



# ENERGY STAR® Residential Pool Pumps

## Framework Document and Test Method Stakeholder Webinar

December 20, 2011  
Washington, DC

# Agenda



- Welcome and Introductions
- ENERGY STAR Program Overview
- Overview of Specification Development Process
- Framework Document Discussion
  - Definitions
  - Eligible Product Categories
  - Criteria
- Draft Test Procedure
  - Test method development
  - Results
- Call for Data
- Connected Functionality
- Timeline and Next Steps

# What is ENERGY STAR

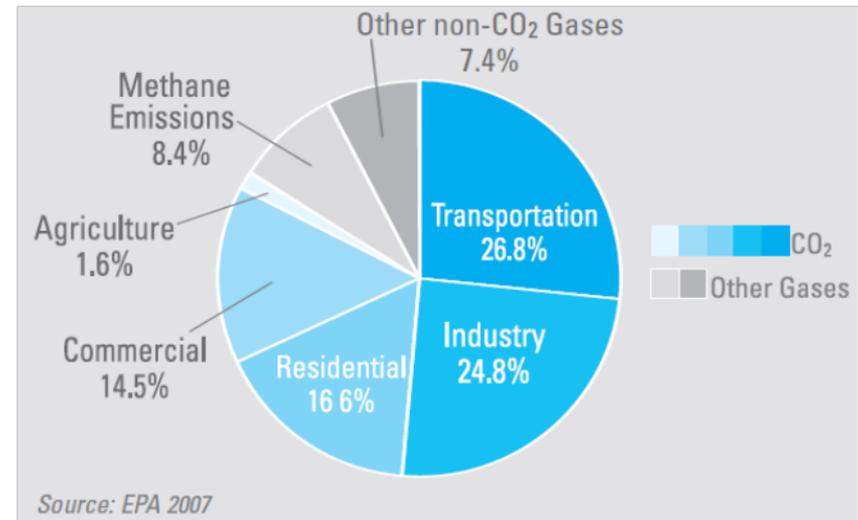


- **ENERGY STAR** is a voluntary government-backed program dedicated to helping individuals protect the environment through superior energy efficiency
- **ENERGY STAR** is the national symbol of energy efficiency, making it easy for consumers and businesses to identify high-quality, energy-efficient products
- **ENERGY STAR** distinguishes what is efficient/better for the environment without sacrificing features or performance
- Products that earn the **ENERGY STAR** meet strict energy performance criteria set by EPA

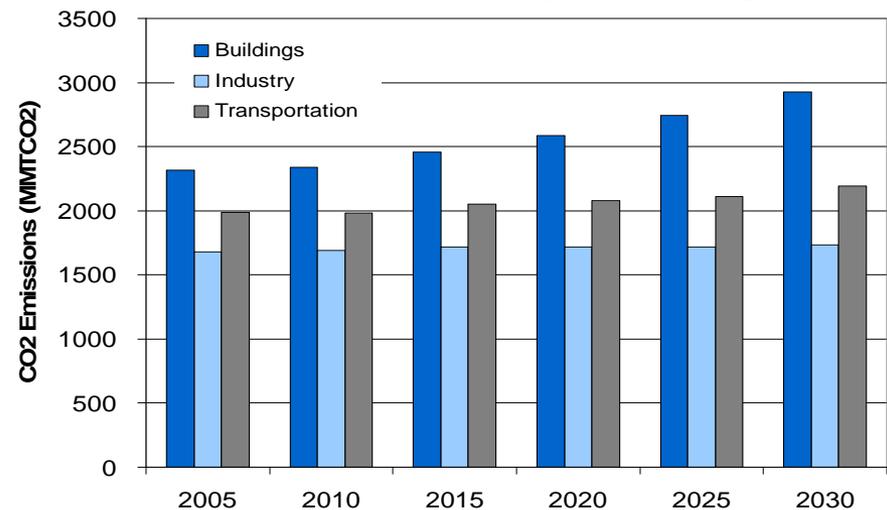
# ENERGY STAR



- Started in 1992; voluntary program
- GOAL: Reduce greenhouse gas (GHG) emissions through large win-win-win opportunities with today's energy efficient technologies and practices.
- Provide credible information to buyers
- Work with the marketplace to capitalize on motivations of individuals



Projected GHG Emissions from Key Sectors through 2030



Source: AEO 2008

# ENERGY STAR Portfolio



- Define and educate on energy/environmental performance through a single designation: **ENERGY STAR**
  - Product Efficiency
  - New/Existing Home Efficiency
  - Commercial Building Efficiency

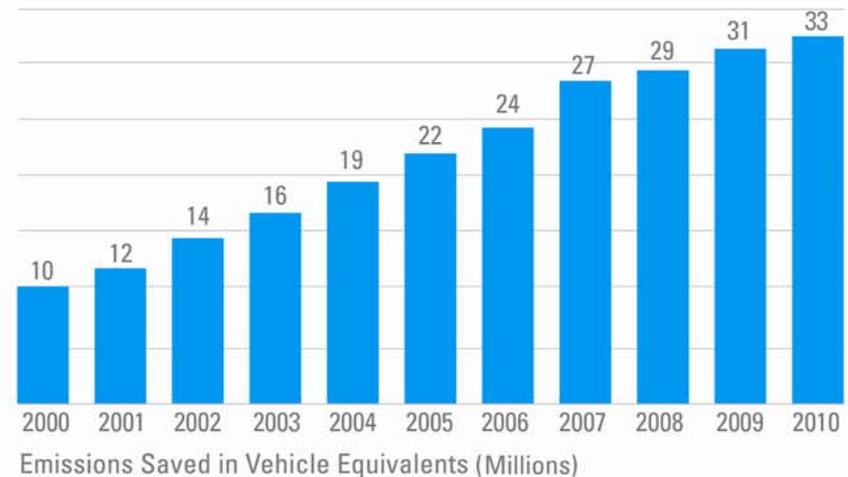
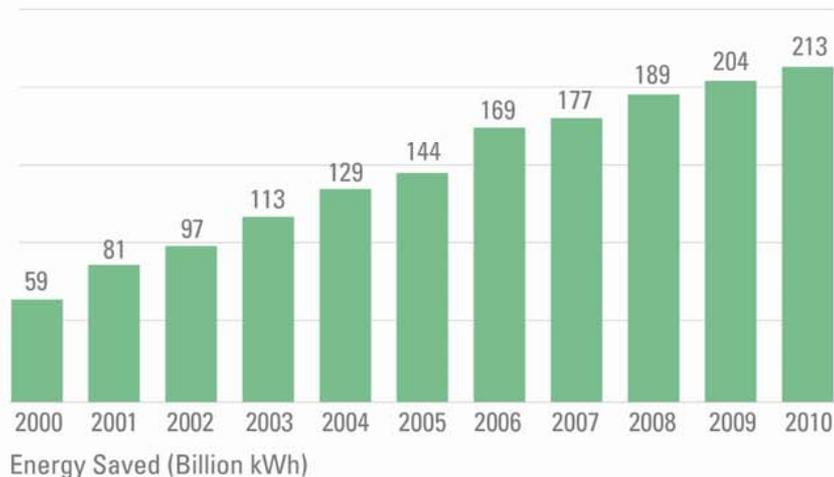




