Where Will Electric Energy Efficiency Program Savings Come From in the Next Decade?

A Scenario Analysis

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ENERGY STAR Products Partner Meeting
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Study Objectives

- Identify key opportunities for electric energy efficiency programs over the coming decade based on:
  - Technologies
  - Program delivery models
  - Cost-effectiveness test reform
- Understand magnitude of portfolio-wide savings available under various scenarios and inform EPA recommendations on ENERGY STAR measures and best practices

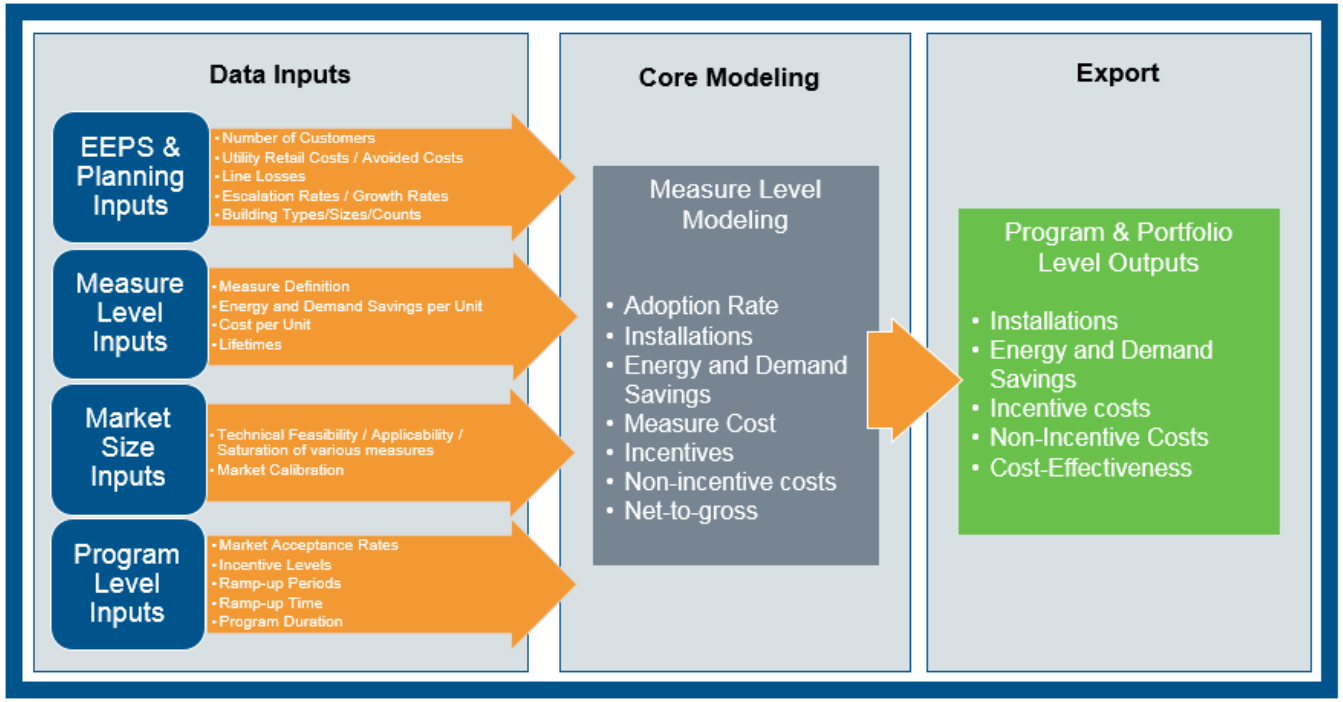
Questions Explored

- If programs are to achieve the same level of savings in the future, how important are midstream program designs? How important is benefit-cost test reform?
- If benefit-cost frameworks are reformed what happens to savings, costs, and cost effectiveness?

Approach

Study Overview

- Base year: 2018
- Forecast period: 2019-2028
- Focus is **achievable potential**
- Fuels modeled: Electricity
- Model utilized: ICF's Energy Efficiency Potential Model (EEPM)



EE Potential Model Framework:

- Includes EEPS input module; stock turnover module; program modeling at measure level
- Weather handled outside of the model, and input into the model through the measure savings

Model Inputs Informed by Market Leaders

- Gathered the following input to inform scenarios and program modeling (6 EEPS per climate region as well ICF internal experts):
  - How portfolio savings levels are likely to change and why
  - What measure types will grow/diminish in importance and by how much
  - Current and future role of midstream program design
  - Current and future benefit-cost frameworks

Residential and Commercial Sector Models

Cooler climate models

- Based on an energy efficiency program in heating-driven climate in Northern half of United States
- Modeling assumptions:
  - Programs continuous for a decade or more & sponsors meeting annual savings goals of 1.5% of system sales
  - Eligible stock for efficiency measures shrinking, baselines becoming more stringent, marginal cost of savings increasing

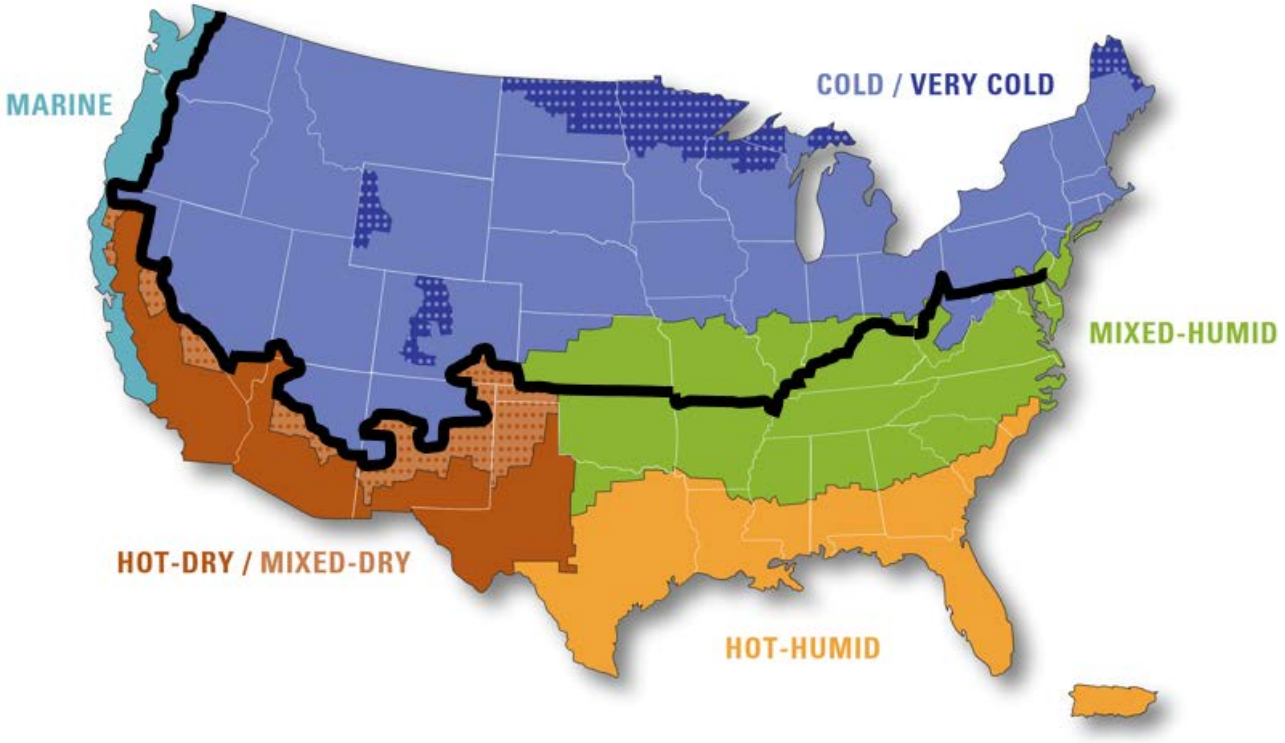
Warmer climate models

- Based on an energy efficiency program in cooling-driven climate in Southern half of United States
- Modeling assumptions:
  - Programs less mature for much of region; program sponsors assume to have annual savings targets = 1.5% of system sales
  - Lower market penetration across all measures compared to cooler climate

Reality: regions are mixed with individual states having more or less program maturity than their modeling region!

