastructure with adequate investments eventually erodes productivity, resilience, and growth potential. Unfortunately, while progress has been made in the past few years, a substantial gap exists between the infrastructure investment necessary to support continued economic vigor and growth and what is currently financed and projected to be financed in the near term. In the United States, the funding gap is estimated by the American Society of Civil Engineers (ASCE) to be nearly $2.6 trillion over the next ten years. Further, at current rates of U.S. infrastructure investment, the ASCE projects this gap to cost the United States $10 trillion in aggregate forgone gross domestic product, more than 3 million jobs, and $2.4 trillion in exports through 2039.

Following the 2008 financial crisis, the supply of long-term U.S. infrastructure funding increasingly fell to institutional investors, such as insurance companies, pension funds, sovereign wealth funds, and other institutions that must maintain long-term investments to minimize duration gaps and interest-rate-risk. Infrastructure projects are usually collateralized, offering additional protection against default risk, and they typically generate relatively predictable and stable cash flows over the long term while minimizing potential capital erosion, which well-suits the needs of these institutions.

Insurance companies have long been a significant presence in infrastructure financing. For example, an earlier assessment, had estimated U.S. insurers holding as of Dec. 31, 2015 approximately $223 billion in U.S. securities, $198 billion in general obligation bonds, $296 billion of municipal revenue bonds, and $780 billion of corporate bonds in the following broad infrastructure sectors: utilities; natural resources; communications; transportation; social infrastructure and power generation.[1] While these values were not meant to be definitive, nor were they generated from a precise definition of what infrastructure is (as we do here), the total amount highlights the potential presence of insurance companies as an institutional investor in this asset class.

1 Dimitris Karapiperis, "Infrastructure Investment and the Insurance Industry," *CIPR Newsletter*, Center for Insurance Policy & Research, National Association of Insurance Commissioners, August 2017.

This study is a joint effort of the National Association of Insurance Commissioners' (NAIC) Center for Insurance Policy & Research (CIPR) and Capital Markets Bureau to establish a baseline understanding of infrastructure investment by the insurance industry (size, performance, etc.) and to subsequently investigate the industry's potential for closing the infrastructure gap. Importantly, we first define specifically what we mean by "economic infrastructure," and we then size the market for financial investments in economic infrastructure. We then provide empirical evidence on the credit performance and risk return profile of these financial investments in infrastructure and calculate the current financial exposure to infrastructure within the U.S. insurance industry. Finally, we discuss existing and potential regulatory treatment of financial investments in U.S. infrastructure by the NAIC.

Our infrastructure definition focuses on economic infrastructure and includes six broad sectors: transportation, broadband, telecommunications, waste management, power and energy, and water and water resources. Social infrastructure and emerging infrastructure are not included in this study and may be considered in a future report.

Financial investments in infrastructure are made through debt, both corporate and municipal; equity; and concession structures—an increasingly popular approach— such as public-private partnership (PPP, or P3) model. For debt securities, we include corporate debt, structured debt, and municipal bonds. For equity, we include private equity funds, joint ventures, and direct purchases as well as common and preferred stock.

Historical data show that municipal bonds backing infrastructure outperform infrastructure bonds issued outside of the public sector.

Based on the best available data from multiple sources, our estimate of global market size for insurance company investments in infrastructure is $6.6 trillion. This figure is comprised of global insurance company direct investments in infrastructure projects ($1 trillion), global investments in infrastructure through corporate bonds and project finance ($4.4 trillion), and global investments in unlisted infrastructure equity funds ($781 billion). In addition, it includes $494 billion economic infrastructure financed through U.S. municipal bonds. The inclusion of municipal-bond-type financing of infrastructure outside of the U.S., for which data are unavailable, would push the aggregate value higher. Thus, our "global" estimate should be considered a lower bound.

Historical data show that municipal bonds backing infrastructure outperform infrastructure bonds issued outside of the public sector. Corporate Infrastructure debt, in turn, outperforms all non-financial corporate debt (which includes infrastructure). The superior performance is evident across performance metrics, including default rates, recovery rates given default, and rating migration. Unlisted global infrastructure funds also exhibit exceptional performance, with 77.7 percent having a multiple of 1 and above. The average net internal rate of return (IRR) of infrastructure funds is about 11.4 percent, and returns are similar across infrastructure funds and other private equity funds (buyout, venture capital, real estate, mezzanine), although the dispersion of returns for mezzanine is lower.

. . . using NAIC data, we estimate total U.S. insurance industry exposure to economic infrastructure to be roughly $566 billion by our definition.

We use several methods to more precisely estimate U.S. insurance industry exposure to infrastructure financing; specifically, economic infrastructure. Using 2019 NAIC data we estimate total investment in corporate bond financing economic infrastructure to be $413 billion, municipal bonds to be $144 billion, and a modest amount for equities of about $9 billion ($1 billion in preferred stock). Thus, using NAIC data, we estimate total U.S. insurance industry exposure to economic infrastructure to be roughly $566 billion by our definition. Corporate bonds and equities backing infrastructure are invested almost entirely in the broad energy sector: 95 percent and 99 percent, respectively. The infrastructure mix backed by municipal bonds is much more varied, with the majority invested in public works. Additionally, using data from Preqin, we identify $4.5 billion in private equity infrastructure funds held by U.S. insurance companies, bringing the total to $570.5 billion in insurance investments in economic infrastructure.

Various insurance industry representatives believe the risk-based capital (RBC) treatment of infrastructure investments should be revised to more accurately reflect better credit performance for debt issues and more stable cash flows and less volatile project valuations than other equity investments. More favorable capital requirements would likely induce more infrastructure investment by the industry; however any changes cannot compromise the core regulatory mission to preserve the solvency of regulated insurance companies and protect policyholders.

Effective infrastructure is an essential requirement for economic growth, but American infrastructure is far from where it needs to be to meet the nation's evolving needs and is in dire need of additional investment. The insurance industry already has a sizeable stake in financial assets backing infrastructure. Our analysis suggests that it may be well-positioned to contribute more to the rebuilding and enhancement of U.S. infrastructure with additional investments in the sector.

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Can Insurance Company Investments Help Fill the Infrastructure Gap?

The United States, as in much of the world, has a persistent infrastructure gap. Infrastructure plays a critical role in economic activity, development, and growth in the United States and around the world. Indeed, infrastructure is an input to virtually every economic activity. Assets such as transportation, communications, power, safe water, sanitation, and other basic facilities are necessary components of not only economic growth and development, but also resilience and competitiveness. The United States may be relatively more prone to the negative effects of poorly maintained and inadequate infrastructure, given that the nation relies on comparatively low transportation costs and efficient and reliable delivery of water and power to businesses, among other factors like innovation and productivity (which itself is related to infrastructure), to help offset higher costs in other areas, particularly wages.

The U.S. insurance industry appears primed to make additional infrastructure investments under the right circumstances. In a 2017 poll by Ceres, a nonprofit organization focused on environmental sustainability, 70 percent of insures reported having increased their investments in infrastructure in the prior two years.[2] In that year, life insurance companies alone held

Infrastructure investments have many qualities that should be appealing to insurers, including long duration, mostly stable and secure cash flows, attractive risk-adjusted returns, and low correlation to other asset classes.

2 Ceres, "Scaling U.S. Insurers' Clean Energy Infrastructure Investments: Challenges and Solutions in the Clean Energy Transition," March 2019.

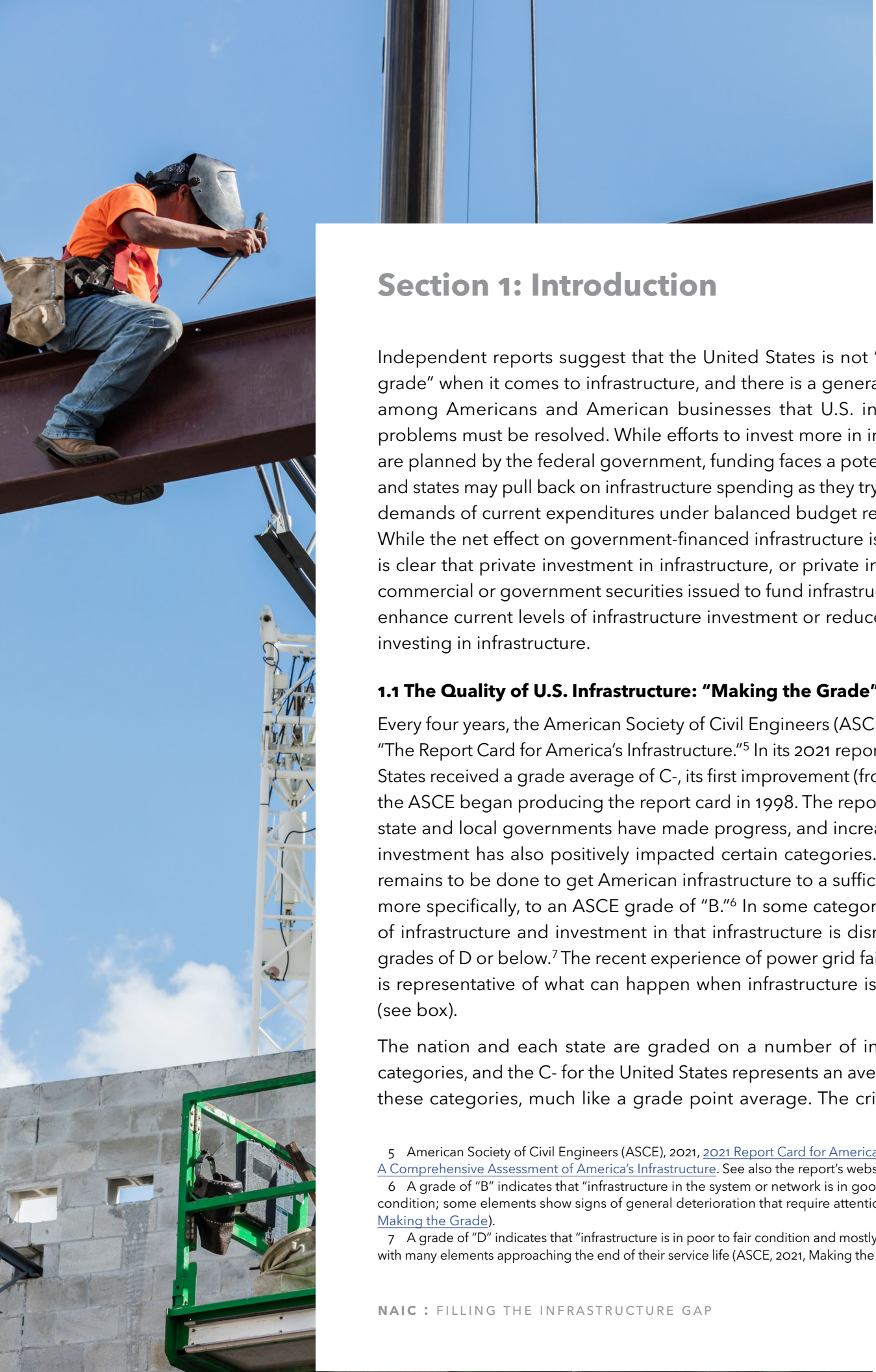
$1 trillion in infrastructure investments, broadly defined.[3] Infrastructure investments have many qualities that should be appealing to insurers, including long duration, mostly stable and secure cash flows, attractive risk-adjusted returns, and low correlation to other asset classes.[4] We discuss most of these characteristics of Infrastructure investments in this report. Further, (additional) infrastructure investments may lead to a more diversified investment portfolio, particularly if the investment is outside of the fossil fuel energy sector, which we show to be the overwhelmingly dominant sector for insurance industry infrastructure investments.

Although insurers have been increasingly investing in infrastructure-backed financial assets—mostly bonds—they could be encouraged to invest more, helping to fund a smaller U.S. infrastructure gap, but only if the investments are right for insurers. This report explores the appropriateness of additional infrastructure investments for the U.S. insurance industry and its capacity to contribute to reducing the infrastructure gap.

We begin in the introduction with a discussion of the size and nature of the infrastructure gap in the United States, including the quality of U.S. infrastructure as it currently stands and recent developments in infrastructure financing in the public sector. We also outline the goals of the report and provide some highlights, or key takeaways. Section 2 delves more deeply into the current state of U.S. infrastructure and the size and relevance of the infrastructure gap. Section 3 examines various characteristics of investment assets that fund infrastructure as well assizes the current market for infrastructure investments and details the composition of that market. Section 4 discusses the relative performance of infrastructure-backed financial investments. Section 5 reviews examines current exposure of the insurance industry to infrastructure investment. Section 6 discusses one way to potentially incentivize more infrastructre investment by insurers—the regulatory capital treatment. Finally, Section 7 provides summary and concluding remarks and implications of our findings including the idenftication of next steps. Putting it all together, we attempt to answer the question posed in the title of the report.

3 TIAA, "Building Roads to the Future: Policy Opportunities for Infrastructure Investment by Life Insurers." 2018.

4 National Association of Insurance Commissioners, Center for Insurance Policy and Research, Infrastructure Investments. November 30, 2020.



Section 1: Introduction

Independent reports suggest that the United States is not "making the grade" when it comes to infrastructure, and there is a general consensus among Americans and American businesses that U.S. infrastructure problems must be resolved. While efforts to invest more in infrastructure are planned by the federal government, funding faces a potential hurdle, and states may pull back on infrastructure spending as they try to meet the demands of current expenditures under balanced budget requirements. While the net effect on government-financed infrastructure is not clear, it is clear that private investment in infrastructure, or private investment in commercial or government securities issued to fund infrastructure, would enhance current levels of infrastructure investment or reduce the cost of investing in infrastructure.

1.1 The Quality of U.S. Infrastructure: "Making the Grade"

Every four years, the American Society of Civil Engineers (ASCE), publishes "The Report Card for America's Infrastructure."[5] In its 2021 report, the United States received a grade average of C-, its first improvement (from D+) since the ASCE began producing the report card in 1998. The report states that state and local governments have made progress, and increased federal investment has also positively impacted certain categories. " But much remains to be done to get American infrastructure to a sufficient level, or more specifically, to an ASCE grade of "B."[6] In some categories the state of infrastructure and investment in that infrastructure is dismal, earning grades of D or below.[7] The recent experience of power grid failure in Texas is representative of what can happen when infrastructure is suboptimal (see box).

The nation and each state are graded on a number of infrastructure categories, and the C- for the United States represents an average among these categories, much like a grade point average. The criteria for the

5 American Society of Civil Engineers (ASCE), 2021, 2021 Report Card for America's Infrastructure: A Comprehensive Assessment of America's Infrastructure. See also the report's website.

6 A grade of "B" indicates that "infrastructure in the system or network is in good to excellent condition; some elements show signs of general deterioration that require attention" (ASCE, 2021, Making the Grade).

7 A grade of "D" indicates that "infrastructure is in poor to fair condition and mostly below standard, with many elements approaching the end of their service life (ASCE, 2021, Making the Grade).

The Texas Freeze-Out

In February 2021, a Polar Vortex subdued Texas, and much of the problem was inadequate infrastructure; specifically, utilities and an electric grid that could not handle the heavy demand. The power outages and rolling blackouts disrupted many industries, including energy, and crucially, power company operations across the state, reflecting utilities' rising exposures to business interruption.

The primary impetus for the system break-down was when 185 power generating units tripped offline during the brunt of the storm. Moreover, wind turbines in West Texas froze, and a nuclear unit near the Gulf of Mexico shut down for more than 48 hours. Further, some power plants lost their pipeline supply of gas used to generate electricity. Equipping plants like those in cold-weather states may have avoided these serious mechanical problems. The potential for such a catastrophe was made clear following cold-weather events in 2011 and 2014.

Part of the problem in Texas is that it is independent of the U.S. power grid and power cannot be imported. But a failure to maintain and modernize its power plant and grid infrastructure is at the root of the problem.

All told, insured loss estimates from the event were "at least" $15 billion, according to Aon's Impact Forecasting. For perspective, these insured losses would rank as the 10th highest U.S. CAT event on record, just above those incurred from Hurricane Wilma in 2005. This extraordinary loss highlights the need for a climate and natural catastrophe resilience of infrastructure.

Sources

Blunt, Katherine and Russell Gold, "The Texas Freeze: Why the Power Grid Failed," *Wall Street Journal*, February 19, 2021.

Insurance Information Institute, "Top 10 Costliest Natural Catastrophes, United States." (adjusted for inflation) Original Source: Aon. Last accessed July 22, 2021.

Jolly, Sarah, "First-Half Insured Losses Highest in Ten Years: Aon," *Global Risk Manager*, July 22, 2021.

Treglia, Dan and Jessica Meyerson, "Texas Outages Shed Light on a Different Kind of Infrastructure: Human," *The Hill*, February 25, 2021.

Wilkinson, Claire, "Southern Storms Could Further Squeeze Energy Insurance," *Business Insurance*, March 2, 2021.

grade include capacity (does it meet current and future demands), condition, funding, future need (cost to improve along with funding prospects), operation and maintenance, public safety (to what extent is it jeopardized), resilience (protection from hazards), and innovation. Rail received the highest grade among categories (B), followed by ports (B-), solid waste (C+), and bridges (C). Transit received the lowest grade (D-). ASCE infrastructure categories, along with their grades and respective gaps, are provided in Table 1.1.

The ASCE projects infrastructure needs to be about $6.1 trillion between 2020 and 2029 and roughly $6.8 trillion between 2020 and 2039, or $13 trillion over the next 20 years.[8] Based on a trend analysis, the ASCE projects funding

8 ASCE, 2021, Failure to Act: Economic Impacts of Status Quo Investment Across Infrastructure Systems. The ASCE analysis uses a pre-COVID-19 2019 baseline for its projections (p. 2). The report's assessment of the COVID-19 pandemic's impact on ASCE estimates is that GDP in some later years (certainly 2020, perhaps later) might lag GDP used in the projections (p.2). Unless the pandemic consumed significant additional infrastructure, which is improbable, the ASCE projections should be largely unaffected. Also possible, although not noted in the report, is that less infrastructure has been consumed during the pandemic as the economy slowed and people are working remotely in large numbers. Nevertheless, the pandemic's effect on the ASCE estimate of underinvestment in infrastructure and associated costs is probably minimal. That being said, later in this section we

will be available to cover only 57 percent, or $3.5 billion, of infrastructure needs through 2029 and about the same percentage ($7.3 trillion) through 2039. The projected gap between infrastructure needs (to earn an overall "B" grade) and "likely investment" is thus more than $2.6 trillion through 2029 and $5.6 trillion through 2039. In their 2017 report, the ASCE projected a ten-year gap of $2.1 trillion.[9] Thus, in the last four years, the infrastructure gap has grown by about 24 percent, or $500 billion in needed additional investment.[10] These investments include a necessary enhancement and expansion of existing infrastructure, but much of it is to fill a significant "maintenance backlog."

Table 1.1 ASCE Infrastructure Grades and Projected Gaps

Sector	Δ	Grade	Sector	Δ	Grade
Aviation	↑	D+	Ports	↑	B-
Bridges	↓	C	Rail		B
Dams		D	Roads		D
Drinking Water	↑	C-	Schools		D+
Energy	↑	C-	Solid Waste		C+
Hazardous Waste		D+	Storm Water		D
Inland Waterways	↑	D+	Transit		D-
Levees		D	Wastewater		D+
Parks and Recreation		D+			

Sector	Projected Gap to earn an overall B Grade ($Billions)	Sector	Projected Gap to earn an overall B grade ($Billions)
Surface Transportation	1,215	Dams	81
Water/Wastewater/ Storm Water	434	Hazardous and Solid Waste	7
Electricity	197	Levees	70
Airports	111	Public Parks and Recreation	68
Inland Waterways and Marine Ports	25	Schools	380
		TOTAL	2,588

Sources: ASCE, 2021, 2021 Infrastructure Grades and ASCE, 2021, Investment Gap 2020–2029."

discuss likely government responses to pandemic-induced economic losses, which could alter the trajectory of public investment in infrastructure going forward. The trajectory of investment used in the projection model likely would be altered in that case, although there are many unknowns, and the direction is not clear.

9 American Society of Civil Engineers, 2017, 2017 Infrastructure Report Card: A Comprehensive Assessment of America's Infrastructure.

10 Inflation adjustment and discounting would result in a less substantial gap, although inflation has been historically low for several years. We express the data in nominal dollars (not inflation-adjusted) to remain consistent with the ASCE reports.

The ASCE projects significant losses associated with this infrastructure funding gap.[11] Specifically, if the investment gap is not adequately addressed, across sectors, the expected outcome is $10.3 trillion is forgone gross domestic product (GDP), more than 3 million fewer jobs, and $2.4 trillion in reduced exports. The ASCE also projects a decrease of $1.8 trillion in imports into the United States; thus, in the aggregate, would expand the trade deficit by $626 billion (p. 7). GDP in the ASCE baseline, 2019, was $21.4 trillion (Bureau of Economic Analysis). Therefore, the ASCE projection of forgone GDP over the next ten years is just under half the value of GDP for all of 2019.

. . . if the investment gap is not adequately addressed, across sectors, the expected outcome is $10.3 trillion is forgone gross domestic product (GDP), more than 3 million fewer jobs, and $2.4 trillion in reduced exports.

Accounting for forgone income due to job losses and a decline in business activity (which is reflected in GDP), these projected losses amount to $1,500 per year of lost disposable income per household over 2020–2029 and $5,400 annually over 2029–2039 (p. 7).

