



U.S. Department of Energy  
Energy Efficiency and Renewable Energy

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

## Commercial Clothes Washers Supplemental Notice of Proposed Rulemaking (SNOPR) Public Meeting

Building Technologies Program  
Office of Energy Efficiency and Renewable Energy  
U.S. Department of Energy

November 16, 2009

[http://www1.eere.energy.gov/buildings/appliance\\_standards/commercial/clothes\\_washers.html](http://www1.eere.energy.gov/buildings/appliance_standards/commercial/clothes_washers.html)



# Purpose of the Public Meeting and Comments From Participants

## ■ Purposes

- To invite comment on the proposed energy conservation standard level TSL 3 for commercial clothes washers (CCWs);
- To present methodologies and characterize results for this rulemaking analyses, including updates to the analyses presented in the Supplemental Notice of Proposed Rulemaking (SNOPR);
- To discuss specific issues related to each analysis;
- To seek input from interested parties on methodologies, assumptions, data sources, and results from the analyses; and
- To describe the next steps.

## ■ Comments from Participants

- Participants are invited to provide summary comments or statements;
- Participants are invited to raise additional issues for discussion today; and
- SNOPR comment period closes December 9, 2009.



## **Statutory Authority – the Energy Policy and Conservation Act (EPCA) as amended**

- **The Energy Independence and Security Act of 2007 (EISA) amended EPCA (42 U.S.C. 6295(g)(10),(cc)) to prescribe standards for dishwashers and dehumidifiers, so DOE is not proposing standards for these products.**
- **DOE published a Final Rule addressing energy conservation standards for residential electric and gas kitchen ranges and ovens and microwave ovens on April 8, 2009. 74 FR 16040.**
- **The proposed notice addresses in part the requirements of section 136(e) of the Energy Policy Act of 2005 (EPACT 2005), which amended EPCA (42 U.S.C. 6313 (e)) to require DOE to publish a Final Rule addressing standards for CCWs by January 1, 2010.**



# DOE Actions on Commercial Clothes Washers

## ■ Test Procedures

- Final Rule for CCWs, which adopted the EPACT 2005 amendments to EPCA requiring that CCWs be rated according to the residential clothes washer test procedure, published on October 18, 2005. 70 FR 60407, 60416.

## ■ Energy Conservation Standards

- Notice of availability of the Framework Document published March 27, 2006. 71 FR 15059.
- Advance Notice of Public Rulemaking (ANOPR) published November 15, 2007. 72 FR 64432.
- Technical Support Document (TSD) posted on DOE website.
- Notice of Public Rulemaking (NOPR) published October 17, 2008. 73 FR 62034. (October 2008 NOPR)
- SNOPR published in the Federal Register November 9, 2009. 74 FR 57738.
  - Issued by DOE on October 30, 2009.
  - Available to stakeholders for review approximately two weeks prior to the public meeting.
- Final Rule scheduled for January 2010.



## Background and Purpose

- **The October 2008 NOPR proposed amended energy conservation standards for certain products and equipment, including commercial clothes washers.**
- **That rulemaking published a final rule in March 2009, well ahead of the CCW statutory deadline of January 1, 2010.**
- **CCWs were not among the products covered in the final rule because comments on the accuracy of the stated max-tech efficiency level for top-loading CCWs led to:**
  - **Three sample max-tech top-loading units being tested, none of which achieved the efficiency levels stated by the manufacturer; and**
  - **DOE fulfilling its obligation to develop an SNOPR based on the new information since the NOPR had proposed a TSL for top-loading CCWs at the max-tech level.**
- **This SNOPR presents the revised analysis and proposes new standard levels for comment.**



## EPCA directs DOE to consider seven factors when setting energy conservation standards

Factor	Analysis
1. Economic impact on consumers and manufacturers	Life-cycle cost analysis Manufacturer impact analysis
2. Lifetime operating cost savings	Life-cycle cost analysis
3. Total projected energy savings	National impact analysis
4. Impact on utility or performance	Screening analysis Engineering analysis
5. Impact of any lessening of competition	Manufacturer impact analysis
6. Need for national energy conservation	National impact analysis
7. Other factors the Secretary considers relevant	Environmental assessment Utility impact analysis Employment impact analysis



## Selection of Proposed Standards

- **DOE considered five trial standard levels (TSLs), beginning with the most efficient level (TSL 5) and worked down to a level where the benefits of potential standards outweighed the burdens.**
  - DOE tentatively concludes that at TSL 5 and TSL 4, the benefits of energy savings, economic benefits, and emissions reductions would be outweighed by the potential for disincentivizing consumers to purchase high-efficiency front-loading CCWs and the large capital conversion costs that could result in a substantial reduction in manufacturers' INPV.
  - DOE tentatively concludes that TSL 3 saves a significant amount of energy and is technologically feasible and economically justified.
  - At TSL 3, DOE tentatively concludes that the potential adverse impacts to one Low-Volume Manufacturer (LVM), and therefore the potential adverse impacts on CCW market competition, would be minimized. DOE has also taken into consideration the Department of Justice's review of the standards proposed in the October 2008 NOPR. (Competitive impacts are discussed in more detail in the Manufacturer Impact Analysis section of this presentation).



