U.S. Department of Energy

Energy Conservation Program for Consumer Products and Commercial and Industrial Equipment

Energy Conservation Standards Rulemaking for Commercial Clothes Washers and Residential Dishwashers, Dehumidifiers, and Cooking Products

April 27, 2006

U.S. Department of Energy
Washington, DC

Welcoming Remarks

- Purpose of Framework Workshop:
  - To discuss how the Department will develop and implement a standards rulemaking for commercial clothes washers and residential dishwashers, dehumidifiers, and cooking products
  - To solicit information from stakeholders to use as input for conducting the Department's analysis

Today's Agenda

- Welcome / Opening Remarks / Introductions / Agenda Review
- Introduction and Analytical Methodology
- Market and Technology Assessment, Screening Analysis, and Engineering Analysis
- Energy and Water Use, Markups for Equipment Price Determination, and Life-Cycle Cost and Payback Period Analysis
- Shipments Analysis, National Impact Analysis, and LCC Subgroup Analysis
- Manufacturer Impact Analysis
- Utility Impact Analysis, Employment Impact Analysis, Environmental Assessment, and Regulatory Impact Analysis
- Other Issues and Comments / Closing Remarks

Workshop Content

1	Introduction	9	Shipments Analysis
2	Analytical Methodology	10	National Impact Analysis
3	Market and Technology Assessment	11	Life-Cycle Cost Subgroup Analysis
4	Screening Analysis	12	Manufacturer Impact Analysis
5	Engineering Analysis	13	Utility Impact Analysis
6	Energy and Water Use	14	Employment Impact Analysis
7	Markups for Equipment Price Determination	15	Environmental Assessment
8	Life-Cycle Cost and Payback Period Analysis	16	Regulatory Impact Analysis

Rulemaking Background

- Four products are bundled together in a single rulemaking
- Commercial Clothes Washers and Residential Dehumidifiers
  - EPACT 2005 legislated standards
  - Test procedures will be codified in CFR
- Residential Dishwashers and Cooking Products
  - NAECA (1987) legislated standards
  - DOE updated dishwasher standards in 1994
  - Electric Cooking Products – DOE issued Final Rule in 1998; further standards not economically justified as burdens outweighed benefits
  - DOE updated test procedures
    - 1997 Cooking Products
    - 2003 Dishwashers

Rulemaking Schedule

- Workshop Comments Due – May 11, 2006
- Data Collection Complete – June 2006
- ANOPR – August 2007
- NOPR – July 2008
- Final Rule – March 2009

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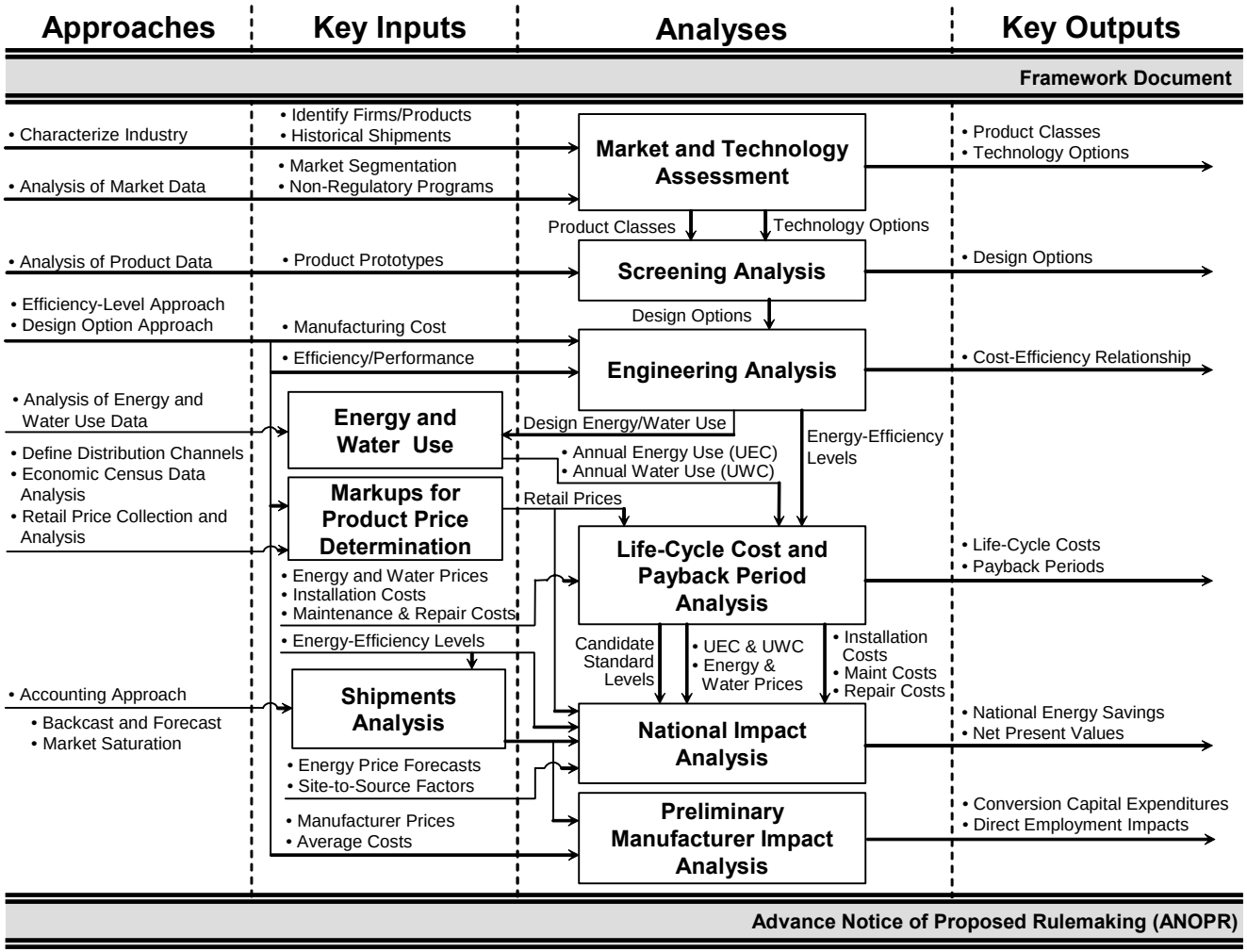
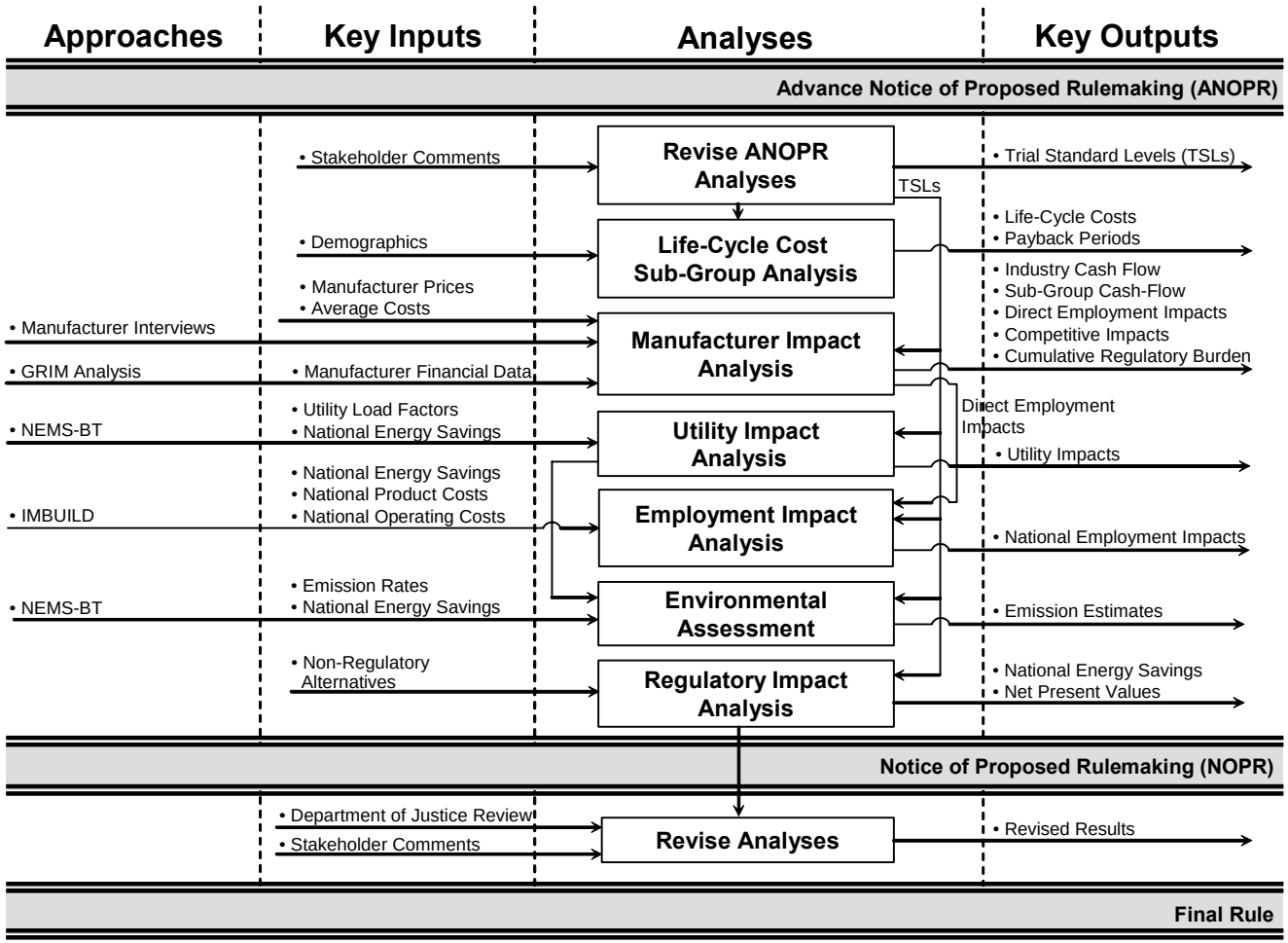
Analyses for ANOPR



