BOSTON SMART UTILITIES

CITY OF BOSTON
Martin J. Walsh, Mayor
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bpda

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Thank you to the Barr Foundation for their generous support of Boston's Smart Utilities Vision

And a special thanks to our Steering Committee:

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INTRODUCTION

This document provides a summary of the Boston Smart Utilities whiteboarding session ("session") convened by the Boston Planning & Development Agency (BPDA) at District Hall on July 25th, 2017.

The Boston Smart Utilities Vision is a collaborative study between city government and Boston's utility companies that offers a new model for integrated planning among energy, transit, water, and communications utilities. By improving coordination among utilities, the Vision aims to make urban districts more equitable, resilient, connected, and sustainable.

BACKGROUND

Phases of the Smart Utilities Vision

The Smart Utilities Vision (SUV) is a planning study of utility infrastructure in the 144-acre PLAN: South Boston Dorchester Avenue planning district ("Study Area"). The challenge of smart utility planning was addressed in a series of phases during the year-long duration of the SUV.

The SUV began in its *Define the Base Case* phase by assessing the cost of "business-as-usual" utility installation costs and processes. That information was used to shape the second phase, *Define the Opportunity*, where a preliminary estimation of the benefits and savings offered by Smart Utility Technologies was modeled.

The Smart Utility Technologies (SUTs) with the greatest potential to achieve the City's goals were evalued in a cost benefit analysis. The concluding phases developed implementation solutions for the engineering, construction, and incorporation of select Smart Utility Technologies in Boston's future developments.

Smart Utility Technologies

Smart Utilities Technologies ("SUT") is a term used to define the suite of technologies whose concurrent design, construction, and activation would provide the data and electricity connections necessary for a Smart City-ready district. They are the hardware and software solutions that are central to enhancing social equity, resource efficiency, community resilience, and economic competitiveness. The SUTs evaluated during the Boston Smart Utilities Vision include:

Energy	**District Energy Microgrids**	A District Energy Microgrid consists of a central energy plant and underground pipes carrying hot and cold water to buildings. The system would substitute for in-building boilers and chillers and provide auxiliary power in the event of a larger-scale grid outage.
	Solar/Battery Microgrids	A Solar/Battery Microgrid includes a renewable power source and underground electric cables that can break-away from the larger grid and self-power in the event of a large scale power outage.
Water	**Green Infrastructure**	Green Infrastructure consists of gardens and pavers that take the place of sidewalk space in order to allow rainwater to percolate into the ground.
	Rainwater Reuse	Rainwater Reuse consists of a system for capturing and storing water in tanks for use in landscaping.
	Greywater Reuse	Greywater Reuse consists of extra piping and water treatment capabilities within a building to collect, clean, and recycle sink and shower water for reuse in flushing toilets.
Transportation	**Adaptive Signal Technology**	Adaptive Signal Technology is a series of motion sensors and traffic signals that communicate in order to improve traffic flow.
	Autonomous Vehicle Infrastructure	Autonomous Vehicle Infrastructure consists of clear road-markings and low-glare road signage that can be easily interpreted by autonomous vehicle cameras and algorithms.
Communication	**Public WiFi & Smart Sensors**	Public WiFi enables access to the internet in the public right-of-way. Smart Sensors monitor public spaces for environmental, maintenance, and other concerns. They are both mounted on traditional light poles.
	Smart Street Lights	Smart Street Lights control street lighting brightness to reflect the needs presented by other light levels.
	Telecom Utilidor	The Telecom Utilidor is a high capacity conduit system where all cable/internet providers lease space for their wires and fiber optics.

SUMMARY OF PRIOR WORKSHOPS

The July 2017 Whiteboarding Session was preceded by two other workshops, the outcomes of which are summarized below.

Recap: May 2016 Workshop and Findings

The primary purpose of the first Whiteboarding Session held on May 25, 2016 was to solicit feedback from multiple stakeholder groups on a draft Request for Proposals (RFP) for consultant services to initiate the Smart Utilities Vision. The May Whiteboarding Session explored the risks and rewards of coordinated utility planning and implementation, and began the process of mapping value drivers to stakeholders.

The BPDA compiled the insights from the session, incorporated changes into the draft RFP, and issued the final RFP in July 2016 for a "Smart Utilities Vision" that would yield engineering and policy recommendations for utility infrastructure in the 144 acre PLAN: South Boston Dorchester Avenue planning district.