# Success: 2010 Accomplishments

- Americans with the help of ENERGY STAR prevented 170 million metric tons of GHG emissions in 2010 – equivalent to 33 million vehicles and saved \$18 billion on energy bills
- More than 17,000 partners
- Nearly 3 billion qualified products sold since 2000
- Over 1 million new homes are ENERGY STAR qualified
- Tens of thousands buildings benchmarked and thousands upgraded

**Since 2000, ENERGY STAR Benefits Have More Than Tripled**

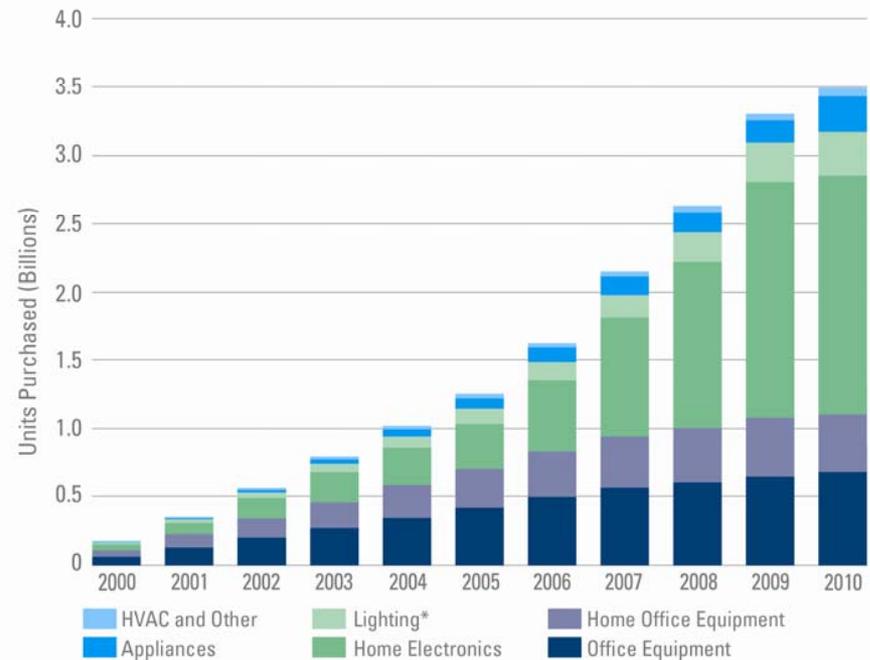


# ENERGY STAR Products



- American purchases about 200 Million ENERGY STAR qualified products in 2010
- In more than 60 categories
- Cumulative total of almost 3.5 billion products since 2000
- Ranging from 20 – 60% more efficient

**Almost 3.5 Billion ENERGY STAR Qualified Products Purchased Since 2000**



*\*Lighting category does not include purchases of compact fluorescent bulbs.*

# 60+ Product Categories Are Covered by ENERGY STAR in the US



**Lighting**  
CFLs  
SSL  
Integral LED lamps  
Residential light fixtures



**Home Envelope**  
Roof products  
Windows/Doors

**Heating & Cooling**  
Central AC  
Heat pumps  
Boilers  
Furnaces  
Ceiling fans  
Room AC  
Ventilating fans  
Water Heaters

**Office Equipment**  
Computers  
Monitors  
Printers  
Copiers  
Scanners  
Fax machines  
Multi-function Devices  
Servers

**Commercial Food Service**  
Dishwashers  
Refrigerators  
Freezers  
Ice Machines  
Fryers  
Steamers  
Hot Cabinets  
Griddles  
Ovens  
Vending machines

**Appliances**  
Clothes washers  
Dishwashers  
Refrigerators  
Dehumidifiers  
Air cleaners  
Water coolers

**Home Electronics**  
Battery chargers  
Cordless phones  
TV  
Set Top boxes  
Home audio

# Loyalty is the goal



**Awareness**

**Relevance**

**Differential Value**

**Satisfaction**

**Loyalty**

**70+%**

of households recognize the label.

**65+%**

of households that recognized ENERGY STAR feel that "buying ENERGY STAR labeled products helps protect the environment for future generations."

**55+%**

agree "buying ENERGY STAR labeled products makes me feel like I am contributing to society."

