Behavior Change
at the Garrison Institute

Karen Ehrhardt-Martinez and Adam Meier

Climate, Cities and Behavior Symposium
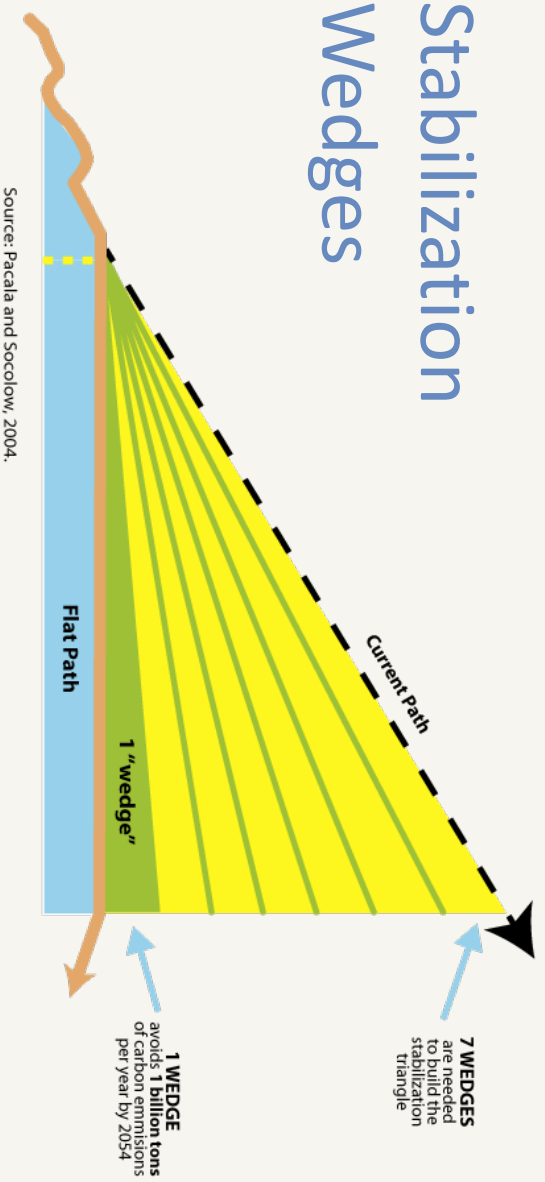
March 13-15, 2013

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A Slice of the Pie:

Profiling Behavioral Opportunities in Your City

Stabilization Wedges

Source: Pacala and Socolow, 2004.

Current Path

Flat Path

1 "wedge"

1 WEDGE
avoids **1 billion tons**
of carbon emmisions
per year by 2054

7 WEDGES
are needed
to build the
stabilization
triangle

Karen Ehrhardt-Martinez and Adam Meier
(In collaboration with USDN)
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National Behavior Wedge Research

	Dietz et al. (2009)	Laitner & Ehrhardt-Martinez (2009)	Gardner & Stern (2008)
Focus:	Carbon Emissions Savings	Energy Savings Opportunities	Energy Savings Opportunities
Scope:	17 Household Actions	110 HH Actions (Roughly)	27 HH Actions (Roughly)
Potential Savings: Residential Sector	20% (of HH Direct Emissions)	22%	30%
Potential Savings: National	7.4% (of National Emissions)	9%	11%
Period to Achieve Max. Annual Savings	10 years	5 to 8 years	N/A

Conservative estimates for Residential and Personal Transport only.

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Savings by Behavior Type

Action Type		Estimated Savings (% of sector emissions)
Invest.	Buy a more fuel efficient vehicle	13.5%
Low cost	Install and upgrade attic insulation and ventilation	Up to 7%
Beh.	Car pool to work with one other person	4.2%
Beh.	Replace 85% of all incandescent bulbs with cfls	4.0%
Beh.	Get frequent tune ups and air filter changes	3.9%
Beh.	Turn HH temperature down (heating) or up (cooling)	3.4%
Beh.	Alter driving practices (no jack rabbit starts, etc)	3.2%
Invest.	Install more efficient heating unit	2.9%
Invest.	Replace poor windows with high efficiency windows	2.8%
Beh.	Combine trips to ½ current mileage	2.7%
Beh.	Cut highway speed from 70 to 60 mph	2.4%
Invest.	Install more efficient AC unit	2.2%
	13 Other Actions	6.6%
	TOTAL potential savings (unadjusted)	58.8%
	TOTAL potential carbon savings (adjusted for HH eligibility and double counting of savings)	30%

