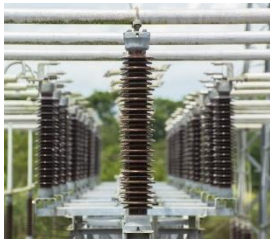




# Multi-Sector Approach to Reducing Greenhouse Gas Emissions in the Metropolitan Washington Region

Draft GHG Strategy Analysis – Energy and Built Environment Sector

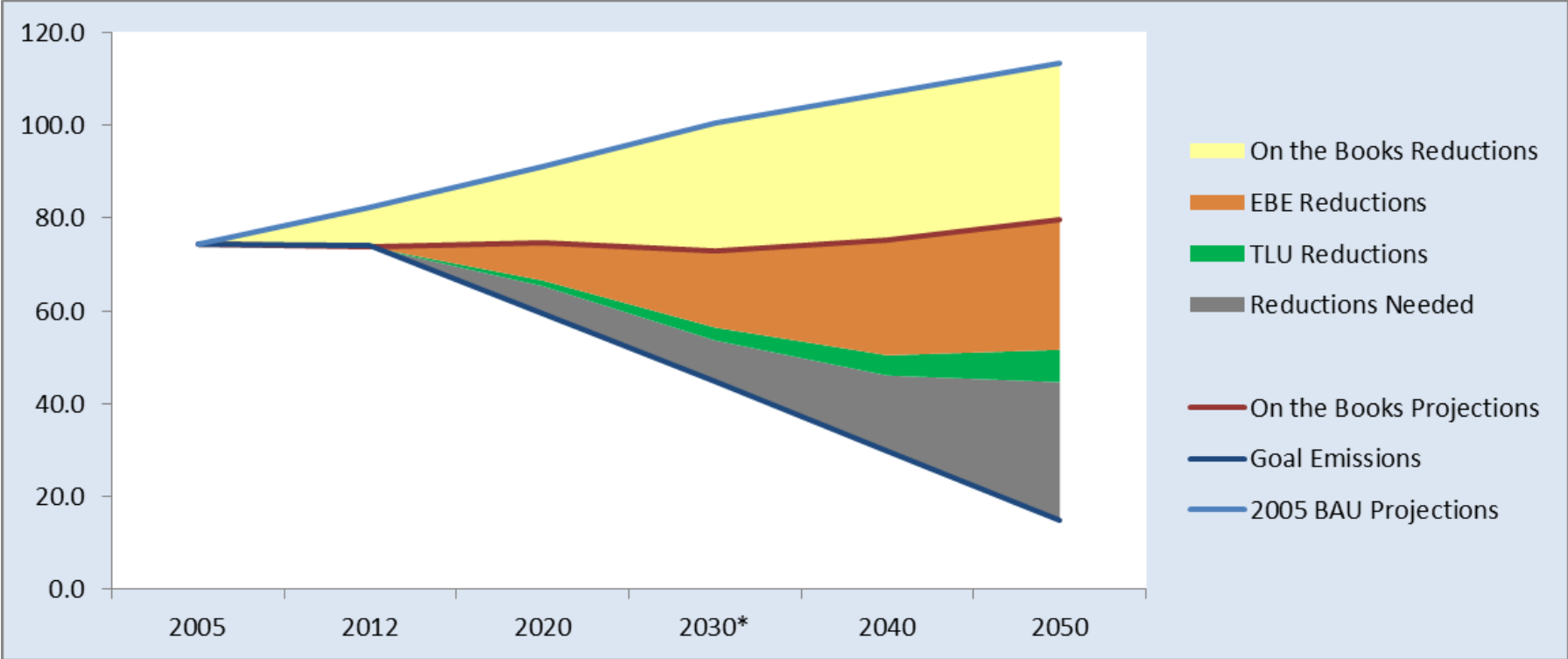


Prepared for:  
**Metropolitan Washington Council of Governments**



Thursday, July 16, 2015

# Overview of Projected Reductions (MMT CO2e)

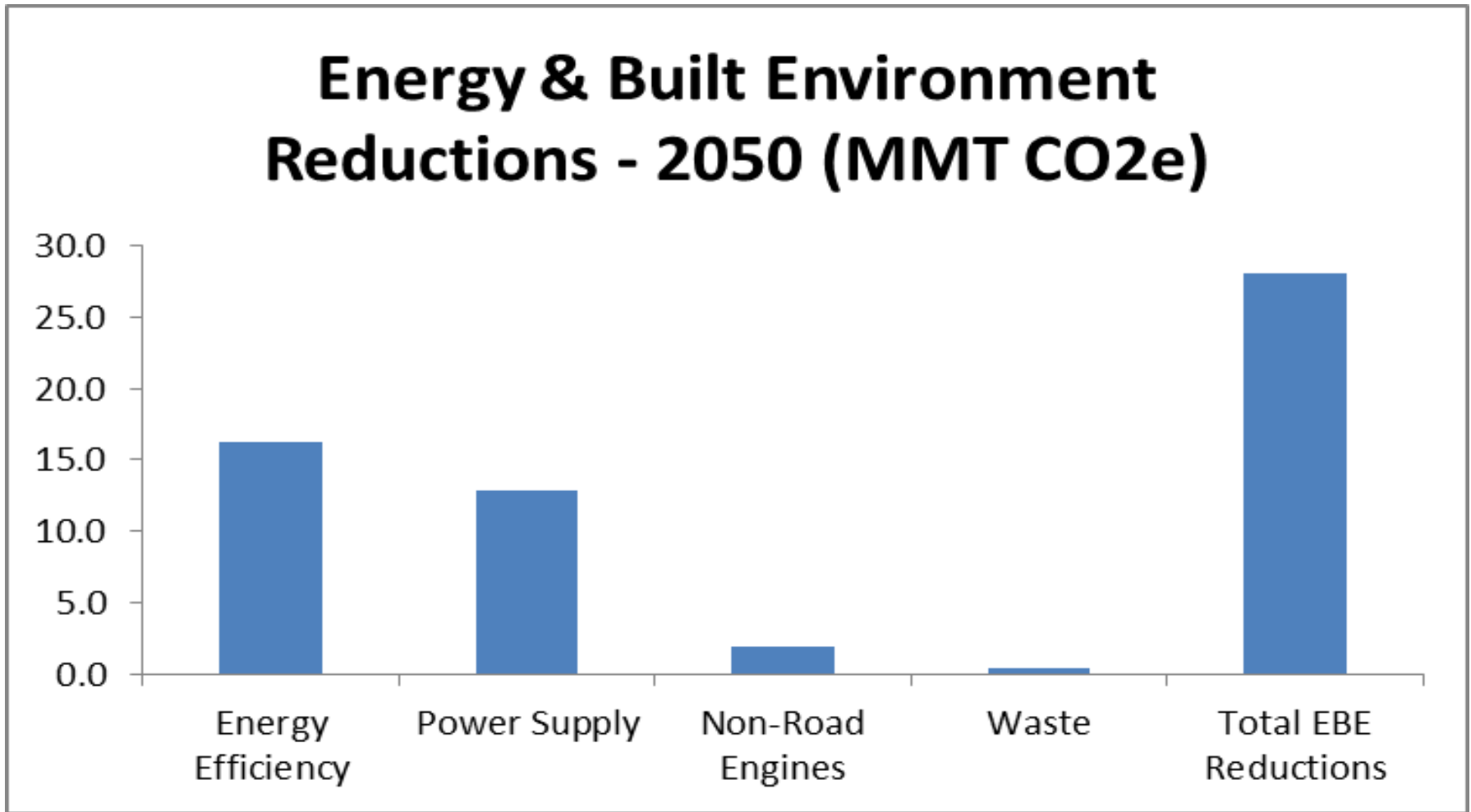


\*2030 reductions are a linear interpolation between 2020 and 2040 for the purposes of this chart.

