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ASSESSMENT OF POLICIES FOR INNOVATIVE FINANCING IN INFRASTRUCTURE SYSTEMS

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Challenge of Infrastructure Financing

Infrastructure systems are drivers of the economy in the nation. A dollar spent on infrastructure development yields roughly double the initial spending in ultimate economic output in the short term; and over a twenty-year period, and generalized ‘public investment’ produces an aggregated \$3.21 of economic activity per \$1.00 spent [1]. Thus, formulation of policies pertaining to infrastructure investment and development is of significance affecting the social and economic wellbeing of the nation. The aim of this policy brief is to evaluate innovative financing in infrastructure systems from two different perspectives: (1) through consideration of the current condition of infrastructure in the U.S., the current trends in public spending, and the emerging innovative financing tools; (2) through evaluation of the roles and interactions of different agencies in the creation and the diffusion of innovative financing tools. Then using the example of transportation financing, the policy brief provides an assessment of policy landscapes which could lead to the closure of infrastructure financing gap in the U.S. and proposes strategies for citizen involvement to gain public support of innovative financing.

Infrastructure investment in the U.S.

In 2013, the American Society of Civil Engineers (ASCE) gave U.S. infrastructure a grade of "D+" (deficient). An investment of \$3.6 trillion was estimated to be required between 2013 and 2020 to improve the current condition of the infrastructure to a functionally good condition [2]. The World Economic Forum’s *Infrastructure Index* ranks the U.S. infrastructure fourteenth among different countries around the globe [3]. Currently, the U.S. government spends an amount equal to 3.3 percent of its GDP on domestic infrastructure investment [4]. However, this fiscal space for infrastructure development is not sufficient to address the renewal needs. For instance, (i) transportation systems require about \$20 billion more annually to keep services at current levels [5], (ii) the electric utilities industry will need to make a total investment of at least \$1.5 trillion between 2010 and 2030 to keep pace with demand [6], and (iii) drinking water and wastewater systems need an average annual investment of \$24.6 billion to \$41 billion for the years 2000 through 2019 [7]. Based on the estimate of the US Environmental Protection Agency [8], there is a \$334.8 funding gap to improve the condition of water infrastructure in the US. On a similar note, ASCE [2] states that, the available fiscal space is only sufficient to meet 50% of the need for restoring infrastructure.

Rutledge-Connery [9] and the National Academy of Science (NAS) [10] stressed the significance of investment in infrastructure as an opportunity for sustainable development. For example, investment in highway infrastructure enhances mobility and reduces the level of emissions due to congestion; investment in water infrastructure enhances public health; and investment in sustainable energy enhances energy security by reducing the dependency on fossil fuels.

Global trends in infrastructure investment

According to the estimation of the Organization for Economic Cooperation and Development (OECD), the global average investment need for infrastructure development is about 4.2 percent of the global GDP [4]. The European Union spends 3.1 percent of its GDP while China invests about 9 percent of its GDP on infrastructure development [4]. Both Europe and the U.S. recently experienced fiscal deficit which is expected to last until 2016., and this situation is expected to exacerbate the financing gap for infrastructure renewal. The importance of infrastructure development for economic growth and the insufficiency of fiscal space for addressing the investment need in infrastructure have led to the emergence of innovative financing tools. Innovative financing offers new financing tools and mechanisms for funding, financing, and delivering infrastructure projects that complement traditional mechanisms to expand the fiscal space of public agencies for infrastructure development.

Financial Innovations: Thinking outside-the-box

Infrastructure financing consist of three different components: *financing*, *funding*, and *delivery*. *Financing* helps to bridge the time gap between the need for funds and their generation by the project or other fund providers while *funding* generates the financial resources to cover expenditures and amortize the financing, and *delivery* includes the modes for the construction and the operation of the infrastructure. Infrastructure is financed either on a pay-as-you-go basis (earmarking funding revenues to infrastructure projects) or by borrowing. Taxation and user fees are the only methods of funding. Infrastructure is delivered either publicly or privately, or through varying combinations of public/private partnerships (such as build-operation-transfer, leaseback agreement, joint venture, and concession) [11] and [12]. Innovative financing in infrastructure can be defined as development of new financing and funding approaches that complement the governmental fiscal space to address existing challenges and to enhance sustainable infrastructure. Innovative infrastructure can be evaluated in different contexts (e.g., sectoral, geographical, and industrial), and the definition of innovative infrastructure can vary from sector to sector.

Innovative financing tools: U.S. transportation infrastructure

In the context of the U.S. infrastructure, transportation infrastructure has been traditionally financed using state and federal grants, funded by taxation, and delivered by public agencies. Three *categories* of financial innovation could exist: (a) different use of traditional financing and funding tools (e.g., earmarking property taxes for capital investments); (b) creation of new tools

(e.g., build America bonds or new public-private-partnership (PPP or P3) models); and (c) use of familiar financing and funding tools employed in other sectors (e.g., the Grant Anticipation Revenue Vehicles (GARVEE), which has been used for financing water infrastructure) [11]-[14].

