CITY OF BOSTON
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Economic and Sustainability Benefits of Boston's ARRA Investments

Introduction

The American Recovery and Reinvestment Act (ARRA) of 2009 had two primary purposes:

- First and foremost, to provide near-term economic stimulus and job creation to counteract the largest economic recession since the Great Depression; and
- Second, to make investments in infrastructure and innovation to generate longer-term productivity and energy efficiency benefits to increase the country's competitiveness.

The City of Boston has been a recipient of ARRA stimulus funding across multiple departments and functions as documented in the City's ARRA at Year One report. Consistent with the two goals of ARRA, the objective of this study is to estimate the near-term economic impacts and longer-term sustainability benefits of Boston's ARRA investments. Near-term economic impacts measure the job creation and income generation of retaining jobs, new expenditures, and construction activities across all areas of Boston's ARRA investments. Key economic impacts are jobs by industry, gross regional product, and wages and personal income. The Boston Redevelopment Authority (BRA) applied its customized economic impact model from Regional Economic Models, Inc. (REMI) to conduct this analysis.

The sustainability analysis recognizes the increasing importance of environmental, energy and social factors when evaluating the use of public funding. In fact, ARRA funding requires consideration of: rapid implementation, green industry creation, energy efficiency and security, greenhouse gas reduction, job creation, and return on investment. The competitive funding programs for ARRA funds, whereby Boston competes for funding opportunities with communities across the country, are increasingly requiring a public benefit-cost analysis and estimation of environmental and energy benefits such as reduced greenhouse gas emissions and reduced dependency on oil and gas consumption. Consequently, this study has developed an innovative approach to measuring sustainability benefits and return on investment based on HDR's sustainable return on investment (SROI) approach. Sustainability benefits are measured over time in terms of energy cost savings, emissions reductions, water preservation, travel time savings, safety, and accelerated development value for a subset of Boston's ARRA investments.

Economic and Sustainability Benefits of Boston's ARRA Investments

Overview of Methodology

The methodology applied in this study included three components:

- Identifying and measuring the ARRA investments and total leveraged investment[1] across all City of Boston departments;
- Estimating the economic impacts of these ARRA-related expenditures using the REMI model; and
- Estimating the sustainability and long-term benefits of ARRA-related investments using a customized version of HDR's SROI modeling approach.

Boston's ARRA Investments

As of February 12, 2010, the City of Boston has been awarded over $309M in Federal stimulus funds across 15 different departments as shown in Table 1. This money is primarily made up of funds distributed directly to the City based on Federal formulas. A portion of the City's current ARRA portfolio is money allocated directly from the Commonwealth, as well as a few projects selected on a competitive basis. The City's current ARRA portfolio leverages an additional $113M in funding and investment [2].

TABLE 1 ARRA Funding by City Department

Department	ARRA Investment (thousands)
Boston Public Schools (BPS)	$ 86,100
Boston Housing Authority (BHA)	$ 70,100
Boston Transportation Department (BTD) & Public Works (PW)	$ 43,100
Boston Redevelopment Authority (BRA)	$ 27,600
Department of Neighborhood Development (DND)	$ 26,900
Administration and Finance	$ 20,000
Boston Police Department (BPD)	$ 17,500
Energy and Environmental Department (EE)	$ 7,500
Jobs and Community Services (JCS)	$ 4,400
Management and Information Systems (MIS)	$ 1,900
Boston Fire Department (BFD)	$ 1,400
Emergency Preparedness	$ 1,300
Boston Public Health Commission (BPHC)	$ 602
Elderly Commission	$ 347
Boston Center for Youth & Families (BCYF)	$ 250
Total	**$309,000**

[1] In some cases, ARRA funding does not provide the full-value of individual project investments but rather is matched by other funds or acts as a "gap financing" method to complete the funding for a project. For example, the Energy and Environmental Department received $6.2 million in ARRA funding, which contributed to a total ARRA-related investment of $29.5 million, meaning that the ARRA funds leveraged additional funding.

[2] Decisions on how some of the current ARRA portfolio will be allocated have not been made yet. Once those decisions are made, the City of Boston's ARRA projects will leverage a larger amount of additional funding and investment.