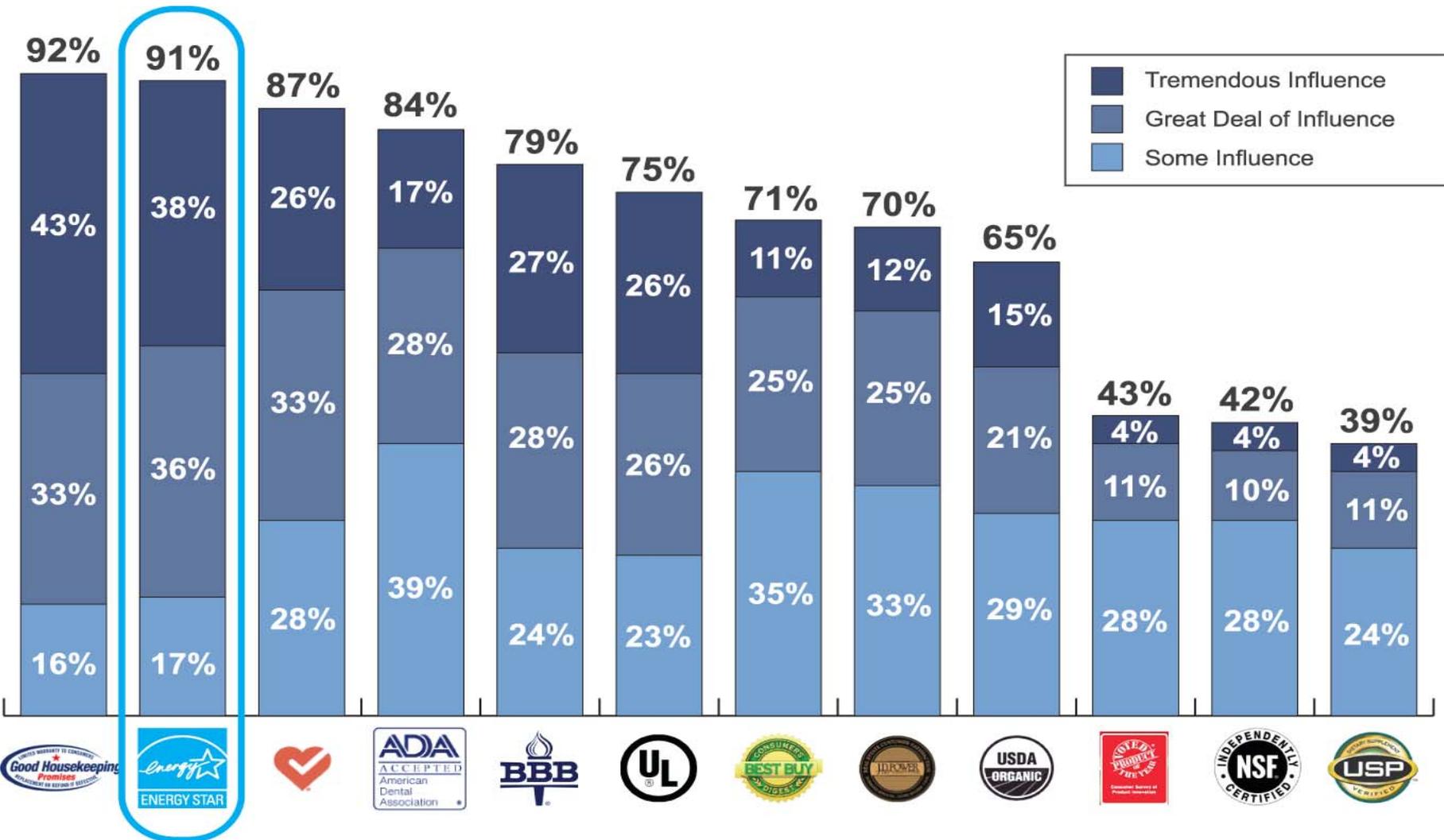
**75%**

agree that "the ENERGY STAR label indicates superior performance with respect to energy efficiency relative to products without the label."

**80%**

of knowing purchasers would likely recommend ENERGY STAR to a friend.

# ENERGY STAR is one of the most influential labels in the marketplace



Source: Fairfield Research, July 2009

# Enhanced ENERGY STAR marketing campaign



- Goal: Sustained behavioral change around energy-efficiency
- Strategy: Integrated social marketing Campaign
  - Enhanced “Change the World, Start with ENERGY STAR” campaign:
    - Interactive web platform
    - Social sharing: Be an ENERGY STAR video challenge
    - Event series: ENERGY STARs Across America

# Coordinated Outreach Across Program Partners and Key Areas



- Broad
  - PSA – profiles of real people
  - ENERGY STAR Home Energy Advisor
  - Change the World, Start with ENERGY STAR
- HVAC
  - Cool your world – summer campaign
  - DIY Home sealing
  - Properly used thermostat
- Office equipment
  - Monitor enabling; Low Carbon IT campaign
- New Homes
- Commercial and Industrial
  - National Building Competition

## Multiple Goals

**Build Awareness**

**Provide value of program partners**

**Promote action**

**Promote growth in product sales**

# Guiding Principles for Specification Development



- Significant energy savings can be realized on a national basis
  - ENERGY STAR specifications are created only when the energy savings potential translates into tangible energy savings
  - Ensures ENERGY STAR qualified products deliver promised savings
- Product performance can be maintained or enhanced with increased energy efficiency
  - Label is not only a credible symbol for energy efficiency, but it is also found on products with the features and performance that consumers demand

# Guiding Principles, *cont.*



- Purchasers recover their investment in increased energy efficiency within a reasonable period of time
  - Some energy-efficient products may have a price premium while others do not. Maximum ROI is around 5 years
  - Every product has *two* price tags:
    - 1) initial cost of the product at purchase, and
    - 2) cost of energy to operate over products lifetime
- Energy-efficiency can be achieved through several technologies
  - Specifications take a technology neutral approach
  - Do not favor one manufacturer over all others by designating a proprietary technology or unique design approach when establishing or revising the performance attributes of an ENERGY STAR product specification

# Guiding Principles, *cont.*



- Product energy consumption and performance can be measured and verified with testing
  - Available, industry accepted test procedure
  - Several manufacturers and products represented
  - Target top 25% in terms of energy efficiency
- Labeling would effectively differentiate products and be visible for purchasers
  - ENERGY STAR's goal is to provide value to purchasers by enabling them to easily identify energy-efficient products that have earned the label
  - EPA develops and revises specifications so they reflect the performance of products meeting the highest conservation standards

# Guiding Principles for When to Revise ENERGY STAR Specifications



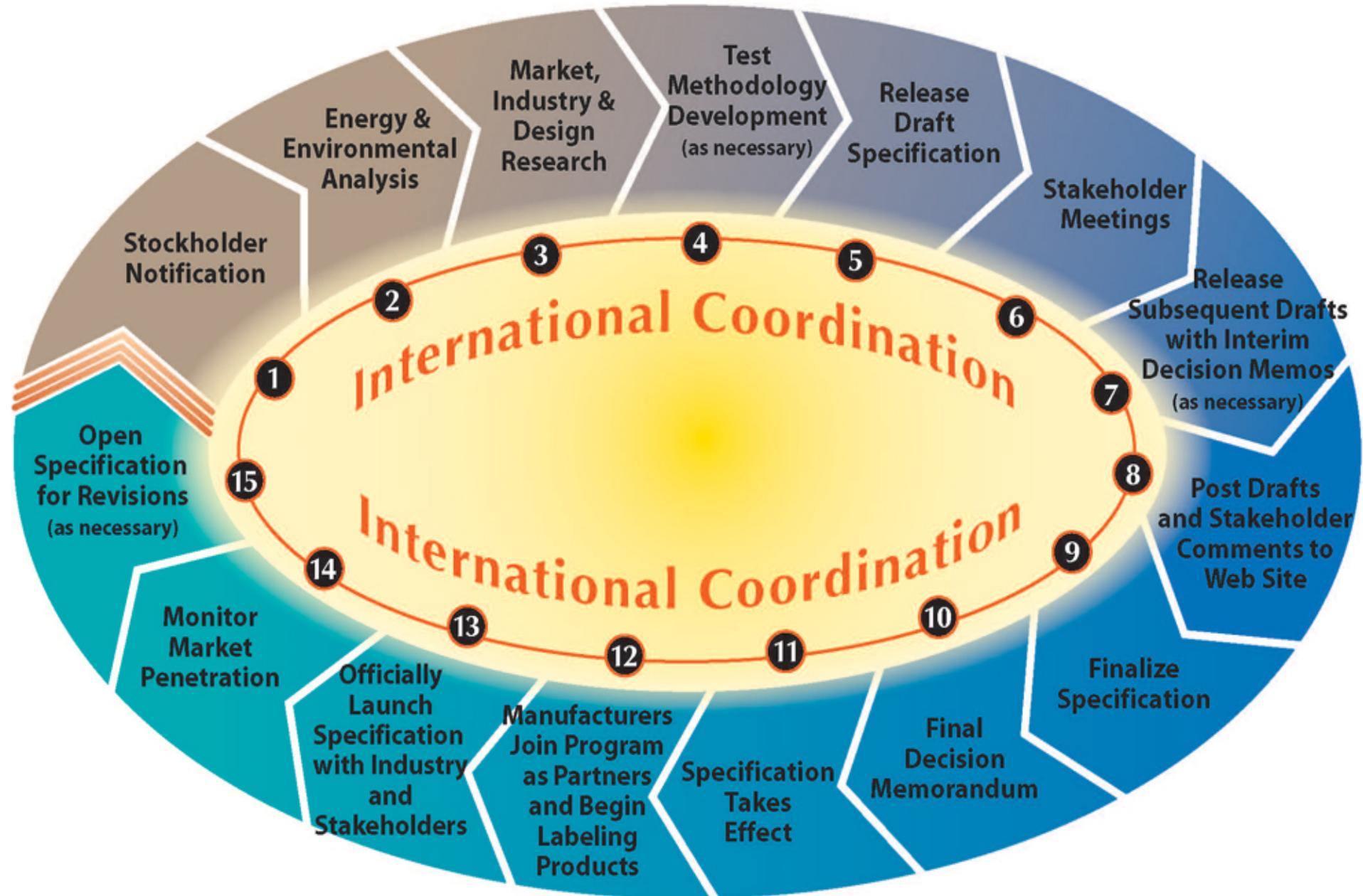
- Significant increase in market penetration of ENERGY STAR qualified models
- Change in the Federal minimum efficiency standards
- Technological advancements
- Product availability limitations
- Issues with consumers realizing expected energy savings
- Performance or quality issues
- Issues with test procedures