On September 15th, 2016, the BPDA board approved the selection of the AECOM consulting team for consulting services to execute the project.

Recap: January 2017 Workshop and Findings

The second whiteboarding session, held on January 25, 2017, began with a presentation by the Boston Planning & Development Agency (BPDA) of its preliminary financial and engineering model of "business-as-usual" utility development as well as the Smart Utility Technologies (SUTs) it intended to evaluate.

Stakeholders participated in a series of tabletop exercises to evaluate and refine the engineering methodology, the Smart Utility Technologies proposed, and the potential solutions for implementing new types of utilities.

The event concluded with a conversation between Chris Osgood, the Chief of the Streets, Transportation, and Sanitation, Jascha Franklin-Hodge, the Chief Information Officer, and Sara Myerson, the Director of Planning for the BPDA. The senior officials discussed the City's role as a catalyst for making Boston a "Smart City" that better serves its citizens.

JULY 25TH WHITEBOARDING SESSION OVERVIEW

Executive Summary

The July 25, 2017 Whiteboarding Session, the final session of the year-long Smart Utilities Vision study, invited participants to review Boston's new:

- Smart Utility Standards
- Smart Utility Technology recommendations for new development

Chris Osgood, the City's Chief of the Streets, Transportation, and Sanitation, welcomed attendees and spoke of Boston's collaborative advantage in solving tough problems through partnerships with its industries, NGOs, and universities. The Smart Utilities Vision is prepared to implement the physical foundation for achieving the goals of Boston's Resilience Strategy, Climate Ready Boston, Vision Zero Boston, and Imagine Boston 2030.

The Boston Planning & Development Agency (BPDA) presented the progress of the Smart Utilities Vision, including a summary of the Baseline Engineering Report discussed in the January 25 session and the Cost Benefit Analysis conducted on Smart Utility Technologies.

Following a summary of the research to date, the BPDA shared the City's primary deliverables. The first was a set of *Smart Utility Standards*, a booklet of roadway cross-sections and technology definitions that will guide the placement and construction of utilities in Boston. The second was a series of recommendations for including select Smart Utility Technologies in real estate developments of a sufficient size.

Stakeholders participated in a series of tabletop exercises to discuss potential delivery models for two of those technologies: a District Energy Microgrid and a Telecommunications Utilidor.

The day concluded with a plenary discussion of the collaboration and governance structures needed to implement the Smart Utility Technologies.

Presentation

Chris Osgood, the City's Chief of the Streets, Transportation, and Sanitation, opened the event with a discussion of Boston's commitment to Smart Utility Technologies as a means of achieving the equity, safety, resilience, sustainability, and economic development goals Boston's Resilience Strategy, Climate Ready Boston, Vision Zero Boston, and Imagine Boston 2030.

Travis Sheehan, the BPDA's Senior Infrastructure Advisor, followed Chief Osgood's remarks with a presentation of Boston's unprecedented urban growth and the opportunities offered by coordinated utility construction as demonstrated in the SUV's Baseline Engineering Report and Cost Benefit Analysis for select Smart Utility Technologies.

The BPDA presented its recommendations for implementing these technologies in Boston. The first was a set of underground design guidelines called the *Smart Utilities Standards*. The *Smart Utilities Standards* present a series of cross sections that identify an ideal placement for utilities underground. The guidelines aim to add predictability to the utility construction process while increasing capacity under the roadway to make room for future technologies. The *Smart Utility Standards* also include definitions and depictions of the Smart Utility Technologies evaluated in the course of the study for use by developers hoping to implement SUTs in their new projects.

The BPDA also presented its recommendations for including *Smart Utility Technologies* in new real estate developments of various sizes. Two SUTs, District Energy Microgrid and Telecom Utilidor, were determined by the City and the BPDA to present the greatest value to achieving Boston's goals and are being recommended for developments over 1.5 million square feet.

District Energy Microgrids consists of a central energy plant and underground pipes carrying hot and cold water to buildings. The system would substitute for in-building boilers and chillers and provide auxiliary power in the event of a larger-scale grid outage.