## Data Behind “Wedge” Graphic

	2020	2030	2040	2050
<b>2005 BAU Projections</b>	91.0	100.4	106.9	113.3
<b>On the Books Projections</b>	74.7	72.9	75.2	79.7
<b>On the Books Reductions</b>	16.3	27.5	31.6	33.7
<b>EBE Reductions</b>	8.2	16.5	24.8	28.0
<b>TLU Reductions</b>	1.2	2.7	4.3	6.8
<b>Reductions Needed</b>	5.8	9.0	16.3	30.0
<b>Goal Emissions</b>	59.6	44.7	29.8	14.9
<b>Remaining Emissions</b>	65.4	53.7	46.1	44.9
<b>Reductions from 2005 levels (%)</b>	12%	28%	38%	40%
<b>Reductions from 2005 BAU Projections (%)</b>	28%	47%	57%	60%

## EBE Projected Reductions



- Sub-sectors show “Non-layered” reductions followed by sector-wide “layered” reductions

# EBE Strategy Groupings

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- **Energy Efficiency:**

- EBE-1
- EBE-3
- EBE-4
- EBE-5

- **Power Supply:**

- EBE-2
- EBE-6
- EBE-7

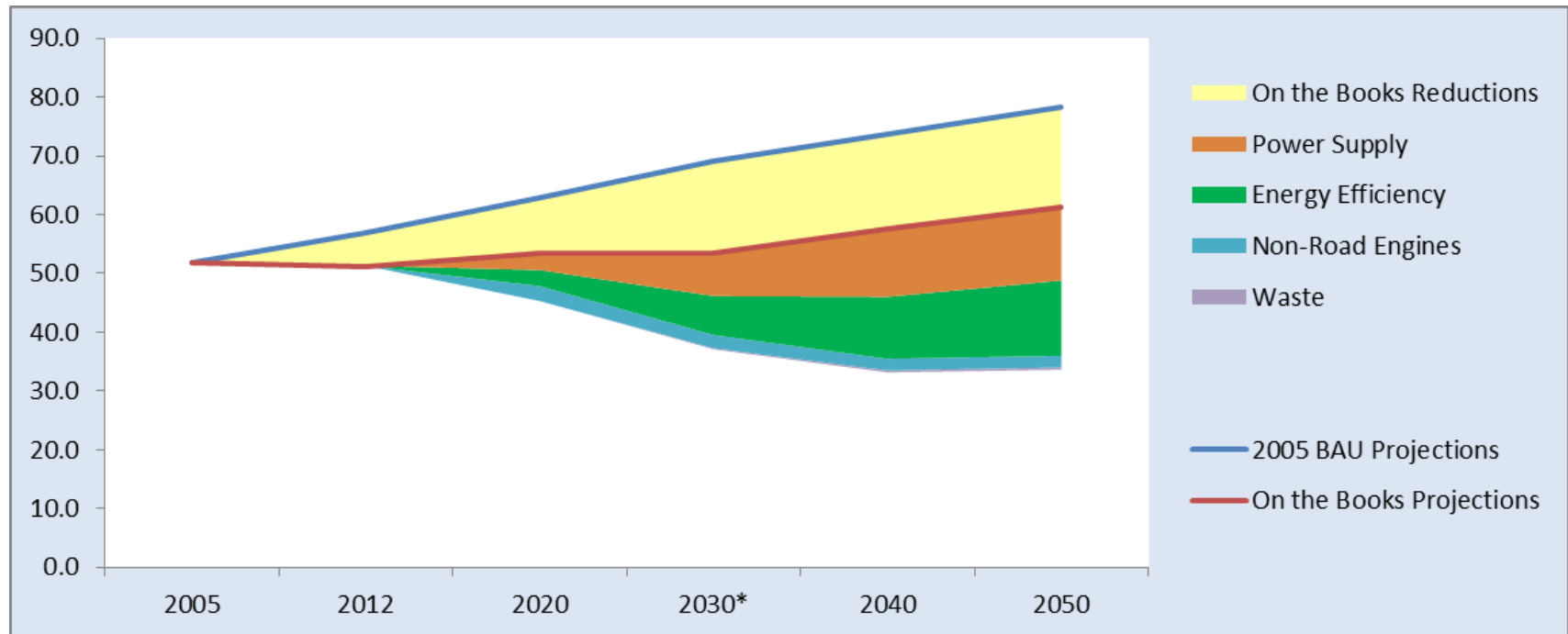
- **Non-Road Engines**

- EBE-9

- **Waste:**

- EBE-8

# EBE Portion of Projected Reductions (MMT CO<sub>2</sub>e)



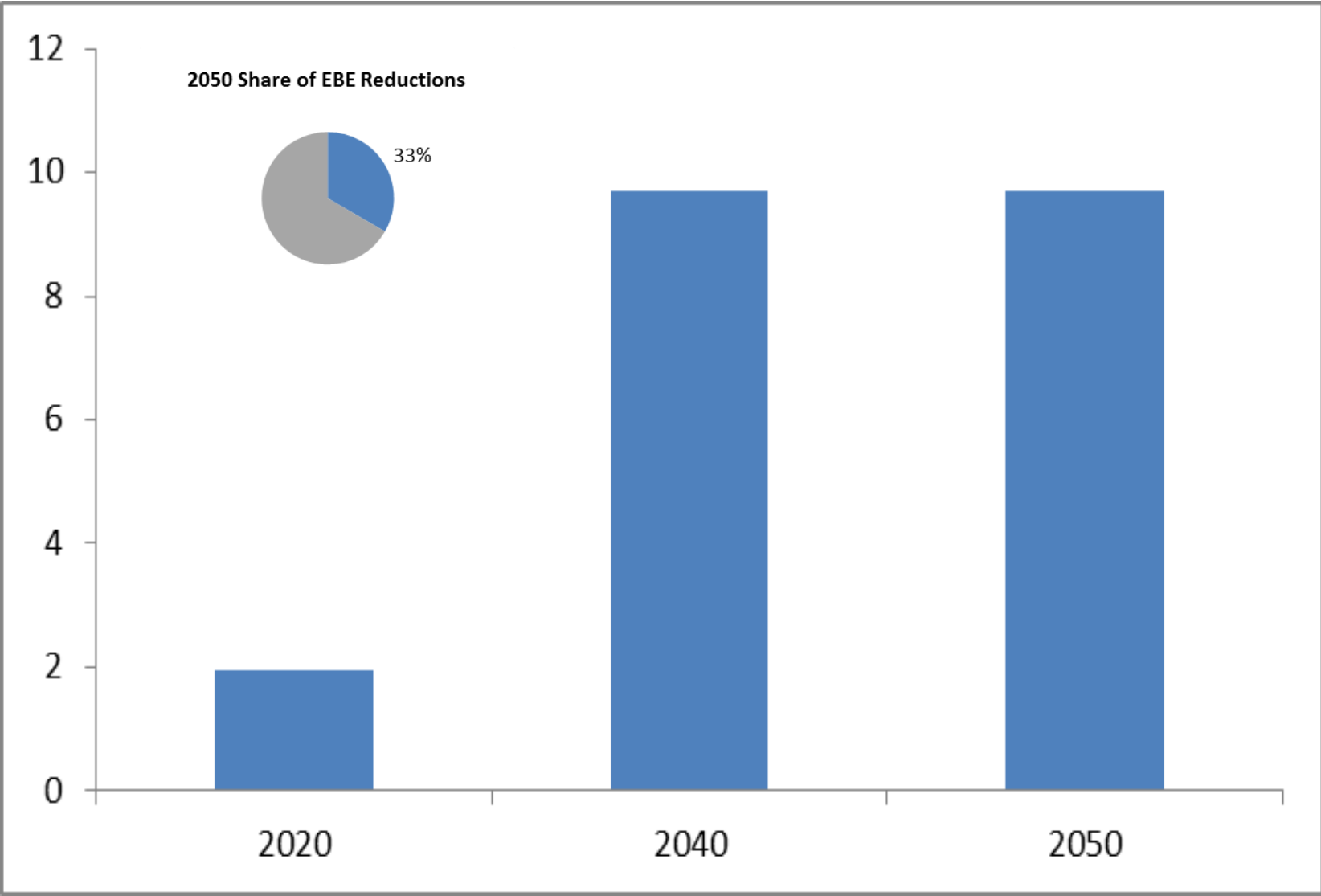
\*2030 reductions are a linear interpolation between 2020 and 2040 for the purposes of this chart.

