POWERING THE FUTURE:

ELECTRIFYING & EXPANDING THE MBTA BUS NETWORK

A BETTER CITY

WEDNESDAY, AUGUST 7TH, 2019

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WELCOME

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EXECUTIVE VICE PRESIDENT, A BETTER CITY

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PANEL INTRODUCTION

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CAMRON GORGUINPOUR, PhD.

HOW TO ENABLE ELECTRIC BUS ADOPTION IN CITIES WORLDWIDE:

A GUIDE REPORT FOR TRANSIT AGENCIES

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WORLD RESOURCES INSTITUTE

WORLD RESOURCES INSTITUTE: E-BUS BARRIERS & ENABLERS

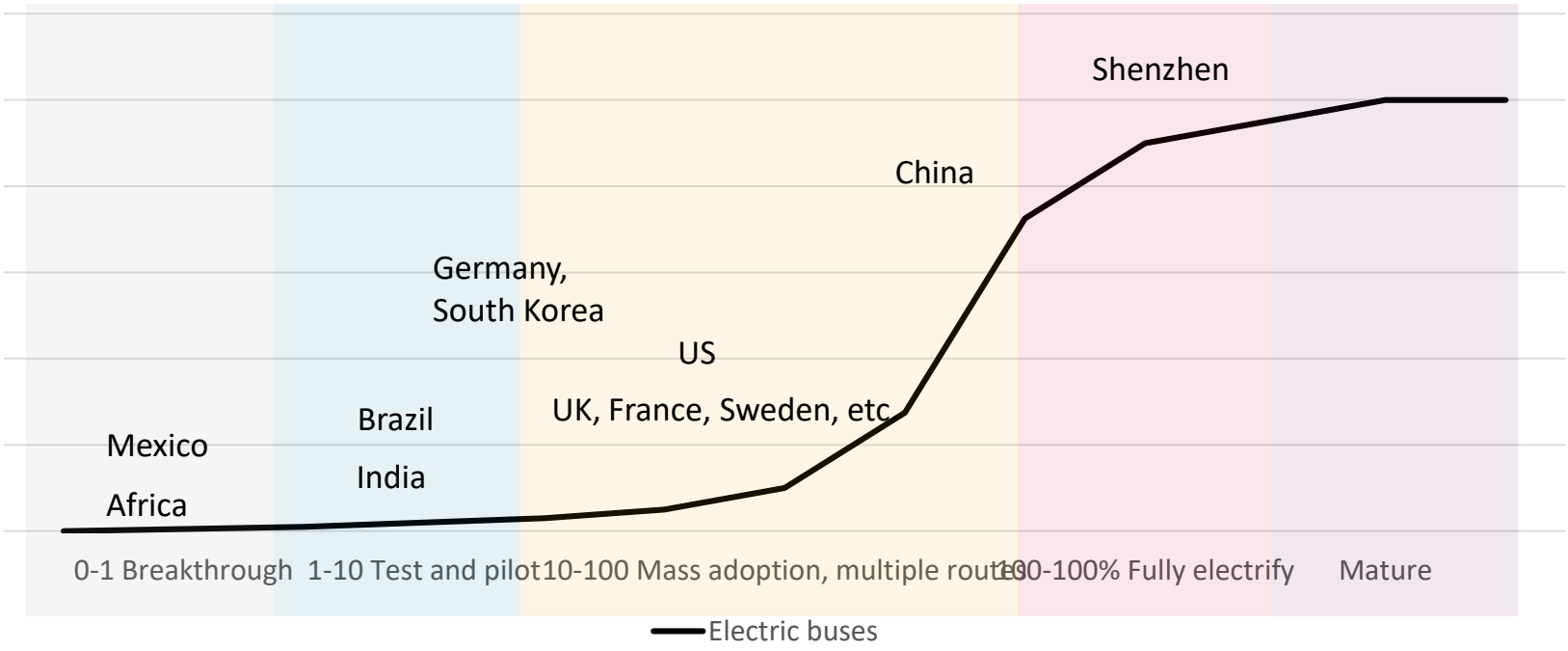
Presented by:
Camron Gorguinpour, PhD
Senior Global Manager for Electric Mobility

OBJECTIVE: ACCELERATE THE TRANSITION TO ELECTRIC BUSES

Type
Battery electric buses
Hybrid buses

- Still many barriers
- Growth concentrated in the global north

LEADING TO THE DEVELOPMENT OF A FRAMEWORK



E-Bus Projections through 2025

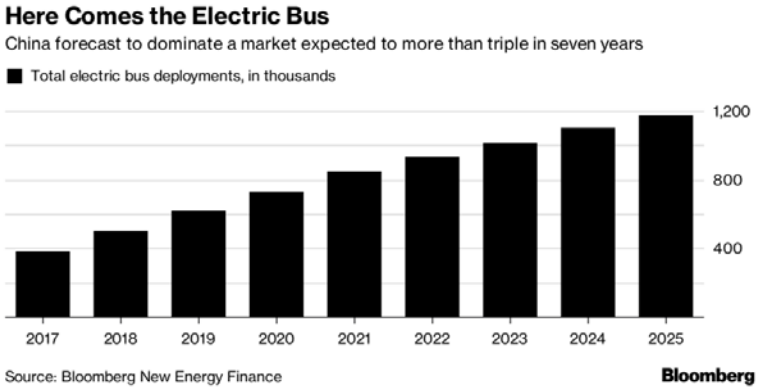
Despite global progress, electric bus adoption outside of China will be marginal in 2025.

Estimated total # of e-buses in 2025:

India
13,000

Latin America
16,000

China
1,200,000



WRI E-BUS PORTFOLIO

Tools

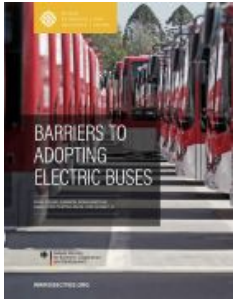
- E-bus cost-benefit calculator
- E-mobility infrastructure cost calculator
- E-mobility infrastructure analytic model
- (Coming Soon) E-bus operational data portal
- (Coming Soon) E-bus technical specification database

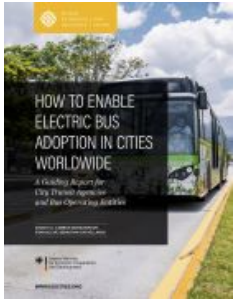
Technical Assistance Projects (Sample)

- Beijing
- Bogota
- Delhi
- Medellin
- Sao Paulo
- Santiago

Stay tuned for more

Recent Reports



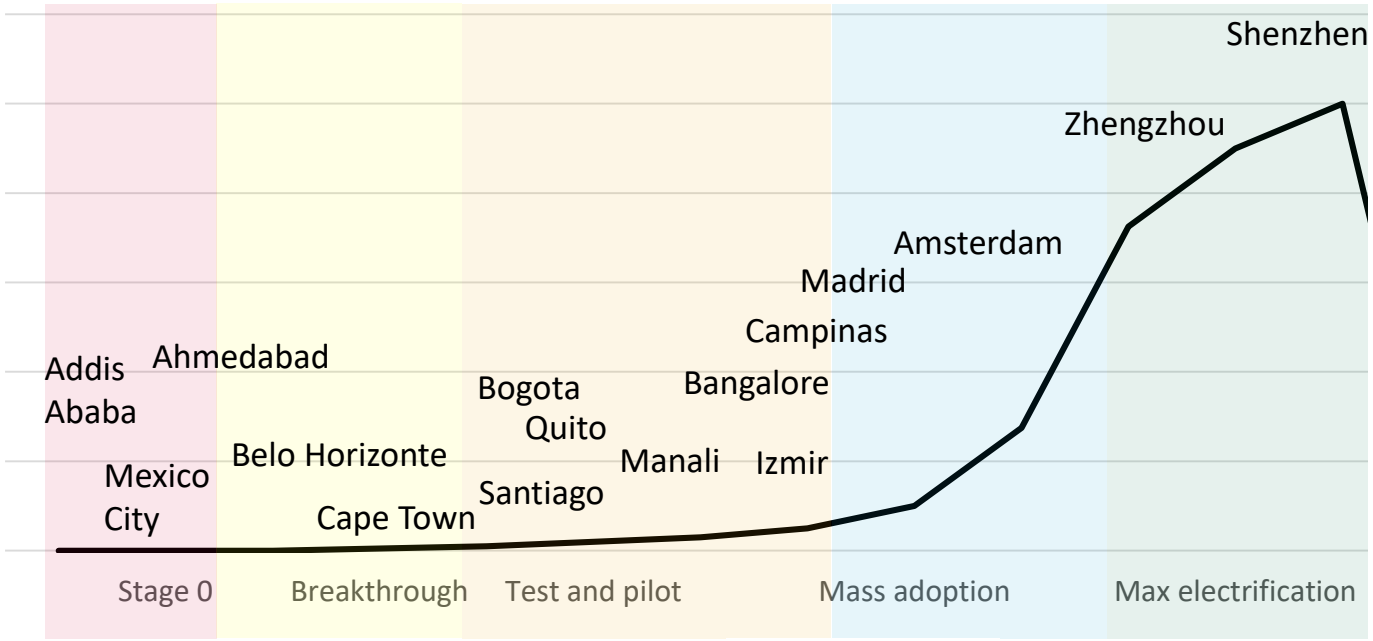


WRI E-BUS REPORTS CONSIDERED 16 CASE STUDIES

Criteria:

- Stage of development
- Expert input
- City request
- “Interesting” features

CASE STUDY CITIES DISTRIBUTED ACROSS ADOPTION CURVE



CONSISTENT CASE STUDY METHODOLOGY

Interviews with local stakeholders through an in-depth questionnaire

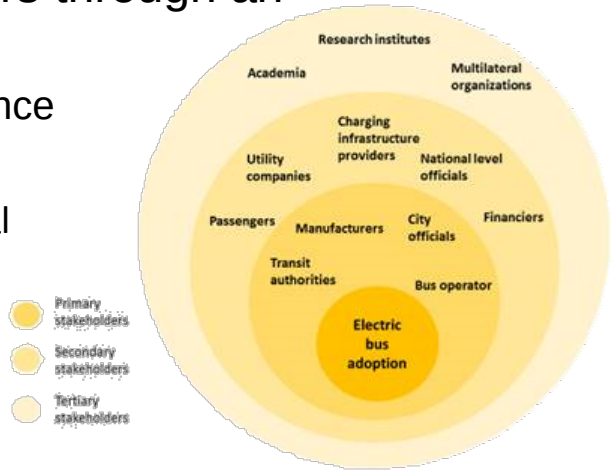
INSTITUTIONAL

GOVERNANCE

TECHNOLOGY

OPERATIONS

- Cost and finance
- Social
- Environmental

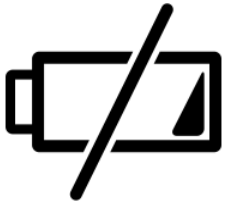


Standardised case-study template

Pervasive Barriers to E-Bus Adoption

Common Challenges Across Regions

Lack of knowledge



Technical limitations

Procurement Practices

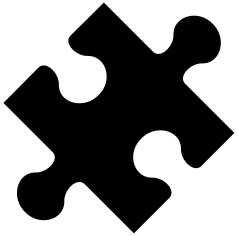
Non-Scalable Financing

Institutional Limitations

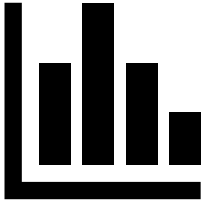
Pilot Paralysis

Most common oversight: Charging Infrastructure & Associated Real Estate

PLAN FOR MASS E-BUS ADOPTION



Consider the policy landscape



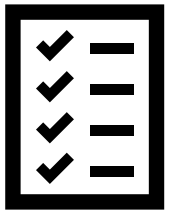
Perform an initial analysis

Launch a structured pilot project

Conduct a cost-benefit analysis

Set actionable and detailed targets

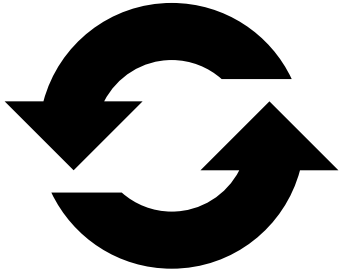
ACHIEVE MASS E-BUS ADOPTION



Formalize and implement long-term infrastructure plan

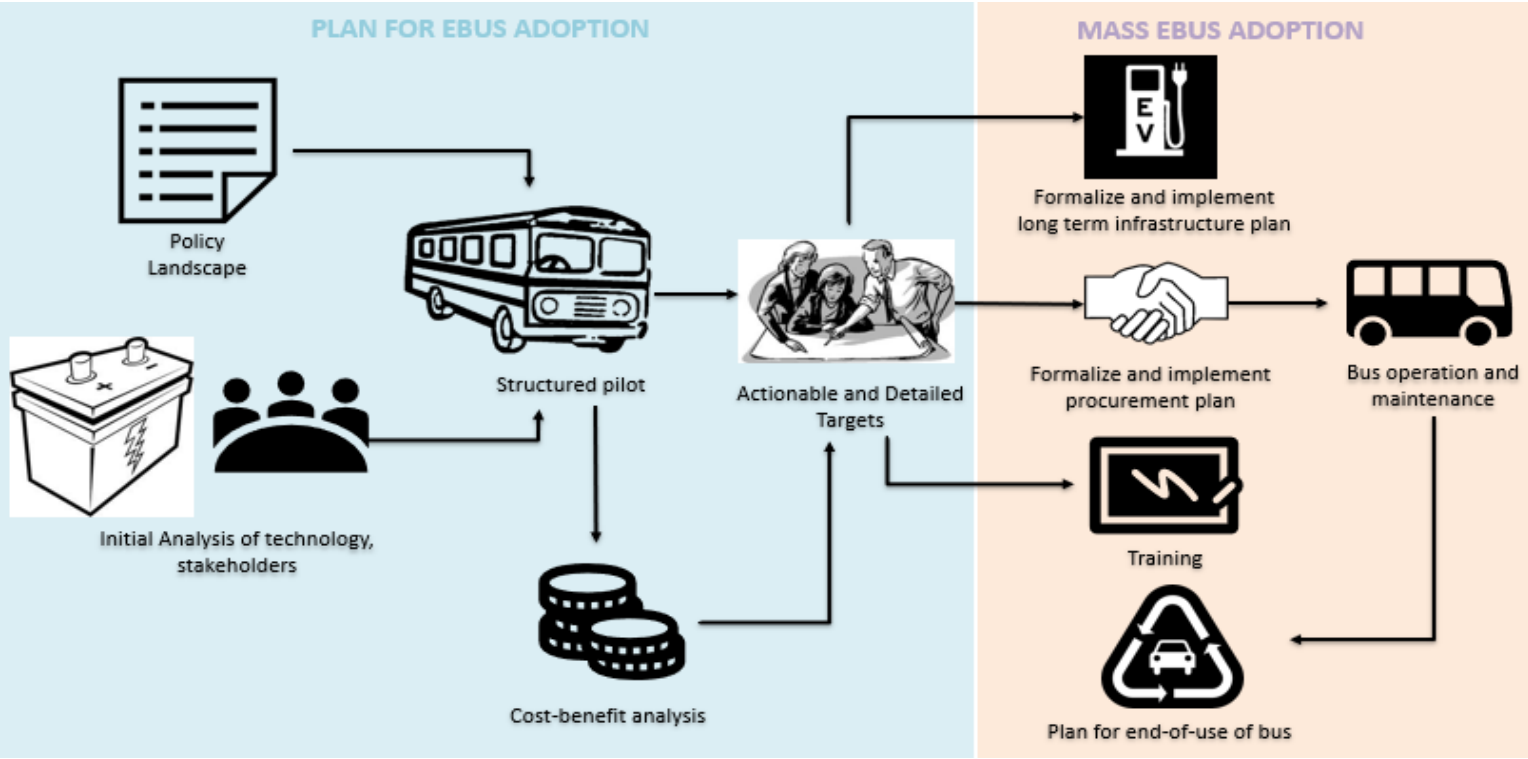
Create and execute e-bus procurement plan

Provide training



Plan for end of use

ENABLERS


PLAN FOR EBUS ADOPTION
MASS EBUS ADOPTION
Policy Landscape
Structured pilot
Actionable and Detailed Targets
Formalize and implement long term infrastructure plan
Formalize and implement procurement plan
Bus operation and maintenance
Initial Analysis of technology, stakeholders
Training
Cost-benefit analysis
Plan for end-of-use of bus

QUESTIONS?