The Telecom Utilidor is a high capacity conduit system where all cable/internet providers lease space for their wires and fiber optics, thereby reducing the need for telecommunications providers to construct expensive and disruptive individual conduit lines.

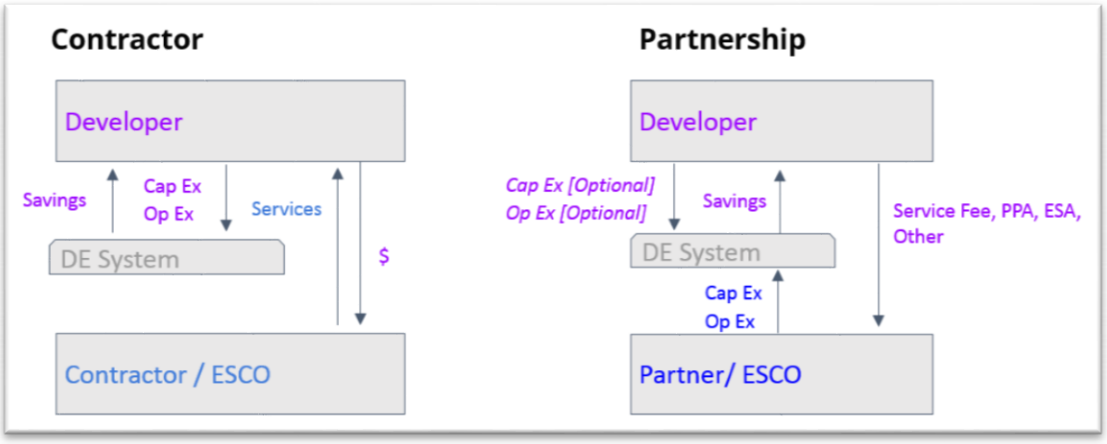
Tabletop Exercises

Attendees were divided into four teams of 10 and assigned to a discussion of either District Energy Microgrids or a Telecom Utilidor. The District Energy Microgrid groups discussed the benefits and concerns of Contractor and Partnership delivery models before outlining the steps required for building a system in a new development project. The Telecom Utilidor groups were presented with a scenario planning exercise and asked to discuss how two adjacent developers would coordinate the construction and cost-sharing of a utilidor. They then discussed the benefits and concerns of a Contractor, Partnership, and Transfer delivery model.

DISTRICT ENERGY MICROGRIDS

Exercise 1 Recap: Project Delivery Models

The BPDA Asked:
What are the benefits and concerns of different delivery models?



The BPDA presented two delivery models for the implementation of a District Energy Microgrid in a new development project. The Contractor Model described a scenario wherein a developer would use capital to contract an Energy Services Company (ESCO) to build a system on behalf of the developer. The Partnership Model described a scenario wherein a developer would partner with an Energy Services Company, sharing both the capital expenses and the energy cost savings from the system. Attendees identified a number of themes for each scenario:

	Contractor Model	Partnership Model
Benefit	• Fewer parties to manage • Legally straight-forward • A developer does not have to be familiar with energy systems	• Partnership brings more knowledge to the discussion • Higher incentive to build a better product for the long-term
Concern	• Initial cost increase for developers	• Risk and responsibility-sharing needs to be agreed upon upfront • Longer-term commitment
Question	• Which model best enables the inclusion of future technology? • Where does the technology risk for the agreement lie?	

Overall, the participants determined that either model could effectively be used to deploy a District Energy Microgrid provided the financial and technological risks were understood at the project's outset. The Developer would have to evaluate their level of experience with energy systems, their want of a partner, and their interest in a long vs. short term engagement.