Warmer and Cooler Regions Defined

- The Warmer Climate model includes the entire population of the South census region, as well as marine and hot-dry/mixed-dry climate zones of the West census region.
- The Cooler Climate model includes the entire population of all remaining regions.



⇧ Above the line – Cooler Model Region

⇩ Below the line – Warmer Model Region

Model	Degree days used to model weather sensitive measures (65° F baseline)	
	Cooling Degree Days	Heating Degree Days
Warmer Climate	2,020	2,456
Cooler Climate	844	5,974

Scenarios Modeled

Variable/Scenario	Reference Case	Midstream Push	Midstream Push plus Benefit/Cost Reform (+BC Reform)
Annual EE resource standard	1.5% kWh sales	1.5% kWh sales	1.5% kWh sales
EE performance incentive/penalty	Incentive yes/penalty yes	Incentive yes/penalty yes	Incentive yes/penalty yes
EISA General Service Lamp (GSL) backstop provision status	GSL backstop implemented	GSL backstop implemented	GSL backstop implemented
Midstream programs include	Light bulbs	All prescriptive equipment moved to Midstream	All prescriptive equipment moved to Midstream
Primary BC test	TRC	TRC	Societal
Discount rate	6%	6%	3%
Measure BC ratio threshold	≥ 1.25	≥ 1.25	≥ 0.75**
Other benefits captured (avoided cost adder)	0%	0%	+25%
AMI meter penetration	100%	100%	100%
Program incentive levels (% of measure incremental costs)	50%-100%	50%-100%	50%-100%

Text in red indicates difference between scenario and reference case

**In this scenario, individual measures are allowed to be less cost effective so long as the BC ratio is ≥ to 1 at the portfolio level

Programs Modeled

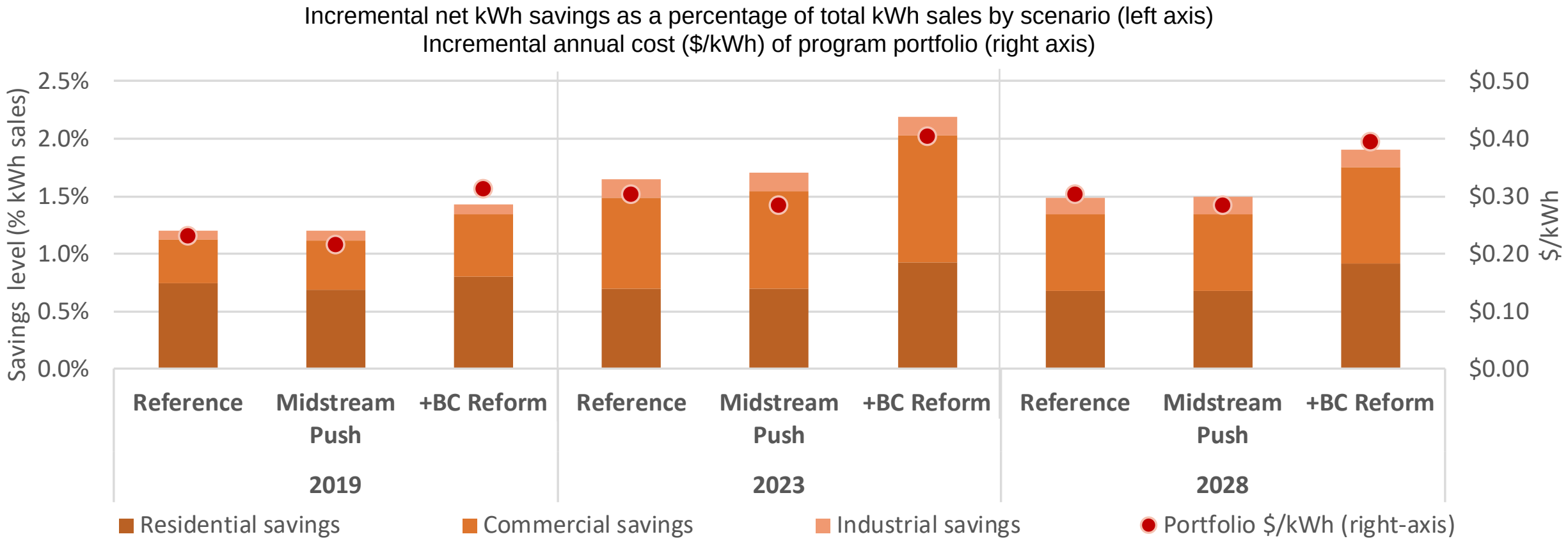
Residential	C&I
• Prescriptive Appliances & Electronics • ENERGY STAR New Homes • HVAC and Tune-Up • Appliance Recycling • Home Audit and Retrofit • Low-Income Weatherization • Residential Behavior • Midstream Lighting • Midstream Non-Lighting • Smart Thermostat	• Commercial--Prescriptive & Custom • Small Business Solutions • Retro-commissioning (RCx) • Midstream Lighting • Midstream Non-Lighting • Commercial New Construction • Industrial Systems • Industrial Facility • Industrial Strategic Energy Management

Study is conservative:

- Does not include CVR/VVO, as only behind the meter measures are considered
- Does not include emerging technologies
- Does not explore implications of electrification of transportation or other end uses

Portfolio-Level Findings

Achievable Portfolio Potential in 2019, 2023 and 2028 – Warmer Climate



Savings levels of 1.9% of kWh sales are achievable in 2028 with combined +BC reform and midstream push