Contact:

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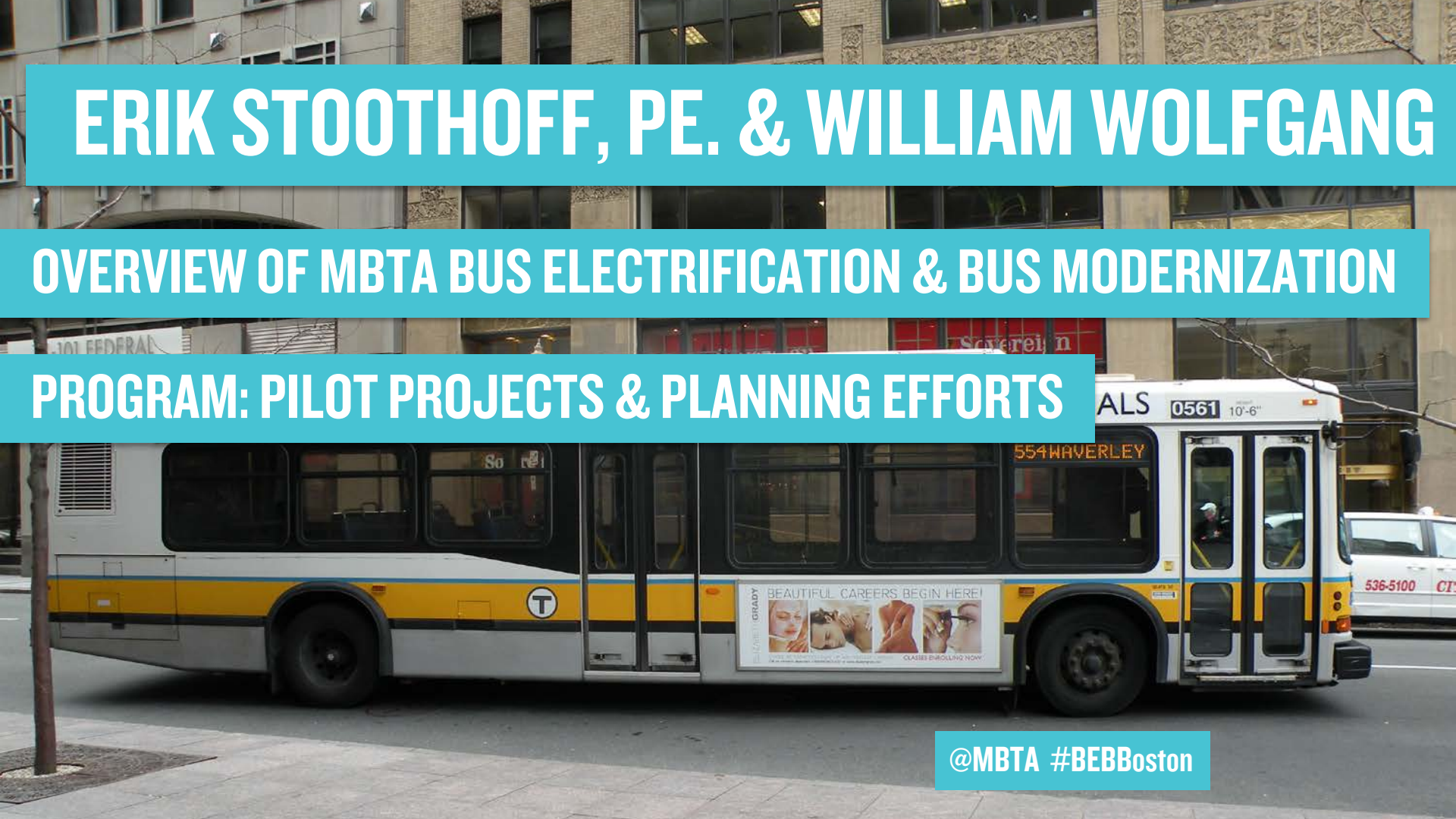
ERIK STOOTHOFF, PE. & WILLIAM WOLFGANG

OVERVIEW OF MBTA BUS ELECTRIFICATION & BUS MODERNIZATION PROGRAM: PILOT PROJECTS & PLANNING EFFORTS



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Massachusetts Bay Transportation Authority

BUS FACILITIES MODERNIZATION PROGRAM

Erik J. Stoothoff, MBTA Chief Engineer

August 7, 2019

OVERVIEW OF FACILITY PROGRAM

1. The MBTA has a deferred investment need to address the condition and capacity of the bus maintenance facility network
2. We have a need to act with urgency to:
   - MEET THE FUNCTIONAL NEED OF OUR CURRENT BUS NETWORK
   - ADDRESS THE WORKING CONDITIONS WITHIN OUR GARAGE INFRASTRUCTURE
   - EXPAND OUR INFRASTRUCTURE TO FACILITATE NETWORK-WIDE MODERNIZATION AND REDESIGN
3. We need to prepare our infrastructure for future fleet electrification and other modern technologies
4. Each facility needs investment
5. Near term action is necessary while the entire strategy is developed
6. Multiple projects will be executed concurrently and include the committed $25M annual investment in our bus maintenance facilities

BUS FACILITY POLICY AND PRINCIPLES

- Prioritize safety and health
- Increase fleet reliability and resiliency
- Minimize operating and maintenance costs of the bus system
  - MINIMIZE THE USE OF SMALL AND SPECIALTY GARAGES
  - MINIMIZE DEADHEAD MILES
- Build overall capacity and capability to exceed existing, and meet future demand and technology
- Bring facilities to a state of good repair in **13 years** while:
  - ENABLING FACILITIES TO CONTINUE SUPPORTING REVENUE FLEET
  - ENSURING FACILITIES ACCOMMODATE A MODERNIZED FLEET
    - Each facility will be designed to accommodate **future electrification** of bus fleet
    - Each facility will maximize **indoor fleet storage**
- Minimize impact on current bus system operations
- The program will be a phased approach: End-state quantity and location of facilities is not known yet, but will develop over time along with other MBTA, MassDOT, and Municipal initiatives

FOCUS 40 The 2040 Investment Plan for the MBTA

Better Bus Project Making transit better together

Bus Network Redesign

MBTA BUS FACILITIES MODERNIZATION PROGRAM (RECAP FROM MARCH 4, 2019)

- **MBTA's Bus Garage Infrastructure consists of 10 Maintenance Garages, including Everett Heavy Maintenance**

- **MBTA Garages have a bus capacity ranging from 28 to 254**
- **Current Facilities Status**
  - At or beyond capacity
  - Average age 54 years
  - Some functionally obsolete (e.g. capacity, ceiling heights, door heights)
- **Action: Develop an executable bus facility modernization/replacement program**
  - Locations/Permitting
  - Emerging Propulsion Technologies
  - Battery Charging
  - Utility Requirements
  - Bus Storage
  - Maintenance Improvements

All garages are near or above capacity, and are beyond their useful life or are functionally obsolete.

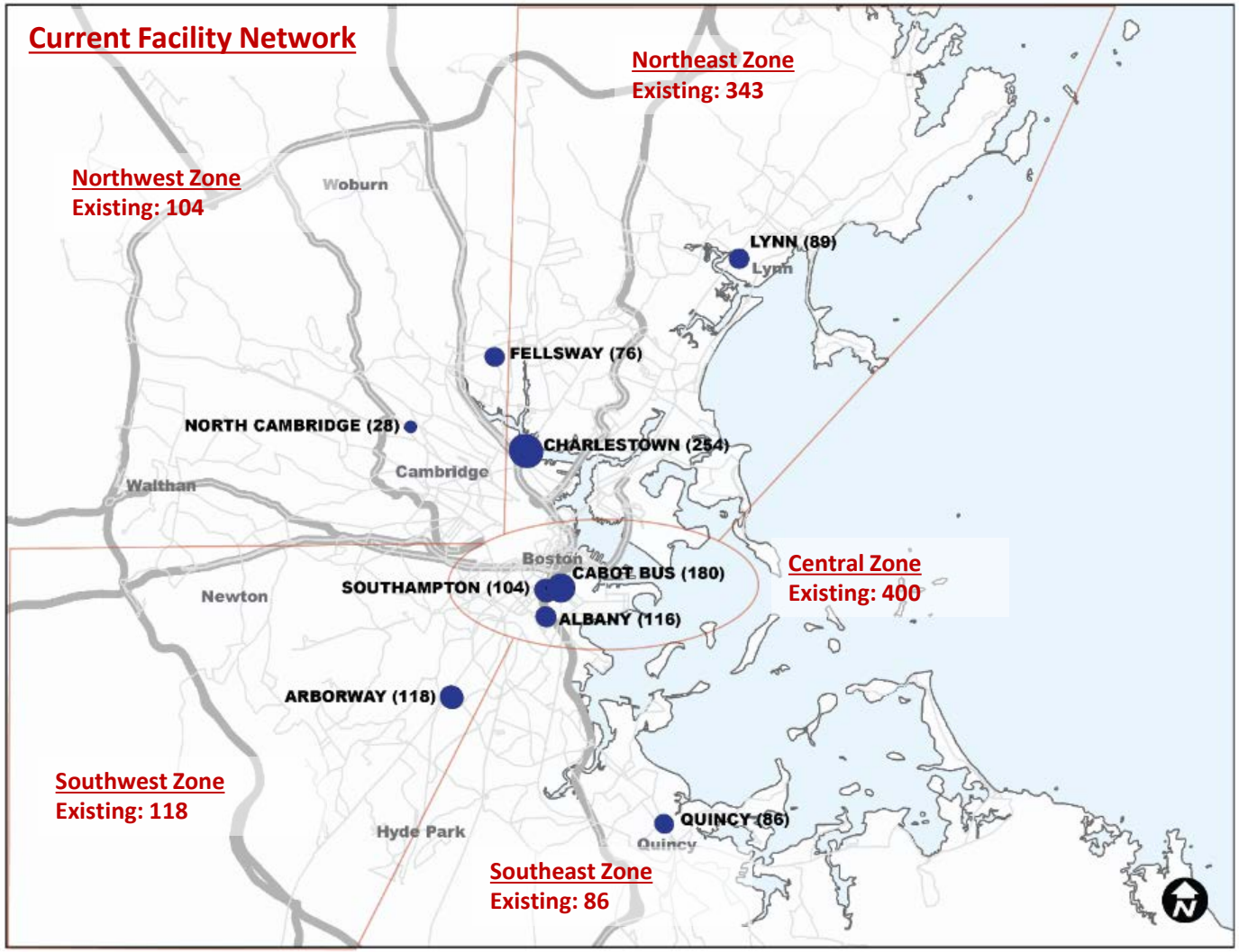
Intent is to re-use all facility sites that can support the future plan

BUS MAINTENANCE FACILITIES - OVER CAPACITY

Facility	Year Built	Bus Count	Maint. Capacity*	% of Maint. Capacity	Storage Capacity	% Storage Capacity	Condition Rating
Albany Street	1941	116	35	333%	116	100%	2.7
Arborway	2004	118	52	226%	118	100%	3.1
Cabot	1975	180	104	172%	160	111%	2.8
Charlestown	1975	254	157	162%	310	82%	2.5
Everett Heavy Maintenance	1947	-	-	-	-	-	2.6
Fellsway	1925	76	52	146%	74	102%	2.4
Lynn	1936	89	87	102%	99	90%	2.7
North Cambridge	1979	28	35	80%	32	88%	3.2
Quincy	1930	86	70	124%	90	95%	2.4
Southampton	2002	104	76	137%	101	103%	3.6

*Based on prior study ratio of 8.7 buses per maintenance bay (40-foot buses)

Current Facility Network



FUTURE BUS FACILITY CAPACITY

The optimal fleet size is difficult to predict at this time:

- ONGOING TRANSPORTATION INITIATIVES; BETTER BUS PROJECT AND NETWORK REDESIGN ARE NOT YET COMPLETED
- THE INTENT IS TO MAXIMIZE FACILITY CAPACITY AND FLEXIBILITY FOR FLEET TYPE AT EACH SITE UNTIL THE WORK IS COMPLETE TO DEVELOP THE TARGET SIZE OF THE MBTA BUS FLEET
- MUNICIPAL PARTNERSHIPS W/ DEDICATED BUS LANES, QUEUE JUMPS, AND SIGNAL PRIORITY WILL INFLUENCE FLEET NEEDS
- REPLACEMENT OF DIESEL BUSES WITH BATTERY ELECTRIC BUSES IS NOT CURRENTLY A 1 FOR 1. ADDITIONAL REPLACEMENT VEHICLES ARE NECESSARY DUE TO:
  - Travel range
  - Refuel/Recharge time
  - Energy consumption due to HVAC

Current working target necessary for progressing the planning for maintenance

- **For planning purposes, assume an the need to support an increasing fleet size**
- **Subject to further refinement following Network Redesign, Better Bus Project, and Bus technology advancements**

BUS FACILITY MODERNIZATION STRATEGY

Strategy: Develop a sequence of investments to address the need

1. Prioritize garage construction to meet the needs of the fleet and workforce
   - MOST URGENT NEEDS ARE AT THE QUINCY AND ALBANY FACILITIES
   - EXPAND CAPACITY AT SOUTHAMPTON FACILITY
   - CURRENT FLEET OF TROLLEY BUSES ARE BEYOND THEIR USEFUL LIFE: CONSIDER ALTERNATIVES FOR CONVERSION OF NORTH CAMBRIDGE FACILITY TO SUPPORT A BATTERY ELECTRIC BUS FLEET. ADDED BENEFIT IS THE ELIMINATION OF OVERHEAD CATENARY SYSTEM (OCS) INFRASTRUCTURE.
2. Build additional capacity throughout the Modernization Program
   - TO PROVIDE CAPACITY (SWING SPACE) TO CARRY OUT THE MODERNIZATION PROGRAM
   - TO CREATE THE CAPACITY FOR FUTURE GROWTH
   - BUILD APPROPRIATE REGIONALIZATION OF FACILITIES
3. Address past commitments
4. Accelerate facility modernization through alternative procurement methods such as Design Build contracting
5. Incorporate future bus fleet conversion to battery electric technology in facility designs
6. Engage in community outreach
7. Engage Real Estate team in developing strategy for land planning and acquisitions
8. Engage design community to develop standards for future facilities, and full program

BUS FACILITY MODERNIZATION STRATEGY: ALIGNMENT WITH FLEET PROCUREMENTS

Desire is to move bus procurement schedule to a more steady-state 100+ buses per year

- SIMPLIFIES BUS COMMISSIONING
- OFFERS A MORE PREDICTABLE AND MANAGEABLE FLEET LIFE-CYCLE MAINTENANCE PROGRAM

Challenge is sustaining the Quincy and Albany bus operations during the facility replacement timeline

- Replacement of 192 40 ft. ECD buses will begin this summer, when complete, the average fleet age will decrease to 6.2 years old, and the average age of non-electric buses drops to 5.6 years old.
- The 11 and 13 year old fleets of 40 ft. Diesel buses are the only buses that can be serviced by the Albany and Quincy Garage due to height restrictions
- The 11 and 13 year old fleets cannot be replaced until the Albany and Quincy Garages are replaced with facilities that can support modern buses