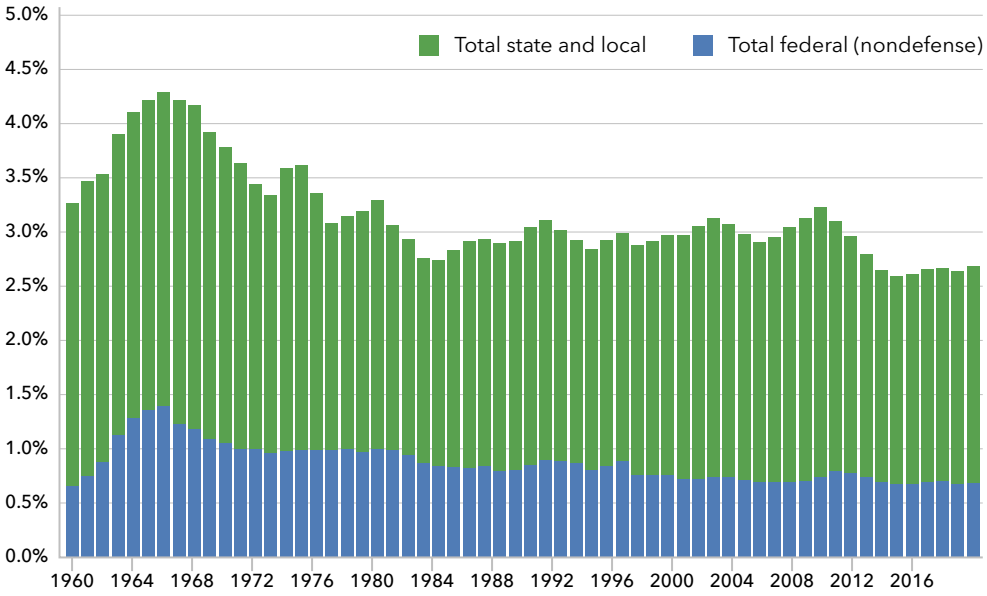
1.2 Trends in Infrastructure Investment

Much of the leaden infrastructure grade in the United States owes to a paucity of public investments. Public investment in "basic infrastructure" has been in a long-term decline in the United States, falling consistently since the late 1950's as a share of gross investment, while shares of "social infrastructure" and "digital infrastructure" have increased.[12] Annual government investment in nondefense public infrastructure fell from 4.3 percent of GDP in the 1960s to 2.6 percent in the 2010s (Figure 1.1). Infrastructure investment was initially a meaningful component of the American Recovery and Reinvestment Act (ARRA), the stimulus package passed during the 2007–2009 recession and financial crisis. However, the final bill was less focused on infrastructure than initially proposed. The comparison of public investment before and after the crisis shows a decline in public investment (Figure 1.1 and 1.2). Average annual federal nondefense investment in public physical capital declined by roughly 35 percent from 1960s to the 2010s (Figure 1.1 and 1.2). Average annual state and local investment in public physical capital also declined, falling about 28 percent from 1960s to the 2010s.

11 ASCE, 2021, Failure to Act: Economic Impacts of Status Quo Investment Across Infrastructure Systems.

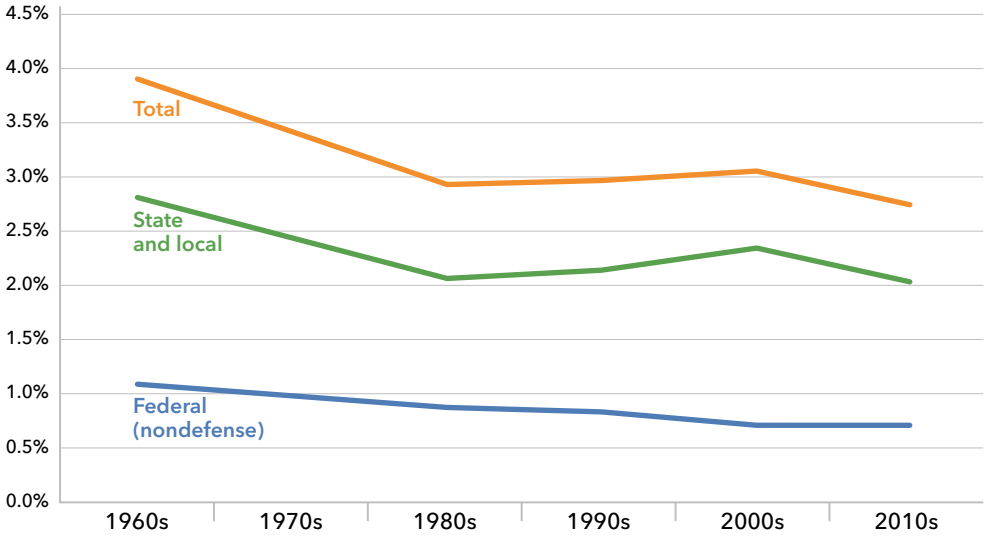
12 Bureau of Economic Analysis, 2020.

Figure 1.1 Annual Investment in Government Fixed Assets as A Share of GDP



Data Source: Bureau of Economic Analysis

Figure 1.2 Average Annual Investment in Government Fixed Assets as A Share of GDP

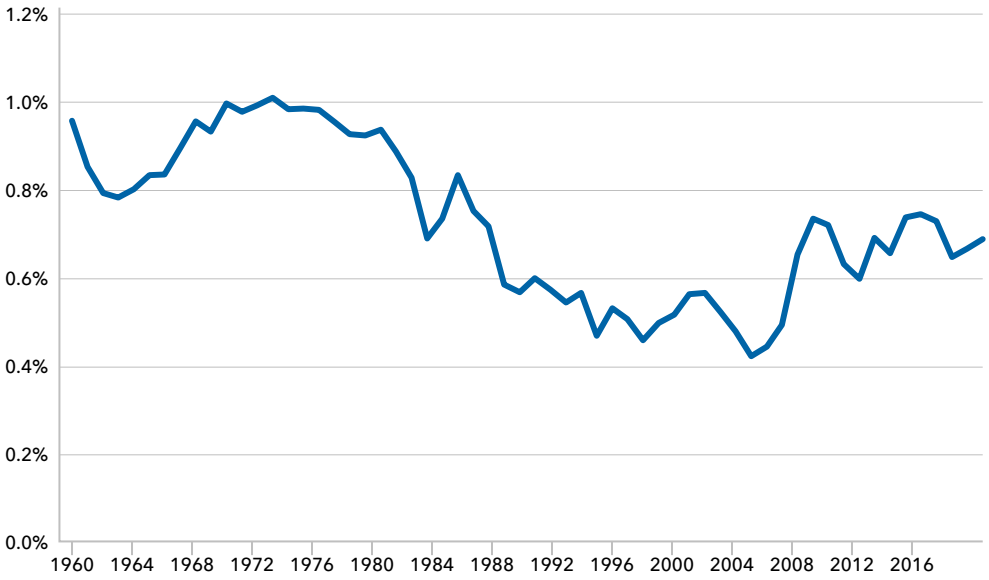


Data Source: U.S. Bureau of Economic Analysis

Average annual private investment in public infrastructure in the 2010s was higher than in the previous two decades

Private sector investment in public infrastructure as a share of output has declined since 1960s, but this decline came to an end in 2004. The share started to grow in 2005, although there were small dips in 2010 and 2011 (Figure 1.3). Average annual private investment in public infrastructure in the 2010s was higher than in the previous two decades with increases of about 29 percent over the 1990s and 21 percent over the 2000s.

Figure 1.3 Annual Investment in Private Fixed Assets

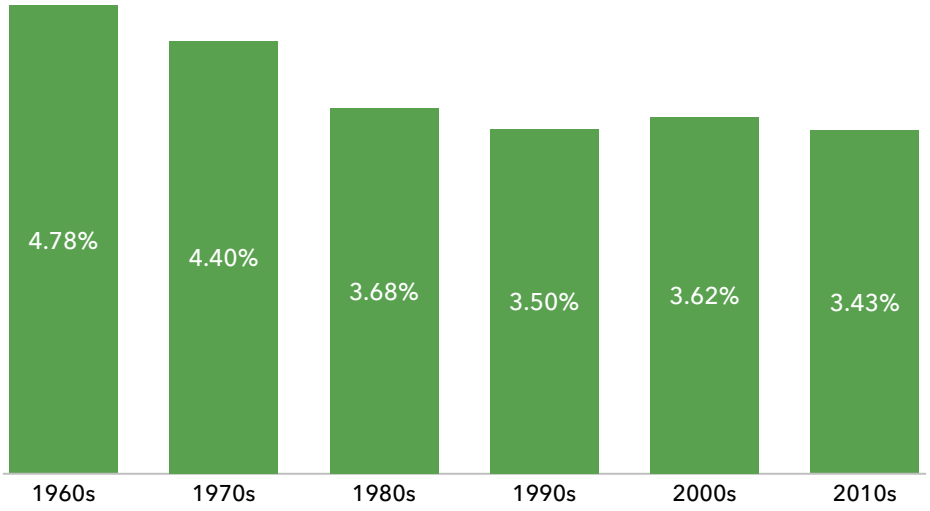


Data Source: U.S. Bureau of Economic Analysis

Notes: Annual investment in private fixed assets that relate to infrastructure, excluding social infrastructure.

Unsurprisingly, combined public and private investment in infrastructure remains well below the (relative) levels of the 1960s and 1970s, and despite increasing private sector investment, have not yet returned to pre-financial-crisis levels (Figure 1.4).

Figure 1.4 Average Annual Investment in Government and Private Fixed Assets as a Share of GDP



Data Source: U.S. Bureau of Economic Analysis

1.3 Recent Developments in Government Funding of U.S. Infrastructure

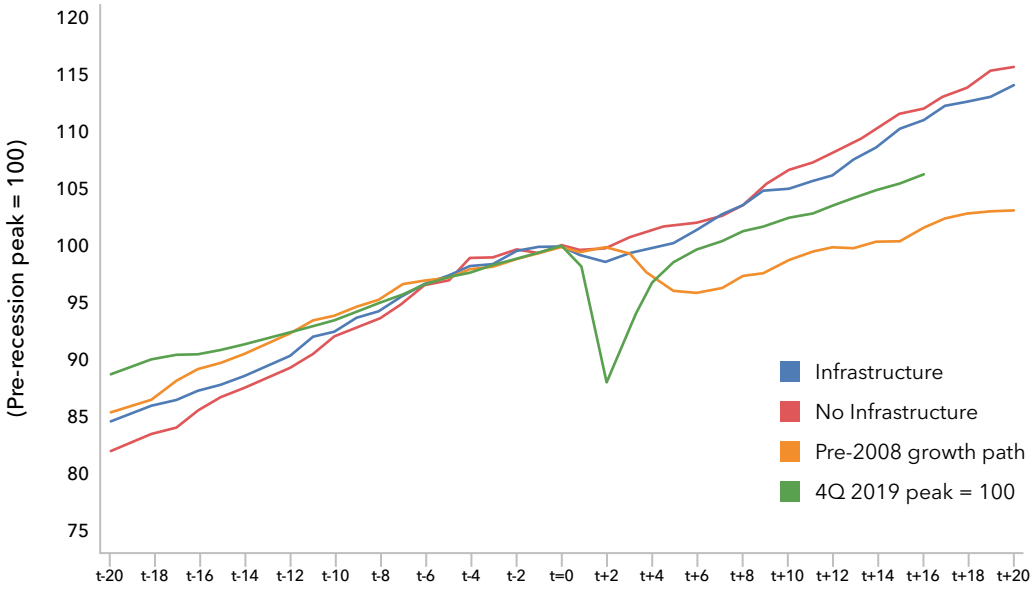
Because infrastructure is critical to economic growth and social well-being, securing needed funding and mobilizing different channels of funding to support infrastructure development is a key issue for governments and policymakers. Among the first actions taken by the Biden administration once in office was to propose new infrastructure spending of about $2.3 trillion.[13] Since then, the proposal has been significantly reduced in size but remains substantial with good prospects for passage and implementation.

S&P Global Ratings reported that a $2.1 trillion (newer, August 2021 study: $1 trillion) investment in public infrastructure over a ten-year (an eight-year horizon) horizon could create (880,000) 2.3 million jobs by 2024 as the work is being completed, and "if done wisely," could add up to $5.7 trillion ($1.4 trillion) in U.S. GDP over the next decade (eight years).[14] Their estimated GDP growth would be lifted from 1.7 percent to 2.2 percent (from 2.0 annually to 2.1) (Figure 1.5).

13 The Coronavirus Aid, Relief, and Economic Security Act (CARES) (December 2020) and the American Rescue Plan Act of 2021 (ARP) (March) also included some limited provisions for infrastructure investment, although mostly in social infrastructure, such as hospitals.

14 Joe Maguire,2020, Infrastructure: What Once Was Lost Can Now Be Found – The Productivity Boost. S&P Global.

Figure 1.5 The Path of GDP With and Without Infrastructure



Source: Joe Maguire,2020, Infrastructure: What Once Was Lost Can Now Be Found – The Productivity Boost. S&P Global. Chart 3.

At its unveiling, the President stated that the bill would fix 20,000 miles of roads and 10,000 bridges, and the bill allocated $621 billion to transportation infrastructure.[15] However, only $212 billion of that spending, or just over one-third, would have been allocated to investments that meet the CIPR/NAIC definition of infrastructure: $115 billion for roads and bridges; $80 billion for railways; and $17 billion for inland waterways, coastal ports, land ports of entry, and ferries.[16] The CIPR/NAIC definition is broadly "economic infrastructure" and is detailed in Section 2 of the report.

An additional $100 billion would have been allocated to expand high speed broadband, ostensibly mostly in rural areas; $111 billion for water infrastructure; and $100 billion to improve the power grid. Thus, $523 billion (23 percent) was proposed *in total* for infrastructure that meets the CIPR/NAIC definition. The substantial share of expenditure in the original proposal was directed toward social and emerging infrastructure, which are excluded from the CIPR/NAIC definition of economic infrastructure. The two largest (broad) items in the proposal, totaling $613 billion, were destined for "caregivers for elderly and people with disabilities" and $213 billion to "retrofit two million homes and commercial properties. The third

15 Jim Tankersley, "Biden Details $2 Trillion Plan to Rebuild Infrastructure and Reshape the Economy," New York Times, March 31, 2021 (updated April 15, 2021).

16 Javier Zarracina, Joey Garrison and George Petras, "Joe Biden Wants to Spend $2 Trillion on Infrastructure and Jobs. These 4 Charts Show Where the Money Would Go," USA Today, April 1, 2021 (updated April 6, 2021).

largest category was electric vehicles ($174B), largely for charging stations, which we classify as an emerging industry and not economic infrastructure.

According to a February 2021 *New York Times*/ Survey Monkey poll, 65 percent of respondents approved of the infrastructure bill . . . however, support was stronger for individual components of the bill, such as "funding improvements to ports, waterways and airports."

The President's infrastructure proposal seemed to have fairly strong support from the public. According to a February 2021 *New York Times*/Survey Monkey poll, 65 percent of respondents approved of the infrastructure bill, which included proposed tax financing in the question; however, support was stronger for individual components of the bill, such as "funding improvements to ports, waterways and airports" (78 percent); "increasing spending on highways, bridges, major roads" (84 percent); and "making high speed broadband internet available nationwide" (78 percent).[17] However, there is a tendency for citizens to favor infrastructure investment, but not the method of paying for it.[18] For example, the federal motor fuel tax, now at 18.3 cents per gallon (24.3 cents per gallon on diesel), the proceeds of which are put into the Highway Trust Fund for road maintenance and construction , has not been increased since 1993.[19] States also implement fuel taxes that range widely from 8.95 cents per gallon (gasoline) in Alaska to 55.5 cents per gallon in California.[20]

Although the President's party holds a majority of seats in the U.S. House of Representatives and the U.S. Senate (with the Vice-President's vote), it is unclear how the final legislation will play out and whether budget reconciliation will be required, as the bill includes several tax rate increases at which some Members of Congress have balked, most prominent being an increase in the corporate income tax rate from 21 percent to 28 percent.[21] Indeed, in June 2021, the Biden Administration offered to lower its initial request to $1 trillion in hopes of garnering more support for federal infrastructure spending.[22] A bipartisan legislative agreement was tentatively reached in late July 2021.[23] In that form of the bill, $110 billion would fund roads , bridges, and "major [surface transportation] projects."[24] An additional $66 billion would be invested in rail, $42 billion in ports and airports, $55

17 Laura Wronski, "New York Times | SurveyMonkey Poll," Curiosity at Work, Survey Money; Jim Tankersley, Ben Casselman and Emily Cochrane, "Voters Like Biden Infrastructure Plan; G.O.P. Still Sees an Opening on Taxes," New York Times, April 15, 2021.

18 Fred Treyz, Xiaochu Ma, and Julian Brubaker, "Economic Modeling and Biden's $2.3 Trillion Infrastructure Plan," REMI, April 2021.

19 Tax Policy Center, "Briefing Book: What are the major federal excise taxes and how much money do they raise?" See also Congressional Research Service, "The Federal Excise Tax on Motor Fuels and the Highway Trust Fund: Current Law and Legislative History."

20 State Motor Fuel Excise Tax Rates, Federation of Tax Administrators. Current as on January 1, 2021.

21 If the proposal meets the standards of "budget reconciliation," as determined by the Parliamentarian, the bill would require a majority vote, compared with 60 percent supermajority if not considered under budget reconciliation rules. For additional detail, see House Committee on the Budget, "Budget Reconciliation: The Details."

22 Jim Tankersley and Emily Cochrane, "Biden Narrows Infrastructure Request, but Hurdles Remain for Bipartisan Deal," New York Times, June 3, 2021.

23 Emily Cochrane and Jim Tankersley, "White House and Senators Cement a $1 Trillion Bipartisan Infrastructure Deal," New York Times, July 28, 2021.

24 Eliza Collins, "What's in the Bipartisan Infrastructure Deal, and What Hurdles Lie Ahead," Wall Street Journal, July 28, 2021.

billion to clean drinking water, and $73 billion to "update and expand" the power grid. All told, roughly one-third of the spending would finance economic infrastructure as we define it below. The immediate economic impact of the infrastructure bill is expected to be "minimal," but it is expected to yield a moderate long-term gain to U.S. productivity.[25] The bill passed in the U.S. Senate on August 10 with bipartisan support but could face a more difficult test in the House of Representatives, where Republican support is "less assured."[26] Even centrist Democrats are "locked in a . . . standoff" with the Speaker of the house on when to vote for the infrstructure bill.[27]

The immediate economic impact of the infrastructure bill is expected to be "minimal," but it is expected to yield a moderate long-term gain to U.S. productivity.

Regardless of the final infrastructure bill that is enacted at the federal level, state efforts to balance budgets could offset much of federal infrastructure investment or more so. Taking cues from state responses to the Great Recession (2007–2009), recent research suggests the necessary rebalancing of state budgets likely will shift resources away from capital expenditures in favor of current expenditures (Figure 1.6).[28] Moreover, within current expenditures, spending on transportation would drop precipitously relative to other expenditure categories. Current expenditures on utilities also would drop, although modestly compared with transportation. While federal infrastructure investment under the Biden plan would target mostly investments in social and emerging infrastructure, likely state reductions in both capital and current expenditure would likely target the types of economic infrastructure that meet the CIPR/NAIC definition.

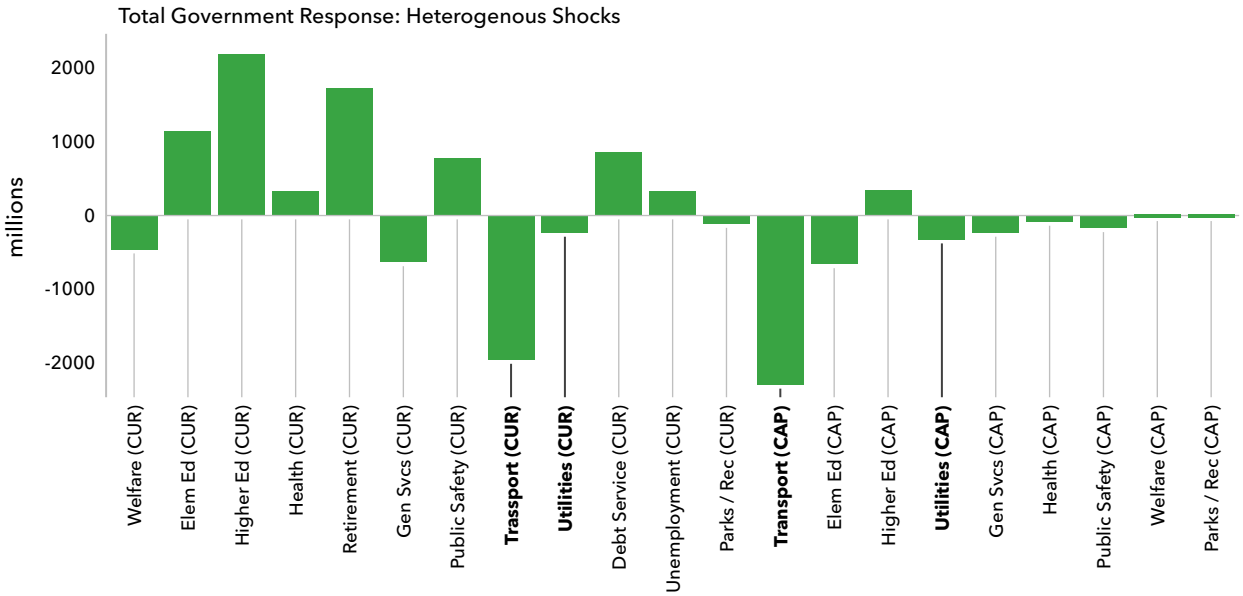
25 Paul Kiernan, "Infrastructure Bill's Boost to Economy Is Likely to Be Limited," Wall Street Journal, August 8, 2021.

26 Andrew Duehren, "Senate Passes Bipartisan Infrastructure Bill," Wall Street Journal, August 10, 2021.

27 Kristina Peterson, "Pelosi, Centrist Democrats in Standoff With Key Vote Ahead," Wall Street Journal, August 22, 2021.

28 Troup Howard and Adair Morse, 2021, "Teacher or Roads: How Fluctuations in Public Finances Erode Public Infrastructure," Working Paper, University of Utah (presented at the 2021 Annual Meetings of the Allied Social Sciences Association / American Economic Association). A more recent version of the paper is available from the Brookings Institution, as are slides from a presentation at Brookings' 10th Annual Municipal Finance Conference.

Figure 1.6 Estimated State and Local Government Budget Rebalancing due to COVID-19 Revenue Losses



Source: Troup Howard and Adair Morse, 2021, "Teachers or Roads: How Fluctuations in Public Finances Erode Public Infrastructure," manuscript, University of Utah, February, Figure 3 (*highlights added by CIPR*) (presented at the 2021 Annual Meetings of the Allied Social Sciences Association / American Economic Association).

Notes: "(CUR) indicates current expenditures, while (CAP) indicates capital (or long-term, debt-financed) expenditures. "Heterogenous Shocks" indicates that the authors accounted for differences in government spending preferences across states and regions. The underlying conceptual basis for the analysis is that state and local budget-balancing choices would be similar to those made during the Great Recession of 2007-2009. There likely will be some differences that are unlikely to affect the qualitative message that social expenditures will replace infrastructure spending. For example, we might expect increases in spending on public health and possibly health (social) infrastructure.