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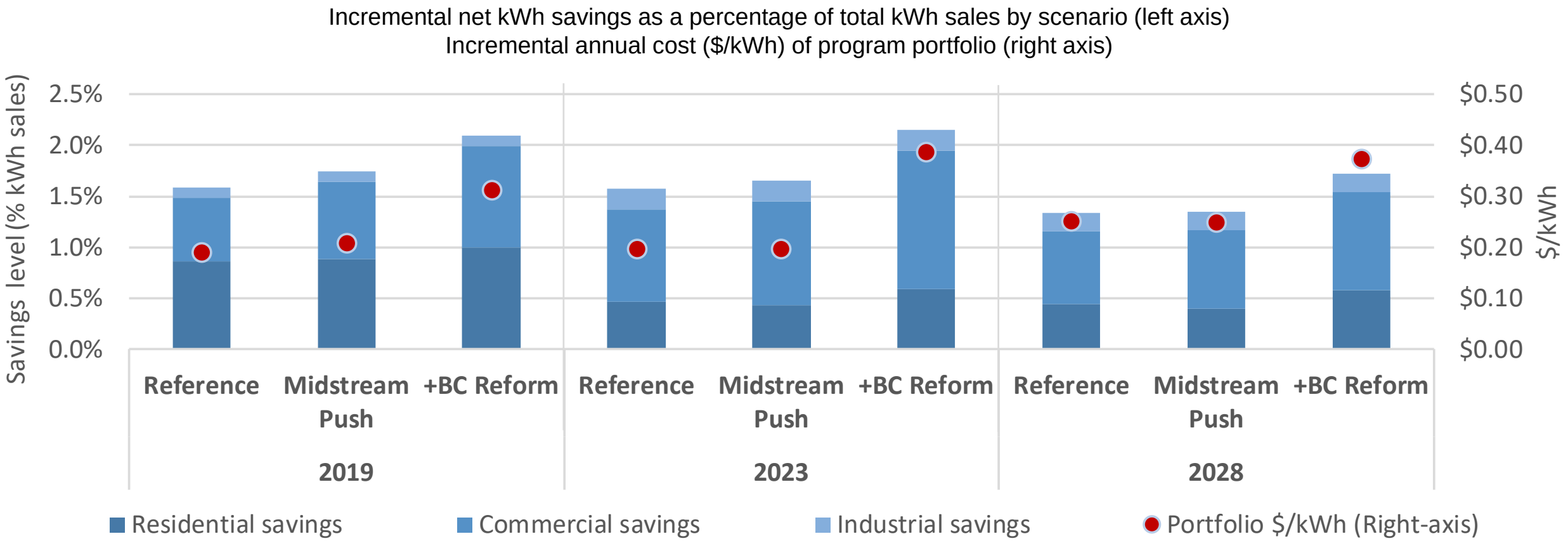


Savings levels of 1.7% of kWh sales are achievable in 2028 with combined BC reform and midstream push

Residential Findings

Residential Cost Effectiveness

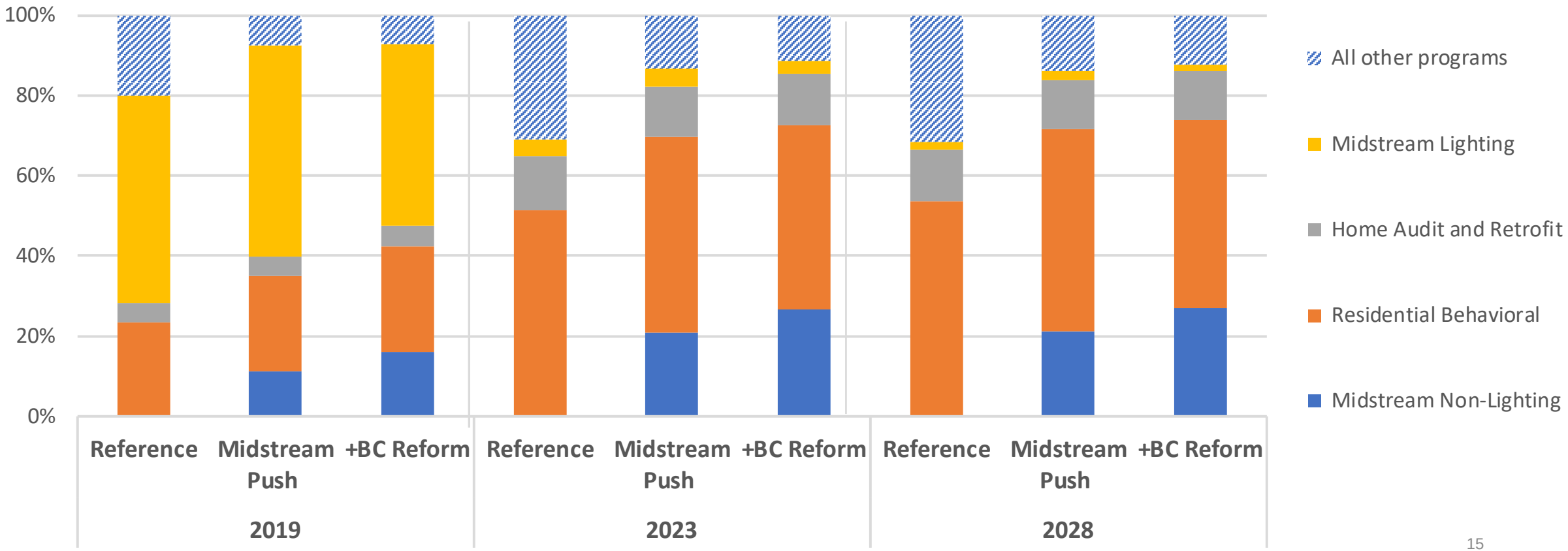
Scenario	Levelized Cost/kWh		Incremental Cost/kWh		TRC BC Ratio	
	Cooler	Warmer	Cooler	Warmer	Cooler	Warmer
Reference	$0.04	$0.06	$0.27	$0.32	1.6	1.1
Midstream Push	$0.03	$0.05	$0.27	$0.27	1.7	1.2
+BC Reform	$0.04	$0.06	$0.36	$0.37	1.8*	1.4*

Warmer climate model - In the +BC reform scenario, levelized costs are comparable to the reference case, while the benefit-cost ratio is 24% higher

Cooler climate model - In the +BC reform scenario, levelized costs are comparable to the reference case, incremental costs are a third higher, and the benefit-cost ratio increases from 1.6 to 1.8

Marginal Savings—Warmer Climate

Behavioral programs fill the lighting gap, followed by midstream non-lighting



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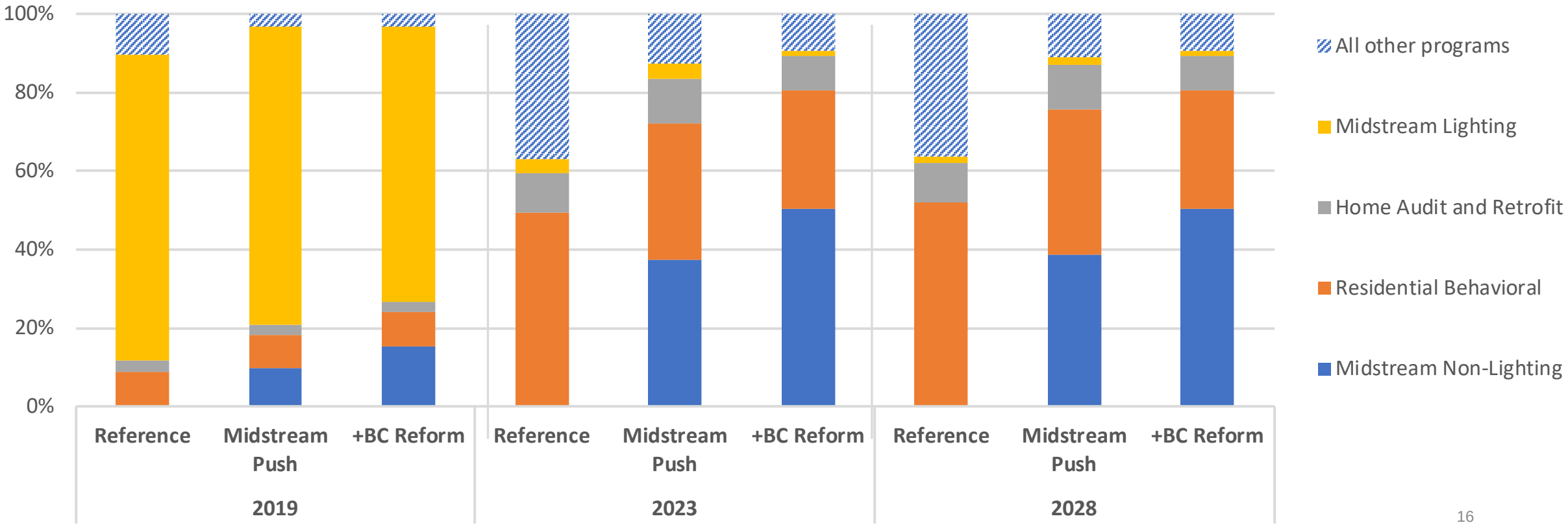
Midstream non-lighting becomes the easiest residential program to ramp up to meet goal in the +BC reform scenario