Current Fleet Consists of:

Fleet size = 1017, Average Age = 9 years

Non-Electric Fleet size = 957, Average Age = 8.6 years

Only buses that fit in Albany and Quincy

Fleet Type	40 ft. CNG	40 ft. Diesel Hybrid	60 ft. Diesel Hybrid	40 ft. Diesel Hybrid	60 ft. Diesel Hybrid	40 ft. Diesel	40 ft. Diesel	40 ft. Emissions Cont. Diesel	60 ft. Duel Mode Articulated	40 ft. Electric Trolley Bus
Quantity	175	150	45	60	25	155	155	192	32	28
Age	3	3	3	5	9	11	13	15	15	15
Bus Height	11'-1"	10'-10"	10'-10"	10'-10"	10'-8"	10'-3"	10'-3"	10'-6"	11'-3"	11'-10"

MOST URGENT NEEDS: QUINCY GARAGE REPLACEMENT

- Functionally Obsolete – The existing building structure cannot be rehabilitated to meet MBTA needs
- Critical height restrictions: Unable to accommodate any new buses being purchased
- Inefficient work space configuration and site layout
- Other areas of concern are:
  - Condition of floors
  - Deterioration of roof and walls
- Current Capacity is 90 buses, need to increase capacity to approx. 130 to 150 buses
- Supports the oldest buses in the MBTA fleet, which are due to be replaced starting in 2022
- Need to explore nearby alternative locations and real estate opportunities for future redevelopment of current site

MOST URGENT NEED: ALBANY GARAGE REPLACEMENT

- Functionally Obsolete – The existing building structure cannot be rehabilitated to meet MBTA needs
- Critical height restrictions: Unable to accommodate any new buses being purchased
- Inefficient work space configuration and site layout
- Other areas of concern are:
  - Condition of floors
  - Deterioration of roof and walls
- Current Capacity is 116 buses, need to increase capacity to approx. 130 buses
- Supports the oldest buses in the MBTA fleet, which are due to be replaced starting in 2022
- Need to explore nearby alternative locations and real estate opportunities for future redevelopment of current site

OPTION: SOUTHAMPTON GARAGE EXPANSION

- Southampton facility currently operating over capacity – built for 76 buses, now supporting over 100
- Need to expand to approximately double the existing usage
- Expansion would allow for an increase to the number of 60-foot buses in operation
- Provides capacity (swing space) to facilitate investments in other garages
- Provides for flexibility to maintain future vehicle technology

OPTION: NORTH CAMBRIDGE GARAGE CONVERSION TO BATTERY ELECTRIC FACILITY

- Upgrades required to support upcoming replacement of Electric Trolley Buses with battery buses
- Would allow removal of overhead catenary
- Many alternatives to be considered for the conversion to battery electric bus technology
  1. Convert current service to diesel buses while BEB facility is constructed
  2. Move maintenance of ETBs to Southampton and build outdoor temporary BEB storage and Charging station on maintenance building land
  3. Build separate BEB capable facility, then replace ETBs with BEBs, decommission, and build new BEB facility

MODERNIZATION PROGRAM PLAN

Phase 1 (0-5 Years)

- Increase Capacity by 150+ ***(consistent with current capacity target)***
- Expand capacity at Southampton
- Address needs at Albany Street and Quincy Garages
- Modernize North Cambridge Garage to support battery electric service

Phase 2 (2-10 Years)

- Increase Capacity by 50+ ***(subject to further fleet size study)***
- Determine strategy for Arborway and Cabot Garages
- Identify location for garage for expanded Silver Line fleet

Phase 3 (10-15 Years)

- Increase Capacity by as needed
- Determine strategy for Fellsway and Charlestown garages
- Determine strategy for potential additional garages

Site Selection Criteria
Property Size. Must be able to accommodate anticipated fleet size
Limits dead-head miles/Proximate to bus network
Internal site circulation suited for buses
Circulation to and from the site.
Consistency with existing land use and zoning
Environmental constraints
Property availability
Tenant Relocation

Massachusetts Bay Transportation Authority

MBTA Bus Fleet Update / Plans

William G. Wolfgang, MBTA Vehicle Engineering

August 7, 2019

Draft

Current MBTA Bus Fleet

MBTA bus fleet is currently made up of 922 40-foot and 107 60-foot buses of various propulsion technologies.

Fleet Type	Year	Quantity
Neoplan 40-ft Diesel	2003-04	193
Neoplan 60-ft Dual Mode	2004-06	32
Neoplan 40-ft Electric Trolley	2004	28
New Flyer 40-ft Diesel (base)	2006-07	155
New Flyer 40-ft Diesel (option)	2008-09	155
New Flyer 60-ft Hybrid	2010	25
New Flyer 40-ft Hybrid (option)	2014	60
New Flyer 40-ft Hybrid	2016-17	156
New Flyer 40-ft CNG	2016-17	175
New Flyer 60-ft Hybrid	2016-17	44
New Flyer 60-ft Ext Range Hybrid	2018	1
New Flyer 60-ft Battery Electric	2019	5
New Flyer 40-ft Hybrid*	2019-2020	194

**MBTA Vehicle Engineering is in-process of taking delivery of this fleet*

Life of an MBTA Bus

New Bus Costs (approx.)*	
Diesel	$650k
Hybrid	$750k
CNG	$700k
BEB	$850k

*Note: Costs are for 40-foot buses
60-foot buses typically cost 40% more

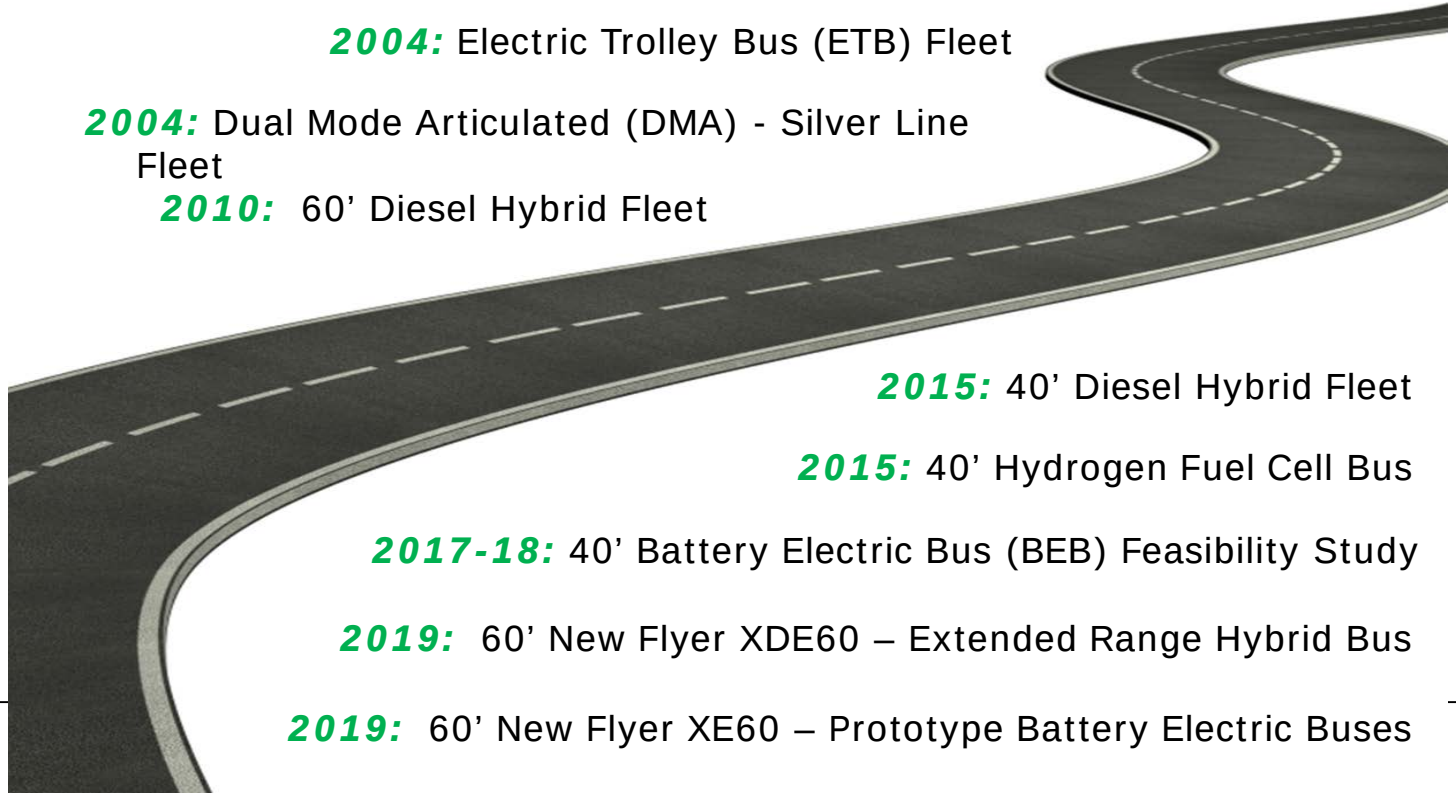
Bus Overhauls	
155 New Flyer 40-foot Diesel	Completed 2017
32 Neoplan DMAs	Completed 2018
155 New Flyer 40-foot Diesel	Ongoing (95 delivered)
25 New Flyer 60-foot Hybrid	Pending Award
60 New Flyer 40-foot Hybrid	Program Development

Bus Industry Overview

Trending towards advanced extended range hybrid and battery electric buses to reduce environment impacts and improve customer experience.

- Multiple bus manufactures capable of producing various propulsion types
- Reduced maintenance and operating costs
- Improved reliability and passenger amenities
- Electric bus infrastructure upgrades required

Path to a Zero Emissions Fleet



2000: Compressed Natural Gas (CNG) Buses

2004: Electric Trolley Bus (ETB) Fleet

2004: Dual Mode Articulated (DMA) - Silver Line Fleet

2010: 60’ Diesel Hybrid Fleet

2015: 40’ Diesel Hybrid Fleet

2015: 40’ Hydrogen Fuel Cell Bus

2017-18: 40’ Battery Electric Bus (BEB) Feasibility Study

2019: 60’ New Flyer XDE60 – Extended Range Hybrid Bus

2019: 60’ New Flyer XE60 – Prototype Battery Electric Buses

Future of MBTA Bus

In accordance with:

- Fleet and Facilities Plans
- Focus 40
- Better Bus Program

Key Objectives:

- Improve performance of advanced hybrid buses with extended engine-off operations (upwards of 30% fuel savings)
- Reduced GHG emissions
- Improved overall service, accessibility, and mobility
- Add passenger amenities and safety features

Upcoming plans include:

- 194 New Flyer hybrid buses – delivery commencing in August 2019 through 2020
- Continued evaluation of five New Flyer prototype battery electric buses
- Purchase of additional battery electric buses – RFI released to the industry
- Purchase of next fleet of advanced hybrid buses – RFI released to the industry

MICHAEL KODRANSKY

YOU MUST WALK BEFORE YOU CAN RUN:

GLOBAL PRACTICE OF HOW TO GET AN ELECTRIC BUS FLEET RUNNING

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ITDP | Institute for Transportation & Development Policy

The Climate Emergency and Bus Electrification

August 2019

Michael Kodransky

Institute for Transportation and Development Policy

ITDP Institute for Transportation & Development Policy

ITDP: global impact for 30+ years

Mexico

US

Brazil

Africa

India

Indonesia

China

- ITDP Office
- Current engagement

125+ staff | 10+ offices | 7 countries

50+ cities with projects | $10M+ annual funding

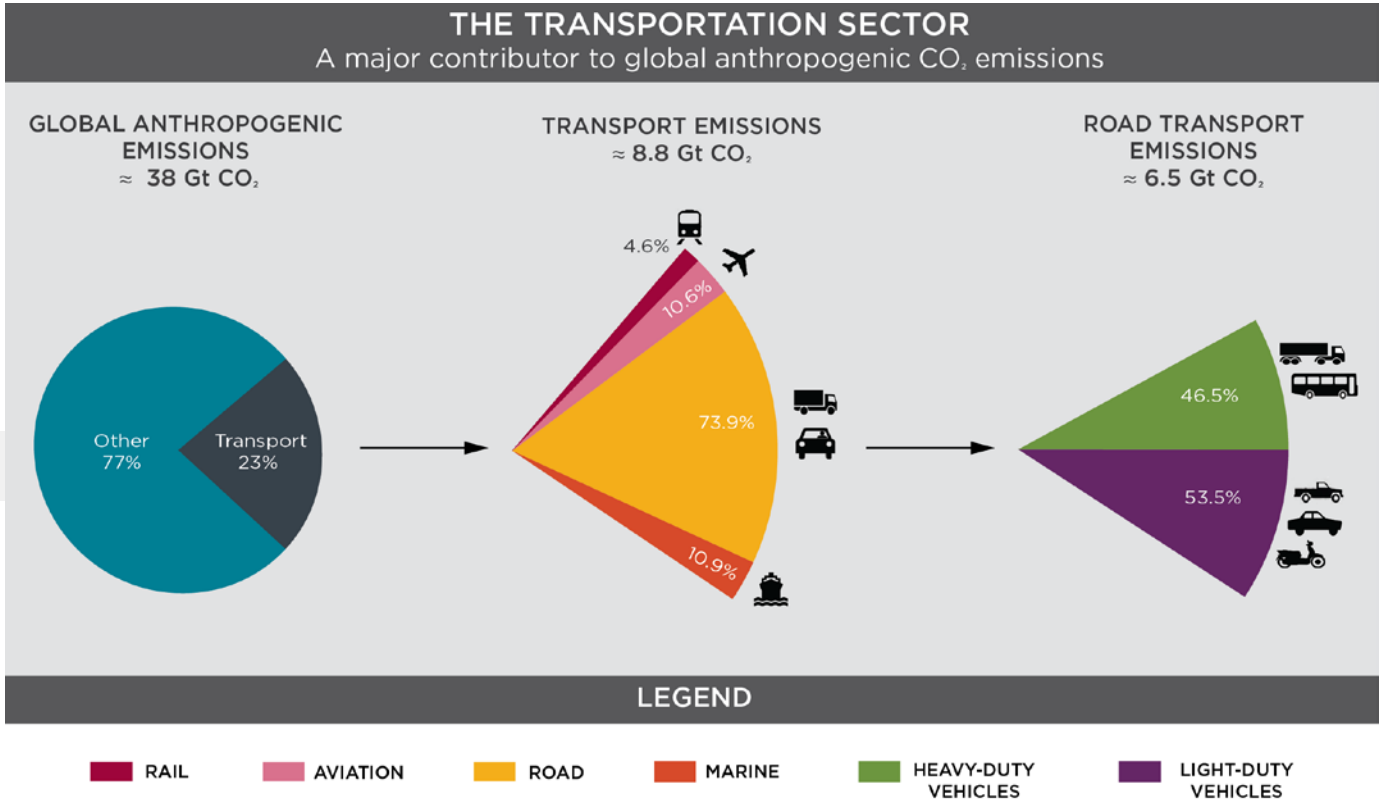
ITDP Institute for Transportation & Development Policy

Transportation emissions soaring

Fastest-growing source of climate emissions

~25% of all GHG emissions

Single largest source of black carbon



Sources:
ICCT (2014). Global Transportation Roadmap Model. Available from http://www.theicct.org/global-transportation-roadmap-model
IPCC (2014). Summary for Policymakers. Climate Change 2014, Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

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All 3 required to limit climate change