Analyses for NOPR and Final Rule



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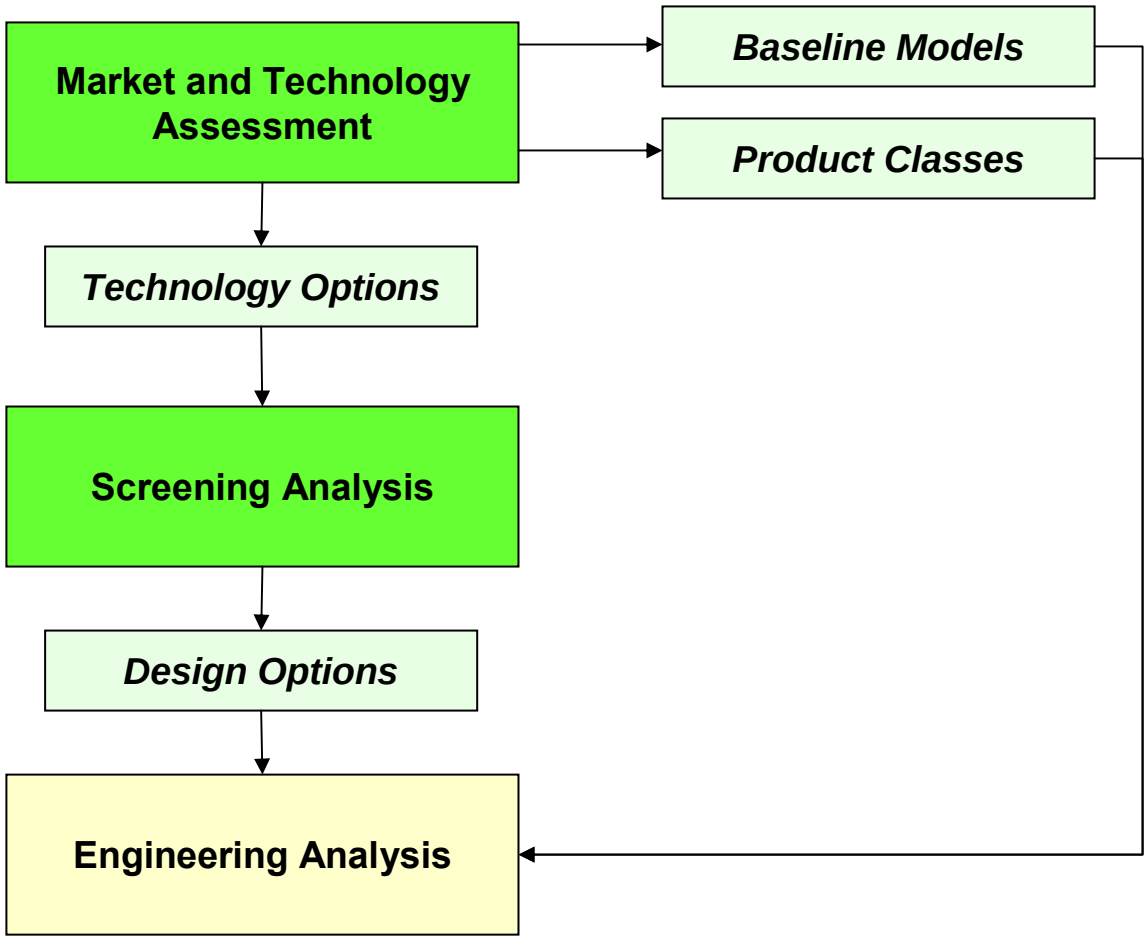
Relationship of Analyses



Market and Technology Assessment

- The Department is currently gathering information including:
  - Market structure data
  - Historical product shipments and prices
  - Current product features and efficiencies
  - Product-feature and efficiency trends
  - Distribution channel information
  - Non-regulatory incentives

- ***The Department requests information that would contribute to the market and technology assessment.***

Product Classes

- The Department separates each product into product classes based on type of energy used, capacity or other performance-related features.
- The Department establishes separate energy conservation standards for each product class.

Baseline Models

- The Department defines baseline model characteristics to serve as the basis for the analysis:
  - Includes capacity, configuration, efficiency, and features.
  - Usually based on the most commonly sold minimum efficiency product in each product class.
  - Serves as the basis for cost and performance estimates that are intended to represent the “typical” product.

Technology Options

- The Department identifies technologies manufacturers could use to attain higher energy efficiency levels for each product.
- Initially, the Department intends to develop the list of technologies for each product that can and should be considered in the analysis, including all those technologies considered to be technologically feasible.

Screening Analysis

- In the screening analysis, DOE will eliminate from further consideration technology options that: are not technologically feasible; are not practicable to manufacture, install and service; have significant adverse impact on the utility of the product to consumers; or adversely affect health or safety.
- Technologies not screened out are referred to as design options.

Product Discussions

1	Commercial Clothes Washers
2	Residential Dishwashers
3	Residential Dehumidifiers
4	Residential Cooking Products

Commercial Clothes Washer Product Class

- EPACT 2005 establishes one product class for commercial clothes washers that encompasses both top- and front-loading units.
- EPACT 2005 defines commercial clothes washers as soft-mount, front-loading or soft-mount, top-loading washers that have a clothes container compartment that is not more than 3.5 cubic feet for horizontal-axis clothes washers and not more than 4.0 cubic feet for vertical-axis clothes washers.
- The Department is considering using the EPACT 2005 product class for their rulemaking.

Commercial Clothes Washer Baseline Model

- EPACT 2005 establishes energy and water conservation standards for commercial clothes washers:
  - Minimum modified energy factor (MEF*) of 1.26
  - Maximum water factor** of 9.5
- The Department is considering using the EPACT 2005 levels to characterize the baseline model.

*** MEF means the quotient of the cubic foot (or liter) capacity of the clothes container divided by the total clothes washer energy consumption per cycle, with such energy consumption expressed as the sum of the machine electrical energy consumption, the hot water energy consumption, and the energy required for removal of the remaining moisture in the wash load.**
**** Water factor means the quotient of the total weighted per-cycle water consumption divided by the cubic foot (or liter) capacity of the clothes washer.**

Commercial Clothes Washer Technology Options

Potential technology options to be considered:

- Added insulation
- Adaptive control systems
- Automatic fill control
- Direct-drive motor
- Horizontal-axis design
- Horizontal-axis design with recirculation
- Improved-fill control
- Improved water extraction to lower remaining moisture content
- Thermostatically controlled mixing valves
- Increased motor efficiency
- Tighter tub tolerance
- Bubble action
- Electric disassociation of water
- Ozonated laundering
- Reduced thermal mass
- Suds-saving
- Ultrasonic washing
- Steam washing
- Improved horizontal-axis-washer drum design

Issues on Which DOE Seeks Comment

- ***Should the Department consider different product classes for commercial clothes washers? For what reasons?***
- ***Are the energy and water conservation levels identified appropriate for characterizing the performance of baseline commercial clothes washers?***
- ***Are there other technologies that can improve commercial clothes washer efficiency that DOE should consider as technology options?***
- ***Of the technology options listed on the previous slide, are there any that DOE should not consider because they are not technologically feasible; are not practicable to manufacture, install and service; have significant adverse impact on the utility of the product to consumers; or adversely affect health or safety?***

Residential Dishwasher Product Classes

- On May 14, 1991, DOE established energy conservation standards for two product classes of residential dishwashers. The product classes are based on the size of the dishwasher (as specified in ANSI/AHAM Standard DW-1).
  - Compact, capacity less than eight place settings plus six serving pieces
  - Standard, capacity equal to or greater than eight place settings plus six serving pieces
- The Department is considering using the product classes from this previous rulemaking for their rulemaking.

Residential Dishwasher Baseline Models

- The minimum energy conservation standards for dishwashers, as measured by the energy factor (EF*) in cycles per kWh, became effective on May 14, 1994.
  - Compact = 0.62 EF
  - Standard = 0.46 EF
- The Department is considering using these levels to characterize the baseline models.

