Climate Change Preparedness and Resiliency: Funding and Financing Strategies for New Jersey

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Executive Summary

New Jersey is faced with preparing its residents, property, infrastructure, and related systems to meet the challenges of a changing climate. Failure to do so can be costly, both economically and socially. Similarly, poorly targeted or short-sighted investments in climate change preparedness and resiliency can be costly if the benefits over the lifetime of the investments do not outweigh the costs. The goal is to make well-targeted and forward-looking investments that have a positive return on investment across a range of possible future climate outcomes. The funding and financing strategies needed to make these investments can be found by examining current and proposed policies throughout the state, in addition to leading practices from governments and organizations at the municipal, state, regional, and national levels across the United States and abroad.

A variety of funding options are available to address climate preparedness and resiliency needs of the state. For some funding options, climate change adaptation may be the primary objective of a program associated with the specific revenue source. For others, it may not be the primary objective, but the funding option may support programs with the potential to yield climate change preparedness and/or resiliency co-benefits, an approach that is particularly relevant for public infrastructure investments. Funding and financing options include tax instruments and fees, market-based mechanisms, public-private partnerships and infrastructure banks, and innovative risk transfer mechanisms. These options range from traditional to nontraditional or innovative uses of conventional funding or financing sources.

Existing tax revenues provide one avenue to support climate change resiliency and preparedness measures. The state sales tax is a funding source that has historically supported programs with climate-related benefits or co-benefits including land preservation and transportation projects. However, additional funding is needed to meet future needs. The State Legislature has considered a series of bills over the last two sessions that would dedicate additional revenues from the state sales tax to continue support for these programs, but despite its previous use for this purpose, the legislative support necessary to bring these measures to the ballot for voter approval has been lacking due to the perceived fiscal impacts of dedicating additional state sales tax revenues. An alternative option for funding the state's land preservation programs that is currently under discussion is to tap revenues from New Jersey's corporate business tax. Another option used elsewhere in the U.S. has been to provide local governments with the flexibility to assess a local option sales tax, many of which support the same types of programs at the local level as the state sales tax does in New Jersey. This approach has been used to support land preservation programs of several county or municipal governments in California, Colorado, and Arizona; local transportation and transit projects in Los Angeles County in California and the Puget Sound region of Washington; and water infrastructure or flood prevention programs in Tulsa, Oklahoma, and the southwestern region of Illinois. However, with few exceptions, local governments in New Jersey are not authorized to assess a local option sales tax.

Other traditional tax instruments and fees that can be used to support climate resiliency and preparedness include local property taxes and utility fees. While local governments in New Jersey rely upon the property tax to support a myriad of responsibilities including school districts and municipal and county government functions and operations, this measure can be used in new ways to support

resiliency at the local level. King County in Washington State provides an example of an innovative use of this conventional option. Supported by a special property tax levy, the King County Flood Control District manages the region's investment in flood control measures, including levee improvements, floodwall construction, home elevations, and flood protection upgrades designed to protect critical facilities based on future flood risk projections.

An existing fee that supports programs yielding climate resiliency and preparedness benefits is the Societal Benefits Charge, a surcharge on gas and electric utility customers in New Jersey. This utility fee represents a vital source of funding for energy efficiency and alternative energy programs, low-income energy assistance programs, and has been used in the aftermath of Superstorm Sandy to help residents, businesses and local governments recover by providing rebates through the New Jersey Office of Clean Energy for the replacement of equipment/appliances that were destroyed with upgrades to more energy efficient options. However, despite significant investment in the New Jersey's Clean Energy Program over the last decade, and continued support for the Universal Services Fund, revenues from the Societal Benefits Charge have often been the target of appropriation to the state's general fund to fill gaps in the budget. This diversion of funds reduces the potential impact of energy efficiency and other energy programs in New Jersey. Better utilizing this utility fee could help support climate resiliency and preparedness in this area.

revenues by the New Jersey Office of Clean Energy helped numerous state residents, businesses and local governments replace and upgrade destroyed appliances with more energy efficient options

Nontraditional funding and financing options include innovative fees, alternatives to the traditional motor fuels tax to support transportation and transit projects, carbon taxes or markets, other market mechanisms including portfolio standards and transferrable development rights, public-private partnerships and infrastructure banks, and new approaches to risk transfer. For example, county governments in Maryland and the City of Philadelphia have begun to assess fees on property based on impervious surface cover in order to address stormwater infrastructure needs of those communities.

Several governments throughout Europe and pilot projects in multiple U.S. metropolitan areas have begun experimenting with alternative funding options to the traditional tax on motor fuels, which has experienced deteriorating real revenues in New Jersey because the tax rate is not tied to inflation and has not been increased in over 25 years. Goals of alternative funding options for transportation, such as a vehicle miles traveled fee, are to generate revenues necessary to support transportation infrastructure and better tie the mechanism to activity in this sector.

Carbon taxes have been assessed by subnational governments at the local and regional levels. Leading the way in the U.S. is the City of Boulder, Colorado, which assesses the tax on electricity usage and uses the revenues to support the city's climate protection programs including energy efficiency and conservation, micro-grid projects, and reduction in local air pollutants through transportation projects. This approach yields both climate mitigation (emissions reduction) and climate adaptation benefits. Similarly, carbon markets, with which New Jersey has experience as a former member of the Regional Greenhouse Gas Initiative (RGGI), are a way to generate revenues to reinvest in energy efficiency,

renewable energy or stewardship/restoration projects while accounting for carbon emissions of a sector or sectors. As a former member of RGGI, New Jersey generated over $113 million in revenues from the sale of CO2 emissions allowances offered in quarterly auctions between January 2009 and December 2011. The State Legislature has attempted to rejoin RGGI on several occasions since New Jersey withdrew at the end of 2011, but has yet to secure the support necessary to override the governor's veto. As a result of withdrawing from RGGI, New Jersey has and will continue to forgo revenues from the sale of carbon emission allowances through the program. If New Jersey had been a member of RGGI during 2012 and 2013, it is estimated that the state would have generated approximately $83.7 million in revenues based on its previous share of total allowances and the proportion offered and sold at auction

Additional market mechanisms with climate-related benefits or co-benefits are transferrable development rights (TDRs) and portfolio standards. New Jersey has vast experience with both of these approaches, which could be expanded in application to further support climate adaptation needs. TDRs have been used to support agricultural preservation in New Jersey, as well as protect vulnerable environmental areas in the Pinelands and Highlands region of the state. TDRs are a form of realty transfer in which the development rights of property are separated from the property itself and sold to developers of other property in order to direct development away from unsuited or vulnerable areas. Most importantly, a properly designed TDR program can benefit all parties involved—landowners through the fair market value of the property development rights, developers through the ability to more fully develop other land, and governments by encouraging land preservation and smart growth while saving public funds.

Similarly, a portfolio standard is an alternative to providing direct funding or financing support for a public program. New Jersey has experience with this approach through its renewable portfolio standard (RPS) for renewable energy market penetration. The state could expand its existing program to include energy efficiency or alternative energy resources known to yield climate preparedness and resiliency benefits, such as combined heat and power. Both of these options have been under discussion in New Jersey, with an RPS-like standard for combined heat and power under consideration in the State Legislature and a petition filed with the Board of Public Utilities (BPU) to create an energy efficiency resource standard (EERS).

Public-private partnerships (P3s) represent a financing and procurement option available to governments to expand the pool of financing available to governments and transfer risk from the public sector to private sector participants. P3s are intended to deliver goods or services traditionally provided by the public sector more efficiently through private sector entities without full privatization of the public assets. P3s are most commonly used for delivery of public infrastructure and can take a variety of forms in which private sector participants can be involved in the design, building, financing, operation and/or maintenance of the public infrastructure asset. Potential advantages of infrastructure P3s include: faster delivery of services; access to alternative sources of financing; cost and operational efficiencies; access to private sector expertise and technology solutions; up-front payments to municipalities and increased flexibility for local governments, which can focus attention and resources on their other functions. However, implementing successful P3s has its own challenges including: public

and political opposition out of fear of losing control over public facilities and rates; higher borrowing costs of private financing and difficulties in combining private financing with public financing, particularly tax-exempt municipal bonds; and lack of experience with P3s resulting in costly and difficult contracting and legal issues. Evaluating the costs and tradeoffs of P3s to the public sector requires expertise, and to address this need, several governments that have successfully pursued P3s have established formal guidelines or created lead agencies or public corporations to oversee the implementation of P3s. These include PPP Canada and the recently formed West Coast Infrastructure Exchange, which provides models for New Jersey should the state consider P3s as a strategic option.

New Jersey has also sought to address its infrastructure needs by proposing to create an infrastructure bank of the state. Infrastructure banks represent another avenue to support public infrastructure projects with an array of funding and financing sources, both public and private. A current legislative proposal would place an infrastructure bank for transportation and energy infrastructure projects within the state's existing Environmental Infrastructure Trust, whereas an agency-led proposal of the New Jersey Economic Development Authority, BPU and New Jersey Department of Environmental Protection would create an energy resiliency bank funded by federal post-Superstorm Sandy aid. As the state pursues this option, examples to draw upon include the Connecticut Energy Finance and Investment Authority (CEFIA), Chicago Infrastructure Trust, and NY Works. The sources of capital of these banks range from private investors to innovative public revenues (e.g., RGGI auction proceeds to CEFIA).

The last option discussed that can help improve the climate resiliency and preparedness of New Jersey is the use of innovative risk transfer mechanisms. Governments have typically financed disaster recovery and resiliency expenses after a catastrophe has taken place, as was the case in New Jersey following recent extreme weather events. This approach can have a negative impact on those in need of recovery assistance, whereas insurance solutions established pre-disaster can reduce the overall financial burden on governments after a disaster occurs. Disaster risk transfer solutions can reduce the financial burden on public finances post-disaster by protecting budgets from the volatility of recovery; prevent the need to raise taxes in a fragile, disaster-stricken economy, or raise expensive debt to fund recovery efforts; prevent the need to build up and maintain disaster reserve funds, which can face political opposition when disaster events occur infrequently and funds sit unused; improve the planning certainty of governments with assurances that disaster risks have been accounted and provide other benefits. Examples of innovative disaster risk transfer solutions for New Jersey to draw upon include the multi-year, multi-peril, and multi-tranche catastrophe bond of the World Bank's MultiCat Program used in Mexico; the first of its kind storm surge catastrophe bond issued by the New York Metropolitan Transportation Authority (MTA) post-Superstorm Sandy; and the risk pooling platforms of the Caribbean Catastrophe Risk Insurance Facility (CCRIF), Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) pilot program, and the Combine Re catastrophe bond covering multiple reinsured entities in the U.S. Some noted advantages of these options include securing quick access to disaster relief funding relative to traditional indemnity-based insurance or reinsurance contracts; multi-year risk coverage and price stability; and potentially easier to manage politically than building up a catastrophe reserve fund with public monies.

The above-mentioned options represent several ways for governments to address the funding and financing needs to improve their climate resiliency and preparedness. There is no single option or silver bullet that can address all needs. However, a portfolio of options can be implemented to address challenges and risks across several impacted areas. Choosing and implementing a suite of funding and financing tools from those listed in the table below can help New Jersey and its residents better prepare for the challenges from a changing climate.

Summary of options discussed in report by area addressed

Funding and financing options	Climate change preparedness and resiliency areas					
	Farmland, wetlands and open space	Flood prone property acquisition	Public infrastructure			Disaster recovery
			Energy	Stormwater	Transportation	
State sales tax	H, P	H, P			C	
Local option sales tax	X	X		X	X	
Motor fuels tax					X, C	
Property tax	X, C	X, C		X	X, C	
Carbon tax			X		X	
Vehicle miles traveled fee					X, P	
Utility surcharge			X, C, P			
Stormwater fee				X		
Business tax	P	P				
Carbon markets	H		X, H		X	
Portfolio standards			C, P			
Transferrable development rights	X, C					
Infrastructure banks			X, P	X	X, P	
Public-private partnerships & agencies			X, P	X	X	
Catastrophe bonds						X
Pooled reinsurance facilities						X
Insurance premiums						X

X - used out of state

H - historically used in NJ

C - currently used in NJ

P - proposed in NJ

Introduction

Adapting society to climate change requires preparing people, property, infrastructure, and related systems to meet current and future climate conditions. Various adaptation options are available to make these systems more resilient to withstand weather and climate extremes and stresses. For some actions undertaken by the public sector, climate change adaptation may be the primary driver (e.g. elevating public assets that are increasingly threatened by sea level rise). For other actions, a broader public policy issue may be the primary driver with potential co-benefits for climate change adaptation (e.g. addressing underinvestment in critical infrastructure that is also at risk from the impacts of climate change).

Failure to invest in climate change adaptation and risk reduction measures can be costly, with the impacts of recent severe weather events on the economic and physical well-being of New Jersey and its residents shedding light on what might be expected more frequently in the future.[1] Similarly, poorly targeted or short-sighted investments in climate change preparedness and resiliency can be costly if the benefits over the lifetime of the investments do not outweigh the costs. The goal is to make investments that are well-targeted and forward-looking, resulting in a positive return on investment across a range of possible future climate outcomes. In order to make these investments for a better and more resilient New Jersey, financial resources must be secured and dedicated by the public sector.

