FROM PROJECTS TO PORTFOLIOS

MAINSTREAMING LARGE-SCALE INVESTMENT IN INTEGRATED INFRASTRUCTURE

EARTH ECONOMICS

EXAMPLE OF CURB CUTS| LOS ANGELES, CALIFORNIA

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Special thanks to all who participated in interviews for this project. A complete list of participants can be found in the Appendix.

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The authors are responsible for the content of this report.

EXECUTIVE SUMMARY

URBAN GARDEN | CHICAGO, ILLINOIS

Investment in natural capital and green infrastructure (GI) in American cities is happening at neither the speed nor scale necessary to meet the urgent demands of a rising population, economic growth, and climate adaptation. Speed of adoption and implementation can be accelerated with strategies that consider the complexities of behavior change, innovation adoption, and risk perception alongside procedural and institutional barriers. And the challenges of scale must be met with the development and aggregation of diverse, multi-purpose, community assets worthy of institutional investment as well as with market-based instruments that facilitate the spread of risk-adjusted and performance-based green financing. Ultimately, we are talking about a shift from champions to systems, from a movement to the mainstream, and this is no small task. It will require action from the individual to the societal level, and it will require rethinking not only how government delivers services, but how communities receive and benefit from them. Evidence from the public sector as well as private markets indicates this shift is underway, and if we effectively leverage the advancements that have already been made, we can ensure that our nation's infrastructure maximizes public benefits by delivering critical services, improving quality of life, and ensuring a prosperous future for generations to come. But this will require bold leaps rather than baby steps, decisive action at all levels, clear commitments to common goals, and a highly coordinated approach.

KEY TAKEAWAYS

1 **We need to shift our focus from supply to demand.**

The national conversation about barriers to green infrastructure implementation has centered largely on the supply side, from operational difficulties to the transactional obstacles imposed by governance. While these concerns are legitimate, we need to begin focusing on the demand side of the issue. Few things shift political will more consistently than public demand. If we want to get around the supply-side roadblocks currently in the way of implementation, we need to start investing in building demand through awareness raising and education.

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2 **If we want to get to scale, we need to develop policies that push us there.**

While "top-down" approaches are frequently described as unpopular, our research shows unequivocally that regulation has a strong, positive impact on investment in green infrastructure. It is also one of the most effective means of ensuring that it isn't the pet project of a single administration but part of standard operating procedures that all municipalities are held accountable for.

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3 **The capital is out there, but it is not being matched with appropriate investment opportunities.**

Cities need to deliver assets at the scale that attracts investors, and investors need to make their demand for such assets more widely known. This is a two-way disconnect.

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4 **Municipalities need to change the way they do business, and they will require help from the private sector, NGOs, academia, and the public.**

Government needs to incentivize innovation and efficiency; citizens need to be more informed and more engaged; and both the private sector and the philanthropic community need to pioneer more strategic investment relationships with the public sector.

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5 **GI has a perception problem that is being perpetuated by both detractors and proponents.**

As long as it is presented and viewed as being based in ideology rather than reality, it will never be mainstreamed. Green infrastructure is real infrastructure that performs as well as or better than many of its grey counterparts on both cost and service delivery. It's time to stop debating this point and start making it the pillar of the conversation. In some cases, that may require dropping the word green altogether.

URBAN PARK | NEW YORK CITY, NEW YORK

RESEARCH METHODS

This report is the product of 10 months of interdisciplinary research conducted from January through October of 2018. The research design encompassed the following core activities. More detailed methodologies and data can be found in Appendix A.

INTERVIEWS

We conducted in-depth phone and in-person interviews with 29 municipal practitioners representing a variety of functional roles (e.g. engineers, project managers, attorneys, budget officers, etc.) from 20 US municipalities. We also interviewed 8 topical experts (some of whom are former municipal practitioners) from academia, NGOs, and the private sector, as well as 6 philanthropic funders, for a total of 43 cross-functional interviewees

LITERATURE REVIEW

We examined the academic, grey, and professional literature on green infrastructure funding, financing, costs, performance, and implementation. We also studied the academic and professional literature on organizational change, behavior change, risk perception, and innovation adoption.

OPERATIONAL SURVEY

We reviewed organizational charts, planning processes, and decision flows for numerous cities, not limited to those included in the interviews.

FINANCIAL ANALYSIS

We analyzed the current state of infrastructure dollar flows from a variety of sources – from the federal transportation budget to the green bond market – and used our calculations to identify viable opportunities for expansion.

GEOSPATIAL SURVEY AND ANALYSIS

Using public data as well as data provided by partner cities, we surveyed the existing geospatial data on green infrastructure assets in order to understand the level at which they are currently tracked and managed and to help visualize both scale and function.

ECONOMETRIC ANALYSIS

Upon identifying it as a critical gap in the current literature, we conducted our own empirical analysis of the drivers of green infrastructure investment among a sample of nearly 3,000 American cities. Our findings are crucial to both validating our recommendations as well to making clear the need for more empirical analysis in this field.

FEEDBACK SESSIONS

After identifying the key themes and preliminary actions that would define a blueprint for increased investment in green infrastructure, we hosted 4, hour-long, participatory webinars with interview participants. A digital version of the webinar was provided to those who could not attend, and all were given a period of at least one week to submit their feedback for incorporation.

INTRODUCTION

This report is the culmination of months of research and incorporates extensive conversations with practitioners and volumes of diverse literature and data. The blueprint itself synthesizes this research into actionable steps – from the individual to the societal – that must be taken to get where we need to be in regards to growing our urban portfolios of green infrastructure assets to scale. Cities will prioritize these steps differently based on where they are in the process, and, as the report illustrates, the process of implementation is non-linear. In many ways, this work will look different across individual cities, but the basic truths and foundational steps remain the same.

Green infrastructure is a broad term that describes the use of natural elements in order to mimic nature's systems for the delivery of critical services like air purification, water filtration and conveyance, and hazard mitigation. From open space conservation to permeable pavement installation, there are many tactics for pursuing nature-based solutions. Mainstreaming diverse green assets as part of a comprehensive capital planning process that attracts large-scale investment across US cities is a major undertaking that requires a rethinking of how our government delivers services. Such significant innovation within entrenched public systems will surely pose diverse challenges at all levels, but meeting these challenges with bold action centered in shared commitments promises outsized rewards for generations of Americans. It is precisely this scale of reimagining government that our systems are borne from, and there is evidence that this shift is already underway. However, it will require participation from private industry, the philanthropic community, academia, and the general public in order to be truly successful. While it is the government's mandate to deliver services that promote the success of our communities and our economy, it is clearly in everyone's interest to contribute diverse expertise and resources to ensure that it succeeds.

HOW TO USE THIS REPORT

The report is composed of 3 major sections and aims to be direct, practical, and at least somewhat customizable in its application. For nearly all sections, additional detail is included in the appendix.

The report begins with an overview of general public infrastructure spending. This helps to frame the conversation around increasing green investment and is meant to be useful to a general audience. It discusses where we are, where we want to be, and how to get from the former to the latter in regards to more sustainable and effective infrastructure investment.

This section is followed by The Blueprint for Increased Investment in Green Infrastructure, which is intended primarily for municipalities to engage with and act upon directly, hence the use of the second person voice in the steps to be taken. No two municipalities are the same in their operations, fiscal realities, political climates, or level of experience with green infrastructure, and thus it is incumbent upon readers to prioritize efforts in light of their respective circumstances. The Blueprint is organized under 5 major shifts, each with a set of accompanying actions. Following each set of actions is a set of resources for accomplishing them. Resources range from case studies to calculators to visualizations to external links.

The Blueprint section of this digital PDF is live! Whenever you see something like this: 🔗 Earth Economics Online Resource Center, click to be taken to an online database, tool, or resource.

The Blueprint is followed by a set of recommendations for the philanthropic community to strategically engage with the process. Because these recommendations are structured according to the Blueprint, it is recommended that those interested in this section read the Blueprint, as well.

URBAN ROOFTOP GARDEN | NEW YORK CITY, NEW YORK

PUBLIC INFRASTRUCTURE SPENDING

WESTWOOD HILLS NATURE PARK| ST. LOUIS, MISSOURI

WHERE WE ARE

INFRASTRUCTURE SPENDING STREAMS AT A GLANCE

Infrastructure projects are funded at the federal, state, and local levels, and it's no secret that they are under-funded. Total annual public spending on infrastructure ranges from $375 billion - $450 billion per year,[1] with federal spending accounting for only about a quarter of that.[2] The majority of infrastructure funding comes from states, counties, cities, and towns, but these local infrastructure spending streams are more diverse and less easily tracked than federal expenditures.[3]The two (federal and other) funding streams are generally directed to different ends: federal funding is typically used for development of new infrastructure projects, while state and local funding is more often allocated to operations and maintenance of existing infrastructure. While this would indicate that the federal government needs to take the lead in funding new green assets, that currently appears unlikely. States and cities will need to find ways to access these dollars at the local level.

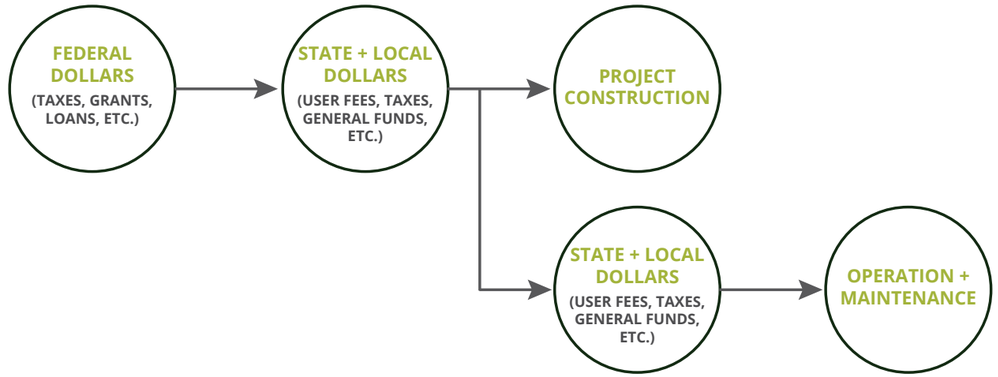

Figure 1. Current Infrastructure Spending Stream

While federal and state dollars alike help to fund project construction, operations and maintenance spending occurs solely at the state and local levels and puts significant pressure on local infrastructure budgets.

EXPENDITURES BY SECTOR

FEDERAL SPENDING

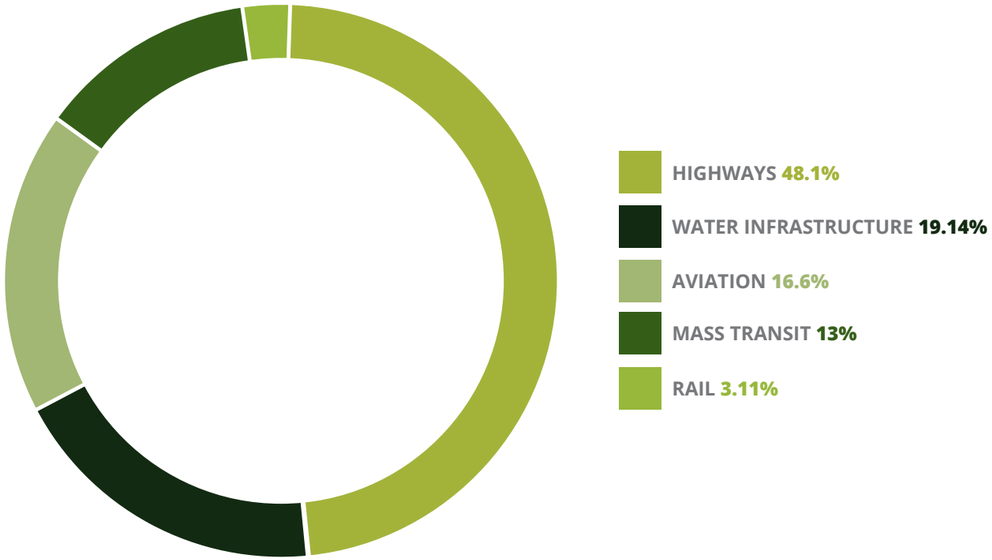

*Figure 2. Federal Expenditure by Sector**

The federal government funds infrastructure through direct investment and through grants and loans to state and local governments. 65% of federal expenditure is distributed through state and local grants and subsidized loans, largely to fund roads and highways.[6,7] Federal funding is primarily allocated to the transportation sector, with the largest allocation going to highways.[8] The vast majority (up to 90%) of federal highway funding is generated by gas and vehicle taxes, and the remainder is funded through general fund appropriations. The federal fuel tax is the primary driver of this funding source, and fuel tax revenues are collected and dispersed as grants from the Highway Trust Fund (HTF).[9] The HTF revenue source has diminished significantly in recent decades as a result of increased vehicle fuel efficiency and the political nature of taxing fossil fuels in the United States. The so-called "gas tax" is not tied to inflation and has remained at $.18 per gallon of gas and $.24 per gallon of diesel for nearly three decades. Raising the gas tax is a hotly politicized issue that is unlikely to gain traction anytime soon, and thus the primary source of federal infrastructure funding is increasingly insufficient to cover annual outlays.[10]

STATE + LOCAL SPENDING

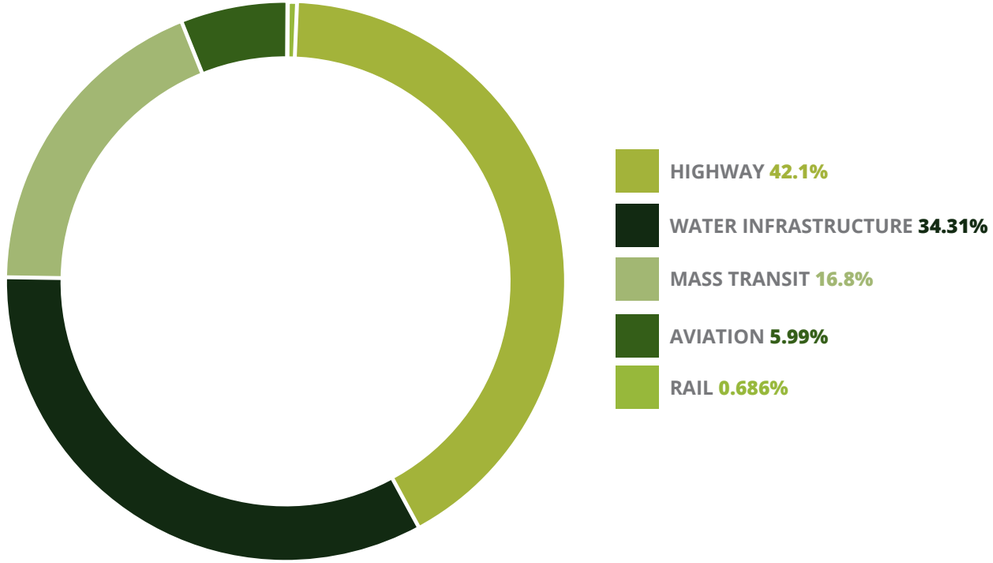

*Figure 3. State and Local Expenditure by Sector**

While substantially more state and local dollars are directed toward water infrastructure, highways and roads still comprise the largest portion of spending. And, as federal funding of this sector decreases, state and local streams have to compensate. This puts significant strain on other sectors and requires state-level measures like tax increases.[11] Approximately 40% of state and local roadway funding comes from gas and vehicle taxes. Gas and vehicle taxes are almost always levied at the state level and are rarely used as a city- or county-level funding mechanism. Additional sources of revenue include tolls, taxes, investment income, and general fund support. General fund support is especially significant at the local level.[12] Water infrastructure funding is sourced primarily from user rates and fees.