## EBE-1: Reduce energy and water consumption in existing buildings

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Strategy/Analysis Scenario	Policy and Program Actions
<p><b>Scenario:</b></p> <ul style="list-style-type: none"><li>• <b>2% annual reduction, 30% cumulative by 2030</b></li></ul>	<ul style="list-style-type: none"><li>• Leverage utility programs for incentives, technical assistance, smart metering data applications</li><li>• Adopt Architecture 2030 goal</li><li>• Extend enforcement of energy codes to existing buildings</li><li>• Reduce water usage</li><li>• Mandate energy/water benchmarking</li><li>• Expand low-income energy/water savings programs</li><li>• Expand financing options</li></ul>

# EBE-1: GHG reductions - stand alone (MMT CO2e)





## EBE-1: Reduce energy and water consumption in existing buildings

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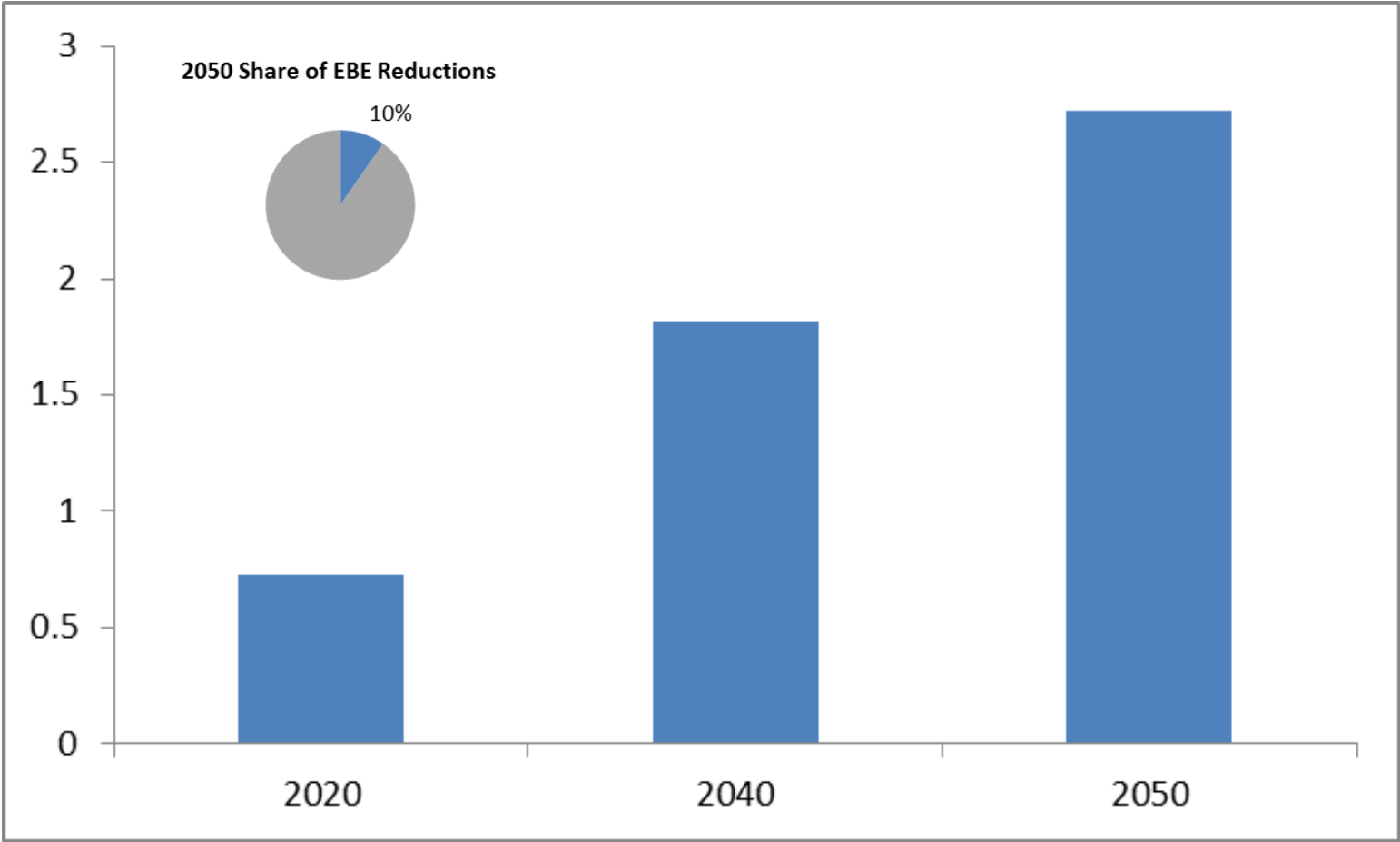
- **The built environment accounts for a large fraction of baseline emissions**
- **A 2% annual improvement, though modest in the near term, cumulates to large savings over 15 years (~30%)**
- **Reductions were calculated top-down, as % of baseline calculations, rather than built bottom-up**
- **Field experience with energy efficiency in buildings tends to support the achievability of 2% annual savings**
  - DC's mandatory benchmarking regulation shows savings >2% annually
  - EPA data trends analysis shows benchmarked buildings save >2% annually
  - Residential benchmarking programs show evaluated 2% annual savings effect
  - Most aggressive state utility programs realize ~2% annual kWh savings, e.g. MA
- **Sustaining 2% reductions over the longer term, across all sectors, is challenging**

## EBE-2. Existing building-level renewable energy development

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Strategy/Analysis Scenario	Policy and Program Actions
<p><b>Scenario:</b></p> <ul style="list-style-type: none"><li>Initially included in EBE-6, now based on buildup of building solar PV development</li></ul>	<ul style="list-style-type: none"><li>Support cooperative/aggregated renewable energy purchasing for public, residential and commercial sectors</li><li>Provide incentives for building-level renewable technologies (e.g. property tax abatements, density allowances).</li><li>Adopt solar access ordinances and similar regulations to support renewable development.</li></ul>