1.4 Goals and Highlights of this Report

The over-arching goal of the present study is to assess whether the insurance industry could or should help to fill the infrastructure gap by shifting some of its investments into assets that finance infrastructure, including corporate bonds, municipal bonds, and equities. Specifically; after highlighting our definition of what constitutes "economic infrastructure," we discuss investment characteristics, such as asset types, of financial instruments that fund infrastructure projects, we make an effort to appropriately size the market for financial investments in infrastructure, we discuss the performance of infrastructure-related financial investments, and we measure current insurance industry exposure to infrastructure through its financial investments. Based on the information provided, we are able to circle back and address the question posed in the title of the report; that is, are additional financial investments in infrastructure sensible for the insurance industry.

To initiate the project in late 2019, we sent a Request for Information (RFI) to a variety of stakeholders in the insurance industry. We queried state regulators, insurance companies, trade associations, asset managers, and other market participants views on the proper definition of infrastructure, whether the market for financial assets that back infrastructure could be sized and how market size might be determined. The RFI served as a springboard to set critical issues for discussion, which ultimately resulted in this report. The information contained in the report comes from many sources, but RFI responses were especially significant in shaping the issues in the report and how they are covered.

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Section 2: Defining Economic Infrastructure

Before attempting to characterize and size infrastructure investments and to judge their financial performance, infrastructure must first be well-defined. A standard definition of infrastructure does not exist nor is likely feasible. "Infrastructure," as a concept, is imprecise and subjective. It can vary greatly depending on its context, and alternative definitions abound. Indeed, the definition of "infrastructure" has been contentious in the U.S. Congress as President Biden's infrastructure investment plan is being scrutinized and debated.[29]

In the context of insurance industry investments, the market must agree on a common, specific definition of what constitutes infrastructure, and even then there will likely be a significant level of ambiguity and the definition will be open to interpretation. Defining infrastructure is therefore a significant challenge. Nevertheless, a clear definition of infrastructure is critical for our purpose so that investments in those assets can be assessed for financial performance and its variance; various financial and nonfinancial risks and uncertainties; appropriate levels of diversification; stable and predictable cash flow, and appropriate use of hedging vis-à-vis speculation, particularly for derivative securities. These are necessary features if the insurance industry is to participate more broadly and effectively going forward.

In 2020, the CIPR/NAIC released a report with its own specific definition of economic infrastructure.[30] The goal of the report was to advance a uniform definition of infrastructure that could be used as a basis for discussions around financial investments in infrastructure within the insurance industry. The definition mostly aligns with the definition of infrastructure used in the American Society of Civil Engineers (ASCE) infrastructure report card. Generally, economic infrastructure is "long-lived, capital-intensive, large physical assets that provide essential services or facilities" to some jurisdiction.[31] Examples include facilities for the purposes of transportation,

29 Jim Tankersley and Jeanna Smialek, "Biden Plan Spurs Fight Over What 'Infrastructure' Really Means," New York Times, April 5, 2021.

30 Michele Lee Wong, Jeffrey Czajkowski, Kaitlyn Kaminski, Eric Kolchinsky, and Hanchun Zhang, 2020, "Economic Infrastructure Definition." National Association of Insurance Commissioners. Much of the material in this section comes from this source.

31 Ibid., p. 2.

. . . economic infrastructure is "long-lived, capital-intensive, large physical assets that provide essential services or facilities" to some jurisdiction. Examples include facilities for the purposes of transportation, rural broadband, waste management, power generation and energy, and water resources and transmission.

rural broadband, waste management, power generation and energy, and water resources and transmission. Our definition also aligns well with the Bureau of Economic Analysis' definition of "basic infrastructure" used in its national economic accounts: "those asset- types, both structures and equipment, related to power, transportation, water supply, sewage and waste disposal, and conservation and development (dams, levees, sea walls, and related assets)."[32]

To arrive at an infrastructure definition that would be amenable to a wide range of relevant parties, the CIPR/NAIC first proposed a working definition, largely based on the ASCE definition and the definition used by the Trump administration.[33] We then distributed a Request for Information (RFI) to market participants to solicit input on the "reasonableness" of the definition and its scope. We received 14 written responses from state insurance regulators, insurance companies, trade associations, asset managers, and other market participants.[34] We reviewed suggested definitions in the responses and examples of assets we should include. This information was incorporated into our definition. Finally, we held an open conference call with market participants to get their assessment of our revised definition and the infrastructure sectors we chose to exclude. Importantly, the CIPR definition of *economic* infrastructure does not include *social* infrastructure or what we define as *emerging infrastructure*.

Social infrastructure typically consists of assets that are intended to accommodate social services and civic life. It refers to a "collective project" that makes "social capital possible."[35] Examples would include health facilities (such as hospitals), education (such as primary and secondary schools and colleges and universities), community facilities and public spaces (such as sports stadiums, convention centers, recreational facilities, and libraries), public safety, and correctional institutions, among others.

Emerging infrastructure transforms emerging technology into physical assets. "Emerging technologies" are, first of all, new technology or continuing development of existing technology."[36] The term is usually reserved for technologies that are creating, or are expected to create, substantial social or economic effects. Most emerging technologies, and perhaps associated infrastructure, have a 5–10 year time window.

32 Jennifer Bennet, Robert Kornfield, Daniel Sichel, and David Wasshausen, 2020, Measuring Infrastructure in the Bureau of Economic Analysis National Economic Accounts," BEA Working Papers Series, WP2020-12, December, p. 6.

33 See, American Society of Civil Engineers, "Policy Statement 299 – Infrastructure Investment," as adopted July 11, 2020.

34 Information used here is an amalgam of responses we received from the RFI. Attributing specific thoughts to specific responses is not tractable and diminishes the clarity of our explanation of the process and our definition.

35 Eric Klinenberg, 2018, *Palaces for the People: How Social Infrastructure Can Help Fight Inequality, Polarization, and the Decline of Civic Life* (New York: Broadway Books), pp. 5, 10.

36 See Winston & Strawn, LLP, "What Is the Definition of Emerging Technology?"

Finally for further context of our infrastructure definition, the International Association of Insurance Supervisors (IAIS) defines infrastructure as "physical assets, structures or facilities, systems and networks that provide or support essential public services," where the issuers are "an entity or corporate group which derives most revenues from owning, financing, developing, or operating infrastructure assets," and the projects "are typically set up for the construction phase of a new project." Under their definition, infrastructure would include "debt or equity investments in infrastructure corporates or projects which support owning, financing, developing, or operating infrastructure assets." Our report focuses on these kinds of financial investments. In many way our definition aligns with the IAIS definition, although there are differences. Table 2.1 reconciles the two definitions.

Table 2.1 CIPR (NAIC) and IAIS Infrastructure Definitions Compared

SECTORS	NAIC/CIPR STUDY	IAIS
Transportation	Roads (streets and highways), bridges, tunnels, public transit, rail, airports, and maritime and inland waterway ports	**Airports**, **ports**, **roadways**, and **railway network**
Broadband	For rural communities (includes other high-speed data and communication conduits)	
Telecommunications	Wireless towers	Core telecom infrastructure such as **broadband equipment**, optical fibers, radio masts, etc.
Waste Management	Wastewater, stormwater, solid waste, sewage, landfills, land revitalizations and Brownfields	**Facilities dedicated to waste management and recycling**
Power and Energy	Power utilities, power generation, transmission and distribution facilities, renewable energy, pipelines, energy processing, distribution and storage, offshore infrastructure, production platforms, and liquified natural gas (LNG) terminals	**Generation**, **transmission**, **distribution**, **storage**, and **district heating**
Water and Water Resources	Drinking water, flood risk management (dams and levees), water supply and waterways	**Water supply** and **wastewater collection/ treatment**

Having defined what we mean by "infrastructure," we now turn to the characteristics of the financial assets that fund many infrastructure projects and are commonly held by insurance companies in their investment portfolios.

Section 3. Infrastructure Investment Characteristics and Market Size

Infrastructure investments come in several forms with a variety of risks that could encumber the investments. We discuss the most common types of assets used to finance infrastructure, make an effort to size the market for these assets. and enumerate several risks associated with infrastructure investments that span these various asset types.

3.1 Infrastructure Investment Asset Types

Financial investments in infrastructure are made through a wide variety of asset types. The most common of these are corporate bond debt, municipal bonds, and preferred and common stock in infrastructure-producing or -operating companies, which we highlight in this report. Several other asset types also are employed, including structured debt, but these investment vehicles are less commonly used to finance infrastructure.[37] Table 3.1 briefly describes the variety of financial assets used to fund infrastructure.

We believe, as a rough approximation, globally total infrastructure investment in corporate infrastructure and project to be about $4.4 trillion.

37 A "structured investment" usually combines a debt security (generally a bond) with exposure linked to the performance of an underlying asset, such as an equity investment.

Table 3.1 Asset Types and Descriptions

Security Type	Asset Type		Description
Debt	Corporate Bonds		Debt issued by a company whose major business is owning, operating, or building infrastructure or operating infrastructure resources under concession agreements. /a/
	Structured Debt or Project Finance		Debt issued by a special purpose entity (SPE) created to own, operate, or build infrastructure or to operate related resources under a concession agreement. The SPE is a non-recourse investment limited to a single asset or set of assets with a finite lifespan. /b/
	Municipal Bonds		Debt issued by state and local governments or their agencies to finance infrastructure projects. The debt may be serviced with general own-source revenues, revenue earmarked to the project, or possibly intergovernmental grants. /c/
Equity	Private Equity Fund		Collective investment vehicle where an adviser pools money from investors and uses that money to make investments on behalf of the fund in long-term opportunities (usually 10 years or more), which can be fixed assets like infrastructure.
	Joint Ventures		A business entity created by two or more parties, characterized by shared ownership, shared returns and risks, and shared governance.
	Direct Purchases	Common stocks, preferred stocks, and publicly-traded REITS /d/	The purchase of the common stock/ preferred stock/publicly traded REITs trading on public exchanges that own/ operate significant economic infrastructure assets.
		Direct investment in economic infrastructure projects or assets	Direct investment by acquiring ownership of a project or asset.
Other	Public-Private-Partnership (PPP)		A cooperative arrangement (often a concession agreement) between two or more public and private entities, which work together to complete a project or to provide services generated by the resource.

Notes:

/a/ A concession agreement is similar to outsourcing, where, in the case if public-private partnerships (PPPs), the private entity assumes responsibility for operations of a public asset. Generally, concession agreements are used when the private entity is more capable of operating the resource than the public entity or can do so more efficiently. Solely private parties may also make concession agreements, often to transfer risk to a limited liability company (LLC).

/b/ SPEs generally are used by businesses to finance large project—usually narrow in scope—to protect the corporation at large from the risk of the specific project. Project finance is funding of a long-term infrastructure project that is paid back from cash flow generated by the project. It has a non-recourse or limited recourse financial structure.

/c/ State constitutions generally require balanced budgets for current expenditures and revenues. Therefore, all municipal bond funding is targeted to capital projects, although not necessarily economic infrastructure.

/d/ A REIT is a Real Estate Investment Trust, which is a company that owns, finances, or operates multiple income-producing properties. REITs allow investors to participate in property markets with purchasing or managing real estate themselves.

3.2 Infrastructure Investment Market Size and Recent Growth

Unfortunately, good estimates of the total infrastructure-backed financial asset market are not readably available. We combine various sources of information on the size of financial asset markets to arrive at "best guess" estimate of the market

We combine various sources of information on the size of financial asset markets to arrive at "best guess" estimate of the market for financial investments financing infrastructure, concentrating on four categories we feel have reasonably high quality and reliable data that are accessible: municipal bonds, corporate bonds and project finance (debt), and equity.

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According to Municipal Securities Rulemaking Board (MSRB), municipal bonds account for approximately $4 trillion of capital market value, of which economic infrastructure, broadly defined, accounts for $494 billion, or 12.1 percent.[38]

At year-end 2019, Moody's had rated 1,000 distinct corporate infrastructure and project finance entities, which include both bonds and preferred stock. In sum, the par value was about $2.2 trillion. North America accounted for 62 percent by volume, the largest regional holding. About 37 percent by volume of the infrastructure securities, or $740 billion, were issued by corporate infrastructure and project finance entities domiciled in the US and Canada. After consulting with experts from several stakeholders, including rating agencies and investment advisory agencies, we believe that Moody's-rated infrastructure securities account for half of total global corporate infrastructure and project finance, with S&P Global Ratings covering the other half. By this reasonsing, we believe, as a rough approximation, globally total infrastructure investment in corporate infrastructure and project to be about $4.4 trillion.

According to data from the data vendor and analytics firm Preqin, global unlisted infrastructure assets under management (AUM) as of December 2020 stood at a record-high of $781.3 billion. Globally, there were around 5,282 institutions making investment allocations to infrastructure of which 2,010 investors are from the U.S.

Thus, based on the best available data from multiple sources, our *lower-bound estimate* of global market size for any potential insurance company investments in infrastructure is $6.6 trillion. This figure is based on global insurance company direct investments in infrastructure projects ($1 trillion), global investments in infrastructure through corporate bonds and project finance ($4.4 trillion), and global investments in unlisted infrastructure equity funds ($781 billion). In addition, it includes $494 billion in economic infrastructure financed through U.S. municipal bonds. The inclusion of municipal-bond-type financing of infrastructure outside of the U.S., for which data are not available, would push the aggregate value higher.

While we provide a static estimate of $5.4 trillion of global private debt and private equity as well as $494 billion U.S. municipal issurance based on the most recent data (we have excluded unlisted private equity funding),

38 Municipal Securities Rulemaking Board, Muni Facts. Our own definition of economic infrastructure is significantly more narrow, resulting in a much smaller number.

. . . looking back in time we find some evidence that infrastruture investment opportunities have been growing appreciably over the past ten to twenty years.

looking back in time we find some evidence that infrastruture investment opportunities have been growing appreciably over the past ten to twenty years. For example, many industry watchers believe that infrastructure was undervalued in the 1990s but enjoyed a resurgence in the 2000s.[39] Assets were overheated in the pre-financial crisis years, especially 2006-2007. According to a 2006 report from Standard & Poor's, now known as S&P Global Ratings, "the infrastructure sector is in danger of suffering from the dual curse of overvaluation and excessive leverage – the classic symptoms of an asset bubble similar to the dotcom era of the last decade."[40] During the financial crisis (2007-2009), the infrastructure sector faced substantial de-leveraging, investor withdraw of commitments, and more stringent lending conditions.[41] According to our analysis of data from Preqin, fundraising rose strongly in the years up to 2007 (USD 45.2bn) but slowed sharply to USD 15.4bn in 2009 then.

In the 2010s, the deployment by institutional investors into infrastructure increased further. Preqin's data show the number of infrastructure fund raised each year grew from 36 to 146 between 2009 and 2019. The number of infrastructure financial investments and the average deal size were both at historical highs at the end of 2019. As of April 2020, the total number of infrastructure deals was roughly evenly split between North America (8,342 deals), Europe (9,908 delas), and the rest of the world (9,039 deals). A 2017 Towers Watson report asserted an ongoing trend of capital concentration with large funds raising larger funds than before.[42]

3.3 Infrastructure Investment Risks

Investors including insurance firms will of course want to adequately assess all risk exposures associated with infrastructure assets they may want to add to their portfolio including risks at the project level, investor-based knowledge risks, and any third-party risks All of these risks reflect uncertainties that leave the investor at risk of receiving less than the required or expected rate of return or that a debt issuer would default and the debt be uncollectable. Based upon our review of the literature[43] and the responses of CIPR/NAIC RFI we describe these three categories of infrastructure risk below (Additionally, in the "SVO Infrastructure Case Study" in Section 6 we provide an example of how the NAIC evaluates

39 Georg Inderst, 2010, Infrastructure as an Asset Class. EIB Papers, 15(1), 70-104. ISSN 0257-7755. European Investment Bank (EIB), Luxembourg,

40 Standard & Poor's, 2006, "The Amazing Growth of Global Infrastructure Funds: Too Good to Be True?"

41 Inderst, Infrastructure as an Asset Class, 22.

42 Towers Watson, 2017, Global Alternatives Survey 2017, July.

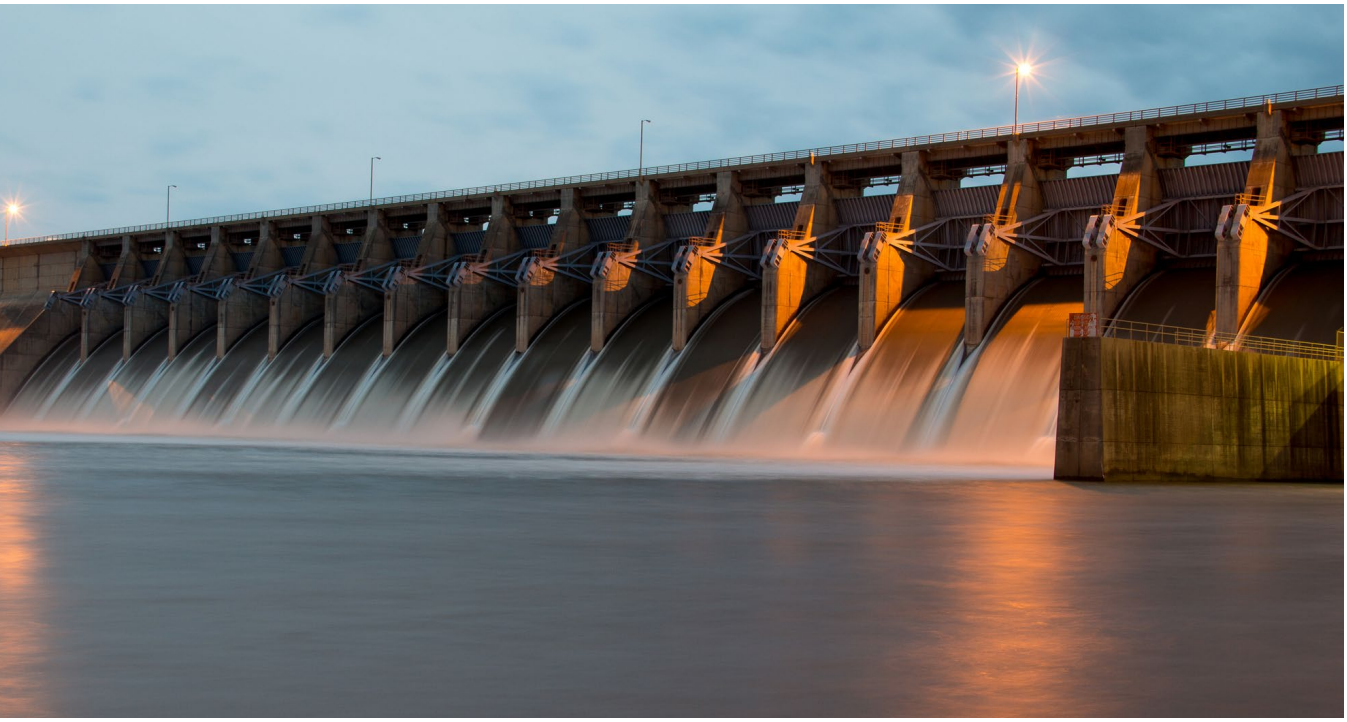
43 Global Infrastructure Hub; Inderst, Infrastructure as an Asset Class, 22; Jobst, Andreas A.. 2018. Credit Risk Dynamics of Infrastructure Investment : Considerations for Financial Regulators. World Bank, Washington, DC.; CERES, Scaling U.S. Insurer's Clean Energy Infrastructure Investment, March 2019; World Economic Forum, Renewable Infrastructure Investment Handbook, December 2016.

the credit risk of infrastructure projects related to project financed power generation transactions):

1) Risks at the infrastructure project and company level:

Key risks here include construction risk, operational and management risk, leverage and interet rate risk, maintenance risk, business risks (uncertainty of supply and demand), environmental and social risks, and technology risk.[44] *Construction risks* include those associated with construction schedules, contract validity and adherence, quality of engineering, and elevated default risk common in the construction phase of new project. A particularly significant construction risk is that the project would not be completed at all. *Operational and management risks* reflect the uncertainty of project operations; that is, there may be operational delays or difficulty getting the project "off the ground." Moreover, there are risks of incorrect projections of operating costs and unanticipated capital expenditure needs going forward. *Leverage and interest rate risks*, the risk of interest rate fluctuation over the life of the project brings uncertainty to the company that takes on debt to finance its assets (or financial leverage) as the company must pay interest on that debt. Also, a company with high financial leverage is more vulnerable (such as risk of bankruptcy) then a low financial leverage firm during business shutdown due to lower liquidity. *Maintenance risks* is s a lack of assurance the condition of the funded asset will be adequately monitored and serviced at an appropriate standard, otherwise subjecting the operation to potential cost overruns. *Business risks* reflect the uncertainty of raw material supply and revenue stream. Any projects rely on raw material for operation such as fuel is the key raw material for power station, are subject to the risk of supply such as ceasing to be available or not being the required specification, as such failure can seriously undermine the proper operation and the economics of a project. Demand risk or uncertainty of revenue stream is crucial to infrastructure investment in general especially for projects that do not benefit from a contractual offtake (such as take-or-pay obligation) or projects with no long-term offtake contracts. Both lenders and project company may want to review the demand profile (such as prospects of growth, demographic movements, macro assumptions, etc.) for project offtake to make sure the revenue stream is certain and forecast of revenue is accurate. A incorrect or inaccurate demand projection leads losses to all investors or at least less revenue than expected. *Environmental and social risks* refers to the negative impact on the environment, local communities and business, and quality of life (such as pollution, population displacement,

44 Global Infrastructure Hub; Inderst, Infrastructure as an Asset Class, 22; Jobst, Andreas A.. 2018. Credit Risk Dynamics of Infrastructure Investment : Considerations for Financial Regulators. World Bank, Washington, DC.; CERES, Scaling U.S. Insurer's Clean Energy Infrastructure Investment, March 2019; World Economic Forum, Renewable Infrastructure Investment Handbook, December 2016.



disruption, etc.) in the construction and operation of the project. It is crucial that the project company and lenders comply with all environmental licences, detailed permits and environmental authorisations required for the project as well as applicable environmental laws. Social impact study, compensation scheme, risk management plan aims to minimise any negative impact of the project, local community consultation, and the like will also be critical to avoid litigation, reduce the risk of opposition, achieve key milestones on time and ensure the project is delivering infrastructure that serves its public purpose. *Technology risk* refers to technologies that are not yet well-established enough such as clean energy techonogy, there are risks the new technology will prove unreliable or potentially hazardous (again, as discussed in section 2 emerging technologies are excluded from the definition of economic infrastructure for this report).