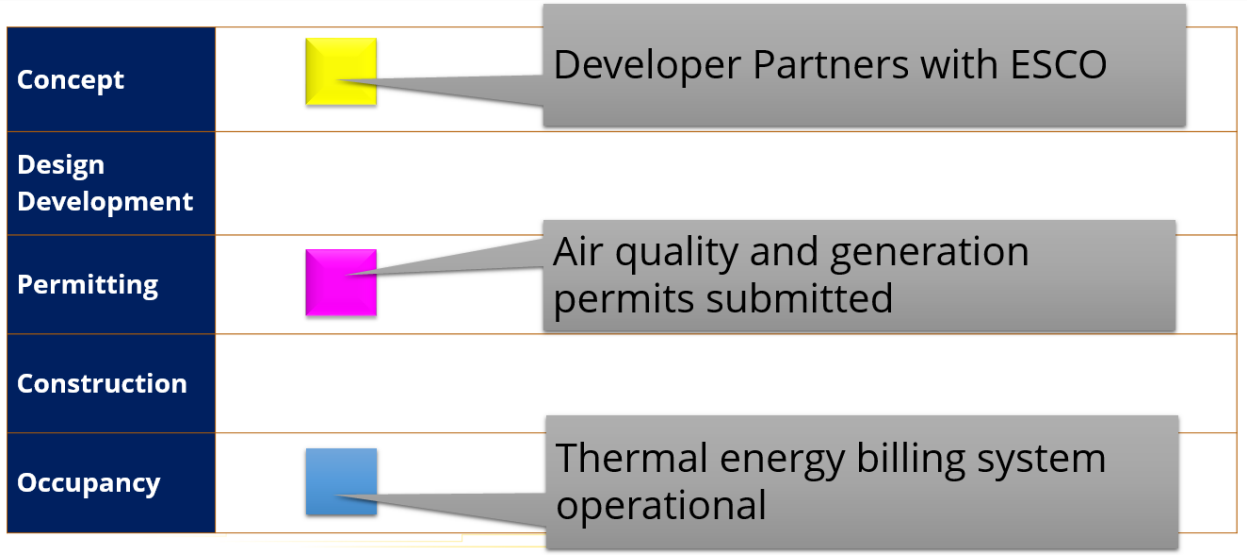
Exercise 2 Recap: Stages of Development

The BPDA Asked:
What are the steps required to build a District Energy Microgrid in a new development project?

The BPDA presented participants with an outline of the real estate development process, including the agency's checkpoints:

Concept	Land acquisition, land use exploration, massing designs, financial modeling [Before Pre-file Phase]
Design Development	Schematic through detailed design, community meetings and negotiations, building project entitlements [Article 80 + Planned Development Area (PDA)]
Permitting	From drawing inspection to ground breaking
Construction	From ground-breaking to occupancy permits
Occupancy/Use	Full building operations to project stabilization and beyond

Participants identified the steps that the design and construction of a District Energy Microgrid would bring to the development process:



A sample of the themes and feedback identified is presented in the following table:

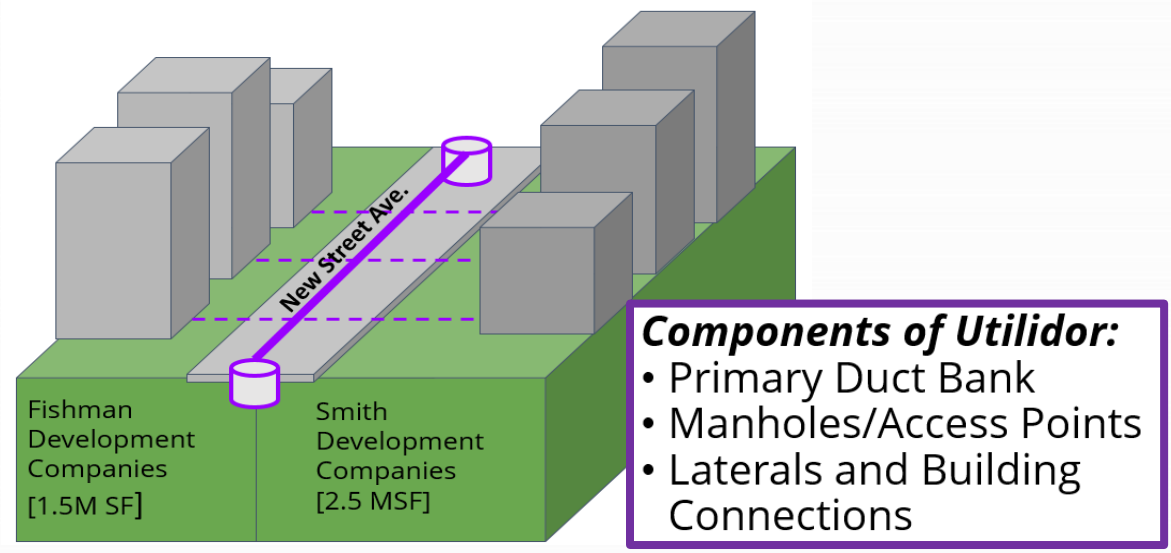
Concept	• The Governance Structure (contractor or partnership) must be decided at the outset • An interconnection agreement would have to be discussed with the utility • A feasibility study should determine the scale and projected load of the district energy microgrid
Design Development	• Define the components of the energy system exactly to match capacity needs and the City's goals
Permitting	• Prepare access to electrical switchgear
Construction	• Coordination between the energy services company and the utility partners is paramount
Occupancy/Use	• New value streams of the technology will affect financing • Long-term service agreements will need to be devised