*** Energy factor (EF) is the number of cycles per kilowatt-hour per year.**

Residential Dishwasher Technology Options

Potential technology options to be considered:

- Improved food filter
- Improved spray-arm geometry
- Improved fill control
- Modified sump geometry with and without dual pumps
- Microprocessor controls and fuzzy logic including adaptive or soil-sensing controls
- Reduced inlet-water temperature
- Increase motor efficiency
- Increased insulation
- Flow-through heating
- Ultrasonic washing
- Variable washing pressures and flow rates
- Variable-speed drive system
- Condenser drying
- Fan/jet drying

Issues on Which DOE Seeks Comment

- ***Should the Department consider different product classes for dishwashers? For what reasons?***
- ***Are the energy conservation levels identified appropriate for characterizing the performance of baseline dishwashers?***
- ***Are there other technologies that can improve dishwasher efficiency that DOE should consider as technology options?***
- ***Of the technology options listed on the previous slide, are there any that DOE should not consider because they are not technologically feasible; are not practicable to manufacture, install and service; have significant adverse impact on the utility of the product to consumers; or adversely affect health or safety?***

Residential Dehumidifier Product Classes

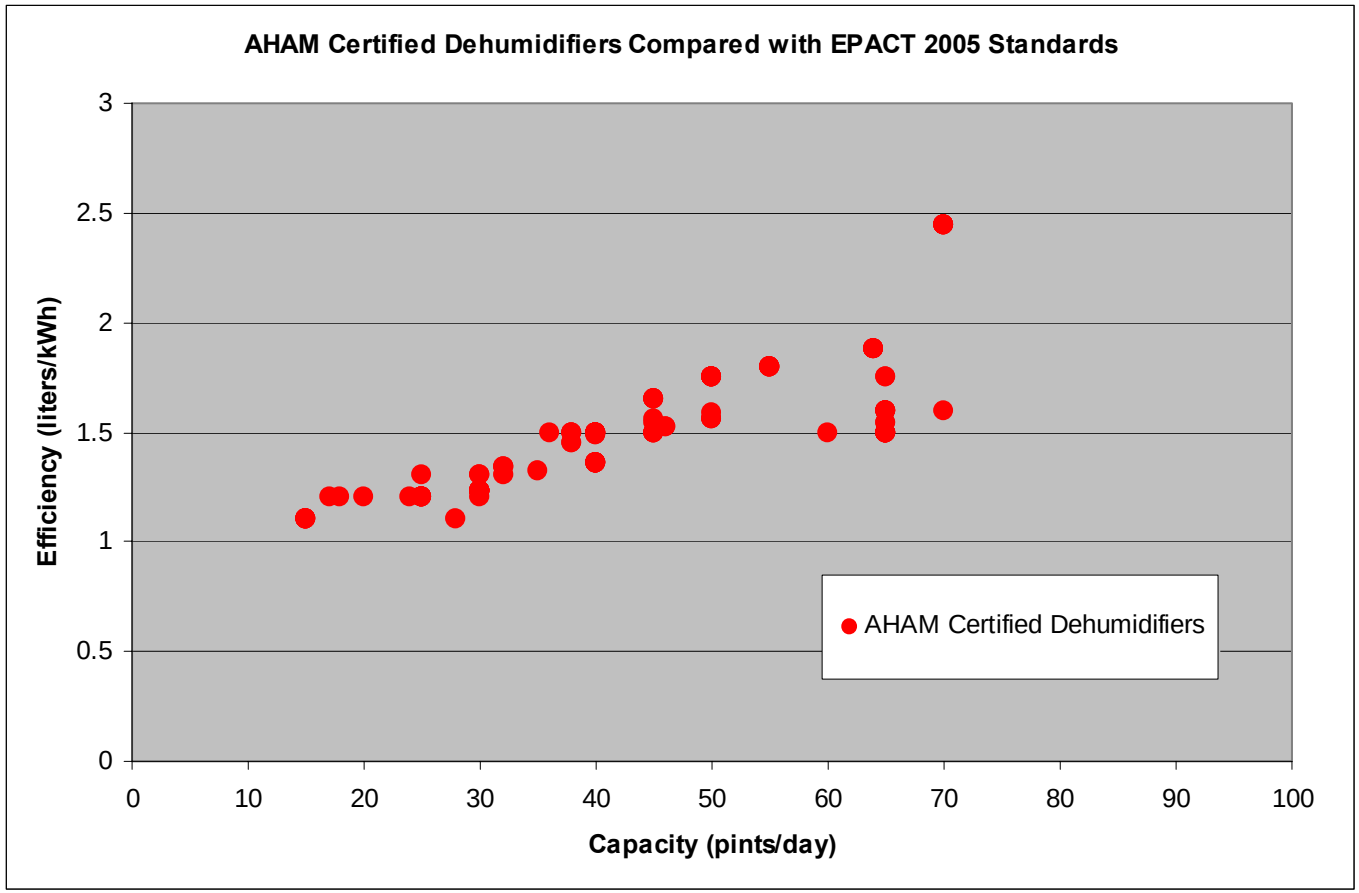
- For dehumidifiers, EPACT 2005 establishes six product classes based on the capacity of the unit as measured in pints of water extracted per day.
  - 25.00 pints/day or less
  - 25.01-35.00 pints/day
  - 35.01-45.00 pints/day
  - 45.01-54.00 pints/day
  - 54.01-74.99 pints/day
  - 75.00 pints/day or more

→ **Combined for 2007 standard**

- The Department is considering using the EPACT 2005 product classes for their rulemaking.

Dehumidifier Capacity-Efficiency Relationship

- An initial review of dehumidifier models in AHAM's *Directory of Certified Dehumidifiers* seems to show a correlation between efficiency and capacity.



Residential Dehumidifier Baseline Model

- Because efficiency seems to be a function of capacity, the Department plans to complete the engineering and life-cycle cost (LCC) analyses on the product class with the greatest percentage of shipments and then extrapolate to the other five product classes.
- The Department plans to use 35.01-45.00 pints/day as the representative product class.
- The EPACT 2005 standard for this product class is 1.30 liters/kWh.
- The Department is considering using the EPACT 2005 level to characterize the baseline model.

Residential Dehumidifier Technology Options

Potential technology options to be considered:

- Improved compressor efficiency
- Improved fan-motor efficiency
- Improved fan efficiency
- Improved evaporator performance
- Improved condenser performance
- Improved flow-control devices
- Improved demand-defrost controls
- Heat-pipe technology

Issues on Which DOE Seeks Comment

- ***Should the Department consider different product classes for dehumidifiers? For what reasons?***
- ***The Department seeks input on possible methods of extrapolating the standard levels and national impact analysis of the representative dehumidifier product class to the other five product classes (e.g., maintaining relative incremental energy use specified in EPACT 2005 across product classes).***
- ***Is the energy conservation level identified appropriate for characterizing the performance of baseline dehumidifiers?***
- ***Are there other technologies that can improve dehumidifier efficiency that DOE should consider as technology options?***
- ***Of the technology options listed on the previous slide, are there any that DOE should not consider because they are not technologically feasible; are not practicable to manufacture, install and service; have significant adverse impact on the utility of the product to consumers; or adversely affect health or safety?***

Product Classes for Residential Electric Cooking Products

- For electric cooking products, the Department is considering product classes based on the list of classes defined by DOE in its 1996 technical support document (TSD) for residential cooking products.
  - Electric Cooktops
    - **Low or high wattage open (coil) elements**
    - **Smooth elements**
    - **Grill with or without down draft feature**
    - **Griddle with or without down draft feature**
  - Electric Ovens
    - **Standard oven with or without catalytic line**
    - **Self-clean**

Not analyzed in the 1996 TSD due to the small amount of empirical data and because the current DOE test procedure cannot measure the energy consumption of grills and griddles.

Product Classes for Residential Gas Cooking Products

- For gas cooking products, the Department is considering product classes based on the list of classes defined by DOE in its 1996 TSD for residential cooking products.
  - Gas Cooktops
    - **Conventional burners**
    - **Grill with or without down draft feature**
    - **Griddle with or without down draft feature**
    - **Warming/Simmer burners**

    → **Not analyzed in the 1996 TSD due to the small amount of empirical data and because the current DOE test procedure cannot measure the energy consumption of grills, griddles, and warming burners.**

    - **Commercial type** → **Not analyzed in the 1996 TSD due to the small number of shipments, insufficient engineering/cost data, higher burner firing-rate, and larger cavity volume specifications.**
  - Gas Ovens
    - **Standard oven with or without catalytic line**
    - **Self-clean**
    - **Commercial type** → **Not analyzed in the 1996 TSD due to the small number of shipments, insufficient engineering/cost data, higher burner firing-rate, and larger cavity volume specifications.**

Product Classes for Residential Microwave Ovens

- For microwave ovens, the Department is considering one product class, encompassing units with and without browning elements, as presented in DOE's 1996 TSD for residential cooking products.
- The 1996 TSD notes stakeholder comments requesting five additional product classes for residential microwave ovens:
  - Portable Microwave Only (cavity volume < 0.8 ft^3)
  - Portable Microwave Only (cavity volume of 0.8 to 1.19 ft^3)
  - Portable Microwave Only (cavity volume > 1.2 ft^3)
  - Portable Microwave/Thermal (convection)
  - Built-in (fixed)

Electric Residential Cooking Product Baseline Models

- The 1996 TSD for residential cooking products established the following baseline energy factors (EFs*) and characteristics for the largest-selling electric product classes:
  - Electric Cooktops, open (coil) elements = 0.737 EF
    - Cooktop cooking efficiency = 73.7%; two 6-inch (1250 watt) and two 8-inch (2100 watt) elements
  - Electric Cooktops, smooth elements = 0.742 EF
    - Cooktop cooking efficiency = 74.2%; two 6-inch (1500 watt) and two 8-inch (2000 watt) solid disk elements
  - Electric Ovens, standard with or without a catalytic line = 0.107 EF
    - Cooking efficiency = 12.15%; clock power = 3.9 watts; 2" of 1.09 lb/cu. ft. insulation; 3.9 cu. ft. volume
  - Electric Ovens, self-clean = 0.096 EF
    - Cooking efficiency = 13.79%; clock power = 3.8 watts; 2" of 1.90 lb/cu. ft. insulation; self-cleaning energy consumption = 5286 watt-hours; 3.9 cu. ft. volume
  - Microwave Ovens = 0.557 EF
    - Cooking efficiency = 55.7%; input power = 1485 watts

*** EF is a measure of overall cooking product efficiency. EF is expressed as a percent and is the ratio of the annual useful cooking energy output of the cooking appliance (energy conveyed to the item being heated) to its total annual energy consumption.**

Gas Residential Cooking Product Baseline Models

- The 1996 TSD for residential cooking products established the following baseline energy factors (EFs*) and characteristics for the largest-selling gas product classes:
  - Gas Cooktops, conventional burners = 0.156 EF
    - Cooktop cooking efficiency = 39.9%; four conventional 9000 Btu/hr burners, two 117 Btu/hr standing pilots
  - Gas Ovens, standard with or without a catalytic line = 0.030 EF
    - Cooking efficiency = 5.92%; 2" of 1.09 lb/cu. ft. insulation; standing pilot ignition = 175 Btu/hour; 3.9 cu. ft. volume
  - Gas Ovens, self-clean = 0.054 EF
    - Cooking efficiency = 7.13%; clock power = 3.6 watts; 2" of 1.90 lb/cu. ft. insulation; electric ignition = 176 watt-hours; self-cleaning energy consumption = 43,158 Btu; 3.9 cu. ft. volume