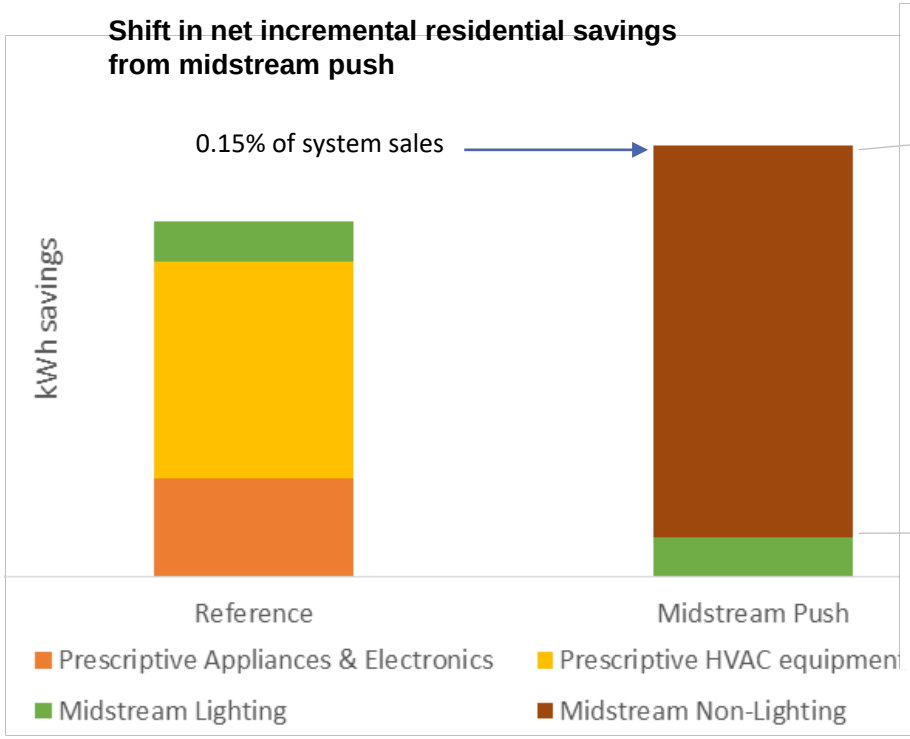


Which Measures Benefit the Most with a Shift to Midstream Program Design?

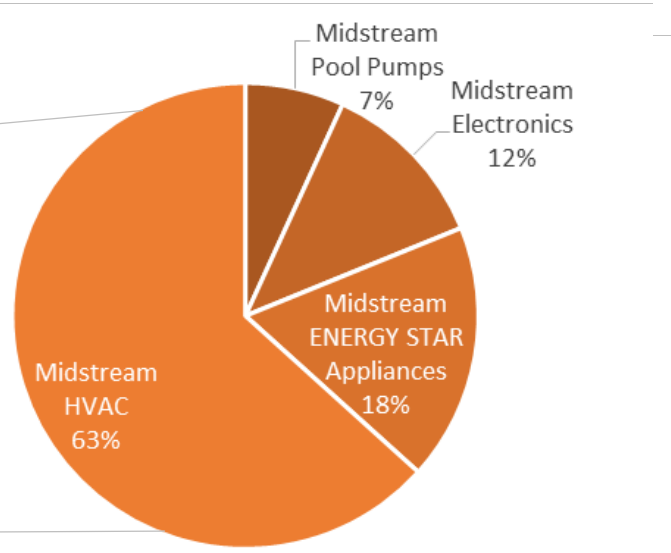
Midstream Push Scenario–Warmer Climate

Moving prescriptive (non-lighting) equipment midstream increases net savings on those measures by a quarter in 2028; gross savings increase by 40%

Shift in net incremental residential savings from midstream push



Distribution of net incremental residential savings for midstream non-lighting programs in 2028



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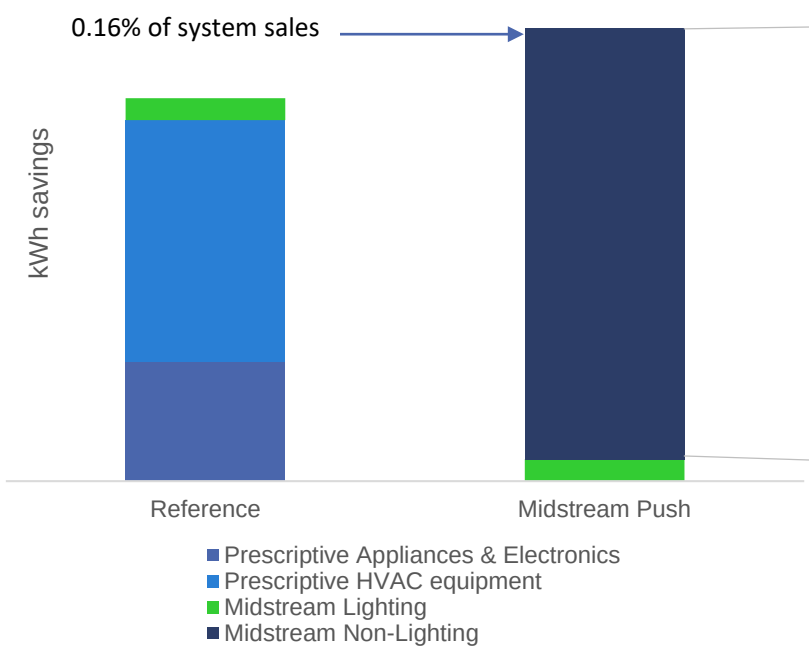