# EBE-2: GHG reductions - stand alone (MMT CO2e)



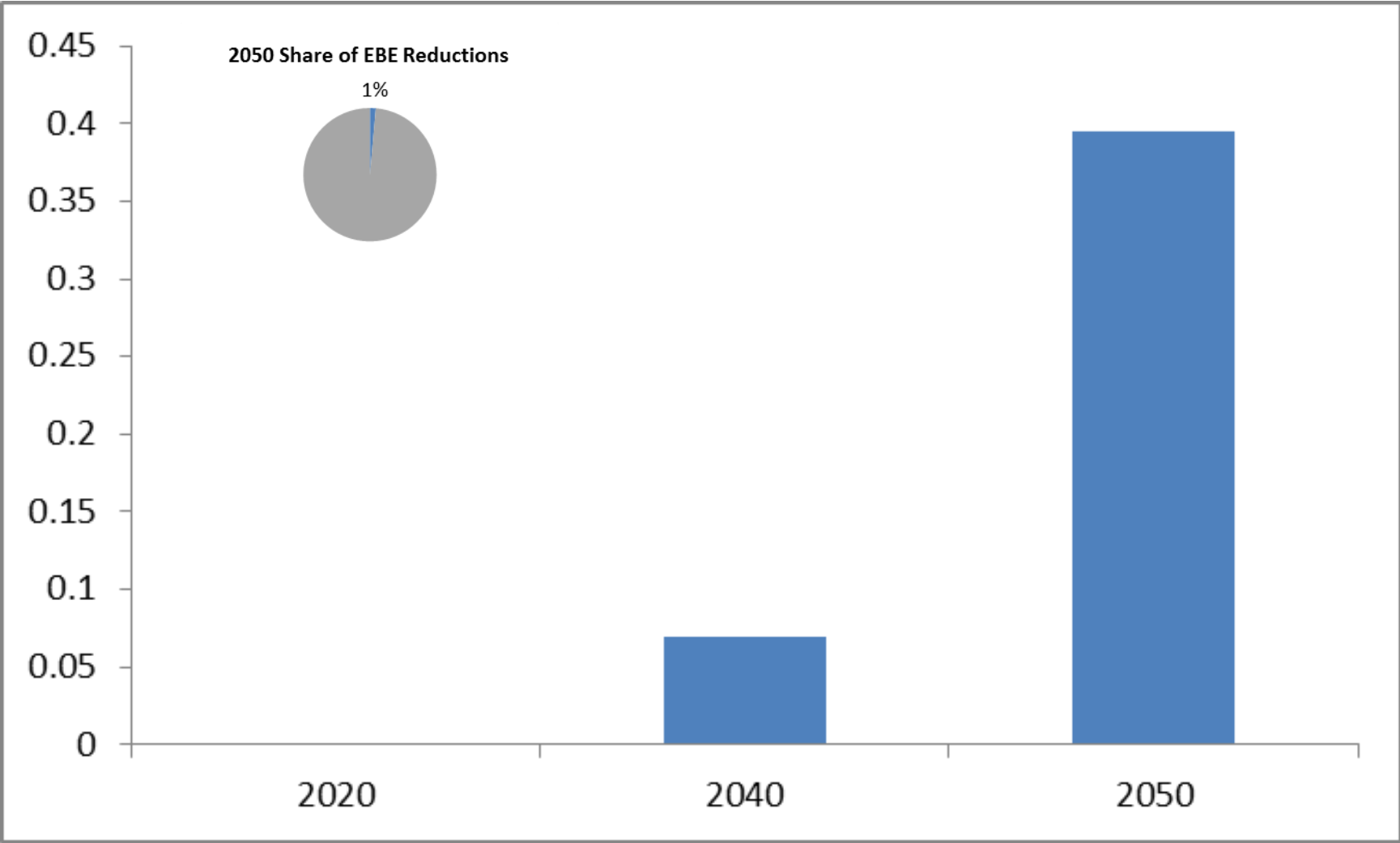
## **EBE-2. Existing building-level renewable energy development**

- **Scenario calculations based on building-level solar PV development**
- **ICF utilized Excel and PVWatts modeling to estimate impacts**
- **Impacts were built up from a set of specific actions:**
  - Support cooperative/aggregated renewable energy purchasing for residential sector
  - Support cooperative/aggregated renewable energy purchasing for commercial sector
  - Support cooperative/aggregated renewable energy purchasing for government sector
  - Provide incentives for building-level renewable technologies
  - Adopt solar access ordinances and similar regulations to support renewable development
- **This scenario represents a lot of solar**
  - Equivalent of almost 1 million kW residential PV installations
  - About 4,500 MW of peak capacity

## EBE-3: Encourage development in activity centers

Strategy/Analysis Scenario	Policy and Program Actions
<p><b>Scenario:</b></p> <ul style="list-style-type: none"><li>• Increase in the proportion of new development built in Activity Centers by 2030.</li></ul>	<ul style="list-style-type: none"><li>• Update comprehensive plans to include energy and transportation efficiencies as a factor in public facility siting decisions.</li><li>• Update zoning policies and permitting guidelines to encourage low-impact site development.</li><li>• Locate development at sites and in densities that can be served by efficient and renewable district energy systems.</li><li>• Encourage activity-center residential density to reduce average housing unit size and energy demand.</li><li>• Tie development review to GHG performance.</li></ul>

# EBE-3: GHG reductions - stand alone (MMT CO2e)



## **EBE-3: Encourage development in activity centers**

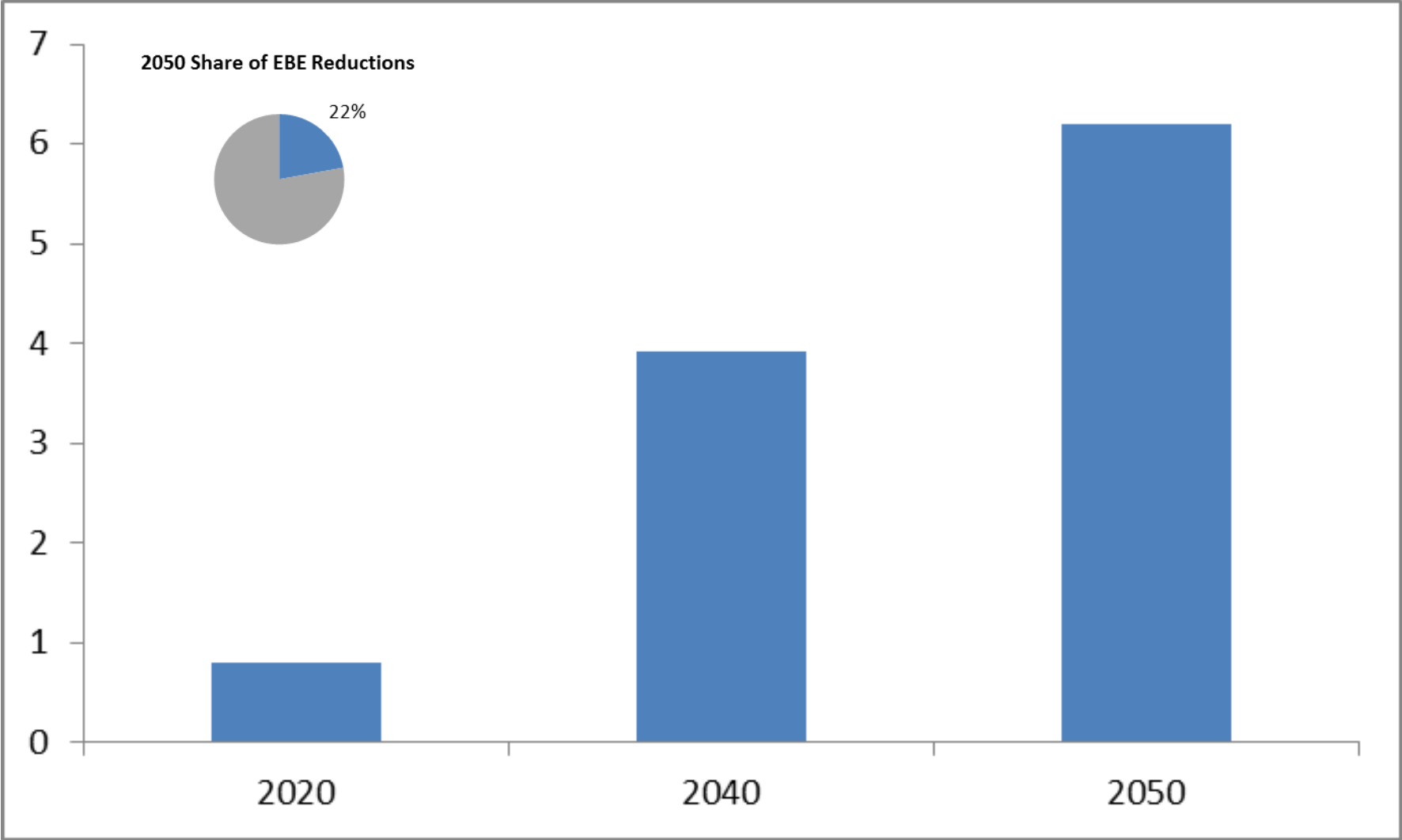
- **TLU strategies that shift development to activity centers are assumed to reduce building energy use by shrinking dwelling units and commercial space**
- **Primary analysis of household and employment shifts conducted in TLU-2**
- **EBE-3 analysis applied a simple reduction ratio to household and commercial space energy use, based on assumed space reductions**
- **We used a space reduction factor of 20% based on TLU/EBE staff subject matter expertise**
- **Reduction calculations began in 2040 to correspond with TLU analysis, with the 2040 energy consumption calculation incorporating sector growth adjusted by 2005 – 2012 energy intensity trends**