In the early 1990s, the Federal Highway Administration (FHWA) recognized the need to expand investment in the nation's transportation infrastructure and launched a comprehensive initiative (ISTEA) to create new systems and expanded the flexibility of the federal-aid highway funding program. This innovative financing initiative was an attempt to meet the increasing gap between the transportation capital needs and the available resources without direct increases in federal grant funding. The total capital investment by all levels of government was \$64.6 billion in the year 2000, well short of the \$106.9 billion needed (42.3 billion short) to improve the system [15]. The initiative also responded to the call by states for greater flexibility in the use of their federal-aid funds [16]. The following innovative financing approaches were developed:

Advance Construction: The advance construction approach facilitates the acceleration of cash flows. State or local governments independently secure the up-front capital required for a federally-approved project, thereby preserving eligibility for future federal-aid reimbursement for that project. At a later date, the state can obligate federal-aid highway funds for reimbursement of the federal share. This approach allows states to take advantage of access to a variety of capital sources, including its own funds, local funds, anticipation notes, revenue bonds, bank loans, etc., to speed project completion [16].

Tapering: Tapering is defined by the USDOT [16] as allowing the federal/non-federal share of payments to vary over the life of a project, as long as the appropriate matching ratio is achieved by the end of the project. Thus, state transportation agencies could start their projects with the federal share of the payments and supplement the non-federal share when the funding is available. Hence, tapering leads to accelerating the projects.

Toll Credits: "Section 1044 of the Intermodal Surface Transportation Efficiency Act permitted states to apply the value of certain highway expenditures funded with toll revenues toward the required state match on current federal-aid projects" [16].

Flexible Match: A flexible match includes any non-federal match that is allowed under FHWA laws and regulations, other than state and local cash contributions to a project, and includes use of private cash and in-kind contributions, publicly owned right-of-way, and funds from other federal agencies [16].

Grant Anticipation Revenue Vehicles (GARVEE): "A GARVEE is any bond or other form of debt repayable, either exclusively or primarily, with future federal-aid highway funds under Section 122 of Title 23 of the United States Code. Although the source of payment is federal-aid funds, GARVEEs cannot be backed by a federal guarantee, but rather are issued at the sole discretion of, and on the security of, the state issuing entity" [16].

State Infrastructure Banks (SIBs): SIBs are defined by USDOT [16] as state or multi-state revolving funds that provide loans, credit enhancement, and other forms of financial assistance to surface transportation projects.

Section 129 Loans: "Section 129 of Title 23 of the U.S. Code permits states to use federal-aid funds to make loans to any federally eligible project. The loans must be repaid with a dedicated, non-federal source" [16].

Transportation Infrastructure Finance and Innovative Act (TIFIA) Loans: TIFIA provides federal credit assistance in the form of direct loans, loan guarantees, and standby lines of credit to finance surface transportation projects of national and regional significance.

Innovative financing tools: U.S. water infrastructure

Traditionally, drinking water infrastructure investments have been largely financed by local water sale revenues and private market debt [8] with about 20% of the capital funded by the federal government [17]. Emerging innovative financing tools for water infrastructure include the following:

Private Activity Bonds (PABs): PABs are issued by state and local governments, and many are tax-exempt for a range of qualified projects. However, these qualified tax-exempt bonds are subject to a federally imposed cap that limits the number that can be issued in states each year, which is about \$32 billion. Since the interest income earned by buyers of PABs is not subject to federal income taxes, bond issuers can benefit from lower interest rates and ultimately realize greater cost-savings in projects [18].

The Water Infrastructure Finance and Innovation Authority (WIFIA) Loan: In Spring 2013, legislation was introduced to establish a TIFIA-like loan program for the water sector which was approved by the Environment and Public Works Committee on March 20, 2013 [19]. "If passed, the Act would authorize the U.S. Treasury to lend \$50 million annually over five years directly to large water projects or to state revolving funds, which allow states to provide low-interest loans to water utilities to make infrastructure improvements to comply with federal standards. Typically funded by federal money set aside through appropriations, these state revolving funds also rely on state matching dollars (federal funding granted with a caveat for matching state money) and investments and loan repayments." [19] The use of WIFIA loan could enhance the creditworthiness of water projects and encourage the involvement of private institutional investors in financing and delivery of water infrastructure projects.

Water Infrastructure Now Public-Private Partnership Act (WIN P3 Act): In 2013, Water Infrastructure Now Public-Private Partnership Act was introduced by the congress to create a pilot program to explore public private partnership in water infrastructure. The bill authorizes the U.S. Corps of Engineers to accept 15 flood protection projects using P3 arrangements. The bill will not be applicable to municipal water and wastewater projects. However, the success of the pilot program could lead to further expansion of P3 financing in water infrastructure in the U.S.

Innovative financing tools: Global infrastructure

Innovative financing has been adopted in different forms of Public-Private partnerships (P3) in different countries in Europe, East Asia, and Australia. Initial P3 investment in 1995 in Europe (e.g., Spain, Portugal, and England) was about 2 billion Euros. It increased to about 25 billion Euros in 2010 [20]. P3 investment has contributed to infrastructure development in an amount equal to 4%-8% of public investment in different European countries. The United Kingdom and Portugal had P3 investments equal to about 25 percent of their public investment in infrastructure systems between 2001 and 2006 [20].

After the financial crisis in 2008-2012, the level of P3 investments in infrastructure in Europe decreased since private investors were not able to access the capital markets due to the collapse of monoline insurance companies as well as sovereign bond crisis. In 2012, the European Union started the *Europe 2020 Project Bond Initiative* to provide loan credit assistance to significant infrastructure projects in Europe and to encourage the participation of private investors. The bonds would be issued by the project company, while the European Investment Bank (EIB) would provide credit assistance in the form of subordinate instruments.