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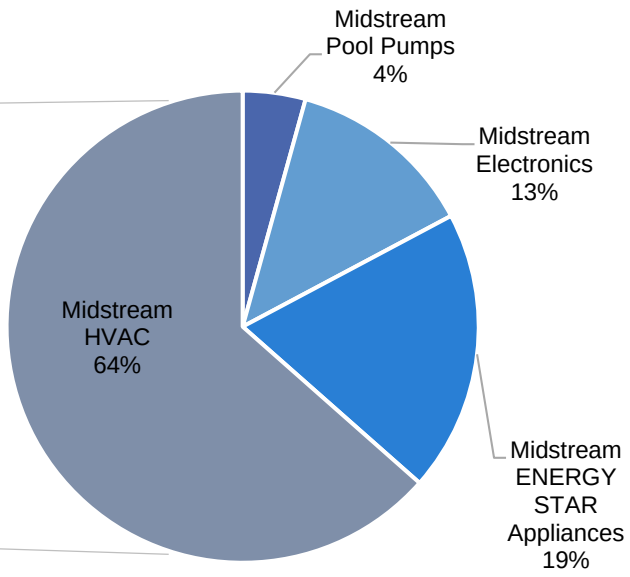
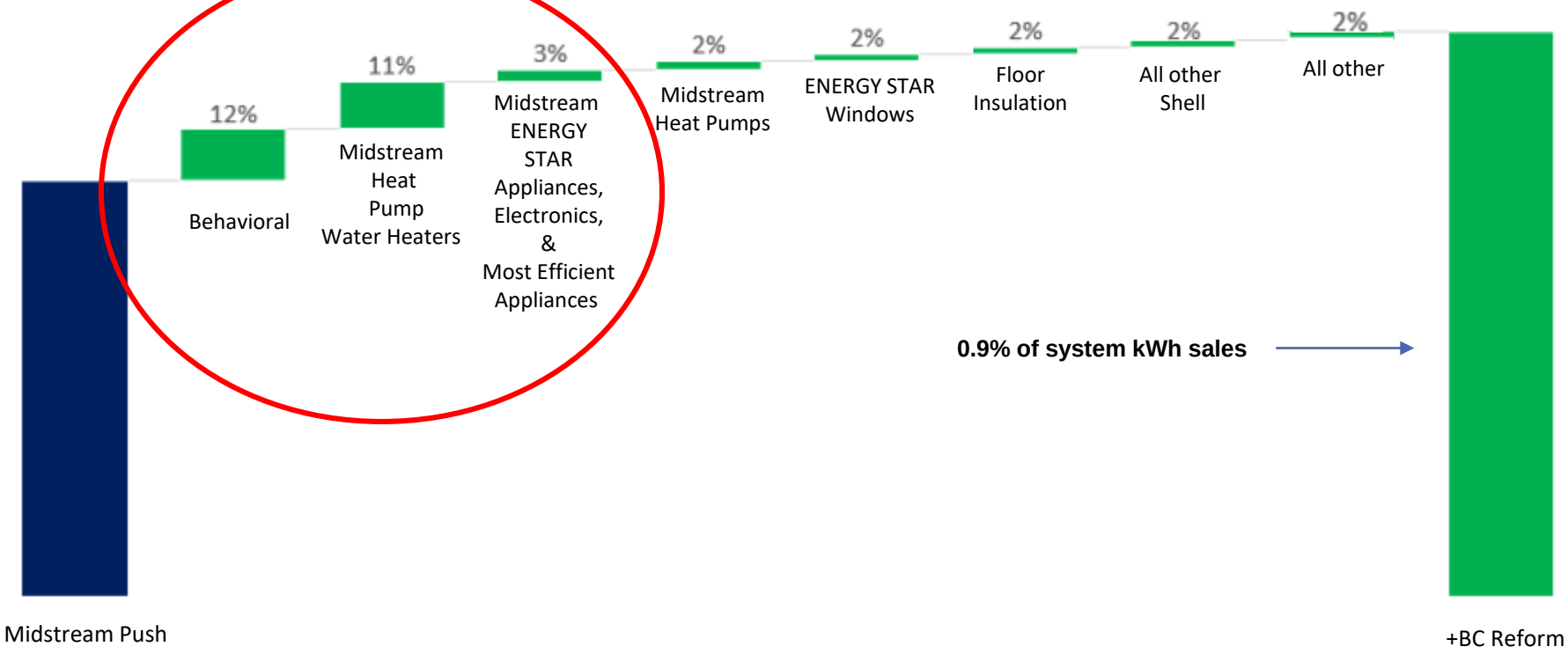


What Measures Benefit from the Addition of Benefit Cost Reform?

Benefit Cost Reform—Warmer Climate

Previously uneconomic applications in four programs add 36% to residential savings in the +BC reform scenario (compared to midstream push alone)

Decomposition of additional **net incremental residential** savings by program in the +BC Reform scenario in 2028



The +BC reform scenario builds on the midstream push scenario in that all prescriptive equipment measures are moved midstream before the benefit-cost framework is reformed.

Benefit Cost Reform—Cooler Climate

Heat pump water heaters deliver more than half of the 44% incremental savings gained in the +BC reform scenario (compared to midstream push alone)

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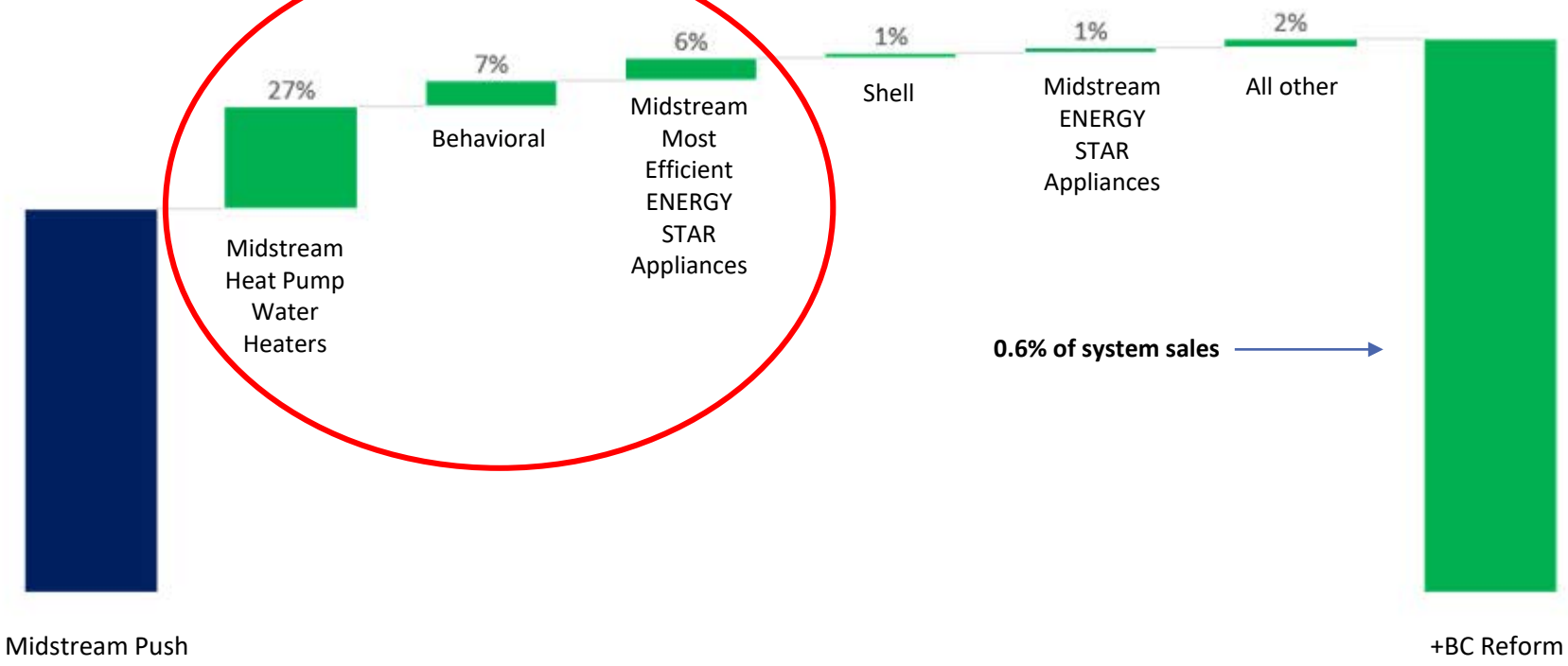