# Important Process Elements

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- Consistency
- Transparency
- Inclusiveness
- Responsiveness
- Clarity

# Specification Development Cycle



# ENERGY STAR's Third-Party Certification Process



**January 2011:** ENERGY STAR Labeled Products Program moved from self certification to third party certification.

Entities apply to become EPA-recognized laboratories, certification bodies, or accreditation bodies



Manufacturers test products with EPA-recognized laboratory or manufacturer lab (W/SMTL)



EPA-recognized certification body reviews data & certifies performance



EPA lists qualified models on website and partners market as ENERGY STAR qualified

Details available at [www.energystar.gov/3rdpartycert](http://www.energystar.gov/3rdpartycert)

# EPA Interest in Pool Pumps



- For the past several years (2007, 2009, 2011), EPA has been evaluating the opportunity to develop an efficiency program on pumps
- Completed an engineering analysis in Fall 2011
  - Based on data available from the California Energy Commission
  - Sufficient availability of energy efficient products
  - Opportunity for product differentiation
  - Appliance efficiency standards adopted in 5 states
  - Significant home and national energy savings potential
- ENERGY STAR Residential Pool Pump Framework Document and Draft 1 Test Procedure were distributed 11/29/11

# Framework: Definitions

- Definitions proposed in the framework provided by
  - ANSI/APSP/ICC-15 2011 “American Standard for Residential Swimming Pool and Spa Energy Efficiency”
  - Also proposed are non-standard definitions
- Preliminary list included:
  - General definitions
  - Product types
  - Product ratings
  - Performance metrics

# Definitions - Questions



- Are there any other sources that EPA should review for variations of, or additions to, this list of definitions?
- EPA is interested in the key design or engineering differences, if any, that exist between pumps meant for commercial and residential, inground and above ground, spa, waterfall, or booster applications to clarify definitions?

# Framework: Eligible Product Categories



- EPA is considering a scope that covers all residential inground swimming pool pumps including:
  - Single-speed
  - Multi-speed
  - Variable-speed
- EPA anticipates excluding from the scope the following devices:
  - Speed controllers
  - Timers
  - Replacement motors

# Eligible Products - Questions



- Are there any technologies or product types which are not included within the proposed program scope that should be included?
- How prevalent are pumps requiring the installation of an aftermarket relay kit, and should these be excluded?
- What data is available on the prevalence and effectiveness of labeling the pump with statements stating the need for a controller for two-, multi-, or variable speed pumps?
- What other methods might ensure controller implementation?
- Should pumps without onboard controllers be excluded?

# Framework: Efficiency Criteria



- Where possible, EPA harmonizes with existing standards and is considering referencing the following:
  - California Energy Commission (CEC) CA Title 20 “California's Appliance Efficiency Regulations”
  - ANSI/ASPS/ICC-15 2011 “Residential Pool and Spa Efficiency” standard
  - Consortium for Energy Efficiency (CEE) Residential Swimming Pool Initiative (under-development)
- Two possible criteria approaches identified
  1. Distinguish energy efficient pumps based on attributes (i.e. pump size, speed functionality, motor type)
  2. Base criteria on performance using the Energy Factor metric (Gal/Wh) using ANSI/HI 1.6-2000 testing methods.