**These charts display allocation proportion only. Total state and local infrastructure spending is nearly four times total federal infrastructure spending.*

GREEN INFRASTRUCTURE SPENDING

The percent of total infrastructure that is developed as green infrastructure is largely unknown, pointing to a significant need for comprehensive asset tracking and management. Although total green infrastructure investment in not tracked, data on green bonds can serve as a useful tool to estimate trends and scale of green infrastructure investment. Small-scale green infrastructure projects are funded in a variety of ways, which are not captured by green bonds issuances. Large-scale green infrastructure investments are primarily funded through either state revolving fund (SRF) infrastructure banks, or directly through municipal bonds.[13] Many states issue bonds to fund a portion of their infrastructure banking activities, so both financing streams are partially captured by the issuance of green bonds. It is important to note that measuring green infrastructure investment and implementation levels with green bonds data still provides a significant underestimate of totals, because many infrastructure projects are not funded through bonds, but it is nevertheless a useful tool to approximate the market. Based on a review of green bond issuances,[14] green infrastructure appears to comprise a minimum of 2% of total expenditure.

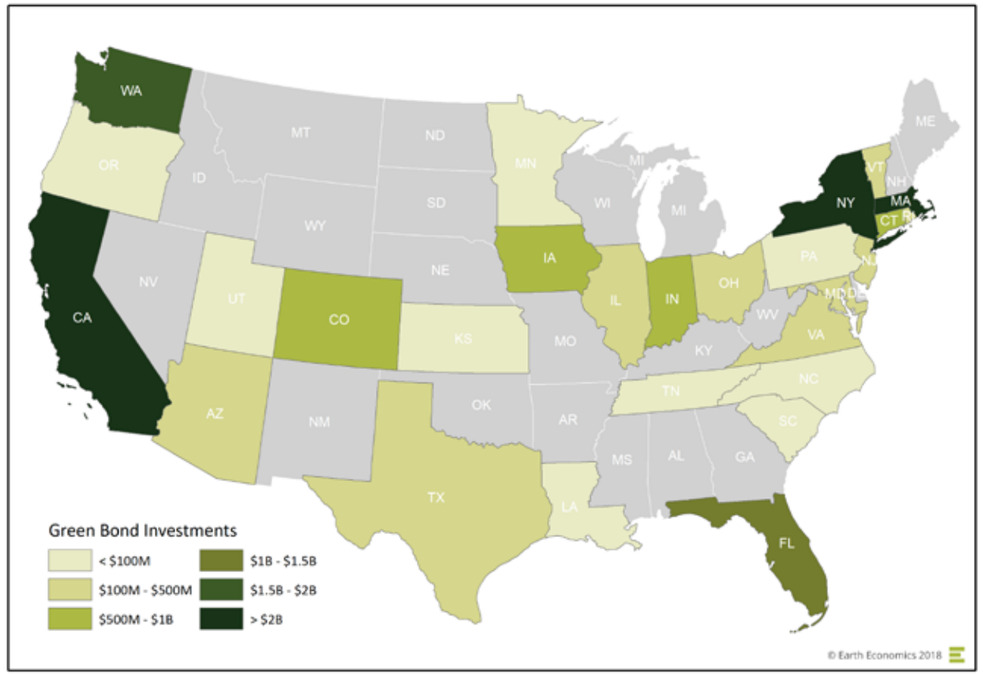

Figure 4. Green Bond Levels, by State

The map above displays the significant variation in green bond levels among US states based on issuances recorded since 2013 in the Green Bonds Database.

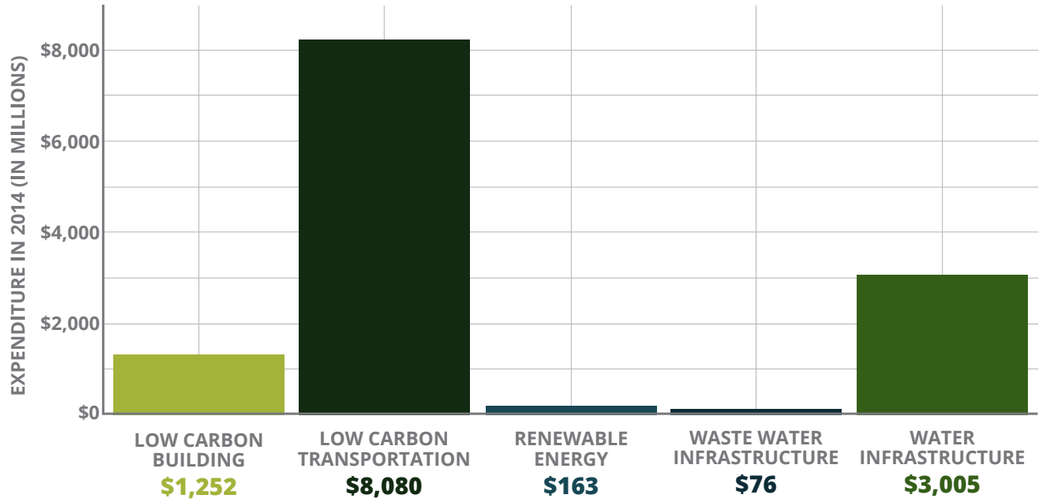

Figure 5. Green Bond Levels, by Asset Type

The chart above displays the significant variation in green bond levels among various green asset types based on issuances recorded since 2013 in the Green Bonds Database.

More than 160 green bonds have been issued in the US since 2013. These bonds are issued by municipalities and municipal agencies, educational institutions, utilities, and state agencies. Although green bonds are not a formally defined class, the majority of issuances are used to finance low-carbon transportation, water infrastructure, and energy-efficient building construction.

Most green infrastructure projects, particularly green stormwater infrastructure (GSI), are installed at the local level. A survey conducted by the American Society of Landscape Architects (ASLA) in 2012 found that 68% of all green infrastructure projects receive at least partial funding from local, public sources.[15] Centralized, natural water collection projects (such as bioswales, rain gardens, and retention ponds) are most common.[16] Stormwater capture projects were installed predominately at educational institutions and open space areas.[17] Over half of projects were developed to meet a local ordinance, and only 25% of projects were reported to ASLA as having increased costs for the project owner. Nearly half of GI projects provided cost savings over grey alternatives, and the rest were cost neutral.[18]

GREEN INFRASTRUCTURE INSTALLATIONS

INSTALLATION TYPE

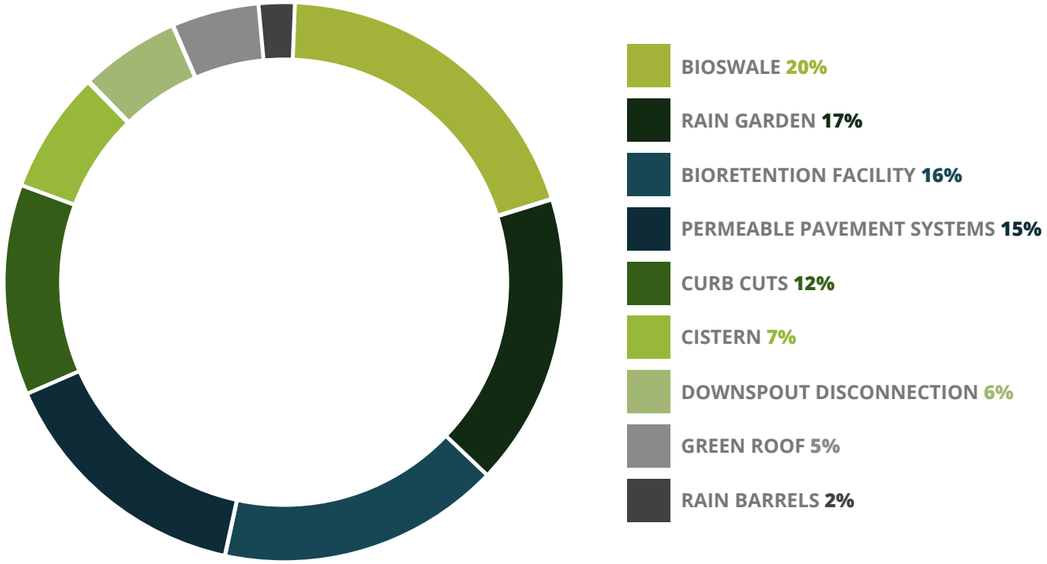

Figure 6. Distribution of Green Infrastructure by Asset Type

As the chart above shows, natural retention and infiltration assets make up the majority of green asset types in US cities. Such assets are used to address stormwater capture, water quality, and water scarcity issues.

INSTALLATION LOCATION

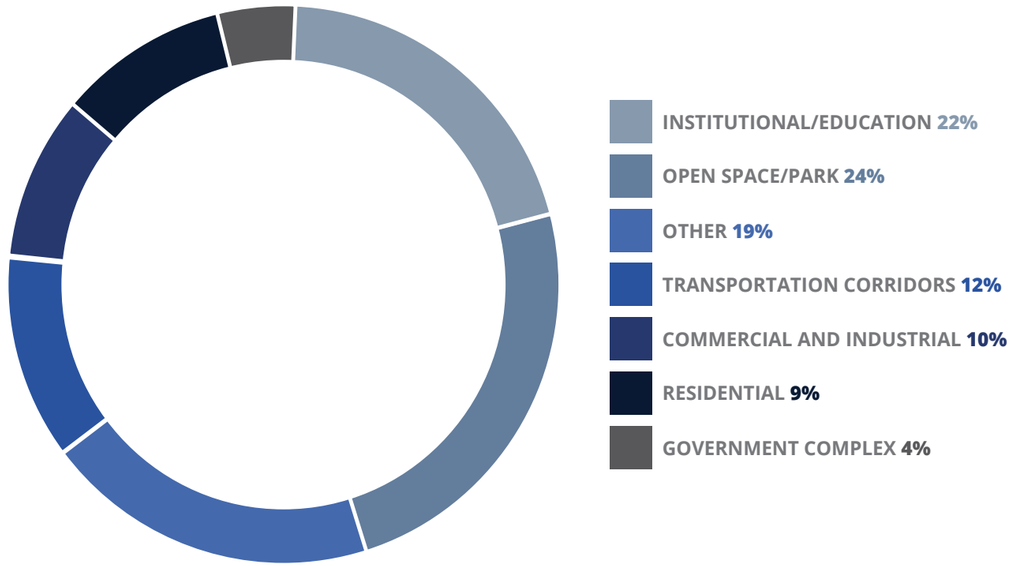

Figure 7. Distribution of Green Infrastructure by Installation Location

Institutions (e.g. educational) and parks are home to nearly half of GI assets in US cities. The chart above makes clear the opportunities to expand installation to other sites, like transportation corridors and private property.

WHERE DO WE WANT TO BE?

DEFINING SCALE

In general, when we talk about scale, we are talking about solutions that can deliver real impacts to the extent that is required by the challenge/s being addressed. So, the scale of the solution is defined by the problem. The complexity and magnitude of climate change cannot and should not be understated, but this makes it especially difficult to gauge and plan a response. It will require enormous levels of awareness building, investment, and collaboration around multi-purpose solutions, because it is a multi-faceted problem. Because it is multi-purpose by nature, green infrastructure addresses a wide range of society's most pressing issues, like critical service delivery for a growing population, disaster preparedness and resilience, and climate adaptation.

Scale can refer to actual land area, persons served, proportion of service delivery, boundaries of governance, and/or levels of investment, among other things. It is critical to address them all, and we do so in this report, at least to some extent. Throughout this report, we frequently use the term scale in relation to investment levels in green infrastructure. However, even this seemingly narrow definition entails inherent complexity and nuance. Investment level can be measured as a dollar amount or as a proportion of total investment. It is necessary to discuss both in order to paint a more comprehensive picture and determine the most broadly applicable takeaways. While institutional investors will certainly be targeting specific, minimum dollar amounts (to the tune of $100 million), budgetary realities vary widely across municipalities, and this may be best captured by proportionality.

THE BENEFITS OF SCALE

The primary benefit of scale is the ability to meet challenges at the level required for real impact, but scale offers myriad inherent benefits that are otherwise unrealized. The economies of scale are well understood and do not require detailed explanation here, but it is worth pointing out that greater implementation of green infrastructure opens the door to shared budgets and resources that increase efficiencies and marginal returns on investment. In short, scale enables the most efficient and cost-effective delivery of the best possible services and products to the most people. This is especially true for large, slow-moving, highly regulated, and bureaucratic organizations like municipalities, because it can minimize costly redundancies. In addition to cost savings and efficiencies, scale allows for the distribution of risk. A sense of shared responsibility is critical to addressing perceived risk (which has been demonstrated to have greater impacts on decision making than actual risk[19]), and deeper pools of both human and financial capital address actual risk in a number of ways. And, as will be made increasingly clear throughout this report, scale is the sole pathway to sustainable revenue streams for green infrastructure, as part of a large-scale, integrated infrastructure plan.

In addition to the economic, procedural, and logistic benefits of scale, the social, environmental, and service benefits of green infrastructure are only fully realized when assets comprise a diversified, comprehensive, service-delivery system. A single rain garden is sufficiently functional for an individual homeowner or as an educational tool for a neighborhood, but a district-scale network of various green assets as part of an integrated capital and community development plan is required to deliver the diverse outcomes necessary to meet city-scale adaptation goals that ensure prosperous, livable communities for generations to come.

WHY AREN'T WE THERE YET?

From a lack of case studies to organizational siloing to individual asset maintenance, much has been written about the stated barriers to implementing green infrastructure. However, if we truly want to get to scale, we also need to shine a light on the larger issues that are driving or impeding the practice. We have identified the following primary issues that are hindering large-scale implementation, and, where the necessary data exists, we confirmed with empirical analysis.

1 **We need to shift our focus from supply to demand.**

The national conversation about barriers to green infrastructure implementation has centered largely on the supply side, from operational difficulties to the transactional obstacles imposed by governance. While these concerns are legitimate, we need to begin focusing on the demand side of the issue. Few things shift political will more consistently than public demand. If we want to get around the supply-side roadblocks currently in the way of implementation, we need to start investing in building demand through awareness raising and education.

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Cities need to deliver assets at the scale that attracts investors, and investors need to make their demand for such assets more widely known. This is a two-way disconnect.

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As long as it is presented and viewed as being based in ideology rather than reality, it will never be mainstreamed. Green infrastructure is real infrastructure that performs as well as or better than many of its grey counterparts on both cost and service delivery. It's time to stop debating this point and start making it the pillar of the conversation. In some cases, that may require dropping the word green altogether.

ADDING IT ALL UP

In our literature review, we determined that no econometric analysis of the determinants of green infrastructure investment data exists. In other words, there has been no empirical examination of what is truly driving and impeding investment in green infrastructure among American cities. So, we conducted one using investment levels in urban tree canopy among cities across the United States. Trees are a popular green infrastructure asset, so the sample is large, and the data is representative of diverse geographies, populations, and politics, allowing for robust analysis of determinants. This analysis allows us to mathematically pinpoint the determinants of investment and compare what we (and others) are hearing in our interviews with what the data reveals to be true. While it is clearly constrained by the limitations of available data and a focus on a single asset type (for example, New York City is a moderate investor in tree canopy but a major investor in green infrastructure overall), our model provides reasonable proxies by which to identify some general trends. This analysis sheds light on both the measurable drivers of investment behaviors as well as the fact that much more econometric research is needed in this area.