The current analysis requires detailed knowledge about projects receiving ARRA and ARRA-related funds. As a result, ARRA funds that were not specifically linked with a project and/or that the necessary detailed information about potential projects was unknown at the time of publication were left out of the current economic analysis. The economic impact analysis focuses on $241.2M of the 309M of the City's ARRA portfolio. The current analysis also includes 86.4M in leveraged funds. Funds left out of the current analysis include $27.6M allocated to the BRA, $1.3M of EE's funding, $16.9M of DND's funding, $1.9M awarded to MIS, and the $20M awarded to Administration and Finance [3]. As detailed specifics regarding these projects become known, the analysis will be updated to reflect that information.

Economic Impact Analysis of ARRA Economic Stimulus and Job Creation

An economic impact analysis of the ARRA economic stimulus program in Boston was completed in order to determine the jobs created and the economic stimulus benefits of the spending in Boston and throughout Massachusetts. The Regional Economic Models, Inc. (REMI model) for Boston consists of three geographic areas: Suffolk County; the four county region of metropolitan Boston surrounding the city (Essex, Middlesex, Norfolk and Plymouth counties); and the remainder of the Commonwealth. Together these total to the statewide economy. The Boston model contains 70 detailed industry sectors. BRA has applied this model since 1999 to assess the economic impacts of a variety of policy changes or investments on the city's economy [4].

As mentioned above, the REMI analysis focuses on 12 of the city agencies receiving funding, together with estimates of private or other public monies leveraged in those projects. For each department, the spending and the direct jobs produced were allocated over the life of the stimulus program (2009 to 2012). REMI model inputs were the direct jobs produced (when available) or the direct spending by the appropriate industry of economic activity [5]. The resulting economic impacts are provided as: jobs by industry, total personal income, gross state (or regional) product, total economic output (economic activity) and total personal consumption spending. In addition, the income and consumption estimates were used to estimate income tax and sales tax revenues generated.

Economic and fiscal impacts are estimated by year from 2009 through 2012 depending upon the timing of the investments for each department. The results include direct, indirect, and induced economic activity, which together form the total economic impact. Ratios of the total impact to the direct jobs (or spending) generate the multiplier effects of economic activity, which usually range from 1.25 through 3.00.

Sustainable Return on Investment (SROI)

While the BRA has been applying the REMI model for economic impact analysis since 1999, the City did not have a modeling framework to assess the broader environmental and social benefits of the City's investments. But with the emphasis in ARRA on energy efficiency and greenhouse gas reduction, the BRA partnered with HDR Decision Economics to customize and apply an SROI approach for Boston. The resulting model broadens traditional financial analysis to incorporate and value social and environmental factors within an expanded cost-benefit analysis framework (see Figure 1). The objective of the model is to demonstrate the sustainability benefits of current and future Boston investments. Of these investments, some are specifically intended as "green" initiatives but had not yet been evaluated in terms of the expected environmental and energy benefits. Other investments are more traditional (e.g., roadway traffic improvements), but are also likely to produce a mix of transportation mobility, environmental and social effects which can be measured.