[Results assume equipment is replaced at the end of old equipment's useful life.]
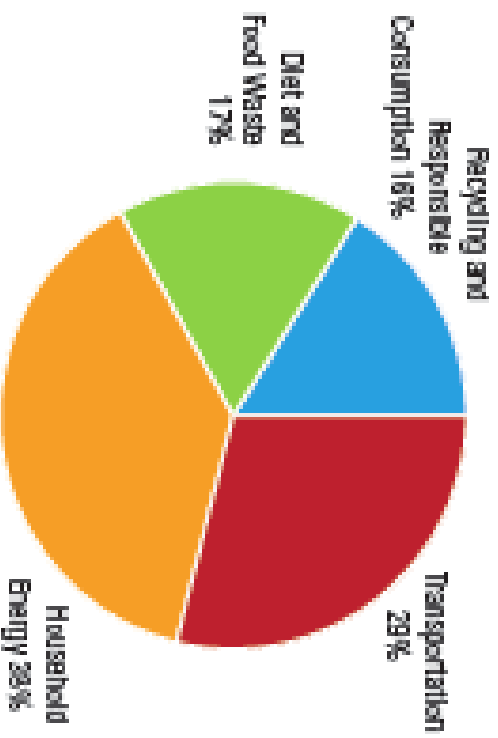Source: adapted from Gardner and Stern (2008)
27 Actions Reviewed

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More Comprehensive Assessment

Simple and Inexpensive Actions Could Reduce Global Warming Emissions by One Billion Tons

Figure 1: Where in Our Lives We Can Reduce Our Impact

Share of Total Reductions, by Sector

Recycling and Responsible Consumption 16%

Diet and Food Waste 17%

Household Energy 39%

Transportation 28%

The data in this pie chart are derived from the chart above.
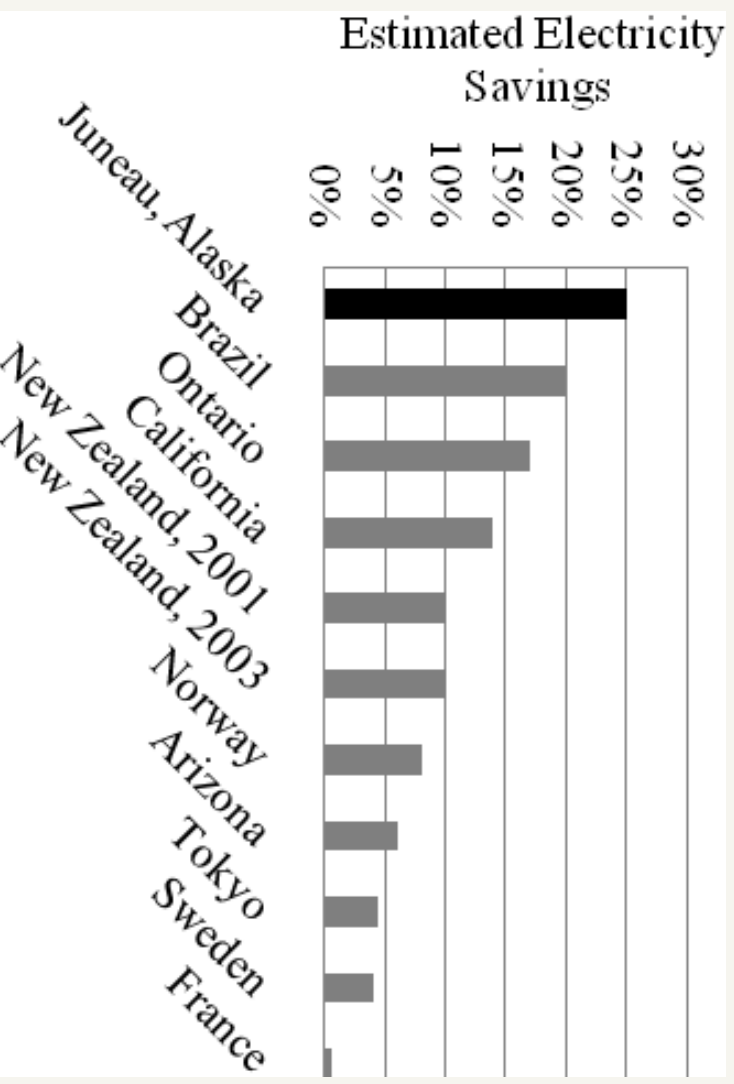
What Happens in Juneau, Alaska?