We obtained tree canopy investment levels from the year 2017 for nearly 3,000 US cities from the Arbor Foundation. This dollar amount included both new planting and ongoing maintenance of existing canopy. We then tested the effects of various decision-making variables in a linear regression model. The model identifies both the strength of a variable's impact on investment levels as well as the magnitude of the investment effect. In other words, it tells us how strongly a factor weighs on investment decisions and by how much it changes overall investment levels (as a percentage). The variables we used represent geographic and environmental conditions, political leanings, political cohesion, education, earnings, employment level, funding mechanisms, regulation, as well as debt and risk levels. Our analysis showed that the greatest drivers of investment are as follows:

POSITIVE DRIVERS OF INVESTMENT IN ORDER OF IMPACT ON INVESTMENT LEVEL

Variable	*Effect*	*Conclusion*
Education Level	8%	More knowledge leads to greater investment
Employment Level	3%	More employment leads to greater investment
Has Stormwater Utility	1%	Dedicated revenue leads to greater investment
Has Sewer Discharge Violation	1%	Regulation leads to greater investment

NEGATIVE DRIVERS OF INVESTMENT IN ORDER OF IMPACT ON INVESTMENT LEVEL

Variable	*Effect*	*Conclusion*
% of People who Walk to Work	-6%	*Greater density/urbanization leads to less investment
State Voters Lean Republican	-3%	Conservative governments invest less

While it represents investment in only a single green infrastructure asset type, the data supports much of what was discovered in interviews. Knowledge is the single most important factor in increasing investment levels. However, we should note that our variable captures education levels, which is likely a proxy for both general awareness and also professional skills and expertise. The presence of a stormwater utility and higher employment levels (i.e. tax base) suggest the critical nature of establishing dedicated, sustainable revenue streams. And the strong response to water discharge violations underscores the importance of regulation; though its investment effect was somewhat modest, its impact on decision making was very strong. While "top-down" approaches are generally seen as unpopular, in all of our interviews, there was no city that was pursuing expanded green infrastructure implementation absent some kind of regulatory driver. Thus, it seems highly likely that increased investment can be most successfully spurred by increasing knowledge, mainstreaming GI revenues, and enacting regulation.

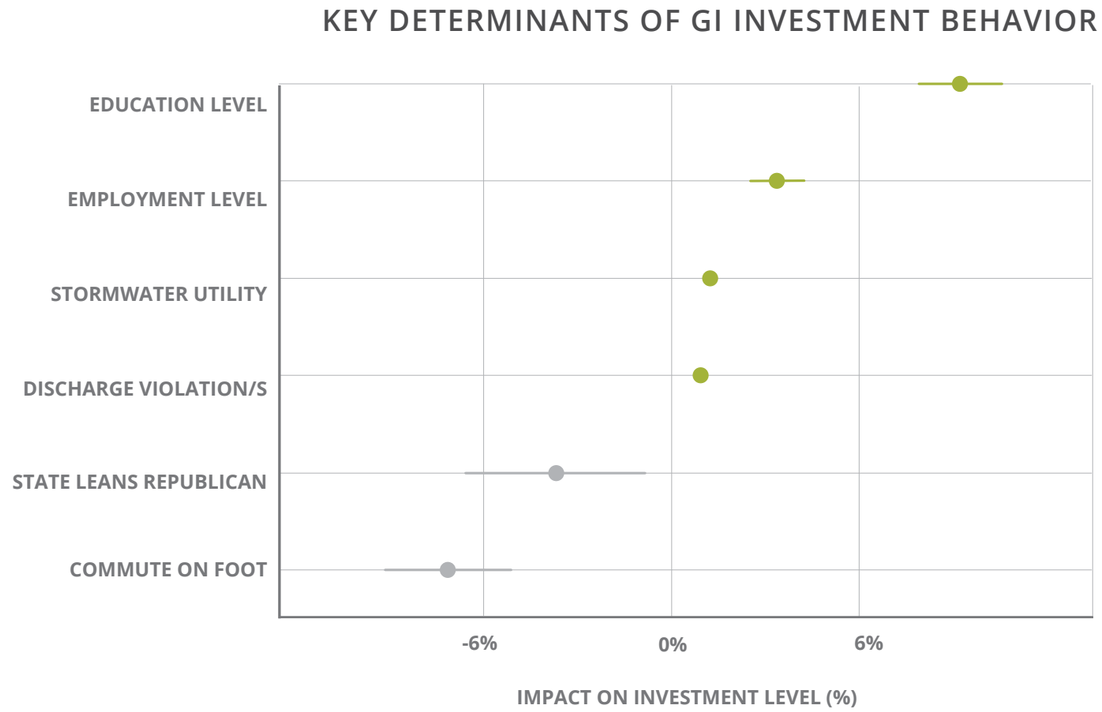


Figure 8. Primary Drivers of Investment in Urban Tree Canopy

While the analysis displayed in the above plot focuses on a single GI asset type, it offers an important empirical assessment of the drivers of GI investment behavior. Green dots indicate a positive effect on investment, while grey dots indicate a negative effect. The horizontal lines through the dots represent the confidence interval. While education level had the most sizable impact (positive) on investment levels, the presence of a stormwater utility and a regulatory violation weighed most heavily on positive investment decisions.

Any plan to increase investment must address the negative drivers, as well. While we can't be certain without further research, the commuting variable may suggest that access to land remains a critical barrier for cities that want to pursue nature-based solutions. There is some evidence in the economic literature that commuting habits proxy density, but it is not a uniform assumption. However, these cities can work to identify creative opportunities and invest in the protection of green assets that are outside urban boundaries but still deliver services across the greater metropolitan region. And, while political leaning does have a significant negative effect on investment, that is not particular to green investment, and we found in our interview research that political leaning is readily outweighed by public demand and general trust in government.

For details on our data sources, variable selection, and model specification, please see Appendix B.

HOW DO WE GET THERE?

THE CART BEFORE THE HORSE

If a critical piece of getting to scale is the shift from funding to financing, as we propose it is, then the key is moving away from one-off and accessory-style projects to developing a portfolio of public assets worthy of large-scale investment. Taxes and user fees currently comprise the funding streams for most public infrastructure developments, but these are insufficient to provide the outlays required by a comprehensive, integrated infrastructure program. Financing is needed to access the upfront capital needed for large infrastructure projects in the face of limited capital improvement budgets.

Currently, the standard order of operations places securing the dollars ahead of developing the project, and we are proposing a reversal. To access the financing required to reach scale, a strong proposal for a comprehensive, integrated plan must be developed first. Until it is mainstreamed into comprehensive capital investment plans, GI will remain a series of largely isolated and under-resourced pet projects. This shift requires a programmatic versus project-based approach that aggregates the value and impact of many projects to meet multiple, citywide objectives and deliver a portfolio of assets that attracts institutional investors.

THE MONEY IS OUT THERE

The primary barrier to accessing capital is not that it isn't available; it's that projects are not being matched to the money. Presumably, this mismatch is a two-way street. If practitioners are claiming the capital isn't available while investors are claiming there are no capital projects to invest in, then two things need to happen. Investors need to make their interest in these large-scale, public investments known, and practitioners need to start developing multi-purpose, public assets worthy of large-scale investment. We need to rethink the idea of traditional, municipal project delivery and start moving towards programmatic, integrated design that develops an entire portfolio of high-performing, high-value, multi-purpose assets. Multiple purposes equal multiple benefits, and that attracts multiple (i.e. new) types of investors.

Such a change in the way municipalities do business will require considerable innovation and relatively rapid adaptation at both the municipal and societal level. In the following Blueprint for Increased Investment in Integrated Infrastructure, we present the following 5 major cultural and institutional shifts required at the societal level along with a comprehensive set of actions that can be taken immediately at the municipal level.

ACCESSORIES ➡ **ASSETS**

CHAMPIONS ➡ **SYSTEMS**

PROJECTS ➡ **PORTFOLIOS**

SERVICE-DELIVERY TARGETS ➡ **COMMUNITY OUTCOMES**

FUNDING ➡ **FINANCING**

We identified these five major shifts using experiential information collected from interviews with municipalities all over the country; an extensive review of financial and operational literature; a geospatial survey of green assets in multiple cities; and a statistical analysis of public data. For each of these shifts, we have identified key tactics for successfully implementing it as part of a modernized, integrated infrastructure planning process for US cities. These tactics – along with data, tools, tips, and additional resources for implementing them – are detailed in the next section, The Blueprint for Increased Investment in Green Infrastructure.

As cities begin to reap the rewards of the systems change required to design, develop, and deliver large-scale, integrated infrastructure programs, more will follow. Once it is implemented to scale, the enormous economic, social, and environmental benefits of integrated infrastructure will yield market and policy shifts that serve to bolster and mainstream its adoption. As investors see the potential for gain, markets will continue to innovate improved financial instruments. As municipalities improve the way they deliver services and benefits, trust in public institutions will grow. And as people begin to understand the true value of our natural resources and public services alike, the historical trend of under pricing them can begin to be corrected.


COLORADO SPRINGS, COLORADO

THE BLUEPRINT

FOR INCREASED INVESTMENT IN GREEN INFRASTRUCTURE

The following pages outline the Five Major Shifts required to get green infrastructure planning and implementation to scale in US cities and lists specific steps to take toward actually making those shifts. These steps are supported with tools, data, and examples that enable on-the-ground action.

For an interactive version with downloadable resources, please visit eartheconomics.org/blueprint

ACCESSORIES
ASSETS

"STOP PLANNING FOR PEOPLE AND **START PLANNING WITH THEM**."

Rather than pet projects or add-ons to grey assets, green infrastructure installations need to be understood and presented as valuable, service-delivery assets that effectively address the same urban challenges as grey infrastructure. Green infrastructure is real infrastructure, and this point needs to be made more effectively to both practitioners and communities. The fact that community engagement and public support are paramount to success was reiterated throughout our research, and this work of identifying individual and shared priorities needs to happen with internal stakeholders, as well. Building a strong foundation of social capital based on shared values and definitions will return significant pay offs as this complex process accelerates and new roadblocks arise.

ADOPT A PORTFOLIO STANDARD FOR YOUR GREEN ASSETS. While much of the change occurring in the energy landscape is being driven by market factors, renewable portfolio standards have, at the very least, been an important part of identifying shared goals around sustainable service delivery and moving collectively toward scale. While "top-down" approaches are allegedly unpopular, both our empirical analysis and our interview research demonstrate that they are highly effective. Regulatory drivers like water quality standards and discharge violations will likely continue to drive action on the stormwater side, but a comprehensive target for green infrastructure assets as a required proportion of a city's entire infrastructure portfolio is critical for defining scale and accelerating the process of getting there. When a city recognizes the value of its natural assets, safeguarding their place within a diverse, economic portfolio is just good business.

ESTABLISH SHARED LANGUAGE + MEANING. A common goal cannot be defined without a shared understanding of it.[20] One of the primary barriers to widespread adoption of green infrastructure as a critical component of capital planning is the ideological and political (i.e. divisive) language used to describe it and the fact that it is rarely defined as real infrastructure. Define it as such immediately, and get everyone on the same page with inclusive terms like ***improved service delivery, cost-effective, community amenity, and multi-purpose***. Present green assets first and foremost as cost-effective solutions to the same service delivery problems as the costly grey alternatives that people are more familiar with. Depending on the values and perceptions of your stakeholder network, doing this might require that you stop calling it green altogether.

IDENTIFY SHARED VALUES + GOALS. Effective collaboration requires a shared goal.[21] Determine what motivates those in your program network, and speak to those objectives. Values like ***community improvement, fiscal responsibility, and city pride*** are powerful consensus builders for gaining broad, long-term buy in. And departmental goals like ***regulatory compliance, service-delivery targets, and public safety*** are powerful incentives for individual staff support. A drainage engineer in the transportation department might not care about heat island mitigation, but s/he is definitely incentivized to find ways to move water off of streets faster. Everyone should be able to commit to the goal of delivering the best possible services and products for their community.

USE VALUES-BASED MESSAGING. The importance of community support cannot be overstated, particularly for programs that will run on ratepayer dollars. So, it's critical that the public understands how integrated infrastructure directly addresses what's important to them. Use the many community benefits of green infrastructure to tell a story about values versus dollars. Describe initiatives in terms that resonate immediately, like "safe neighborhoods" rather than "hazard mitigation." Most people have never been directly affected by a hazard (though more and more are at risk), but no one prefers to live in an unsafe neighborhood. Broadly shared values like ***community identity, pride of ownership, and personal accountability*** can be incredibly powerful unifiers in diverse socioeconomic and political climates. And again, you might just have to stop calling it green if that's not what's important to your community.

HIGHLIGHT GETTING THE MOST VALUE FOR PUBLIC DOLLARS. With ever-increasing demands on shrinking budgets, cities simply cannot afford single-purpose projects. Every public investment must maximize public benefits, so whenever there is an opportunity to increase the return on public dollars by developing a multi-purpose community amenity that delivers critical services, it is imperative that we do. Ask the public: This is your infrastructure that you pay for…shouldn't it do more? And explain how it can, using clear, inclusive terms like ***public safety, community improvement, and economic value***.

ACCESSORIES
ASSETS

RESOURCES FOR COMMUNITY ENGAGEMENT AND VALUES-BASED COMMUNICATION

- **Funders Network** Essential Strategies for Meaningful Engagement
- **Sightline Institute** A Primer: Values-Based Communication
- **FrameWorks Institute** Frameworks Academy: Practical guidance on effectively framing public outreach and policy communication
- **Partners for Places** Community Engagement Guidance

VISUALIZING SHARED MEANING: TREES AS DRAINAGE ASSETS

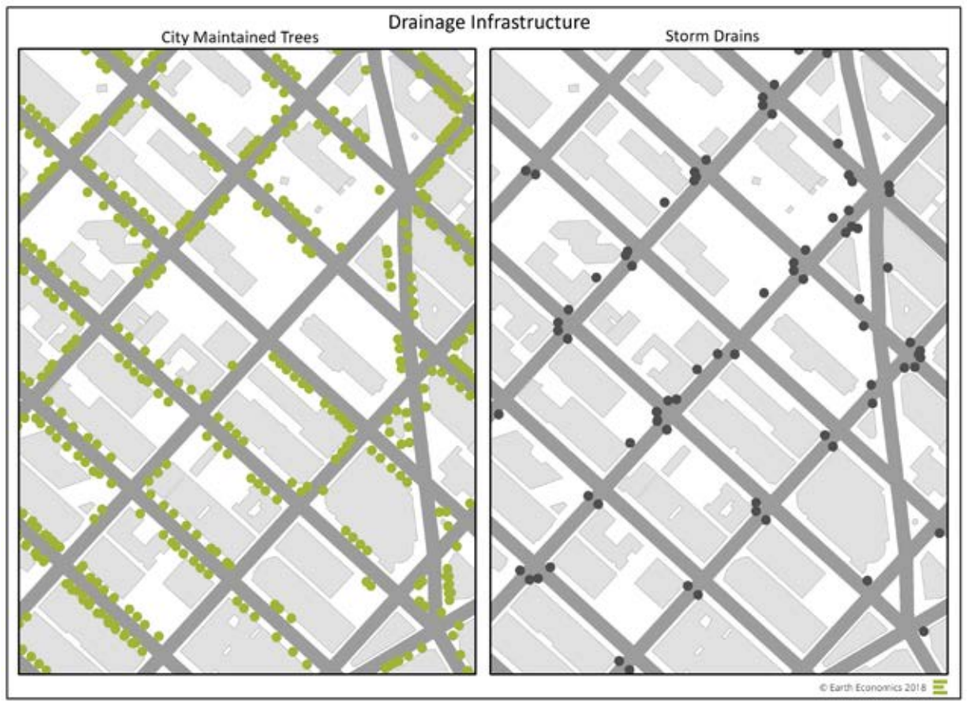


Figure 9. Visualize Shared Meaning: Trees as Drainage Assets

Storm drains are tracked and managed as critical infrastructure, while trees typically are not. The images above show what's missing from the picture when cities fail to recognize and manage green assets as part of an integrated infrastructure system.

EXAMPLES

COLORADO SPRINGS, COLORADO

Established a stormwater utility and implemented an integrated infrastructure plan that meets multiple compliance, service-delivery, and community objectives. They did not use the term green in their outreach. They presented green infrastructure as cost-effective, multi-purpose, REAL infrastructure and capitalized on the community's shared value of personal accountability to make it clear that stormwater is everyone's responsibility.

SPOKANE, WASHINGTON

Built public demand around shared values using a beloved natural resource. While climate adaptation may not have been a strong driver for everyone in the community, protecting the Spokane River was. Their Cleaner River Faster campaign instilled the urgency, sense of responsibility, and shared community value needed to get the public buy-in necessary to issue $540 million in green bonds over two years.