## EBE-4: Improve new building energy and water efficiency performance

Strategy/Analysis Scenario	Policy and Program Actions
<p><b>Scenario:</b></p> <ul style="list-style-type: none"><li>• 100% compliance with most stringent ICC or ASHRAE building code/energy performance standards by 2020</li><li>• 100% of new buildings designed to meet ENERGY STAR Target Finder performance levels by 2030</li><li>• 50% of new buildings designed to be net zero energy by 2040</li><li>• 100% new buildings designed to be net zero energy by 2050.</li><li>• 100% of new buildings use WaterSense fixtures by 2030 to reduce energy needs of water and wastewater)</li></ul>	<ul style="list-style-type: none"><li>• Adopt and enforce updated building codes and energy performance standards</li><li>• Create electric vehicle “charging-ready” infrastructure code provisions.</li><li>• Adopt Architecture 2030 goals.</li><li>• Express preference for zero-energy performance levels in development proposals.</li><li>• Provide Net Zero building incentives.</li><li>• Integrate green power purchasing into new building policies.</li><li>• Support development “green tariff” policies.</li><li>• Require new building sites to meet low-impact site development requirements.</li><li>• Adapt and update planning/zoning policies.</li></ul>



# EBE-4: GHG reductions - stand alone (MMT CO2e)



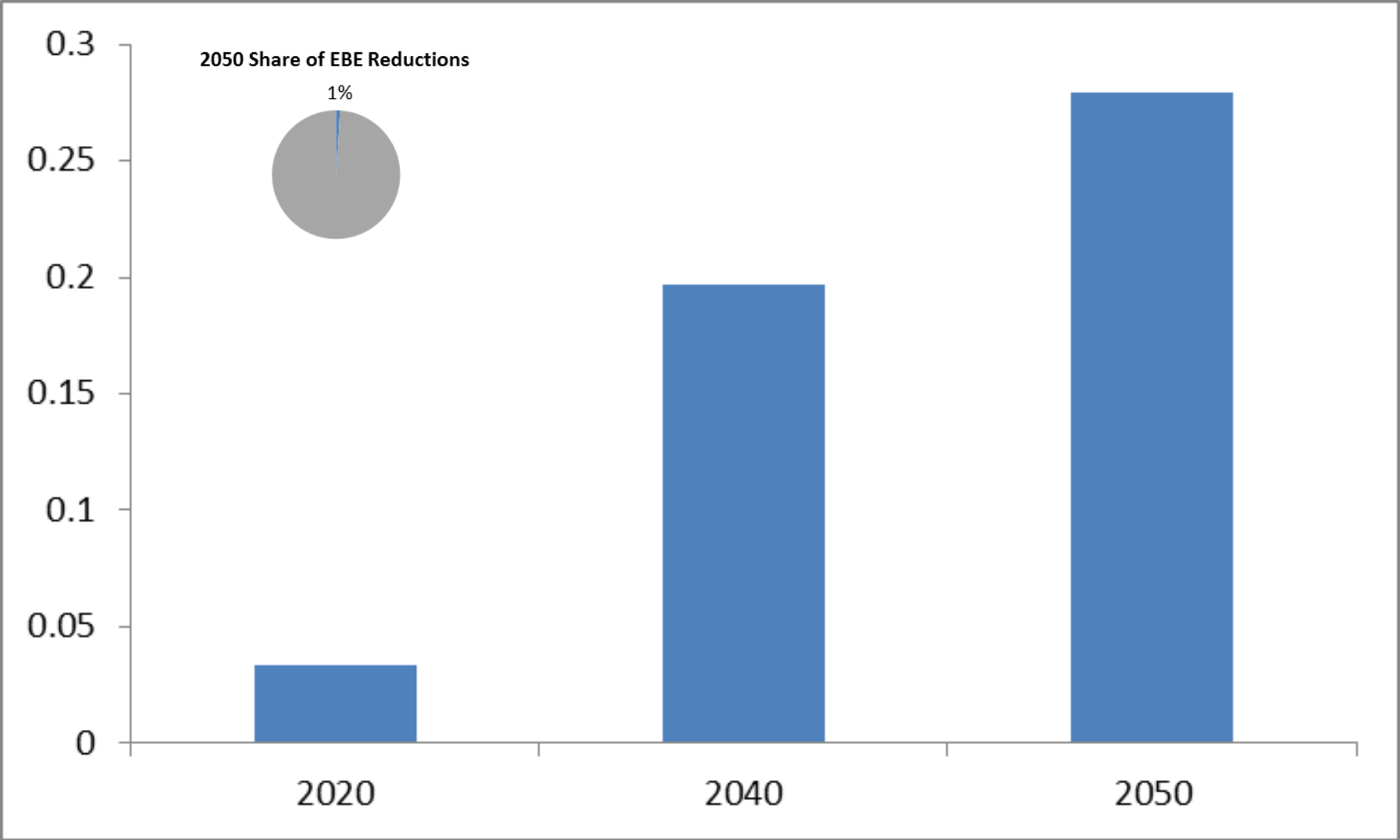
## **EBE-4: Improve new building energy and water efficiency performance**

- **EBE-4 targets the new construction side of the built environment, whereas EBE-1 focuses on existing buildings**
- **New construction accounts for a small fraction of the built environment on an annual basis, but over 25-35 years accounts for a large share of the future stock**
- **EBE-4 calculations were two-fold:**
  - Incremental savings from increased building code stringency, applied through 2030, using an existing ICF-developed calculator tool
  - Attaining net-zero energy performance across the new stock by 2050; we assumed 50% NZE by 2040, 100% by 2050
- **Actions to reach EBE-4 goals include building energy codes, water efficiency regulations, planning/zoning/permitting policies and practices, Net Zero building policies and incentives**
- **Reductions were calculated against projected sector growth adjusted by 2005 – 2012 energy intensity trends**

## EBE-5: Improve infrastructure efficiency and renewable energy use

Strategy/Analysis Scenario	Policy and Program Actions
<p><b>Scenario:</b></p> <ul style="list-style-type: none"><li>• <b>1% annual reduction in fossil energy use, 35% cumulative by 2050</b></li></ul>	<ul style="list-style-type: none"><li>• Reduce energy use by water and wastewater systems by reducing leaks, increasing onsite generation, increasing system efficiency, and fostering process improvements, by working through institutional and utility programs.</li><li>• Implement outdoor lighting and other end-use efficiency technologies, working through institutional and utility programs.</li><li>• Install on-site renewable power systems at facility and transit sites by working through institutional and utility programs.</li></ul>