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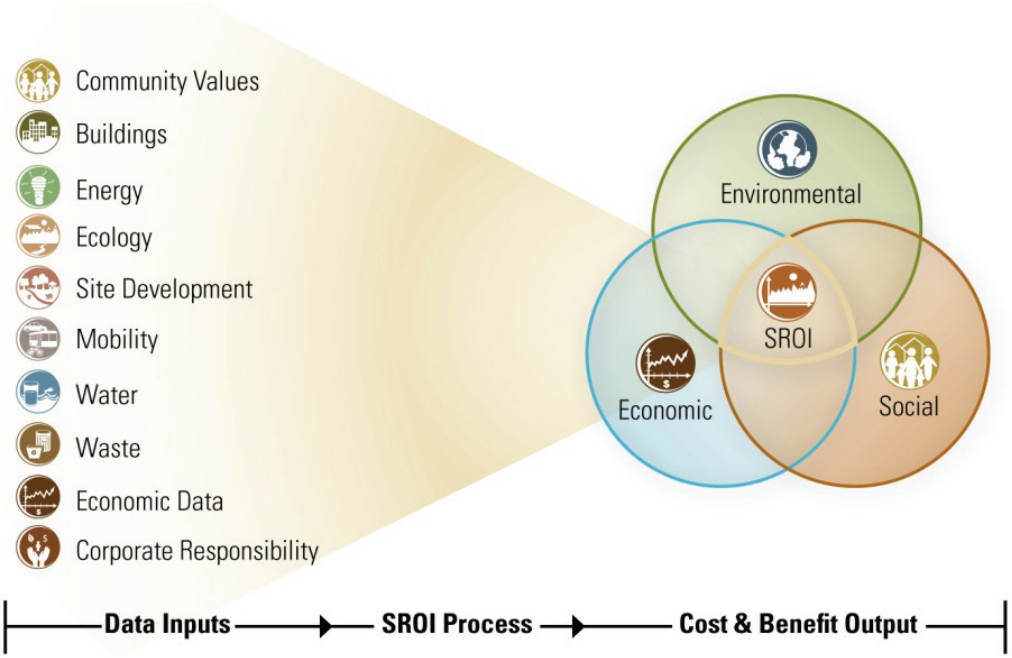
[3] This money is for school construction bonds and will allow the City to save $3.6M in future interest payments. We did not use this award in our economic impact analysis, but it does have a positive effect on the City.

[4] For more information on REMI, visit www.remi.com.

[5] In some cases both spending and employment were entered when ratios of output to employment differed from the internal REMI factors in a manner to constrain spending to the actual level of employment.

FIGURE 1 **HDR's Sustainable Return on Investment (SROI) Methodology**



What is SROI and How Does it Work?

SROI determines the full value of a project by assigning monetary values to all costs and benefits–economic, social and environmental. SROI helps to communicate the full value of investments including direct, indirect/non-cash costs and benefits, as well as externalities that are generally overlooked in economic assessment. Estimation of sustainable benefits such as reductions in energy use and air pollution are subject to uncertainty and scrutiny, even though these factors are directly relevant to responsible decision-making and ARRA funding requirements. The SROI process uses evidence-based research and published statistical parameters to value economic, social, and environmental benefits, and applies a proven risk analysis technique to account for uncertainty and develop a low-to-high range of estimated benefits to increase confidence in the results. The output results from the SROI model can be grouped as:

1) **Direct sustainability impacts** such as tons of CO2 emissions avoided, barrels of oil saved, gallons of fresh water saved, green jobs created, etc.
2) **Monetary value of sustainability impacts** measured in dollars and presented as the amount and share of benefits by City Department and City-wide.
3) **Return on Investment measures** such as net present value (NPV), benefit-cost ratio, internal rate of return (IRR), and payback period.

Customized SROI Model for the BRA

The objective of the SROI model for the BRA was to measure and demonstrate the sustainability benefits of the City's ARRA investments. Successful application of an SROI model for Boston required: a) identification of the ARRA-funded projects likely to lead to measurable sustainability benefits; and b) data inputs and expertise from City departments regarding the direct sustainability benefits in terms of reduced energy use (kilowatt-hours, fresh water preserved, therms of gas, reduced hours of traffic delay, etc.). Based on this evaluation of ARRA-funded projects and working closely with the City's departments, sustainability benefits were measured for four departments totaling $87.6 million in ARRA funding with a total leveraged investment of $162.9 million (see Table 2).

TABLE 2 ARRA Funding Evaluated for Sustainability Benefits

Department	ARRA Funding	ARRA Funding – Sustainability Analysis	Total Funding – Sustainability Analysis
EE	$ 6,160,000	$ 5,250,000	$ 28,595,000
BTD & PW	$ 43,062,524	$21,520,000	$ 21,520,000
DND	$ 10,030,739	$ 1,738,088	$ 14,501,699
BHA	$ 70,106,821	$ 59,108,104	$ 98,310,105
Total	**$129,360,084**	**$ 87,616,192**	**$162,926,804**

The sustainability analysis thus focused on:

- **Energy and Environmental Department (EE)** Sustainability benefits were estimated for most of the $6.2 million in ARRA funding to this Department. Investments include an energy retrofit programs for residential housing, a small business energy program, LED street lights, and installation of solar energy infrastructure. Direct benefits primarily include reduced kilowatt-hours (kWh) and related reductions in emissions.
- **Boston Transportation Department (BTD) and Public Works (PW)** Sustainability benefits and return on investment were estimated for the City's Dorchester Avenue project which reduces traffic delay at intersections as well as the emissions caused by idling. Other direct benefits include energy savings from LED lights and reduced auto accidents.
- **Department of Neighborhood Development (DND)** DND uses ARRA funding primarily as a gap financing mechanism to facilitate and accelerate mixed-used development projects. While a number of projects are likely to be advanced, DND was able to provide information on a current project in Jamaica Plain that will result in a LEED-standard energy efficient building that is expected to accelerate the development of a currently vacant parcel.
- **Boston Housing Authority (BHA)** BHA's portfolio of ARRA-funded projects with sustainability benefits includes modernization of multi-family residential buildings, roof replacements, new hot water heater systems, and new construction of green energy efficient residential properties. Sustainability benefits are measured in terms of reduced kWh, reduced therms of gas, and preservation of fresh water from low-flow bathroom fixtures [6].

Future applications of the SROI approach are expected to:

1) Expand the coverage of ARRA investments assessed by SROI;
2) Increase the functionality of the SROI approach to include a wider range of social benefits not currently measured such as the social benefits of homelessness programs, youth job programs, or community policing; and
3) Help the City prioritize investments and compete for future Federal funding opportunities by estimating critical sustainable benefit concepts.

[6] It is worth noting that the benefits and costs of "green" building investments for DND and BHA such as insulation or energy efficient windows was limited to the expected share of investment needed to achieve a LEED-silver standard of energy efficiency compared to a "base code" building.

Summary of Findings and Results

Boston's ARRA investments are anticipated to achieve success in terms of both short-term economic stimulus and longer-term sustainable benefits. Sustainable benefits will help the City reduce its energy consumption and greenhouse gas emissions while producing significant cost savings to Boston residents and businesses.

Economic Impact Results

Boston's total ARRA stimulus package produces economic impacts based on investments and spending by 12 city departments with $241.2 million from ARRA funding and a total economic spending including other private investment or non-ARRA public funds of $327.6 million. The REMI results are displayed in Table 3.

TABLE 3 Economic Impact of Boston ARRA Stimulus Investments – Total Spending

	Boston	Massachusetts
Over project span of 4 years:		
Total Jobs (Direct, Indirect, and Induced)	2,126	2,861
Gross State Product (2009 dollars)	$ 174,253,457	$ 245,947,611
Personal Income (2009 dollars)	$ 66,111,927	$ 199,150,693
Total Output (2009 dollars)	$ 261,340,716	$ 460,247,615
Personal Consumption Expenditures (2009 dollars)	$ 39,043,480	$ 115,863,657
Total State Tax Revenue over 4 years (2009 dollars)	$ 3,439,645	$ 10,334,019

Source: REMI Model and BRA Research Division calculations

The economic impact of the $327.6 million in investment, which includes the direct $241.2 million ARRA stimulus, translates into 1,276 direct full-time equivalent (FTEs) jobs in Boston (2,126 direct, indirect, and induced). It is estimated that ARRA spending in Boston will help to create an additional 1,585 jobs statewide (indirect and induced). In total, ARRA spending is estimated to generate $460.2 million of statewide economic activity (Total Output) and $261.3 million in additional economic activity in Suffolk County. The Boston ARRA-related investments generate an increase in Gross State Product in the private sector of $245.9 million, with a $174.2 million increase in Suffolk County. These investments also result in $199.1 million of total personal income statewide of which $115.9 million is spending on personal consumption items. The total personal income and consumer spending directly generate $10.3 million of state tax revenue in terms of income taxes and state retail sales taxes.

