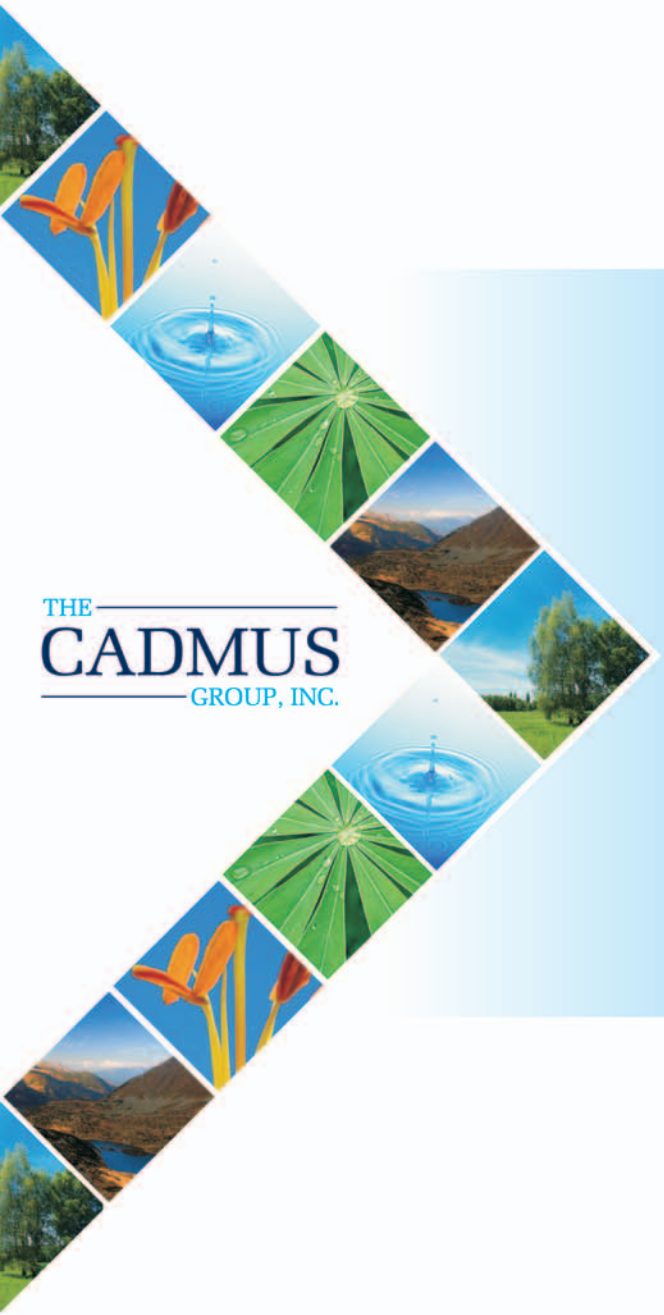

THE CADMUS GROUP, INC.

Status of Phase 1 Protocols

Tina Jayaweera
Hossein Haeri
January 30, 2012

Overall Status

Protocol	Technical Expert 1st Draft	Technical Advisory Group 1st Review	Technical Expert 2nd Draft	Technical Advisory Group 2nd Review	Steering Committee Review
Residential Lighting	Complete	Complete	Complete	Complete	In progress
Refrigerator Recycling	Complete	Complete	In progress	Not started	Not started
HVAC Unitary	Complete	Complete	Complete	In progress	Not started
Commercial Lighting	Complete	In progress	Not started	Not started	Not started
HVAC Furnace	In progress	Not started	Not started	Not started	Not started
Whole-house Retrofit	In progress	Not started	Not started	Not started	Not started
Commercial Lighting Controls	In progress	Not started	Not started	Not started	Not started

RESIDENTIAL LIGHTING

Residential Lighting

- Measures
  - CFLs
  - ENERGY STAR fixtures
  - LEDs
- Delivery Strategies Vary
  - Upstream buy down/mark down
  - Direct installation
  - Giveaway
  - Coupons