Drivers of Financial Innovations: From Factors to Actors

A key to expansion of innovative financing is sustainable policy-making. Exploration of the micro-behaviors and interactions of the different players involved in financing infrastructure is a key step in policymaking pertaining to innovative financing of infrastructure. Creation and diffusion of innovative financing tools is affected by the activities and interactions of different players [21]. In this section of the policy brief, using the example of highway transportation infrastructure, the activities and interactions of different players related to innovative financing is evaluated. The analysis underlying this discussion is based on a study conducted by Mostafavi et al. [22]. Using a systemic approach along with case studies and interviews with different agencies involved in infrastructure financing, Mostafavi et al. [22] investigated the drivers and inhibitors of innovation in transportation infrastructure financing. A similar evaluation would be essential for the assessment of the drivers of innovative financing in other infrastructure sectors.

The major groups of players in the highway transportation infrastructure financing process include the following: federal and state agencies, global and national institutional investors, and the general public. The group of federal players includes the federal government (e.g., legislative components such as the U.S. Congress), the Federal Highway Administration (FHWA) within the USDOT, and stakeholder groups such as the American Association of State Highway and Transportation (AASHTO). State entities include its department of transportation, state legislature, governor's office, and in certain cases, ports, transit, and toll road authorities. Institutional investors include investment banks, venture capitalists, wealth firms, and pension funds. Examples of global institutional investors include Macquarie Group, Cintra, Meridiam, and Brisa; and an example of a national institutional investor is Goldman Sachs. Consulting and advising firms, as well as law firms, constitute another group of players, and include Jacobs, Parsons Brinckerhoff, and AECOM, among many others. Finally, the general public, as end users of the system, is an important group of players.

Federal agencies

The federal government facilitates invention and diffusion of innovative financing systems through policies. An example of such policies is the Transportation Infrastructure Finance and Innovative Act (TIFIA), which provides federal credit assistance in the form of direct loans, loan guarantees, and standby lines of credit to finance surface transportation projects of national and regional significance.

FHWA developed the Office of Innovative Program Delivery (OIPD) to enhance innovative financing of transportation infrastructure through "learning" the best financing practices in other sectors and in other countries and creating guidelines to be used by state DOTs (FHWA 2010) and other project sponsors. Similarly, AASHTO's Center of Excellence in Project Finance (CEPF) was developed to build institutional capacities pertaining to innovative financing. This center partners closely with OIPD for resource development and deployment. All categories of financial innovation (i.e., different uses of traditional tools, development of new tools, and adaptation of familiar tools from other sectors and countries), as defined in the definition phase, are of interest to the CEPF and the OIPD.

State agencies

Innovative financing policies and best practices guidelines developed by federal agencies are provided to state partners, including state DOTs for adaptation and deployment when financing projects. State governments practice innovative financing based on their transportation infrastructure development plans and needs. Based on the analysis of the responses to the survey deployed to the state DOTs, the major objectives of implementing innovative financing include: enhancing public benefit, economic development and job creation, and reducing project costs.

State DOTs adopt policies developed by federal agencies and on their own based on their needs, the characteristics of projects (e.g., project risks, possibility of tolling in the project, and project priority, among others) and prevailing economic conditions such as a recession or unstable financial market conditions. To evaluate the current state of practice related to innovative financing of transportation infrastructure in the U.S., Mostafavi et al. [22] deployed a survey state DOTs in Summer 2011. Twenty two (22) state DOTs responded to the survey. The results of the survey deployed to the state DOTs revealed that 55% of the states considered the efforts of the USDOT and FHWA towards innovative financing to be effective in terms of addressing their financing needs. In particular, tools such as advance construction, toll credits ("soft match"), Grant Anticipation Revenue Vehicles (GARVEE), and State Infrastructure Banks were considered to be the most effective innovative financing tools facilitated by the federal agencies.

Thus far, Sunbelt states such as Florida, Virginia, and Texas which face significant capacity needs have implemented innovative public-private partnerships (P3), such as availability payment and concession deals. As the states began practicing innovative financing, they learned to develop more refined innovative mechanisms. For instance, as Texas DOT increased the use of shadow tolling for facilitating private investments, a "pass-through financing" program was developed in 2008 that led them to consider the possibility of tolling for each project whether it is financed by private investors or utilizes federal or state grants. Furthermore, once a state succeeds in using a specific innovative financing system to close the financing needs for meeting

infrastructure demand, its success gains the attention of other states. Early adopters of innovative financing have tended to communicate their best practices with the other players directly and through public forums, industry forums and conferences, and working with trade associations and other transportation stakeholders to promote innovative financing. These interactions could lead to diffusion of innovative financing in other states. For instance, the states of Georgia and North Carolina have adopted the innovative financing approaches which were initially adopted by Florida, Virginia, and Texas.

Institutional Investors

Institutional investors invest equity in infrastructure, either through infrastructure funds or through concession agreements. These investors seek a long-term stable return (inflation-indexed return) that matches their equity investment portfolios. Global institutional investors who invested in mature markets such as Australia, Spain, and England since the early 1990s started to participate in financing U.S. transportation infrastructure in the (early-mid) 2000s. For instance, the Macquarie Group (from Australia) and Cintra (from Spain) invested in infrastructure in their own countries for over ten years before investing in highway projects in the U.S. (e.g., Chicago Skyway Bridge, Indiana Toll Road, and North Tarrant Expressway). The inclusion of global investors is a form of P3 for financing transportation infrastructure in the U.S.