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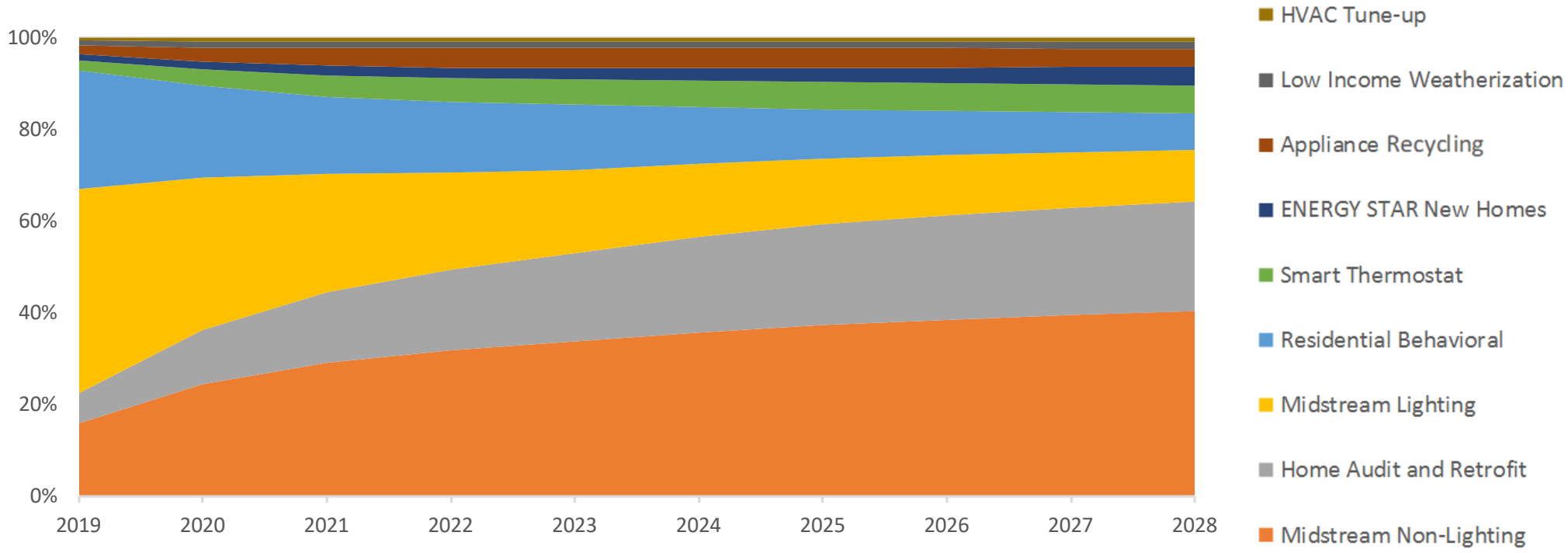
Long-Term Savings—Warmer Climate

Midstream non-lighting measures and home audit & retrofit carry long-term savings in the midstream push and +BC reform scenarios

Distribution of **net cumulative residential savings** in the +BC Reform scenario



Home retrofits account for a quarter of cumulative savings. Advances in program delivery – such as using load decomposition for virtual home audits – could drive down costs and increase savings for the Home Audit and Retrofit and other programs.

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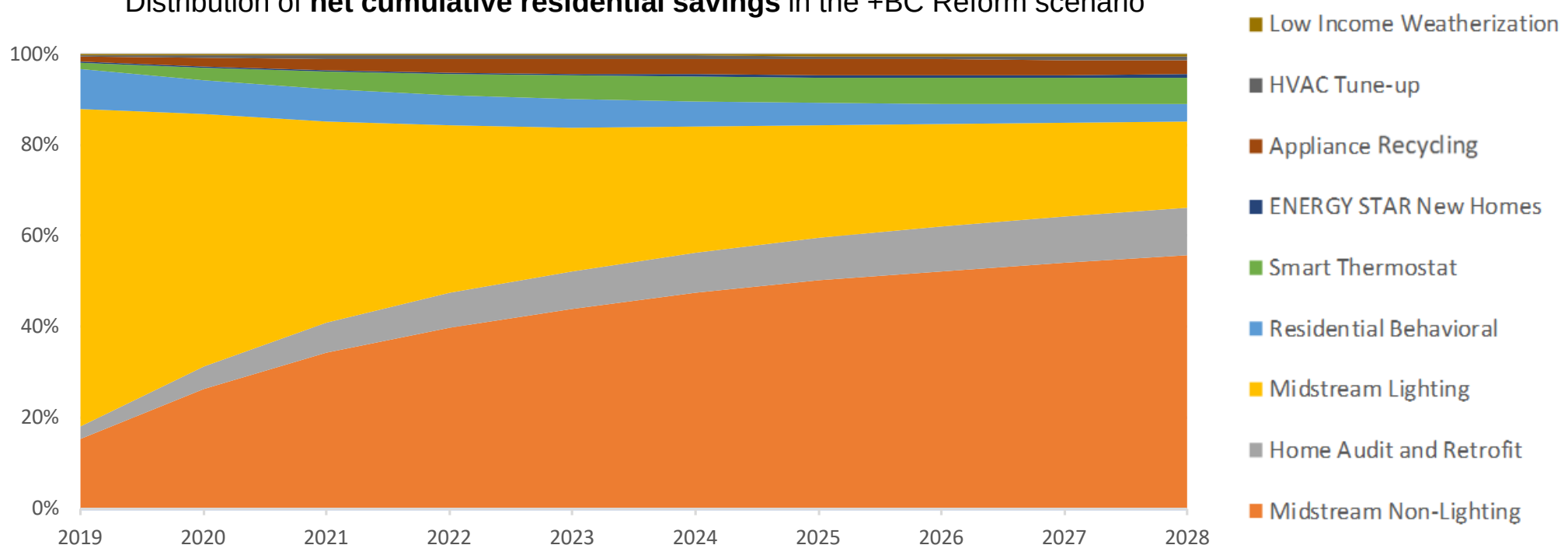

High market acceptance rates of LEDs and final push on GS LEDs in 2019 in Cooler climate model results high participation in Midstream Lighting in that year – assumed LED bulb life is 15 years. LED bulb life may be a big evaluation risk.

In Review

- There is potential to be had!
- Mid-stream program models can yield gains in cost-effectiveness
- +BC Reform could bring some key technologies into focus

Thank you!

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Appendix – Additional Slides for Partner Meeting

Portfolio Cost Effectiveness

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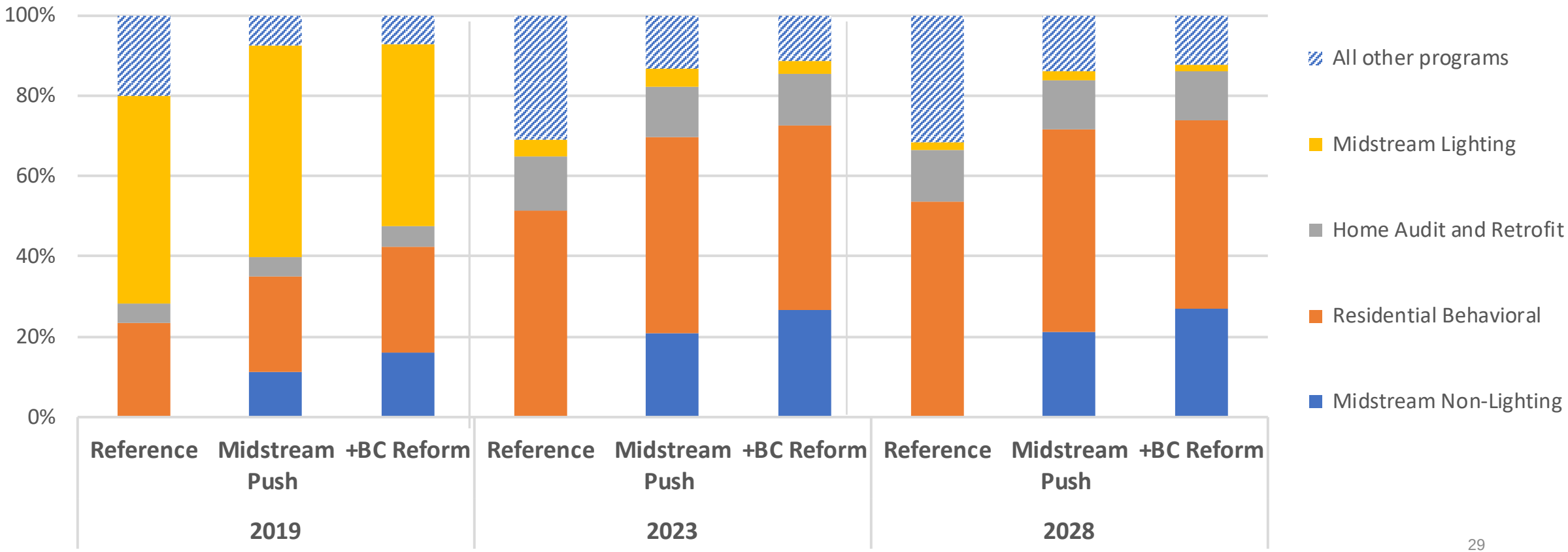