## Proposed Amended Energy Conservation Standards for Commercial Clothes Washers (TSL 3)

Product Class	Proposed Energy Conservation Standards
Top-Loading	1.60 Modified Energy Factor/8.5 Water Factor
Front-Loading	2.00 Modified Energy Factor/5.5 Water Factor

*DOE invites comments on these newly proposed energy conservation standards. (This is identified as Issue #7 of Issues on Which DOE Seeks Comment.)*



# Opening Remarks and Comments from Interested Parties on the Proposed Energy Conservation Standards

## ■ Opening Remarks

- At this time, DOE welcomes opening remarks from interested parties on the SNOPR for commercial clothes washers.



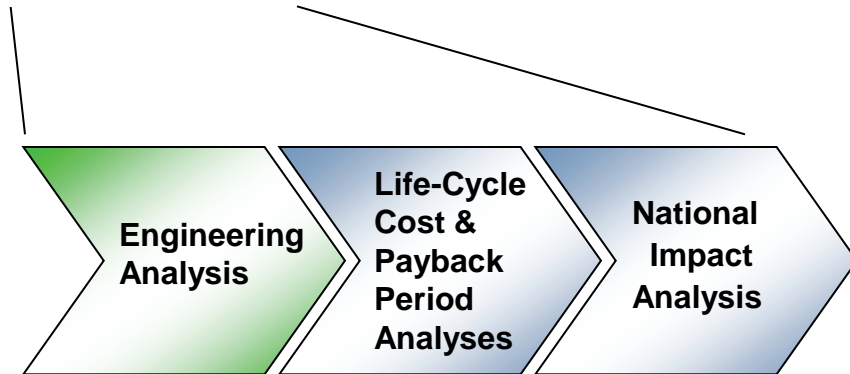
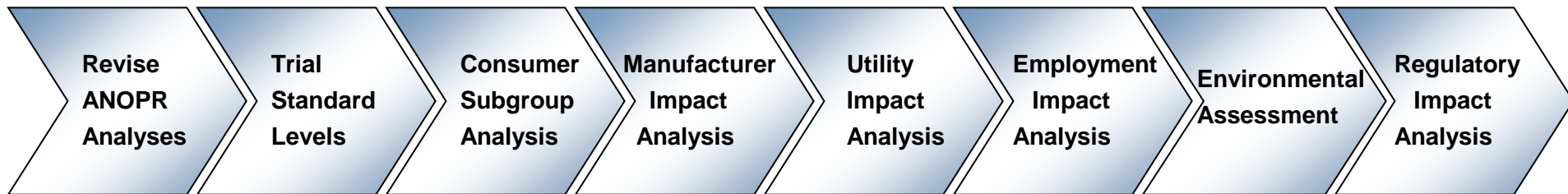
### Summary of Issues on Which DOE Seeks Comment - SNOPR Issues #1-7

1. Whether the method of “loading” clothes washers, or any other characteristic commonly associated with traditional “top-loading” or “front-loading” clothes washers, are “features” within the meaning of 42 U.S.C. 6295(o)(4) in EPCA and whether the availability of such feature(s) would likely be affected by eliminating the separate classes for these equipment types previously established by DOE.\*
2. The revised efficiency levels, including the revised max-tech level for top-loading CCWs.
3. Technological feasibility of the proposed max-tech CCW, including washing and rinsing performance measures for CCWs and population data for water heating CCWs.
4. The determination of short- and long-run price elasticities of demand and cross price elasticities for top-loading vs. front-loading CCWs and used vs. front-loading CCWs.
5. The determination of manufacturer impacts, including the effects of manufacturer tax credits and competitive concerns.
6. The determination of environmental impacts.
7. The newly proposed energy conservation standards.

\* Typically, vertical-axis clothes washers are accessed from the top (“top-loaders”), while horizontal-axis clothes washers are accessed from the front (“front-loaders”).



# NOPR Analyses Flow Diagram



The SNOPR analyses consist of revisions to the NOPR analyses.



# Engineering Analysis

## ■ Purpose

- To characterize manufacturer cost-efficiency relationships for higher efficiency equipment.
- To evaluate design options that improve efficiency relative to the baseline units.
- Sensitivity analysis to look at current material prices.

## ■ Product classes analyzed

- Two CCW equipment classes were analyzed.

## ■ Efficiency-level approach

- For the NOPR, industry supplied cost-efficiency data for two efficiency levels above the baseline.
- DOE analytically supplemented and validated this data to extend the cost-efficiency curves over all efficiency levels for both equipment classes.
- For the SNOPR, DOE revised the top-loader max-tech efficiency level and updated the analysis to \$2008.



## Equipment Classes: Background

- **When evaluating and establishing energy conservation standards, DOE divides covered products or equipment into classes by (42 U.S.C. 6295(q); 6316(a)):**
  - Type of energy used;
  - Capacity;
  - Other performance-related features that affect consumer utility and efficiency.
- **For the ANOPR, CCWs were analyzed as a single equipment class based on EPACT 2005.**
  - EPACT 2005 only mentions one equipment class, though DOE has the authority to add classes as it sees fit.
- **For the NOPR, the equipment classes were split into top-loading and front-loading due to several factors:**
  - Comments from some interested parties regarding consumer utility (In particular, preservation of consumer utility per EPCA).
  - Precedents set by multiple residential clothes washer rulemakings.
  - The California Energy Commission (CEC) Petition for Waiver denial.