# EBE-5: GHG reductions - stand alone (MMT CO2e)



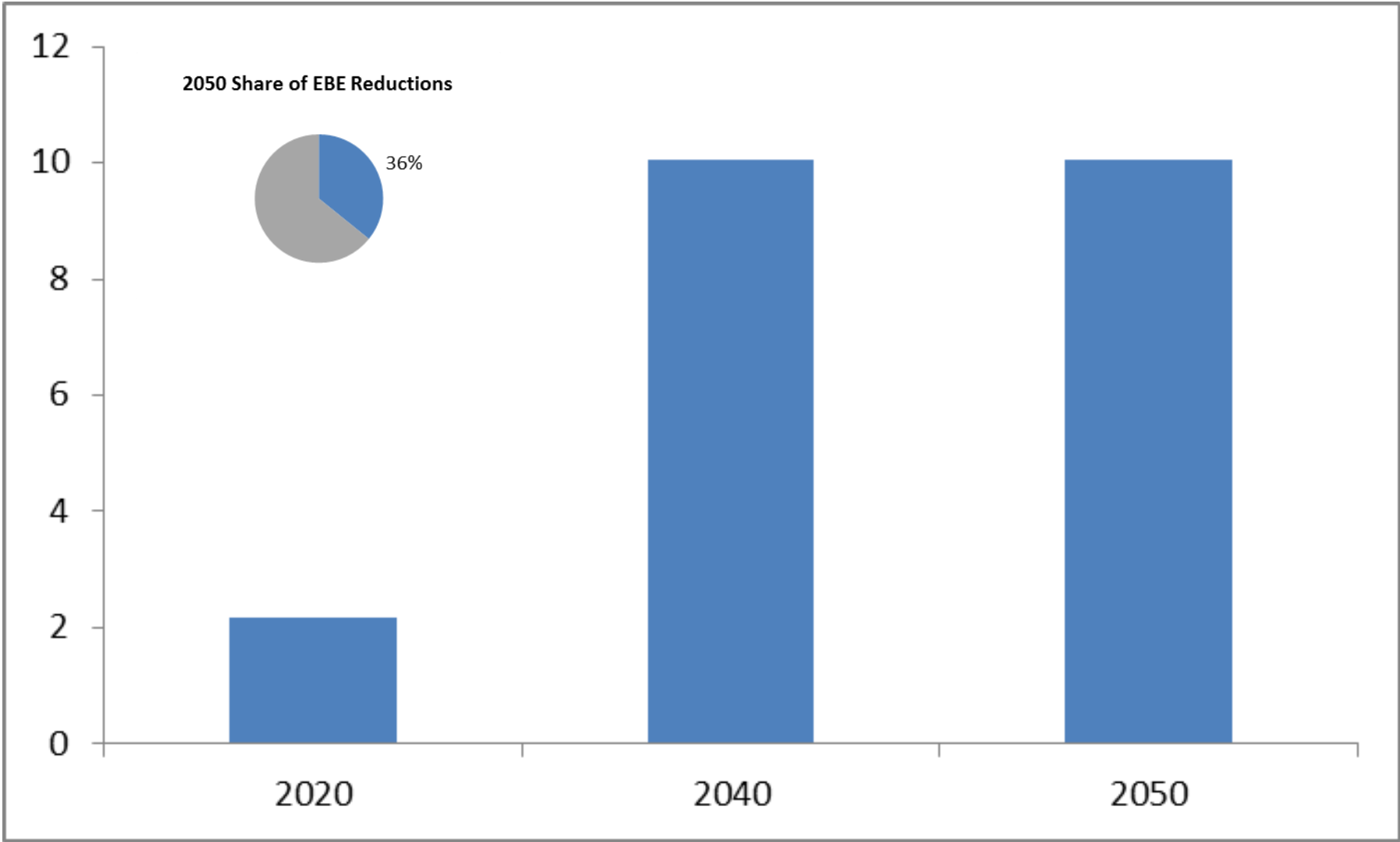
## **EBE-5: Improve infrastructure efficiency and renewable energy use**

- **EBE-5 focuses on the region's infrastructure institutions: water/wastewater authorities, airports, WMATA**
- **EBE-5 can be viewed as a “carve-out” from EBE-1, as institutions' energy usage is included in the EBE-1 baseline, but COG members can have very specific influence on infrastructure institutions' energy actions**
- **Impact calculations involved collecting baseline energy usage data from the institutions, and applying the scenario target of 1% annual/35% cumulative reduction.**
- **Some institutions are moving aggressively on energy efficiency, renewables, and other clean energy actions, and so the nominal scenario target may be modest**
- **For institutions that haven't supplied data we applied energy intensity rates from available sources to their service population.**

## EBE-6: Achieve targeted reductions in power sector emissions

Strategy/Analysis Scenario	Policy and Program Actions
<p><b>Scenario:</b></p> <ul style="list-style-type: none"><li>• <b>30% reduction in emissions from energy generation by 2030 (on a total emissions (mass) basis rather than an emission-rate basis)</b></li></ul>	<ul style="list-style-type: none"><li>• Support state plans to achieve a 30% mass-based reduction in electric sector emissions.</li><li>• Phase out coal use in COG jurisdictions by 2030.</li><li>• Explore increased nuclear capacity.</li><li>• Increase efficiency of thermal power plants.</li><li>• Support increases in state Renewable Portfolio Standards (RPS) to 40% by 2030.</li><li>• Increase electric-grid energy storage capacity.</li><li>• Reduce energy waste from transmission and distribution of energy.</li><li>• Expand natural gas supply infrastructure.</li><li>• Sustain and expand federal, state and local grid-scale renewable energy incentives.</li></ul>

# EBE-6: GHG reductions - stand alone (MMT CO2e)



## **EBE-6: Achieve targeted reductions in power sector emissions**

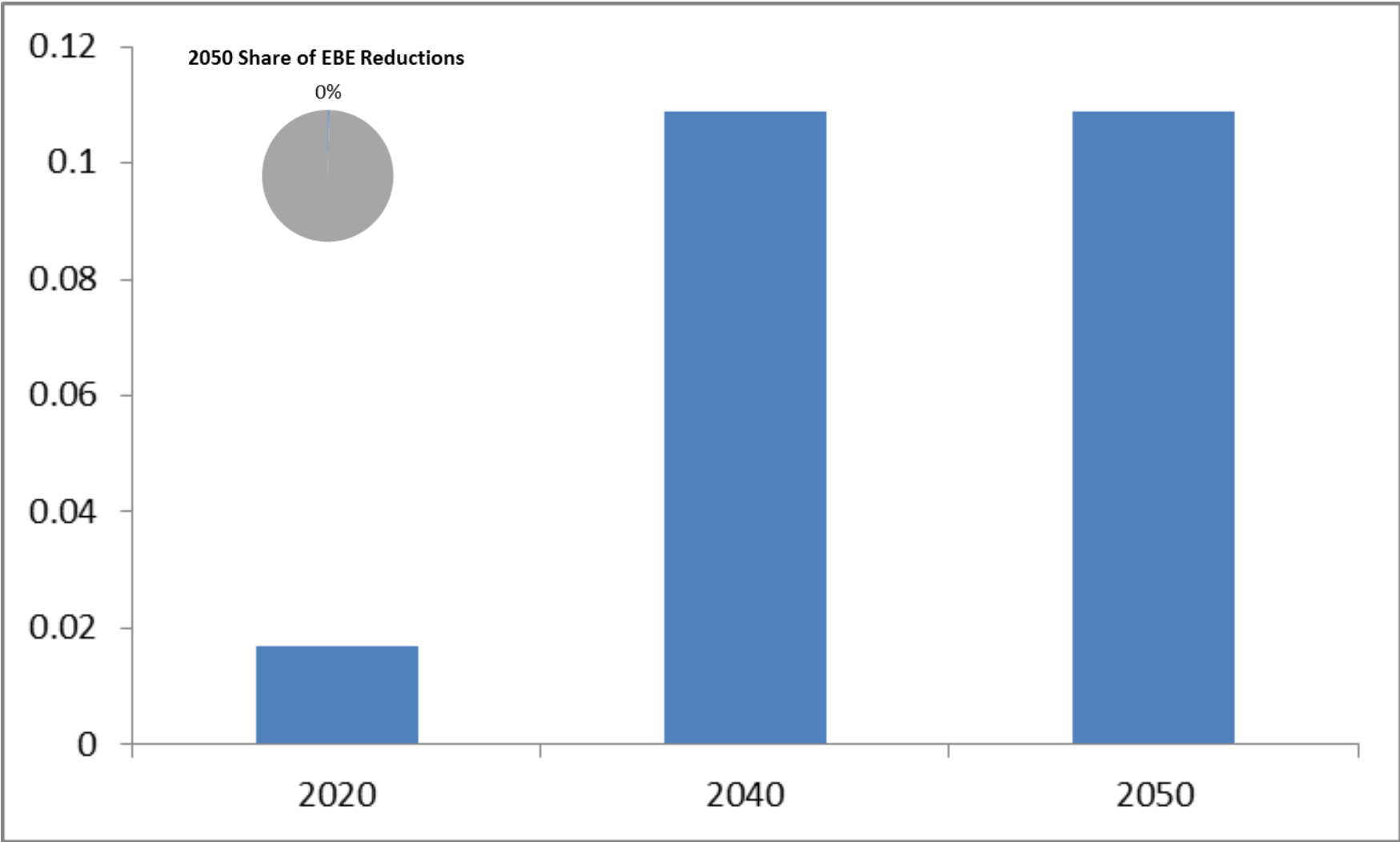
- **EBE-6 represents the entire power supply side of the energy system**
- **The power sector that supplies the greater DC region embraces a much larger geographic area and set of policy jurisdictions; the great majority of electricity usage is imported**
- **EBE-6 analysis based on a scenario target of 30% reduction in total CO2 emissions by 2030; we analyzed two specific actions:**
  - A new 950-MW nuclear unit added by 2030 (e.g., Calvert Cliffs or North Anna)
  - The region's three coal plants retired by 2030
- **These actions came to 10 MMT, which is above the 9 MMT that a 30% reduction in total mass emissions from 2012 would achieve**
- **We analyzed the working group's recommendations—but there are other ways to get to this impact: more renewables, more natural gas, etc.**