Determining the costs and benefits of specific adaptation measures available to the state or municipalities is beyond the scope of this report; rather, this report discusses existing revenue or financial sources to consider, or new mechanisms to implement, under the assumption that at least some climate change adaptation measures are necessary. By examining potential funding and financing sources for climate change preparedness and resiliency efforts in New Jersey, it highlights current and recently proposed policies in the state, in addition to leading practices from governments and organizations at the municipal, state, regional and national levels in the U.S. and abroad. It presents options available to policymakers and other stakeholders in New Jersey as the state moves forward in efforts to adapt to current and future climate challenges and opportunities.

The report is organized in five sections. Section 1 provides an overview of the methods and sources of information. Section 2 highlights current and future climate impacts on key sectors in New Jersey, including: built infrastructure, coastal communities, water resources, public health, natural resources and agriculture. Section 3 briefly discusses the economic case underlying various climate change adaptation measures. Sections 4 and 5 highlight potential funding sources and financial and procurement mechanisms (including innovative risk transfer approaches), respectively, and how they relate to climate change adaptation efforts.

[1] For example, while the economic and physical hardships experienced by New Jerseyans following Superstorm Sandy or Hurricane Irene could not have been prevented entirely, greater adaptation and better preparation could have lessened the impact of these events. For a discussion of the impacts of these events on New Jersey, see Halpin (2013), Monmouth University Polling Institute (2013), and The Cadmus Group, Inc. (2012).

Methods

A literature review of white papers by state and federal agencies, as well as academic sources, helped to identify traditional and innovative funding and financing policies related to climate change, broadly defined. The policy review of New Jersey was taken by reviewing existing and proposed policies and programs related to climate change or areas of impact, with a focus on sources of funding and financing. Program information on the web, news articles and proposed legislation were reviewed. Additional information was identified at conferences focused on climate change impacts and adaptation measures by public and private entities.[2] The information was analyzed for common approaches among governments. Main themes identified are presented in this report.

Current and future climate impacts in New Jersey

Extreme weather and climate impacts have greatly affected the physical and economic well-being of New Jersey and its residents in recent years. From Hurricane Irene in 2011 to Superstorm Sandy in 2012, New Jersey has experienced two of the most extreme storms in its history. However, climate is more than just isolated weather events. Over the past several decades, on average, New Jersey has gotten warmer. The statewide average temperature in 2012 was 2.8˚F above the mean for 1981-2010, and was the highest average annual temperature recorded in 118 years of statewide records (Broccoli et al. 2013). Nine of the ten warmest years recorded in New Jersey's history have occurred since 1990, with the five warmest having occurred since 1998 (Broccoli et al. 2013). Monthly variation in temperature statewide has also changed, with more unusually warm months having occurred in New Jersey than unusually cold months during the last 25 years; moreover, the gap has been increasing since 2000, with unusually warm months outnumbering unusually cold months by 25 to 2 (Broccoli et al. 2013). Future statewide average temperature in New Jersey is likely to continue in an upward trajectory, with rising temperatures expected in all seasons but especially pronounced during the summer months (Broccoli et al. 2013).

In addition to the increase in statewide average temperature in New Jersey, precipitation patterns have changed. There has been an observed increase in precipitation in New Jersey during the last several decades[3], mirroring the trend throughout the northeastern United States (Melillo et al. 2014). Over the last decade plus, New Jersey also experienced severe drought conditions in 2001-2002 and minor droughts in 2005, 2006 and 2010 (NJDEP 2013). The long-term trend in precipitation shows an overall increase throughout New Jersey; however, there is substantial decade-to-decade variability in precipitation levels (Broccoli et al. 2013). More intense or heavy precipitation events have also been

[2] List of conferences: 1) "Climate Change Preparedness in New Jersey: Leading Practices and Policy Priorities" (May 22, 2013), New Jersey Climate Adaptation Alliance: Rutgers University, New Brunswick, NJ, http://njadapt.rutgers.edu/past-conference-materials/leading-practices-priorities-2013; 2) "Building a Sustainable Infrastructure After Sandy" (June 14, 2013), *NJ Spotlight*: Trenton, NJ, http://www.njspotlight.com/after_sandy_roundtable/; 3) "City of Water Day Regional Resiliency Summit" (July 19, 2013), Metropolitan Waterfront Alliance and Parsons Brinckerhoff: Stevens Institute of Technology, Hoboken, NJ; 4) "Sandy One Year Later: Looking to the Future" (October 29, 2013), New Jersey Future: Monmouth University, West Long Branch, NJ, http://www.njfuture.org/cevents/special-events/sandy-anniversary-conference/; and 5) "Financing and Equitable and Resilient Future" (November 19, 2013), Pratt Institute, New York City Bar Association and Better, Inc.: New York, NY.

[3] Statewide and regional monthly precipitation data and trends are available from the Office of the New Jersey State Climatologist at: http://climate.rutgers.edu/stateclim_v1/data/index.html

observed in recent decades, a trend which may continue in New Jersey as surface temperatures increase (Broccoli et al. 2013).

Global sea level has risen as a result of the thermal expansion of water and melting glaciers and ice sheets due to the warming climate. Along the New Jersey coast, sea levels have risen faster than the global average due to a combination of land subsidence with the effects of climate change (Broccoli et al. 2013). A recent study projects that future sea level along New Jersey, relative to that in 2000, will increase 0.6 to 1.3 feet by 2030; 1.1 to 2.3 feet by 2050; and 2.5 to 6 feet by 2100 (Miller et al. 2013).

The case for adaptation

A changing climate poses a serious threat to New Jersey's health and well-being if left unchecked. Costs associated with climate change threaten the state's economy and communities face risks related to rising sea levels in coastal areas, extreme summer heat, and other climate and weather-related extremes (CIER 2008; Georgetown Climate Center & Rutgers Climate Institute 2014). Existing problems will likely be exacerbated, including deficient and deteriorating infrastructure systems resulting from a lack of adequate investment and public health issues typical of a highly urbanized environment. The state's natural resources and agricultural sectors also face serious threats.

Higher temperatures and less water availability and/or more frequent heavy precipitation events during summer months will place added stresses on human and natural systems, negatively affecting the state. Higher energy expenditures are likely to result from increased cooling demand, lesser agricultural yields may result from more variable and extreme weather, and built infrastructure – including roads and stormwater conveyance systems – are likely to be overstressed (CIER 2008; NJDEP 2013; U.S. EPA 2013a, 2013b, 2013c). In the near-term, public health is likely to be threatened by flooding events and extreme heat (McGeehin 2013). Long-term public health impacts from sustained increase in temperature are likely to include longer allergy seasons and greater incidence of respiratory problems (Broccoli et al. 2013).

Sea level rise poses additional threats to society. Aside from claiming the lowest lying coastal land areas, sea level rise will increase coastal flood risk due to a higher baseline water level. Storms that previously posed little flood risk to low-lying coastal areas will become more problematic, and severe storms will become even more dangerous for communities located in these areas. Approximately 22,000 state residents currently live in areas that are less than 1 foot above the local high tide level, with nearly $8 billion (2012 values) of property exposed (Climate Central 2014). Any combination of sea level rise, storm surge, and tidal forces resulting in water levels reaching 5 feet above the current local high tide would expose nearly 295,000 residents and $112 billion in property statewide to flooding (Strauss et al. 2014). In addition to residents and property, numerous critical infrastructure assets – including fire and EMS stations, hospitals, and police stations – as well as other state and municipal properties and hazardous waste sites are located in areas threatened by flooding.[4]

[4] See *Surging Seas* sea-level rise analysis tool of Climate Central (2014) and Strauss et al. (2014) for a list of infrastructure assets, property, and residents exposed to flood risk throughout New Jersey.

Stakeholders–including officials of state agencies, utility commissioners, public health officials, and others—and policymakers have identified various measures intended to help make the state more resilient to the challenges associated with a changing climate. These include making built infrastructure systems more robust and able to withstand additional stresses, e.g. hardening the electricity grid or improving energy efficiency throughout the state to reduce demand; repairing roads and other transportation infrastructure; upgrading vulnerable water and sewage systems; purchasing flood prone properties and protecting economically and culturally important coastal areas by creating coastal defenses for low-lying areas; preserving natural and agricultural areas; and improving systems vital to public health.[5] Investing in these measures will help prepare the state to meet the challenges associated with extreme heat, variable and heavy precipitation, sea level rise, and other changes in climate.

These investments may also yield benefits in addition to those associated with lessening the impact of climate change. For example, a report by the Environmental Finance Center (EFC 2013) at the University of Maryland showed that stormwater infrastructure investments by three urban communities in the Chesapeake Basin resulted in a 1.45 to 3.16 multiplier effect for the local economy with potential to support thousands of jobs in that region.[6] In addition to addressing stormwater management needs and the resulting societal benefits, the public dollars spent on stormwater infrastructure improvements in these communities supported a variety of industries and businesses in the local economies, including product development, engineering, manufacturing, site design, and construction firms, while indirectly supporting other local businesses and activities (EFC 2013). The report points out that that the investments in stormwater infrastructure improvements made by these local governments contributed positively to the local economy, as opposed to taking away from it.

Similarly, investments in energy efficiency and renewable energy projects have the potential to help local economies and yield spending and jobs multipliers in addition to the societal benefits associated with the investments (Ryan and Campbell 2012). The American Council for an Energy-Efficient Economy (ACEEE 2012a) found that investments in energy efficiency create more jobs per dollar spent than an average dollar spent in the economy, particularly in local economies where most energy efficiency projects occur. This occurs initially due to the direct investment expenditure supporting jobs in construction and related industries and thereafter from adjustments in consumer spending patterns due to increased disposable income from energy bill savings (ACEEE 2012b).

Opportunities to better manage public finances and protect budgets from the volatility associated with extreme events related to climate also represent a way to make the state more resilient to the impacts of climate change. Worldwide, the severity and frequency of natural catastrophes has increased in recent decades (Swiss Re 2011). Economic development combined with population growth has led to a higher concentration of assets in areas exposed to natural catastrophes, e.g. coastal areas (Swiss Re

[5] See *Stakeholder Engagement Reports* of the New Jersey Climate Adaptation Alliance at: http://njadapt.rutgers.edu/resources/njcaa-reports. See also Facing Our Future (2013).

[6] The EFC (2013) analysis used the IMPLAN input-output model to assess the impact of new stormwater best management practices (BMP) construction in three urban communities in the Chesapeake Basin: Baltimore, MD; Anne Arundel County, MD; and Lynchburg, VA. For the impact on jobs, the model did not differentiate between jobs created (i.e. new jobs) and jobs supported. The report highlights that while these investments may not create new jobs, at the very least, the investments support jobs, which is not a trivial result. The results from this analysis show that local financing of stormwater BMPs can serve to bolster the local economy, rather than remove money from it.

2011). New Jersey is a microcosm of this trend, marked both by a highly concentrated population and highly valuable assets in areas of high risk exposure. Of the nearly 295,000 residents estimated to live in areas in New Jersey at or below 5 feet above the local high tide level, 23% maintain their usual residence in just three zip codes (Atlantic City, Hoboken and Wildwood), and 29% of the estimated $114 billion in property values statewide located on lands below this elevation fall within the boundaries of the zip codes for Atlantic City, Beach Haven and Wildwood (Strauss et al. 2014).[7] Regardless of the specific impacts of future climate change, coastal development has placed numerous residents and vast amounts of property in very vulnerable locations throughout New Jersey. Rising sea levels and other future climate impacts increase the risk of extreme events for coastal communities throughout the state, which in turn poses a risk to the economic and general well-being of New Jerseyans.

When natural disasters strike, the burden of relief and recovery efforts, such as emergency response and supplies, falls upon the public sector, but governments are also responsible for the long-term reconstruction of public infrastructure (Swiss Re 2011). Insufficient planning and budgeting by the state and municipalities can impede both immediate needs and long-term efforts, especially in the event that a natural disaster slows economic growth and tax revenues fall short of expectations, or immediate needs consume all available funds. In order for governments to be resilient to the risks of potential natural disasters, funding must be made available for each phase of the rebuilding process – immediate relief and recovery, followed by the reconstruction phase (Swiss Re 2011). However, public resources are limited and constituents do not want their representatives budgeting for natural disasters that may not occur. This short term financial planning approach places pressure on governments, resulting in inadequate preparation for the financial aspects of such events. In this way, efforts to better protect public budgets and manage risks through a blend of ex ante (discussed in the *Risk Transfer* section) and post-event financing mechanisms (e.g. federal disaster aid) are complementary to adaptation measures that involve improving infrastructure or building coastal defenses.

Funding options

The following section highlights several funding options available to policymakers. Examples listed throughout this and the subsequent sections are meant to be illustrative, not exhaustive. For some funding options, climate change adaptation may be the primary objective of programs associated with the specific revenue source. For others, it may not be the primary objective, but the funding option discussed may support programs with the potential to yield climate change preparedness and/or resiliency co-benefits. For example, this co-benefit approach is particularly relevant for public infrastructure. Investment in this area is a fundamental issue of public finance; climate change is not typically the driver or primary objective of investment in public infrastructure assets. However, due to stresses related to climate change, it is likely that public infrastructure assets and services will experience increased incremental costs. As such, options that have been discussed in New Jersey

[7] The U.S. Census Bureau defines "usual residence" as: "[The] place where a person lives and sleeps most of the time." Usual residence is not necessarily an individual's voting or legal residence. The concept of usual residence is the guiding principle of the 2010 Census and is used to determine where to count people. For further explanation of the concept of usual residence, see: http://www.census.gov/main/www/glossary.html

and/or implemented elsewhere to better manage the funding, financing and delivery of public infrastructure, in general, are discussed.