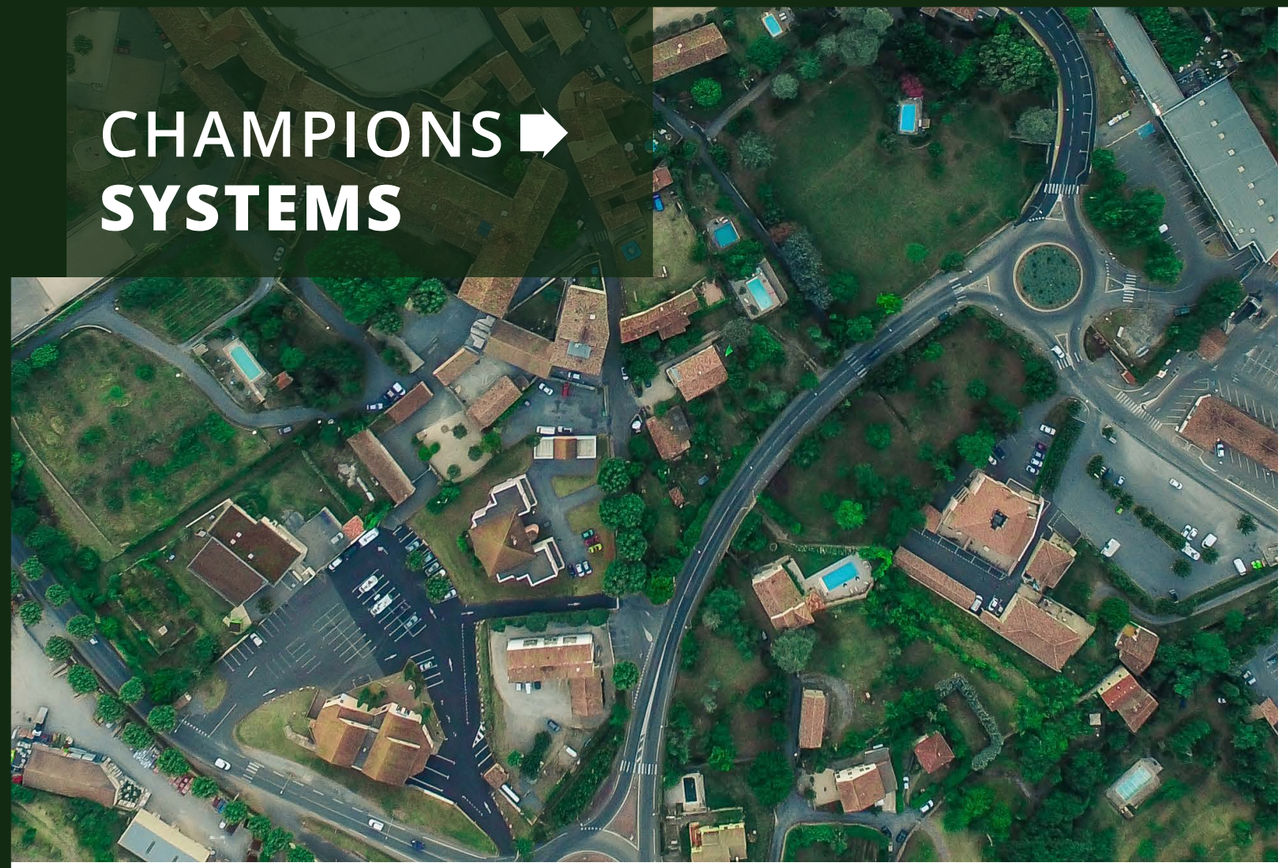
OMAHA, NEBRASKA

Omaha Stormwater hosts Lunch 'n' Learns for engineers and an annual GI tour with engineering students in Nebraska, Iowa, and now the Dakotas. This builds shared understanding and social capital internally and invests in it for the future.

"WE ALL LIVE DOWNSTREAM FROM SOMEONE ELSE. WE DON'T WANT THEM SENDING THEIR POLLUTANTS AND DIRTY WATER TO US. WE ALSO LIVE UPSTREAM FROM SOMEONE ELSE, AND **WE HAVE A RESPONSIBILITY NOT TO SEND OUR WASTE DOWNSTREAM.**"

FROM THE COLORADO SPRINGS STORMWATER MANAGEMENT PLAN

CHAMPIONS ➡ SYSTEMS



“IF IT’S NOT SUSTAINABLE, IT’S NOT EQUITABLE, AND IF **IT’S NOT EQUITABLE, THEN IT’S NOT SUSTAINABLE.**”

From a “visionary leader” who gets the ball rolling, to the small “green team” on the ground that is perpetually seeking opportunities to add on and piece together projects, the advancement of green infrastructure in the United States is almost entirely tied to the individual prerogatives of a few rather than the daily operations of everyone. The shift from a linear, siloed approach toward a non-linear, collaborative, integrated capital planning process will require extensive stakeholder engagement and team-building alongside the development of robust, replicable systems. The shift from champions to systems requires the adoption and implementation of best practices that endure well beyond individual tenure. In order for this process to become mainstream, it must be integrated into the work of many and built on clearly defined and catalogued procedures that are informed by robust and well-maintained data.

IDENTIFY + ENGAGE STAKEHOLDERS. The design and delivery of a large-scale, integrated infrastructure program will require the buy in, support, resources, expertise, and ongoing management of a wide variety of people, departments, firms, and organizations. Identifying who those people are and what their roles will be from the outset is key. From colleagues in other departments (transportation drainage engineers), to city council members and other electeds, local business owners, community members and leaders (especially the underrepresented and underserved), private developers, and NGOs, integrated programming must be a highly collaborative and interdisciplinary effort.

MAP PROCESSES AND IDENTIFY GAPS. Updating and mapping new processes to roles and data is a critical step to managing roadblocks and to ensuring replicability of project delivery. Even though many steps and needs will be identified along the way, starting with a general process map that you can build out over time will result in a valuable tool for developing the systems that move this work into the mainstream. Identify who gets looped in when and to what extent, what data is needed at which decision junctions, which codes and regulations direct the process at which points, and what is needed to redirect the status quo that perpetuates the default to grey solutions.

ADOPT A DATA-BASED APPROACH, BEGINNING WITH A DATA AUDIT AND GAP ANALYSIS. From asset inventory to stormwater management models (SWMM) to geospatial data to performance and cost projections, determine what you have, what you need, how to get it, and how to manage it. Consider partnering with private sector consultants, academia, and NGOs to fill data gaps and develop and manage your data library. There are numerous public sources for green infrastructure cost, implementation, and performance data.

RESET THE DEFAULT. In current capital planning conversations, the burden of proof consistently lies on proponents of nature and nature-based solutions. This perpetuates a default to built solutions by assuming they are the benchmark by which all alternatives are evaluated. We are surrounded by and benefitting from natural infrastructure all the time, and there is significant data that shows mimicking these natural systems provides effective solutions to basic public challenges. ***It’s time to stop debating this, make nature the default in infrastructure planning at all levels, and put the burden of proof on costly, grey alternatives.***

CHAMPIONS
SYSTEMS

TOOLS + DATA SOURCES

EPA Green Infrastructure Modeling Tools This page includes everything from an overview of basic modeling principles to cost and performance spreadsheets to complex SWMM modeling and i-Tree applications.

Naturally Resilient Communities Interactive Tool Guide to nature-based solutions to urban hazards with case studies by region, challenge, and solution. Developed by the Nature Conservancy, in partnership with the American Planning Association, American Society of Civil Engineers, National Association of Counties, and the Association of State Floodplain Managers.

Earth Economics' Screening-Level Benefit Valuation Tool Earth Economics is developing a tool, that will be available online and will allow users to estimate costs and benefits of green infrastructure installations. The tool will estimate a variety of green infrastructure benefits, including flood prevention, property value uplift, and groundwater recharge based on localized conditions and regional demographic characteristics.

CALCULATING COSTS + PERFORMANCE

International Stormwater Best Management Practices Database

A collaboration between the American Society of Civil Engineers and the US EPA, the BMP Database is an online global repository of academic and scientific research on green infrastructure installations. The database houses more than 30,000 values on water quality and water capture performance of green infrastructure. The cost and performance levels of individual green infrastructure assets have been monitored and studied extensively over the past decade. While on-the-ground realities will certainly fluctuate by municipality, the data and evidence are out there to reasonably inform planning decisions. The table below displays some values calculated by Earth Economics from data in the database. Our analysis of the values in the BMP database demonstrates that green infrastructure installations significantly improve water quality, capture stormwater, and reduce peak flows, and that these assets compete with their grey counterparts on cost for both installation and maintenance.

GI PRACTICE	% CHANGE IN HEAVY METALS	% CHANGE IN WATER CLARITY	% REDUCTION IN FECAL COLIFORM BACTERIA	% REDUCTION IN TOTAL FLOW	LITERS CAPTURED/ SQ FT/ DAY	REDUCTION IN PEAK FLOW/ SQ FT/ DAY	LOW	AVERAGE	HIGH	AVERAGE MAINTENANCE/ SQ FT
Biofilter	46%	40%	40%	76%	0.43	25%	$5.15	$11.24	$16.05	$0.33
Detention Basin	30%	54%	54%	60.8%	0.868	>100%	$0.23	$0.23	$0.23	$0.05
Media Filter	49%	59%	59%	50%	0.65	>100%	$3.64	$3.64	$3.64	$0.06
Porous Pavement	33%	62%	62%				$2.50	$6.19	$11.60	$0.10
Retention Pond	54%	72%	72%	24.2%	0.17		$0.24	$1.50	$3.44	$0.07
Wetland Channel	31%	61%	61%	10%		86%	$1.49	$1.77	$2.05	$0.06

Figure 10. Cost and Performance Values of GI Best Management Practices

EXAMPLES

LA CROSSE, WISCONSIN

Flipped the burden of proof and officially reset their default to green. Any project that does not prioritize nature-based solutions must make an official case for why not and have their arguments against green infrastructure reviewed by a city council that has mandated its prioritization as a community asset. When integrated infrastructure is the default, reverting back to traditional capital planning becomes more work.

ATLANTA, GEORGIA

The stormwater management team developed a simple checklist for their engineers that quickly and efficiently operationalized the consideration of green options on all projects. Checklists work.

GREENWAYS | ATLANTA, GEORGIA

PROJECTS ➡ PORTFOLIOS

“THERE IS MORE CAPITAL OUT THERE AT ALL LEVELS. IT'S ALL ABOUT DELIVERY PROCESS AND OUTCOMES.”

Aggregating assets into comprehensive portfolios is paramount to wise investing. It’s necessary in order to maximize returns and effectively distribute risk. It’s also necessary to attract the level of investment needed to get green infrastructure adoption to scale. We must shift away from a system of one-off green projects and begin developing comprehensive, large-scale, portfolios that effectively integrate green and grey solutions to deliver the maximum benefits to communities and investors.

ACKNOWLEDGE THAT GREEN IS NOT GOING TO REPLACE GREY. Yes, it is a multi-purpose approach to service delivery, but green infrastructure is not always the right option. Come to a shared agreement that it is the best solution in some cases, not in others. While it is the best-performing and most cost-effective way to meet a variety of service-delivery goals, and it comes with a suite of added benefits, it is not a fix all, and in some cases traditional infrastructure is the better option. The goal is to optimize implementation of grey and green assets as part of a comprehensive portfolio, and to use the additional benefits of green assets to sway individual project decisions toward green when the two are seemingly equally good or closely comparable.

DEFINE OWNERSHIP. Maintenance is consistently cited as one – if not the – primary barrier to adoption and implementation. The popular narrative asserts that maintaining green infrastructure is more difficult and costlier than maintaining grey assets. However, our research (our own economic analyses and stakeholder accounts) indicates that this is not necessarily true, and that the central question is really more about ownership. An asset that benefits the bottom line of many is difficult to assign ownership (i.e. responsibility) to. This must be clearly defined and documented at the outset, so that maintenance can be incorporated into some entity’s daily operations, just as it is for other assets.

ENLIST EXPERTS AND STAKEHOLDERS TO CONDUCT A REGULATORY REVIEW. Even the best program design can be stopped in its tracks by outdated policy and hundred-year-old codes. The codes and standards that regulate development need to be updated to better fit current and future urban realities. The goal is to identify – from a variety of perspectives - what’s preventing implementation and what could make the process smoother. Some fixes will be simpler than others, but it’s critical to include a comprehensive group of stakeholders to understand how rules and regulations contribute to the big picture rather than just one department or agency. Outside experts can facilitate and draw on diverse experiences with other municipalities, and developers and contractors need a seat at the table.

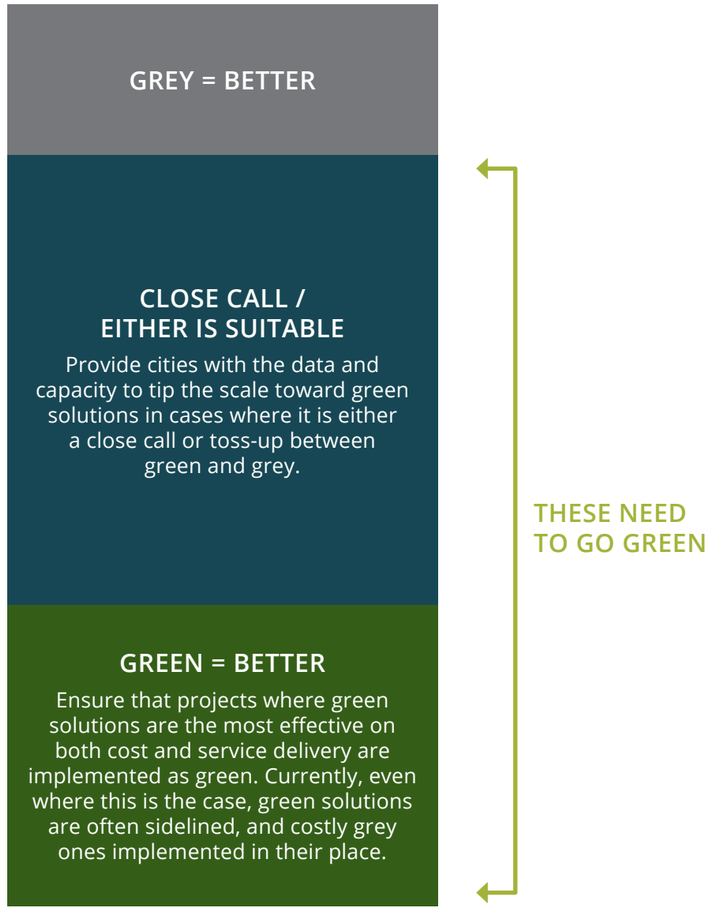
AUGMENT CODE WITH INCENTIVES. Code change is a long, arduous process of compromises, and there will inevitably still be gaps when it is over. Fill those gaps with incentives. A combination of carrots and sticks is key to behavior change, and we can’t get to scale without behavior change, especially on private property.

REVIEW ACCOUNTING STANDARDS WITH FINANCIAL AND LEGAL TEAMS. Integrated infrastructure programs will inevitably be faced with transactional and accounting barriers. Include your financial and legal teams in the process early on and continue to solicit their input throughout. There will be rules and standards that require changing along with some that can already be leveraged creatively.

PROJECTS
PORTFOLIOS

TIPPING THE SCALE

Infrastructure and service delivery needs will differ by city, and so will the composition of their respective portfolios. Thus, the proportions in the graphic below are for presentation only. But among all cities, infrastructure planning can properly prioritize the maximum integration of green assets by taking steps to ensure that green assets get proper consideration and, when they are the right solution, they actually get implemented.