# CEC Database

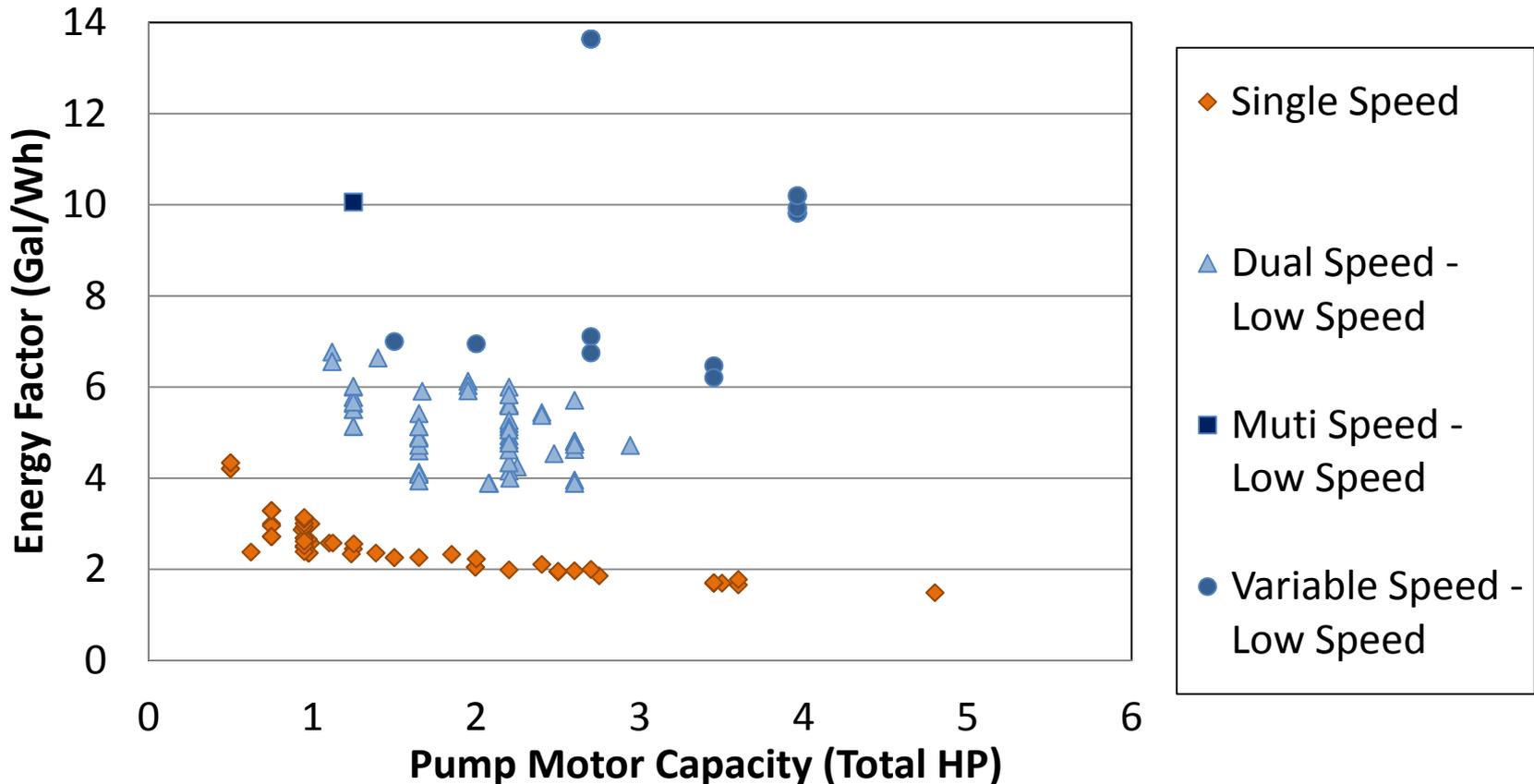


- CEC Appliance Efficiency Database is the only currently available listing of EF data: NOT a full data set
  - only includes CA Title 20 compliant pumps
  - does not include single speed pumps >1HP, or split-phase or capacitor start – induction run type motors
  - some listings are incomplete
  - only 62 single speed pumps listed (~300 on the market)
- ENERGY STAR specifications are a data driven process
  - levels are set based on the data available

# CEC Database – EF Data (Low Speed)



## Curve-A Low Speed Energy Factor vs. Pump Motor Capacity





# Call For Data

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- EPA requests submission of EF performance data using the Draft 1 Test Procedure by **Jan 20, 2012**
  - **Appendix A Data Template provided**

# EPA–DOE Memorandum of Understanding (MOU)



- On September 30, 2009, EPA and DOE signed a memorandum of understanding (MOU) designed to enhance and strengthen the ENERGY STAR program

EPA: Brand Manager	DOE: Technical Support
<ul style="list-style-type: none"><li>• New Products</li><li>• Performance Levels</li><li>• Marketing &amp; Outreach</li><li>• Product Database</li><li>• Monitoring &amp; Verification</li></ul>	<ul style="list-style-type: none"><li>• Test Methods</li><li>• Metrics</li><li>• Monitoring &amp; Verification</li></ul>

# EPA-DOE ENERGY STAR Team



- As part of the MOU, DOE is the lead for writing and updating ENERGY STAR test methods
- Navigant is contracted by DOE to write new test methods and validate and/or update existing test methods
- DOE team will provide overview and support of findings related to the test method

# Existing Pool Pump Test Procedures/Programs

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- *ANSI/HI 1.6-2000, Centrifugal Pump Tests*
- *AS 5102.1-2009, Performance of household electrical appliances – Swimming pool pump-units*
- California Energy Commission Title 20 – Appliance Efficiency Program

# Proposed Draft 1 Test Method



- Proposed Test Method based on *ANSI/HL 1.6* with contributions from *AS 5102.1* and *CEC*

ANSI/HL 1.6	AS 5102.1	CEC Title 20
<ul style="list-style-type: none"><li>• Test setup and instrumentation</li></ul>	<ul style="list-style-type: none"><li>• Test method and measurement requirements</li></ul>	<ul style="list-style-type: none"><li>• EF calculation and reporting</li></ul>

- Combining test procedures provides:
  - Repeatability
  - Flexibility
  - Minimal additional burden

# ANSI/HL 1.6 - AS 5102.1 Comparison

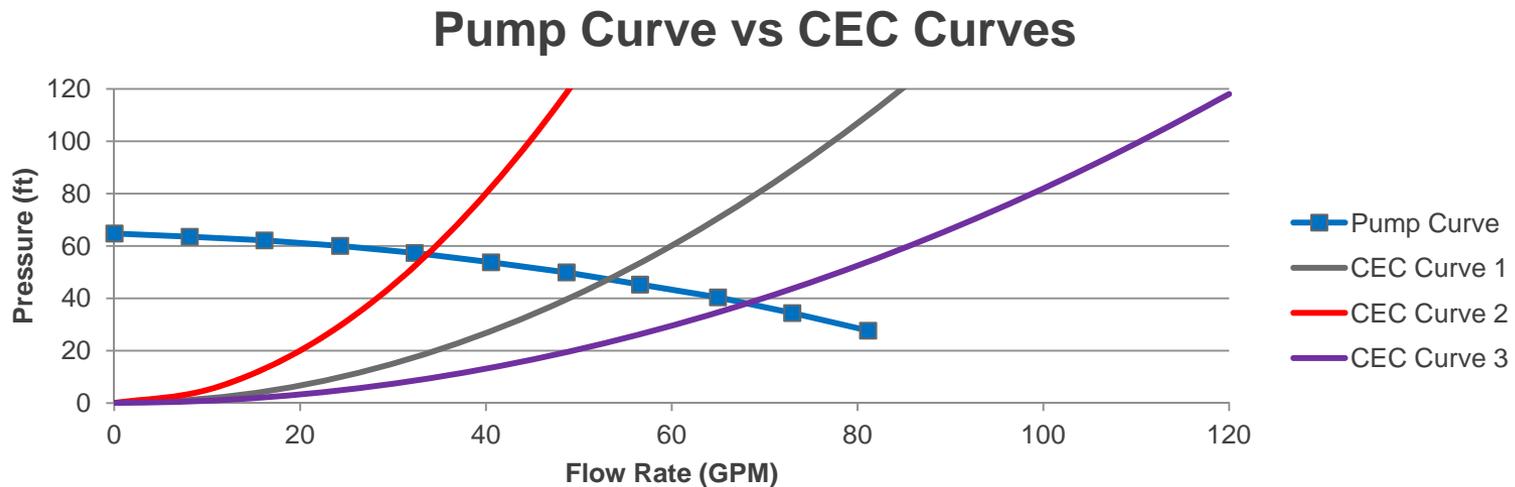


Topic	ANSI/HL 1.6	AS 5102.1	CEC
Measurement Requirements	<ul style="list-style-type: none"><li>• None</li></ul>	<ul style="list-style-type: none"><li>• 30 readings per data point</li><li>• Duration of readings: &gt; 10 seconds</li></ul>	<ul style="list-style-type: none"><li>• None</li></ul>
Steady State	<ul style="list-style-type: none"><li>• None</li></ul>	<ul style="list-style-type: none"><li>• Fluctuation between highest and lowest value: <math>\pm 3\%</math></li><li>• Fluctuation of average value: 0.6%</li></ul>	<ul style="list-style-type: none"><li>• None</li></ul>
Test Method	<ul style="list-style-type: none"><li>• Measurements taken at desired operating point</li></ul>	<ul style="list-style-type: none"><li>• Measurements taken at 10% increments of full flow</li><li>• Total of 11 data points</li></ul>	<ul style="list-style-type: none"><li>• Measurements taken at pump's operating point with the 3 CEC curves</li></ul>