Tax instruments and fees

Existing tax revenues provide one avenue to support climate change resiliency and preparedness measures, but not without diverting resources away from other uses. New Jersey could expand existing taxes or implement new levies, but these options are likely to be unpopular with the public (Greenberg et al. 2014).[8] Clearly, a tradeoff exists, but an expanded base of funding is needed to make investments in climate change preparedness and resiliency. This section reviews current tax instruments in New Jersey and elsewhere through initiatives and programs with potential climate change benefits.

Sales tax

The state sales tax is among New Jersey's most important revenue sources, both in terms of supporting general fund expenditures and specific programs. In SFY2013, sales tax revenues in New Jersey totaled $8.235 billion, or 30.4% of total revenues collected from major revenue sources, making it the state's second largest single source of revenue.[9] In a recent fiscal analysis, the Office of Legislative Services (OLS) determined that the long-run average annual growth rate of the revenue generated from the state sales tax was 4.7 percent. Based on this analysis, state sales tax revenues are projected to be $9.642 billion in SFY2015, rising to $12.131 billion in SFY2020.[10]

Greenberg et al. (2014) also found that while New Jerseyans generally support taking measures to prepare for future climate change, the majority of residents do not support increasing the state sales tax to implement programs and policies designed to reduce climate-related risks.[11] These results are not surprising. In part, this sentiment may reflect how residents view the current state sales tax rate (7 percent) in New Jersey, which ranks second highest among all states in the U.S., trailing only California.[12] However, when state sales taxes are combined with local option sales taxes (an option not permitted in New Jersey) and weighted, New Jersey's sales tax rate falls in the middle of the weighted average

[8] In a 2013 survey of New Jersey residents, less than 1 in 4 (24%) respondents supported raising the state sales tax by 1% for 5 years, and less than 1 in 5 (19%) supported increasing the state income tax, to protect vulnerable coastal areas. Among the general public, there was a greater willingness to support specific tax instruments, as opposed to expanding broad-based taxes, as more than half of respondents (53%) supported adding a 1% tax to hotels, motels, airports and recreation facilities for 5 years to redevelop areas devastated by Hurricane Sandy. See Greenberg et al. (2014).

[9] New Jersey collected $27.088 billion from major revenues sources in SFY2013. OLS Revenue Snapshot, FY2012 Year-End Totals: http://www.njleg.state.nj.us/legislativepub/budget/FY12_Year_End_Final.pdf

[10] In its fiscal analysis of SCR-138 (June 2013), the Office of Legislative Services (OLS) projects the fiscal impact of dedicating one-fifth of one cent (0.2%) of each dollar subject to the state sales tax to fund New Jersey's open space program. The OLS provided projections of revenues from the state sales tax dedicated to this program for SFY2015-2017. The state sales tax revenue projections referenced in this report are derived using the OLS estimates for SFY2015-2017, converted to revenue estimates at the statewide 7 percent sales tax rate, and compounded by the long-run average annual growth rate of 4.7 percent for the 30 year period. The fiscal analysis of SCR-138 by OLS is available at: http://www.njleg.state.nj.us/2012/Bills/SCR/138_E1.HTM

[11] 24% of respondents supported increasing the state sales tax by 1 percent for 5 years to implement risk reducing programs and policies. This result was fairly consistent with public sentiment regarding increasing the state income tax for similar purposes. The survey was conducted between February 13, 2013, and March 27, 2013, and consisted of 1750 telephone surveys, 65% of which were conducted with landline numbers and 35% cell phone numbers. For more information, see Greenberg et al. (2014).

[12] As of April 1, 2014, New Jersey, Indiana, Mississippi, Rhode Island and Tennessee have state sales tax rates of 7 percent. Mississippi and Tennessee permit local option sales taxes ranging from 0%-0.25% and 1.5%-2.75%, respectively. California's statewide sales tax rate is 7.5 percent, which includes the statewide minimum county sales tax rate of 1 percent. See Sales Tax Institute (2014).

combined sales taxes rates nationwide (23rd out of 50), based on a 2013 analysis by the Tax Foundation.[13]

Currently, revenues from New Jersey's state sales tax directly support various programs that have the potential to yield climate change preparedness and resiliency benefits, including New Jersey's Green Acres and Farmland Preservation programs. Popular with state residents,[14] these programs have helped to protect and preserve agricultural lands and wetlands, as well as purchase properties at risk of flooding through the Blue Acres component. Revenues from the state sales tax were most recently dedicated to the Green Acres and Farmland Preservation programs in 1998 through passage of the Garden State Preservation Trust (GSPT) Act, which constitutionally dedicated $98 million annually for 30 years to fund preservation and conservation of open space, farmland, and historic sites, as well as recreational development in New Jersey. These funds were intended to support a 10-year conservation and preservation program by permitting the funding of new efforts only during the first ten years (SFY2000 to SFY2009), with funding during the remaining twenty years (SFY2010 to SFY2029) committed solely for debt service of GSPT-issued bonds.[15]

Voters approved additional bonding capacity to support the GSPT and land preservation programs in 2003, 2007 and 2009.[16] However, despite committing a total of $2.7 billion to land preservation programs statewide through bond measures passed between 1998 and 2009 (supported in part by the stream of revenues from the sales tax), additional funding is needed to meet future needs. In particular, the Facing Our Future (2013) report estimates that the state's Green Acres program needs at least $250 million in funding over the next five years to protect areas vital to water supply and quality throughout New Jersey. With the current bonding capacity of New Jersey's land preservation programs nearly exhausted, these future needs will not be met without additional funding support.[17]

While New Jersey will utilize $300 million in federal disaster recovery funds to implement the NJDEP's voluntary Superstorm Sandy Blue Acres Acquisition Program to purchase properties in flood prone areas[18], new funding is required to meet other land preservation needs, either through additional bond proceeds or newly dedicated revenues. The latter – dedication of tax revenues from the state sales tax – was considered as a potential long-term land preservation funding solution by in the State Legislature in 2013. Two proposals were introduced prior to the November 2013 election that would have placed a constitutional amendment on the ballot for voter approval, with new funding from state sales tax

[13] New Jersey's state sales tax rate trails the combined state and weighted average local option sales tax rate in neighboring New York State, but is greater than Delaware, Pennsylvania and Connecticut. Salem County in New Jersey is not subject to the state sales tax rate and instead collects a local rate of 3.5%. See Drenkard (2013).

[14] Since 1961, voters in New Jersey have approved 13 ballot measures supporting land preservation programs.

[15] The GSPT Act also authorized bonding authority of up to $1.15 billion for preservation programs. More information on the Garden State Preservation Trust is available at: http://www.state.nj.us/gspt/

[16] A list of bond acts and other funding sources for the Green Acres program and related land preservation programs from 1961—2009 are summarized at: http://www.nj.gov/dep/greenacres/bondact.htmlhttp://www.nj.gov/dep/greenacres/bondact.html

[17] From SFY2009 to SFY2013, funding for land preservation programs combined bond proceeds from the GSPT and 2007 and 2009 voter referendum bond funds. In January 2012, the NJDEP anticipated that bond proceeds for the Green Acres program would be fully committed in its next round of funding (see http://www.nj.gov/dep/greenacres/local_faq.html#fund_4). At present, bond proceeds for all land preservation programs are mostly committed. See also Johnson (2014a).

[18] Information on NJDEP's planned use of federal disaster recovery funds for the Superstorm Sandy Blue Acres Acquisition Program is available at: http://www.nj.gov/dep/greenacres/pdf/faqs-blueacres.pdf

revenues dedicated for an additional 30 years.[19,20] However, neither proposal gained the support necessary in the State Legislature to reach the ballot and the creation of a stable source of funding for New Jersey's land preservation programs has been pushed to the November 2014 election or beyond.[21,22]

More recently, the State Senate approved a modified proposal that would dedicate additional revenues from the state sales tax for land preservation programs, while the State Assembly has taken a more traditional approach by approving a new bond measure, a short-term solution to New Jersey's land preservation needs.[23,24] The sales tax measure has won the support of a majority of recreational and conservation organizations, but there are some exceptions within the environmental community in addition to the governor's office.[25] It remains to be seen whether the sales tax remains a viable option for future funding of land preservation needs, and a new bill has been introduced that would fund these programs through dedication of corporate business tax (CBT) revenues.[26] However, the historic use of sales tax revenues through the GSPT Act of 1998 may be instructive as stakeholders consider their options.

Revenues from the state sales tax also support the transportation and transit infrastructure sector in New Jersey, both of which are substantially affected by climate and weather variability. Heat related stresses, sea-level rise and storm surge, and flooding from heavy precipitation pose threats to the provision and longevity of transportation and transit infrastructure and services. Sales tax revenues support climate change preparedness and resiliency measures in these sectors, via the state's Transportation Trust Fund Authority (TTFA), to the extent that transportation and transit planners and agencies in New Jersey incorporate current and future climate scenarios and risks into capital projects and plans.

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[19] SCR-138/ACR-179 would have provided a dedicated, stable source of funding for the state's land preservation programs by constitutionally dedicating one-fifth of one cent of the state sales and use tax to the Preserve New Jersey Trust Fund Account. A fiscal analysis completed by the New Jersey Office of Legislative Services estimated that the measure could potentially result in a net revenue loss of approximately $17 billion to the General Fund as state sales tax revenues were directed to the Preserve New Jersey Trust Fund Account over 30 years, based on the long-run average growth rate of the state sales and use tax. http://www.njleg.state.nj.us/2012/Bills/SCR/138_E1.HTM

[20] SCR-160/ACR-205, a replacement proposal for SCR-138, would have constitutionally dedicated $200 million per year from the state sales and use tax revenues at a total cost of $6 billion over 30 years. http://www.njleg.state.nj.us/2012/Bills/SCR/160_I1.HTM

[21] The State Senate passed SCR-138/ACR-179 on June 20, 2013, with the three-fifths majority needed to be placed on the ballot in November 2013, but the State Assembly did not take up the measure. See Johnson (2013a).

[22] The State Senate passed SCR-160/ACR-205 on July 29, 2013, but failed to gain the three-fifths majority needed to be placed on the ballot in November 2013, and was not taken up by the State Assembly. See Johnson (2013b).

[23] SCR-165 would constitutionally dedicate $200 million, or 2.4%, whichever is less, annually from SFY2015 to SFY 2044 from state sales tax revenues for the preservation of open space, including flood prone areas and lands that protect water supplies, farmland, and historic properties. The bill was passed by the State Senate on January 9, 2014, by a 29-8 vote, but not acted upon by the State Assembly. http://www.njleg.state.nj.us/2012/Bills/SCR/165_I1.HTM

[24] A-4541 would authorize bonding capacity of $200 million for the acquisition and development of lands for public recreation and conservation purposes, farmland development easements, Blue Acres projects, and historic preservation. The bill was passed by the State Assembly on December 19, 2013, by a 64-13-1 vote. http://www.njleg.state.nj.us/2012/Bills/A5000/4541_I1.HTM

[25] Over 180 recreational and conservation organizations have expressed support for the sales tax measure, while two prominent organizations – New Jersey Sierra Club and New Jersey Environmental Federation – oppose it out of fear that such a large dedication from state sales tax revenues would lead to cuts for other environmental programs. For a summary of competing interests, see Johnson (2013c) and Johnson (2014b).

[26] SCR-84, introduced in February 2014, would dedicate 6% of corporate business tax (CBT) revenues for 30 years to land preservation programs, but end the 4% dedication of CBT revenues for environmental programs. The bill has been trimmed back but approved by the State Senate Budget and Appropriations Committee. It requires approval by the full legislature before it can be placed on the ballot in November 2014. See Johnson (2014f) and http://www.njleg.state.nj.us/2014/Bills/SCR/84_I1.HTM

The New Jersey Constitution dedicates a minimum of $200 million per year from state sales tax revenues to the TTFA to finance transportation and transit infrastructure in the state. A total of $222.5 million was appropriated to the TTFA in 2012 and $314.5 million in 2013, which the TTFA combines with other sources of funding to finance projects.[27] Yet, at the state level, there exists an estimated shortfall of $1.5 billion in short-term transportation needs through 2018, a figure which does not include investments needed at the local level, nor does it take a long-term perspective for transportation investment (Facing Our Future 2013). In the future, the TTFA will become more constrained and its resources will likely be dedicated solely to debt service without restructuring, such as rethinking its funding sources (Facing Our Future 2013). Additionally, the TTFA mainly provides support for state-owned transportation infrastructure. Annually, the TTFA provides $175 million in state aid to municipal and county governments for local transportation improvements.[28] This represents less than 15 percent, on average, of total annual expenditures by county and local governments in New Jersey, which are cash-strapped in raising revenue for local transportation projects (Facing Our Future 2013). The TTFA and transportation funding, in general, is discussed further under the ***Motor fuels tax*** section below.