*** EF is a measure of overall cooking product efficiency. EF is expressed as a percent and is the ratio of the annual useful cooking energy output of the cooking appliance (energy conveyed to the item being heated) to its total annual energy consumption.**

Residential Gas Cooktop Technology Options

Potential technology options to be considered:

- Reduce excess air at burner
- Electronic ignition
- Sealed burners
- Reflective surfaces
- Insulation
- Thermostatically controlled burners*
- Catalytic burners
- Radiant gas burners*

*** Indicates technology options for which the DOE test procedure can/may not measure efficiency improvements.**

Residential Electric Cooktop Technology Options

Potential technology options to be considered:

- Open (coil) elements
  - Improved contact conductance
  - Reflective surfaces
  - Insulation
  - Electronic controls*
- Smooth elements
  - Induction elements
  - Halogen elements
  - Radiant elements
  - Electronic controls*

*** Indicates technology options for which the DOE test procedure can not measure efficiency improvements.**

Residential Gas and Electric Oven Technology Options

Potential technology options to be considered:

- No oven-door window*
- Improved insulation
- Added insulation**
- Reduced vent rate†
- Reduced conduction losses
- Reflective surfaces
- Forced convection
- Oven separator
- Improved door seals
- Steam cooking
- Bi-radiant oven (electric only)
- Halogen lamp oven (electric only)
- Pilotless ignition (gas only)
- Radiant burners (gas only)

*** DOE dropped the "no oven-door window" option in 1996 due to potential impacts on consumer utility and safety.**
**** Not analyzed in 1996 over concerns of possible reduced consumer utility.**
† The 1996 TSD did not apply this option to self-clean ovens.

Residential Microwave Oven Technology Options

Potential technology options to be considered:

- Added insulation
- Reflective surfaces
- Improve efficiency of fan
- Improve efficiency of magnetron
- Improve efficiency of power supply
- Eliminate or improve ceramic stirrer cover
- Modify wave guide
- Dual magnetrons

Issues on Which DOE Seeks Comment

- ***Should the Department consider different product classes for cooking products? For what reasons?***
- ***Are the efficiency levels identified appropriate for characterizing the performance of baseline cooking products?***
- ***Are there other technologies that can improve cooking product efficiency that DOE should consider as technology options?***
- ***Of the technology options listed on the previous slides, are there any that DOE should not consider because they are not technologically feasible; are not practicable to manufacture, install and service; have significant adverse impact on the utility of the product to consumers; or adversely affect health or safety?***

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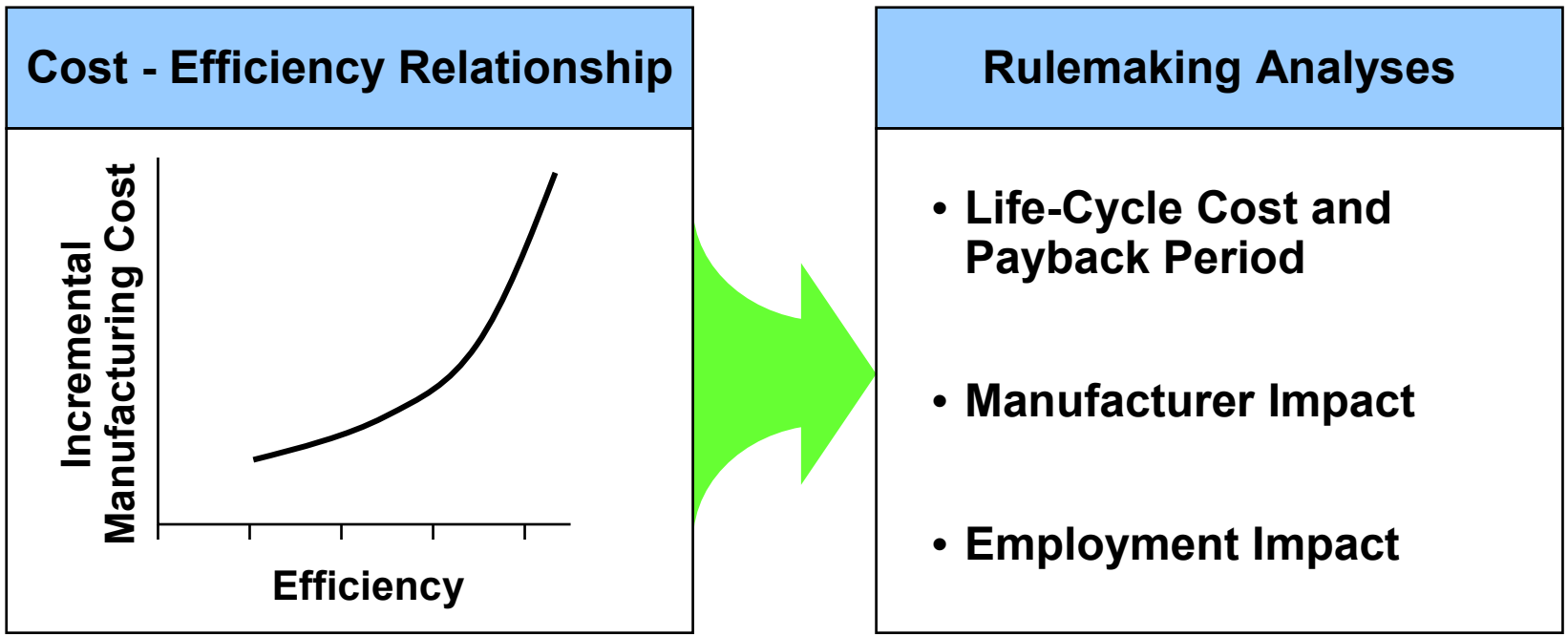
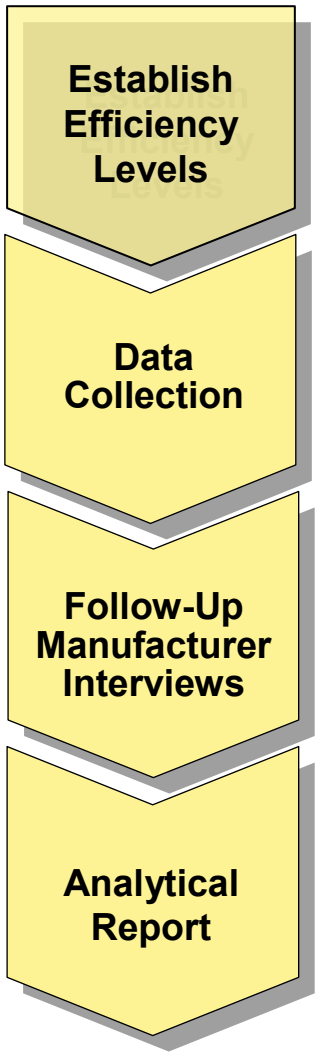
Purpose

- The engineering analysis characterizes the relationship between manufacturer cost and energy efficiency.

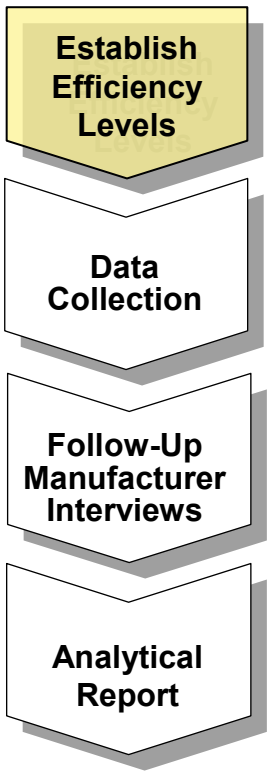


Methodology



- ⇦ Determine efficiency levels for collecting incremental cost data.
- ⇦ Collect incremental cost data, broken down by material, labor, and overhead costs.
- ⇦ Conduct manufacturer interviews to obtain a deeper understanding of the various combinations of technologies used to increase product efficiency.
- ⇦ Document the technologies associated with each efficiency level.

Establish Efficiency Levels



- Determine the baseline model efficiency levels
- Identify the maximum technologically feasible efficiency levels
- Determine the intermediate efficiency levels based on available products on the market, existing voluntary initiatives, and consideration of the performance of design options considered

Data Collection

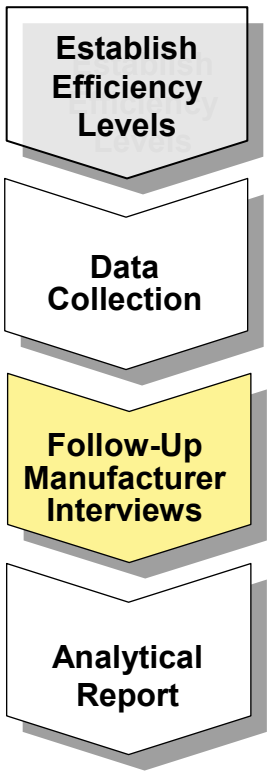
- Establish Efficiency Levels
- Data Collection
- Follow-Up Manufacturer Interviews
- Analytical Report

- The Department seeks to obtain incremental cost data for each of the four products.