## CEC Petition

- **On September 13, 2005, the CEC submitted a petition to DOE for exemption from federal preemption of California's water conservation standards for residential clothes washers.**
  - There are currently no Federal standards in effect for residential clothes washer water use. EISA 2007 added a 9.5 WF standard that will become effective January 1, 2011.
  - The California Code of Regulations would have an 8.5 WF standard effective January 1, 2007 and a 6.0 WF standard effective January 1, 2010.
  - The standards for front-loaders are the same as those for top-loaders in both Federal and California regulations.
  
- **On December 28, 2006, DOE denied the CEC petition for three separate and independent reasons.**
  1. DOE did not have the statutory authority to issue a final rule that would become effective by January 1, 2007 – a three year minimum is required.
  2. DOE determined that CEC did not establish unusual and compelling water interests, which is required by EPCA for DOE to grant a waiver.
  3. ***The standards would likely result in the unavailability of top-loaders in California, which would violate EPCA.***
  
- **The 9<sup>th</sup> Circuit Court of Appeals recently reversed DOE's denial and remanded the petition for further proceedings. Because this opinion was filed October 28, 2009, it occurred too late to be considered in the SNOPR analyses.**



## Equipment Classes Proposed in the SNOPR

- **For the SNOPR, DOE tentatively concluded that top-loading, vertical-axis CCWs provide unique utility and maintained that the axis of access is a feature pursuant to EPCA.**
- **DOE retained the two equipment classes from the NOPR:**
  - Top-loading
  - Front-loading
- **DOE is willing to reconsider its previous conclusions as part of this rulemaking.**
  - If a single equipment class were to be established, DOE would give considerable weight to the potential adverse effects of a single standard on competition in the CCW market.
  - DOE does not intend to set a standard that would produce significant adverse impacts on competition.



## Equipment Classes (Issue #1)

*DOE invites comments on whether the method of “loading” clothes washers, or any other characteristic commonly associated with traditional “top-loading” or “front-loading” clothes washers [such as presence or absence of agitators, ability to interrupt cycles, and possibly others] are “features” within the meaning of 42 U.S.C. 6295(o)(4) in EPCA and whether the availability of such feature(s) would likely be affected by eliminating the separate classes for these equipment types previously established by DOE.*

*DOE also seeks comments as to whether, as a consequence of market and technology developments, it should maintain the same equipment classes for commercial clothes washers as it does for residential clothes washers.*



## Efficiency Levels: Max-Tech Top-Loading

- **The max-tech efficiency level defined for the NOPR for top-loading CCWs —**
  - Was based upon the unit with the maximum available Modified Energy Factor (MEF) in the CEC equipment database.
  - DOE proposed setting the standard at the max-tech top-load efficiency level .
- **At the NOPR meeting, Alliance Laundry Systems stated that it had purchased and tested a max-tech top-loader which did not achieve rated performance and that there were numerous inconsistencies in the efficiency labeling of the unit.**
- **DOE subsequently tested a sample of three identical max-tech units at an independent laboratory**
  - Actual performance (1.63 MEF/8.4 WF vs. 1.76 MEF/8.3 WF) did not match rated performance.
  - Even at this lower level, the unit identified as the max-tech top-loading CCW model for the NOPR continues to be the max-tech unit for the SNOPR.
- **For the SNOPR, DOE has revised the max-tech efficiency level for top-loading CCWs.**
  - The revised level represents what DOE believes the max-tech CCW can actually achieve, given the tolerances and repeatability of the test procedure.
  - This new max-tech efficiency level is the same as the next lower efficiency level (EL 2) in the NOPR.



## Revised Efficiency Levels (Issue #2)

Efficiency Level	MEF/WF	
	Top-Loading	Front-Loading
<b>Baseline</b>	<b>1.26/9.5</b>	<b>1.72/8.0</b>
<b>1</b>	<b>1.42/9.5</b>	<b>1.80/7.5</b>
<b>2</b>	<b>1.60/8.5 (max-tech)</b>	<b>2.00/5.5</b>
<b>3</b>	--	<b>2.20/5.1</b>
<b>4</b>	--	<b>2.35/4.4</b>

*DOE invites comments on the revised efficiency levels, including the revised max-tech level for top-loading CCWs.*



## Technological Feasibility (Issue #3)

- **The max-tech top-loader CCW has the following features:**
  - Currently marketed only to on-premise laundry facilities
  - Based on a standard vertical-axis residential platform with an agitator
  - Four manually-set water levels (most CCWs have three or less)
  - Five wash programs (most CCWs have three)
  - Low wash water temperatures (~71°F “Warm”, 108°F “Hot”)
  - Spray rinse
  - No observed proprietary technologies
- **Market acceptance, which depends on wash performance, is unknown.**
- **Suitability for non-institutional use is also unknown.**
- **DOE also received comments that front-loading CCWs with electric heaters, used in some parts of the northern United States, would not meet the proposed front-loading standards.**