Local option sales tax

Using state sales tax revenues to support land preservation programs and transportation and transit projects is not unique to New Jersey. However, local governments in several other states have the authority to levy local option sales taxes, which in turn are used to support similar land preservation and transportation and transit programs at the county and/or municipal levels. As mentioned above under the ***Sales tax*** section, this funding mechanism is currently unavailable to local governments in New Jersey with few exceptions, which must rely upon other sources of funding (primarily bonding capacity and property tax revenues).[29] An option to provide local governments more flexibility in their financing of transportation, land preservation, or other local climate adaptation needs would be to seek voter approval to amend the State Constitution to allow a local option sales tax or similar levy. Table 1 lists several land preservation and open space programs of local governments outside of New Jersey funded by revenues from local option sales taxes.

Table 1. Select open space programs funded by revenues from local option sales taxes

Program	Location	Governance	Rate	Revenues
Cococino Parks and Open Space Program [1]	Cococino County, AZ	County	0.125%	$33 million over ten years (average cost to county household of $1.63 per month)
Sonoma County Agricultural Preservation and Open Space District [2]	Sonoma County, CA	County	0.250%	$15 million to $18 million annually (average cost per resident of approximately $3 per month)
Marin County Open Space District [3]	Marin County, CA	County	0.250%	$10 million annually (average cost per resident of approximately $3 per month)

[27] New Jersey Transportation Trust Fund Authority: http://www.state.nj.us/ttfa/
[28] New Jersey Department of Transportation: http://www.state.nj.us/transportation/business/localaid/funding.shtm
[29] The state sales and use tax, as amended, is codified at N.J.S.A.54:32B-1 et seq. Municipal and county governments in New Jersey are not authorized to assess a general local sales tax in addition to the state sales and use tax. Exceptions to this include the hotel/motel occupancy tax, which local governments are authorized to assess at a rate of up to 3%, and the tourism tax in Cape May County and luxury sales tax in Atlantic City. A sales tax guide from the New Jersey Treasury, Division of Taxation (2008) is available at: http://www.state.nj.us/treasury/taxation/pdf/pubs/sales/su4.pdf

Arapahoe County Open Space Program [4]	Arapahoe County, CO	County	0.250%	$145.8 million total, 2004-2011
Adams County Open Space Program [5]	Adams County, CO	County	0.250%	$77 million plus over ten years
Trails, Open Space and Parks Program [6]	Colorado Springs, CO	Municipal	0.100%	N/A

[1] http://az-coconinocounty.civicplus.com/index.aspx?NID=694
[2] http://www.sonomaopenspace.org/
[3] http://www.marincountyparks.org/depts/pk/about-us/main/ballotmeasure
[4] http://www.co.arapahoe.co.us/Departments/PW/OpenSpaceProgram/salesandusetax.asp
[5] http://co-adamscounty.civicplus.com/index.aspx?nid=398
[6] http://www.springsgov.com/CCBIndex.aspx?CCBID=21

In the transportation and transit sector, the American Association of State Highway and Transportation Officials (AASHTO 2014) notes that the local option sales tax is an increasingly popular revenue source, particularly for funding rail transit projects. The local option sales tax is by no means a panacea, possessing both attractive and unattractive features for funding transportation and transit projects (Table 2).

Table 2. Advantages and disadvantages of local option sales tax as alternative transportation funding option

Advantages	Disadvantages
High revenue potential for a low marginal tax rate	Susceptible to declines in retail sales
Favorable public perception due to horizontal equity	Regressive nature of sales tax
Fair from a transportation modal perspective (i.e. modes of transportation not captured by motor fuels tax are accounted for)	Removes preferential tax treatment for transportation modes not captured by motor fuels tax, which have positive societal benefits
Exportability of tax to non-resident users of local transportation services and facilities	

Sources: Goldman and Wachs (2003) and AASHTO (2014)

Examples of local option sales taxes supporting transportation and transit needs abound. Two noteworthy examples are the Puget Sound region of Washington State and Los Angeles County in California. In the Puget Sound, the counties of King, Pierce and Snohomish levy a local option sales tax to support Sound Transit, a public agency which provides the region's commuter transit services. The *Regional Transit Authority Tax*, which combines revenues from the local option sales tax (0.9% ad valorem rate), motor vehicle excise tax and rental car tax, is assessed in the Sound Transit taxing district to fund regional light rail and express bus systems linking cities throughout the Puget Sound.[30,31]

In California, countywide sales taxes have played a crucial role in funding the state's local transportation needs, comprising roughly one-third of local transportation revenues in 2005-2006 according to the state's Legislative Analyst's Office (AASHTO 2014). In particular, the local option sales tax in Los Angeles County has been important in funding new transportation and transit projects. In 2008, voters in Los Angeles County approved *Measure R*, which increased the local option sales tax by 0.5 percentage

[30] More information on the Regional Transit Authority Tax is available at the Washington State Department of Revenue website: http://dor.wa.gov/content/FindTaxesAndRates/OtherTaxes/tax_regtransit.aspx
[31] More information on the structure of funding of Sound Transit is available at its website: http://www.soundtransit.org/

points, raising the combined state and local sales tax within the county limits from 8.25% to 8.75%. *Measure R* passed in large part due to support from the local chamber of commerce and labor unions representing construction workers who would benefit from the jobs created by new transportation and transit projects of the Los Angeles County Metropolitan Transportation Authority (Smart Growth America 2012). *Measure R* is projected to generate $40 billion in revenues over the next 30 years, at an average cost per resident of $25 per year.[32]

In addition to supporting open space programs and transportation and transit needs, local option sales taxes are utilized by municipal and regional governments in other states to support water infrastructure improvements. In Tulsa, OK, the Municipal Stormwater Utility is funded in part by a local option sales tax, and a regional sales tax is levied by the Southwestern Illinois Flood Prevention District to support infrastructure improvements to levees.[33] The development of the local option sales tax in Southwestern Illinois in 2009 is particularly relevant to post-Sandy New Jersey, as regional leaders in Illinois sought a local funding source for levee improvements in response to actions by the Federal Emergency Management Agency (FEMA) that would have designated large portions of the region as a Special Flood Hazard Area for flood insurance purposes with potentially devastating economic impacts. These regional leaders successfully sought authorization from the Illinois General Assembly to levy a local option sales tax in the region and created independent Flood Prevention Districts within each county to collect the tax and work collaboratively to oversee levee improvements.[34]

With regard to its sales tax, New Jersey faces several options regarding its funding and financing capabilities for transportation, land preservation and other needs:

- Maintain the status quo, noting that transportation projects face funding shortfalls in the state and land preservation funds are insufficient to meet future needs.
- Dedicate new revenues from the state sales tax, but maintain the structure of the tax, noting that funding available for other purposes will decrease.
- Dedicate new revenues from the state tax and increase the tax rate, nothing that funding for other purposes could be maintained but consumers would face a higher tax burden, posing equity issues.
- Maintain the status quo of the state sales tax, but allow a local sales tax option, which would increase funding available to local governments for purposes they deem necessary, but would pose equity issues and could disadvantage residents of some local governments relative to others.

[32] Projections of the impact of *Measure R* were conducted by the Los Angeles County Economic Development Corporation. More information on *Measure R* is available at: http://www.metro.net/projects/measurer/

[33] Tulsa's Municipal Stormwater Utility was created in 1987 to address the impacts of precipitation and flooding on the city's stormwater infrastructure. The local option sales tax is combined with bond proceeds to fund large capital projects, including acquisition of lands and construction of large water retention facilities and drainage basin improvements, whereas user fees fund the operations of the Municipal Stormwater Utility. More information is available at: https://www.cityoftulsa.org/city-services/flood-control/stormwater-fee-and-funding.aspx

[34] Since 2009, a quarter-cent (0.25%) regional sales tax has been levied in Madison, Monroe and St. Clair Counties, Illinois, to fund needed repairs to the levee system protecting the St. Louis Metro East region. More information is available at: http://www.floodpreventiondistrict.org/

Property tax

Property taxes assessed by local governments typically support a wide range of services, including transportation and land preservation efforts in addition to many other services not related to or impacted by climate. Because common uses of property tax revenues are ubiquitous, these are not discussed at length in this report. However, to the extent that local businesses and government assets are at risk of climate impacts, climate change presents a risk to local government budgets and may strain property tax revenues or bonding capacity, particularly in the aftermath of extreme weather events.

Nontraditional or innovative uses of property tax revenues that have helped increase the ability of local governments to meet current and future climate challenges include flood control and clean energy programs. The King County Flood Control District, a regional commission in Washington State, was created in 2007 to manage the region's investment in flood control measures. Projects include levee improvements, floodwall construction, home elevations, and flood protection upgrades designed to protect critical facilities – including roads, electric and gas, drinking water and wastewater infrastructure – based on future flood risk projections. The Flood Control District is supported by revenues from a special property tax levy of $0.10 per $1,000 of assessed property value. The property tax levy generates approximately $35 million a year for the Flood Control District, which is able to leverage these revenues with state and federal matching funds.[35] Applying the King County Flood Control District property tax levy to 2013 assessed residential property values in select counties in New Jersey, Table 3 provides estimates of the flood control revenue potential of these counties. This flood control concept of King County, mainly used to deal with riverine flooding, could also be applied more broadly to the issue of stormwater management.

Table 3. Estimates of application of King County Flood Control District property tax levy potential for select counties in NJ

County	Number	Average residential assessed value	Total value	Tax rate	Revenue potential
Atlantic	103,779	$257,538	$26,727,036,102	0.0001	$2,672,704
Cape May	87,927	$494,594	$43,488,166,638	0.0001	$4,348,817
Hudson	102,864	$122,297	$12,579,958,608	0.0001	$1,257,996
Middlesex	212,056	$153,025	$32,449,869,400	0.0001	$3,244,987
Monmouth	210,112	$407,500	$85,620,640,000	0.0001	$8,562,064
Ocean	240,386	$309,221	$74,332,399,306	0.0001	$7,433,240
Passaic	107,905	$242,722	$26,190,917,410	0.0001	$2,619,092

Property numbers and assessments from NJ Department of Treasury, Division of Taxation, 2013 average residential assessment: http://www.state.nj.us/treasury/taxation/pdf/lpt/AvgResAsmt/2013AvgResAsmt.pdf

See Appendix A for results for each county statewide

[35] More information on the King County Flood Control District is available at its website: http://www.kingcountyfloodcontrol.org/

Motor fuels tax and vehicle miles traveled (VMT) fee

Motor fuels taxes across the nation have become increasingly insufficient to meet transportation needs and support robust highway construction and maintenance programs (Smart Growth America 2012 and State Smart Transportation Initiative 2012). Non-highway roads and other modes of transportation face even more daunting problems. This is especially true in New Jersey, where the Transportation Trust Fund is projected to run out of money within the next year due to heavy reliance on debt and failure to increase pay-as-you-go financing.[36] Of the combined revenue sources comprising the Transportation Trust Fund, the state's excise tax on motor fuels is the largest. This section discusses New Jersey's motor fuels taxes and highlights alternatives, operating under the assumption that improved funding mechanisms for transportation infrastructure will better enable this sector to address challenges associated with climate change. It draws upon program information from New Jersey and a body of literature regarding transportation funding options.

The TTFA combines revenues from the motor fuels tax and other constitutionally dedicated taxes (revenues from the petroleum products gross receipts tax and a portion of the state sales tax) with statutorily earmarked funds (revenues from toll roads and other fees) to pay debt service on TTF appropriation credit bonds. Additionally, the TTFA contains a pay-as-you-go project funding component (i.e. capital projects funded through current revenues, not debt financing).[37] In SFY2013, revenues from the state's motor fuels taxes represented 53.6% of total revenues appropriated to the TTFA. [38]

Like most other states, New Jersey's motor fuels taxes are set at a flat rate per gallon and are not tied to inflation. The tax rates were last increased over 25 years ago in 1988 and despite actual receipts from the motor fuels taxes having increased over time, the real value of these revenues has eroded due to inflation and the flat rate at which the tax is set. Compared to neighboring states, New Jersey's taxes on motor fuels are substantially lower. For example, the 14.5 cents per gallon tax on gasoline in New Jersey (which combines the motor fuels excise tax and petroleum products gross receipts tax) is much lower than taxes levied in New York (49.86 cents per gallon), Connecticut (49.3 cents per gallon), Pennsylvania (41.8 cents per gallon of gasoline), and Delaware (23 cents per gallon) (API 2014).[39]

Additionally, as the fuel efficiency of vehicles has increased in recent years and new vehicle technologies have been introduced that are not captured by the state's motor fuels tax (e.g. plug-in electric vehicles), the amount of revenue generated per vehicle mile traveled (VMT) in the state has decreased steadily over time in inflation-adjusted terms. In 1994, each VMT traveled in New Jersey

[36] New Jersey's heavy reliance on debt financing for transportation capital projects has resulted from the reallocation of $972 million in toll money from the NJ Turnpike Authority to fill gaps in the general fund from SFY 2013 and SFY 2015 and failure to provide $472 million in pay-as-you-go financing from the state budget, as well as refinancing transportation debt at above interest market rates. See Magyar (2014).