In addition to equity investment, institutional investors (both global and domestic) can engage public agencies at either the national or state level about the process and the potential benefits and costs of the P3 arrangement. In fact, private institutional investors (e.g., Macquarie, Cintra, and Brisa) are pushing the frontiers of innovative financing by using their long-established expertise based on their experiences in financing infrastructure projects in different countries. Greater involvement of the private sector in infrastructure development, financing, and management leads to greater potential for innovation. The objectives of institutional investors regarding the implementation of innovative financing are to diversify their portfolios, obtain appropriate returns on their invested capital, and enter new markets, and hence may be different from those of public agencies. Thus, the institutional investors are motivated to innovate and create tools and mechanisms that make an infrastructure investment opportunity desirable for their investment portfolios. Institutional investors may use the tools provided by public agencies to develop a mechanism which is appropriate for the project of mutual interest. For instance, in the case of the North Tarrant Express project in Dallas, Texas, institutional investors (Cintra, Meridian Infrastructure, and the Dallas Police and Fire Pension System) took advantage of TIFIA loans to enhance the creditworthiness of the project in the absence of bond insurers (“monolines”).

When federal and state agencies set policies and programs for P3 in infrastructure, they send signals of their interest and the degree of their willingness to engage with private partners to invest in the country's infrastructure. As a case in point, the Texas DOT's pass-through financing program created opportunities for private partners to participate in transportation infrastructure investments in the state. As leading institutional investors start to experience successful investments, other investors are encouraged to enter infrastructure markets. In 2009, for example, the Texas Police and Fire Pension System invested in the North Tarrant Express project in Dallas. It was the first equity investment by a public pension fund in transportation infrastructure

in the U.S. This pension system considered the infrastructure investment market after observing successful infrastructure investments made by other pension funds, such as Australian pension funds and the Ontario Municipal Employees Retirement System, which made investments in infrastructure markets in Australia and Canada, respectively. However, the key to enhancing the participation of private institutional investors for implementing innovative financing is for such investors to understand the perspectives and operating environment of public agencies.

The General Public

The general public plays an important role in the development and/or the adaptation of innovative financing systems because user fees and taxes are used for funding infrastructure. Public perception is an important factor to be considered in evaluating innovative financing because innovative mechanisms, due to their novelty and complexity, are not readily understood by the general public. Therefore, it is important to educate the general public regarding the existing condition of the nation's infrastructure, the growing demand for investment, and the potential benefits and costs of innovative finance. Educating the general public could reduce the likelihood of public objections to adoption of innovative financing. Implementation of innovative financing might be perceived as disadvantageous, especially when it is seen to undermine public interests. For instance, mechanisms which include user-fee funding and long-term concession agreements have raised public concerns in recent years. The proposed leasing of the Pennsylvania Turnpike is a good example of the role of public perception and the impact of public and political objections. In 2007, the Governor of Pennsylvania announced his intention to lease the Pennsylvania Turnpike and implement tolls on I-80. When the Pennsylvania Turnpike Commission (PTC) applied to FHWA to permit tolling of I-80, there was objection among community and business groups to the increased costs to travel on the roadway as a result of leasing the Turnpike as well as the distribution plan of the upfront concession payment. Subsequently, there was political opposition and a state senator requested the U.S. Secretary of Transportation to turn down the application for leasing the Turnpike. Ultimately, the concession plan was rejected by the Pennsylvania legislature and the tolling application was not accepted by FHWA.

Landscape of Sustainable Financing Policies

The level of investment in infrastructure systems is affected by the activities and interactions of different agencies. Also, there are uncertain factors, such as economic and financial market conditions, affecting the dynamics of infrastructure investment [23] - [25]. Evaluation of financing policies in infrastructure requires an integrated assessment which captures the micro-dynamics of different players as well as the impacts of uncertainties. To evaluate sustainable policies for closing the financing gap in the U.S., Mostafavi et al. [26] created a policy analysis model that captures the dynamics of investment in highway transportation infrastructure. The objective of this policy model was to explore highly likely scenarios for the closure of the financing gap in the U.S. highway transportation infrastructure based on capturing and simulating the micro-behaviors of the key agencies. Examples of micro-behaviors of players considered in this model include: (1) equity investment decision-making by private institutional investors; (2) bond issuance decision-making by state Departments of Transportation; and (3)

infrastructure development support by general public. The model facilitates simulation and visualization of the impacts of various financing policies (Figure 1). In Figure 1, the level of the financing gap (i.e., financed-to-need ratio) is visualized using colors (i.e., red represents hundred percent financing gap and green represents zero percent financing gap) that represent different levels of financed-to-need ratio values under different policy scenarios. Using the policy analysis model, the landscape of policies which would lead to the closure of financing gap in the U.S. highway transportation sector was simulated [26]. Based on the findings of the policy analysis model, the following recommendations were made for closing the financing gap [26]: i) expansion of pay-as-you-go capacity, ii) expansion of P3 market, and iii) increase of bond financing.