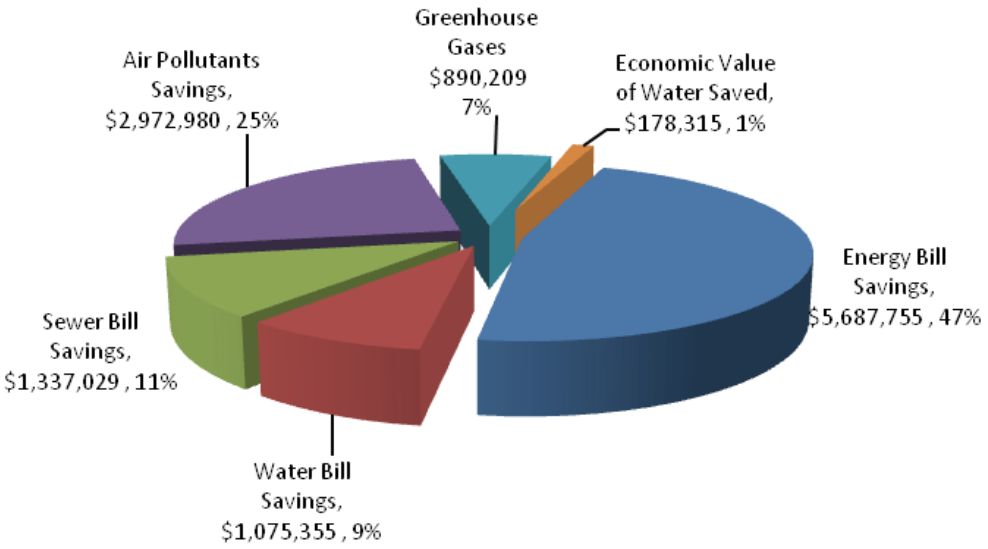
Sustainable Return on Investment (SROI) Results

As discussed above, the SROI analysis focused on four City departments with investments that will produce measurable energy and environmental benefits. Direct sustainability benefits are estimated to be substantial over time, with annual benefits in 2015 of:

- 34.4 million fewer kWh of electricity consumed;
- 277,000 reduction of therms of gas used;
- 23,750 HCF (hundreds of cubic feet) of water preserved; and
- 25,150 fewer tons of greenhouse gas emissions (CO_2).

Figure 2 provides a breakdown of the energy and environmental benefits of the City's ARRA investments estimated for 2015. The largest category of benefits is a direct energy bill cost savings of over $5.7 million per year. Other significant benefits include reduced air pollutants (almost $3 million/year); reduced water and sewer bill costs (over $2.4 million combined); and reduced greenhouse gas emissions ($0.9 million/year).

FIGURE 2 Annual Energy and Environmental Benefits and Cost Savings in 2015



Source: HDR's SROI Model calculations

Table 4 provides a summary of the financial and sustainable return on investment for the four City departments evaluated as well as a total for the City. This comprehensive benefit/cost analysis includes the travel time savings of the Dorchester Avenue project, which generates a net present value (NPV) over $111 million for that project alone. Consequently, there is a strong return on investment with an aggregate benefit-cost ratio of 4.5 meaning that benefits are 4.5 times larger than costs. The aggregate NPV is over $208 million with a 4.5 discounted payback period of about 5 years. This means that the City is estimated to have benefits that exceed the upfront capital expenditures within 5 years. Benefit-cost ratios are estimated to be greater than 1.0 for all departments evaluated with a range of 1.6 to 9.2. The internal rate of return (IRR) is estimated to be 38% across the four departments with even stronger returns for the BTD and PW and BHA investments.