[37] The motor fuels tax is assessed at 10.5 cents per gallon of gasoline and 13.5 cents per gallon of diesel fuel. The NJ State Constitution dedicates the revenue equivalent of 10.5 per gallon from both taxes to the TTFA for transportation capital purposes. The remaining 3 cents from the tax on diesel fuels is not constitutionally dedicated to the TTFA. More information is available at: http://www.state.nj.us/ttfa/financing/apprevenues.shtm

[38] Motor fuels tax revenues constitutionally dedicated to the TTFA totaled $520.2 million in SFY2013, with total constitutionally dedicated and statutorily earmarked funds equaling $970.9 million. http://www.state.nj.us/ttfa/financing/apprevenues.shtm

[39] Tax rates for each state are a combination of each state's excise tax on motor fuels and other state taxes/fees assessed on motor fuels. See API (2014).

generated 1.21 cents (2009 dollars) in motor fuels tax revenues. In 2009, motor fuels tax revenue per VMT traveled in the state had decreased to 0.74 cents.[40]

The issues surrounding the motor fuels tax and its ability to fund transportation and transit services is not unique to New Jersey, but rather a general problem throughout the U.S.[41] A substantive body of research exists on this topic and potential solutions range from conventional to innovative. The most conventional solution is to raise the motor fuels tax, which would immediately infuse new revenue for capital improvement projects and rehabilitation of transportation infrastructure and transit alternatives. However, merely increasing the motor fuels tax will only postpone current issues with the tax instrument into the future. Tying the tax rate to inflation would help address the issue of deteriorating real revenues, as would replacing the motor fuels tax with the state's general sales tax and allowing the price of fuels to determine revenues. Long-term, as new vehicles face stricter fuel efficiency requirements, which will continue to erode revenues generated per VMT, a need to think more creatively than the motor fuels tax may necessitate other potential long-term solutions, e.g. distance-based pricing to capture revenues from vehicles not taxed (or minimally taxed) by the motor fuels tax (these vehicles represent costs to the transportation system; e.g. owners of electric vehicles do not contribute directly to the revenues available for transportation infrastructure projects despite using the road infrastructure). One example, a fee on vehicle miles traveled (VMT fee), is based on the user-pays principle to encourage the most cost-efficient travel decisions while preserving or increasing transportation revenues (Mahendra et al. 2011).[42]

VMT fees are more commonly utilized abroad than in the U.S., where pilot projects have been the norm. In Europe, VMT fees are utilized in Germany, Switzerland, Austria, the Czech Republic, Hungary and Slovakia (Mahendra et al. 2011). In the U.S., several localities have tested the feasibility of VMT fees, including Portland (OR), Seattle (WA), Minneapolis-St. Paul (MN), and Atlanta (GA). In New Jersey, a legislative proposal was introduced in the State Senate in February 2013 that would replace the motor fuels tax in New Jersey with a VMT fee on passenger vehicles registered and titled in the state.[43] However, VMT fees are not without challenges, including how best to collect data on vehicle miles traveled, which vehicles to assess, how to capture miles driven by non-residents, and other issues.

[40] Annual vehicle miles traveled in New Jersey for all vehicle types were estimated by the New Jersey Department of Transportation to be 60.5 billion in 1994 and 73.0 billion in 2010, an increase of 20.8 percent: http://www.state.nj.us/transportation/refdata/roadway/vmt.shtm

[41] In the U.S., on average, taxes on motor fuels cover only half of the costs of maintaining and operating roadways, whereas motor fuels taxes in industrialized European nations more than cover the costs of roadways (Building America's Future 2012).

[42] A study by the American Association of State Highway and Transportation Officials (AASHTO) in June 2009, reviewed by Mahendra et al. (2011), indicated that replacing the motor fuels tax with a revenue neutral VMT fee (i.e. VMT fee set at the level of revenues per VMT generated by the motor fuels tax in that year) would result in between $7 billion – $9 billion additional revenues nationwide by 2030 – an increase of 20 percent compared to revenue projections based on current motor fuels tax rates.

[43] S-2531 would impose a fee on every passenger vehicle (including electric vehicles and other alternative fuel vehicles) registered and titled in the State of New Jersey on the miles traveled by those vehicles. The fee would be set at 0.83906 cents per mile and would be administered by the New Jersey Motor Vehicle Commission. Fees owed by each vehicle would be calculated and self-reported by each vehicle owner through odometer readings. All funds collected from this fee would be deposited in the TTFA. Vehicles subject to the fee would be exempt from the state's motor fuels tax with a sticker on the license plate indicating the exemption. While this proposal is relatively simple in terms of the technology required to administer the fee (compared to GPS-based fees), the literature on VMT fees highlights several practical issues to this approach including: how to treat vehicle miles traveled outside of the state for which motor fuels tax was paid in that state; inability to capture revenue from out-of-state drivers traveling within New Jersey who do not purchase motor fuels within the state; administrative burdens; and others. Text of the bill is available at: http://www.njleg.state.nj.us/2012/Bills/S3000/2531_I1.HTM

With regard to its motor fuels taxes, New Jersey faces several options regarding its funding and financing capabilities for transportation-related needs:

- Maintain its current motor fuels taxes and continue to face funding shortfalls and deteriorating infrastructure.
- One-time increase of its motor fuels taxes, which will infuse new revenues, but postpone revenue generating issues and associated funding shortfalls into the future.
- Tie the motor fuels taxes to inflation, which will maintain a constant dollar value of revenues, but will not capture revenues from alternative fuel vehicles and revenues will erode with increasing fuel efficiency of vehicles.
- Replace the motor fuels taxes with the state sales tax, which will increase revenues based on the price of fuel, but will not capture revenues from alternative fuel vehicles and revenues will erode with increasing fuel efficiency of vehicles.
- Replace the motor fuels tax with a VMT fee, which will increase and maintain revenues with VMT growth, but faces difficulties in implementation.

Carbon tax

Carbon taxes are used by several governments – both national and sub-national – to address activities related to climate change and support programs to increase the preparedness and resiliency of those governments. In a sub-national context, Quebec and British Columbia in Canada provide examples of taking initiative in this regard, as does the city of Boulder, Colorado, the nation's first municipal carbon tax. Approved by voters in 2006 and extended in 2012, Boulder's Climate Action Plan (CAP) Tax is assessed on electricity use by residential, commercial and industrial users at differential rates and collected by the electric utility serving the city.[44] It is Boulder's long-term revenue solution for the city's climate protection programs. In 2010, the CAP tax generated $1.8 million in revenues for Boulder, a city of approximately 100,000 residents. Revenues are used to support various programs including energy efficiency and conservation, micro-grid projects, and reduction in local air pollutants through transportation projects.[45]

Utility fees

Fees levied by governments operate under a user-pays principle and represent a way to specifically target an activity and support related programs. In addition to the VMT fee discussed above, two additional fees are presented below as illustrative of the options available to implement or better utilize to support climate change preparedness and resiliency.

The Societal Benefits Charge (SBC), a surcharge on gas and electric utility customers in New Jersey, represents a vital source of funding for energy efficiency and alternative energy programs in the state.[46]

[44] Residential customers are assessed at 0.49 cents per kWh of electricity used; commercial at 0.09 cents per kWh; and industrial at 0.03 cents per kWh. Over the course of a year, these rates equate to an average annual tax of $21 for residential customers, $94 for commercial customers and $9,600 for industrial customers.

[45] More information on Boulder's carbon tax and programs is available at its website: https://bouldercolorado.gov/climate

[46] More information on the SBC is available at NJ's Clean Energy Programs website: http://www.njcleanenergy.com/main/about-njcep/societal-benefits-charge/societal-benefits-charge-sbc#Anchor-What-47857; and NJ's Universal Services Fund website: http://www.state.nj.us/bpu/residential/assistance/usf.html

In the aftermath of Superstorm Sandy, funding made available from these revenues by the New Jersey Office of Clean Energy helped numerous state residents, businesses and local governments replace equipment/appliances that were destroyed with more energy efficient options (Johnson 2013d). This and similar programs can yield multiple climate-related benefits including reducing energy load and increasing the ability of communities to recover in the wake of extreme weather events. The SBC also supports programs designed to assist low-income households afford heating and cooling needs. As energy needs among New Jersey residents change in coming years due to increased temperature and likelihood of heat waves, these programs may become more important, particularly among the state's vulnerable populations.

Despite significant investment in the New Jersey's Clean Energy Program over the last decade, and continued support for the Universal Services Fund, revenues from the SBC have often been the target of appropriation to the state's general fund to fill gaps in the budget. A total of $800 million in clean energy funds has been diverted over the past three years (Johnson 2013d). This diversion of funds reduces the potential impact of energy efficiency and other energy programs in the state. In 2013, New Jersey ranked tied for 12th among all states by the ACEEE in terms of energy efficiency policy and program efforts (Downs et al. 2013). While this ranking is laudable, New Jersey's score did not improve from 2012 and the state ranks behind neighboring New York (3rd) and other northeastern states including Massachusetts (1st), Connecticut (5th), Rhode Island (6th), Vermont (7th) and Maryland (9th).

This diversion of SBC revenues represents a sizeable funding option New Jersey could better utilize. Ensuring that funds go to their intended purposes would help improve the climate change preparedness and resiliency of the state's energy infrastructure.

Storm water remediation fee

Maryland provides an example of using targeted fees to address its stormwater infrastructure needs. Established in 2012, the Maryland's Watershed Protection and Restoration Program supports stormwater infrastructure projects and the restoration of streams and wetlands that serve stormwater needs. To meet Phase I Municipal Separate Storm Sewer System (MS4) permit requirements under the National Pollutant Discharge Elimination System (NPDES) program, including installation of pollution controls on untreated impervious surfaces within the jurisdiction covered by the MS4 permit, nine counties in Maryland are required to assess local fees on property owners to address stormwater needs. Since the counties operate their own stormwater fee programs, the structure of each fee differs according to the county. Several counties assess the stormwater fee based on impervious land cover, whereas others have adopted a more traditional approach using flat fees, or a combination of impervious cover and flat fee structure depending on the type of property.[47] Revenues from the fees are deposited into local watershed protection and restoration funds managed by the county or local government responsible for assessing the fee. These revenues are not transferrable to the state general fund, thus protecting the revenues for the intended purpose. Revenues from the stormwater fee are often leveraged by local governments with other state funding. In addition to these county-wide

[47] Information on each county's stormwater fee program in Maryland can be accessed by following the relevant links at: http://www.mde.state.md.us/programs/Marylander/Pages/StormwaterFeeFAQ.aspx

programs administered in Maryland, the City of Philadelphia has implemented a stormwater utility fee program based on impervious surface covering property.[48]

Market mechanisms

Carbon markets

Carbon markets represent a potential source of revenue for New Jersey to tap. As a former member of the Regional Greenhouse Gas Initiative (RGGI), New Jersey generated over $113 million in revenues from the sale of CO2 emissions allowances offered in quarterly auctions between January 2009 and December 2011. If New Jersey had been a member of RGGI during 2012 and 2013, it is estimated that the state would have generated approximately $83.7 million in revenues based on its previous share of total allowances and the proportion offered and sold at auction (See Appendix B for more details). The bulk of these potential revenues (72%) would have been generated in 2013 as adjustments to the regional CO2 cap bolstered the ratio of bids to supply to above 2 and raised auction prices as a result.

On several occasions, the State Legislature has advanced measures to rejoin RGGI, but the necessary support has been lacking to override the governor's veto. Several organizations support the state rejoining RGGI and have sought legal remedies;[49] recently, the State Senate Environment and Energy Committee approved a new measure that would require New Jersey to rejoin RGGI.[50] While the prospect of rejoining RGGI poses potential compliance costs for electric providers in New Jersey, it also represents a potential new source of revenue for energy efficiency, renewable energy and energy assistance programs, among other uses detailed below.

It is expected that future auction prices in RGGI will rise in real dollar values due to recent changes to the structure of the regional cap.[51] In particular, due to excess carbon allowances during the initial compliance period, the nine current members announced a 45 percent reduction in the overall CO2 emissions budget beginning with the 2014 compliance year (RGGI 2013b). The resulting reduction will cut the regional CO2 budget in 2014 from 165 million short tons to 91 million short tons, with the cap declining thereafter by 2.5 percent each year from 2015 to 2020. The proportion of allowances allotted to each participating state relative to the overall budget will remain the same as before the reduction. If New Jersey were to rejoin RGGI, after adjusting the state's previous CO2 emissions budget from the initial compliance period to reflect the recent program changes, the estimated revenue potential for

[48] Information on Philadelphia's stormwater utility fee is available at: http://www.phillywatersheds.org/what_were_doing/policy_regulations

[49] Environment New Jersey and Natural Resources Defense Council petitioned the New Jersey Department of Environmental Protection. The DEP's decision was appealed to the Appellate Division of the Superior Court of New Jersey, which ruled that the DEP failed to follow the Administrative Procedures Act in withdrawing from RGGI (Docket No. A-4878-11T4). The appellate court decision is available at: http://www.judiciary.state.nj.us/opinions/a4878-11.pdf

[50] The State Senate Environment and Energy Committee passed S-151 by a vote of 4-1. The bill clarifies the intent of the state's 2007 law requiring participation in RGGI. Text of the bill is available at: http://www.njleg.state.nj.us/2014/Bills/S0500/151_I1.HTM. See also Johnson (2013e).

[51] The most recent auction clearing price was $4.00 per allowance (March 5, 2014). The number of bids to initial supply of allowances was 3.1, which decreased to 2.5 when cost containment reserve (CCR) allowances were added. RGGI auction results are available at: http://rggi.org/market/co2_auctions

New Jersey from the sale of CO2 allowances is $522 million (2010 dollars) from 2014-2020 (See Appendix C for more details).[52]

Member states have dedicated RGGI auction revenues to support various public benefit programs. The majority of auction revenues have gone to support energy efficiency, renewable energy and energy assistance programs. From 2009-2012, the current RGGI member states directed two-thirds of their auction revenues to residential and commercial energy efficiency programs, six percent to greenhouse gas abatement and climate change programs, and another six percent to clean and renewable energy (RGGI 2014). Investments of RGGI auction revenues to-date have resulted in $240 million in energy bill savings with a lifetime expected savings of $2 billion (RGGI 2014).