Participants recognized a need to involve an energy professional at the project's concept phase in order to integrate energy systems planning into initial high-level discussions. As the project progresses, a closer coordination between the developer and their utility partners will help ease the District Energy Microgrid considerations into the existing development process.

TELECOM UTILIDOR

Exercise 1 Recap: Scenario Planning of Coordinated Development

The BPDA Asked:
How would two developers sequence construction and cost-sharing of the Telecom Utilidor in the design scenario?



The BPDA presented a design scenario where two developers constructing along the same new street were recommended to build a Telecom Utilidor to meet the telecommunications needs for their future build-outs. The scenario challenged participants to identify ways to partner in the design, construction, payment, and operations of a shared asset that would benefit both them and their future tenants.

The participants identified the following themes on the coordination process in their discussion:

Costs	• Avoid the "first mover" cost for the initial development • Telecom-owned conduit is revenue neutral; leasing space is a cost
Design	• Design for a predetermined "growth factor"; i.e. 20-30% excess capacity
Management	• Tight inspection of the asset by an impartial owner • Access and oversight are key for telecom providers leasing space
Ownership	• 3rd part impartial ownership is necessary; the City is the ideal owner • A single owner with a single permitting process makes this feasible
Standards	• Standards for engineering, building access, and "meet me" points to enter the utilidor will need to be developed

Exercise 2 Recap: Project Delivery Models

The BPDA Asked:
What the benefits and concerns of each project delivery model?

Contractor	Land acquisition, land use exploration, massing designs, financial modeling [Before Pre-file Phase]
Partnership	Schematic through detailed design, community meetings and negotiations, building project entitlements [Article 80 + Planned Development Area (PDA)]
Transfer	From drawing inspection to ground breaking

The BPDA presented participants with three project delivery models, Contractor, Partnership, and Transfer, and received the following considerations for each:

Contractor	• The specifications would belong to the contractor and would not be universal to all projects • The City would still need to provide oversight of specifications, management, and access
Partnership	• Allows for joint financing • The long-term view of partnership forces cooperation • Telecom competition increases if the costs of roadway construction, asphalt, and trenching is shared
Transfer	• The City as an owner offers a long-term consistency and reduced risk • This will require City resources and a non-partisan management service • City may have to enhance expertise, financial resources, and capacity