Product Class →	Compact Dishwashers							Standard Dishwashers						
Efficiency Level	1	2	3	4	5	6	7	1	2	3	4	5	6	7
EF	0.78	0.84	0.88	0.92	1.01	1.08	1.74	0.58	0.62	0.65	0.68	0.75	0.80	1.11
Average Incremental Costs ($ Per Unit)*														
Material														
Labor														
Overhead#														
Minimum Incremental Costs ($ Per Unit)*														
Material														
Labor														
Overhead#														
Maximum Incremental Costs ($ Per Unit)*														
Material														
Labor														
Overhead#														
Conversion Capital Expenditures ($, Millions)														
Building CAPX														
Tooling/ Equipment CAPX														
One-Time Product Conversion Expenses ($, Millions)														
R&D														
Marketing														

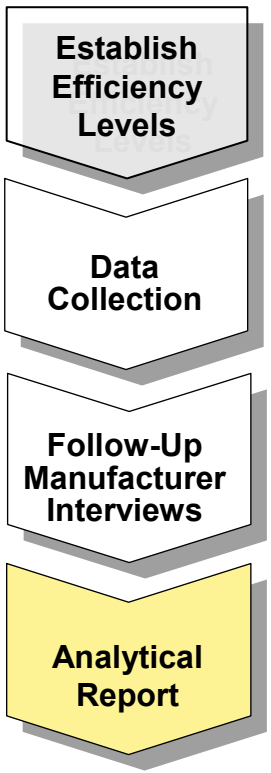
Depreciation on the conversion capital expenditure should NOT be included in the incremental overhead.
* Incremental costs per unit should be reported relative to the baseline unit's cost. The baseline unit complies with the federal standard for residential dishwashers and is equal to 0.62 cycles/kWh for compact dishwashers and 0.46 cycles/kWh for standard dishwashers.

Follow-Up Manufacturer Interviews



- Interviews will help understand and document the cost of improved efficiency. Example questions include:
  - What are the typical components of the baseline unit?
  - What design features are needed to raise the efficiency of the baseline unit to a specified higher efficiency? What are the costs of these components?
  - What are the fundamental differences between required design changes that make the cost increment much higher for some product class/sizes than others?
  - What capital conversion investments are necessary at each efficiency level? What is the nature of the capital investments?

Analytical Report

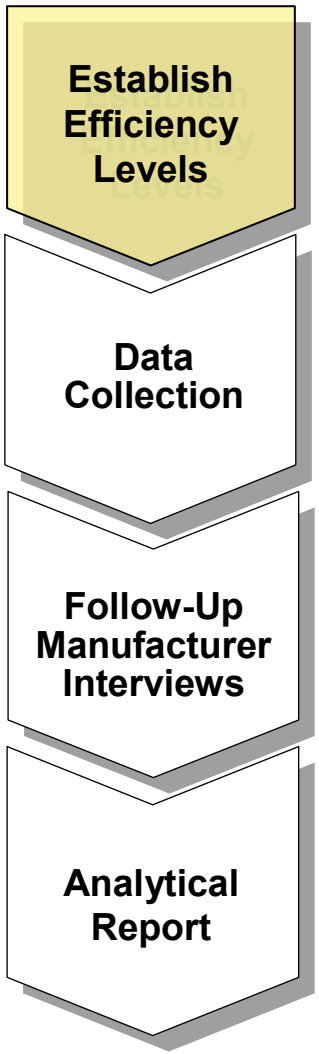


- Document the technologies, and their associated costs, used to achieve each efficiency level.
- Compare new estimates of improved efficiency with market and technology assessment information.
- Document any discrepancies between market and technology assessment information, collected data, and information from manufacturer interviews.

Issues on Which DOE Seeks Comment

- ***The Department requests feedback on the proposed approach for conducting the engineering analysis.***

Establish Efficiency Levels



- ⇦ Determine efficiency levels for collecting incremental cost data.
- ⇦ Collect incremental cost data, broken down by material, labor, and overhead costs.
- ⇦ Conduct manufacturer interviews to obtain a deeper understanding of the various combinations of technologies used to increase product efficiency.
- ⇦ Document the technologies associated with each efficiency level.

Commercial Clothes Washers

- For the purposes of analyzing the cost-efficiency relationship for commercial clothes washers, the Department is considering six efficiency levels.

Level	Efficiency Level Source	Efficiency Level	
		MEF	Water Factor
baseline	DOE Standard (effective 2007)	1.26	9.5
1	CEE Tier 1	1.42	9.5
2	CEE Tier 2	1.60	8.5
3	2007 ENERGY STAR	1.72	8.0
4	CEE Tier 3A	1.80	7.5
5	CEE Tier 3B	1.80	5.5
6	Max Available	2.79	3.5*

* The MEF and WF are not from the same clothes washer. The clothes washer with an MEF of 2.79 has a water factor of 6.0 and the clothes washer with a water factor of 3.5 has an MEF of 2.48. Source: ENERGY STAR qualified clothes washers as of February 7, 2006.

- ***The Department seeks input on the levels for collecting data and the appropriate maximum technologically feasible efficiency levels. The Department also invites comment on suggested MEF and WF pairings.***

Residential Dishwashers

- For the purposes of analyzing the cost-efficiency relationship for residential dishwashers, the Department is considering seven efficiency levels.

Level	Efficiency Level Source	Efficiency Level (cycles/kWh)	
		Compact	Standard
baseline	DOE Standard	0.62	0.46
1	ENERGY STAR (scaled for compact)	0.78	0.58
2	CEE Tier 1 (scaled for compact)	0.84	0.62
3	2007 ENERGY STAR	0.88	0.65
4	CEE Tier 2 (scaled for compact)	0.92	0.68
5	Gap Fill	1.01	0.75
6	Gap Fill	1.08	0.80
7	Max Available	1.74*	1.11**

* Source: Oregon Department of Energy, Tax Credit Qualifying Dishwashers Feb. 2006.
** Source: ENERGY STAR qualified dishwashers as of February 8, 2006.

- ***The Department seeks input on the levels for collecting data and appropriate maximum technologically feasible efficiency levels.***

Residential Dehumidifiers

- For the purposes of analyzing the cost-efficiency relationship for residential dehumidifiers, the Department is considering four efficiency levels.

Level	Efficiency Level Source	Efficiency Levels (liters/kWh)
		35.01–45.00 pints/day
baseline	DOE Standard (effective 2007)	1.30
1	Between DOE and Default 2012 Standard	1.35
2	Default 2012 Standard (EPACT 2005)	1.40
3	Between Default 2012 Standard and Max Available	1.50
4	Max Available*	1.74

* Source: ENERGY STAR qualified dehumidifiers as of November 28, 2005.

- ***The Department seeks input on the levels for collecting data and the appropriate maximum technologically feasible efficiency level.***

Residential Gas Cooktops

- For the purposes of analyzing the cost-efficiency relationship for residential gas cooktops, the Department is considering two efficiency levels.

Level	Efficiency Level Source	Efficiency Level (EF)
		Conventional burners
Baseline	1996 TSD (with standing pilots)	0.156
1	1996 TSD (without standing pilots)	0.399
2	Max Tech (1996 TSD)	0.420

- ***The Department seeks input on the levels for collecting data and the appropriate maximum technologically feasible efficiency level.***

Residential Electric Cooktops

- For the purposes of analyzing the cost-efficiency relationship for residential electric cooktops, the Department is considering three efficiency levels.

Level	Efficiency Level Source	Efficiency Level (EF)	
		Low or high wattage open (coil) elements	Smooth elements
baseline	1996 TSD	0.737	0.742
1	1996 TSD/ Calculated	0.753	0.753
2	1996 TSD/ Calculated	0.769	0.797
3	Max Tech (1996 TSD)	0.777	0.840

- ***The Department seeks input on the levels for collecting data and appropriate maximum technologically feasible efficiency levels.***

Residential Gas Ovens

- For the purposes of analyzing the cost-efficiency relationship for residential gas ovens, the Department is considering three efficiency levels.

Level	Efficiency Level Source	Efficiency Level (EF)	
		Standard oven with or without catalytic line	Self-clean oven
baseline	1996 TSD*	0.030	0.054
1	1996 TSD**	0.058	0.062
2	1996 TSD	0.062	0.063
3	Max Tech (1996 TSD)	0.065	0.065

* For standard oven product class, baseline efficiency level assumes the inclusion of a standing pilot ignition system.
** For standard oven product class, first efficiency level assumes the elimination of the standing pilot ignition system.

- ***The Department seeks input on the levels for collecting data and appropriate maximum technologically feasible efficiency levels.***

Residential Electric Ovens

- For the purposes of analyzing the cost-efficiency relationship for residential electric ovens, the Department is considering three efficiency levels.

Level	Efficiency Level Source	Efficiency Level (EF)	
		Standard oven with or without catalytic line	Self-clean oven
baseline	1996 TSD	0.107	0.096
1	1996 TSD	0.111	0.133
2	1996 TSD	0.118	0.136
3	Max Tech (1996 TSD)	0.180	0.137

- ***The Department seeks input on the levels for collecting data and appropriate maximum technologically feasible efficiency levels.***

Residential Microwave Ovens

- For the purposes of analyzing the cost-efficiency relationship for residential microwave ovens, the Department is considering four efficiency levels.

Level	Efficiency Level Source	Efficiency Level (EF)
baseline	1996 TSD	0.557
1	1996 TSD	0.586
2	1996 TSD	0.588
3	1996 TSD	0.597
4	Max Tech (1996 TSD)	0.602

- ***The Department seeks input on the levels for collecting data and the appropriate maximum technologically feasible efficiency level.***

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Energy and Water Use

- The Department needs annual energy and water consumption data reflecting actual use for the life-cycle cost and payback period analysis to calculate annual operating costs.
- DOE will develop average energy and water use values.
  - For dishwashers and cooking products, test procedures have recently been updated—average test procedure values may already reflect actual consumption.
- DOE also will investigate variability.

Commercial Clothes Washers

- The Department requests per-cycle energy and water use for each efficiency level.