In Delaware, RGGI auction revenues are used to leverage other funding and support local reinvestment and large-scale energy efficiency projects (DDNREC n.d.). Auction revenues support the Delaware Sustainable Energy Utility, a non-profit organization created by the state which is able to leverage RGGI auction revenues with multiple sources of funding including tax-exempt bonds, federal funding and fees and interest on financing. Delaware has also used auction revenues to support low-income energy assistance programs and climate policy and program capabilities. The latter investment area is particularly unique among current member states, and is similar to New Jersey's statutory authority to invest its RGGI proceeds in tidal marsh and forest stewardship programs, these are both mitigation (carbon sequestration) and adaptation approaches (reducing flood risk and reducing local temperature impacts). While a member of RGGI, New Jersey's Global Warming Solution Fund (GWSF) allocated 10% of its share of RGGI proceeds to support programs designed to enhance and protect forests and tidal marshes in the state.[53] In a similar way, Delaware's Division of Energy and Climate utilizes funding from RGGI auction revenues to formulate climate change mitigation, adaptation and land use related projects, including a recent climate projections and impact assessment that will help policymakers in the future (RGGI 2014).

In Connecticut, RGGI auction revenues are used to support programs administered by the Connecticut Energy Efficiency Fund (CEEF) and Connecticut Municipal Energy Cooperative. Additionally, the Connecticut Clean Energy Finance and Investment Authority (CEFIA), the nation's first "green bank," is supported in part by RGGI auction revenues (RGGI 2014). CEFIA is discussed further in the section on *Infrastructure Banks*.

In other carbon markets, auction revenues have been used for similar purposes. In California's cap-and-trade program, the initial investment plan emphasizes investments in the transportation and energy

[52] Annual auction proceeds for New Jersey are based on two scenarios used to analyze the updated RGGI model rule. In both scenarios, annual auction proceeds increase over time and result in similar totals for the 7-year period, despite considerable yearly variation between the two scenarios owing to a gradual increase in auction price in one scenario relative to a steep increase in auction price in the alternative scenario. The IPM Analysis of the updated RGGI Model Rule was performed by ICF International in February 2013. The analysis and data for the modeling results are available at http://www.rggi.org/design/program_review

[53] In addition to the 10% of RGGI proceeds allocated for the protection of forests and tidal marshes, the GWSF allocated 60% to support end-use energy efficiency projects at commercial, institutional, and industrial entities, including development of combined heat and power production; 20% to support energy demand reduction and cost reduction for low- and moderate-income residential customers; and 10% to support programs designed to promote greenhouse gas reduction projects of local governments. P.L. 2007, c. 340 (C.26:2C-45 et al.), available at: http://www.njleg.state.nj.us/2006/Bills/PL07/340_.PDF

sectors with a focus on large reductions in greenhouse gas emissions (CARB 2013).[54] However, California is also examining other areas for investment including waste diversion, sustainable agriculture and forest and ecosystem management. California is also focusing on investment areas with co-benefits including complementary efforts to improve air quality.

Portfolio standards

An alternative to direct funding or financing support for a public program is a portfolio standard. New Jersey has experience with this approach through its renewable portfolio standard (RPS) for renewable energy market penetration. New Jersey has had much success with its RPS, specifically in transforming the domestic solar photovoltaic (PV) market. An additional policy some states have implemented is a portfolio standard for alternative energy resources and/or energy efficiency. The Board of Public Utilities in New Jersey has been granted authority to establish these portfolio standard for energy efficiency and non-renewable alternative energy resources; however, it has not created a comprehensive portfolio standard for the alternative energy or energy efficiency markets to date.[55] These options have been discussed in New Jersey, with an RPS-like standard for combined heat and power (CHP) reported favorably by the State Assembly Appropriations Committee in November 2013 and a petition to establish an energy efficiency resource standard (EERS) filed with the Board of Public Utilities (BPU) in January 2014.[56,57]

CHP facilities represent a cleaner way to produce both heat and electricity locally compared to traditional power generating stations. Additionally, CHP facilities have the potential to increase the resiliency and preparedness of buildings and local communities by preventing shutdown of critical facilities during extreme weather events.[58] Massachusetts provides a successful model of an alternative energy portfolio standard (APS) that includes CHP.[59] Similar to NJ's RPS but for CHP and other alternative energy technologies, certificates are issued for production of energy from qualifying alternative energy technologies. For CHP, the program incentivizes CHP development through the certificate trading system based on gains in energy (electric and heat) efficiency. As a result, Massachusetts has created a market for businesses and governments to install CHP facilities. New Jersey's energy master plan calls for the development of 1,500MW of CHP by 2021, and previously, RGGI auction proceeds were used to support CHP development in the state (U.S. EPA 2009; Schneider and Elliot 2012). Going forward, stakeholders have indicated that an APS market could address the high upfront costs of CHP facilities that would otherwise present a barrier to entry and would require

[54] In addition to CARB (2013), see general information listed at: http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/auctionproceeds.htm
[55] For a list of states with Energy Efficiency Resources Standard (EERS) policies, see ACEEE (2014).
[56] Assembly Bill A-1384 was reported favorably on November 18, 2013. The bill would establish an alternative energy portfolio standard with a certificate program to incentivize the development of CHP and fuel cell technology facilities. The fiscal impact of the bill is indeterminate but likely insignificant. No action has been taken in the new legislative session. Test of the bill is available at: http://www.njleg.state.nj.us/2012/Bills/A1500/1384_R2.HTM
[57] New Jersey has set energy savings goals, but these goals lack consequences if they are missed (ACEEE 2013). The New Jersey Board of Public Utilities (BPU) currently has regulatory authority to establish an EERS. The Sierra Club filed a petition to require the BPU to set an EERS on January 24, 2014. The BPU deferred action on the petition in June 2014, preferring instead to await stakeholder working group results on how best to increase energy efficiency. See Johnson (2014c), Johnson (2014e), and http://www.state.nj.us/bpu/pdf/boardorders/2014/20140423/4-23-14-8B.pdf
[58] CHP facilities that are independent of the electric grid increase resiliency by being able to operate when the grid shuts down, but are more costly. See Johnson (2013f).
[59] Massachusetts Executive Office of Energy and Environmental Affairs, "Combined Heat and Power," http://www.mass.gov/eea/energy-utilities-clean-tech/energy-efficiency/ee-for-business-institutions/combined-heat-power/

significant financial support from the state for CHP development to meet required capacity, funding which has recently been diverted.[60]

An APS represents an alternative or additional way to meet an established goal without directly funding or financing CHP development with state funds. Similarly, an EERS could serve as an additional method of supporting energy efficiency programs in the state. Twenty-five states have an EERS or combined EERS with RPS, including neighboring New York and Pennsylvania and most other northeastern states (ACEEE 2014). New Jersey set nonbinding energy efficiency savings goals of 20% in its 2008 energy master plan, which were reassessed by the 2011 energy master plan. An EERS would formally establish these goals as binding, and with clean energy funds often diverted from intended programs, would help the state meet current goals. In turn, New Jersey would generate energy cost savings, reduce pollution and create jobs in the process.

Transferrable development rights

Another market mechanism with which New Jersey has experience is transferrable development rights (TDRs). TDRs are useful in a land use planning context. They are a form of realty transfer in which a property owner is permitted to separate the development rights of property from the property itself and sell these rights to developers of other property. Once a "development credit" is issued and sold, a restriction or easement is placed on the deed to the land which protects the land in perpetuity for an intended purpose (e.g. agriculture, recreation, or another environmentally-compatible purpose). These development credits help direct growth away from land in need of protection and preservation to areas designated as appropriate for development at higher densities than would otherwise be permitted (NJ SADC 2006). In turn, the development credit enables the owner of property deemed unsuitable for development to be compensated through a market transaction. A properly designed TDR program can benefit all parties involved—landowners through the fair market value of the property development rights, developers through the ability to more fully develop other land, and governments by encouraging land preservation and smart growth while saving public funds. Additionally, societal benefits accrue through protection of vulnerable areas.

In the context of a changing climate, New York State has discussed this mechanism as a way to improve its strength and resilience by directing development away from unsuitable land to other locations more suitable for growth (NYS 2100 Commission 2013). This approach offers promise to reduce potential impacts in extremely vulnerable areas. In New Jersey, the State Agriculture Development Committee's TDR program is one avenue to pursue agricultural protection in a changing climate. Additionally, given New Jersey's history with regional TDR programs, particularly in the Pinelands and Highlands regions, this represents another mechanism to explore for regionally or locally vulnerable areas in a climate change-related context. The Pinelands Development Credit (PDC) Bank was created in 1985 as an independent state agency to oversee and implement the PDC program. Its goal is to help protect environmentally-sensitive land in the Pinelands region of New Jersey by encouraging smart growth and preventing development sprawl in ecologically important areas. The PDC Bank is responsible for issuing the development credits and overseeing the market. Since the PDC program was created,

[60] Stakeholders include panelists on distributed generation from the *NJ Spotlight* conference, "Building a Sustainable Infrastructure After Sandy" (June 14, 2013), Trenton, NJ, http://www.njspotlight.com/after_sandy_roundtable/

approximately 7,060 property rights have been transferred from sending properties, protecting over 58,600 acres in the region (NJ Pinelands Commission 2012). The Highlands Development Credit program has a similar structure.[61]

Creating an efficient and effective market structure for development credits and proper land use planning are important factors in determining the success of TDR programs. If TDRs were to be considered as a viable option to direct development away from climate vulnerable land areas in New Jersey, policymakers could draw upon the state's own experience in developing TDR programs, as well as that of King County, Washington, and Montgomery County, Maryland, two other successful TDR programs.[62]

Financial mechanisms and procurement efficiencies

Government funding is limited. Creative financing can expand the pool of resources available to governments and deliver value for money if structured properly. Ultimately, however, financing should not be confused with funding as governments must repay the financed debt through revenue generated from taxes or fees. The value of financing public investments in climate change preparedness and resiliency measures, like all public financing, is derived from how the financing is structured, efficiencies available from the private sector, and other factors. This section discusses various financial mechanisms and structures, as well as procurement methods, which can yield climate change adaptation benefits to the public.

Public-Private Partnerships and Infrastructure Investment Partnerships

Public-private partnerships (P3s) are intended to deliver goods or services traditionally provided by the public sector more efficiently through private sector entities. In the realm of public infrastructure investment, P3s are a non-traditional procurement method that can expand the pool of financing available to governments and transfer risk from the public sector to private sector participants. P3s involve private financing without full privatization of the asset by the public sector and can take on a variety of structures ranging from little private sector involvement to mostly private sector involvement (i.e. private sector participants can be involved in the design, building, financing, operation and/or maintenance of the public infrastructure asset). Successful P3s tend to be large, complex public infrastructure projects in which some or all of the risks are transferred from the public sector to the private sector and deliver "value for money" (PPP Canada n.d.).[63]

[61] Information of the PDC and HDC programs is available at (respectively): http://www.state.nj.us/pinelands/landuse/perm/pdc/index.html and http://www.highlands.state.nj.us/njhighlands/master/tdr/#2

[62] The TDR program in King County, Washington, is intended to preserve land and steer development toward urban areas and away from rural and resource lands. More information is available at: http://www.kingcounty.gov/environment/stewardship/sustainable-building/transfer-development-rights.aspx

[63] PPP Canada defines "Value for Money" as the comparison of the estimated total costs of delivering a public infrastructure project using a P3 delivery method to the costs of using a traditional delivery method (http://www.p3canada.ca/when-do-p3s-work.php). The West Coast Infrastructure Exchange describes value for money as "the benefits to the public expected to be realized through a particular procurement method, and can be quantitative and/or qualitative in nature. Quantitative value for money is achieved through lower cost of a particular procurement method, whereas qualitative value is achieved when a particular procurement method better supports the goals and objectives of a project without necessarily costing less." (WCX 2013).

Several potential advantages of infrastructure P3s have been identified: faster delivery of services; access to alternative sources of financing; cost and operational efficiencies; access to private sector expertise and technology solutions; up-front payments to municipalities and increased flexibility for local governments, which can focus attention and resources on their other functions (U.S. GAO 2013).[64] P3s can help overcome common barriers to public infrastructure investment: municipal bond markets may be inaccessible; time constraints may necessitate a streamlined approach not attainable through traditional public procurement; and complexities of a project may require private sector expertise.

However, implementing successful P3s has its own challenges. Potential difficulties include: public and political opposition out of fear of losing control over public facilities and rates; higher borrowing costs of private financing and difficulties in combining private financing with public financing, particularly tax-exempt municipal bonds; and lack of experience with P3s resulting in costly and difficult contracting and legal issues (U.S. GAO 2013). The costs and tradeoffs of P3s to the public sector necessitate a case-by-case review of projects to determine whether a P3 arrangement is the appropriate mechanism to deliver the project (U.S. GAO 2009).[65]

Several governments, including sub-national governments in Canada and Australia, have sought to address the challenges of implementing P3s by establishing formal guidelines or creating lead agencies or public corporations for implementing P3s. An underlying goal of these guidelines and agencies is the prioritization of public investment and delivery of public infrastructure at value by considering P3s as a financing option. They provide the framework and expertise necessary to overcome the inexperience many government agencies have with P3s, as well as the technical and legal knowledge necessary to structure P3 arrangements with the public interest in mind. These agencies and public corporations have used their expertise to support infrastructure investments in climate-impacted infrastructure sectors including water and wastewater, energy, disaster mitigation and vital services, and transit and transportation.