Avoid

Shift +

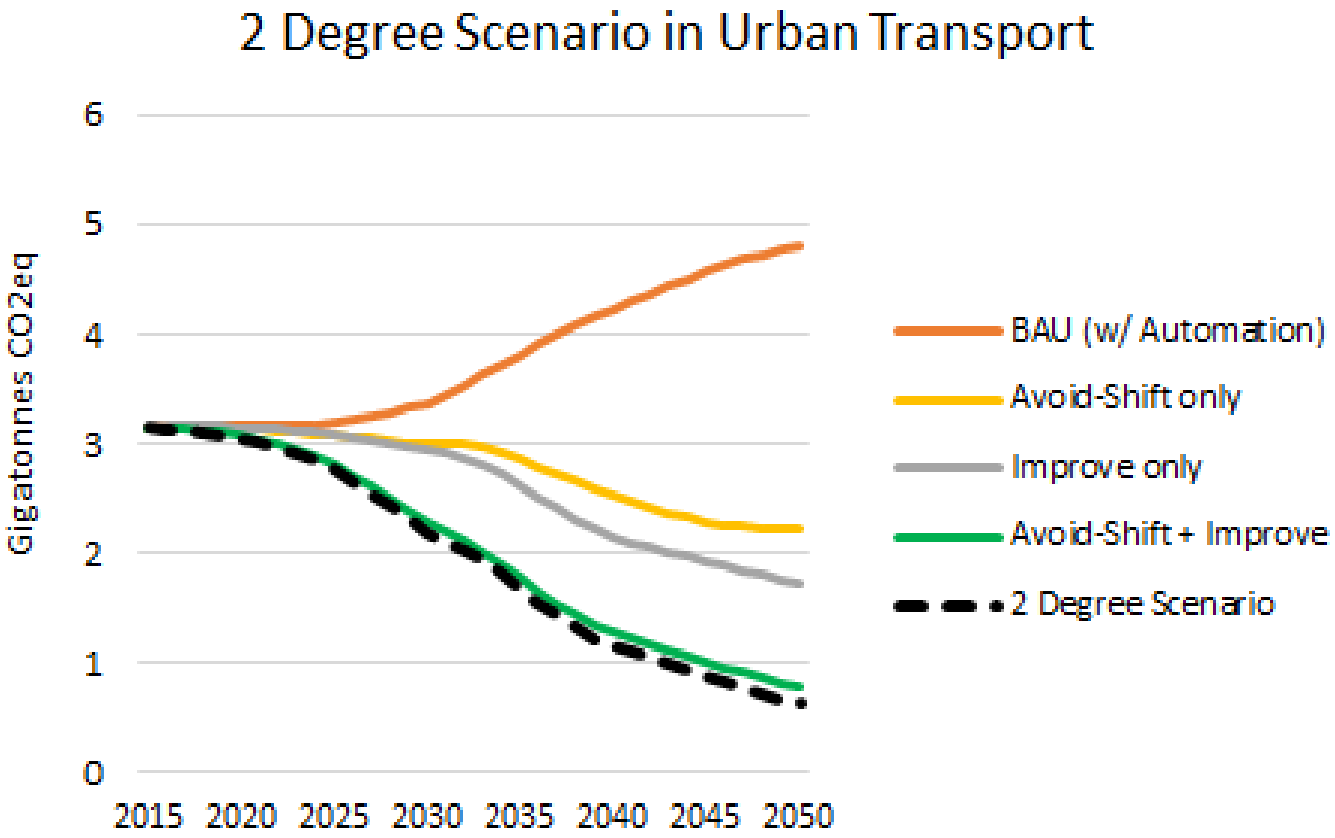
Improve

>>>>>>

Cars

Buses +

Bikes



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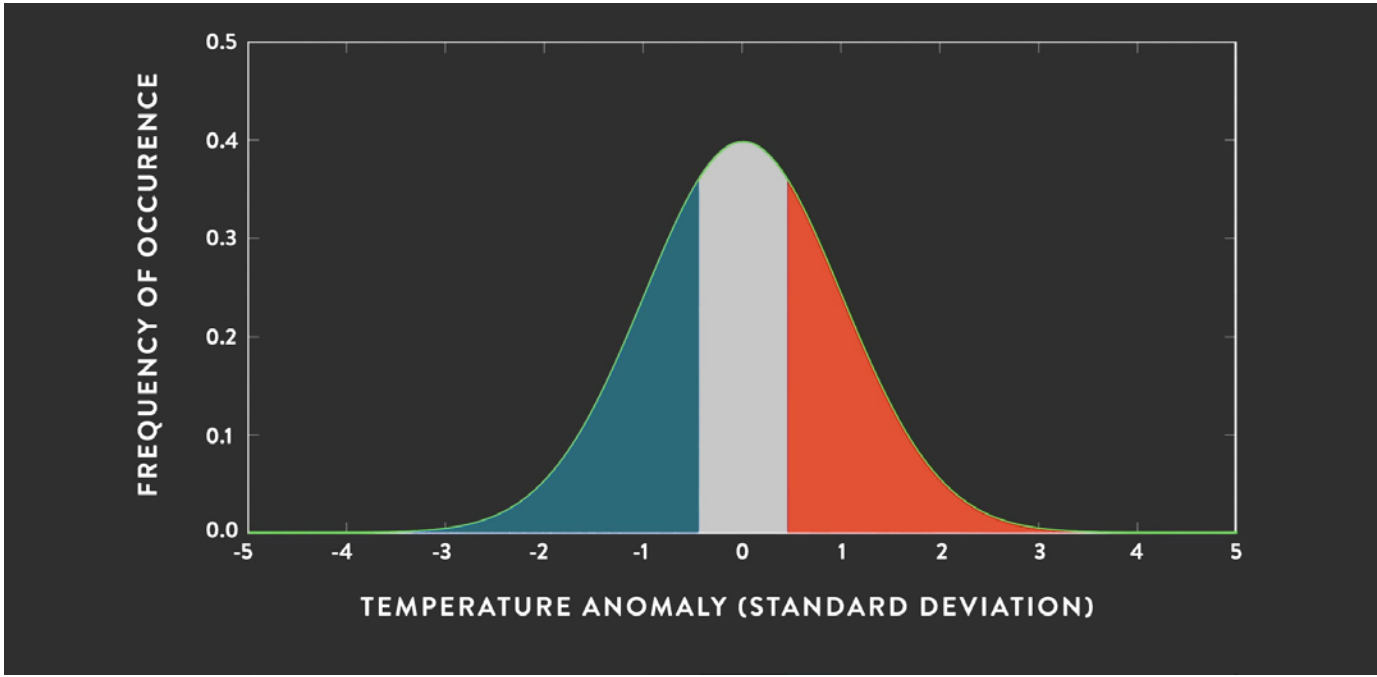
What is the connection between temperature and impact?

The extremes become the norm.



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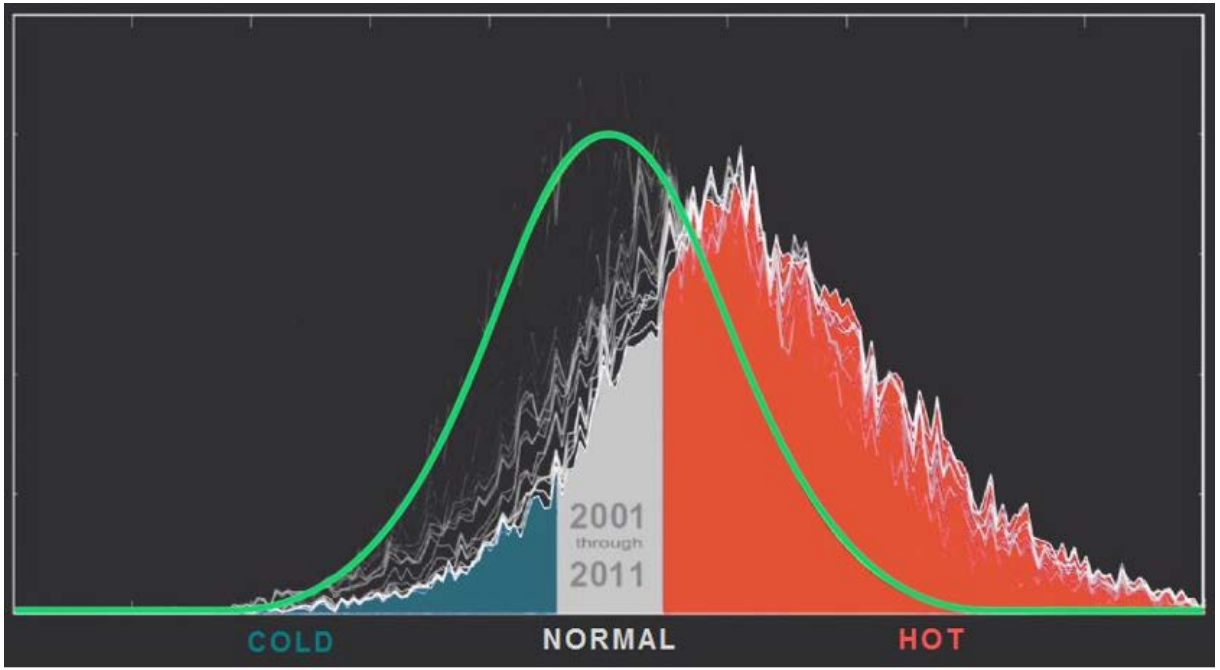

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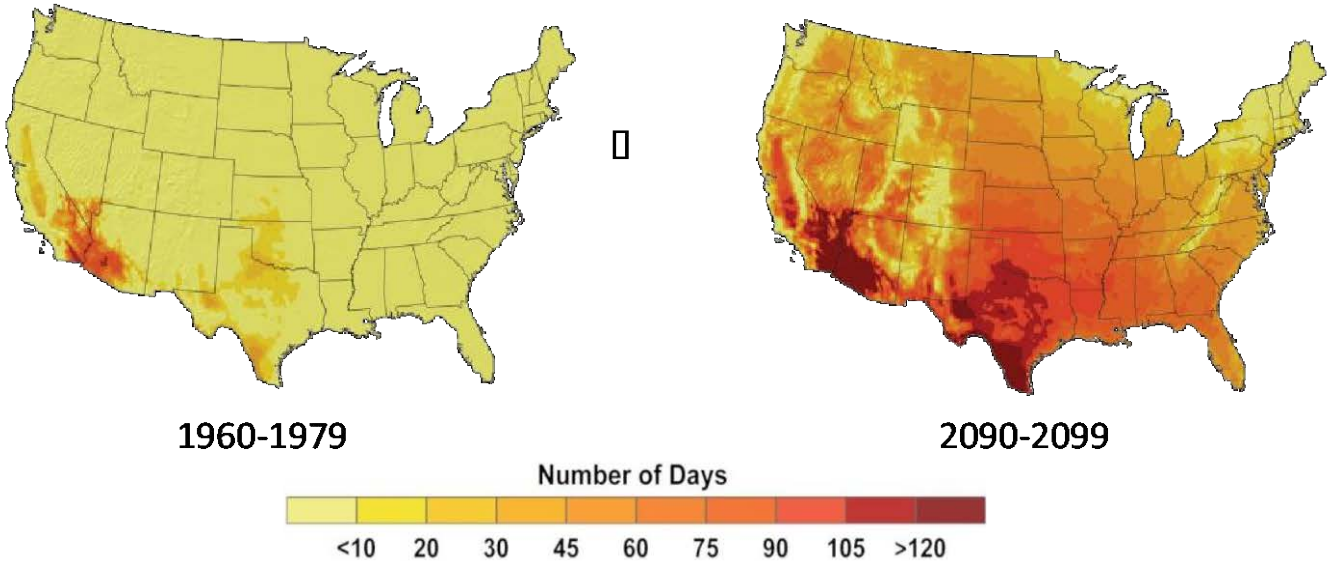
Number of days exceeding 100 ˚F / 37.3 ˚C in United States

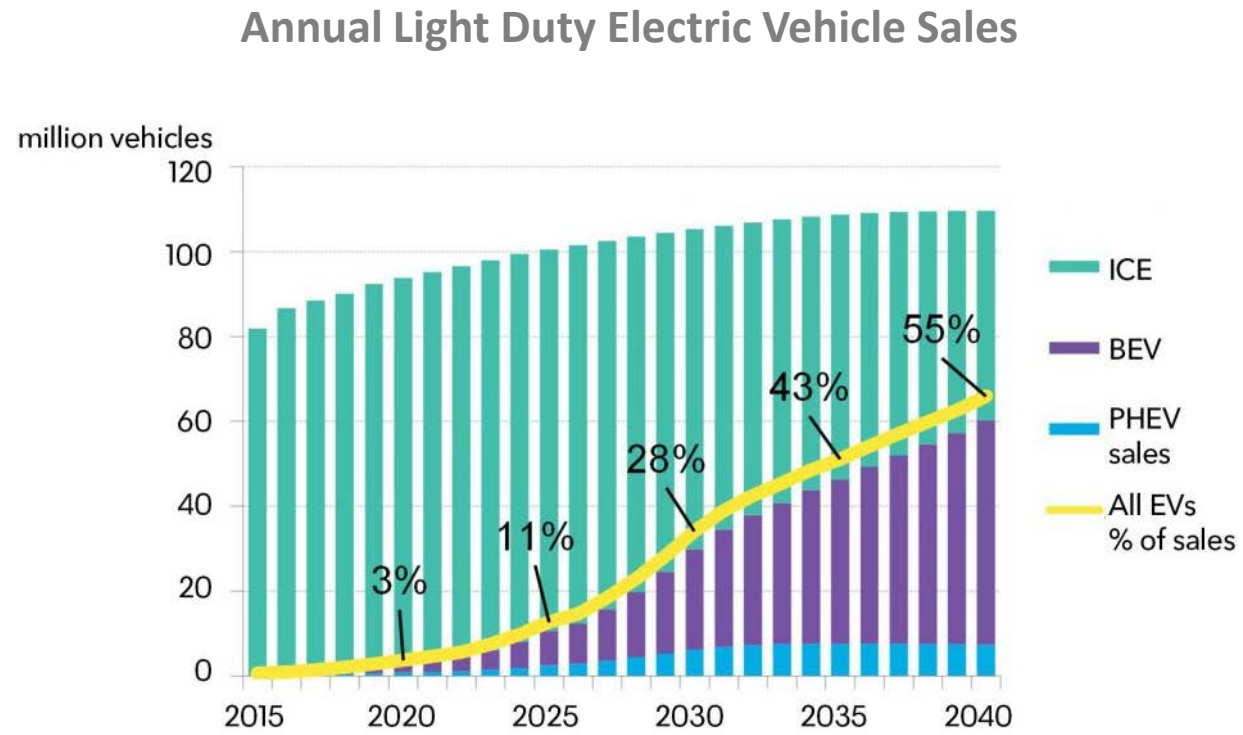
The coldest year in the future will be hotter than the hottest year in the past.