Level	Efficiency Level Source	Efficiency Level		Energy Use (kWh/cycle)			Water Use (gal/cycle)
		MEF	Water Factor	Hot Water	Machine	Dryer	
baseline	DOE Standard*	1.26	9.5				
1	CEE Tier 1	1.42	9.5				
2	CEE Tier 2	1.60	8.5				
3	2007 ENERGY STAR	1.72	8.0				
4	CEE Tier 3A	1.80	7.5				
5	CEE Tier 3B	1.80	5.5				
6	Max Available	2.79	3.5				

* Provide the clothes container volume in cubic feet.

- Convert per-cycle values into annual values using cycles per year
  - Multi-Housing: Multi-housing Laundry Association (MLA) provides various sources to establish cycles/day (1-11 cycles/day).
  - Laundromats: Coin Laundry Association (CLA) provides 3-8 cycles/day.
  - DOE may need to investigate other establishments with on-site laundry facilities.

Dishwashers

- The Department requests per-cycle energy and water use for each efficiency level.

Level	Efficiency Level Source	Efficiency Level (cycles/kWh)		Energy Use (kWh/cycle)			Water Use (gal/cycle)
		Compact	Standard	Hot Water	Machine	Dryer	
baseline	DOE Standard*	0.62	0.46				
1	ENERGY STAR	0.78	0.58				
2	CEE Tier 1	0.84	0.62				
3	2007 ENERGY STAR	0.88	0.65				
4	CEE Tier 2	0.92	0.68				
5	Gap Fill	1.01	0.75				
6	Gap Fill	1.08	0.80				
7	Max Available	1.74	1.11				

- Convert per-cycle values into annual values using cycles per year representative of actual use
  - DOE test procedure establishes a use of 215 cycles/year

Dehumidifiers

- Determine daily energy use from capacity and efficiency level.
  - Efficiency level: water removed per unit energy (liter/kWh)
  - Capacity: water removed per day (pints/day)
  - Daily energy use = Capacity ÷ Efficiency
- Determine annual energy use from daily use and annual operating hours.
  - Operating hours per year not well defined.
  - DOE 2003 priority-setting activities used 970 kWh/y.
  - Shipments data indicate predominant use in East and Midwest.
    - With weather data may provide an indication of operational hours.

Cooking Products

- Annual energy consumption determined from Energy Factor (EF) and Annual Useful Cooking Energy Output ($Output_{useful}$)
  - Annual Energy Use = $Output_{useful}$ ÷ EF
  - DOE test procedure modified in 1997 to reflect more accurate $Ouput_{useful}$ values.
  - Conventional cooking products: $Output_{useful}$ 55–60% lower than values in original test procedure.
  - Microwave ovens: $Output_{useful}$ ~125% higher than original value.

Product Type	Annual Useful Cooking Energy Output		Baseline EF	Annual Energy Use
	Original	Current		
GAS (kBtu/year)				
Cooktops	947.5	527.6	0.16	3300
Ovens	160.7	88.8	0.03	2960
ELECTRIC (kWh/yr)				
Cooktops	277.7	173.1	0.74	234
Ovens	47.1	29.3	0.10	293
Microwave Oven	34.2	79.8	0.56	143

Gas Cooktops

- The Department requests cooking efficiency for each efficiency level and standing pilot data for the baseline unit.

Level	Efficiency Level Source	Efficiency Level (EF)
		Conventional burners
baseline	1996 TSD (with standing pilots)*	0.156
1	1996 TSD (without standing pilots)	0.399
2	Max Tech (1996 TSD)	0.420

* Provide the number of standing pilots for the baseline cooktop and the input rate (Btu/hr) per pilot.

Standard Gas Ovens

- For standard gas ovens, the Department requests cooking efficiency and electrical test energy consumption for each efficiency level and standing pilot data for the baseline unit.

Level	Efficiency Level Source	Efficiency Level (EF)	Cooking Efficiency (Eff)	Standing Pilot Input Rate (Btu/hr)	Electrical Test Energy Consumption (kWh/yr)#
		Standard oven with or without catalytic line			
baseline	1996 TSD	0.030*			NA
1	1996 TSD	0.058**		NA	
2	1996 TSD	0.062		NA	
3	Max Tech (1996 TSD)	0.065		NA	

* For standard oven product class, baseline efficiency level assumes: (1) inclusion of a standing pilot ignition system and (2) no electrical energy consumption.

** For standard oven product class, first efficiency level assumes the elimination of the standing pilot ignition system.

Electrical test energy consumption as measured by DOE test procedure. Includes electrical energy use for ignition system plus any other electrical energy use.

Self-Cleaning Gas Ovens

- For self-cleaning gas ovens, the Department requests cooking efficiency, self-cleaning energy consumption, electrical test energy consumption, and clock power for each efficiency level.

Level	Efficiency Level Source	Efficiency Level (EF)	Cooking Efficiency/Energy Use		Self-Cleaning Energy Use		Clock Power (Watts)
		Self-Cleaning	Cooking Efficiency (Eff)	Electrical Test Energy Use (kWh/yr)#	Gas Use per Cycle (Btu/cycle)	Secondary Elec. Use per Cycle (Watt-hr/cycle)	
baseline	1996 TSD	0.054					
1	1996 TSD	0.062					
2	1996 TSD	0.063					
3	Max Tech (1996 TSD)	0.065					

Electrical test energy consumption as measured by DOE test procedure. Includes electrical energy use for ignition system plus any other non-self-cleaning electrical energy use.

Standard Electric Ovens

- For standard electric ovens, the Department requests cooking efficiency and clock power for each efficiency level.

Level	Efficiency Level Source	Efficiency Level (EF)	Cooking Efficiency (Eff)	Clock Power (Watts)
		Standard oven with or without catalytic line		
baseline	1996 TSD	0.107		
1	1996 TSD	0.111		
2	1996 TSD	0.118		
3	Max Tech (1996 TSD)	0.180		

Self-Cleaning Electric Ovens

- For self-cleaning electric ovens, the Department requests cooking efficiency, self-cleaning energy consumption per cycle, and clock power for each efficiency level.

Level	Efficiency Level Source	Efficiency Level (EF)	Cooking Efficiency (Eff)	Self-Cleaning Energy Consumption per Cycle (Watt-hr/cycle)	Clock Power (Watts)
		Self-Cleaning			
baseline	1996 TSD	0.096			
1	1996 TSD	0.133			
2	1996 TSD	0.136			
3	Max Tech (1996 TSD)	0.137			

Issues on Which DOE Seeks Comment

- ***The Department seeks stakeholder input on the approaches proposed for specifying the typical annual energy and water consumption. Most importantly, the Department is interested in sources of data that can assist in characterizing the cycles per year for commercial clothes washers and the annual energy consumption of dehumidifiers.***
- ***The Department seeks stakeholder input on data sources that it can use to characterize the variability in annual energy and water consumption for each of the four products.***

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Markups for Equipment Price Determination

- The Department uses markups to convert manufacturer prices from the engineering analysis into consumer retail prices.
- DOE needs retail prices for the life-cycle cost and payback period analysis.
- DOE must characterize distribution channels for each product.
  - DOE understands that over 93% percent of consumer products are distributed from manufacturers directly to retailers.
  - Distributors or wholesalers distribute commercial clothes washers to laundromats; Route operators distribute to multi-family buildings.
- DOE develops markups for each party involved in product distribution.
- U.S. Census Bureau provides data for calculating markups.
- DOE may collect retail price data for validation purposes.
- DOE will investigate the variability of retail prices.

Issues on Which DOE Seeks Comment

- ***The Department welcomes suggestions and comments concerning its proposed approach to develop estimates of retail prices.***

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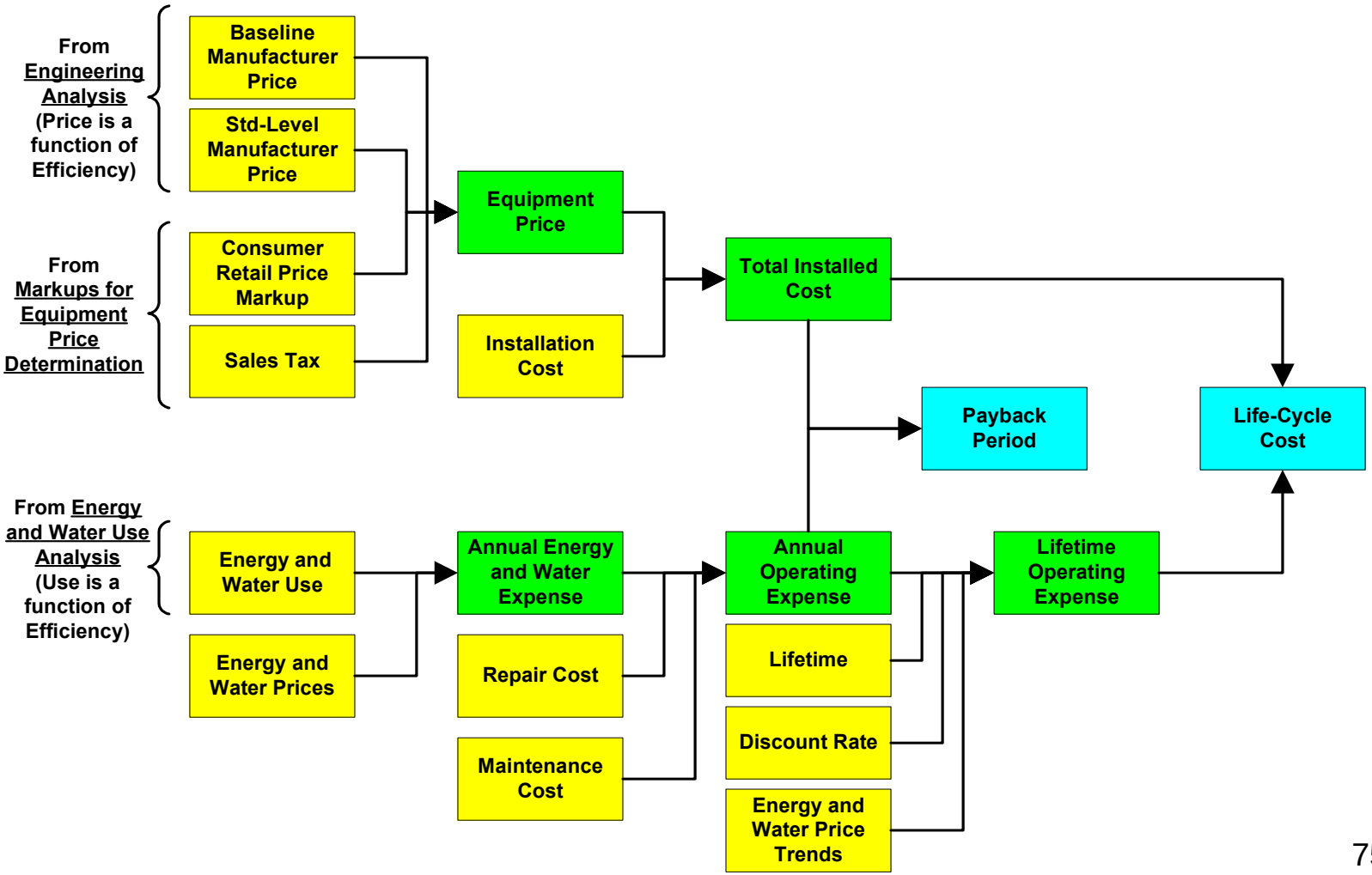
Life-Cycle Cost and Payback Period Analysis