An example of a lead agency dedicated to procuring P3s is PPP Canada. This public corporation is tasked with improving the delivery of public infrastructure throughout Canada by encouraging the use of P3 arrangements while ensuring the private sector entities remain accountable to taxpayers. P3s developed by PPP Canada include a local road infrastructure project involving a multi-use pathway to encourage non-vehicular travel, with infrastructure to accommodate peak rainfall and prevent flooding. PPP Canada estimated that the P3 structure for this project – which involves a private-sector partner that is responsible for designing, building, financing, and maintaining the infrastructure – will provide $31 million Canadian dollars in value for money savings compared to traditional procurement options. [66] PPP Canada has also helped to develop P3 arrangements for wastewater, drinking water, and other infrastructure projects using similar or expanded private sector responsibilities (which include operating the infrastructure).

[64] The advantages and challenges of P3s enumerated by U.S. GAO (2013) were identified through interviews of municipal officials and private company representatives involved in P3s in the water and wastewater sectors.
[65] Analyses by the U.S. GAO and others highlight the potential costs and tradeoffs of using P3s to deliver public infrastructure. For a more detailed discussion of the potential costs and benefits of P3s, see U.S. GAO (2008).
[66] Chief Peguis Trail Extension project in Winnipeg, Manitoba, Canada. Project details are available at: http://www.p3canada.ca/en/about-p3s/project-map/chief-peguis-trail-extension/

In the U.S., a regional entity was created by California, Oregon, and Washington (along with British Columbia, Canada) to source private sector involvement in public infrastructure delivery. The West Coast Infrastructure Exchange (WCX) was established in 2012 to help these governments address the high costs of infrastructure development and limitations in available financing options.[67] In particular, due to strained municipal bond markets and reduced public budgets, these states needed a new model for financing public infrastructure (CH2m HILL 2012). The WCX functions as a regional infrastructure partnership that pools resources and bundles similar projects, forms innovative partnerships (e.g. infrastructure investment partnerships and performance-based infrastructure solutions), and helps to connect public entities with private capital. A goal of the WCX is to tap the expertise and capital of the private sector and target investments necessary to improve aging energy transmission infrastructure, municipal water systems, and wastewater facilities throughout the region, while retaining ownership by the public. By developing best practices to certify investible public infrastructure opportunities, the WCX will help overcome barriers to private sector involvement in public infrastructure investment in the region, which include hesitation by private investors due to unpredictable and inconsistent standards for public infrastructure projects and the perception that these projects carry substantial political risk. The WCX provides a framework for governments interested in a regional approach to infrastructure investment with private sector involvement.[68]

Infrastructure Banks

Infrastructure banks represent another avenue to support public infrastructure projects with an array of funding and financing sources, both public and private. Examples include the Connecticut Energy Finance and Investment Authority (CEFIA), Chicago Infrastructure Trust, and NY Works.[69] The scope of investments made by these organizations differs, as do their sources of capital, but each invests in areas critical to meeting the future challenges of a changing climate such as energy, transportation, and other public works. Sources of capital range from private investors to innovative public revenues (e.g. RGGI auction proceeds to CEFIA). These nontraditional entities enhance the public infrastructure investment capabilities of Connecticut, New York, and the City of Chicago, and provide models for other governments interested in pursuing this approach.

A transportation and energy infrastructure bank was proposed in New Jersey during the 2012-2013 legislative session but ultimately vetoed.[70] A replacement has been introduced in the current legislative session.[71] The infrastructure bank would function as two separate revolving funds residing within New Jersey's Environmental Infrastructure Trust (EIT), thus differentiating it from other infrastructure bank models. It would expand the current mission of the EIT from water and environmental infrastructure investments to include transportation infrastructure investments historically made through the TTFA

[67] Detailed information about the mission and structure of the West Coast Infrastructure Exchange, including the final report by CH2M HILL (2012), is available at: http://westcoastx.com/

[68] The final project certification standards are available at: http://westcoastx.com/news/wcx-releases-final-project-standards.html

[69] For more information, visit: http://www.ctcleanenergy.com/ (CEFIA), http://shapechicago.org/ (Chicago Infrastructure Trust), and http://nyworkstaskforce.ny.gov/ (NY Works).

[70] A-3177/S-2143 was passed by the State Senate and Assembly in January 2014, but pocket vetoed by the governor at the end of the 2012-2013 legislative session. Text of the bill is available at: http://www.njleg.state.nj.us/2012/Bills/S2500/2143_R1b.HTM. The Office of Legislative Services fiscal impact and summary is available at: http://www.njleg.state.nj.us/2012/Bills/S2500/2143_E1.HTM

[71] S-307/A-2268 was introduced in January 2014 and replaces A-3177/S-2143. Text of the bill is available at: http://www.njleg.state.nj.us/2014/Bills/S0500/307_I1.HTM

and renewable energy, natural gas infrastructure, and electric grid investments (i.e., relocation of power lines underground). A primary benefit of the proposed infrastructure bank would be the ability to receive federal transportation infrastructure bank monies. However, the proposal does not authorize additional bonding capacity or establish a funding source to capitalize the bank, which likely would rely upon a range of sources including state, federal or private funds.

It is uncertain whether this new legislative proposal for a transportation and energy infrastructure bank will succeed where its predecessor did not; however, another proposal exists for an energy infrastructure bank with a funding source identified. The New Jersey Economic Development Authority, BPU and NJDEP have issued a preliminary framework for this energy resiliency bank, which would be funded by federal post-Superstorm Sandy aid. The bank would focus on investments to make energy infrastructure statewide more resilient to extreme events and stresses (Johnson 2014d). Federal approval is required before the proposed bank can become a reality, and without a perpetual source of revenue to support bank operations, it remains to be seen how far the federal aid will go in funding energy resiliency projects throughout the state (based on how disbursement of funding from the bank will be structured; i.e., as loans or grants).

Risk Transfer

Ex ante risk transfer mechanisms help governments make public finance more efficient (Michel-Kerjan et al. 2011). Not all risks are fully covered by private insurers, making insurance and other risk-management instruments important for governments, whether it is insuring publicly-owned assets or emergency preparedness needs, or enabling private property owners to address the risks they face or recover in the aftermath of a catastrophe (World Bank 2012). With the severity and frequency of natural catastrophes increasing worldwide and driving up the cost of disaster relief and reconstruction, new forms of insurance and related risk-management tools can help governments become more resilient to the financial consequences of natural catastrophes (Swiss Re 2011). Recent research shows that the macroeconomic costs of natural catastrophes are driven by uninsured losses (von Peter et al. 2012). Thus, having sufficient insurance coverage in place prior to a catastrophic event is beneficial to both governments and citizens and can substantially dampen the economic costs of a catastrophe.

Governments have typically financed disaster recovery and resiliency expenses after a catastrophe has taken place, as was the case in New Jersey following recent extreme weather events. This approach can have a negative impact on those in need of recovery assistance. Swiss Re (2011) notes that post-disaster financing should only be used to cover residual losses after pre-disaster financing and risk-transfer options have been exhausted and that reserve funds and insurance solutions established pre-disaster can reduce the overall financial burden on governments after a disaster occurs. In particular, risk transfer mechanisms established pre-disaster can be a cost effective way to reduce flood risk and protect public finances from losses associated with infrastructure damages (U.S. EPA 2012).

Potential advantages of disaster risk transfer solutions for governments include (Swiss Re 2011):

- Reduce the financial burden on public finances post-disaster by protecting budgets from the volatility of recovery.

- Prevent the need to raise taxes in a fragile, disaster-stricken economy, or raise expensive debt to fund recovery efforts.
- Prevent the need to build up and maintain disaster reserve funds, which can face political opposition when disaster events occur infrequently and funds sit unused.
- Diversify disaster risk by accessing large reinsurance and/or capital markets.
- Improve the planning certainty of governments with assurances that disaster risks have been accounted.
- Innovative risk transfer instruments (e.g. parametric insurance solutions) can be designed to cover different needs, with different triggers, increasing the speed at which funding is made available relative to traditional insurance mechanisms. Parametric, or index-based, insurance solutions settle on the characteristics of the event (e.g. level of storm surge or wind speed), not the loss associated with an event.

Risks that are independent and can be pooled are well suited for traditional insurance and reinsurance, but the highly correlated risks of natural catastrophes challenge the notion of insurability (OECD 2011). Transferring the risks of natural catastrophes to capital markets can provide a solution when traditional insurance and reinsurance is unavailable or too costly. Accessing capital markets through insurance-linked securities can spread risks across a broader range of investors than traditional insurance and reinsurance mechanisms, transforming pure risks into speculative risks (OECD 2011).

Catastrophe Bonds

World Bank's MultiCat Program and MultiCat Mexico

The World Bank's MultiCat Program provides a standard framework and enables governments to purchase parametric insurance-linked securities on affordable terms (World Bank 2012). In 2006, Mexico issued a $160 million (USD) bond, known as Cat-Mex, to protect the country against earthquakes. When the bond matured in 2009, following a comprehensive catastrophe risk management analysis for its public and private sectors (OECD 2011), Mexico issued a diverse, multi-peril bond through the World Bank MultiCat program. An innovative example of pre-financing natural catastrophes by a government, MultiCat Mexico is a multi-year, multi-peril and multi-tranche bond that reduces pressure on public budgets by accessing world capital markets (Swiss Re 2011).

The first MultiCat Mexico bond issue provided three-year coverage and transferred $290 million (USD) in hurricane and earthquake risks to the international capital markets (Michel-Kerjan et al. 2011). The bond was re-issued in 2012, with the notional of the bond increasing to $315 million (USD). A parametric or index-based trigger is used, thereby securing quick access to disaster relief funding relative to traditional indemnity-based insurance or reinsurance should a natural catastrophe occur.

New York MTA's Storm Surge Bonds

In the aftermath of Superstorm Sandy, New York's Metropolitan Transportation Authority (MTA) sought new solutions to address the risk to its rail infrastructure assets posed by storm surge. The solution was to issue storm surge catastrophe bonds to investors in the capital markets. The first known catastrophe bonds in which storm surge serves as the only trigger, these insurance-linked securities provide $200

million in coverage to MTA over three years (Burne and Mann 2013). The impetus to use this new risk transfer approach was MTA's difficulty in renewing traditional reinsurance following Sandy (Kenealy 2013). Other public agencies and corporations in the region and beyond have begun to evaluate the utility of catastrophe bonds for insuring their assets; however, the decision to utilize catastrophe bonds as opposed to traditional insurance and reinsurance will depend upon their specific vulnerabilities to storm surge or other risks under consideration (Burne and Mann 2013).

Advantages and disadvantages

Catastrophe bond solutions have noted advantages and disadvantages compared to traditional insurance and reinsurance options. Advantages include multi-year risk coverage and price stability, which insurance and reinsurance contracts often lack (Michel-Kerjan et al. 2011). If a parametric trigger is used for the catastrophe bond, the transparency of the triggering event and quicker release of funds are advantageous compared to the claims adjustment process involved with traditional insurance options or indemnity-based catastrophe bonds. However, a tradeoff is made between transparency and speed on one side and the relationship between the triggering event and actual damages incurred on the other. A parametric-based catastrophe bond is better suited to support emergency response measures and issues of liquidity following a natural catastrophe, whereas indemnity-based traditional insurance and reinsurance options are better suited to support the recovery and rebuilding efforts once the emergency has subsided (OECD 2011).

Catastrophe bonds represent a potentially attractive asset class for investors. Representing a very different class of assets than that which is traditionally included in a portfolio, catastrophe bonds can enhance returns for investors because the risks typically covered by these instruments are not highly correlated with other financial risks (Michel-Kerjan et al. 2011). As a result, governments should not find it burdensome diversifying risks in this fashion among potential investors.

Catastrophe bonds are also potentially easier to manage politically than building up a catastrophe reserve fund with public monies. Creating a reserve fund to support disaster relief and recovery, e.g. through insurance premiums or dedication of tax revenues, is a simple policy tool available to governments; however, maintaining a catastrophe reserve fund over time is difficult. For example, a catastrophe reserve fund was put in place by Hawaii following Hurricane Iniki in 1992, the most powerful hurricane to strike the state in its recorded history.[72] The Hurricane Reserve Trust Fund that was put in place was funded through payments from homeowner insurance premiums, but the fund has never been utilized by Hawaii and over the course of time, the state has reallocated those funds to other purposes (Insurance Journal 2011). In addition to the challenge of maintaining a reserve fund for uncertain and sporadic events over time, it could take several years to build a reserve fund sufficient in size; if a catastrophe occurred in the early years of building a reserve fund, the fund would be insufficient to cover losses (OECD 2011). Catastrophe bonds can overcome these challenges because the catastrophe risk is transferred to third parties in return for a premium (OECD 2011). Additionally, innovative approaches to financing catastrophe bonds can remove the need to use taxpayer money and replace it with pools of reserves from private insurers (OECD 2011). However, disadvantages of

[72] Hurricane Iniki hit the island of Kauai as a category 4 hurricane in September 1992. It caused $3.0 billion in damages (2013 dollars) and resulted in 7 deaths. See: http://www.ncdc.noaa.gov/billions/events

catastrophe bonds include the degree of technical difficulty in setting up and issuing the catastrophe bond relative to traditional insurance and reinsurance.