*DOE invites comments on the technological feasibility of the proposed max-tech CCW, including washing and rinsing performance measures for CCWs and population data for water heating CCWs.*

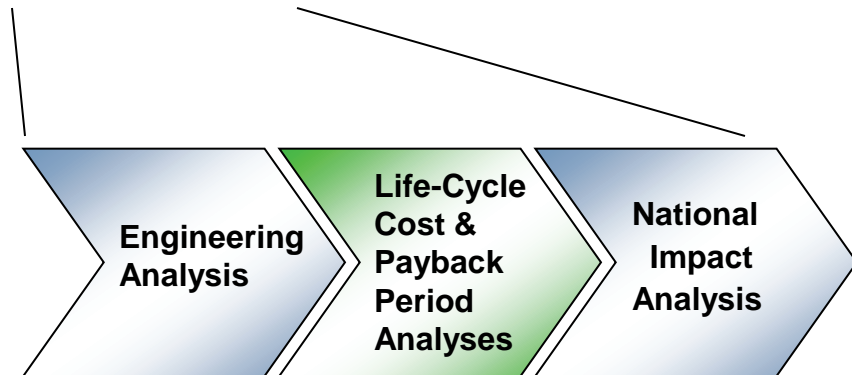
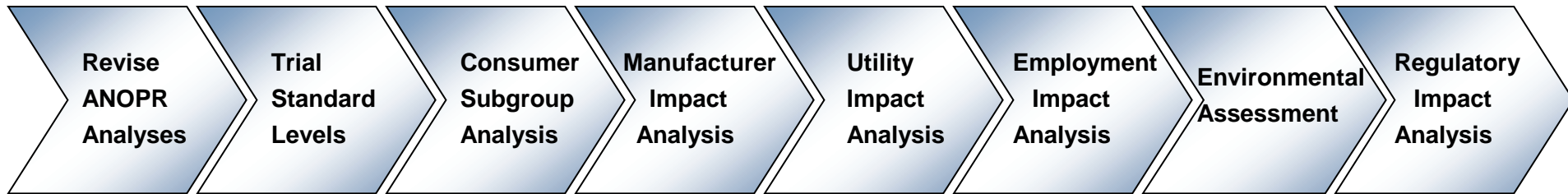


## Request for Additional Comments

*DOE invites comments on any other issues pertaining to the Engineering Analysis.*



# NOPR Analyses Flow Diagram





## Purpose

- **Energy Use Characterization**
  - To develop energy and water consumption savings estimates for selected equipment efficiency levels.
  
- **Markups for Equipment Price Determination**
  - To characterize the channels for how equipment is distributed from the manufacturer to the customer.
  - To determine prices paid by customers based on manufacturer selling prices for baseline and higher efficiency equipment.
  
- **Life-Cycle Cost and Payback Period Analyses**
  - To develop the customer life-cycle cost savings and payback period for higher efficiency equipment.

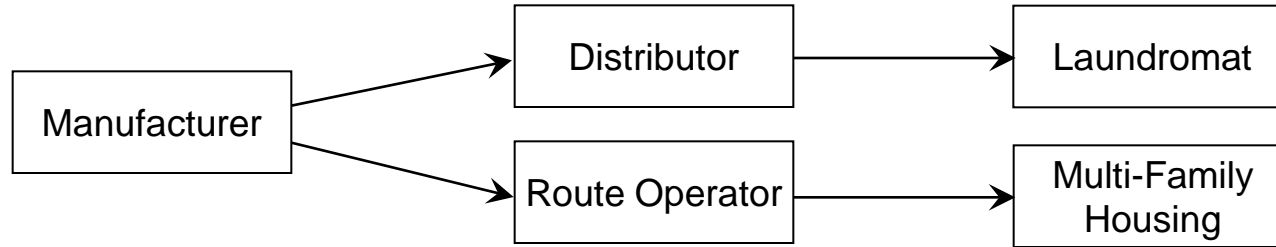


## Approach

- **Based on per-cycle energy and water use multiplied by the cycles per year.**
- **Number of cycles per day based on various studies.**
  - Multi-Family: Average = 3.4; Range = 1 to 10.9.
  - Laundromats: Average = 6; Range = 3 to 8.