2) Investor-based knowledge risks:

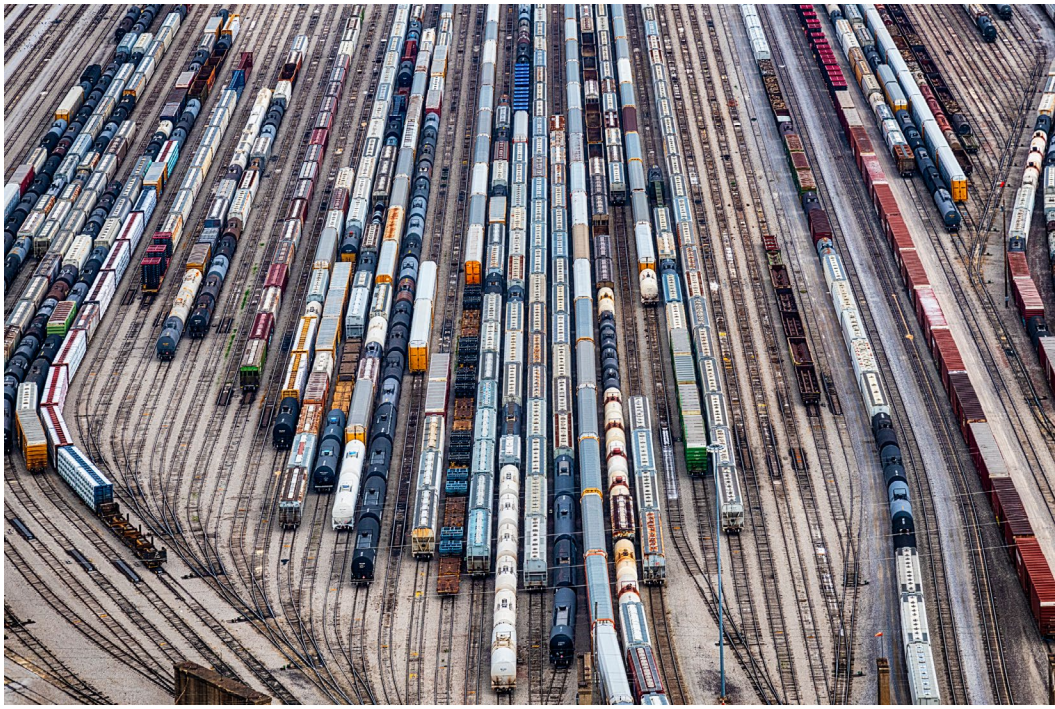
Limited information and lack of experience and knowledge on both underlying project and investment vehicle. For adequate assessment of the project, high-quality data about the specific infrastructure project is needed, however, information hurdle such as data not readily available, not accessible, and nonstandidized, will increase the risk of inaccurate assessment of the project risks. Risk also varies depending on how the financing is structured, as the way the project is financed is often the key differentiator as to whom performs the ongoing management.

3) Third-party risks

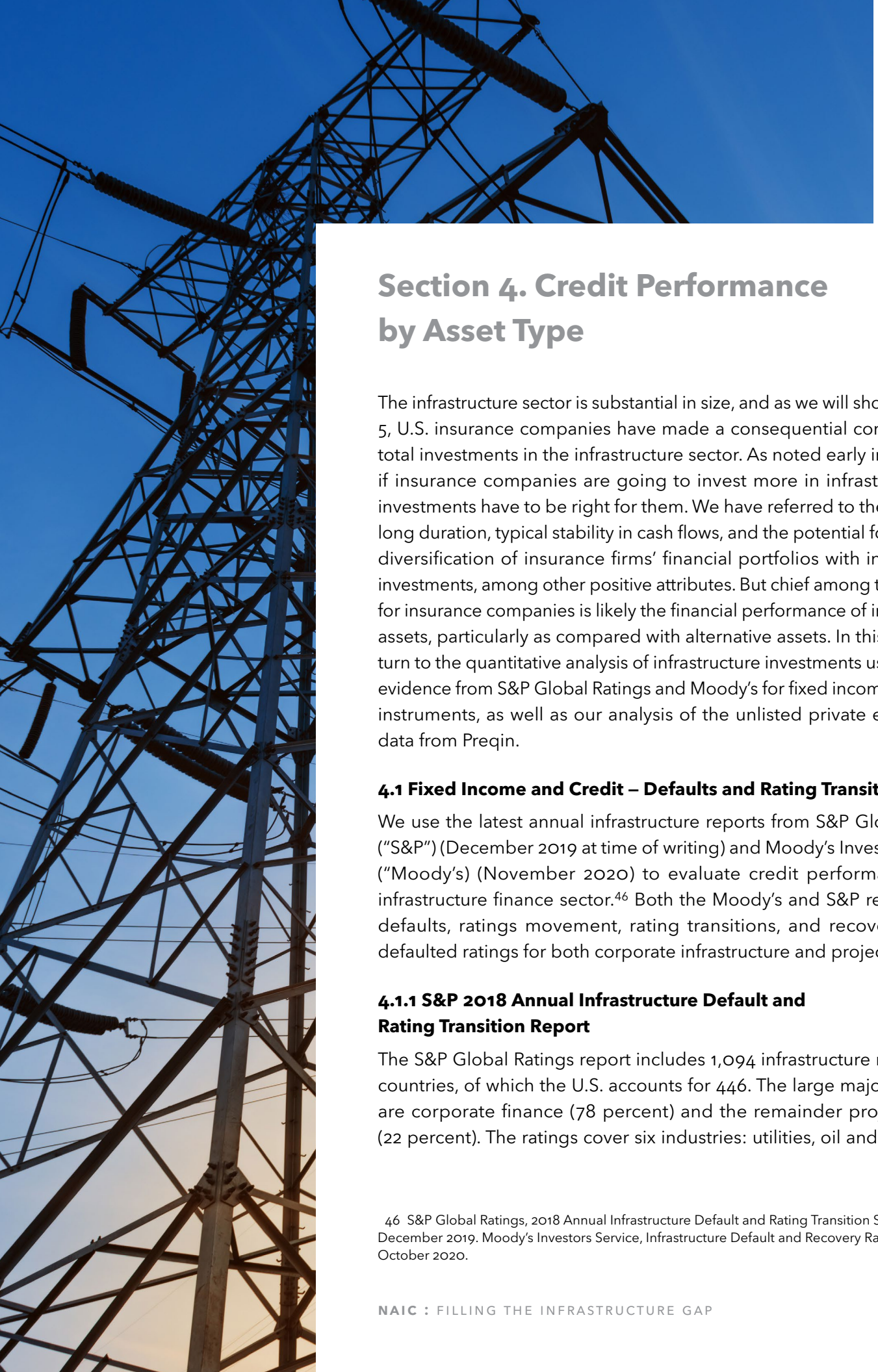
Third-party risk is inherent in the assessment of transactions itself. In particular, Investors such as insurers may have inadequate time for performing due diligence and may therefore need to rely on third-party assessments, which could be limited in scope. Further, there is a "growing perception that the quality of third-party assessments have declined."[45]

Regulatory risk which is common to all infrastructure investments undertaken by insurance ccompanies. Examples of such risks include unexpected changes in law such as taxation, change and uncertainty in financial regulation such as regulatory treatment, capital requirements, etc.

Lastly we also highlight risks specific to public-private partnerships (PPPs) and joint venture asset types. In both, there is potential for enhancing efficiency and quality by leveraging the assets and expertise of each party, but also the potential for disagreements that can lead to significant project delays or even project failure. In addition, for PPPs, there are a number political risks. At the extreme is nationalization of the project, although nationalization would be unlikely in the United States. Additional political risks include changes in tax treatment; failure of the public entity to make timely payment, or payment at all; delays in getting approvals from public authorities; or termination of the project altogether (perhaps due to a decision not to appropriate funds for the project).



45 Ceres, "Scaling U.S. Insurers' Clean Energy Infrastructure Investments: Challenges and Solutions in the Clean Energy Transition," March 2019, p. 9.



Section 4. Credit Performance by Asset Type

The infrastructure sector is substantial in size, and as we will show in Section 5, U.S. insurance companies have made a consequential contribution to total investments in the infrastructure sector. As noted early in the report, if insurance companies are going to invest more in infrastructure, the investments have to be right for them. We have referred to the benefits of long duration, typical stability in cash flows, and the potential for enhanced diversification of insurance firms' financial portfolios with infrastructure investments, among other positive attributes. But chief among the concerns for insurance companies is likely the financial performance of infrastructure assets, particularly as compared with alternative assets. In this section we turn to the quantitative analysis of infrastructure investments using existing evidence from S&P Global Ratings and Moody's for fixed income and credit instruments, as well as our analysis of the unlisted private equity funds data from Preqin.

4.1 Fixed Income and Credit – Defaults and Rating Transitions

We use the latest annual infrastructure reports from S&P Global Ratings ("S&P") (December 2019 at time of writing) and Moody's Investors Service ("Moody's) (November 2020) to evaluate credit performance in the infrastructure finance sector.[46] Both the Moody's and S&P reports cover defaults, ratings movement, rating transitions, and recovery rates of defaulted ratings for both corporate infrastructure and project finance.

4.1.1 S&P 2018 Annual Infrastructure Default and Rating Transition Report

The S&P Global Ratings report includes 1,094 infrastructure ratings in 59 countries, of which the U.S. accounts for 446. The large majority of them are corporate finance (78 percent) and the remainder project finance (22 percent). The ratings cover six industries: utilities, oil and gas (mostly

46 S&P Global Ratings, 2018 Annual Infrastructure Default and Rating Transition Study, December 2019. Moody's Investors Service, Infrastructure Default and Recovery Rates, 1983-2019, October 2020.

midstream operators), transportation, power, social infrastructure, and other infrastructure for the period 1981–2018.[47]

Rating Movement. According to S&P, the average annual downgrade rates is about 11.5 percent for corporate infrastructure, compared with 15.6 percent for project finance (Table 4.1). Moreover, the ratings were raised more for corporate securities than for project finance (9.4 percent and 7.1 percent, respectively). Further, the annual default rate was higher for project finance (0.75 percent) than that for corporate infrastructure securities (0.34 percent). Across industries, downgrade-to-upgrade ratios range from 1.05 for oil and gas to 1.79 for power (Table 4.2).

Table 4.1 Infrastructure Project Finance and Infrastructure Corporate Rating Movement (1981-2018)

Type of Debt	Upgrades		Downgrades		Defaults	
	Average annual		Average annual		Average annual	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*
Project finance	291	7.13	466	15.55	36	0.75
Corporate	2,031	9.42	2,417	11.46	83	0.34
All infrastructure	2,322	9.21	2,883	11.6	119	0.39

Source: S&P Global Ratings Research

Table 4.2 Infrastructure Rating Movement Total (1981–2018)

Infrastructure Sector	Upgrades	Downgrades	Downgrades to Upgrades
Power	136	244	1.79
Transportation	116	161	1.39
Utilities	1,493	1,777	1.19
Oil and Gas	351	367	1.05

Source: S&P Global Ratings Research

Defaults. Infrastructure ratings were significantly less likely to encounter default than non-financial corporate ratings (Table 4.3). According to S&P, non-financial corporate (or NFC) consists of all securities outside of the financial sector, including infrastructure. Project finance infrastructure had higher cumulative default rates than corporate infrastructure. Across infrastructure sectors, power had the highest cumulative default rate for

47 Regarding the oil and gas sector, "midstream" involves the transportation, storage, and wholesale marketing of petroleum products. By contrast, "upstream" centers on exploration and production, while "downstream" refers to the refining of crude oil and processing of raw natural gas, along with the transportation of the end products. Pipeline transport is an example of a midstream oil and gas activity.

10-year-period (9.86 percent) (Table 4.4). Initial ratings and time to default were positively correlated, as we would expect (Figure 4.1).

Table 4.3 10-year Cumulative Default Rates (1981–2018)

Rating	All Infrastructure Debt	Corporate Infrastructure Bonds	Project Finance	Non-Financial Corporate Debt Issuers
AAA	0.00	0.00	0.00	0.22
AA	0.00	0.00	0.00	0.33
A	0.79	0.71	2.24	1.14
BBB	1.88	1.89	1.85	3.36
BB	5.47	3.39	10.42	13.18
B	10.08	8.18	14.75	25.33

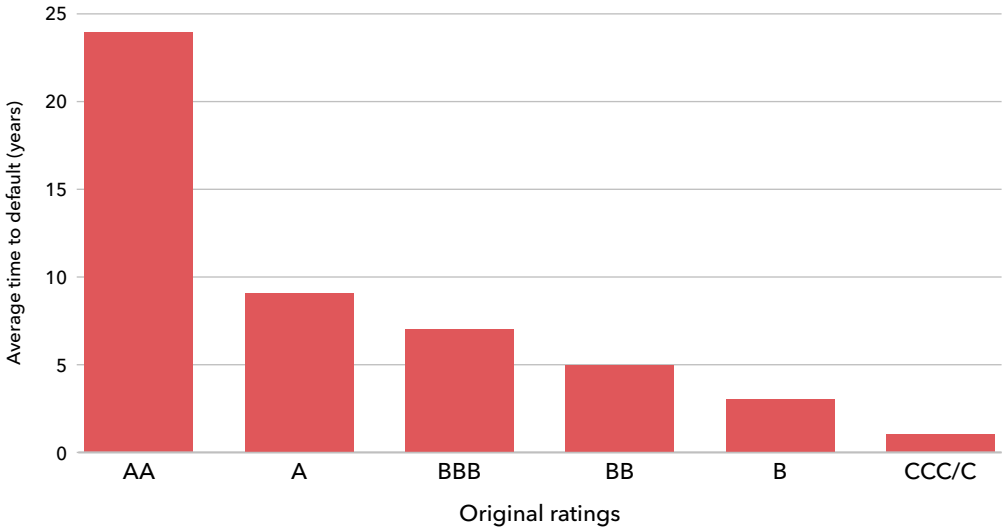
Source: S&P Global Ratings Research

Table 4.4 Average 10-year Cumulative Default Rates by Sector (1981–2018)

	Utilities	Oil and Gas	Power	Transportation
Investment Grade	0.97	0.63	7.09	0.72
Speculative Grade	8.59	1.24	13.3	5.98
All Rated	1.8	0.85	9.86	1.5

Source: S&P Global Ratings Research

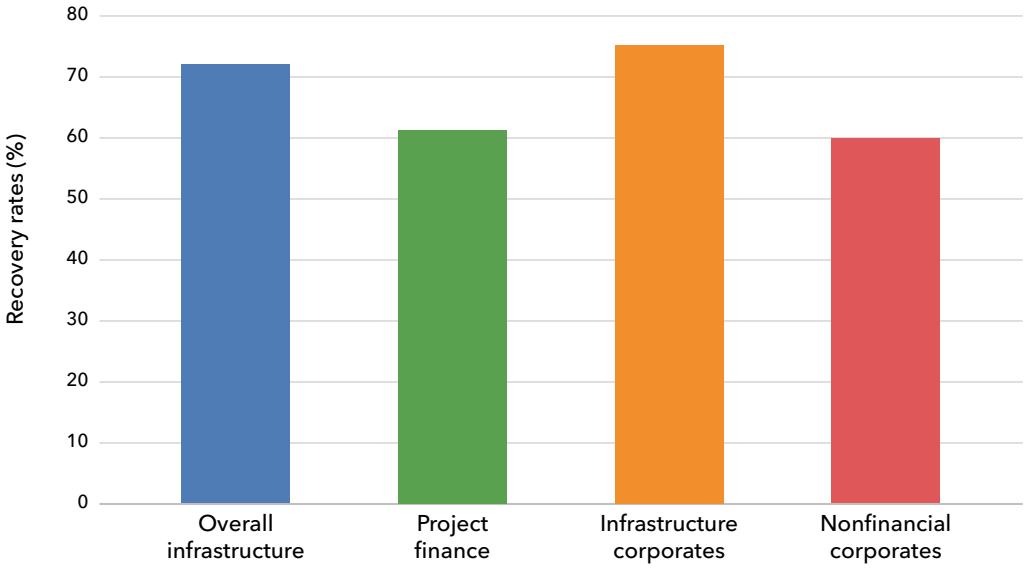
Figure 4.1 All Infrastructure Time to Default



Source: S&P Global Ratings Research

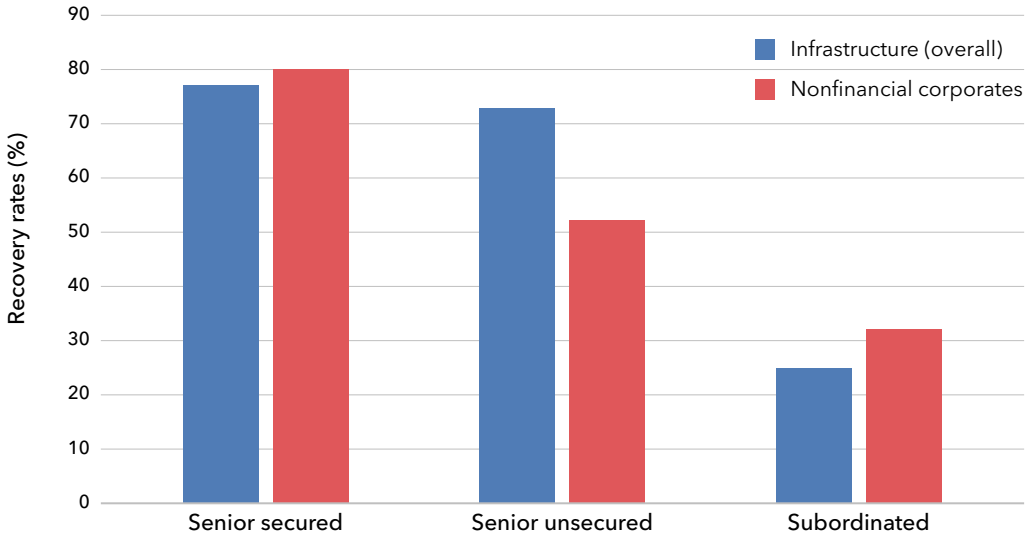
Recovery Rates. The average recovery rate for defaulted infrastructure ratings (including bank debt and bonds from corporate infrastructure and project finance) is higher than that of nonfinancial corporates (NFC) (72 percent, compared with 60 percent) (Figure 4.2). Furthermore, the average recovery rate for infrastructure senior unsecured bonds is 73 percent, which is considerably higher than the 52 percent average recovery for senior unsecured bonds from the NFC sectors (Figure 4.3). Senior secured debt from the infrastructure sector has an average recovery rate of 77 percent, which is only modestly lower than that of NFC senior secured debt, for which the recovery rate is about 80 percent. On the other hand, the average recovery rate for subordinated debt from corporate infrastructure bonds is 25 percent, which is lower than the 32 percent average recovery rate on subordinated debt from the NFC sectors.

Figure 4.2 Recovery Rates for Infrastructure Corporates and Project Finance



Source: S&P Global Ratings Research

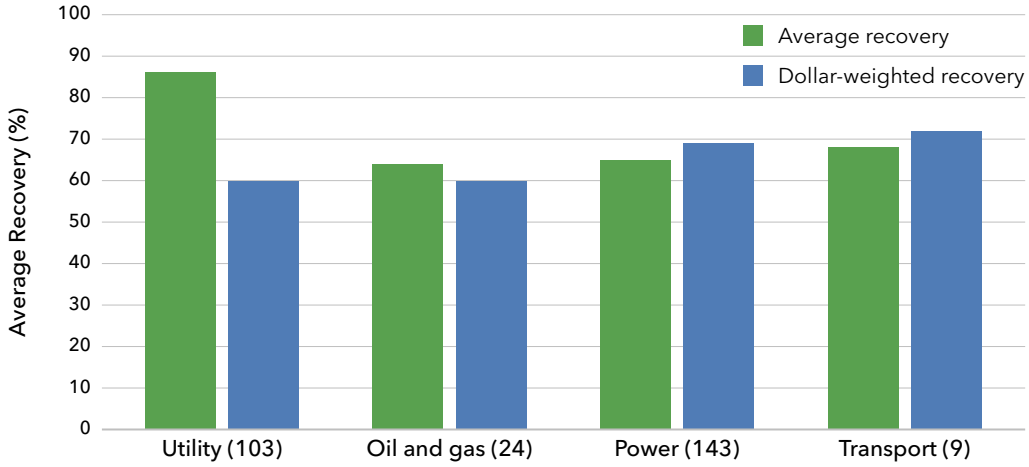
Figure 4.3 Recovery Rates by Instrument Type



Source: S&P Global Ratings Research

Figure 4.4 shows both the simple and dollar-weighted average recovery rates by infrastructure sector. Same as previous two figures (Figure 4.2 and 4.3), the simple average is the recovery rates as an average of instrument recoveries, weighted by number of instruments; the dollar-weighted averages are the sum of debt recovered from the defaulted instruments, divided by the total defaulted debt for that instrument type. The transportation sector had the highest dollar-weighted average recovery rate of 72 percent which is higher than its simple average of 68 percent. However, this percentage reflects recoveries of only nine securities. The power sector accounts for the largest share of securities (143) and had the second-highest dollar-weighted average recovery rate at 69 percent.