EXAMPLES

NEW ORLEANS, LOUISIANA

In 2017, the Mayor's Office of Resilience and Sustainability issued the city's first-ever RFI jointly with the city's Office of Information Technology and Innovation in the form of a Digital Equity Challenge. The response and resulting insights were so overwhelming that the City's Office of Homeland Security and Emergency Preparedness is utilizing an RFI for its Comprehensive Recovery Plan. While neither example is a green infrastructure program, the takeaway remains that much stands to be gained be rethinking the procurement process.

LOUISVILLE, KENTUCKY

Used green assets as a means of reducing costs for sites with significant stormwater conveyance needs. They have consistently found that – without taking any shared or "co-benefits" into account – green is the cheaper solution for conveyance. Deep infiltration trenches have proven to deliver on both cost and performance and effectively tip the scale toward green solutions.

MILWAUKEE, WISCONSIN & ST. LOUIS, MISSOURI

The Metropolitan Sewerage Districts in each of these cities give grants for green infrastructure projects that include long-term maintenance agreements. Milwaukee requires a 10-year easement to ensure system maturity on projects greater than $25,000, and St. Louis requires a maintenance agreement that stays with the property in perpetuity.

PROJECTS ➡ PORTFOLIOS

PROCESS IMPROVEMENT STARTS AT STEP 1

Currently, much of this happens primarily behind closed doors and is based on narrow service-delivery targets that are addressed with status quo processes and solutions. Increased stakeholder and community engagement efforts that allow for a more comprehensive understanding of needs and values and a more inclusive and transparent process to address them will lead to investments that maximize public benefits. Actively including community and agency partners at Step 1 can drastically improve the execution of steps 2-4 and deliver resilient, multi-purpose community amenities in place of single-purpose service delivery mechanisms.

In many municipalities, the existing procurement process isolates the design process from the build process. This incentivizes inefficiencies in the form of a bidding culture that embeds the costs of potential setbacks in the public's price tag. In addition, the separation of these two closely interrelated project-delivery processes ensures that accountability gets passed down the line. The lack of adaptability on the project-delivery side and lack of control on the public side are impeding the adoption of innovative, efficient, multi-purpose projects. Contractors, communities, and public staff all need to be engaged at Step 1 in order to identify and address roadblocks in existing municipal processes.

Assigning responsibility for the ongoing maintenance of new assets that benefit multiple agencies is a difficult and potentially contentious task. Maintenance responsibility needs to be clearly defined and assigned at Step 1, so that those responsible can be effectively included in project design and delivery.

CHECKLIST

GETTING STARTED

In general, determine what is perpetuating the default to grey and identify opportunities to incentivize the integration of green.

PROCUREMENT

- ◯ Do procurement rules - at any level - prohibit design-build, limit the pool of applicants, disincentive new project types, etc?

LEGISLATION

- ◯ Does your state grant authority to establish a stormwater utility?

REGULATION

- ◯ How does regulating for flow instead of volume influence project design?

DEVELOPMENT

- ◯ Require green infrastructure and/or green fund investments on new developments as the cost of doing business.
- ◯ Align codes across watershed/ecological boundaries to streamline collaboration and the process of scaling.

ACCOUNTING

- ◯ Familiarize your finance and legal teams with GASB 62. A 2018 rule clarification establishes the use of the Regulatory Assets Approach to debt-finance distributed infrastructure and incentive programs with muni bonds. 🔗 **Read our primer and get started.**

SERVICE-DELIVERY TARGETS ➡ **COMMUNITY OUTCOMES**

"LINKING ACCOUNTABILITY TO COMPENSATION REQUIRES **INVESTMENT IN COMMUNITY**."

As we mentioned above, the scale of the solution is defined by the scale of the problem, but it is simultaneously constrained by the scale of the processes and decisions that drive it. While many existing systems and mechanisms are sufficient to support some city-scale implementation, a truly comprehensive, integrated infrastructure plan extends beyond jurisdictional borders to ecological boundaries. As we scale our solutions, we will need to scale our consideration of physical boundaries and our procedures around governance and service delivery, as well.

TAKE STOCK OF YOUR NATURAL CAPITAL ASSETS. Strategic investing and effective financial planning require a comprehensive understanding of your assets. While many municipalities have a working knowledge of their built and financial assets, few have taken inventory of their natural capital wealth, despite the fact that it comprises not only enormous value but also extensive long-term gains. In contrast to built capital, natural assets appreciate in value over time, in perpetuity, so taking stock now enables us to make investment decisions that we will maximize benefits now and for generations to come. The natural infrastructure that serves a community frequently resides at least partially outside its official borders.

RETHINK PROCUREMENT. The process by which a city solicits and purchases goods and services from the private sector needs to be updated to reflect modern business realities like the design-build model, incorporate priorities like environmental and social health into the process, and incentivize efficiency and innovation in order to deliver the best services to communities. While the process differs among states and municipalities, the general consensus is that it is currently insufficient to best address modern challenges but could be re-envisioned as an incredible opportunity to access the best the market has to offer. Cities across the country have begun piloting an ***RFI (request for information)*** process to precede or replace the existing RFP (request for proposal) process that is notoriously bureaucratic and opaque. The RFI process allows cities to conduct a broader market analysis of what contractors have to offer in emerging markets like green infrastructure, and it increases transparency. Others have used ***competitions*** to attract new partners, incentivize innovation, and increase efficiency in project delivery. And more and more are looking into how to incorporate ***community benefit agreements*** and ***pay-for-success measures*** into the contracting process. Models like these offer cities critical opportunities to build much-needed accountability into the process.

REDISTRIBUTE DECISION-MAKING CAPACITY. One of the primary barriers to getting green infrastructure (or any climate adaptation plan) to scale is decision-making authority. Currently, there are no clear authorities that fully encompass the natural systems that extend far beyond jurisdictional boundaries but deliver critical services and benefits to communities. Thus, existing public hierarchies and jurisdictional authority do not fully accommodate action at the level required to have significant impacts. Convening a cross-jurisdictional, interdisciplinary "task force" can provide a forum for determining how decisions are currently made, how they need to be made, and how to get from the former to the latter.

INTEGRATE AGENCY MANDATES AND INCENTIVES. The concept of organizational siloing features prominently in conversations about GI implementation, primarily in relation to how agencies do or do not work well together to achieve broadly defined community outcomes. Much of this is due to the fact that agency and utility mandates are typically exclusive to specific service-delivery targets (e.g. gallons of stormwater treated) rather than considered as part of a comprehensive approach to broader community outcomes of economic, social, and environmental well-being. This is perpetuated by the organizational structure of most cities which isolates utilities by singularly goal-oriented strategies, often in a top-down hierarchy. Such a narrow focus reinforces siloing and often generates narrowly defined solutions by creating everyday hurdles to collaboration and innovation.

In order to achieve the level of collaboration required for integrated infrastructure planning, cities need to integrate mandates and create incentives for new, more flexible structures that allow experts to come together for deep, multi-disciplinary problem solving to identify and test new solutions to old problems. These teams should also depend heavily on early and regular community input to ensure that the process and solutions meet the broadest needs of the community. Done well, a spot on such a collaborative team that delivers the best possible services to communities should be a sought-after role for program managers, engineers, and budget officers alike. Rather than represent the interests and targets of a single division, team members share (and are rewarded for) their individual expertise about water, transportation, parks, etc. as well as their larger vision for a healthy and robust community.

SERVICE-DELIVERY TARGETS ➡
COMMUNITY OUTCOMES

TAKING STOCK OF NATURAL CAPITAL ASSETS

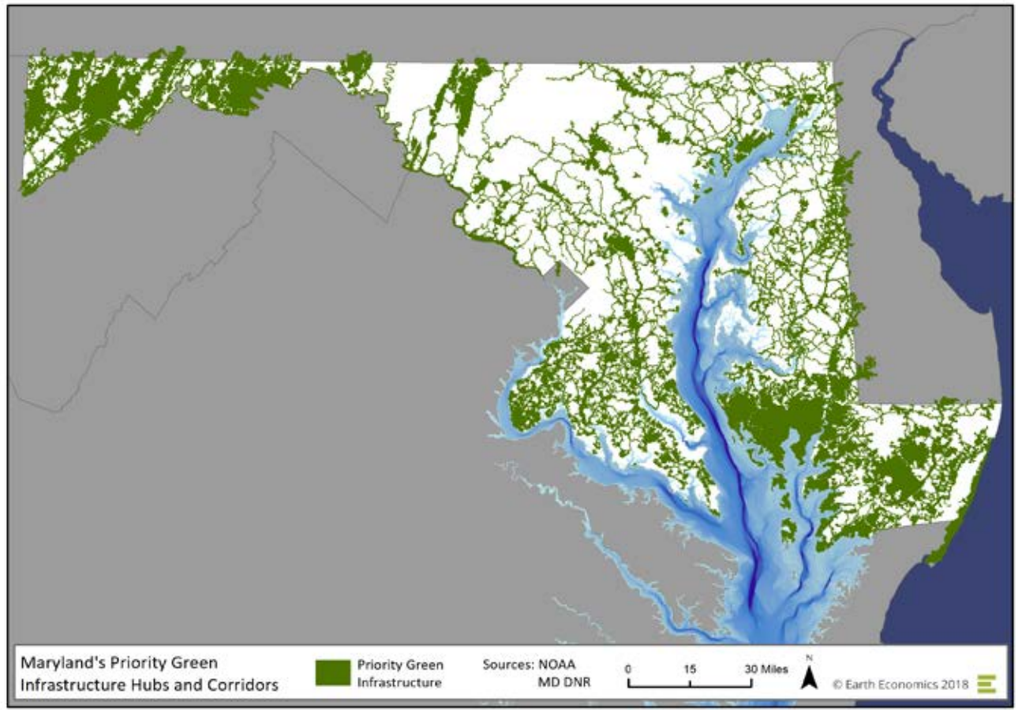


Figure 11. Maryland's Priority Green Infrastructure Hubs and Corridors

The Maryland Department of Natural Resources has taken a large-scale, proactive approach to ensuring continued preservation of valuable natural lands. By mapping priority green infrastructure hubs and corridors, the state can efficiently include these zones in planning decisions, shifting from individual projects to broader landscape considerations.

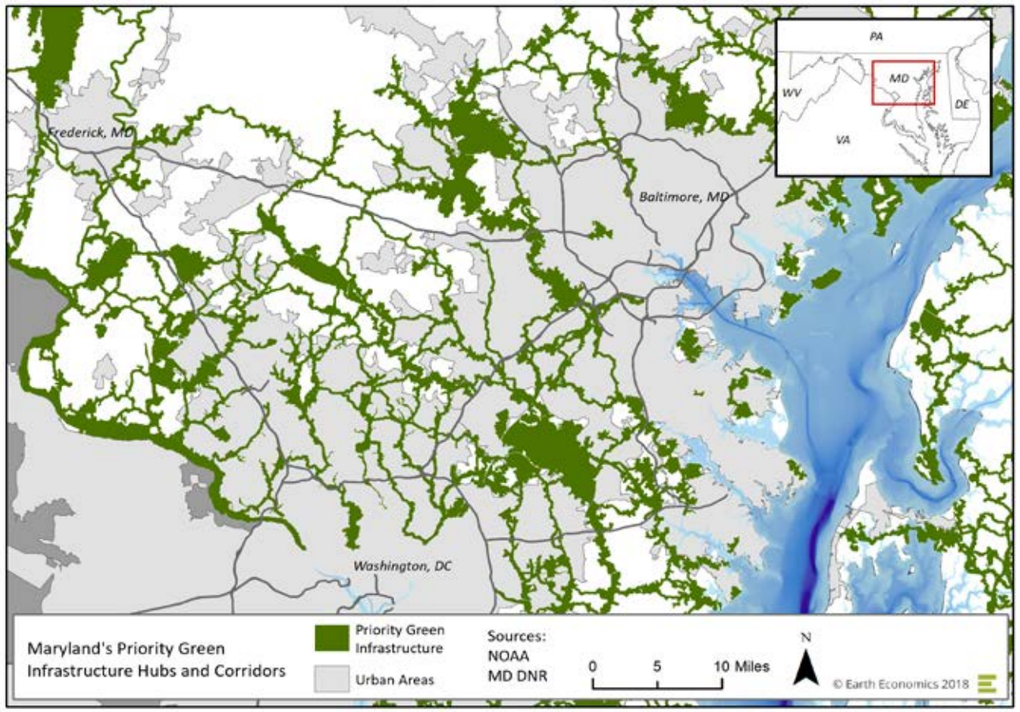


Figure 12. Greater Baltimore Priority Green Infrastructure Hubs and Corridors

Detail from Baltimore - Washington, DC metro area: Understanding priority green infrastructure areas, from riparian zones to larger preserves, helps to inform future urban growth and maintain existing, critical green infrastructure.

SERVICE-DELIVERY TARGETS
COMMUNITY OUTCOMES

VISUALIZING DECISION-MAKING CAPACITY

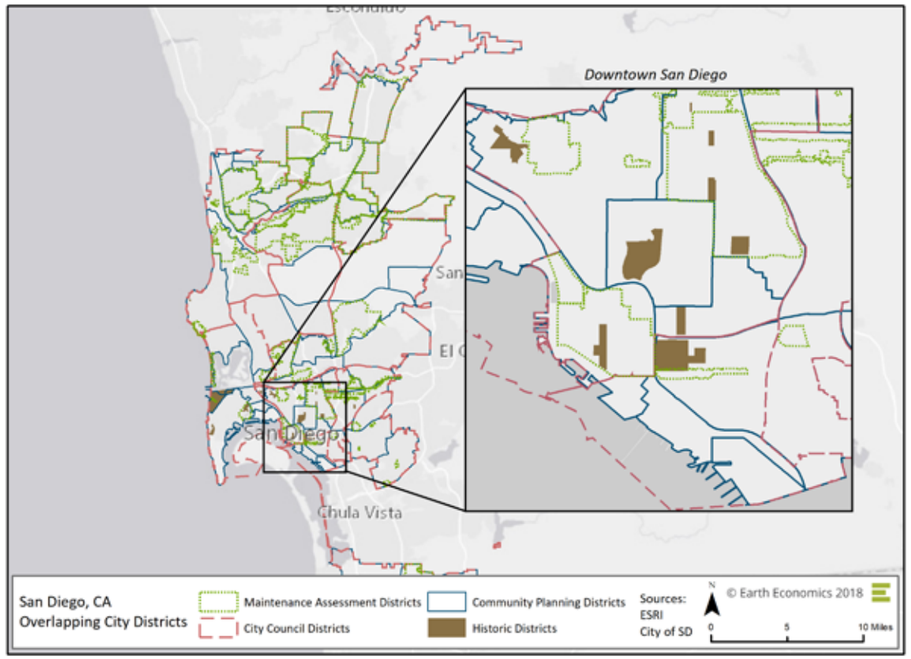


Figure 13. San Diego and Overlapping City Districts

As city governance evolves, the unique boundaries that mark various functional zones and districts can complicate planning at scale. Negotiating the requirements of each entity can add additional roadblocks to already complex, multi-stakeholder projects. For example, in San Diego, one community planning district may cross into multiple council districts while also containing several different historic districts. Negotiating these regulations can create barriers for green infrastructure projects, particularly those connecting areas across a city.