Electric vehicle sales are growing quickly

EVs currently 3% of global light duty vehicle sales

EVs expected to overtake conventional ICE light duty sales by 2040

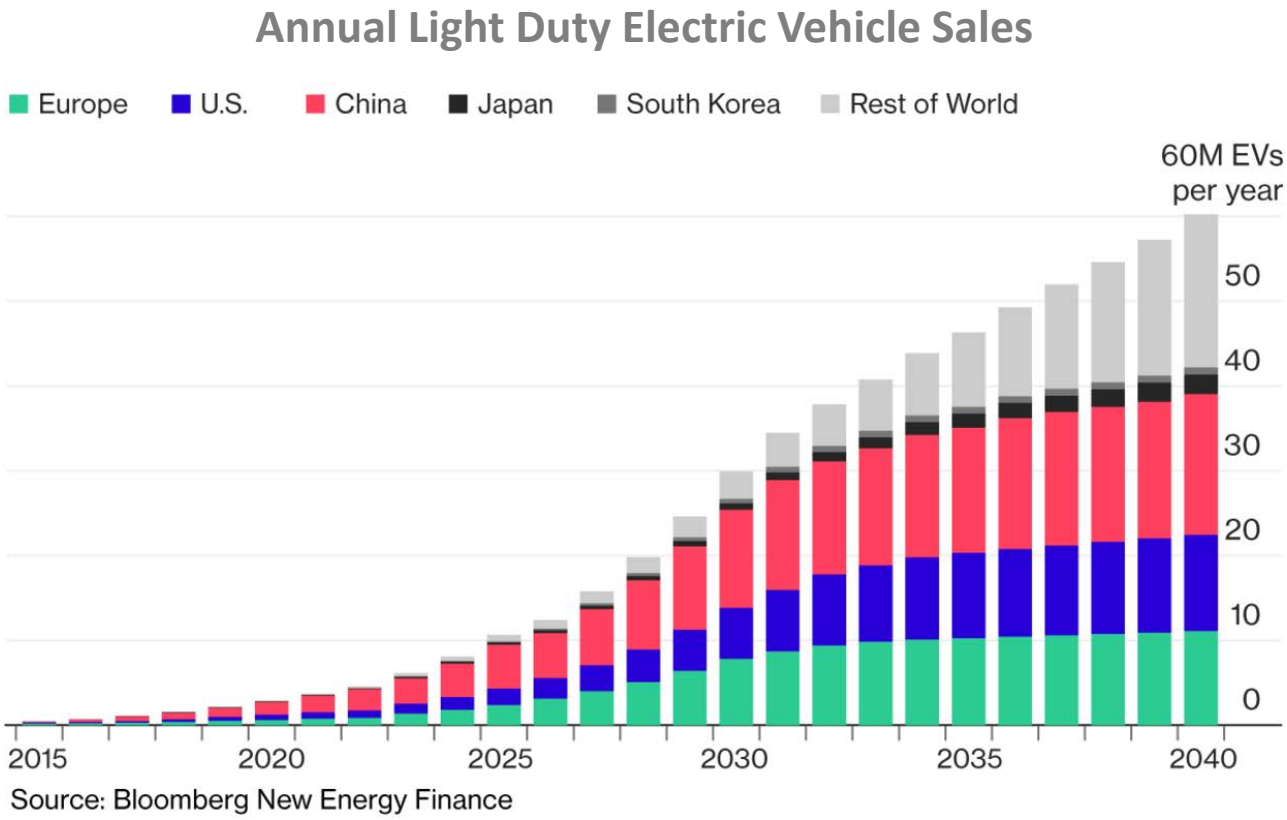


Source: Bloomberg New Energy Finance

China expected to lead EV market

China expected to lead the EV market…

with production in the US and Europe catching-up



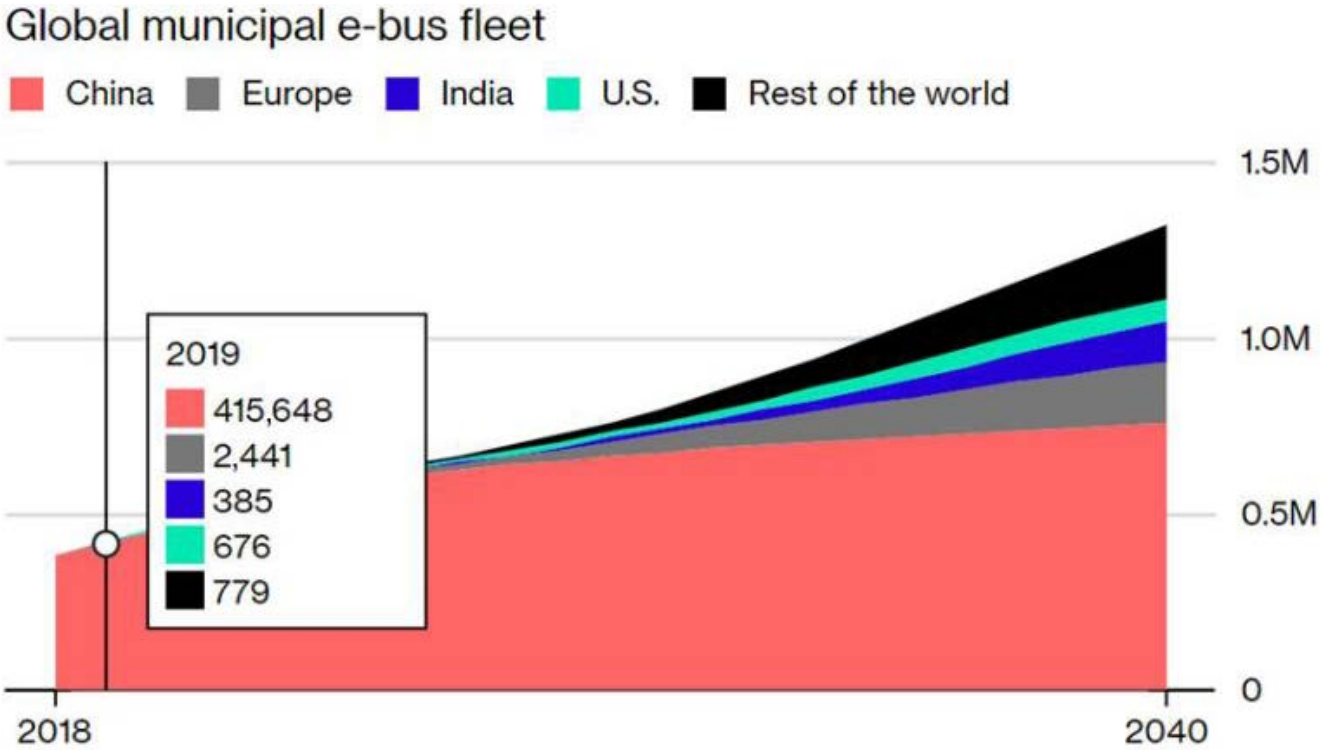
ITDP Institute for Transportation & Development Policy

E-buses expected to grow even faster

By 2040 80% of global municipal bus fleet is expected to be electric

Currently ~420,000 e-buses on the market

China also expected to lead e-bus market



Source: BloombergNEF's "Electric Vehicle Outlook 2019"

ITDP Institute for Transportation & Development Policy

E-buses are the right focus for cities

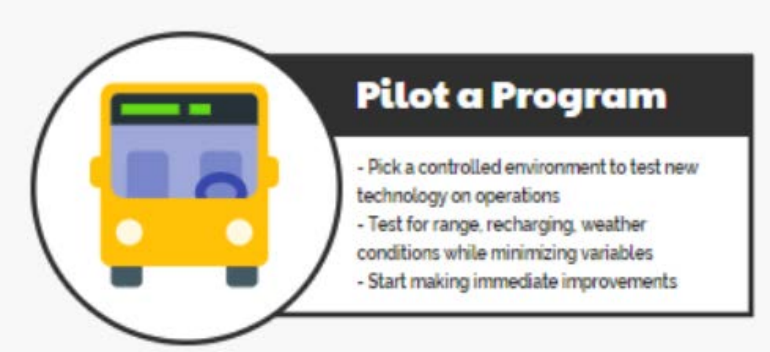
Buses provide an accessible option to move more people sustainably

80% of buses use older, diesel engines and high sulfur fuel

Buses consume 30x more fuel than cars

ITDP Institute for Transportation & Development Policy

3-Steps to Electrify Your Bus Fleet



ITDP Institute for Transportation & Development Policy

Early leaders in bus electrification

China: 38,000+ electric buses, +9,500 each week

Shenzhen, China: full transit electrification
- 20% reduction in CO_2 emissions
- 75% reduction in black carbon

Latin American cities: with 50% power from renewables, well-poised to electrify bus fleets

Colombia: intends to reach 600,000 EVs by 2030, including 100% of its buses

Santiago, Chile: largest electric bus fleet in the Americas; transitioning to fully-electrified by 2050

India: plans to make 30% of bus fleet electric by 2030 with up to 60% subsidy provided

ITDP Institute for Transportation & Development Policy

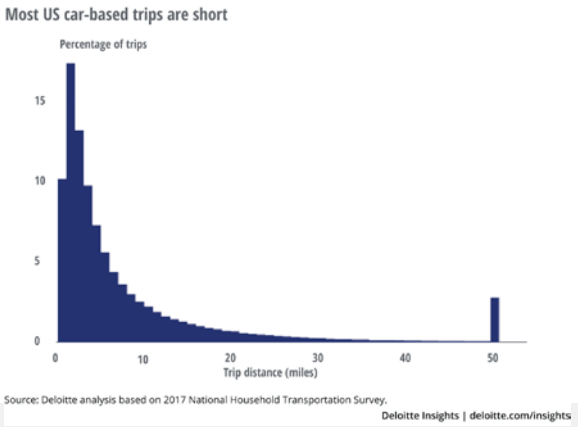
E-bikes & scooters are also important

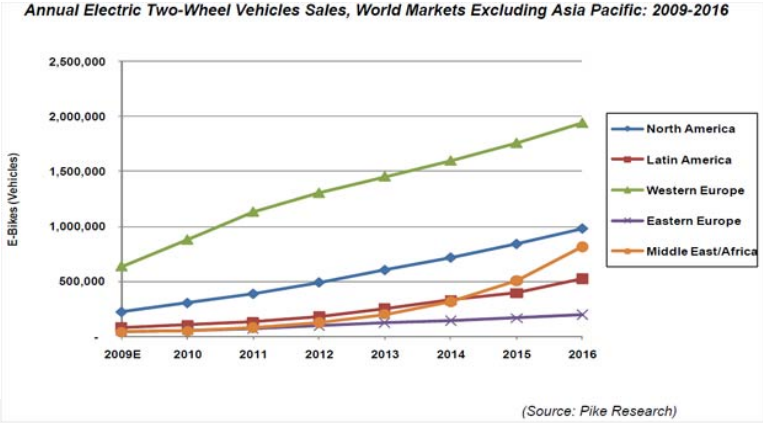
One of the fastest growing transport markets

34 million E-bikes sold in 2017

Shared E-bikes are used 2x as much as pedal bikes

Cover short city distances and connect transit





ITDP Institute for Transportation & Development Policy

Key success factors for electrification

Government Mandates

At the federal, state, and city levels to encourage adoption, especially for public buses and taxi fleets

Charging Infrastructure

By cities in the right locations to maximize charging flexibility and optimize time of day charging

Subsidies & Financing

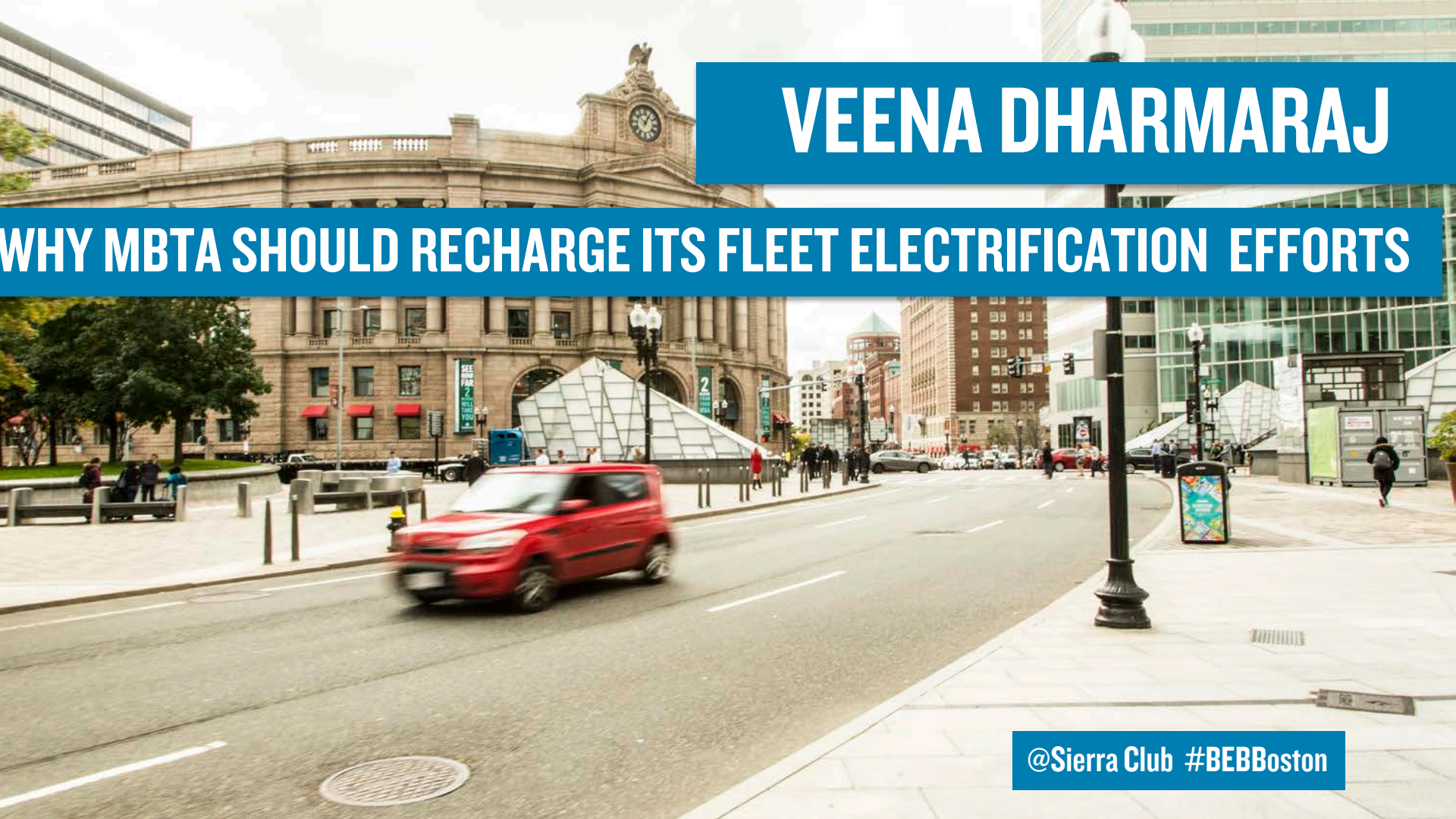
At the federal and state levels to cover higher upfront capital costs, especially for buses which provide more public benefit

Electricity Tariffs

At the state level to set preferential prices to incentivize electrification and optimize time of day charging

Thank you!

Follow me on Twitter: @mkodransky
::: itdp.org ::: @ITPDUS :::



VEENA DHARMARAJ

WHY MBTA SHOULD RECHARGE ITS FLEET ELECTRIFICATION EFFORTS

@Sierra Club #BEBBoston

Why MBTA Should Recharge its Fleet Electrification Efforts

SIERRA CLUB

Table of Contents

SIERRA CLUB

Founded by John Muir in 1892

Largest, most influential grassroots environmental organization in the country, 63 Chapters

130,000 members and supporters across the Commonwealth

Sierra Club

Areas of Action

Organizing Climate Action

Protecting water, air, land and wildlife

Acting for social justice

Connecting people to the natural world

Climate Emergency and Local Impacts

45%

We need to reduce carbon emissions by 45% by 2030 to avoid mass extinctions, famines, displacement, and diseases

7.4 ft

Boston is likely to experience 3.2 to 7.4 feet of relative sea level rise in the next 80 years because of climate change impacts

>40%

Transportation is the largest source of emission in MA impacting climate change

SIERRA CLUB

Emission Reduction Strategies

- Stronger fuel efficiency and emission reduction standards
- Access to equitable transit options
- Safer bikeable and walkable communities
- **Transition to electric vehicles**

"Achieving the Commonwealth's 2050 GWSA mandate will require the near-complete transition of our vehicle fleet to electric vehicles or other zero-emission vehicle (ZEV) technology. The Governor should establish a goal that by 2030, all cars, light duty trucks, and buses purchased with state resources will be ZEVs."