## Distribution Channels, Inputs and Results

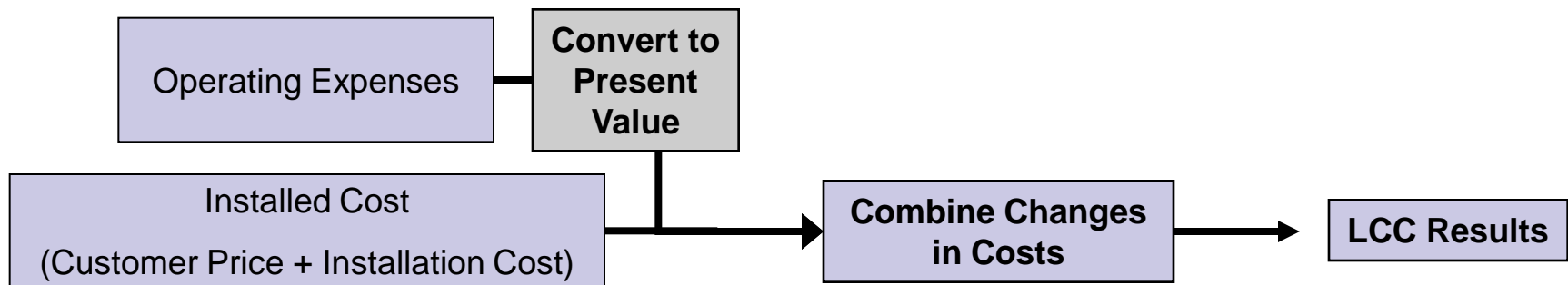


- **According to data from the Consortium for Energy Efficiency, the overwhelming majority of equipment is sold through distributors or route operators.**
  - Laundromats generally purchase equipment through distributors.
  - Multi-family housing and large institutions generally lease equipment through route operators
- **Based markup calculations only on the distribution channel involving distributors.**
  - Assumed resulting equipment prices would be representative of prices paid by consumers acquiring equipment from route operators.
- **Overall baseline markup = 1.93; overall incremental markup = 1.59**



## Approach

- LCC equals consumer price plus the sum of operating costs discounted to a particular base year.
- Economic evaluation from the customer perspective.
- Analysis implemented in an Excel<sup>®</sup> spreadsheet combined with Crystal Ball<sup>®</sup>.
- Analysis models the uncertainty and variability of inputs using Monte Carlo simulation and probability distributions.
- Results are expressed as LCC savings (baseline minus standard level).
- Simple payback period (in years) is also calculated and reported in this analysis.





## Energy and Water Prices

### ■ Electricity Prices

- Based on the Energy Information Administration (EIA) Form 861 Data.
- Developed for 13 Regions: 9 Census Divisions and 4 Large States.

### ■ Natural Gas Prices

- Based on data from EIA's *Natural Gas Monthly*.
- Developed for 13 Regions: 9 Census Divisions and 4 Large States.

### ■ Water and Wastewater Prices

- Based on data from Raftelis Consultants and American Water Works Association (AWWA).
- Developed for 4 Census Regions due to data limitations.

### ■ Energy Price Forecasts

- Based on 2009 Annual Energy Outlook.

### ■ Water and Wastewater Price Forecasts

- Projections from 1970-2008 based on CPI national water price index (U.S. city average).
- Price projections to 2043 based on average growth rate from 1970-2008.



# Installation, Repair and Maintenance Costs; Discount Rates and Equipment Lifetime

## ■ Installation Cost

- Base cost = \$190 based on RS Means

## ■ Repair and Maintenance Cost

- Annualized cost a function of  $\frac{1}{2}$  consumer equipment price divided by equipment lifetime.

## ■ Discount Rates

- Based on the finance cost of raising funds to purchase appliances.
  - Financial cost of any debt incurred to purchase equipment.
  - Opportunity cost of any equity used to purchase equipment.
- Calculated from the weighted-average cost of capital to the firm (WACC) to obtain equity and debt financing.
- Weighted-average real value = 5.7%.

## ■ Equipment Lifetime

- Based on various sources including *Appliance* magazine and past DOE TSDs.
  - Minimum = 7 (Multi-Family), 5 (Laundromat)
  - Average = 11.3 (Multi-Family), 7.1 (Laundromat)
  - Maximum = 15.5 (Multi-Family), 9.3 (Laundromat)
- All equipment lifetimes characterized with Weibull distribution.