Immediate community-wide electricity savings of 25% and post-crisis savings of 8 to 10%.

2008 Avalanche

Source: Leighty and Meier 2010

Estimated electricity savings

Estimated Electricity Savings

Juneau, Alaska
Brazil
Ontario
California
New Zealand, 2001
New Zealand, 2003
Norway
Arizona
Tokyo
Sweden
France

0% 5% 10% 15% 20% 25% 30%

Residential Feedback

*Average Household Electricity Savings (4-12%)
by Feedback Type**

Potential Resource Savings:	20 to 35%

Enhanced Billing
Household-specific info, advice

3.8%

Estimated Feedback
Web-based energy audits with info on ongoing basis

6.8%

Daily/Weekly Feedback
Household-specific info, advise on daily or weekly basis

8.4%

Real-Time Feedback
Real-time premise level info

9.2%

Real-Time Plus Feedback
Real-time info down to the appliance level

12.0%

Real-Time Plus Feedback w/ Smart Program Design

"Indirect" Feedback (Provided after Consumption Occurs)

"Direct" Feedback (Provided Real Time)

Plus Smart Application of S.S. Insights

Behavioral Approach

Benefits:
- Large Savings Opportunities
- Relatively Inexpensive
- Relatively Fast Change

Questions:
- How to Create the Change?
- Where to Focus the Efforts?

Problem/Need:
- National-level studies aren't helpful.
- City-level Information about Behavioral Opportunities is needed.

Can We Create City-level Wedges?

Cities have suggested that a BWP could help them:

1. Document the scale of behavioral opportunities,
2. Identify specific behaviors with the most promise of resource savings for a particular city,
3. Evaluate the relative importance of behavioral initiatives as part of a larger, city-wide sustainability, climate, and/or energy initiative,
4. Write more effective funding proposals,
5. Make the case for pursuing behavior-based opportunities with team members, supervisors, partner organizations, city councils, and others,

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City-level Behavior Wedge Profiles:

What Cities Want and Need.