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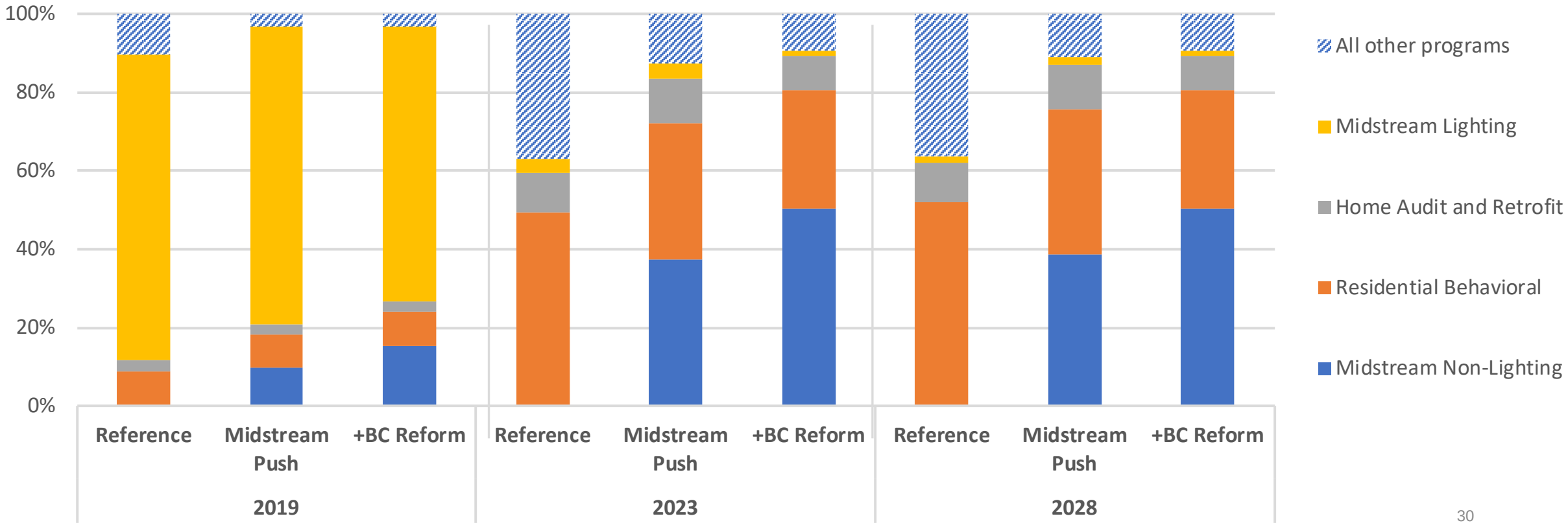
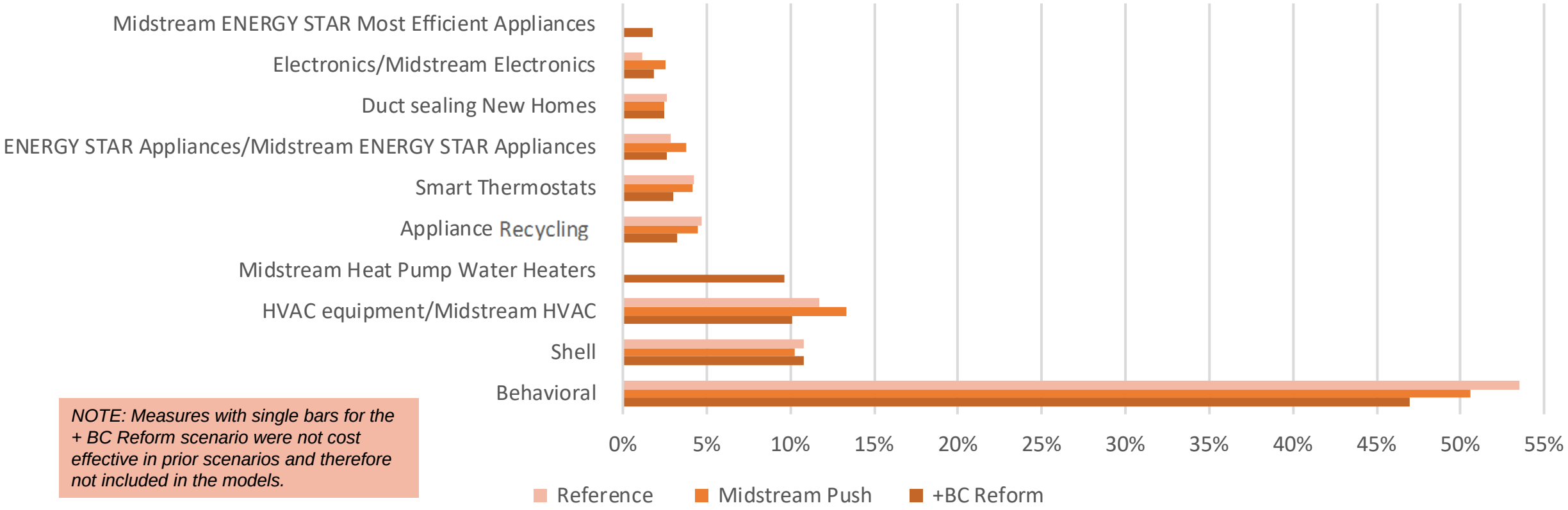


Top Measures—Warmer Climate (Residential)