# ANSI/HI 1.6 Modifications



- Test method
  - Increased number of data points: 11 total



- Allows determination of full pump performance curve



# Testing Overview

- Testing Purpose
  - Validate draft test method
  - Identify potential gaps
- Testing Scope
  - In-ground pool pumps – 9 models
  - Repeatability testing – 3 units of 1 model

Motor Types	Rated HP	Flow Rates
Single-Speed Two-Speed Variable-Speed	0.75 – 3 HP	0 – 150 Gallons per Minute (GPM)

# Testing Overview

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- Testing performed at internal DOE lab
- Test setup built per *ANSI/HI 1.6*:
  - Closed piping system
  - Pressure sensors upstream and downstream of UUT
    - Accuracy  $\pm 0.5\%$
  - Throttling device
  - Flow meter
    - Accuracy  $\pm 1.5\%$
  - Power meter
    - Accuracy  $\pm 1.5\%$

# Testing Overview



- Tests performed:

Pump Type	Speed Tested (RPM)		
	3450*	1725**	Low
Single-speed	X		
Two-speed	X	X	
Variable-speed	X	X	X

\* All single-speed pumps tested operated at 3450 RPM

\*\* All two-speed pumps tested operated at a high speed of 3450 RPM and low speed of 1725 RPM

- Standby testing performed on variable-speed pumps
- Three units of one model were tested to evaluate test repeatability

# Test Setup



# Test Methodology



- Based on *AS 5102.1* test procedure



- Measurements taken at 10% increments of full flow
- Measurements taken:
  - Upstream and downstream pressure
  - Rate of flow
  - Power, voltage, current inputs

# Calculations and Reporting

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- Single test provides 11 data points
  - Performance curve determined from data points
- Final metrics reported per CEC Title 20
- Following reported for each speed tested at each CEC Title 20 Curve
  - Flow Rate (GPM)
  - Total Head (ft)
  - Power (watts and volt amps)
  - Energy Factor (gal/Wh)

# Calculations and Reporting

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- Single test provides 11 data points
- Report for each speed and each CEC Title 20 curve:
  - Flow Rate
  - Total Head
  - Power (watts and volt amps)
  - Energy Factor (gal/Wh)

# Test Observations

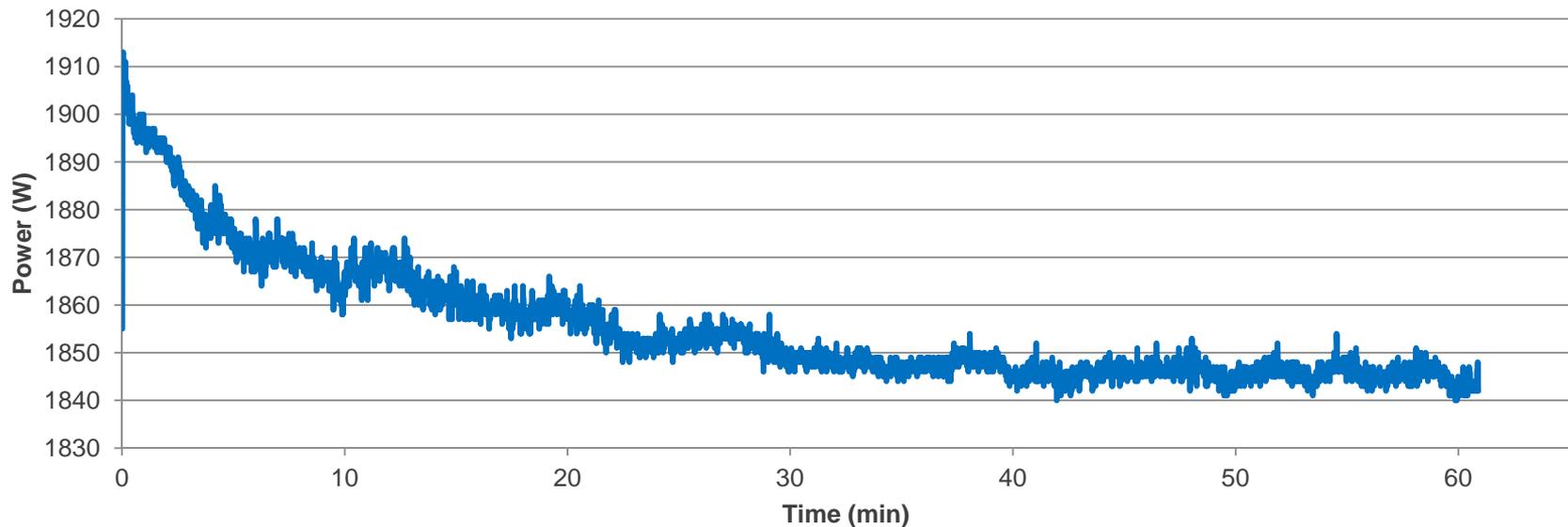


- Pumps required pre-conditioning period to reach steady state at full flow
  - Pumps took up to one hour to reach steady state
- Standby Power
  - < 5W for all pumps tested
- Test time was short after pre-conditioning
  - < 30 minutes per speed tested
  - Testing can be automated
- Repeatability testing was successful
  - < 2.5% variation between EF values at all speeds tested

# Pre-conditioning Period



- Pumps required time to reach steady state power consumption at full flow



- Time needed to reach steady state varied by pump
  - No pump took more than an hour

# Test Observations



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# Standby Power

- Standby power tested for 10 minutes
  - Variable speed pumps only

Pump	Standby Power (W)
7	4.2
8	4.9
9	4.3

- Active power ranged from 100-3000 W
- Standby not included in Draft 1 Test Method
- DOE interested in stakeholder feedback on standby
  - Active use hours per year
  - Seasonal differences