- Effect of increased efficiency standards on lifetime operating expense savings compared to the increase in purchase price
- Approach
  - Calculate average LCC savings and PBPs from average input values
  - Analyze variability with sensitivities using high and low input values

LCC and PBP Analysis Inputs



Energy and Water Prices

- Determine energy prices from DOE-Energy Information Administration (EIA) data.
- Determine water and wastewater prices from American Water Works Association (AWWA)/Raftelis Financial Consultants data.
- DOE will analyze variability using high and low price estimates.
- DOE will base energy price forecasts on EIA's Annual Energy Outlook.
- DOE will base water price forecasts on historical trends.

- ***The Department seeks input on the proposed approaches for estimating current and forecasted energy and water prices.***

Discount Rates

- DOE uses discount rates (DR) to discount future operating costs savings.
- DR for residential products – DOE will use similar approach as for other residential product standards rulemakings.
  - Derived from estimates of the "finance cost" to purchase residential products.
- DR for commercial clothes washers – DOE will use similar approach as for other commercial product standards rulemakings.
  - Derived from estimates of the cost of capital for companies that purchase commercial clothes washers.

- ***The Department seeks input on the proposed approaches for estimating discount rates for residential and commercial consumers.***

Maintenance, Repair, Installation Costs

- DOE assumes that increases in maintenance and repair costs are negligible for more-efficient products.
- DOE assumes that increases in installation costs are negligible for more-efficient products.
  - Exceptions are gas cooking products that require no electricity; efficiency increases requiring electricity may require electrical outlets to be installed.

- ***The Department seeks input on whether it is correct to assume that, with the exception of gas cooking products, changes in maintenance, repair, and installation costs will be negligible for more-efficient products.***

Product Lifetimes

- Past DOE analyses have used the following lifetimes:
  - Commercial Clothes Washers: 10 years
  - Dishwashers: 13 years
  - Dehumidifiers: 11 years
  - Cooking Products
    - Conventional: 19 years
    - Microwave Ovens: 10 years

- ***The Department seeks input on product lifetimes for the products of interest to this rulemaking.***

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Shipments Analysis

- Required to calculate national impacts from standards.
- Required to calculate future cashflows of manufacturers.

Base Case Forecast

- The base case forecast:
  - Depicts the situation where new standards are not adopted
  - Serves as a reference point from which to evaluate the impacts of standards
  - Forecast accounts for products going to replace failed units, and those going to new construction
    - For dehumidifiers, forecasts may need to account for units going to existing households that do not already have the product.
- Data needed to develop base case forecast:
  - Historical shipments
  - Historical shipment-weighted average efficiencies
  - Market share efficiencies

Commercial Clothes Washers

- The Department requests historical shipments and shipment-weighted efficiency data.

Year	Shipments, Domestic + Imports (Thousands of Units)	Shipment-Weighted Average Efficiency	
		(EF or MEF)	(Water Factor)
1990			
1991			
↓	↓	↓	↓
2004			

- The Department requests market share efficiency data.

Efficiency Bins (MEF)	Market Share (percent) 2002	2003	2004	Efficiency Bins (Water Factor)	Market Share (percent) 2002	2003	2004
< 1.20				**< 9.5**			
1.20-1.29: Baseline = 1.26				**8.6-9.5:** Baseline = 9.5			
1.30-1.59: CEE Tier 1 = 1.42				**8.6-9.5:** CEE Tier 1 = 9.5			
1.60-1.69: CEE Tier 2 = 1.60				**8.1-8.5:** CEE Tier 2 = 8.5			
1.70-1.79: 2007 E. STAR =1.72				**7.6-8.0:** 2007 E. STAR = 8.0			
1.80-1.89: CEE Tier 3A =1.80				**6.1-7.5:** CEE Tier 3A = 7.5			
1.80-1.89: CEE Tier 3B =1.80				**4.0-6.0:** CEE Tier 3B = 5.5			
> 1.89: Max Available = 2.79				**< 4.0:** Max Available = 3.5			

Dishwashers

- The Department requests historical shipments and shipment-weighted efficiency data.

Year	Shipments, Domestic + Imports (Thousands of Units)		Shipment-Weighted Average Efficiency (EF)	
	Standard	Compact	Standard	Compact
1990				
1991				
↓	↓	↓	↓	↓
2004				

- The Department requests market share efficiency data.

Standard				Compact			
	Market Share (percent)				Market Share (percent)		
Efficiency Bins (EF)	2002	2003	2004	Efficiency Bins (EF)	2002	2003	2004
0.45-0.49: Baseline = 0.46				**0.60-0.64:** Baseline = 0.62			
0.50-0.59: E. STAR = 0.58				**0.65-0.79:** E. STAR = 0.78			
0.60-0.64: CEE Tier 1 = 0.62				**0.80-0.84:** CEE Tier 1 = 0.84			
0.65-0.67: 2007 E. STAR = 0.65				**0.85-0.89:** 2007 E. STAR = 0.88			
0.68-0.69: CEE Tier 2 = 0.68				**0.90-0.94:** CEE Tier 2 = 0.92			
0.70-0.79: Gap Fill = 0.75				**0.95-1.04:** Gap Fill = 1.01			
0.80-0.84: Gap Fill = 0.80				**1.05-1.09:** Gap Fill = 1.08			
> 0.84: Max Available = 1.11				**> 1.09:** Max Available = 1.74			

Dehumidifiers

- The Department requests historical shipments and shipment-weighted efficiency data.

Year	Shipments, Domestic + Imports (Thousands of Units)						Shipment-Weighted Average Efficiency (EF)					
	≤ 25.00	25.01-35.00	35.01-45.00	45.01-54.00	54.01-74.99	≥75.00	≤ 25.00	25.01-35.00	35.01-45.00	45.01-54.00	54.01-74.99	≥75.00
1990												
1991												
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
2004												

- The Department requests market share efficiency data.

≤ 25.00 pints/day				25.01-35.00 pints/day			
Efficiency Bins (EF)	Market Share (percent)			Efficiency Bins (EF)	Market Share (percent)		
	2002	2003	2004		2002	2003	2004
< 1.00				**< 1.20**			
1.00-1.09: Baseline = 1.00				**1.20-1.24:** Baseline = 1.20			
1.10-1.19: Mid Point 1 = 1.10				**1.25-1.29:** Mid Point 1 = 1.25			
1.20-1.29: EPACT 2005 = 1.20				**1.30-1.39:** EPACT 2005 = 1.30			
1.30-1.37: Mid Point 2 = 1.30				**1.40-1.44:** Mid Point 2 = 1.40			
> 1.37: Max Available = 1.38				**> 1.45:** Max Available = 1.45			

- The Department is requesting the same data for other product classes.

Cooking Products

- The Department requests historical shipments data.

Year	GAS COOKING PRODUCTS: Shipments, Domestic + Imports (Thousands of Units)							
	Free-Standing Ranges			Built-In Ovens			Cooktops	
	Standard			Standard				
	Pilot	No Pilot	Self-Clean	Pilot	No Pilot	Self-Clean	Pilot	No Pilot
1990								
1991								
↓	↓	↓	↓	↓	↓	↓	↓	↓
2004								

Year	ELECTRIC COOKING PRODUCTS: Shipments, Domestic + Imports (Thousands of Units)								
	Free-Standing Ranges				Built-In Ovens		Cooktops		MW Ovens
	Coil/Std	Coil/SC	Smooth/Std	Smooth/SC	Std	SC	Coil	Smooth	
1990									
1991									
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
2004									

Approach – Accounting Methodology

- This approach accounts for products going to replace failed units and those going to new construction
  - For dehumidifiers, may need to account for units going to existing buildings that do not already have the product.
- EIA's Annual Energy Outlook provides forecasts of new construction.
- DOE needs historical saturation rates to properly account for existing stock of products.
  - Data provided by industry and government publications for residential products.
  - Data needed for commercial clothes washers.