Risk Pooling

Caribbean Catastrophe Risk Insurance Facility

Pooling catastrophe risk among several governments is another innovative pre-disaster financing option in use. An example is the Caribbean Catastrophe Risk Insurance Facility (CCRIF). Created in 2007 as a World Bank venture, the CCRIF functions as a mutual insurance company that combines the benefits of retaining some of the risk transferred from the 16 participating Caribbean countries through pooled reserves and transferring the remainder of the risk to international reinsurance and capital markets when it is cost effective to do so (OECD 2011). The CCRIF is designed to mitigate common risks among the participating countries by providing them with short-term liquidity in the wake of major hurricanes (in addition to earthquakes) (Bapna & McGray 2008). Annual premiums differ based on the risk exposure of each participating country, and by pooling their major catastrophe risks together the CCRIF reduces the costs of disaster insurance to these Caribbean countries by an average of 40 percent (Bapna & McGray 2008). The CCRIF enables its member governments to share the costs of accessing reinsurance and/or capital markets for risk transfer. By pre-financing disaster response needs, the CCRIF represents a cost-effective way to begin post-disaster recovery immediately (OECD 2011 and Swiss Re 2011). For example, in the seven years since the CRRIF has been in existence, it has made 8 payouts (including after Hurricane Tomas in November 2010) and all payouts were transferred to the respective governments immediately after the stipulated waiting period (CCRIF 2014).

In part due to the success of the CRRIF, an analogous catastrophe risk insurance facility was established in the Pacific. Launched in January 2013 as a World Bank venture, the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) pilot program protects six Pacific island countries from tropical cyclone and hurricane risks. Risk is spread to the reinsurance markets through parametric derivative contracts with the World Bank acting as an intermediary (PCRAFI 2014). In its short existence, the PCRAFI insurance program has already made a payout following Tropical Cyclone Ian in January 2014.

CCRIF and PCRAFI provide examples of separate government entities pooling risk together on a regional basis. A pooled risk approach could yield benefits for New Jersey and other states where risks are relatively low (Linkin 2014). A similar example within the U.S. is the Combine Re catastrophe bond issued by Swiss Re in 2012. Combine Re marked the first time that multiple reinsured entities (North Carolina Farm Bureau and Country Mutual) were combined into a single catastrophe bond (Artemis n.d.). Risks covered by this catastrophe bond include hurricane, severe thunderstorm, winter storm and earthquake. The inclusion of severe storm and winter storm risks in the Combine Re catastrophe bond provides a framework for insuring against additional, non-hurricane extreme weather events.

Summary

Stakeholders from across the state and around the country—including agency officials, utility commissioners, public health officials, and many others—have indicated climate change preparedness and resiliency needs across many areas, including public infrastructure, agriculture and public health.[73] There are numerous funding and financing options are available to New Jersey to address these needs (Table 4). These options range from traditional (e.g. sales and motor fuels taxes) to innovative (e.g. market mechanisms and risk transfer solutions). To address New Jersey's needs, policymakers may need to think more broadly about the societal benefits derived from various programs, rather than thinking narrowly about the concept of what climate change preparedness and resiliency represents.

There is no single option or silver bullet that can address all needs. However, a portfolio of options can be implemented to address challenges and risks across several impacted areas. For example, King County in Washington State has implemented several options discussed throughout this report including funding a regional flood control district with property tax revenues, partnering with neighboring counties to fund a regional transit agency with local option sales tax revenues combined with motor vehicle excise tax and rental car tax revenues, and creating transferrable development rights to encourage smart growth. Choosing and implementing a suite of funding and financing tools can help New Jersey and its residents better prepare for the challenges from a changing climate.

[73] For an overview of climate change preparedness needs of various stakeholders in New Jersey, consult the NJ Climate Adaptation Alliance *Stakeholder Engagement Reports* at: http://njadapt.rutgers.edu/resources/njcaa-reports

Table 4. Summary of options discussed in report by area addressed

Funding and financing options	Climate change preparedness and resiliency areas					
	Farmland, wetlands and open space	Flood prone property acquisition	Public infrastructure			Disaster recovery
			Energy	Stormwater	Transportation	
State sales tax	H, P	H, P			C	
Local option sales tax	X	X		X	X	
Motor fuels tax					X, C	
Property tax	X, C	X, C		X	X, C	
Carbon tax			X		X	
Vehicle miles traveled fee					X, P	
Utility surcharge			X, C, P			
Stormwater fee				X		
Business tax	P	P				
Carbon markets	H		X, H		X	
Portfolio standards			C, P			
Transferrable development rights	X, C					
Infrastructure banks			X, P	X	X, P	
Public-private partnerships & agencies			X, P	X	X	
Catastrophe bonds						X
Pooled reinsurance facilities						X
Insurance premiums						X

X - used out of state

H - historically used in NJ

C - currently used in NJ

P - proposed in NJ

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Appendix A

Estimates of application of King County Flood Control District property tax levy potential for each county and total statewide

County	Number	Average residential assessed value	Total value	Tax rate	Revenue potential
Atlantic	103,779	$257,538	$26,727,036,102	0.0001	$2,672,704
Bergen	248,690	$468,969	$116,627,900,610	0.0001	$11,662,790
Burlington	145,044	$228,720	$33,174,463,680	0.0001	$3,317,446
Camden	156,250	$172,222	$26,909,687,500	0.0001	$2,690,969
Cape May	87,927	$494,594	$43,488,166,638	0.0001	$4,348,817
Cumberland	43,020	$139,507	$6,001,591,140	0.0001	$600,159
Essex	152,882	$362,497	$55,419,266,354	0.0001	$5,541,927
Gloucester	93,326	$203,504	$18,992,214,304	0.0001	$1,899,221
Hudson	102,864	$122,297	$12,579,958,608	0.0001	$1,257,996
Hunterdon	45,045	$368,770	$16,611,244,650	0.0001	$1,661,124
Mercer	107,803	$240,594	$25,936,754,982	0.0001	$2,593,675
Middlesex	212,056	$153,025	$32,449,869,400	0.0001	$3,244,987
Monmouth	210,112	$407,500	$85,620,640,000	0.0001	$8,562,064
Morris	150,967	$405,222	$61,175,149,674	0.0001	$6,117,515
Ocean	240,386	$309,221	$74,332,399,306	0.0001	$7,433,240
Passaic	107,905	$242,722	$26,190,917,410	0.0001	$2,619,092
Salem	22,039	$177,336	$3,908,308,104	0.0001	$390,831
Somerset	102,213	$415,993	$42,519,892,509	0.0001	$4,251,989
Sussex	57,027	$237,188	$13,526,120,076	0.0001	$1,352,612
Union	129,360	$135,476	$17,525,175,360	0.0001	$1,752,518
Warren	36,299	$231,990	$8,421,005,010	0.0001	$842,101
Total	2,554,994	$292,814	$748,138,013,116	0.0001	$74,813,801

Property numbers and assessments from NJ Department of Treasury, Division of Taxation, 2013 average residential assessment: http://www.state.nj.us/treasury/taxation/pdf/lpt/AvgResAsmt/2013AvgResAsmt.pdf

Appendix B

Allowances offered and sold at RGGI auctions during second compliance period with projection of estimated proceeds foregone by New Jersey

Auction	Allowances offered (actual)	Allowances sold (actual)	Percent allowances sold (actual)	NJ allowances (projected) [1]	NJ allowances sold (projected) [2]	Auction Price ($) [3]	Auction proceeds forgone by New Jersey [4]
2012 (Mar)	34,843,858	21,559,000	61.9%	5,150,864	3,187,003	$1.93	6,150,916
2012 (Jun)	36,426,008	20,941,000	57.5%	5,150,864	2,961,188	$1.93	5,715,092
2012 (Sep)	37,949,558	24,589,000	64.8%	5,150,864	3,337,446	$1.93	6,441,270
2012 (Dec)	37,563,083	19,774,000	52.6%	5,150,864	2,711,524	$1.93	5,233,240
2013 (Mar)	37,835,405	37,835,405	100.0%	5,150,864	5,150,864	$2.80	14,422,419
2013 (Jun)	38,782,076	38,782,076	100.0%	5,150,864	5,150,864	$3.21	16,534,273
2013 (Sep)	38,409,043	38,409,043	100.0%	5,150,864	5,150,864	$2.67	13,752,807
2013 (Dec)	38,329,378	38,329,378	100.0%	5,150,864	5,150,864	$3.00	15,452,592
						TOTAL	**83,702,610**

[1] In 2012 and 2013, the budget of allowances that would have been allotted to New Jersey under RGGI was 22,892,730 allowances per year. The projected number of allowances offered for sale by New Jersey at each auction was determined by dividing the yearly allotment by four and multiplying the quarterly total by 90%. This 90% figure approximates the cap-wide percentage of allowances offered for sale at auction during the first control period under RGGI (2009-2011) and is derived from the default value listed in the State Energy Analysis Tool (Georgetown Climate Center 2013). The projected number of allowances offered for sale by New Jersey at each auction is calculated as (22,892,730/4)*0.9 = 5,150,864.

[2] The projected number of allowances sold at each auction by New Jersey was determined by multiplying the projected number of allowances offered by New Jersey by the percentage of total allowances that were sold. It was assumed that demand for allowances by regulated entities in New Jersey would be the same as region-wide demand and that the percent of allowances sold would remain the same after introduction of the new supply of allowances from New Jersey.

[3] It was assumed that the auction price would not change with the introduction of new supply and demand of allowances in New Jersey.

[4] Estimated auction proceeds foregone by New Jersey is the product of the projected number of allowances sold at auction by New Jersey and the auction price.

Proceeds are in current dollars.

Sources:

Georgetown Climate Center (2013), http://www.georgetownclimate.org/tags/state-energy-analysis-tool

RGGI (2013b), http://rggi.org/docs/ProgramReview/_FinalProgramReviewMaterials/Model_Rule_Summary.pdf

Appendix C

Projection of RGGI auction proceeds for New Jersey (2014-2020)

Year	Allowances (millions) [1]	Percent auctioned [2]	Average Scenario		IPM Analysis Cap 91 Scenario		IPM Analysis Alternative Cap 91 Scenario	
			Auction price (2010$) [3]	Auction proceeds (millions 2010$)	Auction price (2010$) [5]	Auction proceeds (millions 2010$)	Auction price (2010$) [5]	Auction proceeds (millions 2010$)
2014	12.63	90%	4.81	54.66	6.02	68.41	3.60	40.91
2015	12.31	90%	5.76	63.76	6.37	70.57	5.14	56.95
2016	12.00	90%	6.65	71.83	6.73	72.70	6.57	70.97
2017	11.70	90%	7.21	75.88	7.13	75.04	7.29	76.73
2018	11.41	90%	7.76	79.69	7.52	77.22	8.00	82.15
2019	11.12	90%	8.54	85.45	7.97	79.75	9.11	91.16
2020	10.85	90%	9.31	90.88	8.41	82.10	10.21	99.67
			TOTAL	**$522.15**		**$525.78**		**$518.52**

[1] In February 2013, the nine participating Northeastern and mid-Atlantic RGGI states announced a 45% reduction in the overall CO2 emissions budget (RGGI 2013). The resulting reduction will cut the 2014 regional CO2 budget from 165 million short tons to 91 million short tons, with the cap declining thereafter by 2.5 percent each year from 2015 to 2020. The table has been adjusted to reflect the impact of the regional reduction on New Jersey's historic share of the overall CO2 emissions budget during the first compliance period, such that the state's baseline budget of 22.89 million allowances per year has been reduced by approximately 45% to a total of 12.61 million allowances in compliance year 2014 and decreasing by 2.5% per year from 2015-2020.
[2] The percent of allowances offered at auction is derived from the State Energy Analysis (SEA) Tool (Georgetown Climate Center 2013). The percentage listed (90%) is the default value of the SEA Tool and represents the approximate cap-wide percentage of allowances offered for sale at auction during the first control period under RGGI (2009-2011). The projected annual allowances allocated to New Jersey is adjusted by this percentage and multiplied by the auction price to obtain a projection of the auction proceeds available to New Jersey.
[3] The auction prices listed in the "Average Scenario" column are the average prices of two scenarios modeled in the IPM Analysis of the updated RGGI Model Rule Scenario.
[4,5] Auction prices for 2017 and 2019 were not presented in the IPM Analysis of the Cap 91 and Alternative Cap 91 Scenarios for the updated RGGI Model Rule. The average of the years preceding and following 2017 and 2019 were used as the auction prices.

Proceeds are in millions of 2010 dollars (based on projected auction prices in 2010 dollars in the IPM Analysis of the updated RGGI Model Rule).

Sources:
Georgetown Climate Center (2013), http://www.georgetownclimate.org/tags/state-energy-analysis-tool
RGGI (2013b), http://rggi.org/docs/ProgramReview/_FinalProgramReviewMaterials/Model_Rule_Summary.pdf
RGGI program review including IPM analysis of amended model rule, prepared by ICF International, http://rggi.org/design/program-review/materials-by-topic/modeling