Figure 4.4 Recovery Rates by Infrastructure Sector



Source: S&P Global Ratings Research

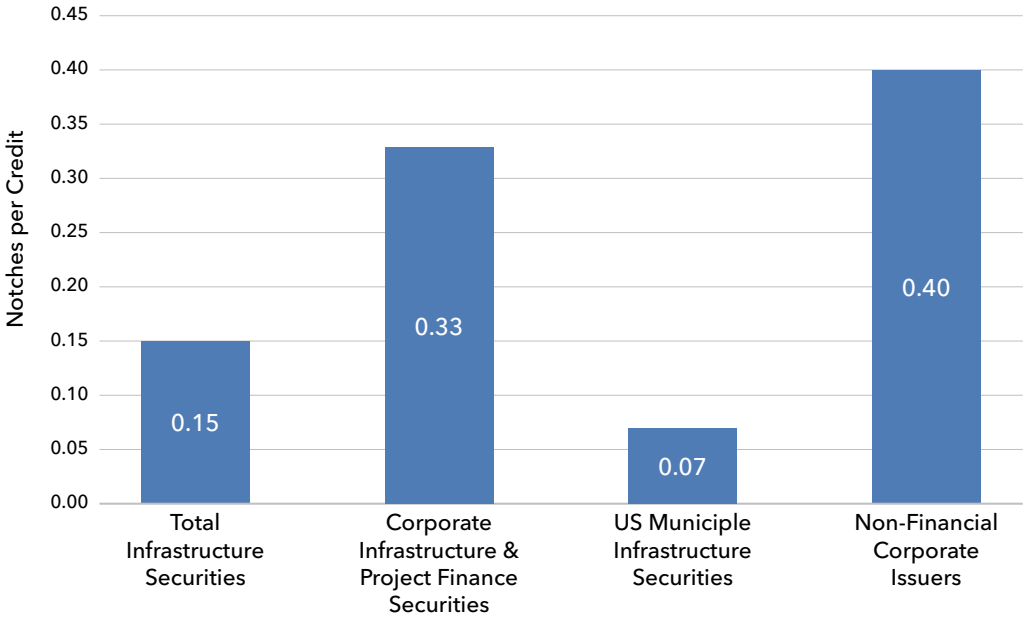
4.1.2 Moody's Infrastructure Default and Recovery Rates, 1983–2019

Moody's report includes 1,000 corporate infrastructure and project finance securities ($2.2 trillion in debt and preferred stock) and 1,300 US municipal securities ($0.7 trillion).[48] The majority (79 percent by count and 62 percent by volume) of these securities are concentrated in North America. US municipal infrastructure accounts for 57 percent by count, but only 25 percent by volume. Three broad infrastructure sectors are covered: which are utilities, transportation, and other; which account for 72 percent, 23 percent, and 5 percent by volume, respectively. The utilities sector includes power-generation systems, electric and natural gas transmission and distribution networks, long-haul energy pipelines, water and wastewater utilities, and integrated utilities; the transportation sector includes roads, bridges, ports, airports, and rail networks; and the "other" sector includes the remainder, which consists of other, mostly fundamental facilities, such as stadiums, military installations, and hospitals.

Ratings Volatility. Moody's report provides a one-year rating volatility average over the entire study period (Figure 4.5). The one-year rating volatility is the sum of the average upgraded notches and average downgraded notches per debt security. According to Moody's "Nonfinancial corporate issuer –the benchmark comparison dataset of global NFC issuers. Corporate infrastructure issuers are included in the benchmark, while project finance entities are excluded." Infrastructure ratings have been relatively more stable than non-financial corporate issuer (NFC) ratings with total infrastructure securities rating volatility of 0.15 as compared to NFC rating volatility of 0.40.

48 Similar dollar value amounts are not available for S&P

Figure 4.5 Average One-year Rating Volatility, 1983–2019



Source: Moody's Investors Service

Defaults. Moody's report provides the 10-year cumulative default rates for infrastructure debt securities (preferred stock is excluded) (Table 4.5). It can be seen from the table that average default rates are increasing as one moving down the rating scale. The comparison between total infrastructure debt securities and NFC issuers shows that infrastructure default rates have been, on average, lower than NFC default rates for the same rating level; Corporate infrastructure and project finance debt securities defaulted at a much higher rate than US municipal infrastructure debt securities (according to Moody's, by count the US muni represented 57 percent of total infrastructure securities but only 6 percent of defaulted total infrastructure debt securities).

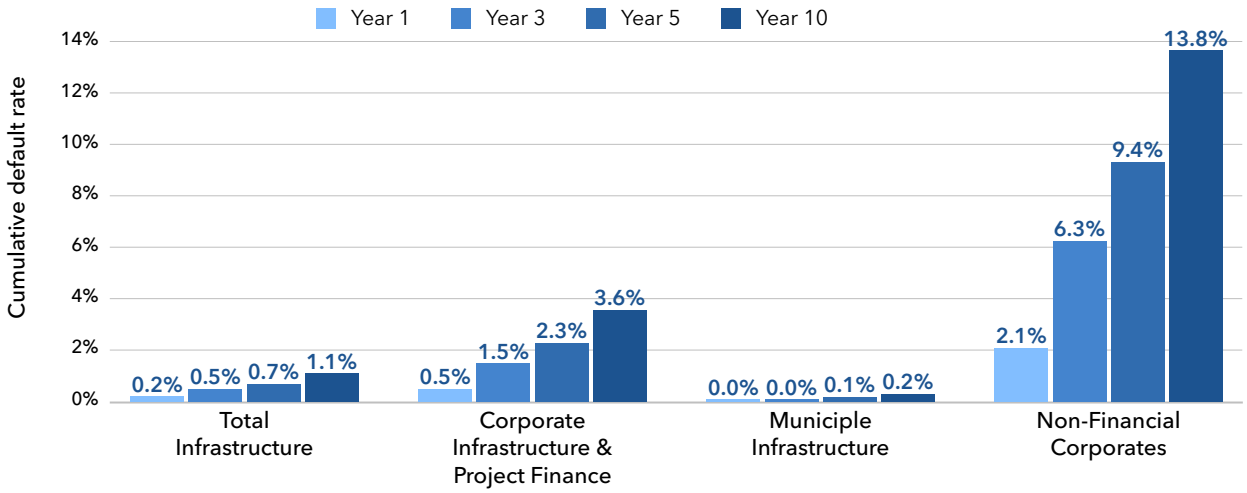
Table 4.5 Average 10-year Cumulative Default Rates, 1983–2019

Rating	Total Infrastructure Debt Securities	Corporate Infrastructure & Project Finance Debt Securities	US Municipal Infrastructure Debt Securities	Non-Financial Corporate Issuers
Aaa	0.0%	0.0%	0.0%	0.3%
Aa	0.0%	0.4%	0.0%	0.3%
A	0.4%	1.3%	0.1%	1.2%
Baa	2.2%	2.8%	0.6%	3.0%
Ba	7.9%	8.9%	2.3%	16.6%
B	25.4%	25.5%	23.8%	36.4%
Caa-C	54.5%	55.4%	n/a	50.5%

Source: Moody's Investors Service

Over the past ten years (2010-2019), infrastructure debt securities have defaulted less frequently than NFC securities (Figure 4.6).

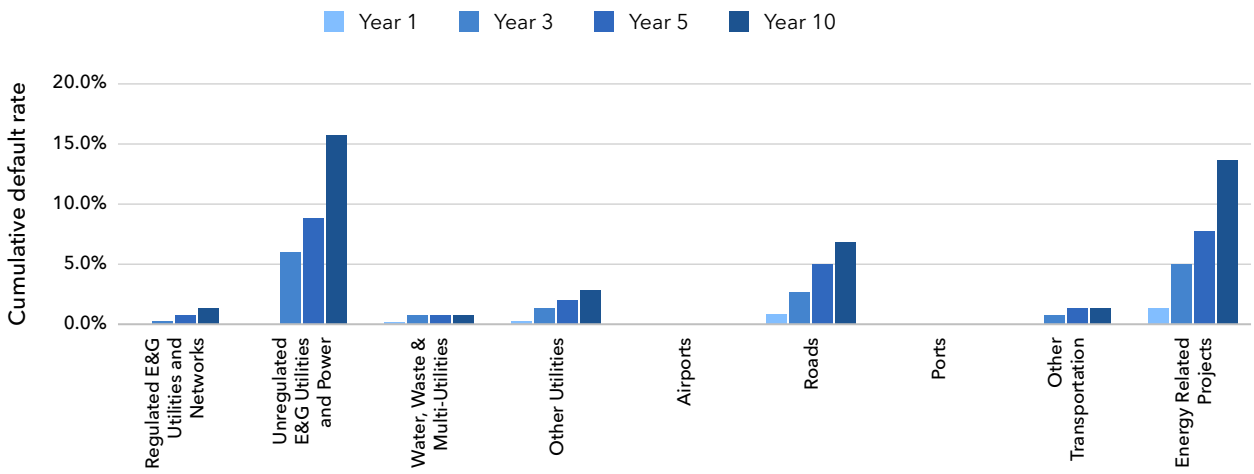
Figure 4.6 Average Overall Cumulative Default Rates, 2010–2019



Source: Moody's Investors Service

Among corporate infrastructure and project finance debt securities, Unregulated Electric and Gas Utilities and Power, Energy-Related Projects, and Roads exhibited elevated incidence of default over the study period (Figure 4.7).

Figure 4.7 Average Overall Cumulative Default Rates for Corporate Infrastructure and Project Finance Debt Securities, 1983–2019



Source: Moody's Investors Service

Recovery Rates. In Moody's report, due to very few U.S. municipal infrastructure defaults with recovery information, the analysts focus on average recoveries for corporate infrastructure and project finance and compare them with the global NFC debt issues. Senior secured and senior unsecured recovery rates for corporate infrastructure and project finance debt securities were much higher than those of NFC issuers (Table 4.6). The average recovery rates for the three broad sectors utility, transportation, and other infrastructure were 80 percent, 74 percent, and 60 percent, respectively (Table 4.7).

Table 4.6 Average Recovery Rates for Defaulted Corporate Infrastructure & Project Finance Debt Securities, by Instrument Type, 1983–2019

Sector	Senior Secured	Senior Unsecured	Subordinated
Corporate Infrastructure and Project Finance Debt Securities	72%	56%	34%
Non-Financial Corporate Debt Issues	55%	38%	33%

Source: Moody's Investors Service

Table 4.7 Average Recovery Rates for Defaulted Corporate Infrastructure & Project Finance Debt Securities, by Sector, 1983–2019

Sector	Senior Secured	Senior Unsecured	Subordinated
Utilities	80%	57%	36%
Regulated E&G Utilities and Networks	81%	62%	n/a
Unregulated E&G and Power	80%	54%	23%
Transportation	74%	n/a	n/a
Other Infrastructure	60%	n/a	n/a
Energy Related Projects	62%	n/a	n/a

Source: Moody's Investors Service

4.1.3 Comparison of S&P Infrastructure Study and Moody's Infrastructure Study

. . . the key findings are consistent. That is, infrastructure credit had lower default rates and higher recovery rates upon default and was less likely to receive a rating downgrade than NFC's with equivalent ratings.

While the definition of infrastructure is not completely aligned across the S&P and Moody's reports, the key findings are consistent. That is, infrastructure credit had lower default rates and higher recovery rates upon default and was less likely to receive a rating downgrade than NFC's with equivalent ratings. Moreover, since both S&P and Moody NFCs include infrastructure, infrastructure therefore would compare even more favorably with NFC sans infrastructure

There are some modest differences across the reports. The Moody's analysis includes 1,300 municipal bond issues and finds U.S. municipal infrastructure securities to have lower default rates than corporate infrastructure and project finance securities. S&P's analysis separates corporate infrastructure and project finance. They find that project finance experiences more frequent defaults and higher ratings volatility than corporate infrastructure bonds.

Across the sectors they analyze, S&P finds downgrade-to-upgrade ratios to have been highest for the power sector at 1.79 (ratios range from a low of 1.05 for oil and gas to 1.79 for power). However, power had the second-highest dollar-weighted average recovery rate at 69 percent. The power sector accounts for the largest share of defaulted securities (143 out of total 282 defaulted securities). In the Moody's analysis, the average recovery rates for the three broad sectors utility, transportation, and other infrastructure were 80 percent, 74 percent, and 60 percent, respectively

4.2 Equity Performance – Preqin Data Analysis

For analyzing equities, we use infrastructure funds data from Preqin, which is a major provider of data on alternative investments. In addition to the infrastructure, Preqin covers several additional asset classes, including natural resources and real estate, along with private equity, venture capital, private debt, secondaries (private equity on a secondary market), and hedge funds. The database includes data on fund, fund manager, investor, performance, and deal information.

4.2.1 The Preqin Database

As of June, 2021, the Preqin infrastructure investor database consisted of 2,285 institutional investors (such as public pension funds, private pension funds, insurance companies, sovereign wealth, endowments and foundations, etc.) from 71 countries investing in 1,116 infrastructure funds.[49] 43 percent (or 987) of those investors are from the U.S., and the U.S. insurance companies accounts for 9 percent (or 91 investors) of the U.S. investors and being the third largest institutional investor after private pension funds (336 investors) and public pension (180 investors). The total initial investment commitment made by the U.S. insurance companies (only 42 of the 91 U.S. insurance companies reported their initial commitment) is more than $5.57 billion. The database also provides fund vintage (year in which the fund made its first investment), fund size, fund status, fund performance measures, geographic focus, strategy, primary sector, etc.

There are 453 infrastructure funds (all unlisted, closed-end funds) that reported their performance, with the vintage years from 1993 to 2020, and making investment in seven sectors that match to our infrastructure definition: Energy (101 funds), Renewable Energy (87 funds), Telecommunication (8 funds), Transportation (32 funds), Utilities (14 funds), Waste Management (2 funds), and Diversified (205 funds) (Table 4.9).[50] Geographically, North America and the U.S. are the most popular investment areas of funds, with 33 percent (or 146 funds) and 10 percent (or 46 funds) respectively, followed by Europe (27 percent, or 121 funds) (Table 4.10).[51]

49 "Listed" funds are tradable securities on formal securities exchanges. An "institutional" investor is an entity that invests on behalf of its members (such as a mutual fund) or otherwise pools money to purchase securities or other assets. They may include organizations such as commercial banks and credit unions, mutual funds or hedge funds, pension funds, and of course, insurance companies.

50 Unlisted fund is a fund that is not listed on a stock market; Closed-end fund is a fund with a fixed life span that typically does not allow redemptions or the entry of additional investors after the initial formation of the fund. We include the "diversified" sector although it is possible it is not a perfect match to our infrastructure definition.

51 According to Preqin, funds with US as the geographic focus target investments solely in the US; funds with North America as the geographic focus most likely invest in the US as it is the largest market in the continent, but also invest in or look at other North American countries (most likely Canada and/or Mexico).

About 14 percent (65 funds) of the 453 funds we consider are liquidated (the fund company has decided to either sell off the fund's assets or merge the fund's holdings into another fund) (Table 4.8). Majority (about 81 percent or 367 funds) of the funds are closed to investors. About 4.6 percent (21 funds) are in the status of interim closes.[52] As shown in the last column of Table 4.11, fund size ranges from very small ($5.3 million) to very large ($22 billion).

Table 4.8 Status Distribution of Infrastructure Funds

Status	Frequency	Percent	Cumulative Percent
Closed	367	81.02	81.02
Fifth Close	2	0.44	81.46
First Close	11	2.43	83.89
Liquidated	65	14.35	98.23
Second Close	3	0.66	98.90
Sixth Close	1	0.22	99.12
Third Close	4	0.88	100
Total	453	100	

Data Source: Preqin

Table 4.9 Infrastructure Funds Sector Distribution

Primary Sector	Frequency	Percent	Cumulative Percent
Diversified	205	45.66	45.66
Energy	101	22.49	68.15
Renewable Energy	87	19.38	87.53
Telecommunications	8	1.78	89.31
Transport	32	7.13	96.44
Utilities	14	3.12	99.55
Waste Management	2	0.45	100
Total	449	100	

Data Source: Preqin

52 Interim closes are named in the sequency they occur. The first interim close is termed "first close", second interm close is termed "second close", etc. Once the fund has held a first close, it can begin to make investments.

Table 4.10 Infrastructure Funds Geographic Focus Distribution

Geographic Focus	Frequency	Percent	Cumulative Percent
Africa	3	0.68	0.68
Americas	4	0.9	1.58
Asia	18	4.06	5.64
Australia	3	0.68	6.32
Brazil	9	2.03	8.35
Canada	2	0.45	8.8
Central and East Europe	1	0.23	9.03
Chile	3	0.68	9.71
China	2	0.45	10.16
Colombia	1	0.23	10.38
Europe	121	27.31	37.7
Finland	3	0.68	38.37
France	3	0.68	39.05
Greater China	1	0.23	39.28
India	6	1.35	40.63
Italy	4	0.9	41.53
Japan	1	0.23	41.76
Mexico	7	1.58	43.34
Middle East	1	0.23	43.57
North America	146	32.96	76.52
Peru	1	0.23	76.75
Portugal	1	0.23	76.98
Russia	1	0.23	77.2
South Africa	1	0.23	77.43
South America	7	1.58	79.01
Sub-Saharan Africa	5	1.13	80.14
Switzerland	1	0.23	80.36
Turkey	1	0.23	80.59
UK	19	4.29	84.88
US	46	10.38	95.26
West Europe	21	4.74	100
Total	443	100	

Data Source: Preqin

4.2.2 Main Performance Statistics and Return Profiles for Infrastructure Funds

Table 4.11 summarizes the main performance statistics of the 453 unlisted infrastructure funds. Median internal rates of return (IRRs) and multiples are the most common measures to benchmark the performance of private equity-type funds (see definitions of terms in Table 4.11 notes). The DPI and RVPI are provided for 442 and 441 funds respectively, while the Net IRR are available for 260 funds, and Called is available for 448 funds.

Net IRR ranges from -39.5 to 448 percent with a median of 9 percent and an average just under 11.5 percent (Table 4.11). Multiples ranges from 0.01 to 4.76 with a median of 1.2 and an average of 1.3. RVPI has a very wide range from 0 to 476 percent with a median of 86 percent. DPI ranges from 0 to 358.1 percent with a median of 28 percent and a higher average (56.8 percent), suggesting the distribution is skewed to the right (some comparatively high numbers for a limited number of funds). Called ranges from 1 to 182.6 percent with a median of 90 percent.

Table 4.11 Descriptive Statistics of Unlisted Infrastructure Funds

	Called (percent)	DPI (percent)	RVPI (percent)	Multiple	IRR (percent)	Size (USD M)
Number of funds	448	442	441	441	260	424
Median	90	28	86	1.2	9	613
Average	80.7	56.8	72.1	1.3	11.4	1,363.2
Standard deviation	30.9	68.6	51.7	0.53	29	2,262.8
Minimum	1	0	0	0.01	-39.5	5.3
Quartile 1	65	3.8	25	1	4.6	230.5
Quartile 3	100	93	103.1	1.5	13.9	1,517
Maximum	182.6	358.1	476	4.76	448	22,000

The called-up percentage (Called) is the proportion of the limited partners' aggregate commitments that have been contributed to the fund. DPI (distributed to paid-in percentage) refers to distributions between the fund and the investors. RVPI (remaining value to paid-in percentage) is the valuation of unrealized assets expressed as a percentage of called capital. The multiple is the sum of called DPI and RVPI (divided by 100). Net IRR is the rate of return earned by a limited partnership to date after fees and carry interest. The IRR is an estimated figure based on the realized cash flows and the valuation of unrealized assets.

Data Source: Preqin

Although the sample goes back to the early 1990s, the majority of funds were launched in the 2010s. In Table 4.12, the 28-year period is grouped into five sub-periods: 1993–1999, 2000–2002, 2003–2007, 2008–2009, and 2010–2020 (2010–2018 for the analysis of IRRs, which were not reported for later vintages).

Table 4.12 Five Sub-periods and Number of Funds

Sub-period	Frequency	Percent	Cumulative Percent
1993–1999	8	1.77	1.77
2000–2002	7	1.55	3.31
2003–2007	61	13.47	16.78
2008–2009	39	8.61	25.39
2010–2020	338	74.61	100
Total	453	100	

Data Source: Preqin

Table 4.13 compares the number of funds available and the median values for each performance variables. Since the capital called percent measures the cumulative LP (Limited Partner) capital invested, there is little surprise that the majority of the older funds have a call ratio of around 100 percent and the value goes down in recent years (2010–2020); Capital distribution (DPI) is the returns that an investor in a fund receives, the early vintages have achieved a DPI of 200 percent or over, but for vintages newer than 2010 the figures are generally very low; The remaining value (RVPI) or also called residual value is generally low for older funds and high for recent funds, as shown in Table 4.13 the median RVPI starts from 0 for 1993–1999 and 2000–2002 and rises since 2003 then stabilizes at around 93 percent in 2010–2020. Net multiple (Multiple) reveals how many times investors have received (or are likely to receive) their money back and make a profit from their investment. It is the sum of DPI and RVPI. As shown in the table, the median multiple of all five sub-periods has a value of at least 1.13. The median multiple for the funds created in 2000–2002 has the highest value of 2.01, as measured by the net return (IRR) these funds also performs well with the median value at about 25.6 percent. The net IRR is the money-weighted return expressed as a percentage, and it excludes any carry/performance fees earned by the GP (General Partner). As presented in the table, the median IRR of all sub-periods is above 8.8 percent.