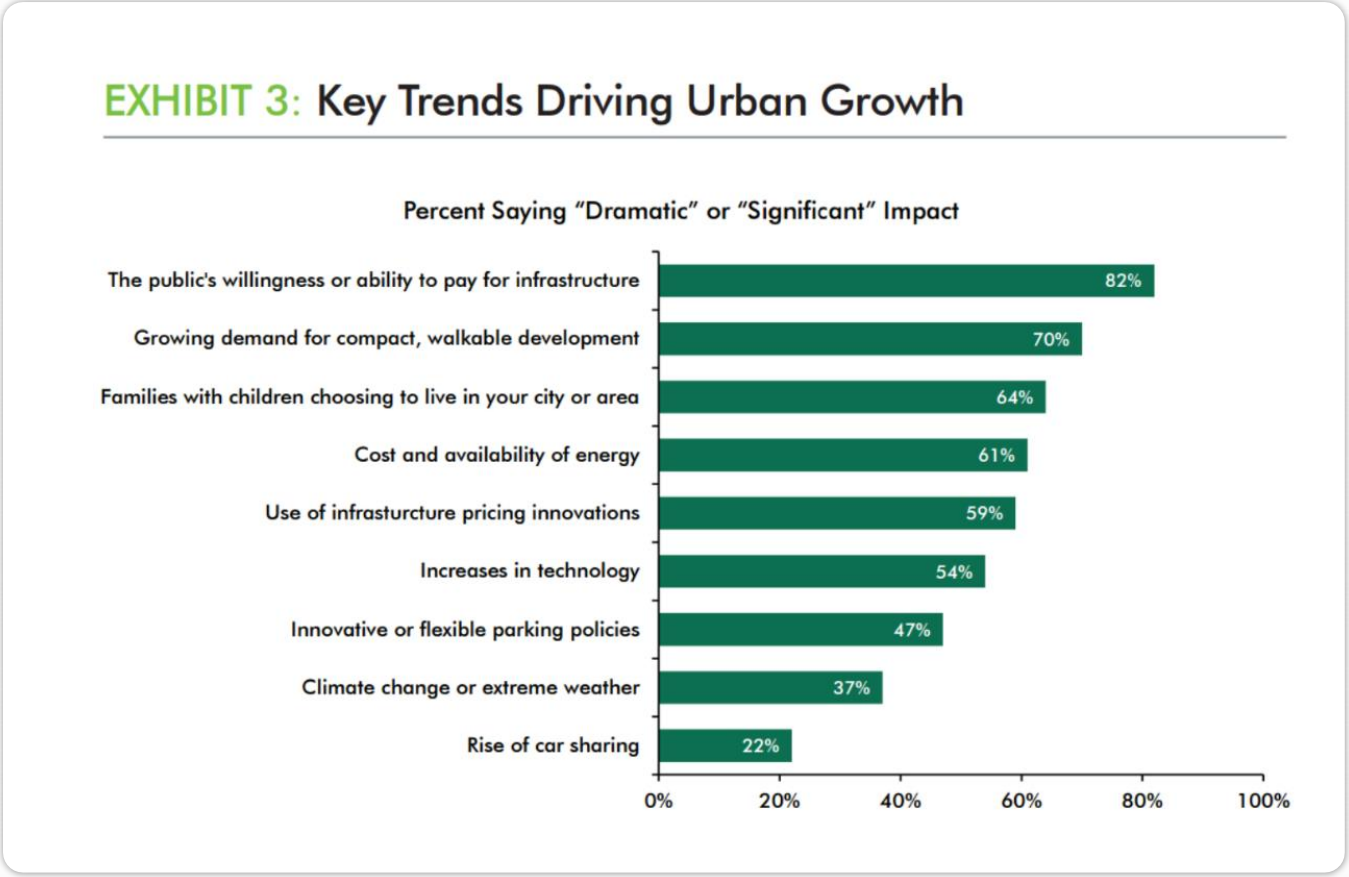
CONCLUSION

The BPDA concluded the event by asking participants what the City could do to help its partners as the Smart Utilities Vision moves towards implementation. Participants emphasized the need for the City to continue its cross-sector facilitation efforts and educate its partners on its goals, progress, and planning considerations. Ultimately, the success of the *Smart Utility Standards* and the Smart Utility Technology recommendations depends on the City and the BPDA's ability to develop clearly defined standards, procedures, and practices.

APPENDIX A: SUPPLEMENTAL INFORMATION FOR ATTENDEES

CONTEXT- URBAN INFRASTRUCTURE SPENDING IN US CITIES

- $416 BN spent on US Transportation + Water Infrastructure in 2014 [1]
- $582 BN projected spending on electric distribution (non-transmission) from 2010-2030 [2]
- $2.2 BN average municipal budget for top 100 US Cities with 62% Growth in Infrastructure spending for municipalities [3]



Source: CBRE US Urbanization Trends and Investment Implications for Commercial Real Estate

[1] Congressional Budget Office, based on data from the Office of Management and Budget and the Census Bureau
[2] Stifel Nicolaus, ASCE, EEI, and IIR
[3]"Analysis of spending in America's largest cities", The Encyclopedia of American Politics, Ballotpedia, 2014

CONTEXT- BOSTON GROWTH CONDITIONS

- Boston is experiencing major urban growth spurred by strategic planning for housing, transportation, and overall comprehensive growth strategy.
- The Mayoral initiative Imagine Boston 2030 has identified "investment in infrastructure, open space, and culture" as a key priority.
- The Boston Community Energy Study demonstrates national thought leadership on innovative solutions to energy infrastructure.
- Other Boston indicators for growth and spending:
    - A Booming Real Estate market- $4.71 Billion in construction activity in 2014 , 37% increase in building permit revenues
    - Boston allocated $90 million dollars for Public Works and Transit in 2016 [1]
    - Boston aims to grow housing stock by 50,000 units by 2030 [2]