Expansion of pay-as-you-go capacity

Currently more than about 50% of funding for highway infrastructure investment is provided by federal funds and state gas tax. Given the fiscal deficit of the federal government, expansion of the pay-as-you-go capacity requires policies to: 1) increase the revenues to be used as the source of funding by identifying new revenue streams, and 2) reduce project costs so that more infrastructure facilities can be built using current revenues. Examples of policies to expand revenues include increasing gas tax and using other user fees such as vehicle registration and license fees. In 2013, eight states, including Wyoming, Connecticut, California, Maryland, Kentucky, Nebraska, Georgia and North Carolina, have increased their gas taxes to increase their pay-as-you-go capacity for highway infrastructure spending. Another issue pertaining to the use of gas taxes for infrastructure funding is its sensitivity to economic conditions. When the price of gas is high, people drive less and use less fuel, and thus, the amount of gas tax funding will decrease. Also, with technological enhancements for fuel efficiency, the fuel consumption will be reduced and gas tax funding will decrease. Thus, there is a need for alternative strategies to expand the pay-as-you-go capacity for infrastructure financing.

Another potential solution could be the use of Tax Increment Financing (TIF). TIF uses the increased property taxes that real estate developments generates to finance infrastructure. The other policies that could expand the pay-as-you-go capacity include land-based financing and land value taxation. Particularly in urban cities, infrastructure development in an area could increase the value of land. Land value taxation includes collection of the revenue due to taxation of the increased value of lands. Land value taxation is particularly helpful for financing transportation and transit infrastructure in urban areas.

The other approach for expansion of the pay-as-you go capacity is through innovations that would lead to cost savings. An example of such innovations includes practical design philosophy, which has been implemented by state Departments of Transportation such as Missouri, Pennsylvania, Idaho, Oregon, Kentucky, and Minnesota. The basic premise of practical design philosophy is that it is essential to have a balance among operational efficiency, safety, project constraints, and costs in construction projects. Practical design challenges traditional standards to develop efficient solutions to solve today's project needs and tends to facilitate building more projects with the taxpayers' money. For example, in I-5 Beltline

Interchange project, Oregon DOT saved \$20 Million using the practical design philosophy without compromising safety and efficiency [27].

Expansion of P3 market

The expansion of the P3 market is the second most significant factor for closing the financing gap and could complement the pay-a-you-go financing to close the financing gap in a shorter period of time [28]. Expansion of the P3 market size includes increasing the number of projects financed using private equity and the dollar value of P3 projects. Increasing the number of projects financed through private equity requires establishment of pre-specified processes (e.g. standardized procurement processes and contract provisions) to facilitate effective participation by institutional investors. Financial innovations could lead to increasing the number of projects financed through private equity. Examples of such innovations include federal credit programs (such as TIFIA and WIFIA) and state and national infrastructure banks. Loans made by state and national infrastructure banks would be matched by private equity investments so that the infrastructure bank provides half or less than half of the total funding.

The other critical factor in increasing the number of projects financed through private equity is ensuring the success of the investment (i.e., private institutional investors are able to obtain the required return on their invested capital). This would encourage the private equity market to increase its participation in infrastructure development. The private equity investors need to make returns on their investment proportional to the existing risks. There are different sources of risks ranging from construction and operation risks to political and country risks that need to be considered while infrastructure projects are evaluated for private equity investments. Currently, the U.S. infrastructure market is ranked 12th in terms of its attractiveness for private equity investors while countries such as Singapore, Qatar, and Canada are ranked 1st-3rd, respectively [29]. To enhance the attractiveness of U.S. infrastructure market and to ensure the success of investments using private equity, the appropriateness of innovative financing systems for adoption in a specific project should be evaluated. P3 approaches are not one-size-fits-all. The specific project characteristics and risks should be evaluated for adoption of an appropriate P3 approach.

Appropriate legislation should be set across all the states to enable the use of P3 in infrastructure projects. A clear and well defined legislation would enhance the likelihood of private equity investment. In 2013, thirty-three (33) states have enabling legislation for using P3 in transportation projects. Lack of P3 enabling legislation across all the states have caused the use of different financing approaches in projects which extend across different states. For example, in the Ohio River Bridge project which includes two new bridges between South Indiana and Louisville, Kentucky, one bridge is financed through P3 by Indiana (since Indiana has P3 enabling legislation), and the other project is financed using the state and federal grants by Kentucky (since Kentucky does not have P3 enabling legislation).

Increase of bond financing

The increase of funding for debt repayment is equally important for closing the financing gap as the expansion of the P3 market. However, since the current outstanding debt in most of the state Departments of Transportation is very close to their caps, increasing the funding for debt repayment would not have an immediate effect in closing the financing gap. Two strategies to increase bond financing can be the creation of: (1) new bonding tools, and (2) new revenue sources by leasing the existing infrastructure.

One strategy to expand the bonding capacity of the states is to adopt off-balance sheet debt financing (i.e. creating new bonding tools that are either asset-based or funded through federal resources). Examples of asset-based bonds include private-activity bonds, which are issued on behalf of private institutional investors and thus will not affect the current outstanding debt of the states. An example of bonds supported by the federal tax code includes Transportation and Regional Infrastructure Project (TRIP) bonds. TRIP would allow states to issue up to a total of \$50 billion – \$1 billion per state – in bonds for transportation infrastructure projects over a six year period. The principal amount of the bonds would be covered by a state match to a trust fund and invested for the life of the bonds. In lieu of interest, the bondholders would receive federal tax credits that could be applied against federal income tax liabilities.