1. A low-cost approach:

2. A focus on achievable savings opportunities:

- (Eligibility) **x** (Likelihood of Participation) **x** (Range of Savings)
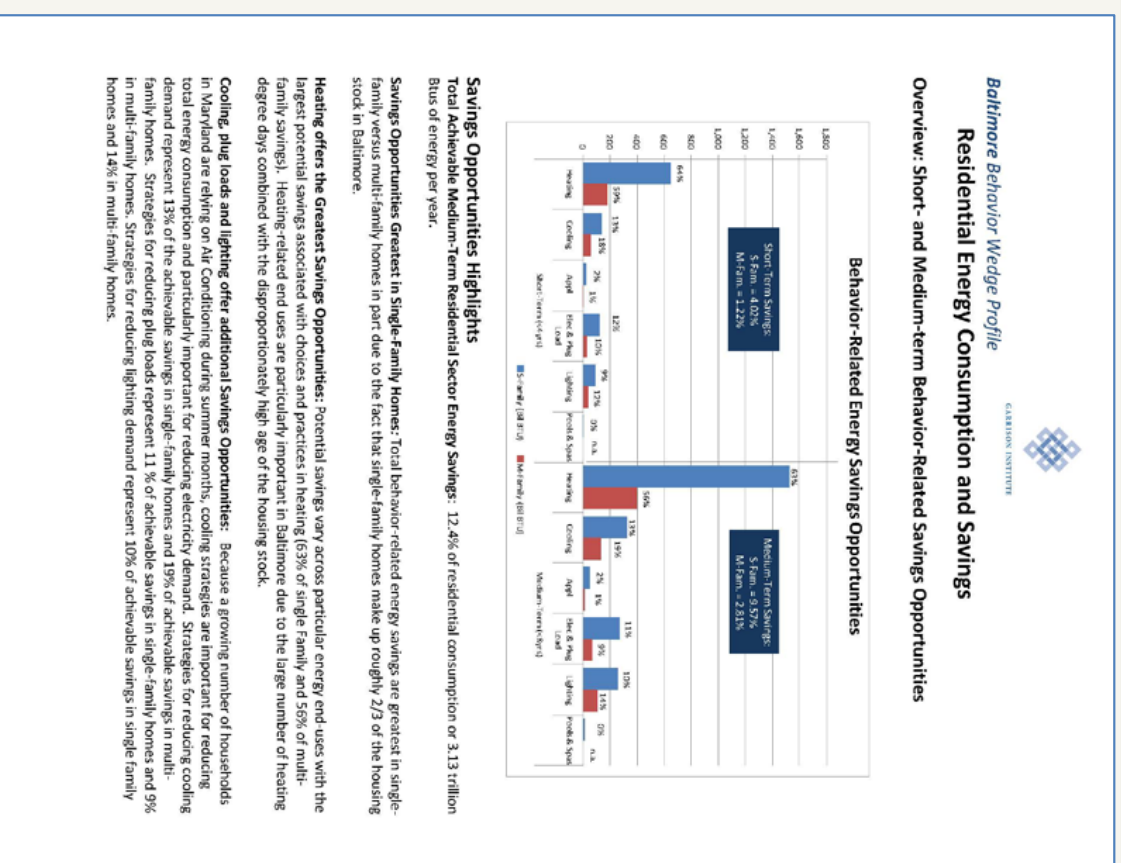
3. Targeting behavioral solutions:

Line-Drying
Versus
Dryer

The Sample Behavior Wedge Profile:
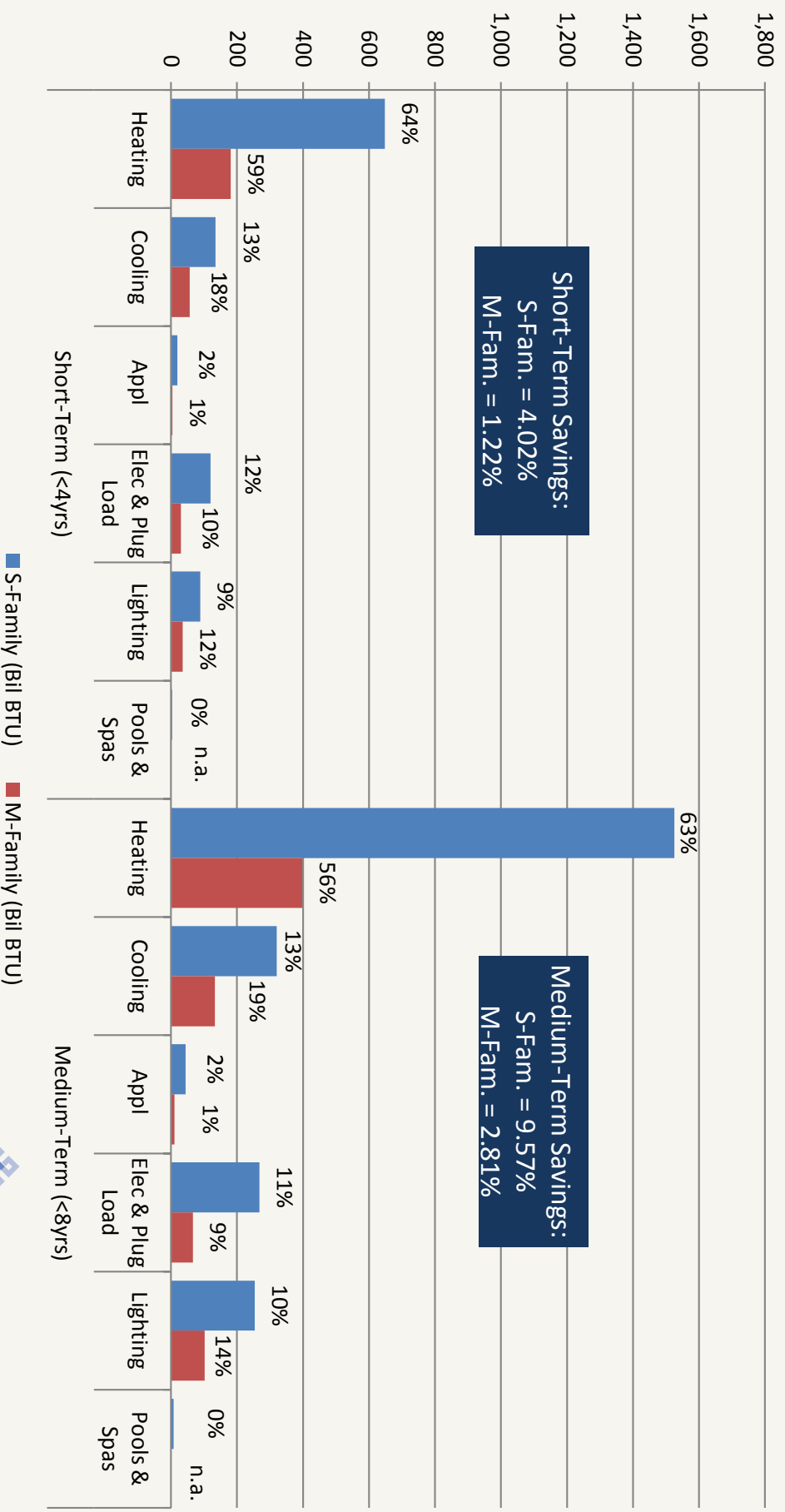
Residential Energy Sector – Baltimore, Maryland

Core Profile Components:

- Overview
- Top Ten Lists
- Opportunities by End-Use

Baltimore Behavior Wedge Profile

Residential Energy Consumption and Savings

Overview: Short- and Medium-term Behavior-Related Savings Opportunities

Behavior-Related Energy Savings Opportunities

Savings Opportunities Highlights
Total Achievable Medium-Term Residential Sector Energy Savings: 12.4% of residential consumption or 3.13 trillion Btus of energy per year.

Savings Opportunities Greatest in Single-Family Homes: Total behavior-related energy savings are greatest in single-family versus multi-family homes in part due to the fact that single-family homes make up roughly 2/3 of the housing stock in Baltimore.

Heating offers the Greatest Savings Opportunities: Potential savings vary across particular energy end-uses with the largest potential savings associated with choices and practices in heating (63% of single Family and 56% of multi-family savings). Heating-related end uses are particularly important in Baltimore due to the large number of heating degree days combined with the disproportionately high age of the housing stock.

Cooling, plug loads and lighting offer additional Savings Opportunities: Because a growing number of households in Maryland are relying on Air Conditioning during summer months, cooling strategies are important for reducing total energy consumption and particularly important for reducing electricity demand. Strategies for reducing cooling demand represent 13% of the achievable savings in single-family homes and 19% of achievable savings in multi-family homes. Strategies for reducing plug loads represent 11 % of achievable savings in single-family homes and 9% in multi-family homes. Strategies for reducing lighting demand represent 10% of achievable savings in single family homes and 14% in multi-family homes.