# Test Observations



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# Repeatability Testing

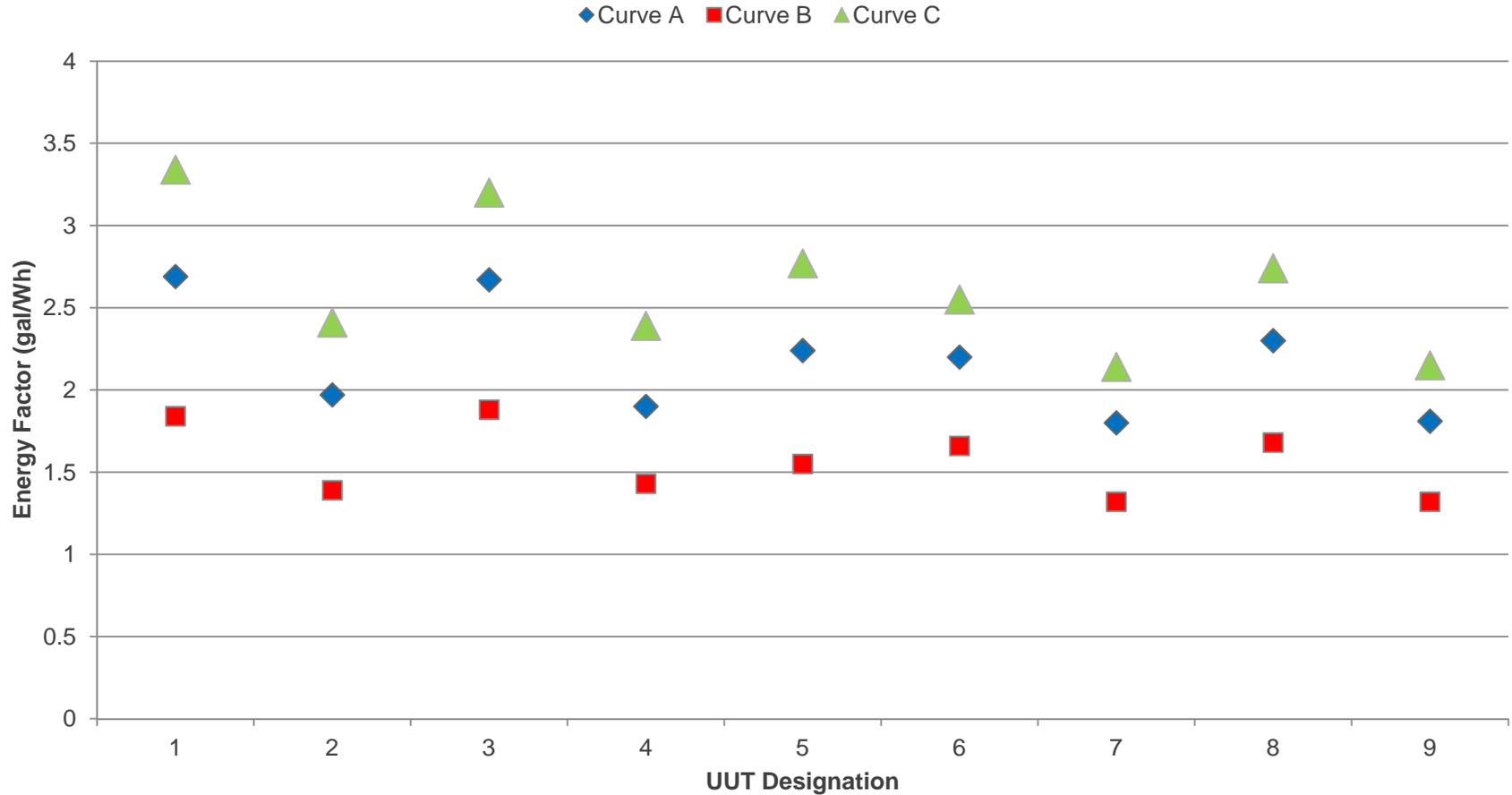


- Three units of model 6 were tested to determine repeatability

Speed (RPM)	Pump	EF (gal/Wh)		
		Curve A	Curve B	Curve C
3450	6a	2.20	1.66	2.55
	6b	2.22	1.67	2.59
	6c	2.21	1.65	2.59
<b>Variation (% of mean)</b>		<b>0.4%</b>	<b>0.6%</b>	<b>0.9%</b>
1725	6a	5.58	4.03	6.57
	6b	5.84	4.19	6.89
	6c	5.68	4.06	6.78
<b>Variation (% of mean)</b>		<b>2%</b>	<b>2.1%</b>	<b>2.4%</b>