Residential Lighting: Proposed Approach

$$kWh_{saved} = NUMMEAS * (\Delta W/1{,}000) * HRS * ISR * INTEF$$

- *ΔW* - Delta watts
  - Recommended: Lumen equivalence
  - Typically provides same as manufacturer rating
  - Matches up with EISA
- *HRS* - Annual operating hours
  - Recommended: Metering study
  - Adjust for seasonality
  - Can select sample of measures/home
  - Weighting techniques

Residential Lighting: Proposed Approach

- *ISR* - In-service Rate
  - Recommended: Onsite audit for upstream programs
  - Based on all similar measures (i.e., do not need to identify program bulbs)
  - For recent launch or smaller programs: telephone survey
- *INTEF* - HVAC Interactive Effects
  - Recommendation: Use existing TRM or Calculator, considering HVAC saturations

Residential Lighting: TAG Comments

- Market data should be analyzed as a check on the validity of lumen equivalence
- Calculating baselines
  - Can different programs use different baselines if they will later be compared to each other?
  - If so, what steps should be taken to ensure a useful comparison?
- Hours of use can differ by building vintage

Residential Lighting: Progress and Status

- TWG Meeting on Nov. 14th
- Protocol draft sent to TAG on Dec. 6th
- TAG submitted comments on Dec. 16th
- Protocol revised draft sent to TAG for approval on Jan. 6th
- Final TAG comments submitted on Jan. 13th

REFRIGERATOR RECYCLING

Refrigerator Recycling

- Programs offering rebates to pick up and recycle participants' working refrigerators and/or freezers

Refrigerator Recycling: Proposed Approach

- *In situ* Metering Study
- Minimum Sample: 80 appliances
- Key Stratification: Primary/Secondary Units
- Seasonality
  - Two metering waves: Summer/Fall and Winter/Spring
- Duration: Minimum of Two Weeks

Refrigerator Recycling: Proposed Approach

- Key Parameters
  - Energy consumption, cabinet temperature, ambient temperature and light sensor (door openings)
- Regression Modeling
  - Independent Variables
    - Universal: Age, Size, and Configuration
    - Study-Specific: Primary/Secondary, CDD and/or HDD, Household Size, Code/Vintage

Refrigerator Recycling: TAG Comments

- Perhaps expand definition to low-income direct-install programs
- Consider adding unit location to the data collected (conditioned or unconditioned space)
- Discuss how to capture seasonality in space temperature

Refrigerator Recycling: Progress and Status

- TWG Meeting on Nov. 18th
- Protocol draft sent to TAG on Dec 28th
- TAG submitted comments on Jan 9th
- Protocol revised draft sent to TAG on Feb 1st
- Final TAG comments to be submitted by Feb 8rd

HVAC UNITARY

HVAC Unitary

- "Unitary" – all components necessary to heat, cool, dehumidify, filter, and move air are included
- Unitary equipment is available as single package or as split systems
- Focus on 5.4 ton – 15 ton AC systems

HVAC Unitary: Proposed Approach

$$kWh = Size * (1/EER_{base} - 1/EER_{inst}) * EFLH$$

- Size and efficiency (*EERinst*) of installed units
  - Desk review of paperwork using invoices
  - Field verification of sample
- *EERbase* - Baseline efficiency
  - Review of relevant codes
  - Vendor interviews to determine standard practice (may be covered in NTG)
- *EFLH* – Equivalent full load hours
  - Power metering
  - Stratify by climate zone, size (if needed), and building type (if possible)

HVAC Unitary: Comments

- More defined purpose and scope
- Recommend using SEER and IEER and only use EER when the IEER is not available
- Can efficiency vary for site-specific reasons that are not deficiencies?