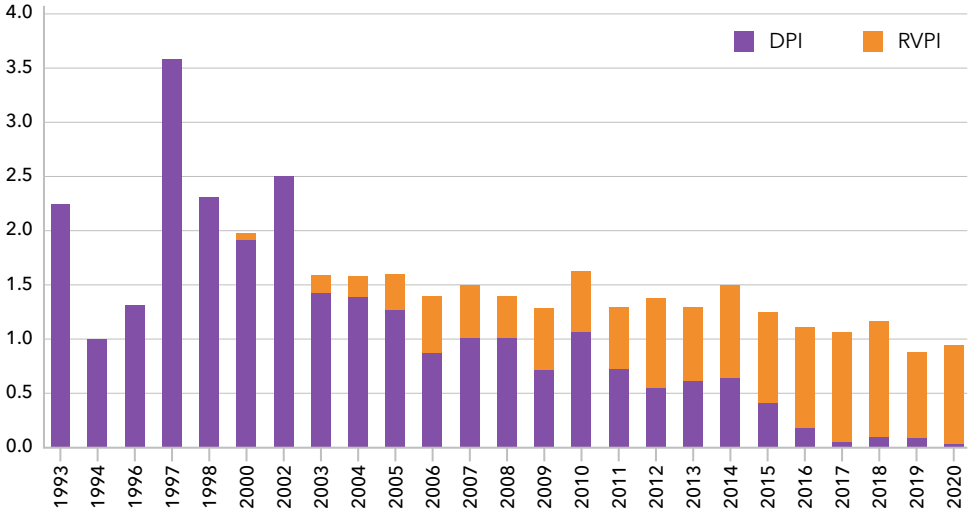
Table 4.13 Number of Funds and Median by Sub-periods

	Number of Funds					Median				
Sub-period	Called (%)	DPI (%)	RVPI (%)	Multiple	IRR (%)	Called (%)	DPI (%)	RVPI (%)	Multiple	IRR (%)
1993–1999	8	8	8	8	7	94.4	182.3	0	1.83	10.3
2000–2002	7	7	7	7	6	99	201	0	2.01	25.6
2003–2007	60	60	60	60	45	100	113	9.7	1.5	8.8
2008–2009	38	38	38	38	23	100	80.8	34.6	1.3	9
2010–2020	335	329	328	328	179	85.5	15	93.3	1.13	8.8
Total	448	442	441	441	260	90	28	86	1.2	9

Data Source: Preqin

Figure 4.8 shows DPI, RVPI and multiples over vintage years. It is a snapshot that shows how each vintage of infrastructure funds has performed on average, as of June 2020. For example, column 2007 shows that infrastructure funds created in 2007 have distributed 1.01 times their paid-in capital and that the remaining value represents 0.48 times the paid-in capital. This results in a multiple of 1.01 + 0.48 ≈ 1.49. Multiples are highest for vintages in the late 1990s and early 2000s. Both 1993 and 1997 had only one fund and did well, the 1993 fund invested in the utilities sector while the 1997 fund invested in the energy sector. New funds in 2019 and 2020 have average multiples below 1, this is because some of these new funds haven't started to distribute returns/incomes yet or DPI=0 and several funds have a remaining value (RVPI) below 50 percent (one extreme case is RVPI=1.18 for a fund in 2019, at the same time its DPI=0), these low values drag down the average of both measures (DPI, RVPI).

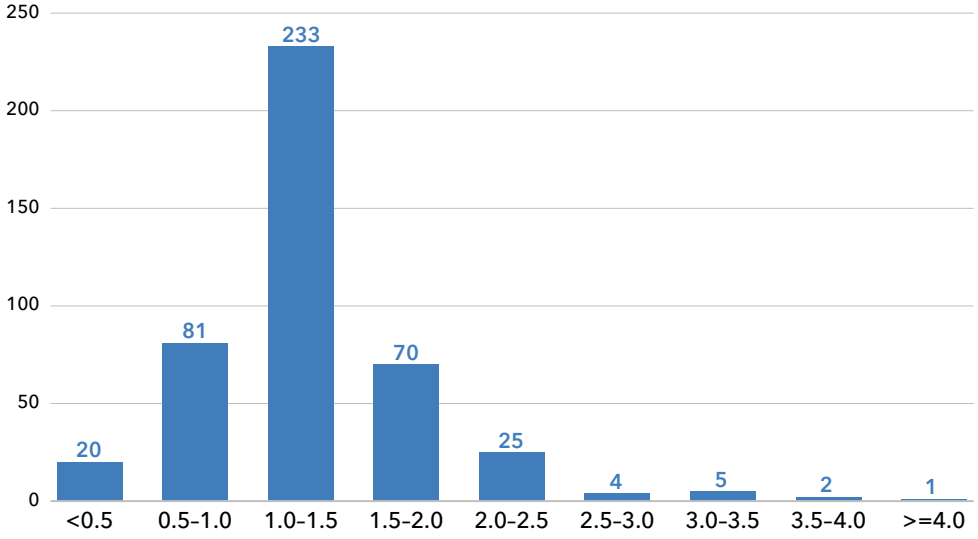
Figure 4.8 DPI, RVPI, and Multiples Over Vintage Years for All Infrastructure Funds



Data Source: Preqin

Over the course of 28 years, median and average values of the multiples are close (1.2 and 1.3 respectively) with the average being slightly higher, this suggests that the multiples are roughly evenly distributed around the midpoint (or the median) with the values of those multiples above the median being slightly higher. The standard deviation is 0.53 while the first and third quartiles have values of 1.0 and 1.5, respectively. Figure 4.9 presents the frequency distribution of the multiples of the 441 infrastructure funds. The majority of the funds (340 funds or about 77.1 percent) have a multiple of 1 and above, with a multiple of 1 to 1.5 being the most concentrated group. Specifically, 233 funds (or about 53 percent of the total 441 funds) have a multiple of 1 to 1.5, and 107 funds (or 24 percent of the total 441 funds) have a multiple in the range of 1.5 to 5. The extremes on the left side (multiple < 0.5) are the investments in the following sectors: diversified (8), energy (5), renewable energy (4), telecommunications (1), and transport (2); the extremes on the right side (multiples ≥ 3) invest in the energy (4), renewable energy (1), telecommunications (1), and diversified (2).

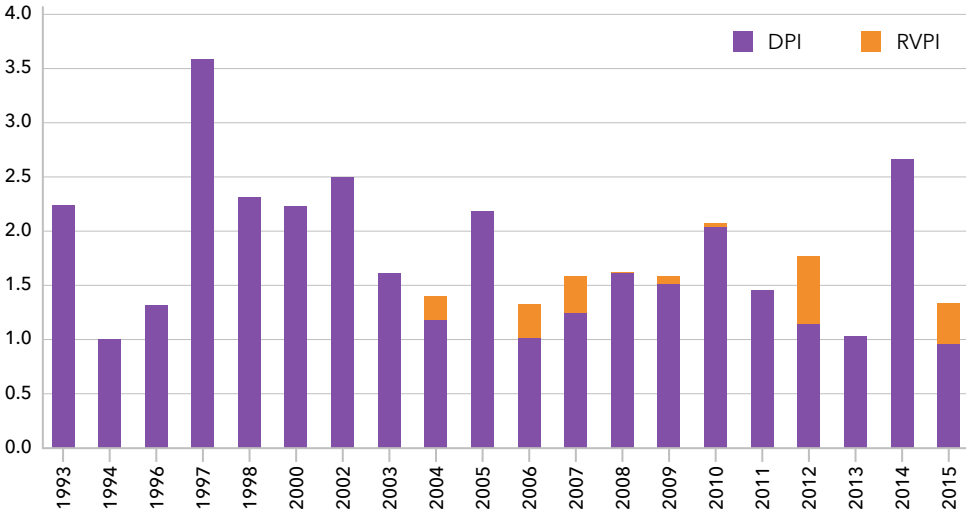
Figure 4.9 Frequency Distribution for Multiples of All Funds



Data Source: Preqin

Figure 4.10 shows the DPI, RVPI and multiples for the liquidated funds. It is expected that the remaining value (RVPI) of these funds is minimal, and the multiples should typically above one or it means you're losing money on the investment. For funds created in 2006, there is an extreme low multiple of 0.13, it is worth noting that this fund invests in the renewable energy sector.

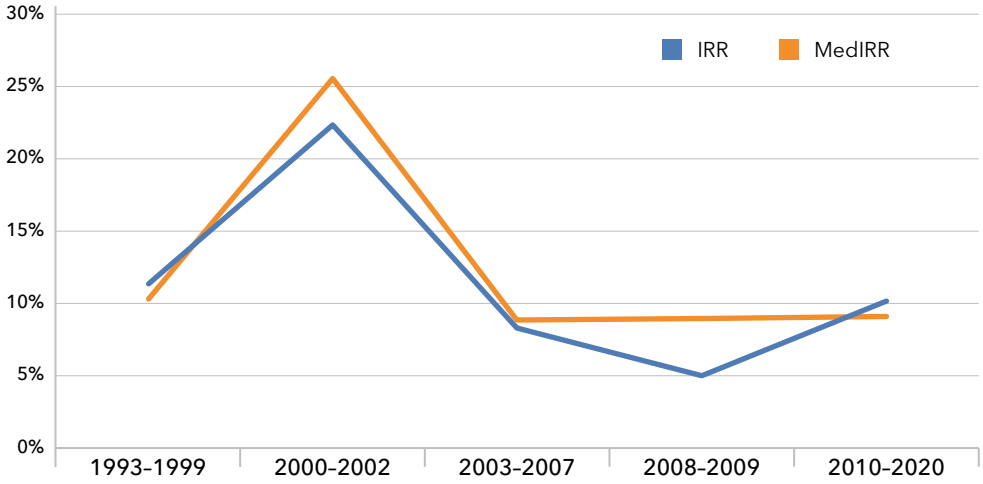
Figure 4.10 DPI, RVPI, and Multiples Over Vintage Years for Liquidated Funds



Data Source: Preqin

Figure 4.11 shows the median and average IRRs for each sub-period. In 2008-2009, there is a fund we considered as an outlier with an extremely high net IRR of 448 percent, to reduce the impact of this outlier on the already small sample size (total 25 funds reported IRR in 2008–2009), we removed it from the sample for this period. It is interesting to note that this outlier is from the renewable energy industry.[53] The median and average value for the other sub-periods (1993–1999, 2000–2002, 2003–2007, and 2010-2020) are generally close to each other. The significant difference between the median and average (median: 8.6 vs. average: 4.6) in 2008–2009 reflects the existence of three extreme negative IRRs: –20.70 in renewable energy sector of 2008 in North America, –16.66 in diversified sector of 2009 in Asia, and –12.30 in renewable energy sector of 2009 in North America. Thus, we could infer that the investment return of the funds in renewable energy sector in the global financial crisis period can be quite volatile. Another thing to note in this figure is that funds of 2000–2002 perform very well compared to other periods with both median and mean IRR above 22 percent, this is consistent with our previous analysis findings (Table 4.13 and Figure 4.8). Further investigation shows that five out of the six funds in this period have a net IRR above 22 percent, and four out of the five funds invest in the energy sector in North America while the rest one invests in the telecommunications sector in Europe.

Figure 4.11 Median and Average IRRs Over Vintage Periods



Data Source: Preqin

53 The fund with net IRR of 448 is a liquidated fund that have invested in renewable energy in Europe.

4.2.3 Comparison with Other Private Equity Funds

In this section, we compare the infrastructure funds' performance from section 4.2.2 with other private-equity funds, including buyout, venture capital, private-equity real estate, and mezzanine.[54] Mezzanine is under the private debt asset class in Preqin database, it is added into our comparison because its investment characteristics might a priori be more in common with equity than it does with a bank loan due to its focus on cash flow, long-term investment horizon and enterprise valuation. Preqin's data goes back to 1969 for venture capital, 1977 for buyout, 1980 for real estate, and 1985 for mezzanine. Since the infrastructure funds only go back to 1993, we drop the funds that before 1993. Tables 4.14 and 4.15 show the distribution of private-equity funds analyzed in our final dataset by category and period, respectively.

Table 4.14 Funds Distribution by Private-Equity Categories

Private-Equity Funds	Number	Percent	Cumulative Percent
Infrastructure	453	6.02	6.02
Buyout	2,268	30.14	36.15
Venture Capital	2,138	28.41	64.56
Real Estate	2,283	30.33	94.90
Mezzanine	384	5.10	100
Total	7,526	100	

Data Source: Preqin

Table 4.15 Funds Distribution Over Time

Sub-period	Number	Percent	Cumulative Percent
199–1999	988	13.13	13.13
2000–2002	657	8.73	21.86
2003–2007	1,467	19.49	41.35
2008–2009	502	6.67	48.02
2010–2020	3,912	51.98	100
Total	7,526	100	

Data Source: Preqin

54 Mezzanine in Preqin's database are the investments to debt subordinated to the primary debt issuance and senior to equity positions; Further categories of private-equity in preqin database are: secondaries, funds of funds, growth, early stage, etc.

The top panel of Table 4.16 presents the median returns (net IRR) of different categories and the bottom panel of the table shows the dispersion (or the standard deviation) of these returns. As shown in the top panel, category All funds (which includes all funds of the five categories) has double-digit median returns for virtually all vintage periods except for vintages from 2003 to 2007. 2003–2007 turns out to be a weak period, with both VC and Real Estate have a median IRR around 5 and further investigation shows that about 30 percent (29 percent for VC, 33 percent for Real Estate) of them are still in negative territory; Buyout (median IRR 11.4 percent) outperforms other categories though it is also at the lowest compare to the other periods of itself; Although there is a significant gap with the buyout, Infrastructure in this period positions as the second-highest earning fund at 8.8 percent, slightly higher than the Mezzanine of 8.5 percent. In the 1990s, Infrastructure median IRR is 10.3 percent, similar to Mezzanine funds, slightly higher than Venture, but below Buyout and Real Estate. In 2000–2002, Infrastructure funds' median IRR Is 25.6 percent, which is the highest among all categories and about 5 percentage points higher than the second-highest earning fund, Buyout. During the financial crisis and Great Recession (2008–2009), median infrastructure fund IRR was 8.6 percent, which is similar to Mezzanine (9.1 percent) and Venture Capital (8.9 percent), but lower than Real Estate (10 percent) and Buyout (13.5 percent). In the years following the recession, Infrastructure funds' median IRR is 8.8 percent, which is slightly lower than Mezzanine of 9.5 percent and further lower than the rest categories.

Among the broad private-equity fund categories, the time file of Infrastructure is broadly similar to that of Mezzanine with stronger vintages in early 2000s and low sensitivity to swings in the economy. Both Venture Capital and Real Estate have a wide range of median values of their returns over the various vintage periods. Buyout funds stands out with two-digit median returns in all vintage periods.

. . . over the full period 1993–2020, the return of Infrastructure funds is similar to Mezzaine, but falls short of those to Buyout, Venture Capital, and Real Estate. Moreover, with median return of at least 8.8 percent, Infrastructure funds show more stable returns than other categories over the vintage periods and low sensitivity to swings in the economy.

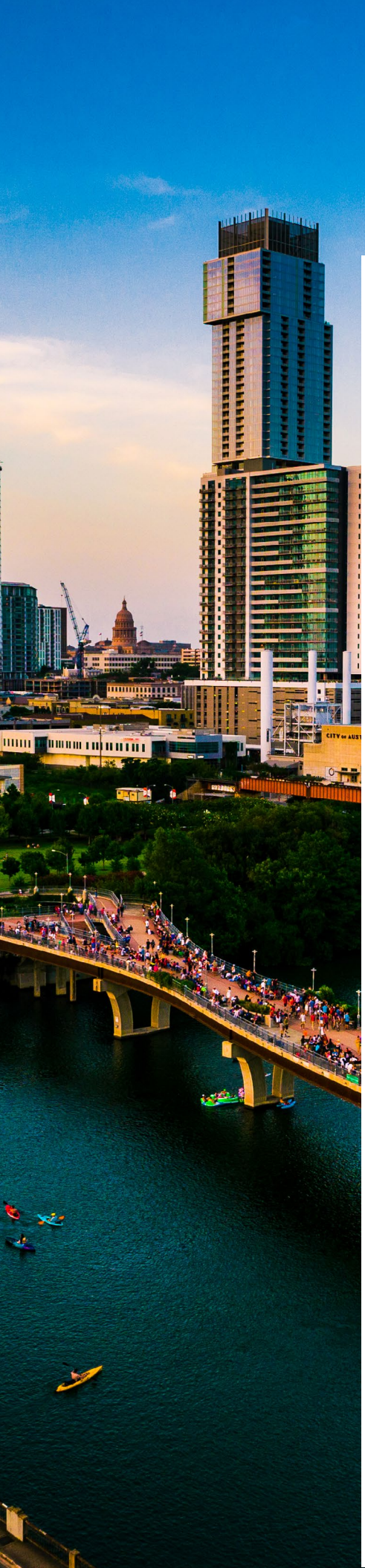
Table 4.16 Median and Dispersion of Returns in Comparison

Median IRR						
Period	**All funds**	**Infrastructure**	**Buyout**	**Venture Capital**	**Real Estate**	**Mezzanine**
1993–1999	11.9	10.3	12.4	9.8	13.8	10.2
2000–2002	11.0	25.6	20.6	1.5	17.6	11.9
2003–2007	8	8.8	11.4	5.3	5.1	8.5
2008–2009	10.8	8.6	13.5	8.9	10	9.1
2010–2020	12.8	8.8	14.7	17.4	11.9	9.5
1993–2020	11.3	9	13.7	10	10.8	9.4
Number of funds	6,067	259	1,898	1,665	1,914	331
Dispersion (standard deviation)						
Period	**All funds**	**Infrastructure**	**Buyout**	**Venture Capital**	**Real Estate**	**Mezzanine**
1993–1999	40.24	10.26	25.53	59.27	10.93	13.05
2000–2002	17.67	12.15	15.33	15.80	11.84	20.69
2003–2007	18.95	12.27	18.85	16.97	21.30	4.80
2008–2009	14.5	10.4	13.51	17.53	13.61	5.79
2010–2020	19.00	9.93	16.99	30.24	10.99	5.83
1993–2020	23.36	10.69	18.98	35.73	14.54	9.67
Number of funds	6,067	259	1,898	1,665	1,914	331

Data Source: Preqin

It is also worth to measure the dispersion of the returns (or riskness) across fund categories and sub-periods. As shown in the lower-half of Table 4.16, the dispersion is expressed as standard deviation of the net IRR. Infrastructure fund returns typically display lower dispersion than Real Estate, further lower than Buyout, then further lower than Venture Capital. Compare to mezzanine, Infrastructure fund returns display moderately higher disperson across sub-periods, over the full period 1993–2020, Infrastructure fund returns' dispersion is about one percentage point higher than that of the Mezzanine (10.69 vs. 9.67).

In summary, over the full period 1993–2020, the return of Infrastructure funds is similar to Mezzaine, but falls short of those to Buyout, Venture Capital, and Real Estate. Moreover, with median return of at least 8.6 percent, Infrastructure funds show more stable returns than other categories over the vintage periods and low sensitivity to swings in the economy. Finally, the dispersion of returns across funds is much lower for Infrastructure than for most other categories (Real Estate, Buyout, Venture Capital).



Section 5: Insurance Industry Exposure to Infrastructure Investment

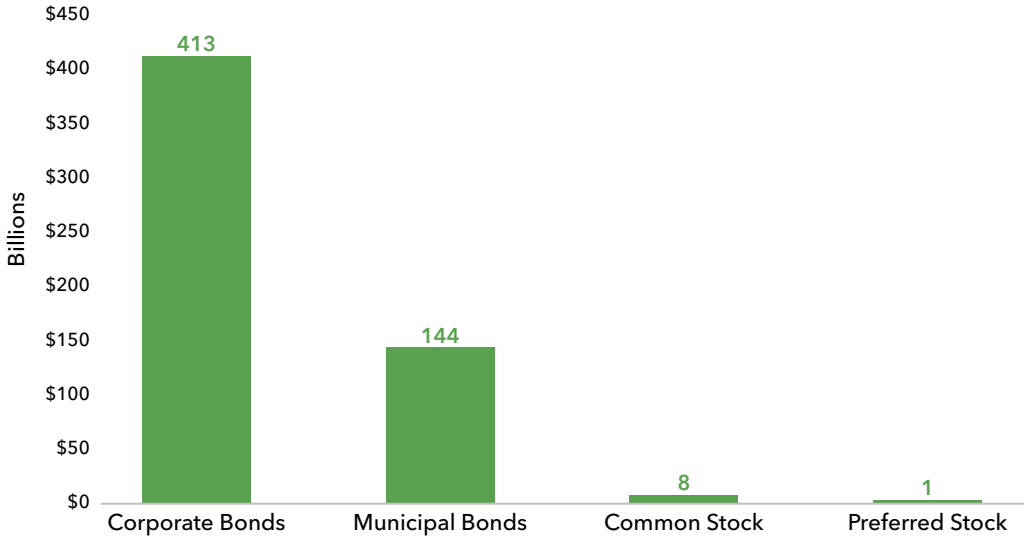
To properly assess the potential for the insurance industry to invest *more* in economic infrastructure, as we have defined it, it is critical to know how invested they are in economic infrastructure *now*. We evaluated insurance industry investments in economic infrastructure through their financial investments; specifically, corporate bonds, municipal bonds, and equities. We did not consider Treasury securities, real estate investments, private equity, agency securities, asset-backed securities (ABS) and other Structured and Loan backed securities, private label residential or commercial mortgage-backed securities (RMBS and CMBS), or any financial investments supporting social infrastructure. Data were collected for 2019, the latest available data at time of writing, from Schedule D of the Annual Statements of all insurance companies. These figures are book-adjusted carrying value (BACV). The BACV is the statutory value of the investment before nonadmitted amounts and is based upon the valuation method prescribed by the appropriate Statement of Statutory Accounting Principles (NAIC); that is; only amounts that are available to meet both current and future policyholder obligations when the obligations are due.

We estimated total investment in corporate bonds financing economic infrastructure at $413 billion, municipal bonds at $144 billion, and a modest amount for equities at about $9 billion ($1 billion in preferred stock). Thus, total U.S. insurance industry exposure to economic infrastructure is roughly $566 billion by our definition (Figure 5.1).[55]

Thus, total U.S. insurance industry exposure to economic infrastructure is roughly $566 billion by our definition.

55 These figures are book-adjusted carrying value (BACV). The BACV is the statutory value of the investment before nonadmitted amounts and is based upon the valuation method prescribed by the appropriate Statement of Statutory Accounting Principles (NAIC).

Figure 5.1 Insurance Industry Investment in Economic Infrastructure, by Asset Type



Source: National Association of Insurance Commissioners (CIPR and Capital Markets Bureau).

Data Source: Schedule D, Annual Statement filings (NAIC). Data are from 2019.

5.1 Corporate Bonds

To calculate corporate bond holdings financing infrastructure, we examined the full compendium of NAICS codes (North American Industry Classification System), selecting codes that fit our definition of infrastructure. We then selected bonds associated with these NAICS codes. The specific industries that both fit our definition of economic infrastructure and have insurance industry corporate bond exposure are reported in Table 5.1.