# EBE-7: Achieve targeted reductions in reduce natural gas pipeline emissions

Strategy/Analysis Scenario	Policy and Program Actions
<p><b>Scenario:</b></p> <ul style="list-style-type: none"><li>• <b>20% reduction in methane leaks from natural gas pipelines by 2030</b></li></ul>	<ul style="list-style-type: none"><li>• Support utility investments by encouraging utility commission action on cost recovery.</li></ul>

# EBE-7: GHG reductions - stand alone (MMT CO2e)



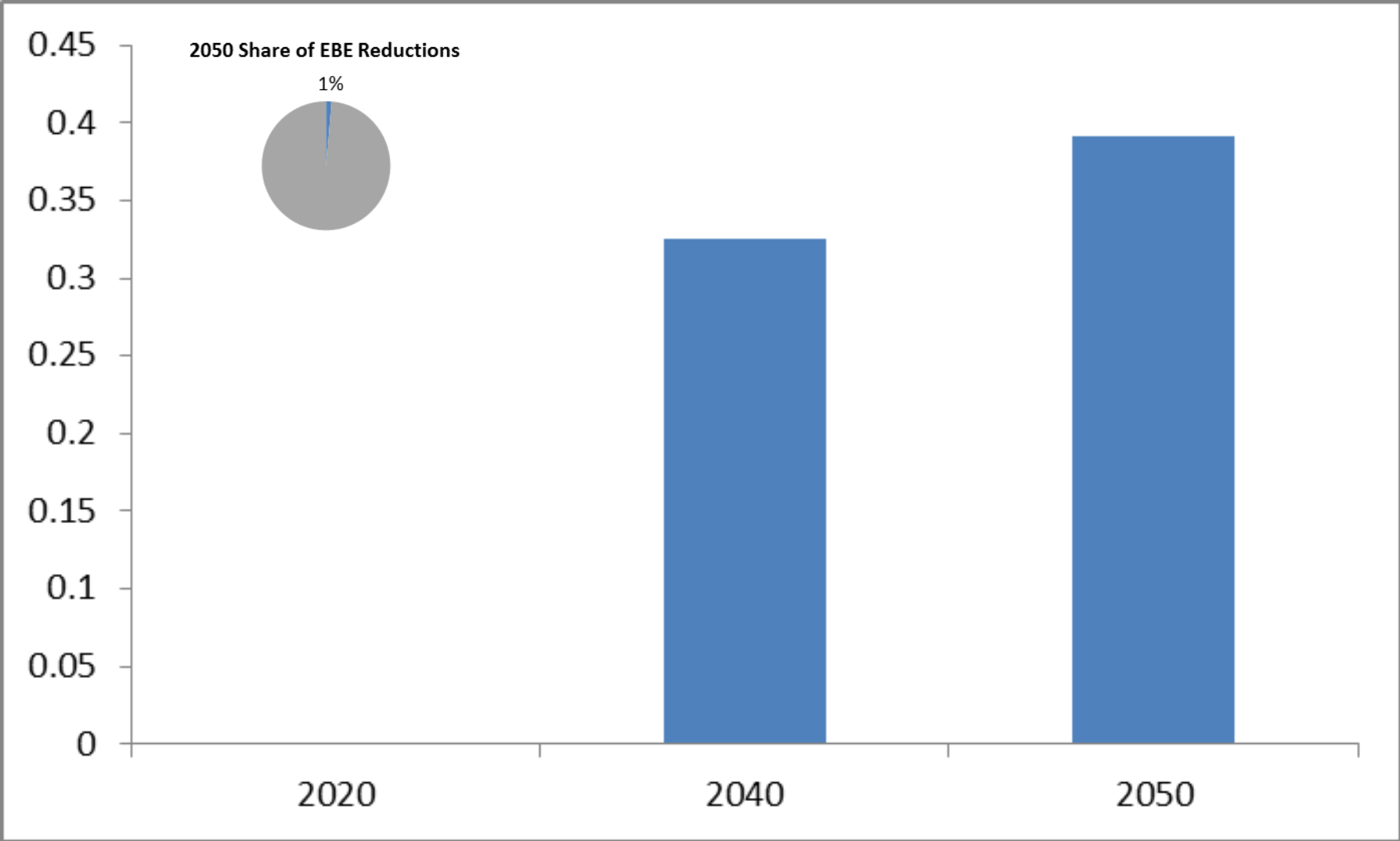
## **EBE-7: Achieve targeted reductions in reduce natural gas pipeline emissions**

- **Natural gas utility distribution pipeline system emits a certain amount of methane**
- **Methane is a potent GHG—more than 20x the per-unit impact of CO<sub>2</sub>**
- **EBE-7 analysis involved establishing a baseline emissions rate, and applying the scenario reduction target of 20% by 2030**
- **We examined data from WGL and other industry sources to establish the baseline leakage rate and total CO<sub>2</sub>e emissions, and have applied reductions to all WGL, BGE, and Columbia Gas pipeline infrastructure**
- **Leakage reduction is already underway; COG member actions involve supporting utility investments via regulatory proceedings**

## EBE-8: Achieve targeted reduction in municipal solid waste

Strategy/Analysis Scenario	Policy and Program Actions
<p>Scenario:</p> <ul style="list-style-type: none"><li>• Net Zero Waste by 2050</li></ul>	<ul style="list-style-type: none"><li>• Increase the recycling rate of the region to 75%.</li><li>• Increase reuse of construction/demolition waste by 15% by 2020 and 100% by 2050.</li><li>• Divert 100% of organic waste by 2040.</li><li>• Implement green purchasing and procurement programs.</li><li>• Increase use of waste to energy plants, including landfill gas projects.</li></ul>