The other approach that could be used for debt financing without affecting the current outstanding debt of the states is the leasing of existing infrastructure (brownfield projects). For instance, in 2006 as a result of the lease of the Indiana Toll Road, Indiana raised \$3.8 billion to invest in its infrastructure. The lease did not affect the current outstanding debt of the state since the capital was obtained without Indiana issuing additional bonds.

Recommendations for Demand Management and Citizen Involvement

The recommendations provided in the previous section are more focused on the supply side of the problem pertaining to the closure of financing gap in infrastructure. Due to the significance disparity between the supply and demand for infrastructure, there is a need for strategies to address the demand side of the problem as well. Further, gaining public support is critical for successful implementation of innovative financing.

Demand management

Due to the significant disparity between the supply and demand for financing sources in infrastructure systems, there is a need for policies to manage the level of demand. An example of policies for demand management in highway infrastructure is congestion pricing. Congestion pricing enhances the efficiency of the existing infrastructure capacity and provides additional funding sources for capacity expansion and maintenance activities. Various innovative approaches (such as dynamic and credit-based pricing) could be adopted for congestion pricing. However, like other innovative financing approaches, congestion pricing could lead to public oppositions which should be addressed through citizen involvement strategies.

Gaining public support and citizen involvement

Gaining public support of innovative financing is a key step that can be achieved through strategic communication. Strategic communication “helps to avert failure by identifying current and potential sources of both support and opposition. This information is crucial not only in setting priorities for communication objectives, developing sound messages, and selecting the best possible communication channels, but also in using those channels effectively and creating new ones if needed” [30]. According to Stich and Eagle [31], the current practices of public agencies for citizen involvement are more focused on advocacy (e.g., preempting potential problems to gain support for specific projects) rather than transparency (e.g., learning about public preferences and communicating the efforts of the public agencies to meet the preferences of the public).

Mostafavi et al. [32] evaluated two strategies to improve marketing and citizen involvement strategies for enhancing the use of innovative financing for transportation infrastructure renewal. The first approach is to communicate examples of successful projects delivered using a similar innovative financing structure in the region or in other states. The second approach is related to emphasizing the expected successful delivery of the project. Public agencies should communicate the strategies for successful delivery of the projects (i.e., on-time and on-budget delivery) and the expected technological innovations used in the project to enhance the likelihood of public support of innovative financing (Mostafavi et al. [32]). If innovative financing of a project includes increased taxation or user-fees, the previous approaches (i.e., (i) communicating the success stories of innovative financing in other states and (ii) highlighting the expected on-time and on-budget delivery) may not be sufficient to enhance the likelihood of public support. Public agencies could implement investigations to identify the benefits of a project on the regional resilience of infrastructure networks and its impacts on the safety of the public during extreme events, and communicate these benefits to the general public.

The final approach is related to choosing the right media for marketing. According to Stich and Eagle [31] marketing paradigms should facilitate a two-way communication between the agencies and the public. Relying solely on the news media may not be sufficient since they provide one-way communication media. Public agencies could take advantage of social networks to promote collaborative paradigms (as suggested by Stich and Eagle [31]) to enhance citizen involvement regarding innovative financing systems for infrastructure development.

Concluding Remarks

Policy-making for expansion of innovative financing in infrastructure systems is complex. This report highlighted the significance of innovative financing in infrastructure and discussed the roles of different players in creation and diffusion of innovative financing tools. Innovative financing cannot be promoted and expanded by a single entity. Thus, it is critical that the role and objectives of each player and the interactions between different players be understood to formulate policies to enhance the creation and diffusion of innovative financing tools. To

enhance the interactions of the players for innovative financing, different activities could be implemented by the players. State DOTs are encouraged to continue exploring innovative financing solutions, beginning at the planning stages of the projects. They could interact with P3 consultants and financial advisors or with private institutional investors to identify the available options for financing projects. State DOTs are also encouraged to examine the appropriateness of public-private partnerships as a potential tool for economic development efforts. They are advised to better understand and communicate the financial benefits and costs of using innovative financing and consider increased flexibility in program delivery [22]. P3 consultants and financial advisors should pay attention to the public needs and perception while formulating innovative financing solutions. They should identify opportunities to work with public agencies, such as state DOTs, and share the burden and successes of investing in infrastructure. They need to seek input from project owners, such as state DOTs, in determining the objectives and formulate innovative solutions for a program of projects rather than just one a single project. Similarly, private institutional investors should learn the unique needs and situations of the different public sector organizations, and make state and federal government officials aware of financial tools. They should use their knowledge, expertise, and experience from investing in different sectors and various countries to formulate innovative financing solutions and commit to the partnership during the entire lifecycle of the infrastructure project [22].

Innovative financing is not “one-size-fits-all”. To close the existing infrastructure financing gap, multiple policy scenarios should be pursued. The closure of the financing gap is highly dependent on the expansion of pay-as-you-go capacity of the state and federal agencies. While expansion of P3 market and innovative bond financing can serve as supplements, they cannot substitute a sustaining growth of public investment. A sustainable strategy for infrastructure financing would consist of sustaining growth in public investment supplemented by innovative bond financing and growing P3 market.