## Equipment Assignment in the Base Case

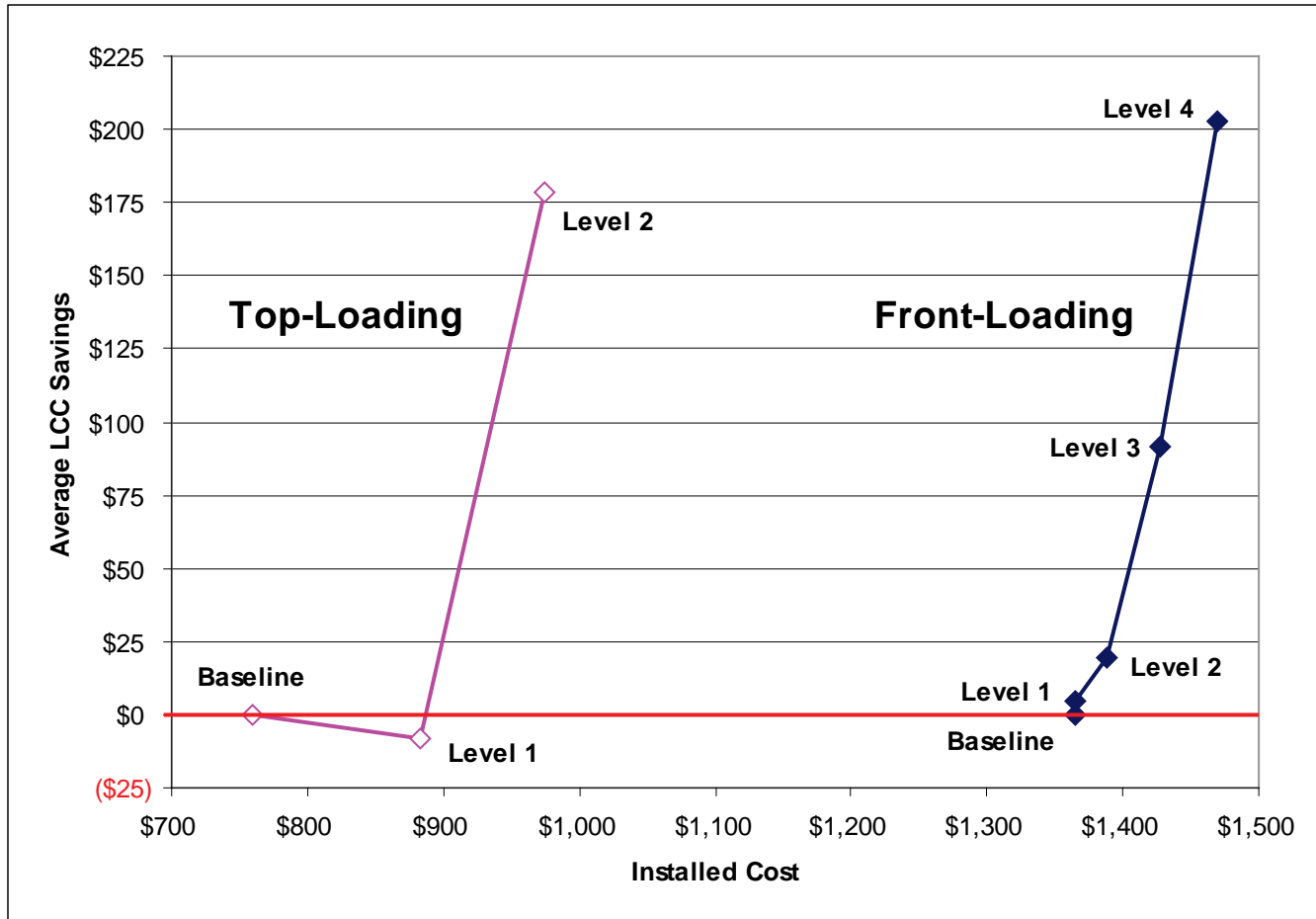
- Avoids overstating the benefits from increasing equipment efficiency by showing the percentage of consumers already purchasing efficient equipment.

Top-Loading				Front-Loading			
Level	MEF	WF	Market Share*	Level	MEF	WF	Market Share*
Baseline	1.26	9.50	64.8%	Baseline	1.72	8.00	3.5%
1	1.42	9.50	33.8%	1	1.80	7.50	0.0%
2	1.60	8.50	1.4%	2	2.00	5.50	73.7%
				3	2.20	5.10	22.8%
				4	2.35	4.40	0.0%

\* Based on distribution of models reported in CEC database.



## Average LCC Savings vs. Installed Cost Multi-Family Application



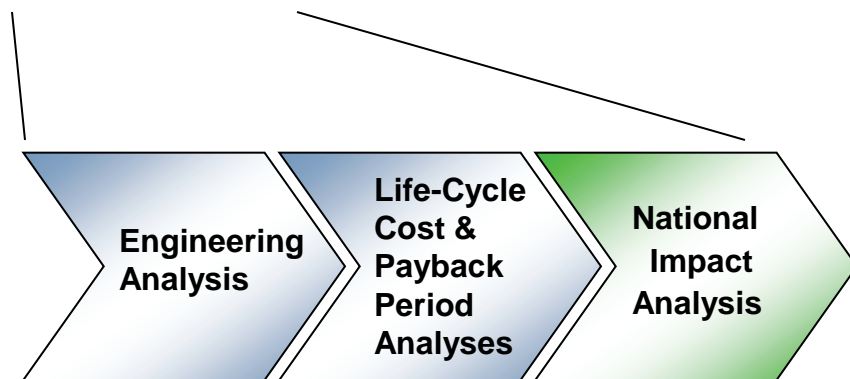
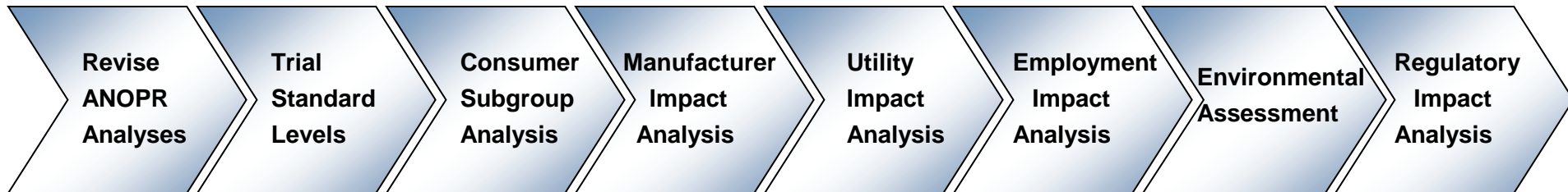
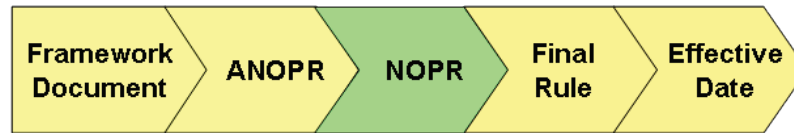


## Request for Additional Comments

*DOE invites comments on any other issues pertaining to the Energy Use, Markups, and Life-Cycle Cost and Payback Period Analyses.*



# NOPR Analyses Flow Diagram





## Purpose

### ■ Shipments Analysis

- To estimate commercial clothes washer shipments over time.