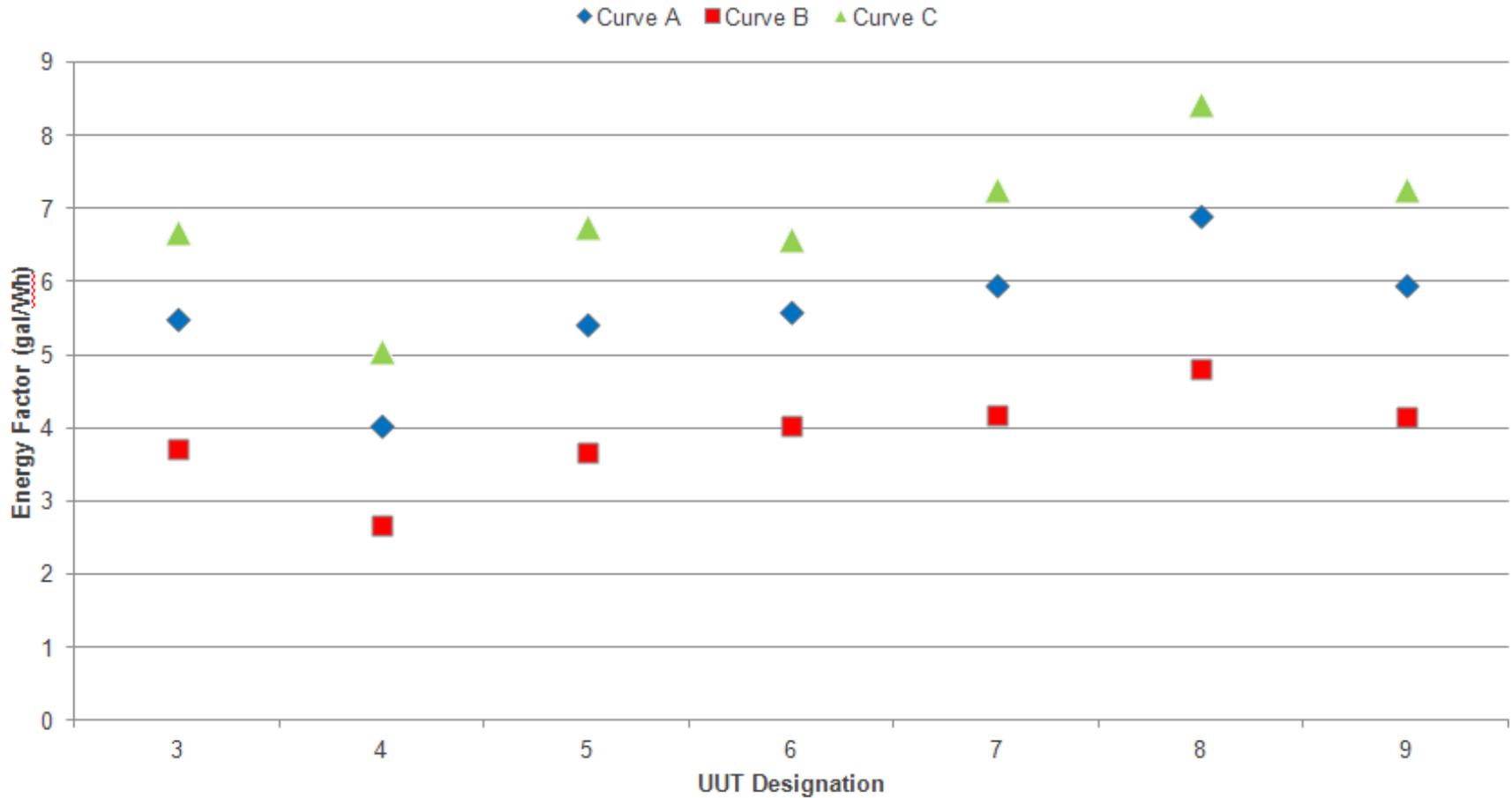
# Energy Factor at 3450 RPM

## Single-, Two-, and Variable-speed Pumps



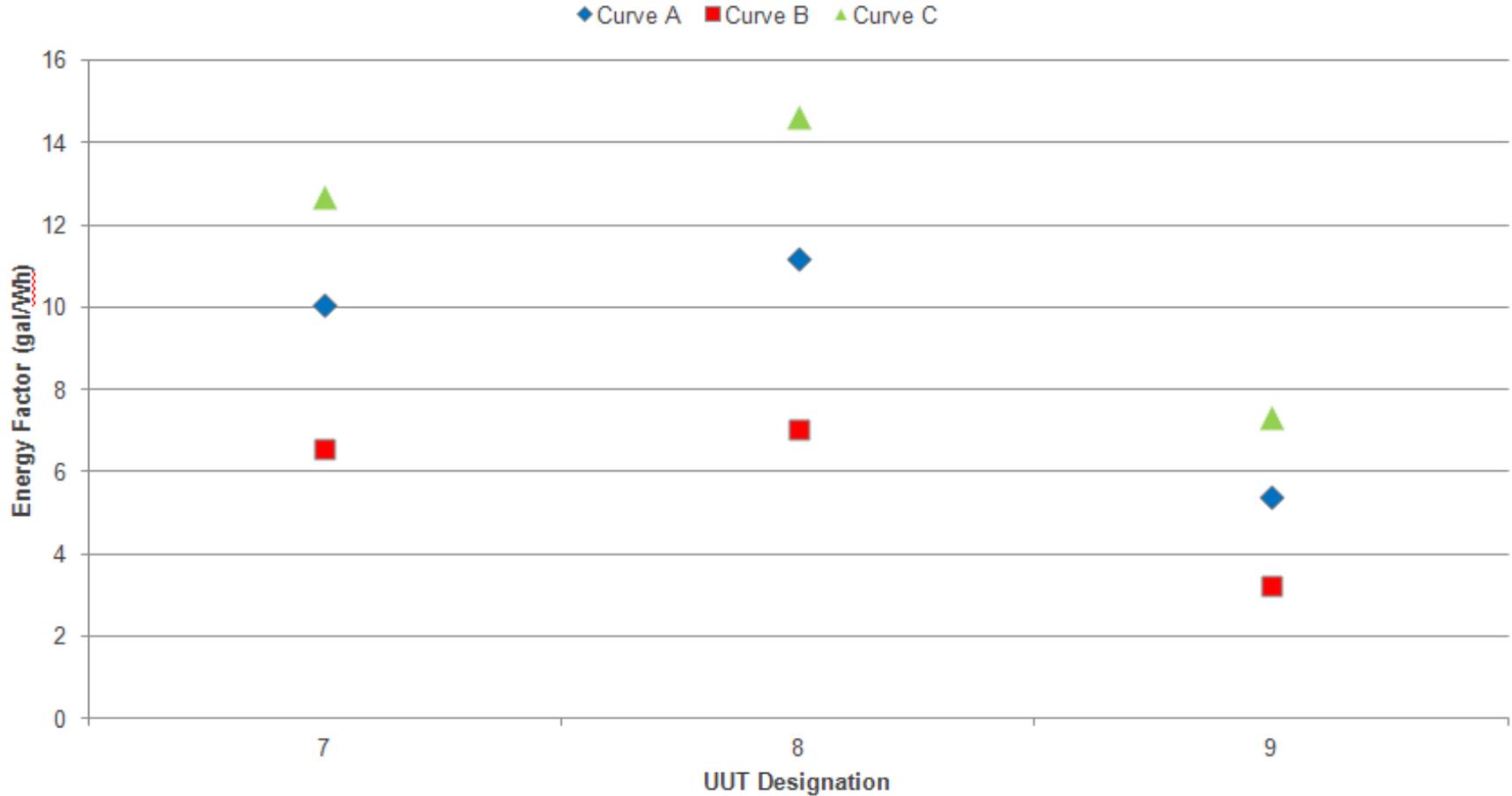
# Energy Factor at 1725 RPM

## Two- and Variable-speed Pumps



# Energy Factor at Lowest RPM

## Variable-speed Pumps



# Criteria and Test Procedure - Questions



- Do the test procedures accurately quantify residential inground swimming pool pump energy efficiency?
- Are any performance or energy efficiency criteria missing from existing test procedures that should be addressed by an ENERGY STAR test procedure?
- What if any challenges are there to testing and submitting to EPA data of CA Title 20 non-compliant pumps?
- Is testing and reporting curves A, B, and C necessary if only one curve is used for evaluation purposes?
- What size limitations are there for curve A?

# Framework: Connected Functionality



- EPA is interested in highlighting products with connected functionality on the ENERGY STAR Qualified Product List (QPL)
- “Connected” pumps shall have the following capabilities (starting point):
  1. *Energy Consumption Reporting*
  2. *Remote Management*
  3. *Operational Status & Alerts*

# Connected Functionality - Questions



- EPA seeks feedback on whether the initial list of criteria provided is applicable to pool pumps or if other criteria would apply.
- EPA is interested in input on what current activities are taking place around smart grid integration and communication for pool pumps.
- EPA would like input from stakeholders as to which industry standards could be leveraged to meet the intent of the initial set of criteria, or recommended variations to these criteria.

# Framework: Preliminary Specification Development Timeline



Pool Pump Launch Webinar	December 20, 2011
Deadline for Written Comments on Framework document and initial Test Method Issues	January 20, 2012
Draft 1 Version 1.0 Specification to stakeholders	February 2012
Draft 1 Version 1.0 Specification comments due to EPA	March 2012
Draft 2 Version 1.0 Specification to stakeholders	April 2012
Draft 2 Version 1.0 Specification comments due to EPA	May 2012
Draft Final Version 1.0 Specification to stakeholders	June 2012
Draft Final Version 1.0 Specification comments due to EPA	July 2012
Final Version 1.0 Specification	August 2012

# Contact Information



Please send any additional comments to [poolpumps@energystar.gov](mailto:poolpumps@energystar.gov) or contact:

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