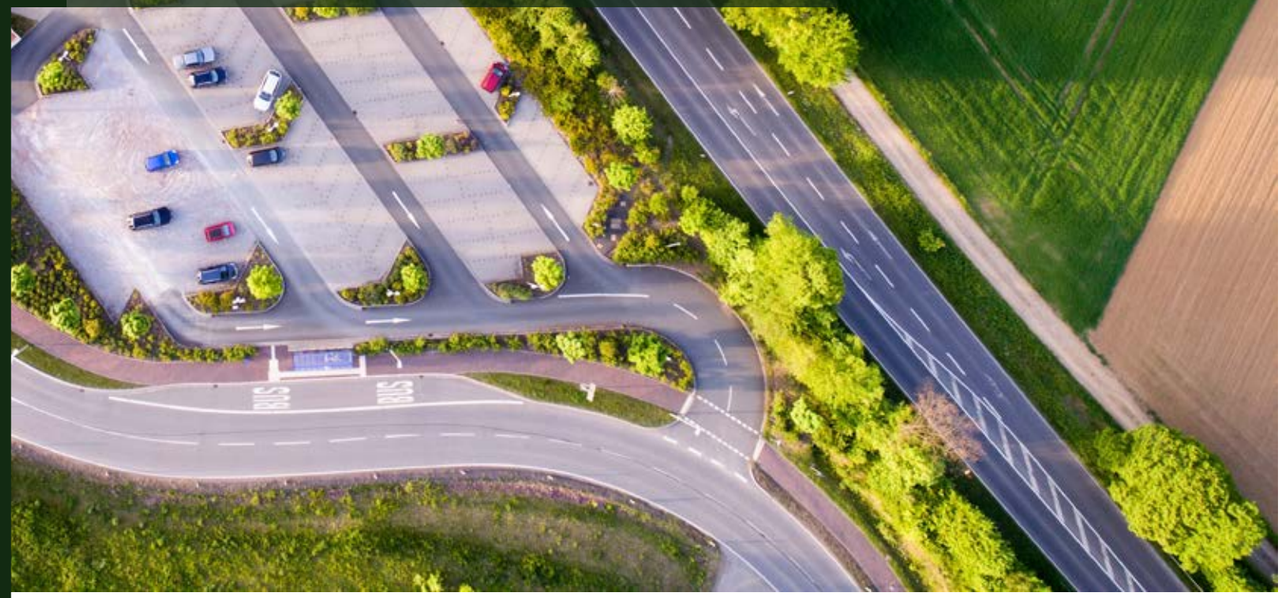
GREATER PUGET SOUND REGION, WASHINGTON

Regional Code Collaboration

In order to maximize efficiency, capitalize on economies of scale, and incentivize regional adoption of sustainable development best practices, communities in the Puget Sound region of Washington state convened a cross-jurisdictional group of planning and code experts to collectively review and revise existing development codes that were impeding sustainable development at scale.

BOARDWALK | GREATER PUGET SOUND REGION, WASHINGTON

FUNDING
FINANCING



“AS AN INVESTOR, WE’RE LOOKING FOR PROJECTS. FOR SOME REASON, THE PROJECTS ARE NOT GETTING TO THE FOLKS READY TO FUND THEM.”

Moving from projects to portfolios will require new methods of funding and, most importantly, a shift toward financing. Because few cities have made the move, and those that have are largely in the early stages of the process, there are a lot of questions about how it can be done. Again, the importance of coming to the table with a solid, integrated infrastructure portfolio that is worthy of large-scale investment is crucial, but so is the establishment of a sustainable revenue stream to repay those low-cost loans and other financing options that your plan attracts. Municipalities need to rethink how dollars move through these new programs and be open to creative and combined solutions, and they need to carefully evaluate options specific to their respective needs and realities. Green infrastructure should be viewed as a means of accessing extensive new capital, and the multiple, shared benefits can be leveraged to attract new investors in the public good. The public health community is likely uninterested in financing a massive concrete pipe, but they have a clear and vested interested in the development of community assets that improve chronic, health-related outcomes, from obesity to asthma.

ESTABLISH A STORMWATER UTILITY. Our empirical analysis shows that the existence of a stormwater utility has a significant, positive impact on city-level investment in green infrastructure. In addition to being a sustainable revenue stream that is necessary for the repayment of loans and other financing options, it can be used for operations and maintenance. It also properly frames stormwater management as a community issue and GSI as real infrastructure that delivers needed services and value, because there is a straightforward connection between the value of the service and the price.

EXPLORE COMMUNITY-BASED PUBLIC-PRIVATE PARTNERSHIPS (P3s). These arrangements can take a variety of forms and combine both funding and financing to deliver large-scale programming. Program priorities are identified by the community, and performance-based fees for service transfer risk to the private sector. In theory (because practice is minimal at this point), they incentivize the market-driven efficiencies and innovation of private business, and they prevent the “padding” that is commonly employed to cover private risk in the current public procurement process. If the program doesn’t meet community objectives, the private partner does not get paid. The number of P3s has risen significantly in recent years as a method to address infrastructure funding gaps. $15 billion in P3s are expected to be established in 2018, more than double the previous year.[22]

ISSUE ENVIRONMENTAL IMPACT BONDS. Another pay-for-success model, these bonds also transfer risk and incentivize efficiency and performance. They can also be used for operations and maintenance. Fundamentally, these are not a wholly new mechanism – the nuts and bolts of issuing debt are the same, but new incentives are driving the market as impact investors seek environmental and social returns in addition to financial ones. The impact investing sector is projected to grow from $77 billion to $700 billion by 2020,[23] and many see it as one of the most viable opportunities to close the massive infrastructure funding gap.

ISSUE MUNICIPAL BONDS UNDER GASB 62. This recent rule clarification from the Government Accounting Standards Bureau is poised to be a game-changing mechanism for engaging private property at scale and as an integrated component of municipal service-delivery systems. Using the Regulatory Assets Approach, distributed infrastructure and incentives (this includes everything from rain gardens to water-efficient appliances) can be booked as capital assets and financed by municipal bonds. 🔗 **Read Earth Economics’ full report on this.**

TAXES. Depending on local tax code, sales and property taxes can be levied to both fund green infrastructure projects and repay the debt issued to finance large-scale programs. Some cities have used taxes as their primary revenue source for GI, while others have used it for particular projects or system components.

FUNDING
FINANCING

ONLINE RESOURCES FOR FUNDING AND FINANCING

- **Go Green: Muni Bond Financing for Distributed Water Infrastructure** Earth Economics' primer for water leaders on how to debt-finance distributed infrastructure projects and consumer rebates
- **University of North Carolina Environmental Finance Center** The center works with communities to implement strategies that help answer the basic "how will we pay?" questions at the heart of successful environmental protection. Their website offers access to databases, networking opportunities, educational events, and more.
- The EPA has published a **webinar** and accompanying **report** which identifies innovative and financing opportunities, primarily within state revolving funds.

STEP BY STEP GUIDES

Integrated infrastructure planning requires innovative financing supported by sustainable revenue streams. Financing will be required to get to scale, but long-term funding for repayment is critical, and gaps may still exist. We've prepared 3 guides to help you navigate the integration of options.

1

GI Financing Guide
PAGE 51

Most large-scale green infrastructure installations are financed through bonds and non-subsidized loans. Financing can be achieved in these 3 easy steps:

1. Investigate subsidized loans
2. Investigate municipal bonds and non-subsidized loans
3. Consider P3s

2

GI Funding Guide
PAGE 52

What funding mechanisms can fill gaps and support an integrated infrastructure program?

1. Look into utility rates and fees
2. Investigate available grants
3. Supplement with general funds
4. Tax increment financing

3

Green Bond Decision Flow
PAGES 53-54

Follow a simple guide by answering yes or no questions to discover when a green bond is a good option to pursue.

EXAMPLES

STORMWATER UTILITY

Colorado Springs created a stormwater utility in July of 2018 to fund erosion and flooding reduction work. The utility and associated fee, passed by voters in 2017, is estimated to raised approximately $20 million per year.[24]

PUBLIC-PRIVATE PARTNERSHIP

Chester, Pennsylvania used a public-private partnership to make federally mandated fixes to the sewer system. The city partnered with Corvias to implement a stormwater fee and use proceeds from that fee to fund 350 acres of green infrastructure. The P3 aims to not only improve stormwater infrastructure, but create jobs as well. The majority of contractors hired by Corvias to complete the work were local residents.[25]

ENVIRONMENTAL IMPACT BOND

Washington DC issued an environmental impact bond in 2016, the first of its kind in the US. The bond paid for $25 million in rain gardens and permeable pavement installations to capture stormwater. The performance of these installations will be monitored closely by third party assessors. If the installation does not meet performance benchmarks, the city will have a reduced payment obligation on the bond.[26]

REGULATORY ASSETS (GASB 62)

Los Angeles Department of Water and Power has financed hundreds of millions of green infrastructure installations, including turf buyback programs, high efficiency fixture rebates, and large-scale investments in upstream water capture infrastructure. **Read Earth Economics' full report on this.**

TAXES

Since 2004, voters in the greater Atlanta area have passed numerous proposed measures for land conservation and infrastructure financing by way of bonds and dedicated sales taxes to fund greenway improvements, greenspace acquisition, green stormwater infrastructure, and recreation.

GI FINANCING GUIDE

HOW CAN YOUR GREEN INFRASTRUCTURE PROJECT BE FINANCED?

Ongoing utility rates can pay back green infrastructure investments over time, but they do not typically provide enough money to fund a large project without some additional infusion of funds. Cities and utilities usually borrow funds to cover these costs. Even if you can get a federal or state grant, they usually require matching funds.

1

Investigate subsidized loans.

State Revolving Funds: Clean Water State Revolving Fund (CWSRF), and Drinking Water State Revolving Fund (DWSRF) are government subsidized loan programs which are operated and partially funded at the state level. CWSRF and DWSRF loans can be used to finance, refinance, or guarantee infrastructure projects. The CWSRF operates a "Green Project Reserve," which exclusively funds green infrastructure projects. Because CWSRF and DWSRF loans require partial state funding, access to these loans can be competitive and can vary between states. CWSRF loans have funded more than $800 million in green projects since 2009 at an average interest rate of 1.4%.[27]

2

Investigate municipal bonds and non-subsidized loans.

Most large-scale green infrastructure installations are financed through bonds (either General Obligation bonds or Revenue bonds) and non-subsidized loans. These financing mechanisms tend to have higher interest rates (municipal bonds averaged 3.25% – 4% interest rates in 2018)[28] than State Revolving Funds, but are more readily available. 'Pay-for-Success' bonds and loans, such as Environmental Impact Bonds, typically receive a more favorable borrowing rate and achieve desired community outcomes.

3

Consider P3s.

P3s are a hybrid of a funding and a financing strategy, and can vary significantly between specific public-private agreements. Cities and municipalities have partnered with private companies to develop and implement green infrastructure. These partners are most commonly seen in public transportation, but can also include development of rain gardens, green roofs, and constructed wetlands.

GI FUNDING GUIDE

WHAT FUNDING MECHANISMS CAN FILL GAPS AND SUPPORT AN INTEGRATED INFRASTRUCTURE PROGRAM?

A comprehensive, integrated capital plan requires comprehensive, integrated revenue sources. While financing will generally be needed to get green infrastructure to scale, sustainable revenue streams like rates and fees are needed to repay those financing options, and there will always be gaps and opportunities that are best addressed by direct funding like grants.

1

Look to utility rates and fees.

A key mechanism to fund green infrastructure is through user utility fees and rates, such as water, wastewater, and stormwater rates. More than 1,500 municipalities have created stormwater utilities to support the funding of effective stormwater infrastructure.[30] Cities don't need to have a stormwater utility to fund these investments, user fees can be levied from any relevant municipal agency. Paired with appropriate financing, significant green infrastructure investments can be funded with only small incremental fee increases.

2

Investigate available grants.

Federal, state, and local grants are an appealing green infrastructure funding strategy, but are rarely sufficient to fund large-scale green infrastructure investments on their own. A list of available grants to fund green infrastructure projects is below/in Appendix C.

- **319 Nonpoint Source Pollution** Federal funding for a variety of pollution reduction projects and programs, dispersed at the state level. Grants are dispersed through state 319 programs.
- **National Estuary Program** The EPA has identified 28 very large estuaries. Federal grants are available for projects in the watersheds surrounding these estuaries. Grants are dispersed through individual estuary programs.
- **Federal Highway Administration FHWA Surface Transportation Block Grant Program** Federal funding for surface transportation is provided to states through the Surface Transportation program, and made available to cities through state allocations. Green streets, and even some public transit projects have been partially funded through this program.
- **Rural Development Water and Environment Programs** Communities with a population less than 10,000 are eligible for grants through the USDA. These grants are allocated towards the development of water facilities in rural communities.
- **State and Local Grants** Many states and counties have grant programs for Green Infrastructure Development. For example, Massachusetts provides a Coastal Resilience Grant Program, and New York has a Green Innovation Grant Program.

3

Supplement with general funds.

When utilities cannot be used to fund green infrastructure, or cannot fund the entirety of the green infrastructure installation, general funds can be used to fill funding gaps. General fund revenue comes, largely, from taxes. General fund revenue tends to be highly competitive and limited. Green infrastructure projects may struggle to find general fund support without an associated revenue stream.

4

Tax increment financing.

Tax increment financing generates revenue through increased property values created from project development. Installing effective and appealing green streets, green roofs, or urban forests will raise adjacent property values and generate tax revenue over the long term. Tax Increment Financing has already proven to be an effective strategy -- Property Assessed Clean Energy Programs (PACE) are a key funding mechanism for small-scale renewable energy installations. The Center for Neighborhood Technology has piloted the use of this financing mechanism to finance tree plantings, called "Tree Increment Financing."[31]

GREEN BOND DECISION FLOW

WHEN IS A (GREEN) BOND A GOOD OPTION?

1. Does your state have active financing available through Clean Water State Revolving Fund (CWSRF), Drinking Water State Revolving Fund (DWSRF) or the Water Infrastructure Finance and Innovation Act (WIFIA) that match your project criteria? **(Y – END4, N - q2)**
2. Does your agency have the authority to set rates and issue bonds (tax-exempt or taxable)? **(Y – q.3 , N- END0)**
3. Does your agency have the staff capacity to develop and issue a new bond? **(Y – q.4 , N - END0)**
4. Is the cost of planned green infrastructure larger than can be comfortably paid for through the annual operating budget? **(Y – q.5, N - END0)**
5. Is the cost of issuing a tax-exempt bond (administrative and legal costs, and bond interest) less that other available financing options (such as taxable bonds, bank loans, or state revolving funds)? **(Y – q.6 , N - END0)**
6. Will the planned green infrastructure investment be owned by the issuing agency? **(Y – q.7 , N - q.8)**
7. Will the bond for the planned green infrastructure investment be paid off exclusively through customer rates or charges? **(Y – END1 , N - q.9)**
8. Will the planned green infrastructure be regulated by your agency (such as a consumer rebate, incentive or interagency investment)? **(Y – END1 , N - END2)**
9. Does your agency have a demonstrable plan to generate the revenue needed to pay back the bond over the long term? **(Y – END3 , N - END0)**

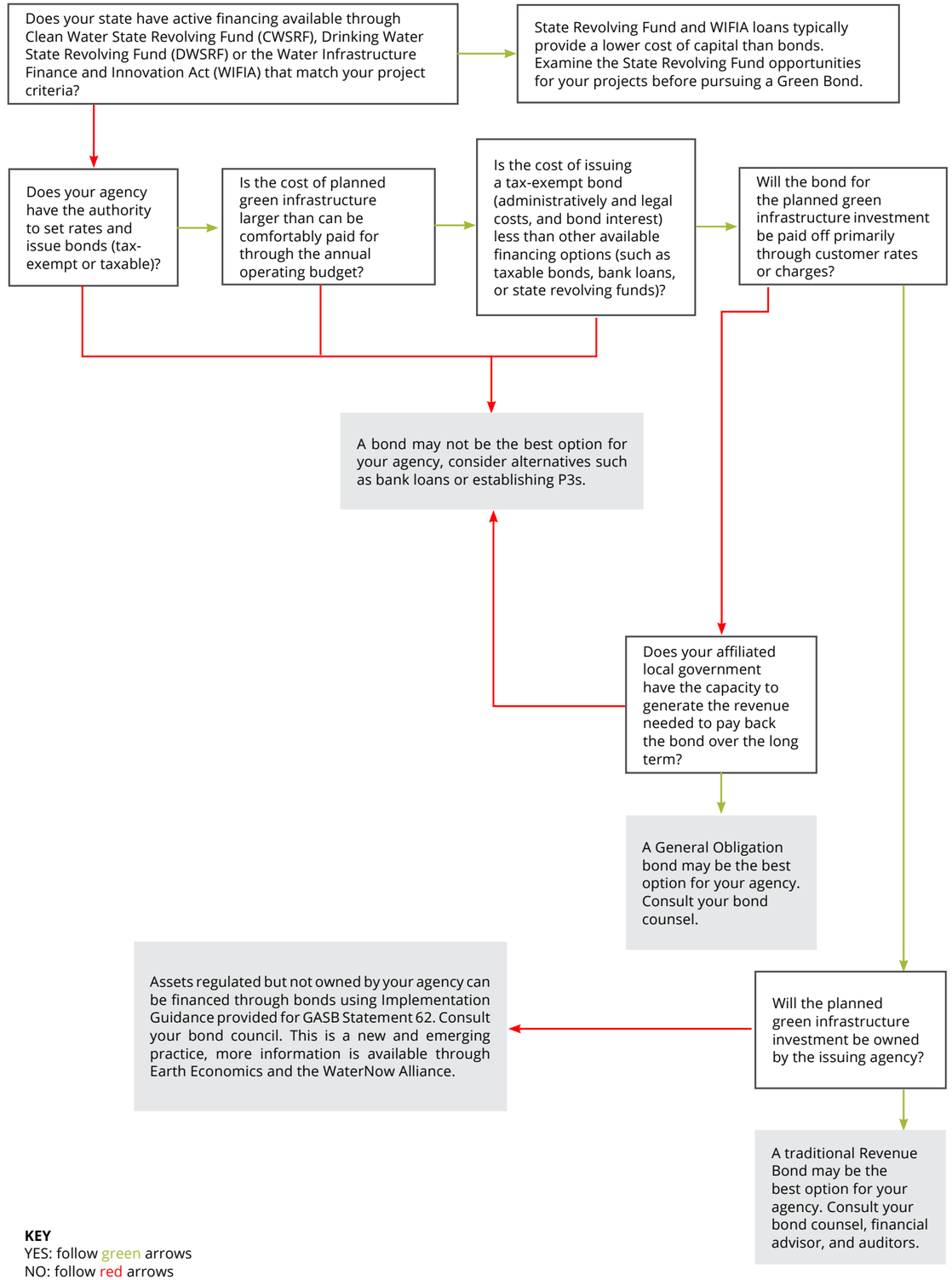
END0 A bond may not be the best option for your agency. Consider alternatives such as bank loans or establishing P3s.