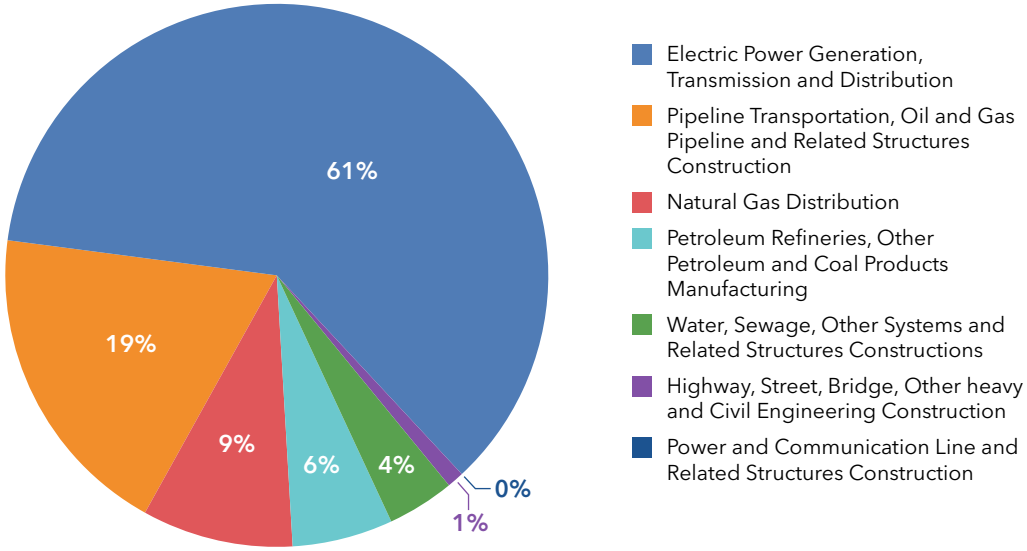
Fully 95 percent of insurance industry corporate bond investment in infrastructure is within the broad industry of energy. Of this amount, almost two-thirds of bond investments are in "downstream" (end user) electric; specifically, electric power generation, transmission, and distribution.

Table 5.1 NAICS Codes Used in Analysis of Corporate Bond Holdings

NAICS Code	Description	NAICS Code	Description
2211	Electric Power Generation, Transmission and Distribution	2373	Highway, Street, and Bridge Construction
22111	Electric Power Generation	237310	Highway, Street, and Bridge Construction
221111 – 221116, 221118	Hydroelectric, fossil fuel, nuclear, solar, wind, geothermal, other electric power generation.	2379	Other Heavy and Civil Engineering Construction
2212	Natural Gas Distribution	237990	Other Heavy and Civil Engineering Construction
22121	Natural Gas Distribution	3241	Petroleum and Coal Products Manufacturing
2213	Water, Sewage, and Other Systems	324110	Petroleum Refineries
22131	Water Supply and Irrigation Systems	324199	All Other Petroleum and Coal Products Manufacturing
22132	Sewage Treatment Facilities	4861	Pipeline Transportation of Crude Oil
2213110	Water and Sewer Line and Related Structures Construction	486110	Pipeline Transportation of Crude Oil
2371	Utility System Construction	4862	Pipeline Transportation of Natural Gas
237110	Water and Sewer Line and Related Structures Construction	486210	Pipeline Transportation of Natural Gas
237120	Oil and Gas Pipeline and Related Structures Construction	4869	Other Pipeline Transportation
237130	Power and Communication Line and Related Structures Construction	486910	Pipeline Transportation of Refined Petroleum Products
		486990	All Other Pipeline Transportation

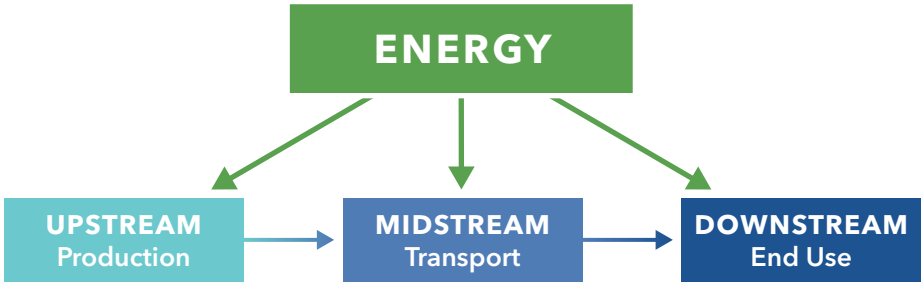
Fully 95 percent of insurance industry corporate bond investment in infrastructure is within the broad industry of energy (Figure 5.2). *Of this amount*, almost two-thirds of bond investments are in "downstream" (end user) electric; specifically, electric power generation, transmission, and distribution (Figure 5.3). An additional 20 percent of industry investments in the energy sector are midstream; that is, natural pipeline transportation and related structures. The remainder of energy sector investments is upstream and includes the subsectors the distribution of natural gas, petroleum refining, the production of petroleum and coal-based products, and a minute amount in power and communication lines.

Figure 5.2 Distribution of Corporate Bond Investments by Major (4-digit) Sector



Data Source: Schedule D, Annual Statement filings (NAIC). Data are from 2019.

Figure 5.3 Energy Sector Structure



The bulk of the remaining 5 percent of corporate bond investments in infrastructure is in water and sewer, with a small 1 percent overall share of corporate bond investment in transportation and other civil construction.

S&P Global Ratings Perspective on Energy in 2020 and Beyond

The Center for Insurance Policy and Research (CIPR) hosted an infrastructure investment webinar on February 1, 2021 (The U.S. Insurance Industry and Infrastructure Investment Webinar). We emphasized in the webinar that NAIC-regulated insurance companies' infrastructure investments are concentrated in power and energy. S&P Global Ratings (S&P) presented information on two related industries: regulated utilities and midstream oil and gas. They discussed the financial performance of these two industries in 2020 moving forward. In this box we provide a summary of their key points. A link to the recording and related materials are provided at the end of the summary.

U.S. Economy and The New U.S. Administration

S&P forecast U.S. real GDP will grow 4.2 percent in 2021,* boosted by the $900 billion stimulus package President Trump signed in late December (updated forecast). By the end of 2023, the economy is expected to remain smaller than S&P had forecasted in December 2019 by $96 billion (or 1.9 percent). Adding to the economic pain is that unemployment is unlikely to fall to its pre-pandemic low until after 2023. With Democratic control of Congress, the new U.S. executive administration is better positioned to push through its legislative agenda. President Biden's stated priority is to help the nation gain control of the pandemic and to bolster the nascent recovery. Besides a flurry of executive orders, he has also proposed an additional $1.9 trillion in economic stimulus. The new administration's climate agenda is significantly more robust than that of the previous administration, and borrowers in the energy and power sectors may feel a substantial impact from the strengthening of environmental regulation.

U.S. Regulated Utilities

The North America Regulated Utility Industry's outlook at the beginning of 2020 was: 81% stable, 1% positive or credit watch with positive implications, and 18% negative outlook or credit watch with negative implications. However, the ratings outlook at the end of 2020 changed to 58% stable, 5% positive or credit watch with positive implications, 36% negative outlook or credit watch with negative implications, and 1% developing (ratings may be raised or lowered). Regarding the number of upgrades and downgrades, during 2020, the downgrades outnumbered upgrades for the first time ever since 2011, by 7 to 1. The last time for the North America Regulated Utility Industry the ratings' downgrades-to-upgrades ratio was greater than 1 was in 2010, at about 1.2.

There are three factors that drove a weakening of credit quality in 2020, which are ESG (environmental, social, corporate governance) factors, regulatory developments, and financial pressures. For ESG, there are a number of ESG-related events during 2020 that included, California Wildfires led several companies' outlook revised to negative due to the adverse wildfire conditions; Climate Change Risks, such as energy company's rating downgrade on storm risks; Outlook revised to negative on bribery charges; Code of Ethics Violation, such as rating downgraded on termination of CEO; Regulatory and Recovery Risks, such as company's outlook revise to negative on higher regulatory risk, elevated spending plan. For regulatory developments, currently there are seven states (WA, IL, OH, NY, CT, NC, SC) that are in the developing regulatory environment according to S&P's regulatory advantage/risk assessment on North America Utilities for each jurisdiction. Take South Carolina for example, the

South Carolina Legislature voted in September 2020 to evaluate potential electricity reform measures, which could result in a restructuring of the state's energy market and lead to fundamental changes to the way regulated utilities operate in the state. For financial pressures, during the webinar S&P presented the FFO (funds from operations) to total debt ratio of a sample of 27 energy companies with their ratings fall in the range from AA- to BB-. The FFO to total debt ratio measures the ability of a company to pay off its debt using net operating income alone. The majority of the companies are considered to have a significant risk (FFO to total debt ratio of 0.13 to 0.23).

What do we expect for 2021?* S&P anticipated marginally improvement in credit quality in 2021 for U.S. regulated utility, at the same time, the corporate tax rate is going to be higher (higher than the rate in 2018-2020), and the improvement will be partially offset by ESG risks. Data shows the electricity industry has reduced the GHG (greenhouse gas) emissions in recent years but still more work to be done, as it is still the second highest industry regarding GHG emissions at 27% of the total emissions and only 2% lower than the first highest GHG emission industry which is transportation. According to S&P's forecast on U.S. energy generation portfolio, by 2030, electricity from coal will be reduced to 6% from 20% in 2020, and renewable energy will increase to 27% from 9% in 2020; By 2040, there will be no coal energy production, and the proportion of energy generated from renewables will be further increased to 37% standing as the largest share in the generation portfolio, with natural gas being the second at 31%.

North America Midstream Energy

Roughly 25% of the North America Midstream Energy issuers were downgraded with 12 issuers were downgraded by multiple notches since February 2020, 38% of portfolio is investment grade, and portfolio shifted to a more negative bias to 33% from 18 % in February 2020. The top risks to the industry's credit conditions includes high leverage, Coronavirus-related health crisis affecting consumer behaviors, U.S.-China strategic confrontation spill over the economy and credit markets, declining commercial real estate asset quality could lead to rising loan losses, low oil demand, etc. By the first quarter of 2022, the industry's credit metrics will recover to 2019 level.

Midstream three sub-sectors: G&P (gathering, processing, and fractionation), pipelines, and diversified energy. Overall, counterparty risk will continue to loom over the midstream industry through 2021. Respectively, diversified energy is generally in a better position comparing the other two sub-sectors, due to size, scale, customer diversification, contractual foundation; G&P has been hit the hardest, as more than 50% downgrades have been the G&P companies. For G&P volume and price declines are one of the key factors, but the overall health of the upstream is another; For pipelines, re-contracting is an on-going risk as demand patterns change, and this is more pronounced for oil than for natural oil in the near-term, regulation and policy changes are also main factors.

Looking forward to 2021 and beyond, most companies will be free cash flow positive in 2021. Pandemic has caused a decline in GDP which negatively affected energy demand, for post-covid-19, net energy projection may vary depending on consumer's future behavior, and on top of it, energy transition of reducing fractionation and increasing hydrogen will be another key risk factor for the midstream industry in the future.

*Forecasts current as of February 1, 2021

5.2 Municipal Bonds

Municipal (muni) bonds are debt obligations issued by a local government, one of its agencies, or a local authority. They typically finance public capital projects such as the construction of roads, schools, and utilities, or other infrastructure or infrastructure improvements.[56]

Computation of municipal bond investments was considerably more complicated than for corporate bond investments. We began by collecting a sample the largest 25 bond issues in each subcategory. These subcategories included, in order of aggregate bond holdings in the subcategory (range was $13.7B to $34.2B): Transportation, Water, Airport, Utility, Power, Utilities, Sewer, Electric, Municipal Utilities District, Flood–Water–Sewer Disposal, Public Utility District, Combine Utility, Drainage District, and Telecommunications. For each bond within each subcategory, we used the CUSIP to look up the bond issue, viewed documentation (usually official statements) to determine the use of the bond proceeds and whether the proceeds were used for economic infrastructure as defined for this report. We excluded bond refinances and redemptions, including refinances of bonds where the initial issue was to finance economic infrastructure.

These amounts were summed within categories and divided by the aggregate value of the *sample* in each category to get an estimate of the percentage of holdings in each category that meet the CIPR/NAIC definition of economic infrastructure. These percentages were then applied to the aggregate value of *all* insurance industry municipal bond holdings in each category. Finally, we summed across categories to capture a final number.

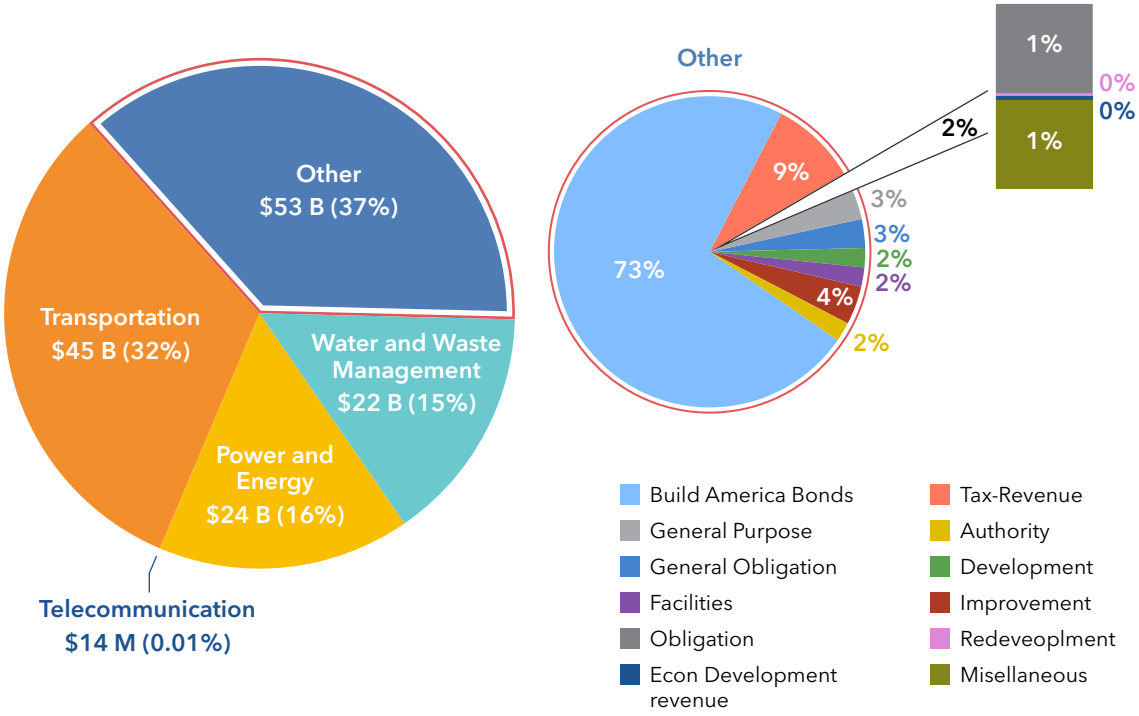
Roughly one-third of all municipal bond holdings held by the insurance industry in economic infrastructure financed transportation projects.

The municipal bond mix was significantly different from the corporate bond mix, which is unsurprising given the nature of the bonds as debt obligations for local public infrastructure (Figure 5.4). The Power and Energy sector accounted for about 18 percent of economic-infrastructure-related municipal bond holdings by the insurance sector, compared with 95 percent for corporate bond holdings in economic infrastructure. Roughly

56 Most local governments are mandated by their respected state constitutions to maintain balanced budgets, and thus, municipal bonds cannot be used to finance general fund expenditures.

one-third of all municipal bond holdings held by the insurance industry in economic infrastructure financed transportation projects. About 27 percent of municipal bond holdings were Build America Bonds (73 percent of 37 percent). Build America Bonds are (taxable) municipal bonds that were introduced in 2009 as part of the American Recovery and Reinvestment Act (ARRA) stimulus bill (the program expired in 2010) to encourage skittish investors to invest in municipal projects. They were largely used for infrastructure projects. The share of bonds financing local public water and sewer projects also was significant at 15 percent of the total.

Figure 5.4 Distribution of Municipal Bond Investments by Sector



Data Source: Schedule D, Annual Statement filings (NAIC). Data are from 2019.

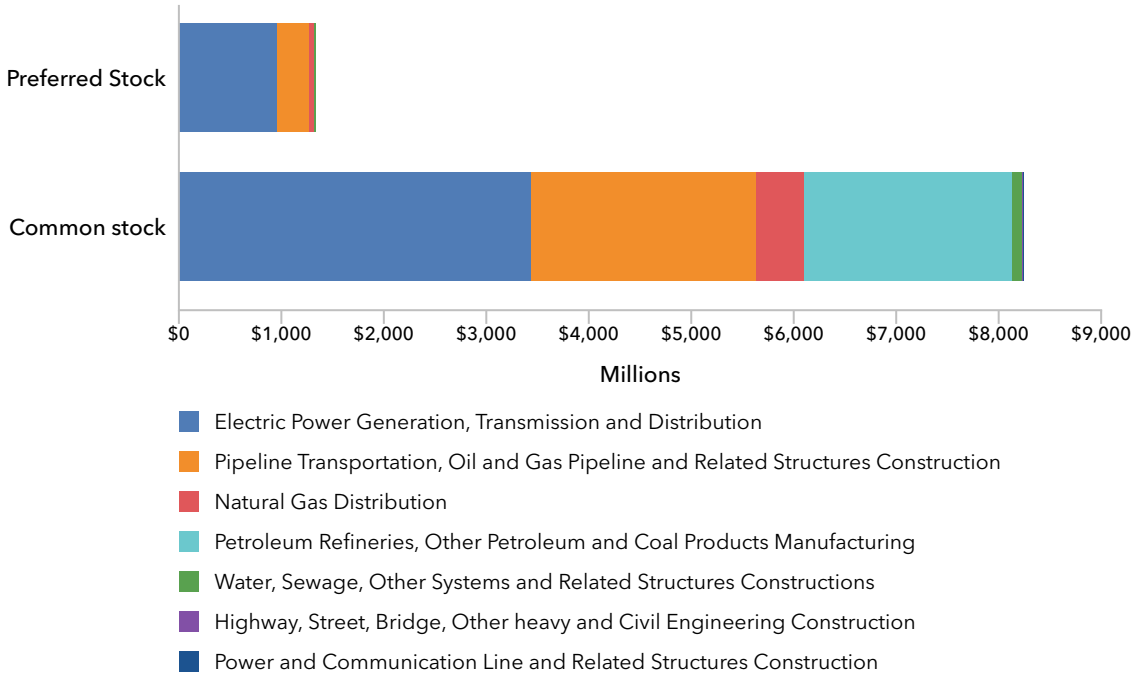
5.3 Equities

Equity holdings: that is, shares of common and preferred stock of public companies, were calculated in a similar fashion to our calculation of corporate bond holdings. A preferred stock share is essentially a hybrid between a common stock share and a bond. Preferred shareholders receive priority over common share owners in the payment of dividends, making them similar to a fixed income investment, although the payment is not guaranteed. Preferred shareholders also have senior rights over common stock holders to liquidated assets in bankruptcy.

Similar to corporate bonds, virtually all of equity holdings of companies involved in economic infrastructure were in the broad energy sector.

Stock holdings were drawn from Schedule D of the Annual Statement. The primary NAICS code was identified through the CUSIP number of each stock held, and, as with corporate bond holdings, we entered equity holdings with NAICS codes fitting our definition of economic infrastructure into the overall calculation. As illustrated in Figure 5.1, equities accounted for only $9 billion of insurance industry assets invested in economic infrastructure (1.6%), most of which ($8 billion) was in common stock. Similar to corporate bonds, virtually all of equity holdings of companies involved in economic infrastructure were in the broad energy sector (Figure 5.5). Overall, the energy sector has inferior credit performance compared with other infrastructure sectors, but better than NFC generally.

Figure 5.5 Total Equity Economic Infrastructure Investments by Major Sector

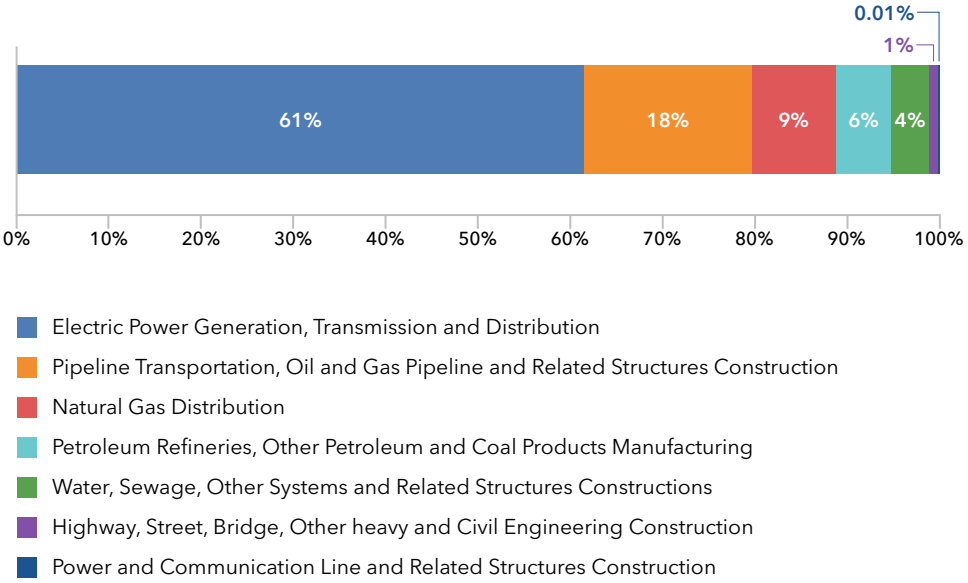


Data Source: Schedule D, Annual Statement filings (NAIC). Data are from 2019.

5.4 2020 Update

While we did not have complete data for 2020 at the time of writing, we can offer some insights. Most notably, total industry investment in infrastructure-backed corporate bonds increased 8 percent to about $446 billion. The distribution across sectors was roughly the same as in 2019; that is, substantially dominated by the energy sector (Figure 5.6). Equities, already a small part of total insurance industry investment continued to dwindle, to about $5.6 billion in common stock and only a negligible amount in preferred stock.

Figure 5.6 Corporate Bond Investment in Infrastructure by the Insurance Industry (2020)



Data Source: Schedule D, Annual Statement filings (NAIC). Data are from 2019.

Section 6: Regulatory Treatment of Infrastructure Investments

One way to encourage specific types of insurance company investment behavior is to provide favorable risk-based capital (RBC) treatment for certain investments. That is, state insurance regulators could encourage infrastructure investment by reducing RBCs on assets financing economic infrastructure. Internationally, there has been increased use of more flexible regulatory guidelines to incentivize the insurance industry to help achieve public policy goals.[57] Currently, fixed income RBC charges are assessed based on an NAIC 1-6 designation, which is driven by a security's NRSRO rating (nationally recognized statistical rating organization) or NAIC Securities Valuation Office (SVO) designation. Currently, no differentiation between fixed income infrastructure investments and other fixed income asset categories exists, nor does differentiation exist for any equity investments. Infrastructure investments are assessed an RBC based on their NAIC designation. Significant changes to Annual Statement reporting and to the RBC framework would be necessary in order to provide different RBC treatment to infrastructure investments. Because the SVO of the NAIC has assigned NAIC designations to infrastructure investments, they have the expertise to assess these types of investments and whether changes should be considered to the RBC system.[58]

Significant changes to Annual Statement reporting and to the RBC framework would be necessary in order to provide different RBC treatment to infrastructure investments.