HVAC Unitary: Progress and Status

- TWG Meeting on Nov. 21st
- Protocol draft sent to TAG on Dec. 15th
- TAG submitted comments on Dec. 27th
- Protocol revised draft sent to TAG on Jan. 19th
- Final TAG comments submitted on Jan. 26th

COMMERCIAL LIGHTING

Commercial Lighting

- Programs offering incentives to encourage promotion, design, and implementation of energy-efficient lighting in nonresidential spaces

Commercial Lighting: Proposed Approach

$$kWh/year_{save} = ((kW_{base} \times HOU_{base}) - (kW_{efficient} \times HOU_{efficient})) * IF$$

- *kW_{base} and $kW_{efficient}$* –baseline and efficient wattage
  - Stipulate using manufacturer's test (ANSI) data or program wattage table
- *IF*- Interactive effect
  - Stipulate based on peer programs, market or regional research
- *HOU* – Hours of Operation
  - Meter

RESIDENTIAL FURNACES AND BOILERS

Commercial Lighting: Progress and Status

- TWG Meeting on Nov. 30th
- Protocol draft sent to TAG on Jan. 26th
- TAG to submit comments on Feb. 7th
- Protocol revised draft to be sent to TAG on Feb. 22nd
- TAG to submit final comments on Feb. 27th

HVAC Residential Boilers and Furnaces

- Delivery mechanism
  - Usually standard rebate to customer or contractor

HVAC Boiler/Furnace: Proposed Approach

- Parameters to include
  - Gross energy savings
    - Unit size
    - Installed unit efficiency
    - Base unit efficiency
    - Estimated hours of use
  - Evaluated gross savings
    - Measured hours of use
    - Adjustments in baseline

HVAC Boiler/Furnace: Proposed Approach

- Evaluated gross savings based on Billing Analysis
- Heating usage can be disaggregated from utility gas bills using standard PRISM like techniques

HVAC Boiler/Furnace: Progress and Status

- TWG Meeting on Nov. 21st
- Protocol draft to be sent to TAG on Feb 8th
- TAG to submit comments on Feb. 20th
- Protocol revised draft to be sent to TAG on Mar. 2nd
- TAG to submit final comments on Mar. 9th

WHOLE-HOUSE RETROFIT

Whole-house Retrofit

- Definition
  - EE Retrofits of a number and/or type that a comprehensive analysis of consumption at the household level is required
- Kinds of Programs
  - Low-income Weatherization
  - Home Energy Audit
  - Home Performance with Energy Star

Whole-house Retrofit – Proposed Approach

- Billing Analysis
  - Pre- and post-installation consumption data
  - Clear "change" period
  - Sufficient number of participants
- Overlap with Furnace/boiler and New Construction evaluation approaches.
  - This protocol will become a basis for all billing analysis

Whole-house Retrofit: Progress and Status

- TWG Meeting on Dec. 9th
- Protocol draft to be sent to TAG on Feb 3st
- TAG to submit comments on Feb. 17th
- Protocol revised draft to be sent to TAG on Feb. 28th
- TAG to submit final comments on Mar. 6nd

COMMERCIAL LIGHTING CONTROLS

Commercial Lighting Controls

- Lighting Control Types
  - Sweep Controls/EMS
  - Occupancy Sensor Controls
  - Dimming Controls
    - Stepped dimming dual ballast (inboard/outboard)
    - Dual ballast high low (HID 400W/275W)
    - Continuous Daylight Dimming

Lighting Controls: Proposed Approach

- Sweep Controls/EMS
  - Monitor fixtures directly using lighting logger or at panel or lighting control relays
- Occupancy Sensor Controls
  - Monitor fixtures directly using lighting logger or power monitoring at panel
  - Pre-monitoring using sensor switch loggers or other occupancy and lighting dual meters

Lighting Controls: Proposed Approach

- Stepped Dimming Dual Ballasts Inboard/Outboard
  - Monitor fixtures directly using lighting loggers, may need fiber optic wand
- Stepped Dimming Dual Ballasts Hi/Low
  - Most efficient to monitor fixtures at the lighting panel and measure true interval power with spot power measurement

Lighting Controls: Proposed Approach

- Continuous Daylight Dimming
  - Most efficient to monitor fixtures at the lighting panel and measure true interval power with lighting counts

Lighting Controls: Progress and Status

- TWG Meeting on Dec. 16th
- Protocol draft to be sent to TAG on Feb 3st
- TAG to submit comments on Feb. 17th
- Protocol revised draft to be sent to TAG on Feb. 28th
- TAG to submit final comments on Mar. 6nd