# EBE-8: GHG reductions - stand alone (MMT CO2e)



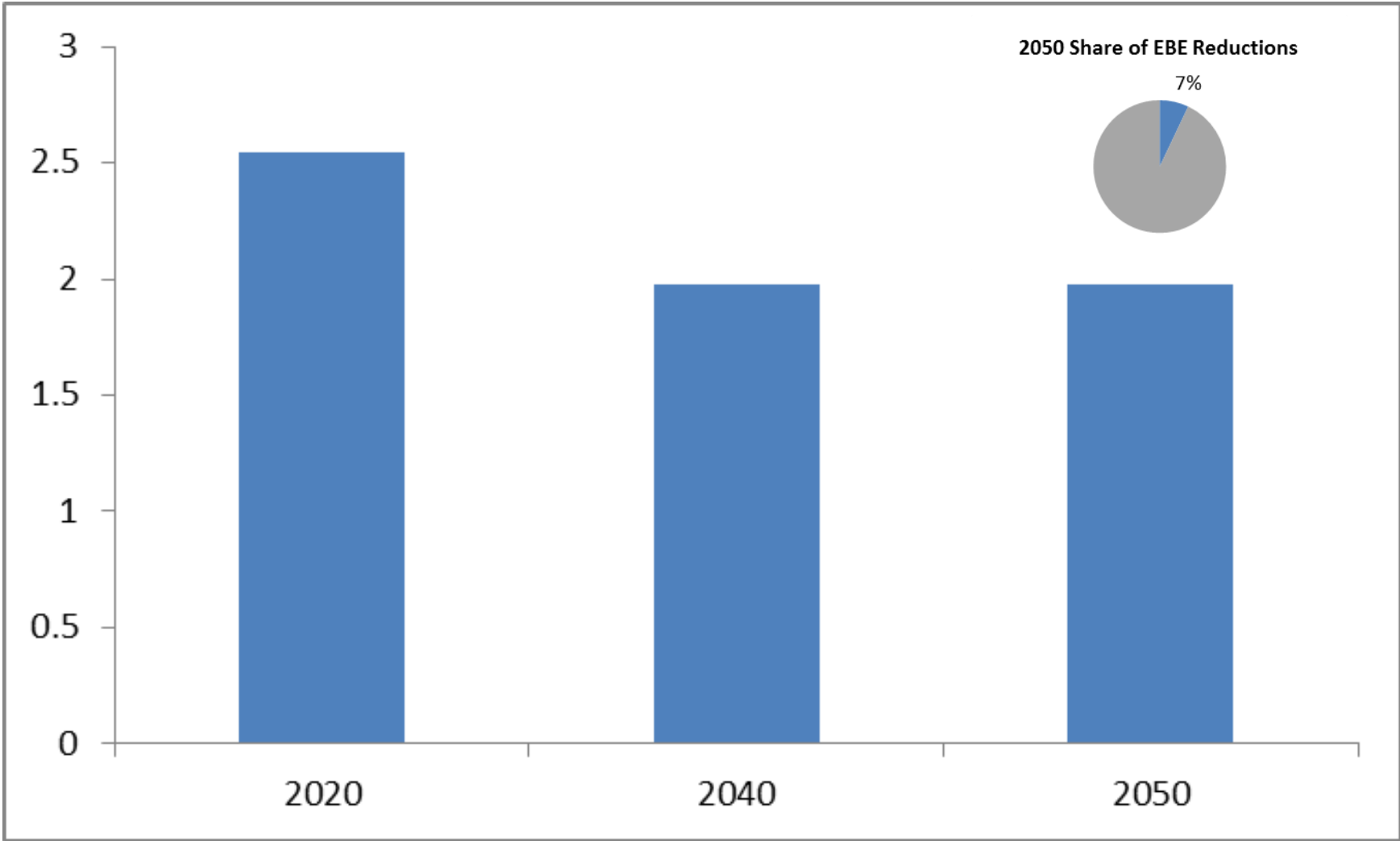
## EBE-8: Achieve targeted reduction in municipal solid waste

- **EBE-8 scenario target is simple: Net Zero Waste by 2050**
- **COG staff provided extensive data on baseline usage, recycling, incineration, and other data by jurisdiction**
- **We used the WARM and SMART models to develop the CO2e impacts from EBE-8**
- **COG member actions will have very strong influence on EBE-8 implementation:**
  - Increase the recycling rate of the region to 75%, via waste collection fees and other policies.
  - Increase reuse of construction /demolition waste by 15% by 2020 and 100% by 2050 via tipping fees, builder incentives, and similar measures.
  - Divert 100% of organic waste by 2040 via tipping fees, waste collection fees.
  - Implement green purchasing and procurement programs via government agency and private sector commitments.
  - Increase use of waste to energy plants, including landfill gas projects.

## EBE-9: Reduce emissions from non-road engines

Strategy/Analysis Scenario	Policy and Program Actions
<p><b>Scenario:</b></p> <ul style="list-style-type: none"><li>• <b>2% annual, 30% cumulative reduction in greenhouse gas emissions from non-road sources by 2030</b></li></ul>	<ul style="list-style-type: none"><li>• Increase market penetration of energy efficient alternatives for non-road engines including back-up generators, construction equipment, agriculture, lawn and garden equipment, construction equipment, commercial and industrial equipment, and recreational equipment, as listed in the MWCOG Gold Book.</li></ul>

# EBE-9: GHG reductions - stand alone (MMT CO2e)





## **EBE-9: Reduce emissions from non-road engines**

- **The EBE-9 scenario target is also simple: 2% annual reduction, with a 30% cumulative reduction by 2030**
- **COG staff provided extensive data on non-road engine emissions for baseline purposes**
- **ICF applied the scenario target calculation to BAU emissions**
- **Specific actions to achieve scenario target are TBD, but could include:**
  - Engine efficiency improvements
  - Fuel carbon content reduction
  - Beneficial electrification
- **This strategy shows potential large impacts, but a technical path to get there has not been specifically demonstrated**

## EBE-10: Educate and motivate public through community engagement

Strategy/Analysis Scenario	Policy and Program Actions
<b>Move education to action - Create measurable results through community energy engagement.</b>	<ul style="list-style-type: none"><li>• Educate on benefits and costs of clean energy technologies and behaviors.</li><li>• Increase motivation through incentives and other measures, linked to utility customer education and information services.</li><li>• Use utility advanced metering data to monitor and influence behavior.</li><li>• Create a culture of responsibility via school curricula and public information campaigns.</li><li>• Encourage employee behavior change to increase teleworking and commuting by public transportation.</li></ul>

## EBE-10: Educate and motivate public through community engagement

- **Results from EBE-10 are subsumed in other strategies. For example:**
  - Utility metering-based feedback and education efforts are captured under EBE-1.
  - While some data exists on the short-term effects of education/behavior change efforts, there is a lack of long-term quantification methods for measuring such effects.
  - Experience suggests that education and information campaigns are essential enabling elements of effective GHG reduction policy strategies.
- **Education and engagement are essential enabling efforts for most of the other strategies; COG member actions could include:**
  - Educate on benefits and costs of clean energy technologies and behaviors, via school curricula and public information campaigns
  - Increase motivation through incentives and other measures, linked to utility customer education and information services
  - Use utility advanced metering data to monitor and influence behavior
  - Create a culture of responsibility via school curricula and public information campaigns
  - Encourage employee behavior change to increase teleworking and commuting by public transportation through actions such as the “Commuter Connections” program

## GHG Reduction strategies in Descending Order of GHG Benefits in 2050

Strategy	Strategy Name	GHG Reductions (MMTCO <sub>2</sub> e)		
		2020	2040	2050
EBE-6	EBE-6: Achieve targeted reductions in power sector emissions	2.19	10.04	10.04
EBE-1	EBE-1: Achieve annual and cumulative reductions in energy and water consumption in existing buildings	2.00	9.36	9.36
EBE-4	EBE-4: Improve new building energy and water efficiency performance	0.80	3.93	6.20
EBE-2	EBE-2: Support existing building-level renewable energy development	0.73	1.82	2.72
TLU-3	TLU-3: Improve Fuel Economy of Light-duty Vehicle Fleet	0.22	1.23	2.14
EBE-9	EBE-9: Reduce emissions from non-road engines	2.55	1.98	1.98
TLU-2	TLU-2: Sustainable Development Patterns & Urban Design (including Enhancements for Non-motorized Modes)	0.34	1.32	1.67
TLU-6	TLU-6: Low Carbon Fuel Standard	0	1.02	1.29
TLU-7	TLU-7: Enhancing system operations	0.34	0.56	0.85
TLU-12	TLU-12: Road Pricing	0	0.03	0.79
TLU-1	TLU-1: Increase urban tree canopy and land stewardship	0.10	0.50	0.54
TLU-9	TLU-9: Travel Demand Management	0.13	0.24	0.54
EBE-3	EBE-3: Encourage development in activity centers	0	0.07	0.39
EBE-8	EBE-8: Achieve targeted reduction in municipal solid waste	0	0.33	0.39
EBE-5	EBE-5: Achieve annual and cumulative reductions in fossil energy use by improving Infrastructure efficiency and increasing renewable energy use	0.034	0.20	0.28
TLU-11	TLU-11: Transit Incentives / Fare Reductions	0.122	0.10	0.19
EBE-7	EBE-7: Achieve targeted reductions in reduce natural gas pipeline leaks	0.017	0.11	0.11
TLU-4	TLU-4: Increase Alternative Fuels in Public Sector Fleets	0.007	0.05	0.09
TLU-10	TLU-10: Transit Enhancements	0.056	0.06	0.08
TLU-8	TLU-8: Reduce Speeding on Freeways	0.005	0.01	0.006
TLU-5	TLU-5: Clean Freight Technologies	0.0004	0.002	0.006