The Sample Behavior Wedge Profile:
Residential Energy Sector – Baltimore, Maryland

Overview of behavior-related energy savings opportunities

Short-Term Savings:
S-Fam. = 4.02%
M-Fam. = 1.22%

Medium-Term Savings:
S-Fam. = 9.57%
M-Fam. = 2.81%

Short-Term (<4yrs)

Medium-Term (<8yrs)

■ S-Family (Bil BTU) ■ M-Family (Bil BTU)

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The Sample Behavior Wedge Profile:
Residential Energy Sector – Baltimore, Maryland

Top Ten Strategies for Reducing Energy Consumption in *Single Family* Homes

	Savings
1 Heating & Cooling: Setbacks and programmable thermostats	3.20%
2 Heating: Furnace maintenance	1.84%
3 Heating: Reduce wasteful heating practices	1.72%
4 Plug load: Plug Load management	1.09%
5 Heating & Cooling: Weatherization	1.06%
6 Lighting: CFL bulb replacement	0.89%
7 Heating: Accelerated furnace replacement	0.67%
8 Cooling: AC maintenance	0.43%
9 Electronics: Accelerated replacement of desktops with laptops	0.26%
10 Cooling: Alternative technologies and reductions in solar heat gain	0.20%
Total Achievable Savings	**11.36%**

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The Sample Behavior Wedge Profile:
Residential Energy Sector – Baltimore, Maryland

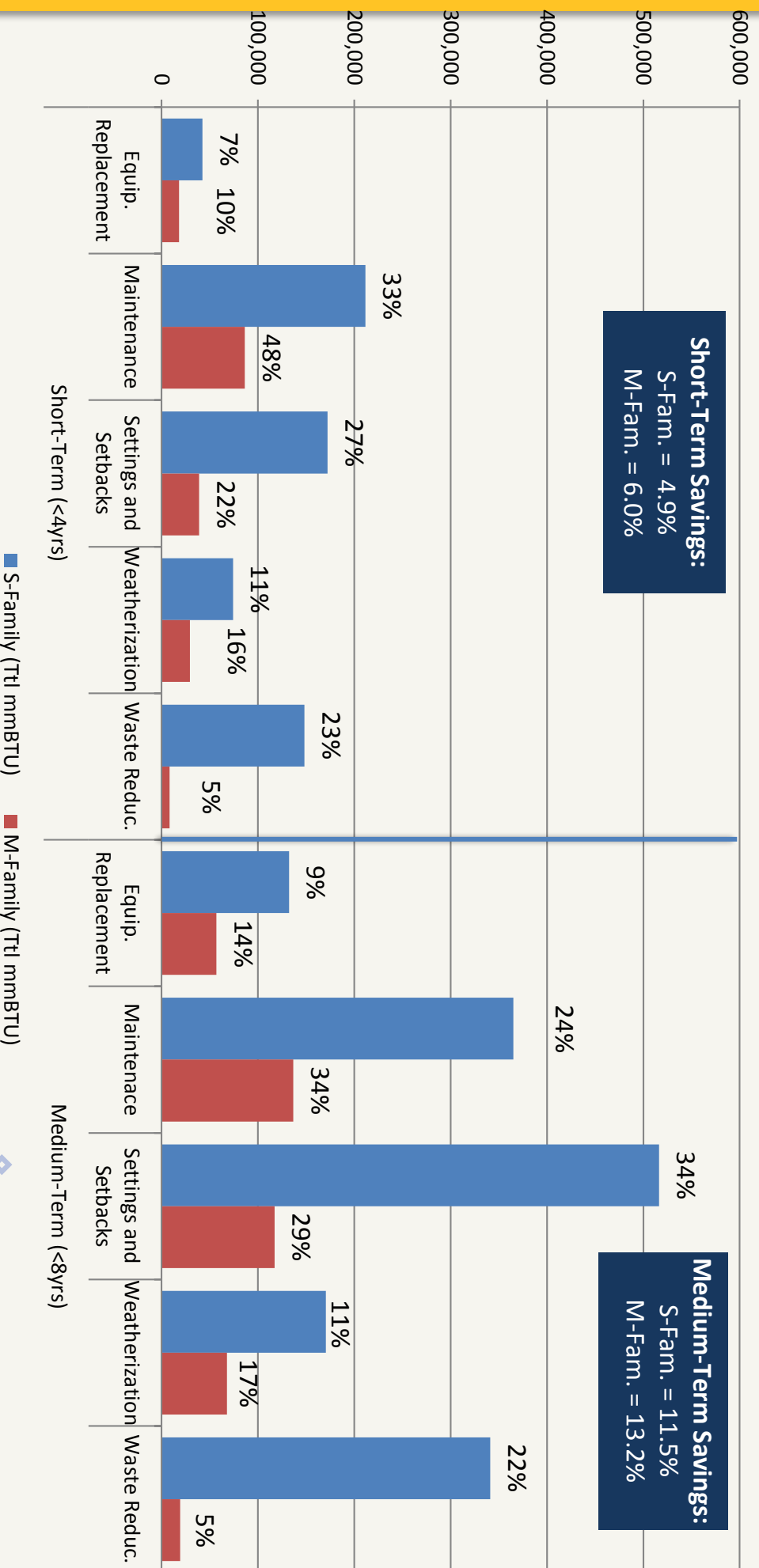**End-Use Categories and Target Behaviors**