- Governor's Commission on the Future of Transportation, 2018

Public Health Impact

Inequitable exposure to vehicle pollution

- 34% - African Americans
- 26% - Latinos
- 36% - Asian Americans

Significant Health costs

- 109,000 asthma attacks
- 220,000 lost work days
- 2500 premature deaths

Potential to save $2.7 billion in public health

By transitioning all vehicle fleets to be powered by electricity Massachusetts will save almost $2.7 billion in public health by 2050.

Source: @MBTA

Economically Attractive

- Saves ~$400,000 in lifetime fuel and maintenance costs
- Battery costs expected to account for 8% of bus price by 2030, down from around 26% in 2016
- Has four times the fuel efficiency
- Runs 250-300 miles on a single charge

Environment Friendly

- Eliminate 1,690 tons of carbon dioxide, 350 lbs of particulate matter, 10 tons of nitrogen oxides
- MBTA can avert ~55,000 tons of carbon emissions annually

MBTA Bus Procurements

Five 60 ft electric buses enter service on the Silverline

Electric bus feasibility report

Purchased 575 fossil fuel buses in the last 4 years, >50% of their fleet

Plans to purchase over 700 buses in the next 5 years, only 35 electric

“We can wait for others and follow – at the expense of residents’ health – or lead and innovate, and reduce emissions as quickly as possible. I’d much rather do the latter.”

- Los Angeles Mayor Eric Garcetti

MBTA Should Be A Leader

Several cities including Los Angeles, New York, Seattle, and Martha's Vineyard have committed to going 100% electric. And Denver, Philadelphia, Chicago and many others are adding more electric buses to their fleet.

Source: @MBTA

- Commit to all electric bus purchases by 2030
- Lay out a clear pathway for a phased transition to 100% electric
- Equip garages for the next generation of bus technologies
- Have at least one garage fully operational for an electric bus fleet by 2020

Veena Dharmaraj

Conservation and Development Program Manager
Sierra Club, Massachusetts Chapter
veena.dharmaraj@sierraclub.org

GLEN BERKOWITZ & MARC DeSCHAMP

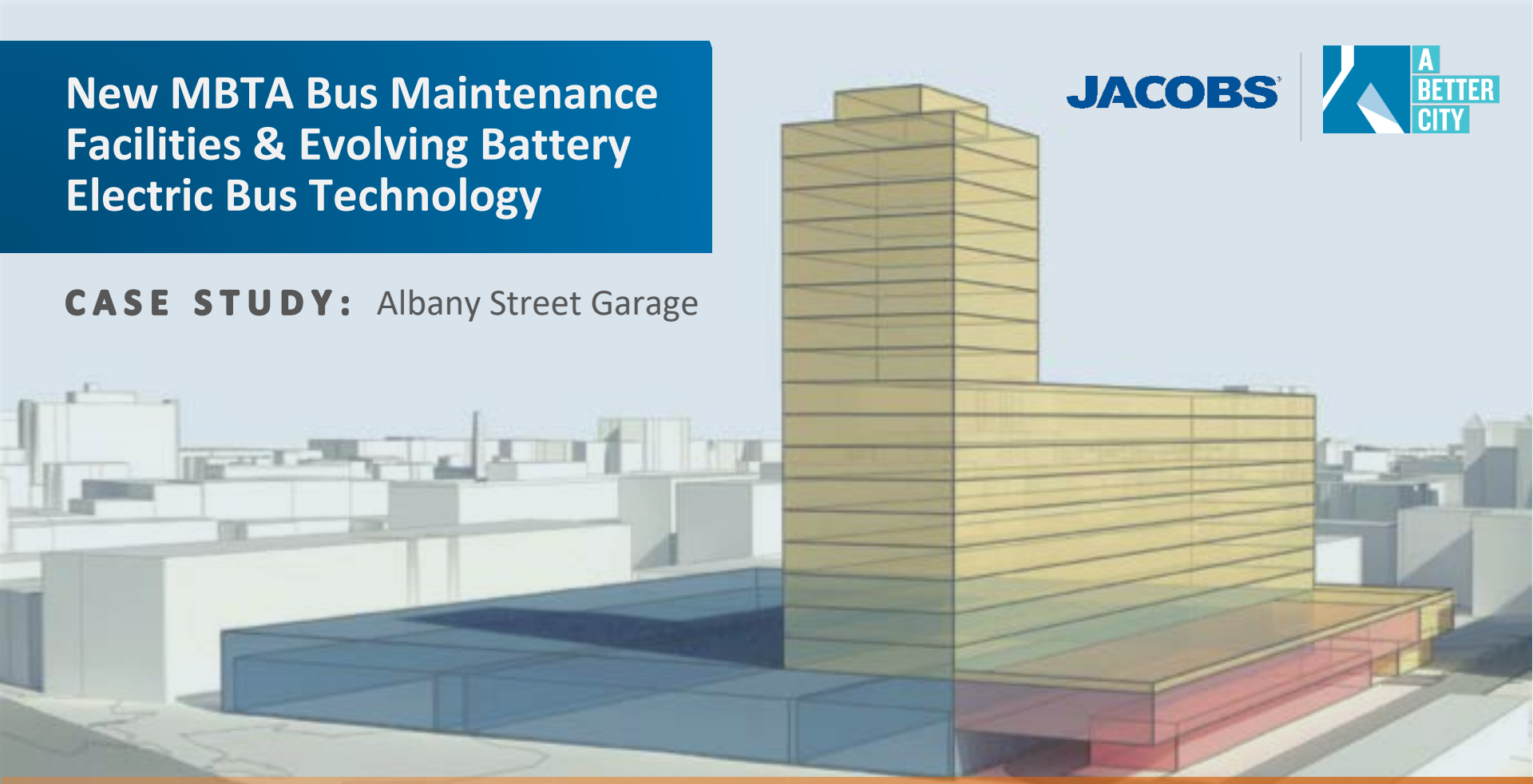
NEW MBTA BUS MAINTENANCE FACILITIES & EVOLVING BATTERY ELECTRIC TECHNOLOGY:

THE POTENTIAL FOR MIXED-USE, PUBLIC-PRIVATE DEVELOPMENT

@ABetterCity @JacobsConnects #BEBBoston

New MBTA Bus Maintenance Facilities & Evolving Battery Electric Bus Technology

CASE STUDY: Albany Street Garage



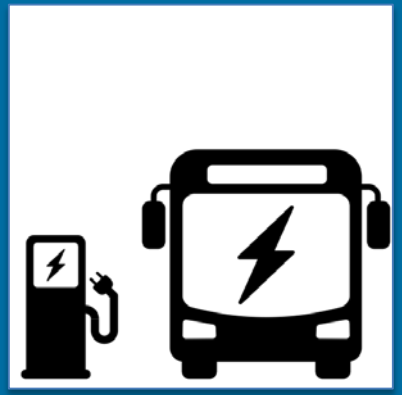
August 7, 2019

TAKEAWAYS

1. Approximately $1 B financial challenge
2. BEB fleets in NE likely in 5-7 years
3. Joint-development benefits may help
   - Cost-effective procurement
   - Better neighborhood fit for facilities, not divest urban sites
   - Decarbonization and climate goals

NEED

Need

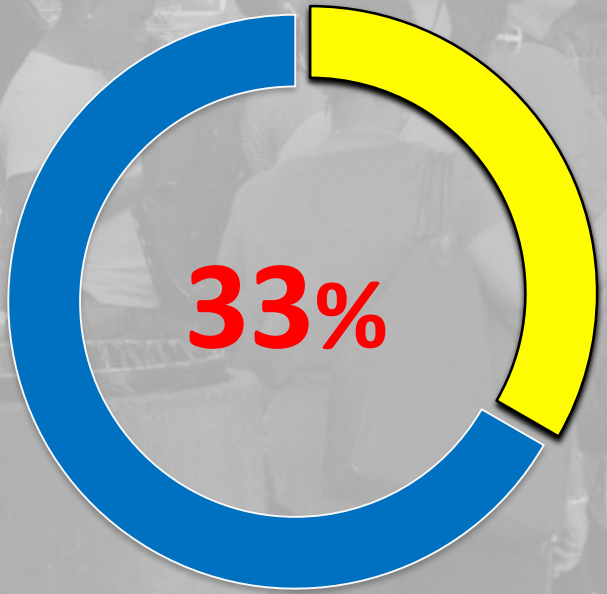


BEB

Multi-use

Next

BUS



$1B FUNDING NEED

	Facility	Age	Capacity	Rating
1.	**Albany**	**76**	116	2.7
2.	Arborway	13	118	3.1
3.	Cabot	42	180	2.8
4.	Charlestown	42	254	2.0
5.	**Fellsway**	**92**	76	2.4
6.	**Lynn**	**81**	90	2.7
7.	North Cambridge	38	28	3.2
8.	**Quincy**	**87**	86	2.4
9.	Southampton	15	98	3.6
	Fleet Average	**49**	1,046	2.8

MBTA, INTEGRATED FLEET & FACILITIES PLAN, DEC. 2017

JACOBS

A BETTER CITY

CHALLENGING LAYOUTS

OUTDOORS & FULL

OBSOLETE


0469
HEIGHT
10'-6"
NOT IN SERVICE
TOW AREA
NO
PARKING
ANYTIME
6
MPH

MODERNIZED

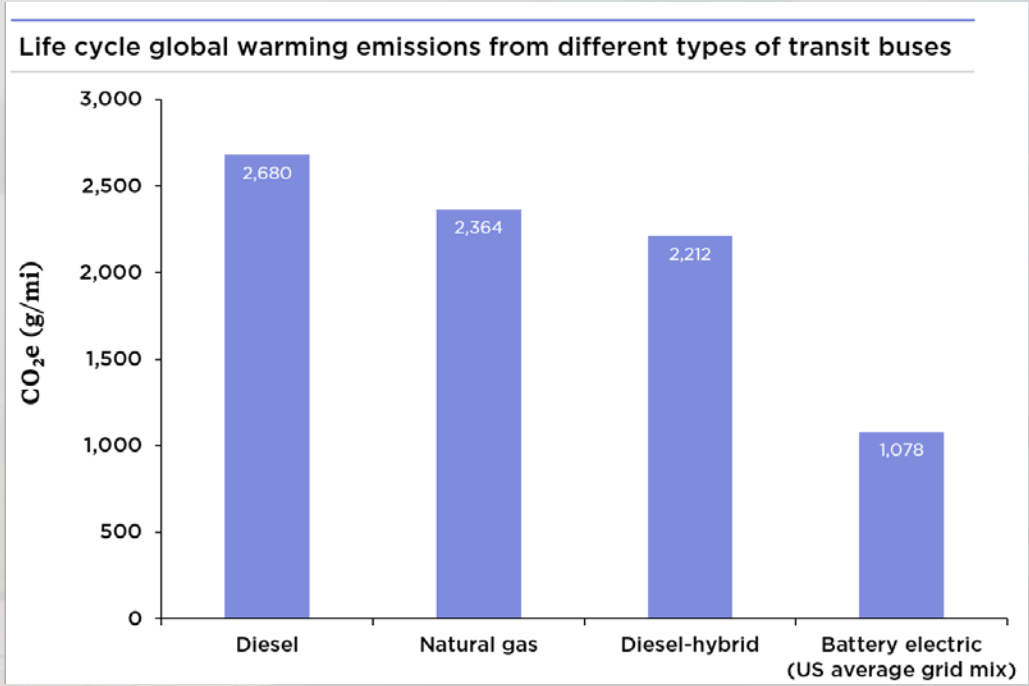
CLIMATE GOALS

- "Achieving the Commonwealth's [2040 goals] will require the near-complete transition of our vehicle fleet…buses…to electric vehicles.

- "…by 2030, all…buses (as appropriate) purchased with state resources will be ZEVs

Governor's Commission on the Future of Transportation, Dec. 18, Vol. 1, pp. 64

BEB CO_2 BENEFITS



https://blog.ucsusa.org/jimmy-odea/electric-vs-diesel-vs-natural-gas-which-bus-is-best-for-the-climate

Note: Power plant data as of 2016

BEB NORTH AMERICAN MARKET

JACOBS

A BETTER CITY

BEB $/BUS

Type	Cost ($)	Year	Agency
40' Proterra E2	**950,000**	2014	The City of Seneca
40' Proterra E2	789,000	2015	Foothill Transit
40' Proterra E2	797,882	2016	King County Metro
40' Proterra E2	784,000	2017	King County Metro
40' Proterra E2	**700,000**	2018	DC's National Mall

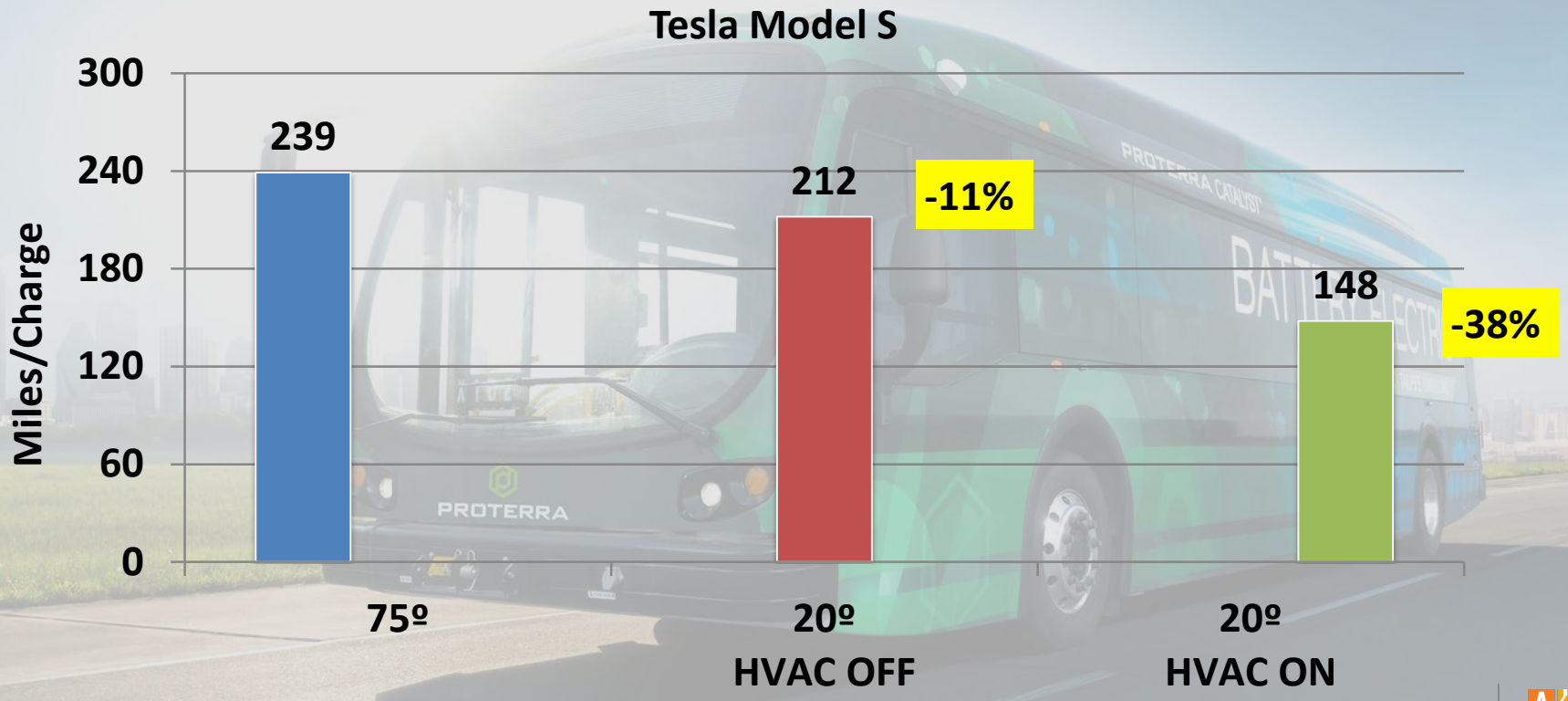
$/BUS COMPARISON

Type	Cost ($)	Year	Agency
Diesel	553,760	2015	MBTA
CNG	585,990	2015	MBTA
Diesel-Hybrid	**769,000**	2017	King County Metro
Diesel-Hybrid	**736,927**	2018	MBTA
BEB	**784,000**	2017	King County Metro