Top measures in the reference, midstream push, and +BC reform scenarios

Share of **net incremental residential savings** in 2028 by measure type



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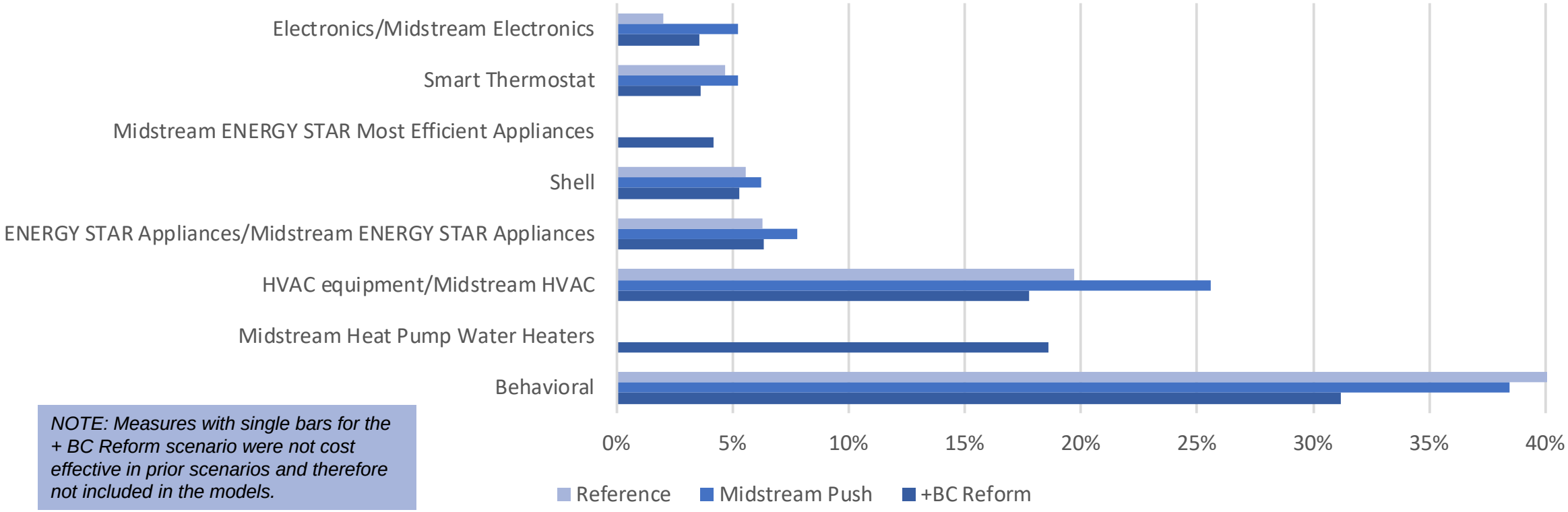

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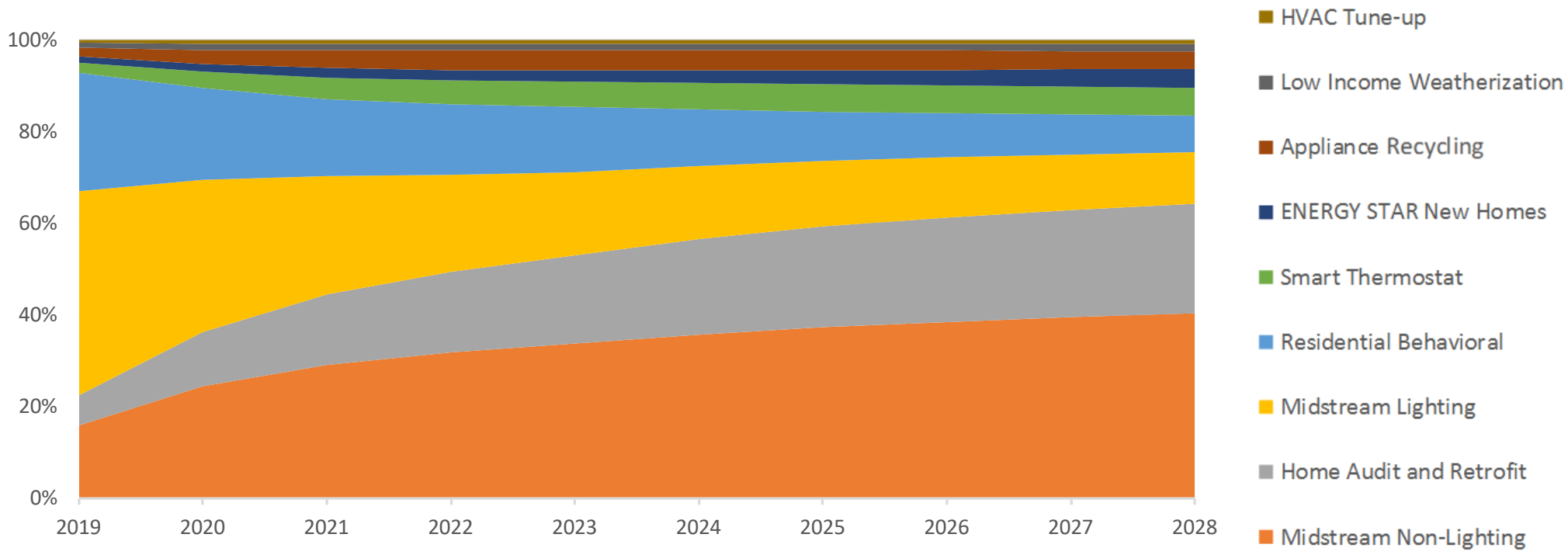

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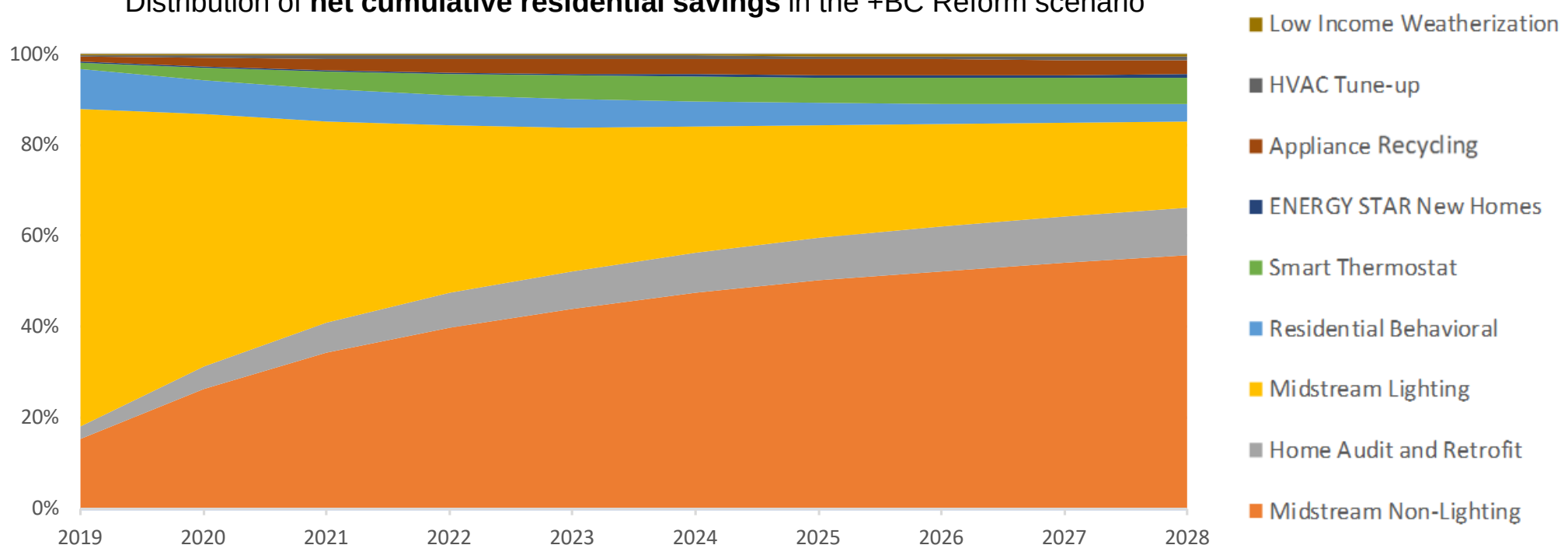

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