57 Susan Neely, President and CEO of the American Council of Life Insurers. Statement in panel discussion at the 2021 National Association of Insurance Commissioners International Forum. May 26, 2021.

58 Only regulators have the authority to consider and make changes to RBC.

6.1 Preliminaries

The ultimate objective of solvency regulation is to ensure that policyholder, contract holder and other legal obligations are met when they come due and that insurance companies maintain capital and surplus at all times as required by statute to provide a margin of safety for potential claimants. Statutory accounting guidance determines the schedule (e.g., Schedule D) on which an investment is reported. The completed schedule is used to determine the RBC for an investment, depending on its NAIC designation. The accounting treatment, the assignment of NAIC designations and the RBC charges for infrastructure investments are the same as those for other like-rated debt and equity securities.

6.2 Accounting Treatment

The Statements of Statutory Accounting Principles (SSAPs) are the authoritative statutory accounting practices and procedures promulgated by the NAIC. They are designed to assist state insurance departments in assessments of the solvency of insurance companies. Because the regulator's ability to effectively determine financial condition using financial statements is paramount in importance to the protection of policyholders, an accounting model based on the concepts of conservatism, consistency, and recognition is essential to proper statutory financial reporting.

The SSAPs provide specific requirements for an investment to be considered an admitted asset, as well as guidance on the annual or quarterly statement schedule on which an investment is reported.[59] Infrastructure bonds are typically reported on Schedule D, Part 1 at book adjusted carrying value, while infrastructure equity investments are reported on Schedule D, Part 2 at fair value. Infrastructure investments that do not fit the reporting requirements for Schedule D are usually reported on Schedule BA.

6.3 NAIC Designations

NAIC designations describe a credit quality-risk gradient from highest quality (least risk) to lowest quality (greatest risk) and elucidate credit risk. While there are some exceptions, investments that have been assigned a credit rating by a NRSRO are identified by the SVO as filing-exempt (FE) securities. The SVO assigns an equivalent NAIC designation to an FE security based on the second lowest NRSRO credit rating. Insurers purchasing investments without NRSRO credit ratings are required to file those purchases with the SVO to obtain NAIC designations, as required by state law.

59 "Admitted" assets must be reported in financial statements.

The SVO has developed transparent review standards, analytical criteria, and methodology for assigning NAIC designations to unrated infrastructure debt investments, particularly power generation and renewable energy projects. The following case study provides insights into how the SVO evaluates the credit risk of infrastructure projects.

SVO Infrastructure Case Study

Dimitri Nikas, SVO Senior Analyst

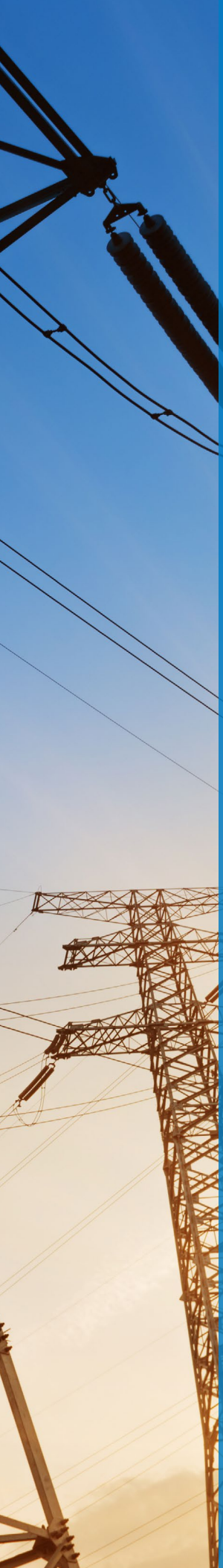
One of the prime examples of infrastructure assets that meet all the characteristics outlined in the study are power plants that generate electricity using either fossil fuels (coal, natural gas, oil) or through renewable forms of energy (wind, solar, hydro, geothermal). Power plants are large physical assets that have long operational lives and require a significant capital investment upfront as well as on an ongoing basis for maintenance. Moreover, power plants provide electricity, an essential service in today's economy, which in turn provides a positive economic impact in the area where the asset is located not only through the provision of electricity, but also through the creation of jobs to maintain and operate the plant. Finally, a power plant is not easy to replicate given the large number of permits and approvals that are necessary even before construction begins.

Regulated utilities fund the construction of power plants usually on balance sheet since the existence of regulation provides for higher earnings and cash flows as the company's regulated asset base grows through capital additions. The credit profile of the plant is then intricately linked to the credit profile of the parent. For companies without the benefit of regulation, power plant construction is often funded in a project finance manner that brings certain benefits to the project sponsor/owner.

In a typical project finance transaction, the issuer of the debt has a contractually finite life (i.e. the tenor of the debt) even though the asset itself can often exist for far longer. The scope of operations is limited (i.e. produce electricity) and construction risk exists during the initial phase only. The project funds the construction of the assets through a combination of equity contribution by the sponsor and through the issuance of debt that is secured by all project assets. Sponsors, typically, invest a modest amount of equity and fund the balance of the investment through debt, such that if the project underperforms the sponsor's losses are limited, while if the project performs to expectations, the sponsor's returns are significant. More often than not, a project will enter into a long-term contract to sell the electricity produced to a third party, ensuring revenue and cash flow stability. Importantly, cash flows to the sponsor are always residual and only after the project pays all expenses, especially operating expenses, maintenance, and debt service. In order to provide control and oversight, project financed transactions include multiple agreements that govern all aspects of the project's operations and provide protection to lenders.

How the NAIC Evaluates the Credit Risk of Infrastructure Projects

The NAIC's Securities Valuation Office designates project financed power generation transactions based on an approach that determines a project's risk assessment and combines it with a project's actual or expected financial performance as captured by the debt service coverage ratio (DSCR) or the net present value of cash flow to debt ratio (NPV/Debt).



To assess a project's risk, we:

1) evaluate the project's cash flows over the tenor of the notes to determine their composition and predictability;
2) analyze the project's competitive position within the market of operation and any off-take agreements in place;
3) assess the project's technology and operating risks; and
4) consider the project's financial profile through a review of its key financial metrics [debt service coverage ratio (DSCR) or net present of cash flow to debt (NPV/Debt)], its liquidity and reserve accounts, and the overall transaction structure including the existence of refinancing risk and structural subordination.

More specifically, in designating a project we start by examining the impact of construction risk. Construction risk, if applicable, is usually tempered when the contractor has significant construction experience and a strong financial position, and the construction contract is structured in a way to minimize or eliminate the impact of increasing costs to the project sponsor while providing a reasonable schedule and budget. Construction risk is also tempered when the actual construction is relatively simple, such as when building a fixed-tilt solar farm in contrast to building an offshore wind farm in an inhospitable environment.

We then consider the impact of the technology employed and the reliability of the resource used to generate electricity. Projects that rely on new technology with little operating history, either domestically or internationally, tend to be at a disadvantage, although actual favorable operation over time can change this assessment. At the same time, a reliable and predictable wind or solar resource or fuel that is purchased through a long-term agreement with fixed pricing, can improve the reliability of the project's cash flow generation.

Projects rely on an operator with enough experience to address operational and technical issues as they arise and to perform regular maintenance to ensure optimum operation. The project benefits when the operator can be easily replaced since that would indicate that there can be competition for the services provided. The project also benefits when the operator's compensation is based on the project achieving certain operational results while the operator is subject to financial penalties for underperformance. Although the penalties are often limited to the maximum of the operator's annual total fee and are unlikely to cover a significant amount of the project's lost revenue, the existence of penalties can motivate an operator to maintain high levels of availability and performance. Importantly, projects also benefit when operations and maintenance (O&M) costs, both scheduled and unscheduled, are funded through an arrangement with fixed pricing which limits the project's exposure to runaway costs.

Most projects with favorable risk attributes, in general, have one or multiple off-take agreements with creditworthy counterparties to purchase all the electricity produced, often for terms that match the tenor of the outstanding debt. Such an arrangement benefits a project's credit profile because it ensures a steady revenue stream at known prices and eliminates the variability and unpredictability associated with sales into the spot market. At the same time, many off-take agreements require certain minimum levels of project availability and electricity production over a specific time frame, affording some protection to the off-taker. More flexible and generous performance terms tend to benefit a project's risk profile since it can continue to receive payment even if its availability and production are below the base case assumptions or expectations.

The last set of factors we analyze in assessing a project's risk attributes relate to the structure of the transaction. Since project sponsors can be companies with non-investment grade credit profiles, strong bankruptcy remoteness and

legal separation provisions can enable a project to be rated higher than its parent/sponsor. These provisions mandate that even though a parent/sponsor may own 100% of the project, they do not necessarily have unfettered access to the project's cash flows through clearly articulated depositary accounts and cash flow waterfalls that can preserve the project's standalone credit profile. The sponsor typically receives equity distributions, to the extent excess cash flow is available and only if the project's financial performance meets or exceeds a certain debt service coverage threshold over the prior 12 months and, increasingly, over the next 12 months.

As part of the transaction structure, we also consider the tenor of the debt and whether or not the debt amortizes. Debt that fully amortizes over the term of an off-take agreement leaves the project free to generate cash flow for the sponsor, whereas debt that does not amortize results in a bullet maturity at the end of the off-take agreement and can present a refinancing challenge. Because projects do not typically have access to the capital markets, they make allowance for liquidity through the creation of a debt service reserve account that can be accessed to pay for debt service in the event of revenue disruption. A standard debt service reserve will contain the next six months of debt service or the maximum six months of debt service and be funded either in cash, through a letter of credit facility or through a guaranty from the sponsor. A cash funded debt service reserve prevents the creation of additional project debt.

Having determined a project's overall risk assessment, we then analyze its financial performance through an average DSCR or the NPV/debt ratios. For any given designation, a stronger risk assessment can offset a weaker financial profile and vice versa. In analyzing and comparing a project's DSCR against that of other projects, we aim for consistency, ensuring that we consider DSCRs among amortizing projects or non-amortizing projects, noting that the two are not directly comparable. We also consider various sensitivities, recognizing that the majority of projects do not always perform according to the base case expectation.

Solar Power Transaction Example

An example of a recently designated transaction was for a solar powered facility in Texas with 110MW of generating capacity. The facility reached commercial operation in 2016, has established some operating history and therefore today has no construction risk. The photovoltaic panels used are polycrystalline silicon modules from two different suppliers and the particular models have been widely used in other installations. The panels feature standard equipment warranties (10-year product warranty and 25 year linear peak power warranty with 80% nameplate capacity production). Similarly, the inverters used are from a well-known supplier and feature standard five-year product warranties. The PV panels are installed on single-axis trackers which are cost effective and reliable with simple operation. As part of the initial due diligence, the independent engineer completed a resource assessment by utilizing actual site data for the past several years and the sponsor determined the total amount of debt based on the results of the resource assessment. Moreover, since the project has been in operation since 2016, it has established some operating history which confirms the original resource assessment. The project had entered into a long-term contract with a creditworthy off-taker through 2041, matching the tenor of the amortizing debt and ensuring revenue predictability. The off-take agreement includes a fairly standard and, likely, achievable performance threshold (70% of the contract year expected metered output) which still requires that the project compensate the off-taker for production short-falls under certain circumstances. Importantly, the agreement does not allow the off-taker to curtail output from the facility for reasons other than emergency, ensuring that the project receives revenues as long as it is producing electricity.

The O&M provider is an affiliate of the sponsor, which is relatively common, although the

agreement does not guarantee a minimum availability or output and the project pays for all maintenance, scheduled and unscheduled, with cash from operations. The project was financed such that it could achieve an average/minimum DSCR of 1.7x/1.5x over the life of the debt under the base case scenario that includes a P50 solar resource with 0.5% annual panel degradation and availability of 99% (a P50 solar resource scenario means that there is a 50% chance that in any given year production will be at least at the specific amount, resulting in a more generous but less certain amount of production. Under a P90 scenario with 96% availability, 0.7% annual panel degradation, a 2% annual O&M increase through the first 12 years and 15% increase subsequently, the project is expected to achieve an average/minimum DSCR of 1.5x/1.4x. A P90 solar resource scenario means that there is a 90% chance that in any given year production will be at least that specific amount resulting in a less generous, but more certain, amount of production, all else equal. The actual project performance over the past few years has been closer to 1.5x annually, which is consistent with the P90 projections. Despite the favorable solar resource, the project experienced reduced availability due to inverter outages over the past few years and has incurred incremental costs for the related repairs.

Given its overall favorable risk attributes, we assess the project's risk profile as being slightly better than average. We than consider the actual DSCR over the past few years as well as its expected average DSCR under the P90 scenario, with the combination of these factors supporting a designation at the lower end of the investment grade category, or NAIC 2.C. Should the actual DSCR improve over time so that it begins to exceed 1.60x, then we would consider a higher designation by one notch. Conversely, should the actual DSCR weaken so that it approaches 1.30x, then we would consider a lower designation after determining the reasons for the weaker financial performance.

6.4 Risk-Based Capital Treatment

RBC requirements are a tool used by state insurance regulators to ensure the financial safety and soundness of insurance companies. It is the minimum amount of capital deemed appropriate for an insurance entity to support its overall business operations, particularly its capacity to pay future claims, given its size and risk profile. Regulators have the authority and statutory mandate to take preventive and corrective measures designed to prevent insolvencies should a company's RBC level be deficient.

While infrastructure investments' long-term, stable and predictable cash flows are attractive investment characteristics for insurance companies, other important investment considerations such as return on capital might not be as appealing, particularly given current capital requirements. Generally speaking, the current RBC framework—which has been in place since the early 1990's—treats all bonds similarly, with the RBC factors for infrastructure

bonds the same as that for similarly rated corporate bonds and municipal bonds. The same is largely true for equity investments and investments reported on Schedule BA.

Based on comments submitted to the RFI, many industry participants believe the RBC treatment of infrastructure investments should be revised to more accurately reflect credit performance. As noted by RFI respondents and as discussed in Section 5, infrastructure debt generally experiences lower default rates and economic losses than similarly rated non-financial corporates. Furthermore, respondents observed that infrastructure equities typically have more stable cash flows and less volatile project valuations than traditional private equity investments.

RFI respondents also recommended a consideration of how infrastructure investments are treated under Solvency II, whereby infrastructure investments carry lower regulatory capital charges. The framework offers lower capital charges for debt and equity infrastructure investments with certain defined risk characteristics, such as stable cash flows, a robust contractual framework, and stress testing. It also includes "matching adjustment" provisions which allow insurers relief for holding long-term assets against matching long-term liabilities.

Evaluating the suitability of infrastructure investments for insurance companies cannot compromise the core regulatory mission to preserve the solvency of regulated insurance companies and to protect policyholders.

The current RBC framework does not differentiate between the various types of bonds, including for municipal bonds, which have a relatively long-term history of lower default compared with non-financial corporates. While the NAIC's Task Forces and Working Groups have discussed and considered the topic in recent years, capital relief for municipal bonds has yet to be approved.

From a regulator perspective, the RBC framework is not intended to be very granular. As a regulatory tool for identifying weakly capitalized companies, too much granularity could weigh too heavily on the capital structure. Furthermore, making changes to the regulatory framework to incentivize infrastructure investments could risk unintended consequences that could negatively impact solvency regulation. Evaluating the suitability of infrastructure investments for insurance companies cannot compromise the core regulatory mission to preserve the solvency of regulated insurance companies and to protect policyholders.

Section 7: Concluding Comments and Next Steps

Independent reports suggest that the United States is not "making the grade" when it comes to infrastructure, having earned a C- on the 2021 American Society of Civil Engineers' *Report Card on American Infrastructure*. There is general consensus among Americans and American businesses that U.S. infrastructure problems must be resolved. Infrastructure plays a critical role in economic activity, development, and growth.

While efforts to invest more in infrastructure are planned by the federal government, funding faces a potential hurdle, and states may pull back on infrastructure spending as they try to meet the demands of current expenditures under balanced budget requirements. While the net effect on government-financed infrastructure is not clear, it is clear that private investment in infrastructure, or private investment in commercial or government securities issued to fund infrastructure, would enhance current levels of infrastructure investment or reduce the cost of investing in infrastructure.

The U.S. insurance industry appears poised to make additional infrastructure investments under the right circumstances. Insurers have increased their investments in infrastructure in recent years. The goal of the present study is to assess whether the insurance industry could or should do more to help fill the infrastructure gap by shifting some of its investments into assets that finance infrastructure, including corporate bonds, municipal bonds, and equities.

In this report we set out to evaluate the potential for the insurance sector to help fill the infrastructure gap, and our findings suggest that they can.

In this report we set out to evaluate the potential for the insurance sector to help fill the infrastructure gap, and our findings suggest that they can. Infrastructure investments have many qualities that should be appealing to insurers, including long duration, mostly stable and secure cash flows, attractive risk-adjusted returns, and low correlation to other asset classes. We discuss most of these characteristics of Infrastructure investments in this report. Further, (additional) infrastructure investments may lead to a more diversified investment portfolio, particularly if the investment is outside of the fossil fuel energy sector, which we show to be the overwhelmingly dominant sector for insurance industry infrastructure investments.

We argue the market must agree on a common, specific definition of what constitutes infrastructure for insurance company investments, although the definition would be open to interpretation. A clear, specific definition of infrastructure is critical for our purpose so that investments in those assets can be properly assessed as candidates for insurance industry investment. We advance a uniform definition of infrastructure that could be used as a basis for discussions around financial investments in infrastructure within the insurance industry: generally, *economic* infrastructure is long-lived, capital-intensive, large physical assets that provide essential services or facilities to some jurisdiction. The definition largely aligns with the definitions of infrastructure used in the American Society of Civil Engineers (ASCE) infrastructure report card and the Bureau of Economic Analysis' definition of "basic infrastructure" used in its national economic accounts.

We asses financial risks to be lower than for infrastructure debt securities than for non-financial corporate sector debt more generally, which includes infrastructure. Because the comparison group also includes infrastructure, our numbers *understate* the relatively better credit performance of infrastructure bonds. Most striking is the average cumulative default rate for infrastructure bonds over 2010-2019, which was 1.1%, compared with 13.8% for all non-financial corporate bonds. Even within similarly rated groups of bonds, infrastructure outperforms. For example, 0.4% of A-rated infrastructure bonds defaulted over 2010-2019, compared with 1.2% for all non-financial corporate bonds. Moreover, ratings are less volatile for infrastructure debt securities; that is, there are fewer upgrades and downgrades over any period of time. Finally, when there are defaults, recovery rates are significantly higher for infrastructure debt than for all non-financial corporate debt. A potential risk to insurance industry infrastructure bond investments is that portfolios are not diversified. Indeed, 95 percent of the industry's infrastructure bond investments are in the energy sector, broadly defined.

To examine equity performance, we asses the performance of infrastructure funds using data from the Preqin database. Equity performance for the

infrastructure sector is less sanguine. The median internal rate of return for infrastructure funds was 8.8% over 2010-2020, compared with 12.8% for all non-financial corporate funds over the period, and infrastructure fund returns were moderately more volatile. However, in 2019, an overwhelming 98.4 percent of insurance company infrastructure investments were bonds, or $557 billion of a total $566 billion. By comparison, the aggregate balance sheet for the insurance industry in 2019 shows 61.9 percent of invested assets in bonds (internal analysis of NAIC data).

Critically important to insurance industry interest in increased investment in infrastructure is regulatory treatment. The current risk-based capital (RBC) framework—which has been in place since the early 1990's—treats all bonds similarly, with the RBC factors for infrastructure bonds the same as that for similarly rated corporate bonds and municipal bonds. The same is largely true for equity investments and investments reported on Schedule BA. Much of insurance industry respondents to our RFI believe the RBC treatment of infrastructure investments should be revised to more accurately reflect credit performance detailed in this report. Lower capital charges likely would entice increased infrastructure investment. However, the NAIC has been slow to act on changes to the RBC requirements for municipal bonds more generally, which suggests such changes could take some time. As stated in the previous section, evaluating the suitability of infrastructure investments for insurance companies cannot compromise the core regulatory mission to preserve the solvency of regulated insurance companies and to protect policyholders.

The current risk-based capital (RBC) framework—which has been in place since the early 1990's—treats all bonds similarly, with the RBC factors for infrastructure bonds the same as that for similarly rated corporate bonds and municipal bonds.

Returning to the purpose of this report, we present evidence that justifies increased financial investments by the insurance industry in the infrastructure sector. From a policy perspective, the economic performance of the United States could be potentially enhanced by increased infrastructure spending, and as large institutional investors, insurers could make meaningful contributions to infrastructure maintenance and development. Previous financial behavior suggests that any increased financial investment in infrastructure would be in bonds, as equity investments in infrastructure are negligible on balance sheets. And we show that infrastructure bonds, from any perspective, have substantially better credit performance than non-fnancial corporate bonds more generally.

Previous financial behavior suggests that any increased financial investment in infrastructure would be in bonds, as equity investments in infrastructure are negligible on balance sheets. And we show that infrastructure bonds, from any perspective, have substantially better credit performance than non-fnancial corporate bonds more generally.

As for next steps, our hope is that this report sheds light on the possibilities for and implications of increased insurance industry financial investments in infrastructure and will spark conversations throughout the industry, including at the NAIC. Ultimately, keeping in mind the primary importance of safety and soundness in the regulatory domain, we hope for actionable steps to arise from these conversations. Going forward in the research domain, we recognize the nexus of infrastructure and climate concerns, especially given the heavy investment of the insurance industry in the energy sector. The recent experience of the deep freeze in Texas highlights these concerns. Climate change will produce both direct physical and transitional risks. These risks are highlighted in our discussion of the Texas freeze in early 2021, when power loss of the TX grid caused nearly $15 billion in insured losses. In a forthcoming supplement to this report, we will address these climate related risks and what they mean for insurance industry infrastructure investment.