[1] City of Boston Office of Budget and Management, 2016
[2] "Housing a Changing Boston" report, City of Boston, 2015

SUPPLEMENTAL INFORMATION ON "PLAN: South Boston Dorchester Avenue"

The Dorchester Avenue Corridor from Andrew Square to Broadway Station is experiencing market pressures to change from its traditional manufacturing and industrial uses to residential and mixed-use. Situated between two major red line MBTA stations and bus hubs, it is a prime corridor for transit-oriented development. The goal of this study and planning process is to create new zoning that aligns the aspirations of the community with predictable, as-of-right development conditions that will enhance overall livability in the area.

CONCEPTUAL development opportunity

- 12 ~ 16 million square feet of space
  - Residential uses ~ 6-8 million square feet
  - Other (office, 21st century industrial) ~ 5-7 million square feet
  - Ground floor retail and cultural uses ~ .5 – 1 million square feet
- Public Realm
  - Roads & Sidewalks ~ 30 – 50 acres
  - Open Space ~ 8 – 12 acres
- Residential uses
  - 6,000 – 8,000 residential units
  - ~14,000 – 16,000 new residents

Boston Smart Utilities will build on the findings from the final zoning and planning work.

More information on PLAN: DOT AVE can be found here:
http://www.bostonplans.org/planning/planning-initiatives/plan-south-boston-dorchester-ave

APPENDIX B: LIST OF ATTENDEES

Name	Organization
Alan Glynn	Arup
Alfredo Barros	Eversouce
Alistair Pim	NECEC
Amy Cording	City of Boston
Anne Schwieger	City of Boston
Arne Hessenbruch	Massachusetts Institute of Technology
Bill Abolt	AECOM
Bob Manning	Harvard
Brad Swing	City of Boston
Brendan Hamilton	StealthNet
Bruce Douglas	Natural System Utilities
Bryan Glascock	Boston Planning and Development Agency
Chris Bleuher	Schneider Electric
Claire Lane	City of Boston
Colin Curzi	Boston Planning and Development Agency
David Reed	Schneider Electric
Douglas Manz	HYM Investments
Douglas Stevenson	Eocgweb
Eduardo Morales	Verizon
Faye Brown	National Grid
Frank Curran	CKM Consulting
Irene McSweeney	Boston Water and Sewer Commission
Jacqueline Royce	Verizon
James Cater	Eversouce
Jason Whittet	AT&T
Jim Newman	Linnean Solutions
John Hoey	Eversource
John Schmid	Nitsch Engineering
Jorge Medina	Verizon
Katie Choe	City of Boston
Marcus Quigley	OptiRTC
Marybeth Riley-Gilbert	Massachusetts Bay Transit Authority
Robert Leber	Cosentini
Ron Burrowes	Verizon
Sarah Slaughter	Built Environment Coalition
Sean Carroll	Commonwealth of Massachusetts
Symone Varnado	Beacon Capital

Name	Organization
Terence Waldron	Waldron Engineering
Terrence O'Brien	Comcast
Tom Lovett	Source1
Tom Rooney	TRC Solutions
Travis Sheehan	Boston Planning and Development Agency
William Hunt	Tufts Medical Center
Yao Wu	Boston Planning and Development Agency

APPENDIX C: STEERING COMMITTEE

The development of the Boston Smart Utilities Vision would not be possible without the insights of the cross-departmental Steering Committee:

Amy Cording	Public Improvement Commission
Anne Schwieger	Department of Information Technology
Brad Swing	Department of Environment, Energy, and Open Space
Bryan Glascock	Zoning, Boston Planning and Development Agency
Colin Curzi	Planning, Boston Planning and Development Agency
Irene McSweeney	Boston Water and Sewer Commission
John "Tad" Read	Planning, Boston Planning and Development Agency
Katie Choe	Public Works Department
Mary Knasas	Planning, Boston Planning and Development Agency
Travis Sheehan	Planning, Boston Planning and Development Agency