END1 A Revenue Bond may be the best option for your agency. Consult your bond counsel, financial advisor, and auditors.

END2 Assets regulated but not owned by your agency can be financed through bonds using Implementation Guidance provided for GASB Statement 62. Consult your bond council. This is a new and emerging practice, more information is available through Earth Economics and the WaterNow Alliance.

END3 A General Obligation bond may be the best option for your agency. Consult your bond counsel.

END4 State Revolving Fund and WIFIA loans typically provide a lower cost of capital than bonds. Examine the State Revolving Fund opportunities for your projects before pursuing a green bond.



SO...NOW WHAT?

Fair question. That was a lot of information that covered some pretty diverse and complex topic areas. While we want to be thorough, we don't want to overwhelm, and we certainly don't want to be the cause of the dreaded analysis paralysis. On the contrary, we want you to be able to readily tailor the Blueprint to your needs in a way that empowers you to act. The following tips can help guide you through identifying priorities and acting on some manageable steps based on where you're currently at.

START A CONVERSATION

If you're like most cities, you're probably still in the CHAMPIONS stage, and if you're reading this, chances are you're one of the champions. (Thank you!) It's time to cast a wider net. Maybe you need to get on the same page with the transportation team. Maybe there's a community partner that's been eager to be part of the process, or a contractor with some big ideas. Take someone out for coffee, host a brown bag lunch, or just start asking people questions about their projects and priorities. The point is to start bringing new voices to the table. Work together to identify which voices are still missing, and how to start moving forward on shared goals.

SELF ASSESS

Where are your department, agency, and city in the process of making the Five Major Shifts? Maybe you're making progress on some but are completely stuck on others. Maybe you haven't even started. Answer the following question to get a baseline understanding of where you're generally starting from.

Which best describes your level of green infrastructure implementation?

1. We have no experience with GI planning or implementation.
2. We have completed or are starting to implement some GI demonstration projects.
3. We have some green infrastructure scattered about the city as part of uncoordinated public and private efforts.
4. We are actively prioritizing nature-based solutions in our capital planning process.
5. We are engaging the community and private contracting partners in an outcomes-driven capital planning process.

PRIORITIZE

Now that you've started talking with others about this and assessed where you're coming from, what are your greatest needs? What seems most achievable? Prioritizing is a balancing act between what needs doing and what can actually get done. Each city's priorities will look a little bit different, especially in the beginning. If your city can commit to, say, community engagement, a code review, and taking stock of natural assets, you'll be well on your way. Use your answer to the question above to help you get the process started with detailed guidance on the next page.

CONNECT

Ok, you know where you're at, where you want to go, some ways to get there, and who's going to help you get there. But, you're still stuck on some things. We can help. Get in touch with us at Earth Economics to discuss how we can support your work to implement the Blueprint.

Instructions: Use your answer from the **SELF ASSESS** question to help you **PRIORITIZE** next steps:

IF YOU ANSWERED 1:

You've come to the right place. Focus on the steps under ACCESSORIES → ASSETS and CHAMPIONS → SYSTEMS to help you build a strong foundation for entering the integrated infrastructure space. We recommend starting out by convening your internal stakeholders and identifying shared values, goals, and roadblocks around service delivery, and then loop in the community soon thereafter to understand what their needs and values are.

IF YOU ANSWERED 2:

You've probably already started some of the work under ACCESSORIES → ASSETS and CHAMPIONS → SYSTEMS. Now is the time to begin taking it to the next level by capitalizing on the lessons learned from your demonstration projects to start planning out high-value portfolios. The PROJECTS → PORTFOLIOS section of the Blueprint will help you overcome common hurdles before they even crop up. But don't neglect the work to be done under the first two shifts: community engagement, collaboration, and process improvement will make or break the best laid plans, and at this stage, they likely still need work.

IF YOU ANSWERED 3:

You're like a lot of cities, and you've probably already started some of the work under ACCESSORIES → ASSETS and CHAMPIONS → SYSTEMS and begun to at least think about the steps under PROJECTS → PORTFOLIOS. In order to get there from where you are, you'll need to really dig into your data and systems and begin taking stock of your natural capital assets as you look to integrate existing assets with new ones. You're in a bit of a messy middle zone of implementation, so you'll need to look backward and reflect in order to get aligned and move forward. Community engagement and stakeholder alignment are still paramount for you to integrate existing and new assets into a comprehensive, fully networked portfolio of community assets. Frequently, these steps receive insufficient attention at the outset, so you may actually have to give them extra attention now to identify and untangle existing issues. It may be especially helpful to hire outside resources to effectively engage the community and assist with organizational siloing at this stage.

IF YOU ANSWERED 4:

This is excellent news! You're well on your way to getting to scale. First, conduct an honest evaluation of how actively and effectively you've engaged the community and contractors thus far in the process – how can you be doing more? Second, you may be now or will be soon facing significant issues around procurement, governance, and paying for your plans. The steps and resources under SERVICE-DELIVERY TARGETS → COMMUNITY OUTCOMES and FUNDING → FINANCING can help. Steps like rethinking procurement, integrating agency mandates, and identifying and evaluating various finance mechanisms will be critical for you. At this point in the process, the need to invest in outside expertise and/or facilitation is likely greater.

IF YOU ANSWERED 5:

Congratulations! At this point, you're probably pretty focused on procurement and how to pay for your innovative, outcomes-based plans. The SERVICE DELIVERY TARGETS → COMMUNITY OUTCOMES section is important for you. In addition to rethinking procurement, it would be especially helpful for you to start focusing on formally integrating agency mandates at this point, so that accountability for your identified outcomes is effectively shared. And the FUNDING → FINANCING section will help you assess your payment options. This may require a legislative change, ballot measure, and/or close collaboration with your finance team and bond counsel.

DEFINING A STRATEGIC PHILANTHROPIC RELATIONSHIP

STATE CAPITAL | LITTLE ROCK, ARKANSAS

Since its implementation by the earliest adopters, green infrastructure has garnered significant attention and support from the philanthropic community. From demonstration projects to neighborhood improvement initiatives to shining a spotlight on community groups and equity, philanthropic funding has helped build a foundation of projects from which we can continue to build to scale. As we move from projects to programs and funding to financing, there are many strategic opportunities for the philanthropic community to engage and impact the public sector and to continue to fuel the process of mainstreaming this work. While we acknowledge that the philanthropic community is a broad categorization of diverse organizations, and that it engages in both funding and financing, the recommendations below align with the necessary shifts outlined in the blueprint above and are meant to spark further conversation about the role of philanthropy in getting green to scale.

ACCESSORIES ➡ **ASSETS**

Municipalities are aware of the power of public demand but frequently cite a lack of resources and capacity for effective community engagement. There is a major opportunity for NGOs to work with municipalities to help deliver a strong, unified message about green infrastructure and for philanthropies to bolster this capacity within municipalities. Community engagement is a primary need that municipalities have little to no capacity around and is comparatively easy to fund.

1. Consultants to educate and align on shared language and meaning
2. Community engagement training and delivery
3. General civic engagement programming
4. Green infrastructure education, mentorship programs, curriculum development, scholarships
5. Consultants to partner with cities on developing and disseminating values-based messaging

CHAMPIONS ➡ **SYSTEMS**

1. Grants as "carrots" in the behavior change paradigm that can incentivize and reward innovation in ways that government currently can't, i.e. awards for cities that adopt natural capital policies, have green requirements in their engineering RFPS, etc.
2. Temporary staff/consultants to foster collaboration and assist with desiloing
3. Programs to connect practitioners - especially engineers and finance - from cities that have had success to those in cities just starting out.
4. Funding for higher risk "living labs" (versus typical pilots and demos) with clearly defined KPI and BMP metrics as deliverables that will inform a larger program

EXAMPLE: The City of Seattle employed a temporary, grant-funded position to facilitate project collaboration between Seattle Public Utilities and Seattle Department of Transportation. A similar position in the Los Angeles Department of Water and Power was also funded by a philanthropic grant.

PROJECTS ➡ **PORTFOLIOS**

1. Life cycle analyses of existing GI assets for better long-term planning
2. Consultants to facilitate organizational change
3. Outside support to help conduct code and accounting reviews and address transactional challenges

EXAMPLE: Having spent a decade on grant-funded work alongside municipalities and directly with the Government Accounting Standards Bureau to implement a 2018 rule clarification about debt-financing green and distributed infrastructure, Earth Economics is now working under multiple grants to help utilities implement the standard.

SERVICE-DELIVERY TARGETS ➡ **COMMUNITY OUTCOMES**

1. Provide impartial conveners/arbiters
2. Consultants/staff positions to assist with desiloing and the integration of agency mandates
3. Support organizations that are facilitating regional data collection and knowledge-sharing
4. Support organizations that facilitate district-scale coalition building around GI as a shared goal

EXAMPLE: Improving the health of the Chesapeake Bay and region at-large has long been a critical goal for states within the bay's watershed. Chesapeake Conservancy is a non-profit focused on enhancing watershed-wide conservation and restoration efforts through new technology. Working across state and agency boundaries, Chesapeake Conservancy's data products and tools can be leveraged at a range of decision making scales. Their approach to large-scale, high-resolution mapping benefits both individual municipalities as well as larger inter-state efforts requiring consistent data coverage. Relying on technical expertise from the organization, partners throughout the watershed can access publicly available tools and data at the scale necessary to make effective decisions for green infrastructure goals.

FUNDING ➡ **FINANCING**

1. Assist in the review and evaluation of options and the identification of potential partners/investors

EXAMPLE: The Kresge Foundation partnership with Greenprint Partners is an innovative approach to strategic philanthropy that meets multiple imperatives. By investing in early-stage capacity building and program development for a private firm that partners with municipalities to aggregate assets in blighted neighborhoods, the partnership serves as a cutting-edge model for cross-sector finance and collaboration. It also aims to leverage scale for both acquisition of capital, but to actively put equity front and center, as under-resourced communities are empowered to access new opportunities by pooling resources as part of a larger effort.

CONCLUSION

URBAN PARK| ST. LOUIS, MISSOURI

Using extensive qualitative and quantitative research, this report has laid out a blueprint for increasing investment in green infrastructure in order to increase implementation to the scale required to meet the challenges of service delivery, population growth, and economic development in American cities in the face of climate change. The scale of the solution is defined by the scale of the challenge, and these challenges are unlike any we've faced to date. Thus, this work will require unprecedented levels of collaboration and innovative decision making at every step. It will require decisive regulation combined with community engagement and public involvement. It will require skill development and knowledge building alongside new and improved systems to catalogue and track information. And it will require strong partnerships across departments and sectors in order to access the totality of expertise and resources needed to develop the types of programs that attract large-scale investment.

As this integrated, programmatic approach promises to pioneer new investment mechanisms and new assets to invest in, the resulting benefits will go well beyond traditional returns. Comprehensive, integrated infrastructure programs move municipalities beyond basic service delivery and into community improvement and economic development for generations to come. Assets that improve quality of life in this way ensure that cities that invest in them achieve a valuable competitive advantage as they attract the diversity of talent and investment that will enable them to thrive. A variety of market signals – from green bonds to impact investments to policy changes – show that the demand for these assets is strong and rapidly growing; cities that fail to capitalize will miss out on enormous opportunities.

Getting green infrastructure implementation to scale through increased investment in comprehensive infrastructure programs poses real challenges, but it is primarily an incredible opportunity. It's an opportunity to improve the way government invests public dollars and delivers services and to increase the public's trust in these functions. It's an opportunity to increase awareness and knowledge about our wealth of natural capital as well as our responsibilities as citizens and neighbors. And it's an opportunity to create new wealth for investors, municipalities, and the public alike in the form of diverse, shared benefits. It will require significant upfront investment of resources to get where we need to be, but staying put is not an option for cities that want to offer the best opportunities to people and businesses, now and for generations to come.

APPENDIX A

QUALITATIVE METHODOLOGY: STAKEHOLDER INTERVIEWS

Selection process.

After conducting a scan of the literature on existing case studies and features, we focused on cities that were not commonly profiled in order to contribute to a more comprehensive literature on the topic. We selected cities based on a diversity of economic, social, political, and geographic factors, with an emphasis on industrial, blue-collar, and recovering economies. We also ensured representation of moderate and conservative politics and a variety of biophysical features. This enabled us to counter the perception of a "green" city as one that is wealthy and politically liberal by demonstrating that green infrastructure is being successfully implemented from Seattle to Omaha to Central Arkansas.

Data collection.

We conducted in-depth phone and in-person interviews with 29 municipal practitioners representing a variety of functional roles (e.g. engineers, project managers, attorneys, budget officers, etc.) from 20 US municipalities. We also interviewed 8 topical experts (some of whom are former municipal practitioners) from academia, NGOs, and the private sector, as well as 6 philanthropic funders, for a total of 43 cross-functional interviewees. Interviews were semi-structured, and the snowball effect was utilized to increase our sample size.

Feedback collection.

After identifying the key themes and preliminary actions that would define a blueprint for increased investment in green infrastructure, we hosted 4, hour-long, participatory webinars with interview participants. A digital version of the webinar was provided to those who could not attend, and all were given a period of at least one week to submit their feedback for incorporation.

Figure 14. Geographic Distribution of Municipal Interview Participants

We interviewed practitioners from the 20 cities above with a clear aim of covering a comprehensive representation of the country. Cities were selected based on a diversity of economic, social, political, and geographic factors, with an emphasis on industrial, blue-collar, and recovering economies. Final selection was constrained by availability, and this is made clear on the map by the gaps in the Gulf of Mexico and the Intermountain West.