- ***The Department seeks data on representative saturation rates for each of the four products under consideration for this rulemaking.***

Standards Impacts on Product Shipments

- DOE develops Standards Case Forecasts from the same data it used to develop the Base Case Forecast.
- Standards Case Forecasts also use purchase price increases and operating cost savings to estimate shipments impacts.
- It is difficult to obtain data showing sensitivity of shipments to purchase price and operating costs.
  - DOE may forecast Standards Case shipments forecasts with scenarios (i.e., specific percentage drops in annual shipments for particular efficiency levels).
- The Department will consider impacts from market-pull programs.

- ***As part of its preliminary manufacturer impact analysis, the Department will seek input on the potential impact of new energy conservation standards on product shipments. The Department also requests input on any market-pull programs that currently exist to promote the adoption of more-efficient products.***

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National Impact Analysis

- Determines Standards Case national energy savings (NES) and national consumer economic impacts relative to Base Case.
- Approach – Take individual consumer impacts due to standards and aggregate them to the national level.
- Analysis relies on inputs from prior analyses:
  - shipments; retail prices; energy and water savings; energy and water prices; repair & maintenance costs; product lifetimes
- DOE calculates consumer economic impacts as net present value (NPV).
  - Difference between national operating cost savings and increased equipment expenditures
- DOE will use a spreadsheet model to determine national impacts.

Issues on Which DOE Seeks Comment

- ***The Department seeks input on its plan to develop NES spreadsheet models for estimating national impacts of amended energy conservation standards.***

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Life-Cycle Cost Subgroup Analysis

- Determine LCC impacts from standards on any consumer subgroups that may be disproportionately impacted by new standards.
- Possible subgroups for residential products include low-income households and senior citizens.
- Possible subgroups for commercial clothes washers include small businesses (e.g., laundromats and landlord-owned apartment buildings).

Issues on Which DOE Seeks Comment

- ***The Department requests input on what consumer subgroups are appropriate for commercial clothes washers and residential dishwashers, dehumidifiers, and cooking products.***

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Manufacturer Impact Analysis

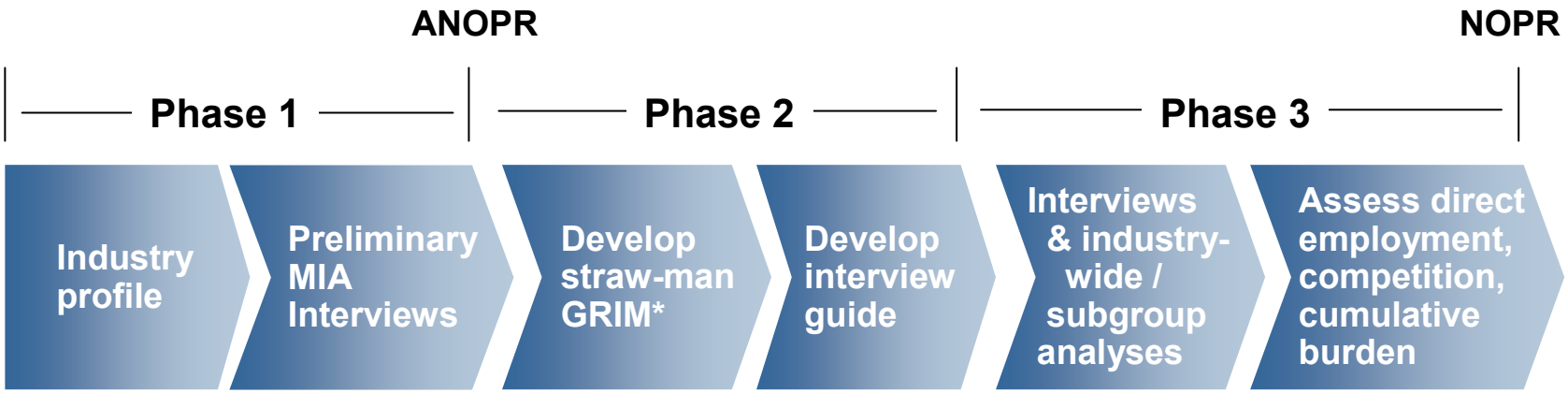
- Purpose
  - To assess the impacts of standards on manufacturers
  - To identify and estimate impacts on manufacturer subgroups that may be more severely impacted than the industry as a whole
  - To examine the impact of cumulative regulatory burden on the industry
- Method
  - Analyze industry cash flow and net present value through use of the Government Regulatory Impact Model (GRIM)
  - Interview manufacturers to refine inputs to the GRIM, develop subgroup analyses, and address qualitative issues
- Output
  - Industry Net Present Value impacts
  - Subgroup Net Present Value impacts
  - Other impacts

Legislative Requirements

- The Manufacturers Impact Analysis (MIA) fulfills a legislative requirement to determine if a proposed standard is economically justified.
  - The Energy Policy Conservation Act (EPCA) provides seven factors to be evaluated in determining whether an appliance efficiency standard [energy conservation standard] is justified. (42 U.S.C. 6313(a)(6)(B)(i)) Two of these factors require the DOE to consider the economic impact of standards on manufacturers and the impacts of any lessening of competition in the industry. Both of these factors are assessed through the manufacturer impact analysis.
  - DOE will provide the Attorney General with a copy of the NOPR for consideration in the evaluation of the impact of standards on the lessening of competition.
  - The Department published Procedures, Interpretations and Policies for Consideration of New or Revised Energy Conservation Standards for Consumer Products (the "process rule"), 10 CFR 430, Subpart C, Appendix A. The process rule contains principles for the analysis of regulatory impacts on manufacturers
  - Recently, the Department announced changes to the manufacturer impact analysis format through a report issued to Congress on January 31, 2006 (as required by section 141 of EPACT 2005). Under this new format, DOE will collect, evaluate, and report preliminary manufacturer impact analysis information in the ANOPR. Such preliminary information includes the anticipated conversion capital expenditures by efficiency level and the corresponding, anticipated impacts on jobs.

Methodology

- The MIA consists of three main phases



* Government Regulatory Impact Model (GRIM)

Phase 1

- Phase 1 consists of the industry profile and preliminary manufacturer impact analysis interviews.

Industry Profile

- Evaluation of current and past industry structure and market characteristics
- Produce an industry profile report with aggregated findings and characteristics
- Identify critical issues that require special consideration in the MIA, for example:
  - Types or groups of manufacturers
  - Access to technology
  - Potential regulatory scenarios

Preliminary MIA Interviews

- Occurs during the engineering analysis
- Topics include:
  - Shipment projections
  - Conversion costs
  - Product mix and profitability
  - Market shares and industry consolidation
  - Cumulative regulatory burden

Phase 2

- Phase 2 consists of the straw-man GRIM and interview guide preparation.

Straw-man GRIM

- Starting point for discussion of impacts
- Inputs include:
  - Manufacturer prices
  - Shipment forecasts
  - Manufacturing cost estimates
  - Financial information

Interview Guide Preparation

- Interview topics include:
  - Engineering analysis
  - Shipments model
  - Cost structure and financial parameters
  - Conversion costs
  - Cumulative burden
  - Direct employment impacts
  - Import / Export issues
  - Consolidation / competitive impacts
  - Replacement parts or refurbishments
  - Impact of the standard's effective date

Phase 3

- Phase 3 consists of the manufacturer interviews, subgroup analyses, and assessment of industry impacts.

Manufacturer Interviews

- Confidential discussion of potential impacts resulting from standards, including:
  - Obsolescence of existing manufacturing assets
  - Tooling
  - Investment

Assessment of Impacts

- Assess competitive impacts on smaller, significant manufacturers
- Assess cumulative regulatory burden on manufacturers from amended DOE standards and other regulatory actions
- Assess impacts on industry employment levels
- Assess impacts on manufacturer subgroups

Issues on Which DOE Seeks Comment

- ***What procedures should the Department follow when scheduling interviews and requesting information?***
- ***What are appropriate manufacturer subgroups for each of the four products?***
- ***What regulations or pending regulations should the Department consider in the manufacturer impact analysis?***

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16	Regulatory Impact Analysis

Utility Impact Analysis

- This analysis will estimate effects on electricity and gas utility industries of reduced energy sales due to new energy efficiency standards.
- The Department will use a variant of EIA's National Energy Modeling System (NEMS) called NEMS-BT to estimate impacts.
- Results are similar to what is found in EIA's Annual Energy Outlook.

Issues on Which DOE Seeks Comment

- ***The Department seeks input on its proposed use of NEMS-BT to conduct the utility impact analysis.***

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7	Markups for Equipment Price Determination
8	Life-Cycle Cost and Payback Period Analysis
9	Shipments Analysis
10	National Impact Analysis
11	Life-Cycle Cost Subgroup Analysis
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Employment Impact Analysis

- Estimate indirect employment impacts that occur from standards.
  - The Department estimates direct employment impacts in the manufacturer impact analysis.
- DOE will use PNNL's 'Impact of Sector Energy Technologies' (ImSET) model.
  - Estimates the employment and income effects of energy-saving technologies in buildings, industry, and transportation.

Issues on Which DOE Seeks Comment

- ***Is this an acceptable approach to assessing employment impacts?***

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Environmental Assessment

- This assessment estimates the impact of standards on three types of energy-related emissions: carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulfur dioxide (SO_2).
- The Department will use NEMS-BT to estimate emissions impacts from power plants.
- DOE will carry out a separate analysis to estimate in-building emissions from gas-fired appliances (gas cooking products and water heating for dishwashers and commercial clothes washers).

Issues on Which DOE Seeks Comment

- ***Are there any other environmental factors the Department should consider in this rulemaking?***

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Regulatory Impact Analysis

- This analysis estimates the potential for non-regulatory approaches to supplant or augment efficiency standards to improve product efficiency.
- The Department will evaluate past, existing, and expected non-regulatory programs.