Acknowledgements

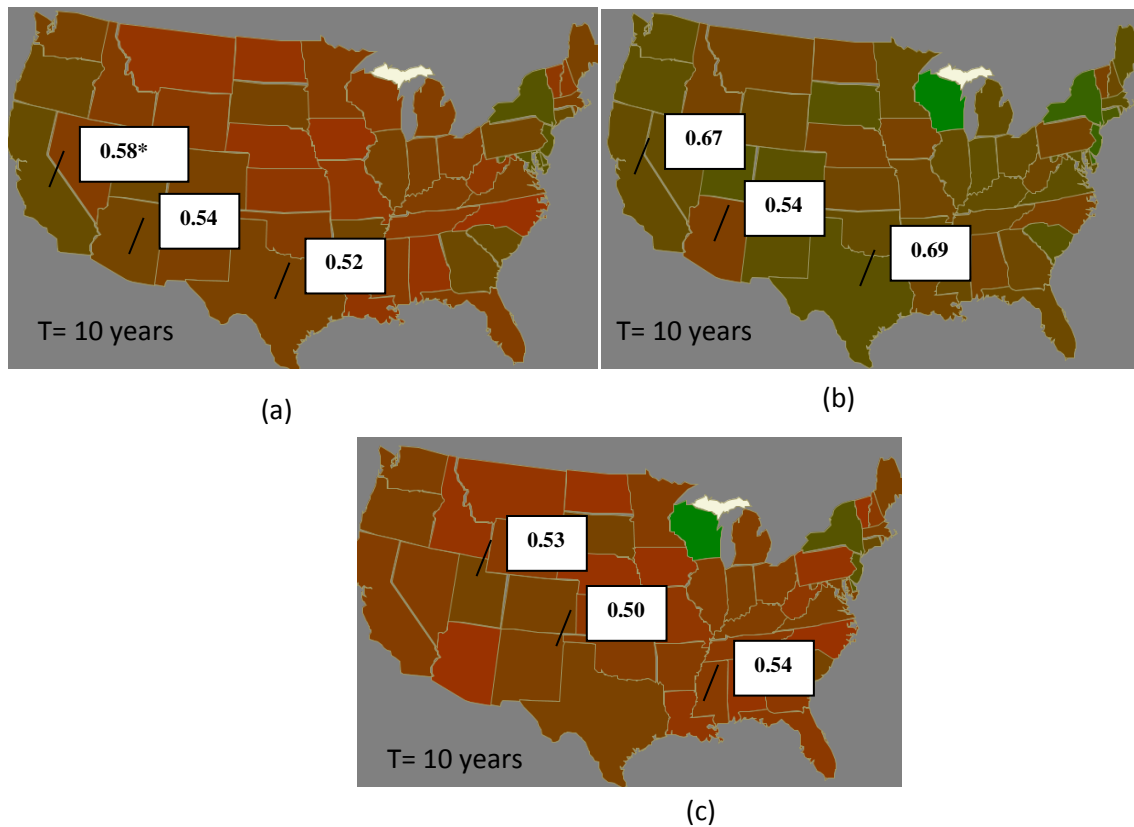
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References

- [1] Cohen, I., Freiling, T., and Robinson, E. (2012). “The Economic Impact and Financing of Infrastructure Spending,” Research Report prepared for Associated Equipment Distributors.
- [2] American Society of Civil Engineers (ASCE) (2013). *Failure to Act: The Impact of Current Infrastructure Investment on America’s Future Economy*, Reston, VA, U.S.
- [3] Schwab, K., and Sala-i-Martin, X. (2012), The Global Competitiveness Report 2012-2013, World Economic Forum.

- [4] Sutherland, D., Araujo, S., Egert, B., Kozluk, T. (2009), “Infrastructure Investment: Links to Growth and the Role of Public Policies”, *OECD Economics Department Working Papers*, No. 686, OECD Publishing. <http://dx.doi.org/10.1787/225678178357>
- [5] Congressional Budget Office (CBO). (2008). Investing in Infrastructure: Testimony. Statement of Peter R. Orszag, Director, before the Committee on Finance, United States Senate. July 10, 2012. Available at <http://www.cbo.gov/ftpdocs/>.
- [6] Chupka, M.W., Earle, R., Fox-Penner, P., and Hledik, R. (2008). Transforming America’s Power Industry: The Investment Challenge 2010-2030. Available at <http://www.eei.org>. Accessed December 2, 2012.
- [7] CBO (Congressional Budget Office). (2002). Future Investment in Drinking Water and Wastewater Infrastructure. Washington, D.C.
- [8] United States Environmental Protection Agency. (2007). *Drinking Water Infrastructure Needs Survey and Assessment Fourth Report to Congress*. water.epa.gov/infrastructure/drinkingwater/dwns/upload/2009_03_26_needssurvey_2007_report_needssurvey_2007.pdf
- [9] Rutledge-Connery, N. (2008). “Development of next generation U.S. infrastructure systems: A framework for national policy.” *Public Works Management and Policy*, Vol.12, Issue 3, pp. 479-482.
- [10] National Academy of Sciences (2009). *Sustainable Critical Infrastructure Systems: A Framework for Meeting 21st Century Imperatives*, Washington DC: The National Academies Press.
- [11] Ploeg, C. V. (2006). *New Tools for New Times: A Sourcebook for the Financing, Funding, and Delivery of Urban Infrastructure*, Canada West Foundation, Canada.
- [12] Chapman, J., (2008). "The Fiscalization of Land Use: The Increasing Role of Innovative Revenue Raising Instruments to Finance Public Infrastructure." *Public Works Management Policy* vol. 12 (4): pp. 551 – 567.
- [13] Pagano, M. A., and Perry, D. (2008). Financing infrastructure in the 21st century. *Public Works Management and Policy*, 13(1), pp. 22-38.
- [14] Mostafavi, A., and Abraham, D. M. (2010). "Frameworks for Systemic and Structural Analysis of Financial Innovations in Infrastructure," working paper, Electronic Proceedings of 2010 Engineering Project Organization Conference (EPOC 2010), John E. Taylor and Paul Chinowsky, Eds., Engineering Project Organizations Society, November 4-6, 2010, South Lake Tahoe CA.
- [15] American Society of Civil Engineers (ASCE) (2009). *Report Card for America's Infrastructure*, Reston, VA, U.S.
- [16] US Department of Transportation Federal Highway Administration (2002). Innovative Finance Initiative, Final Report, U.S.
- [17] Pepping, T.J. (2013). Policy Options for Financing Drinking Water Infrastructure in the United States, Masters project, Duke University.
- [18] Puentes, R. (2012). “Promoting infrastructure investment through private activity bonds”, <http://www.brookings.edu/blogs/the-avenue/posts/2012/10/25-private-activity-bonds-infrastructure-puentes>, Accessed on July 6, 2013.
- [19] Madden, S. (2013). “Federal bills propose innovative financing for water infrastructure,” <http://blog.chicagolandh2o.org/2013/05/13/federal-bills-propose-innovative-financing-tools-for-water-infrastructure/> Accessed on July 6, 2013.