Complete list of participants:

MUNICIPAL PRACTITIONERS

AMANDA HALLAUER
Watershed Management
Watershed Project Manager
Atlanta, GA

CAROLINE SMITH
Watershed Management
Senior Civil Engineer
Atlanta, GA

SUSAN RUTHERFORD
Watershed Management
Watershed Manager
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JULIE BARRETT-ONEILL
Buffalo Sewer Authority
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Buffalo, NY

RANDY EASLEY
Central Arkansas Water
Director of Water Quality
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JEFF BESSE
Water Resources Engineering Division, Water Quality Program Manager
Colorado Springs, CO

LAUREN BALDWIN
City of El Paso
Sustainabilty Program Specialist
El Paso, TX

TOMMY ESQUEDA
Fresno State University
Associate Vice President of Water and Sustainability
Fresno, CA
Formerly of City of Raleigh, NC and City of Portland, OR

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Louisville and Jefferson County Metropolitan Sewer District, Engineer
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JASON DEMPSTER
Louisville and Jefferson County Metropolitan Sewer District
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Metropolitan Sewerage District, Management and Budget Analyst
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GI Program and Policy Manager
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MEGAN ZEIGLER
Water and Sewer Authority
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Portland Water District
Water Resources Specialist
Portland, ME

PAUL THOMAS HUNT
Portland Water District
Environmental Services Manager
Portland, ME

ADAM ORTIZ
Director, Department of the Environment
Prince George's County, MD

GREG CANNITO
Partnership Innovator, Corvias
Prince George's County, MD

BOB HENNESSEY
Seattle Public Utilities
Lobbyist
Seattle, WA

SHANTI COLWELL
Seattle Public Utilities
GSI Manager
Seattle, WA

CADIE OLSEN
City of Spokane
Environment and Sustainability Coordinator
Spokane, WA

LARS GILBERT
City of Spokane
Principal Planner
Spokane, WA

ANDREW WORLOCK
University District
Principal Planner
Spokane, WA

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Metrolpolitan St. Louis Sewer District, Principal Engineer
St. Louis, MO

BRUCE LITZSINGER
Metrolpolitan St. Louis Sewer District, Director of Planning
St. Louis, MO

DEVON DOUGLASS
City of Tulsa
Chief Resilience Officer
Tulsa, OK

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Wilammette Partnership
Clean Water Program Manager

RHYS ROTH
Center for Sustainable Infrastructure at Evergreen
State College, Director

PETE PLASTRIK
Innovation Network for Communities, Partner

SUSANNA SUTHERLAND
Sutherland & Associates
Principal
Former Sustainability Director of Knoxville, TN

PAULA CONNOLLY
Green Infrastructure Leadership Exchange
Director

SETH BROWN
Storm & Stream Solutions
Principal

JOHANNA BOZUWA
Democracy Collaborative
Research Associate

SARAH DIRINGER
Pacific Institute
Senior Researcher

JALONNE WHITE-NEWSOME
The Kresge Foundation
Senior Program Officer, Environment

KIM DEMPSEY
The Kresge Foundation
Deputy Director, Social Investment Practice

DIANE SCHRAUTH
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ANN FOWLER WALLACE
Funders' Network for Smart Growth and Livable Communities
Director of Programs

STEVE WHITNEY
The Bullitt Foundation
Senior Program Officer

DENNIS CREECH
The Kendeda Fund
Fund Advisor for Sustainability

APPENDIX B

QUANTITATIVE METHODOLOGY: ECONOMETRIC ANALYSIS

REGRESSION ANALYSIS

Our scan of the (applied and scholarly) literature returned no studies that provide a solid, empirical analysis for the determinants of either green infrastructure adoption or investment level. While there are some survey-based academic analyses of green technology adoption at the firm level and numerous anecdotal accounts of municipal drivers, we were unable to find municipal-level analyses of investment behavior. We used a mathematical approach called multivariate regression analysis to isolate the impacts of multiple independent variables on a single dependent variable in a linear equation. While limited by the constraints of available data, which is scarce for green infrastructure investment, it provides reasonable proxies and sheds light on both the measurable drivers of investment behaviors as well as the fact that much more econometric research is needed in this area. We used the statistical analysis program R to conduct an Ordinary Least Squares regression analysis of the determinants of investment in urban tree canopy. Our equation is as follows:

```
totalinvest <-  lm(Intotalinvest ~ Population_From_Census + SWutility_dummy +  graduateorprofessional +
                Per_capita_income + Median_income + long + lat + percent_commute_alone_bycar + Percent_
                commute_walk + humidity + soil + State_Debt_Per_Capita + State_Local_Debt_Per_Capita + state_
                leansD + state_leansR + Percent_over_16_inlaborforce + Binary_Number_of_MS4_Violations, data =
                GreenInvestData )
```

This equation allows us to pinpoint the effects of the following variables on urban tree canopy investment levels: population, available revenue sources, education level, debt level, political climate, employment level, and regulation.

The most significant variables are discussed at length on pages 21-22. Other variables, like longitude and latitude, humidity level, median incomes, and state debt level were all significant, but their impacts on investment levels were less than one percent each. Variables like soil type, city debt level, and city-level political leaning had no impacts. This indicates that much of the decision making around city-level green infrastructure investment is tied to state budgets and politics. We also created variables for the level of vote share earned by the favored political party per city in an attempt to measure the effects of political cohesion, assuming this could loosely approximate trust in government. This was to determine whether trust in government, regardless of political party, lead to greater levels of investment, because this notion was reiterated throughout our interviews. While vote share may indeed indicate strong political cohesion, this alone does not increase investment in green infrastructure.

DATA

Data on city tree expenditures was provided by the Arbor Foundation, and was collected as a part of their Tree City USA program. The Arbor Foundation highlights cities which meet specific tree spending and investment criteria as “tree cities.” Nearly 3,000 cities are included within their dataset. Most, but not all, are currently designated as “tree cities.” Demographic information, such as population, income, and commuting habits were collected through the US census. Geospatial information – such as longitude and latitude, regional soil types, and humidity – was collected from US Geologic Survey Hydrologic Landscape Regions data. State and local debt information was collected from the Tax Foundation. Political data was collected from the Pew Research Center and Harvard University.

RESULTS

PREDICTORS	ESTIMATES	CONFIDENCE INTERVAL	P VALUE
(Intercept)	12.15	9.73 – 14.58	<0.001
Population from Census	0.00	0.00 – 0.00	<0.001
Stormwater Utility (Binary)	1.04	0.91 – 1.16	<0.001
Graduate or Professional Degree	7.65	6.54 – 8.76	<0.001
Per Capita Income	-0.00	-0.00 – 0.00	0.086
Median Income	-0.00	-0.00 – -0.00	<0.001
Longitude	-0.00	-0.02 –-0.01	<0.001
Latitude	-0.06	0.07 – -0.04	0.065
Percent Commute Along by Car	-0.8	-7.54 – -4.20	<0.001
Percent Commute on Foot	-5.87	-0.16 – -0.02	0.015
Humidity	-0.09	-0.21– 0.00	0.053
Soil Type	-0.10	0.00 – -0.00	<0.001
State Debt Per Capita	0.00	0.00 – 0.00	<0.001
State Local Debt per Capita	-0.00	-0.00 – -0.00	0.015
State Leans Democratic	1.79	-0.72 – 4.30	0.161
State Leans Republican	-3.03		0.012
Percent of Individuals over age 16 in the workforce	-3.03	-5.40 – -0.66	<0.001
Have MS4 Violation	0.79	2.05 – 3.54	<0.001
Observations	2699		
R^2 / adjusted R^2			0.410 / 0.407

Figure 15. Predictors or Investment in Trees and Tree Related Services

The table above provides a complete list of all regression variables, coefficients, and significance levels from our econometric analysis of the determinants of investment in urban tree canopy.

APPENDIX C

A CLOSER LOOK AT INFRASTRUCTURE SPENDING STREAMS

FUNDING BY SECTOR

Highway Funding

Highways are the largest infrastructure expense, receiving approximately $165 million in federal, state, and local funds each year. Vehicle taxes – both state and federal – provide nearly half of funding, and general fund support provides an additional 30%. General fund support is not expected to increase, especially at the federal level, without changes to the rate and structure of the gas tax.[32] Unlike other infrastructure sectors, highways receive very little (less than 10%) of their funding from user fees.

Mass Transit Funding

Transit funding is determined primarily at the departmental and local level. 23% of transportation funding comes from passenger fares, and an additional 11% is directly generated from related revenue sources such as park-and-ride fees and advertising space.[33] Local governments contribute nearly a quarter of transit funds, largely through general funds collected in the form of taxes. State funding comprises 22% of total investment, and is largely made up of gas and vehicle tax revenues. Although passenger fares are the largest single funding source of mass transit infrastructure, they comprise less than a quarter of total mass transit expenditure.

Water Infrastructure

Water Infrastructure is predominately funded by state and local expenditures. Federal involvement in water infrastructure has declined significantly in recent decades.[34] A small amount of federal funding is dispersed through subsidized grants and local funding, but the majority of federal dollars are spent through direct expenditure to federally controlled infrastructure projects such as dams and levees. The Department of Housing and Urban Development Community Development Block Grant (CDBG) provides general purpose funding for low- and moderate-income areas and is often applied to drinking and waste water projects. The Department of Commerce Economic Development Administration administers a Public Works program to upgrade drinking and waste water projects.[35] State and local funding comprises the remainder of water infrastructure spending. Although some state grants are included in this category, most of this funding is driven by user fees.[36] User fees are estimated to recoup more than 90% of water utility expenditures.[37]

Aviation Infrastructure

Aviation infrastructure is near equally funded from federal, state, and local sources. Across all aviation funding streams, fuel taxes and airport fees comprise the vast majority of the funding base.[38]

Other Infrastructure Spending

The Congressional Budget Office tracks infrastructure spending on highways, mass transit, water resources and utilities, and aviation in a more precise manor than other infrastructure spending. However, several other categories play a significant role in funding profiles. Education infrastructure is a large expense for state and local governments, estimated to average approximately $80 billion annually. The federal government does provide funding to education, and is playing an increasingly large role in education investment.[39] However, federal education investment is not tied to infrastructure. Most education infrastructure funding comes from state and local property and income taxes.[40] Police and fire capital outlays, electrical and gas utilities funding, and parks and recreation funding receive significant financial allocation from state and local governments.[41]

FINANCING

Bonds

Publicly held bonds are debt obligations that a state or locality sells to investors in order to access upfront capital needed for an infrastructure project. Bonds are either issued as General Obligation or Revenue. General Obligation bonds can be repaid with any governmental funds, such as property taxes or sales taxes. Revenue bonds must be repaid with specific user generated revenues, such as user fees. These bonds are most commonly issued by utilities.[42]

Tax Exempt Bonds

The most ubiquitous form of financing is tax-exempt municipal bonds. Nearly $450 billion in municipal bonds were issued in 2016. More than half of these bonds were issued for general purpose capital improvement plans and education projects.[43] Interest from these bonds is tax free, which is attractive to investors. The majority of municipal bonds are held by tax payers. These bonds are typically paid back over 5 - 30 years and have interest rates that are usually near or below treasury rates. In order to receive tax exempt status, these bonds can only be applied to projects that solely benefit the private sector.

Private Activity Bonds

Private Activity Bonds (PABs) can be issued for projects such as airports, docks, and infrastructure used by private utilities that are ineligible for tax-exempt bonds. About $37 billion in PABs were issued in 2018, less than 1/10th of tax-exempt bond issuances.[44]

Alternative Tax-Preferred Bonds

Alternative Tax-Preferred Bonds – including direct pay bonds – are not tax exempt, but a portion of interest paid on these bonds is subsidized by the federal government. These bonds are less common than standard tax-exempt or private activity bonds but still comprise a significant share of the market.[45] Build America Bonds (BABs) were a common form of direct pay bonds that expired in 2010 without renewal.[46]

Green Bonds

Green bonds are not a separate class of bond, but rather a description of projects financed in a bond issuance. Green bonds are an issuer-defined designation for financing of green infrastructure projects. Because green bonds are not a formal class of bond, there is no verification that the financed projects are environmentally positive.[47]

Environmental Impact Bonds

Environmental Impact Bonds (EIBs) are an emergent funding strategy for environmentally aligned infrastructure projects. EIBs use a “pay-for-success” model to mitigate bond issuer risk. EIB project outcomes are monitored (such as gallons of polluted water captured by a natural storm water asset). If outcomes are above the estimates, the bond issuer will pay an additional premium to bond holders. If outcomes fall below estimates then the bond issuer will receive back a portion of their owed interest.[48] The first EIB was issued by Washington DC in 2016, and EIBs are now components of multi-billion-dollar stormwater infrastructure projects in Louisiana, Atlanta, and Baltimore.[49]

(FINANCING CONTINUED)

Publicly Subsidized Loans

Infrastructure projects are also commonly financed through loans. Federal and state governments provide subsidized loans for qualified infrastructure projects that provide discounted access to capital.

Transportation Infrastructure Finance and Innovation Act

The Transportation Infrastructure Finance and Innovation Act (TIFIA) is a program that provides federally subsidized financing for highways, mass transit, and other transportation projects. TIFIA loans are ultimately owned by outside investors, but are guaranteed and partially paid by the federal government. TIFIA rates are tied to treasury rates and provide up to 5-year payment deferral.[50]

Water Infrastructure Finance and Innovation Act

The Water Infrastructure Finance and Innovation Act (WIFIA) is a counterpart to TIFIA intended for water infrastructure projects. The WIFIA program was developed in 2014, and has been used to finance more than $1 billion in water infrastructure projects, including green infrastructure, energy efficiency projects at water supply facilities, and risk mitigation projects.[51]

CWSRF/ DWSRF

The Clean Water State Revolving Fund (CWSRF) funds water quality protection and water management projects. The Drinking Water State Revolving Fund (DWSRF) funds drinking water infrastructure improvements and pollution reduction projects. The funds provide low-cost financing for local water-related infrastructure and combine federal and state subsidization to provide interest rates far below market rates. They have funded nearly 50,000 projects since their development in 1987. Eligible projects include development of wastewater facilities, green infrastructure developments, control of nonpoint source pollution, and improving source water supply.[52, 53]

GREEN INFRASTRUCTURE OPPORTUNITIES

Rural Development Water and Environmental Program (WEP)

The USDA Rural Development Water and Environmental Program (WEP) provides loans for communities of 10,000 or less to develop water and wastewater infrastructure. In addition to loans, the WEP program provides grants and technical assistance to eligible communities, totaling $1.7 billion in federal funding in 2016.[54]

Public-Private Partnerships (P3s)

Public-Private Partnerships (P3s) are agreements between public entities and private companies to develop or maintain infrastructure projects. P3s are typically structured as leases from the public agency to a private operator. The transportation sector is a common venue for P3s. Several counties and states have leased the rights to operate a section of roadway to a private company for an upfront payment. In exchange, the private company has both the obligation to maintain the roadway, and the right to collect tolls on it. 30% of Seattle's treated drinking water is procured through a P3 arrangement. Seattle Public Utilities contracted the design, development, and operation of Tolt Water Treatment Facility to American Water CDM. The facility has been in operation since 2001, and is contracted through 2021. The P3 is believed to deliver significant cost savings for the city.[55]

State Infrastructure Banks

State Infrastructure Banks are dedicated funds used to finance local infrastructure projects from state funds. Cities and counties can borrow from the State Infrastructure Bank at a lower rate than from a conventional bank, and in many cases receive some grants or matching funds from the state as part of the loan agreement. Every state and territory has a Waste/Wastewater Fund which is a key component of the CWSRF/DWSRF programs. Many states also have dedicated Clean Energy and Transportation funds. State clean energy funds have been used to finance over 70,000 clean energy projects ranging from residential solar installations to biomass generation plants. Transportation banks work in largely the same way; many of these banks are used to pool debts from small communities into larger, more cost-effective loans that can be financed through combinations of state investment and bond sales.[56]

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