MBTA BEB INITIATIVES

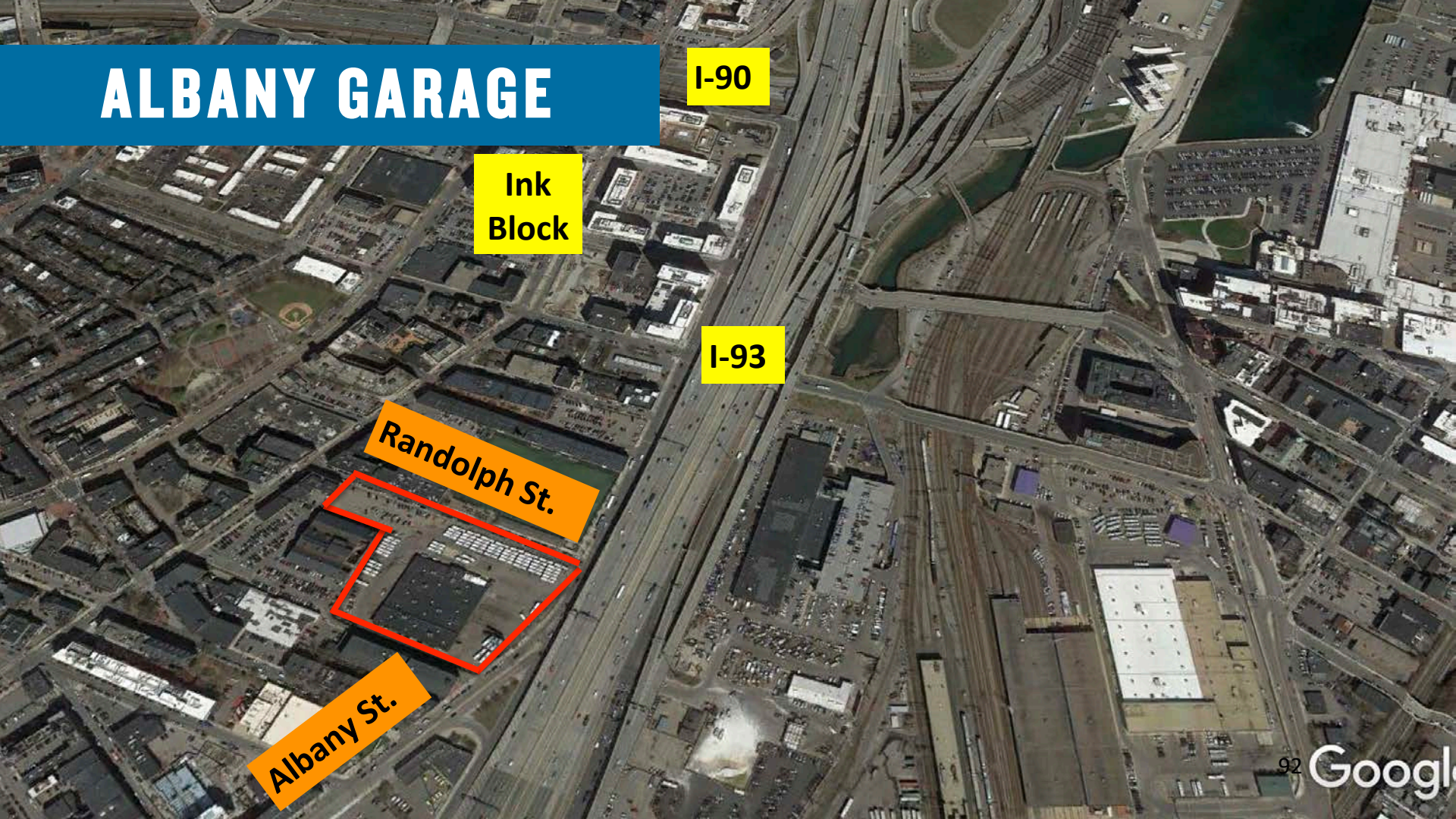
- 5x 60-foot BEBs bought under FTA “Lo-No” grant program
- Support Silver Line service
- Evaluate technology in MBTA service / climate
- 40-foot BEB evaluation program anticipated

COLD IMPACTS RANGE

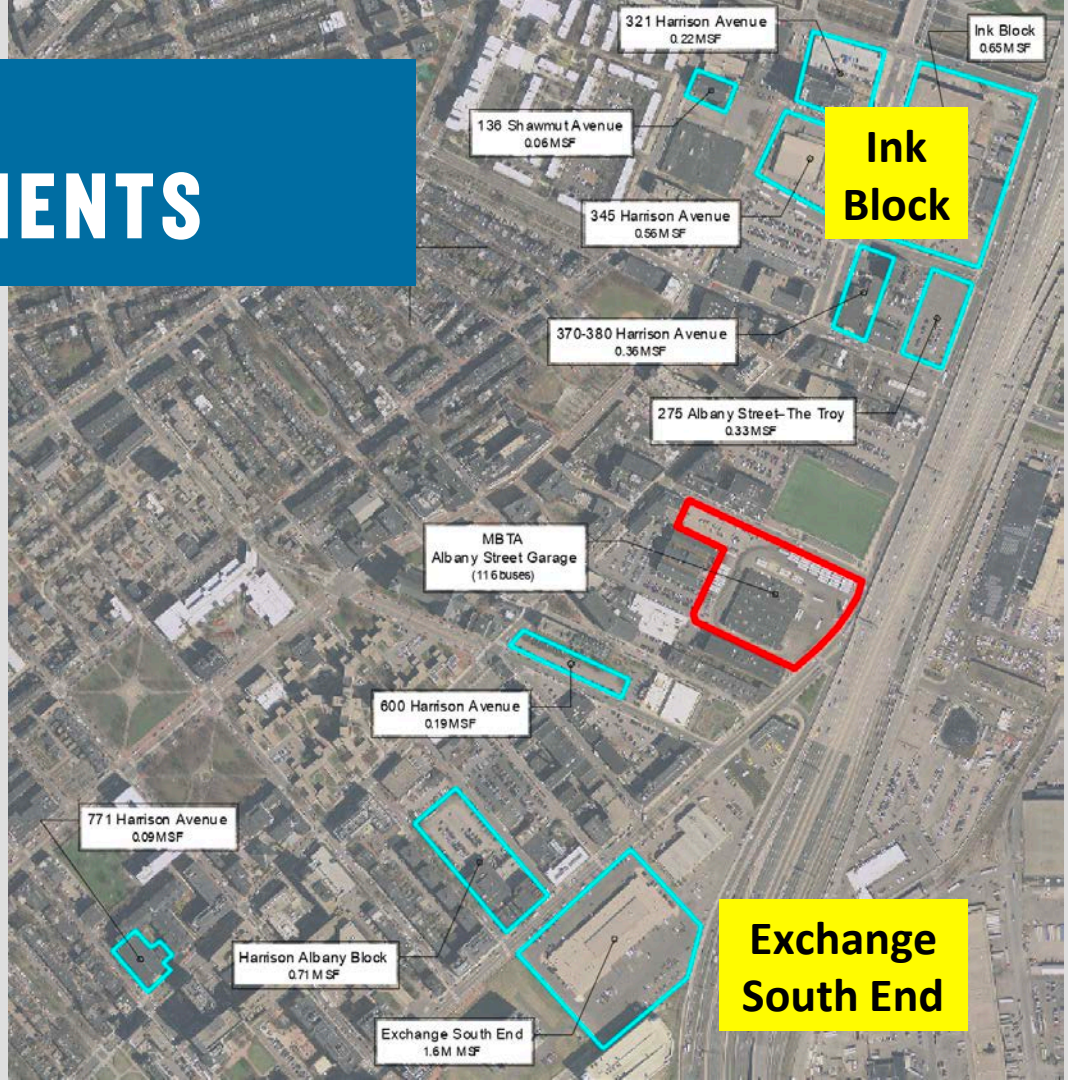


Note: % reductions compared to 75º
AAA-Electric Vehicle Range Testing Report, Feb. 2019

ALBANY GARAGE



MAJOR DEVELOPMENTS



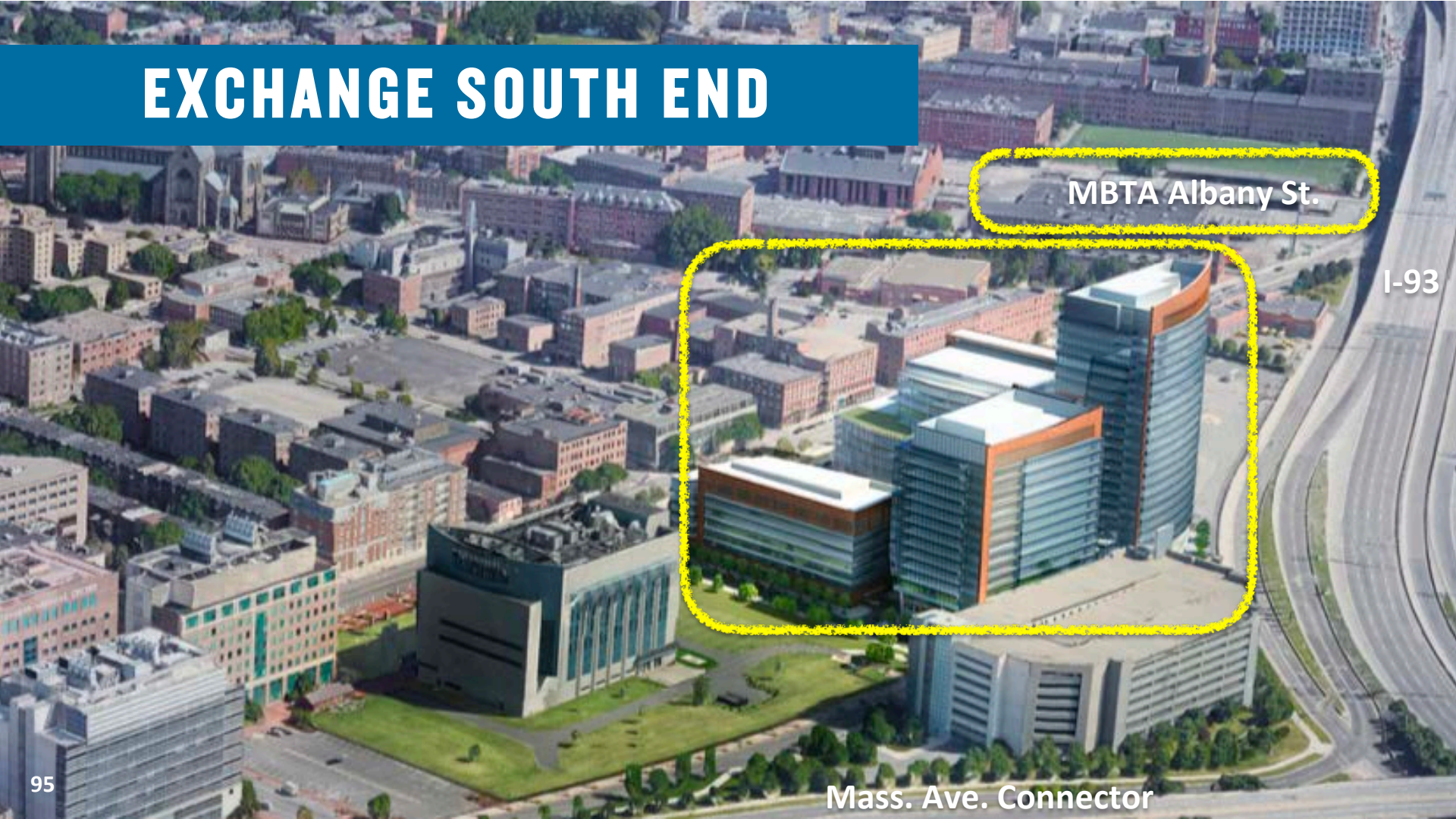
JACOBS

A BETTER CITY

ZONING


MBTA Albany St.
I-93
Albany St.
BOSTON FLOWER EXCHANGE
540 Albany St
Mass. Ave. Connector

EXCHANGE SOUTH END



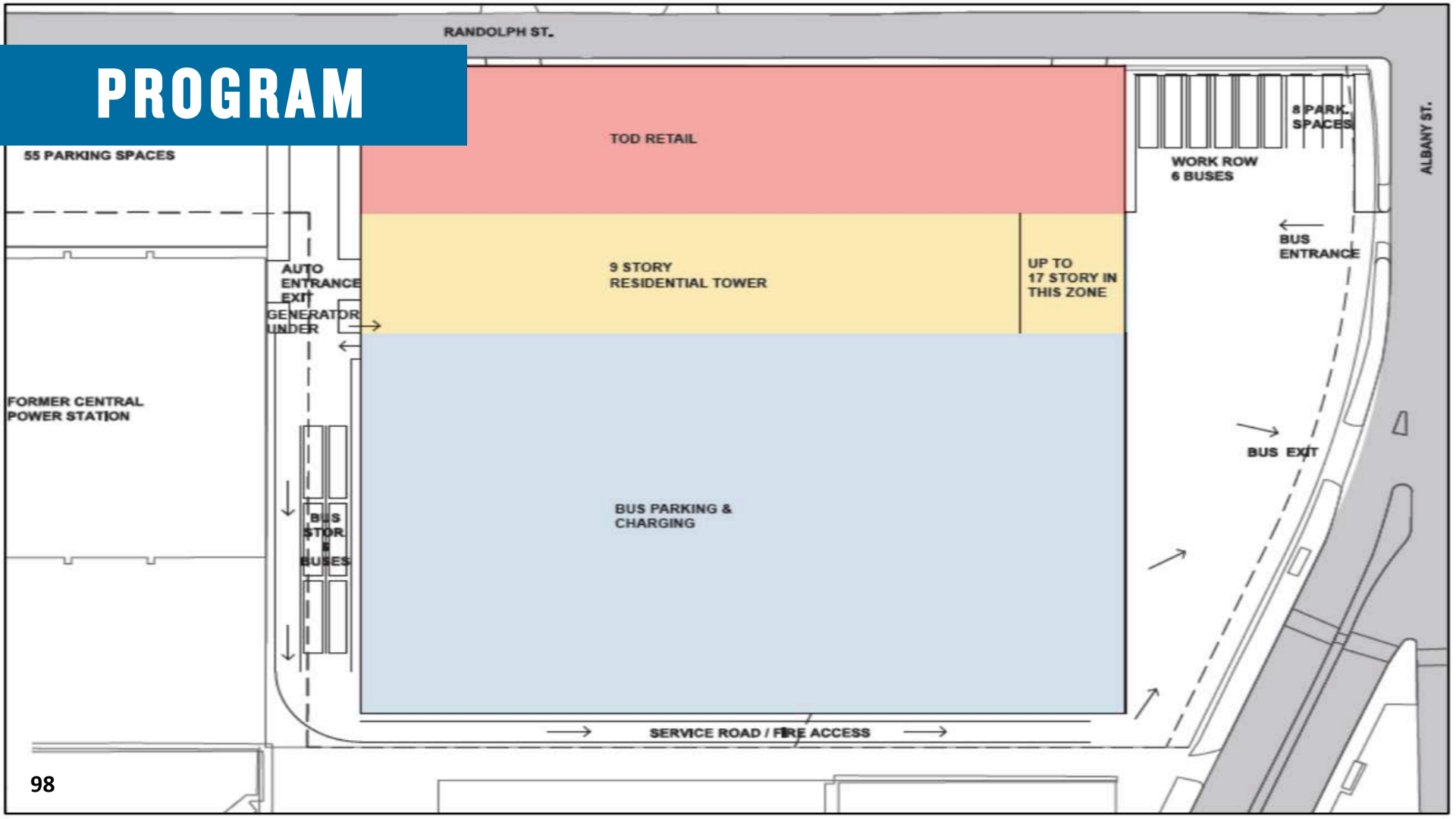
CASE STUDY OVERVIEW

- The Case Study is intended to demonstrate the viability of a concept
- Not specific to the Albany Street Garage
- This model could be adapted to any number of potential locations

KEY BEB CONSIDERATIONS

Issue	Conventional Fleet	BEB Fleet
Maintenance	• Ventilation needed	• Ventilation not needed
Vehicle Range & Cold Weather Performance	• 350+ miles	• 200-400 miles • Cold weather impacts • Indoor storage
Fueling / Charging	• 10 minutes	• 2-5 hours to charge • Strategic parking of buses • Overhead / plug-in / inductive?
Power Infrastructure	• Established fuel supply chain and logistics	• Fleet power requirements under development • Backup generation required for redundancy?
Potential for Joint Development	• Low	• High?