- [20] Engel, E., Fischer, R., and Galetovic, A. (2011). Public—Private Partnership to revamp U.S. Infrastructure, Discussion Paper, The Hamilton Project, February 2011.
- [21] Mostafavi, A., Abraham, D. M., DeLaurentis, D. A., and Sinfield, J. V. (2011). "Exploring the Dimensions of Systems of Innovation Analysis: A System of Systems Framework." *IEEE Systems Journal*, Volume 5, No 2. pp. 256-265.
- [22] Mostafavi, A., Abraham, D. M., and Lee, J. (2012a). "System-of-Systems Approach for Assessment of Financial Innovations in Infrastructure," *Journal of Building Environment Project and Asset Management*, Vol. 2, Issue 2, pp.250-265.
- [23] Mostafavi, A., Abraham, D. M., and DeLaurentis, D. A. (2012b). "Simulation of the Policy Landscape of Transportation Infrastructure Financing Using Agent-Based Modeling," *Proceedings of 2012 ASCE International Workshop on Computing in Civil Engineering*, Raymond Issa and Ian Flood, Eds., pp. 121 – 128, ASCE, June 17-20, 2012, Clearwater Beach FL.
- [24] Mostafavi, A., Abraham, D. M., DeLaurentis, D. A., Sinfield, J., and Queiroz, C. (2012c). "Innovation Policy Assessment for Civil Infrastructure System-of-Systems," *Proceedings of ASCE Construction Research Congress 2012*, pp. 2300 - 2309, May 21-23, 2012, Purdue University, West Lafayette IN.
- [25] Mostafavi, A., Abraham, D. M., DeLaurentis, D. A., Sinfield, J., Kandil, A., and Queiroz, C. (2013a). "A Hybrid Simulation Model for Assessment of Financing Policies in Highway Transportation Infrastructure Systems," submitted to the *Journal of Computing in Civil Engineering*, ASCE, under review.
- [26] Mostafavi, A., Abraham, D. M., and DeLaurentis, D. (2013b). "Ex-Ante Policy Analysis in Civil Infrastructure Systems" *Journal of Computing in Civil Engineering*, ASCE, forthcoming.
- [27] Practical Design Stretches Resources Further, <http://www.oregon.gov/ODOT/GOVREL/Pages/news/071712a.aspx>, Accessed on July 21, 2013.
- [28] Mostafavi, A. (2013). Ex-Ante Assessment of Financial Innovation Policies in Infrastructure System-of-Systems, Doctoral Dissertation, Purdue University, West Lafayette, IN.
- [29] EC Harris Built Asset Consultancy (2013). Global Infrastructure Investment Index: Move from Risk to Reward, http://www.echarris.com/PDF/8437_International%20Infrastructure%20Investment%20Index%20FINAL%20FOR%20WEB.pdf Accessed on July 3 2013.
- [30] Calabrese, D. (2008). Strategic Communication for Privatization, Public-Private Partnerships, and Private Participation in Infrastructure Projects, World Bank Working Paper No. 139., The World Bank, Washington, DC.
- [31] Stich, B. and Eagle, K. (2005). "Planning to include the Public: Transportation policy implementation with effective citizen involvement." *Public Works Management and Policy*, 9(4), pp. 319-340.
- [32] Mostafavi, A., Abraham, D. M., Mannering, F. L., Vives, A., and Valentin, V. (2012d). "Assessment of Public Perceptions of Innovative Financing for Infrastructure," *Proceedings of ASCE Construction Research Congress*, pp. 2260 - 2269, ASCE, May 21-23, West Lafayette IN.



(a) 10% increase in funding for debt repayment

(b) 3% increase in pay-as-you-go capacity

(c) P3 market size= 25 projects per year; Average dollar value of P3 projects: \$500 million

*Financed-to-need ratio values

Figure 1. Policy analysis model for evaluation of the impacts of financing policies [25]