TABLE 4 Sustainable Return on Investment

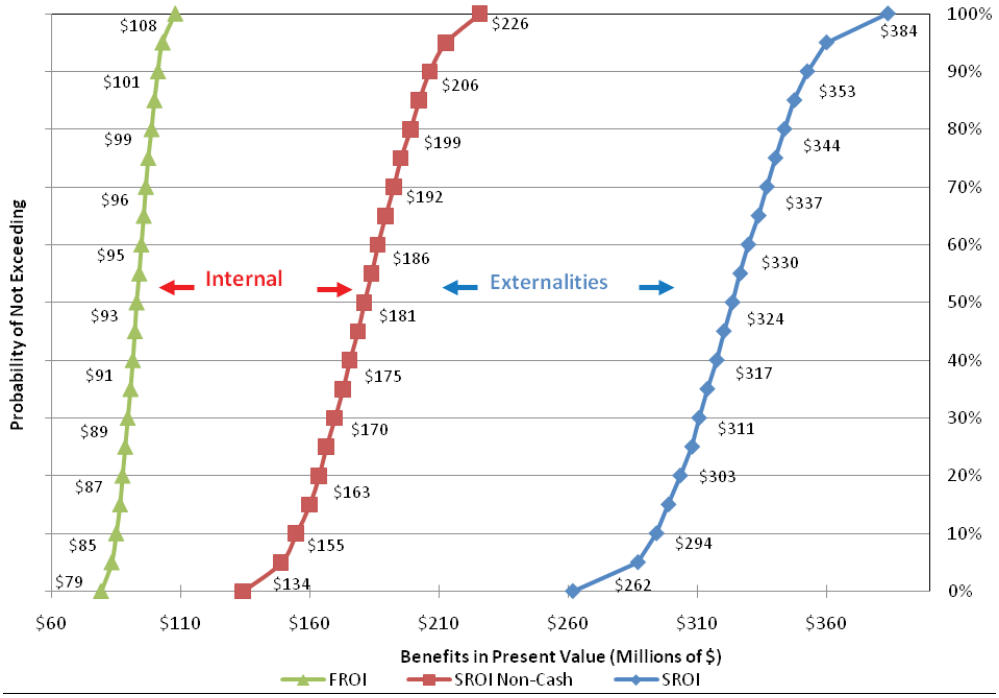
Department	NPV	Discounted Payback Period	IRR (%)	Benefit–Cost Ratio
EE	$ 52,394,089	4	35%	3.0
BTD & PW	$ 111,398,447	4	38%	6.8
DND	$ 1,114,915	13	10%	1.6
BHA	$ 43,746,959	2	63%	9.2
Total	**$208,654,409**	**5**	**38%**	**4.5**

Source: HDR's SROI Model calculations

The risk associated with the results was characterized in cumulative probability or S-curves as shown in Figure 3. The green S-curve depicts the estimated present value (PV) of benefits from a pure financial return perspective with a mean value of $93 million and an 80% confidence interval range between $85 million and $101 million. These results are robust as they include the significant energy bill savings. Shifting to the right, the non-cash internal benefits include social benefits to beneficiaries of the investments such as travel time savings and reduced accidents for travelers. Including these benefits increases the mean PV of benefits to $181 million. When including the full range of benefits, there is a shift to the right-hand S-curve depicting the SROI results which include externality benefits such as reduced emissions and preservation of fresh water. The SROI S-curve has a mean benefit estimate of $324 million while the 80% confidence interval ranges between $294 million (10%) to $353 million (90%), meaning that there's an 80% chance that the actual annual benefits will fall within that range.

Finally, the estimated risk ranges for benefits imply a likely range for the benefit-cost ratio of 4.0 to 5.0. This means that even when applying potential low to high factors, benefits are still expected to exceed costs by at least a four-to-one ratio, demonstrating a strong return on investment to the City of Boston.

FIGURE 3 Risk Analysis of Boston's ARRA Investments and Sustainability Benefits



Source: HDR's SROI Model calculations

Acknowledgements

This analysis was prepared by the Boston Redevelopment Authority's (BRA) Research Division and HDR Decision Economics. Contributing members from BRA's Research Division are Alvaro Lima, Director of Research; Mark Melnik, Deputy Director for Research; and Greg Perkins, Senior Research Associate. Contributing members from HDR Decision Economics include Dan Hodge, Project Manager; Jon Lee, Economist; and Stephane Larocque, Principal Economist. Billy Leung, Vice President, Vivian Kan, Associate Economist, and Rod Motamedi, Associate Economist of REMI supported BRA Research in their economic impact analysis.

The Boston Redevelopment Authority (BRA) provides comprehensive guidance in planning, economic development, and workforce development. The BRA Research Division gathers and analyzes data related to the strength of Boston's economy and provides demographic, social, economic and housing data to support community-based planning initiatives.

HDR Decision Economics provides economic, financial, and risk analysis services to public, non-profit and private sector clients with offices in Boston, Silver Spring, MD and Ottawa and Toronto, Canada. HDR specializes in evaluating the full-range of benefits, costs and risks of infrastructure investments and public policies for economic development, transportation, health care, energy and environmental sectors.

Boston Redevelopment Authority

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