### ■ National Impact Analysis

- To estimate the National Energy Savings (NES) from commercial clothes washer energy conservation standards at different efficiency levels.
- To estimate the national economic impact on the nation (or the Net Present Value (NPV)) from commercial clothes washer energy conservation standards at different efficiency levels.



## Approach

### ■ Estimate base-case shipments forecasts (2013–2043)

- Develop a shipments model that accounts for shipments to:
  - New construction: New housing construction forecasts multiplied by historical rates of equipment ownership.
  - Replacements: Equipment retirement functions (equipment lifetimes) applied to equipment stock.
- Historical shipments used to calibrate shipments model.
  - Non-replacements (retired units not replaced).

### ■ Estimate standards-case shipments forecasts (2013–2043)

- Developed with same data as used to estimate base-case forecasts.
- Accounts for purchase price and operating cost changes due to standards by developing a ‘relative’ price elasticity of demand.
  - Elasticity developed from historical price, efficiency, and shipments data for residential appliances.
  - Purchase price effects dominate.
- Cross price elasticity describing the interactions between top-loading and front-loading washer purchases due to price increases not considered.
- Shipments forecasted to drop due to standards but consumers are forecasted to be less sensitive to initial changes in purchase price based on consumer automobile purchase decisions.
  - Consumers forgoing the purchase of new washers assumed to purchase used machines.
  - Cross price elasticity describing the interaction of used and new purchases not considered.



## Standards-Case Shipments Impacts (Issue #4)

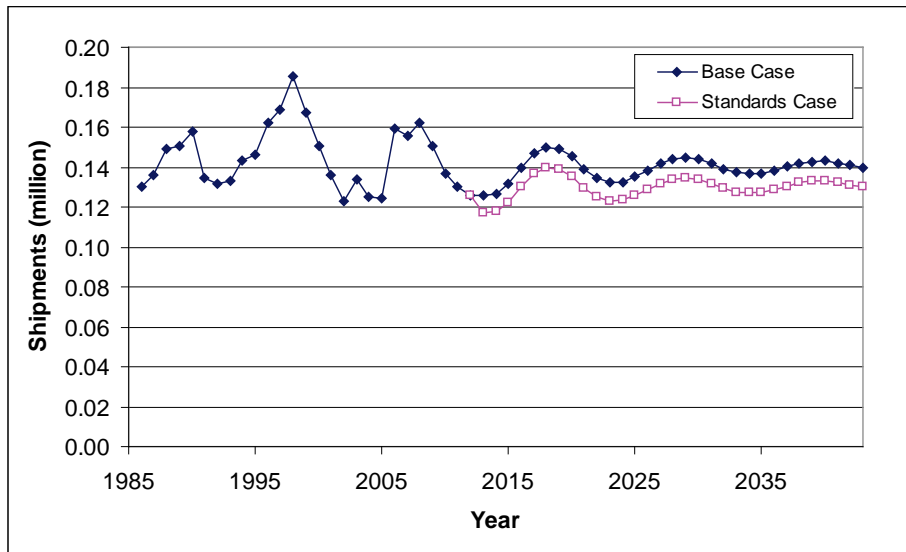
*DOE invites comments on the following aspects of its method to estimate shipments impacts due to standards:*

- (1) Because purchase price and efficiency data for residential appliances were used to develop the short-run price elasticity of demand, DOE seeks comment on how applicable the price elasticity is to the commercial clothes washing market.*
- (2) Because estimates of the long-run price elasticity of demand were derived from consumer automobile purchase decisions, DOE seeks comment on whether it can be inferred that the initial CCW price elasticity of demand would become more inelastic over time.*
- (3) Because a cross price elasticity of demand between top-loading and front-loading CCWs could not be developed due to the lack of specific data, DOE seeks comment and data on the price interactions between the two types of CCWs, especially under those circumstances where the purchase price increase for one CCW equipment class is more significant than for the other.*
- (4) Because DOE is concerned over its assumption that consumers forgoing a top-loader CCW purchase due to a price increase caused by standards would instead acquire used top-loading washers, DOE seeks comments and input on the interactions between the used CCW market and the new front-loading CCW market.*