PROGRAM


RANDOLPH ST.
ALBANY ST.
55 PARKING SPACES
TOD RETAIL
8 PARK. SPACES
WORK ROW
6 BUSES
BUS
ENTRANCE
9 STORY
RESIDENTIAL TOWER
UP TO
17 STORY IN
THIS ZONE
AUTO
ENTRANCE
EXIT
GENERATOR
UNDER
FORMER CENTRAL
POWER STATION
BUS EXIT
BUS PARKING &
CHARGING
BUS
STOR
E
BUSES
SERVICE ROAD / FIRE ACCESS

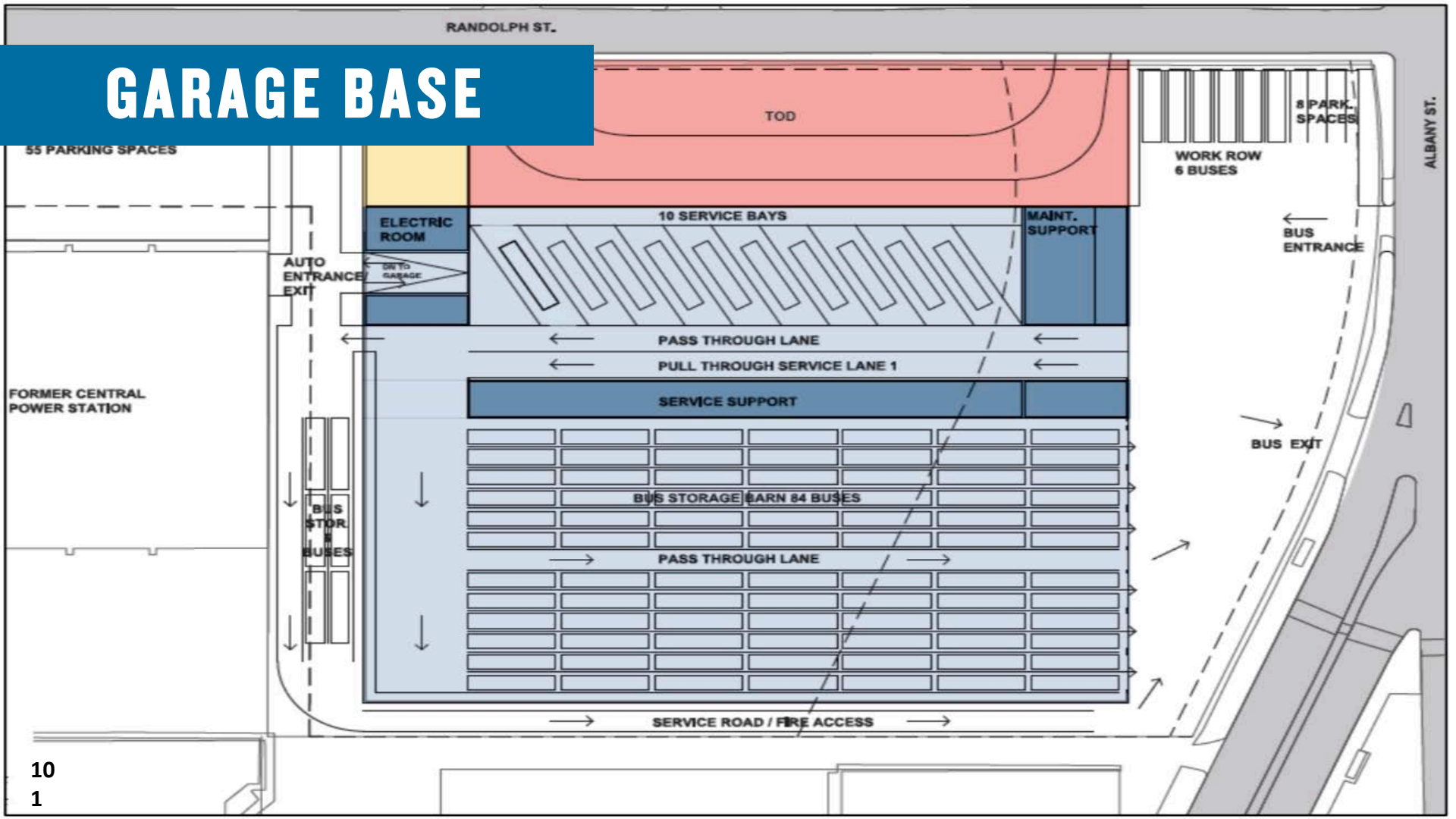
FT² DETAILS

Program	BEB Storage and Maintenance Facility	BEB Facility and TOD Mixed-Use Development
Residential Space	--	226,548 ft^2
Retail Space	--	22,766 ft^2
Transit Hub	--	12,232 ft^2
Bus Maintenance & Support	25,366 ft^2 (10 bays)	25,366 ft^2 (10 bays)
Indoor Bus Storage	80,975 ft^2 (94 buses)	80,975 ft^2 (94 buses)
Onsite Employee Parking	25,562 ft^2 (55 cars)	25,562 ft^2 (55 cars)
Underground Car Parking	63,222 ft2 (68 cars)	63,222 ft2 (68 cars)

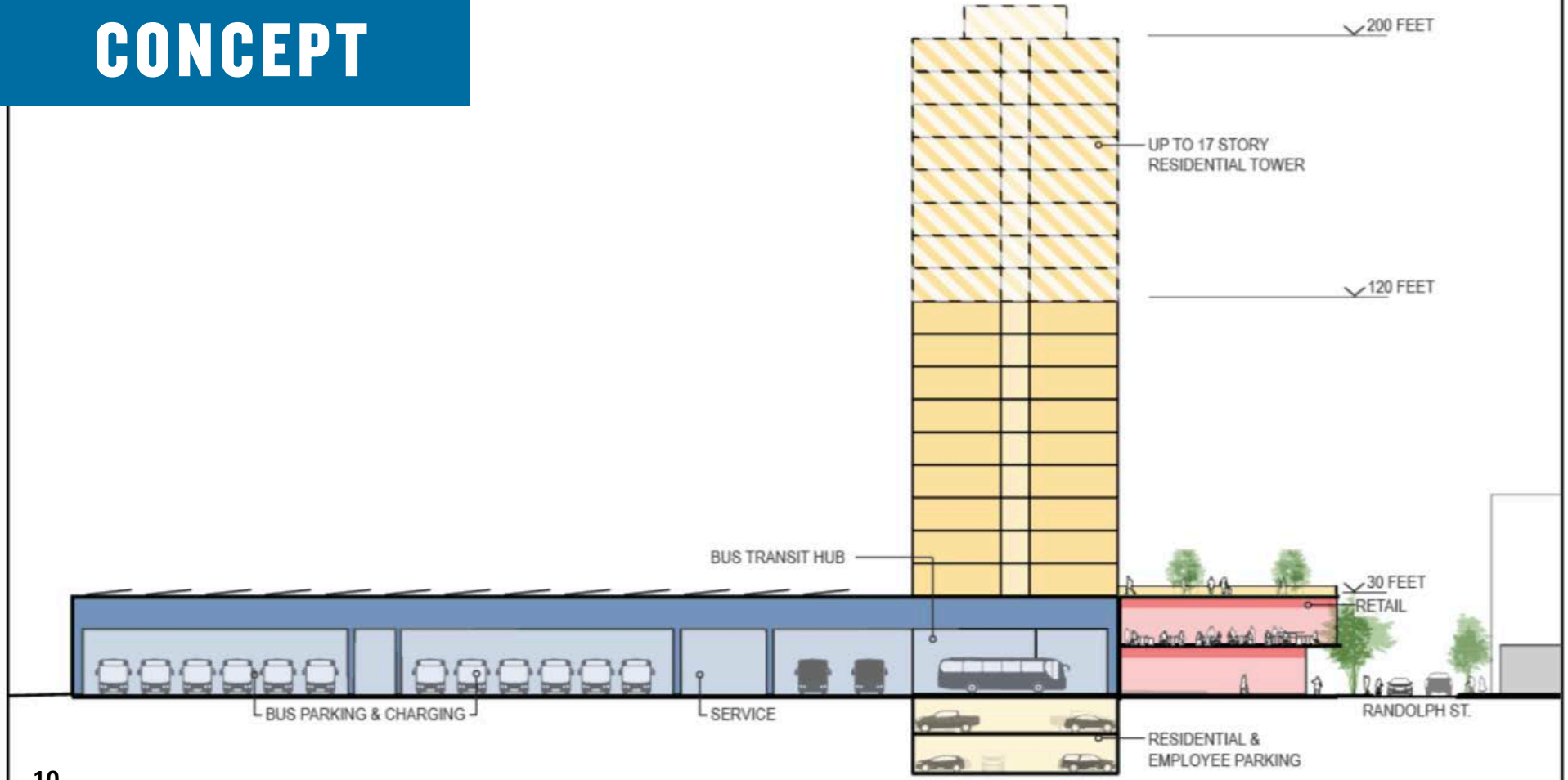
CONCEPTUAL BUDGET

Program	Assumed Cost	BEB Storage and Maintenance Facility	BEB Facility and TOD Mixed-Use Development
Bus Storage	$42,000,000	$42,000,000	$42,000,000
Bus Maintenance	$20,000,000	$20,000,000	$20,000,000
Bus Electrification	$30,000,000	$30,000,000	$30,000,000
Apartment Tower	$255 / square foot		$67,000,000
	Total	**$92,000,000**	**$159,000,000**

GARAGE BASE


RANDOLPH ST.
TOD
8 PARK. SPACES
ALBANY ST.
55 PARKING SPACES
WORK ROW
6 BUSES
ELECTRIC ROOM
10 SERVICE BAYS
MAINT. SUPPORT
BUS ENTRANCE
AUTO ENTRANCE/ EXIT
PASS THROUGH LANE
PULL THROUGH SERVICE LANE 1
FORMER CENTRAL POWER STATION
SERVICE SUPPORT
BUS EXIT
BUS STORAGE BARN 84 BUSES
BUS STOR. 8 BUSES
PASS THROUGH LANE
SERVICE ROAD / FIRE ACCESS

CONCEPT

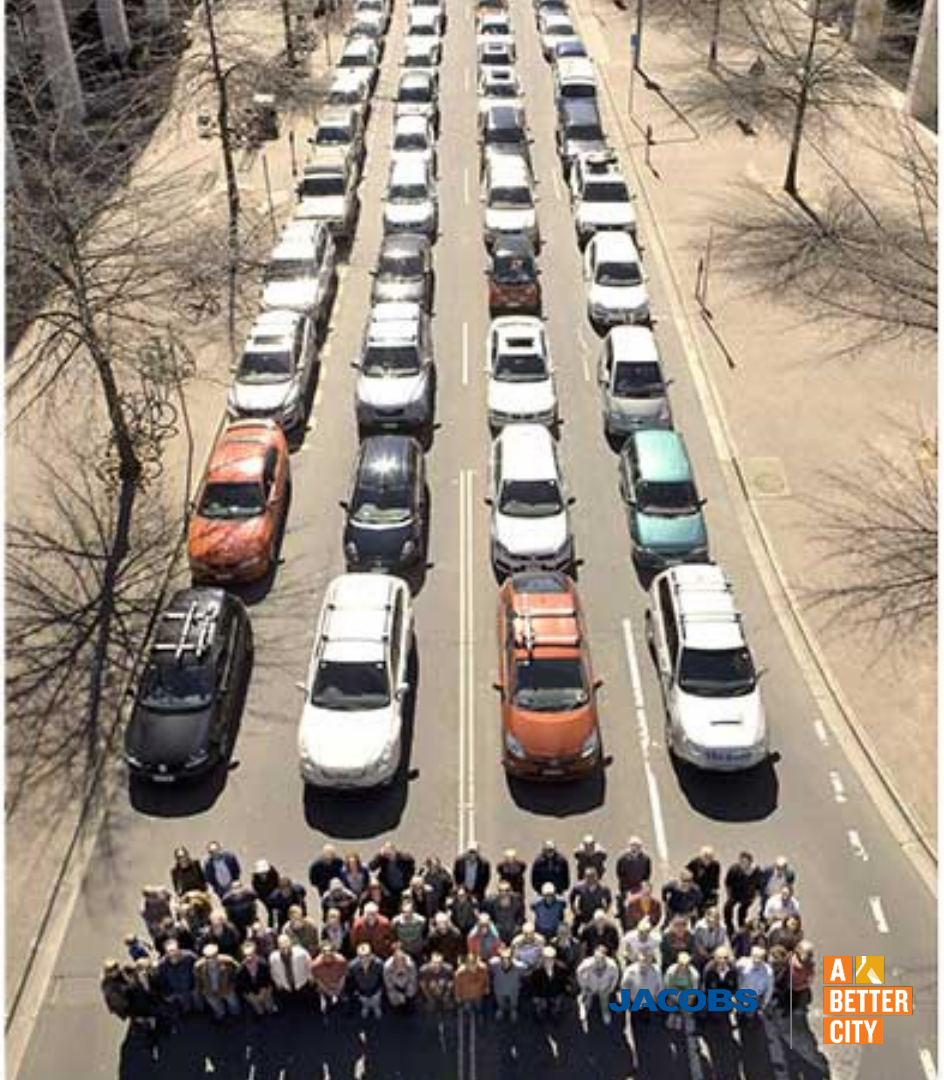

200 FEET
UP TO 17 STORY
RESIDENTIAL TOWER
120 FEET
BUS TRANSIT HUB
30 FEET
RETAIL
BUS PARKING & CHARGING
SERVICE
RANDOLPH ST.
RESIDENTIAL &
EMPLOYEE PARKING

MULTI-USE CONCEPT

SUMMARY

1. Approximately $1 B financial challenge
2. BEB fleets in NE likely in 5-7 years
3. Joint-development benefits may help:
   - Cost-effective procurement
   - Better neighborhood fit for facilities, not divest urban sites
   - Decarbonization and climate goals

52-1



DISCUSSION

Q&A WITH PANELIST








A BETTER CITY

IN CLOSING

KATE DINEEN

EXECUTIVE VICE PRESIDENT, A BETTER CITY

@ABetterCity #BEBBoston


THANK YOU
A
BETTER
CITY