Heating and Cooling
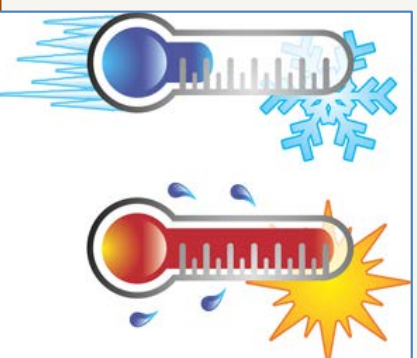
Plug Load & Electronics

Appliances
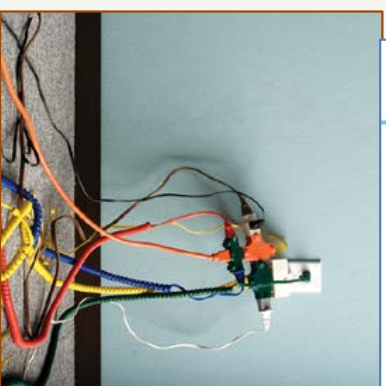
Lighting (Pools And Spas)

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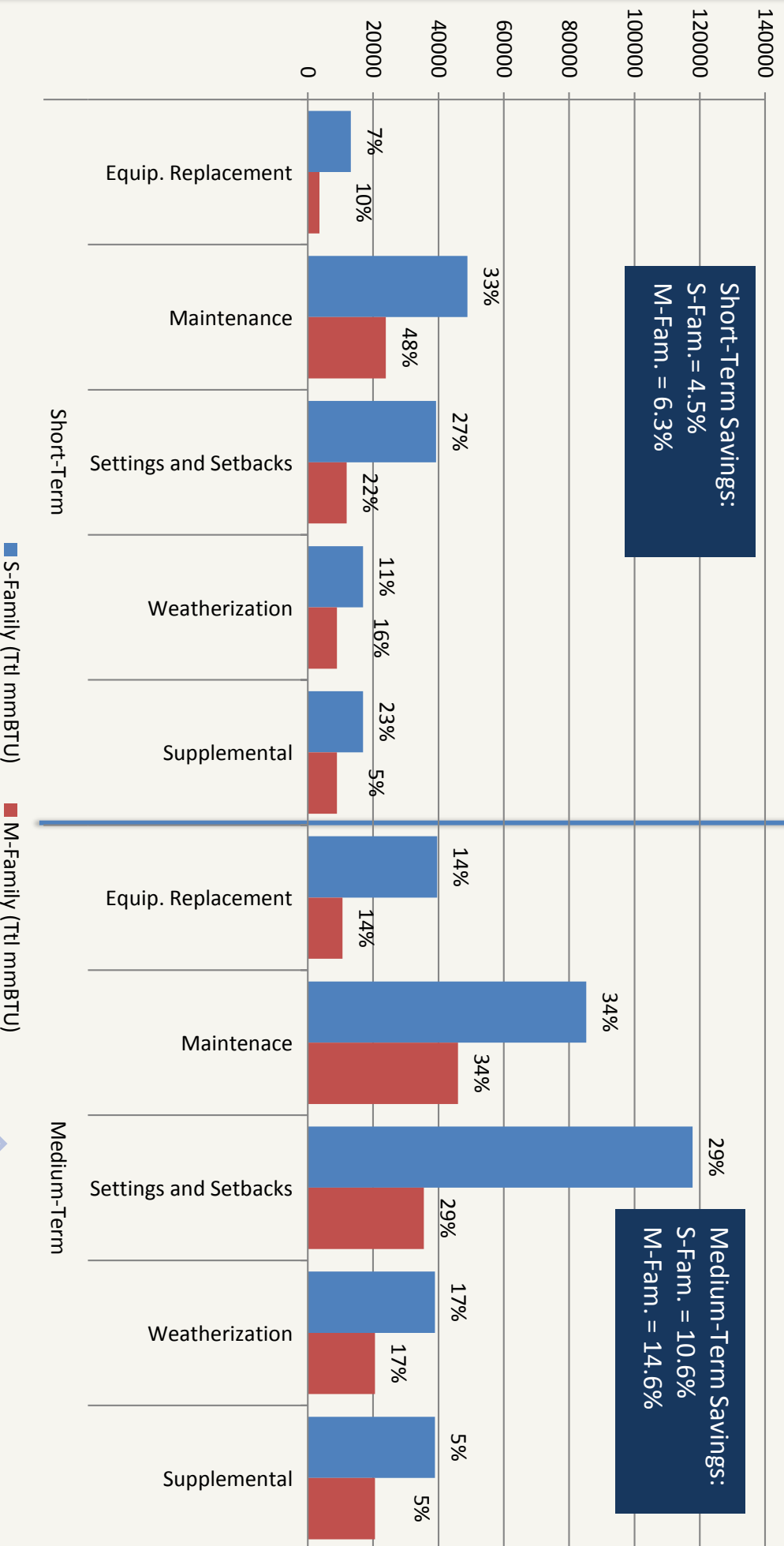
The Sample Behavior Wedge Profile:
Residential Energy Sector – Baltimore, Maryland

Achievable Savings from Heating-Related Practices

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The Sample Behavior Wedge Profile:
Residential Energy Sector – Baltimore, Maryland

Cooling-Related Energy Savings Opportunities

Short-Term Savings:
S-Fam.= 4.5%
M-Fam. = 6.3%

Medium-Term Savings:
S-Fam. = 10.6%
M-Fam. = 14.6%

Short-Term

- Equip. Replacement — 7% / 10%
- Maintenance — 33% / 48%
- Settings and Setbacks — 27% / 22%
- Weatherization — 11% / 16%
- Supplemental — 23% / 5%

Medium-Term

- Equip. Replacement — 14% / 14%
- Maintenace — 34% / 34%
- Settings and Setbacks — 29% / 29%
- Weatherization — 17% / 17%
- Supplemental — 5% / 5%

Legend:
- ■ S-Family (Ttl mmBTU)
- ■ M-Family (Ttl mmBTU)

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Primary Data Source

- The Energy Information Agency's Residential Energy Consumption Survey (**RECS**)

Behavior-Specific Algorithms

cooling conservation actions	(# of homes) x (% of homes with central AC) x (% of homes in which bedrooms > HH occupants) x (short-term participation rate) x (avg. BTUs for AC per HH) x (est. % savings per HH)

Vision for a Fully Developed Behavior Wedge Profile

In addition to residential sector energy, a fully developed profile could contain assessments for:

- Commercial Sector energy/carbon
- Transportation Sector energy/carbon
- Food Sector energy/carbon
- Water-Related energy/carbon
- Waste and Recycling
- Underlying attitudes and opinions that shape our resource use practices

Vision for a Fully Developed Behavior Wedge Profile

Next Steps

- Forthcoming Report – Documentation of model and assessment.
- *USDN Webinar: May*

Refining the Residential sector model & developing the Commercial sector model

- Charlotte, NC
- Miami, FL
  - Boston, MA
  - Baltimore, MD
  - Park City, UT

We hope to work with other cities as well!

- "Join the club!" eh, Tina?

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