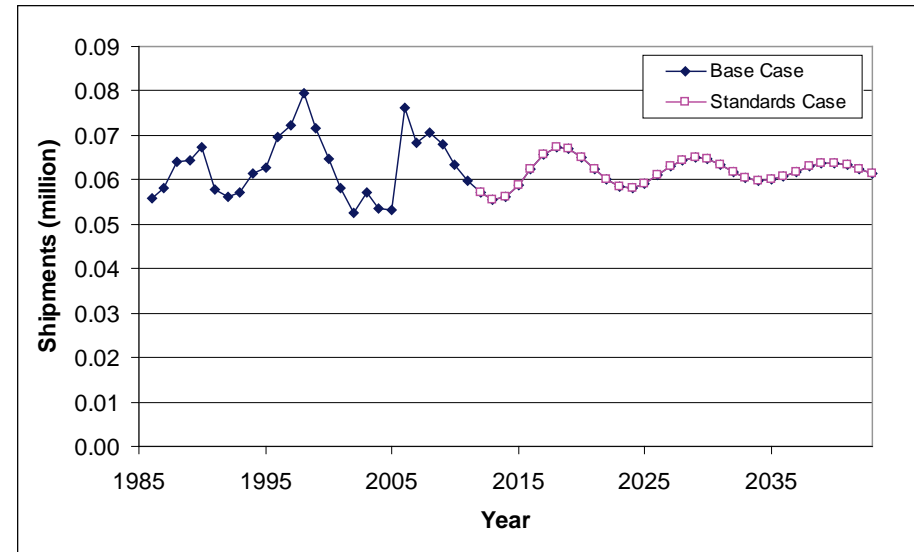
## Results

### Top-Loading Washers



■ Example Standard Level = 1.60 MEF, 8.5 WF

### Front-Loading Washers



■ Example Standard Level = 2.00 MEF, 5.5 WF



## Approach

- National energy savings calculated from 2013-2043.
- National NPV calculated for equipment shipments entering the building stock from 2013-2043.
- Base case incorporates the penetration of higher efficiency equipment.
- Standards “roll up” inefficient equipment but do not affect efficient equipment.

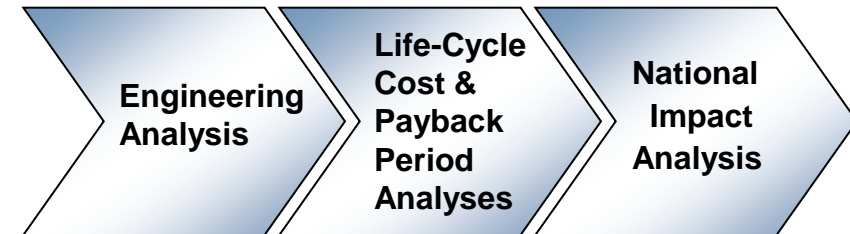
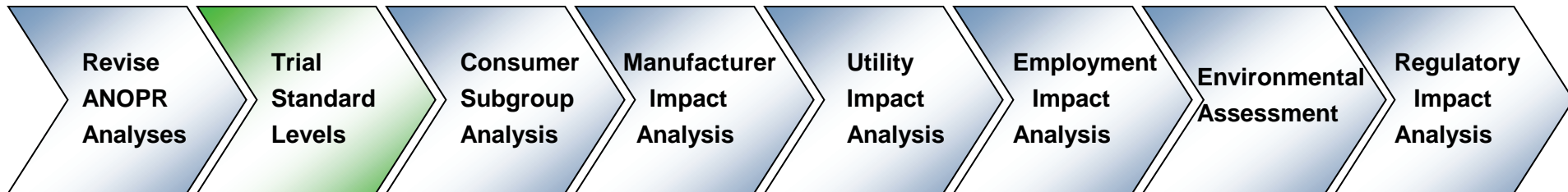
Front-Loading Washers									
CSL	TSL	Efficiencies		Market Shares					
				Base Case	Trial Standard Level				
		MEF	WF		1	2	3	4	5
Baseline	-	1.72	8	3.5%	-	-	-	-	-
1	1	1.8	7.5	0.0%	3.5%	-	-	-	-
2	2, 3	2	5.5	73.7%	73.7%	77.2%	77.2%	-	-
3	4	2.2	5.1	22.8%	22.8%	22.8%	22.8%	100%	-
4	5	2.35	4.4	0.0%	0.0%	0.0%	0.0%	0.0%	100%
SWEF (MEF)*				2.04	2.04	2.05	2.05	2.2	2.35
SWEF (WF)				5.5	5.48	5.41	5.41	5.1	4.4

\* Shipment-weighted efficiency (SWEF) , expressed in terms of MEF

- Once a standard is in place, old equipment goes out of the inventory according to the base-case efficiency mix. New equipment is sold to replace equipment according to the new efficiency mix.
- Use national average equipment prices, annual energy use, energy prices, annual repair and maintenance expenditures from LCC analysis. Streams of energy use and total costs calculated over analysis time periods and costs discounted to the present.



# NOPR Analyses Flow Diagram





## Selection of Trial Standard Levels

### ■ Purpose

- To develop a list of standard levels from which impacts are weighed and a proposed standard level is selected.
  - Each trial standard level consists of a set of potential minimum efficiency levels covering all equipment classes, and may vary between equipment classes; and
  - SNOPR analyses assess impacts for trial standard levels (not equipment classes).

### ■ Method

- Trial standard levels are assembled from the equipment classes identified in the SNOPR.
  - Each trial standard level consists of the standard levels from each equipment class that meets a certain set of criteria.
    - TSL 1: First standard level from each equipment class representing least significant design change.
    - TSL 2: Standard levels for each equipment class that still represent a significant share of the market.
    - TSL 3: Standard levels that minimize the equipment price difference between the two equipment classes.
    - TSL 4: Increments standard level for front-loaders; Standard level for top-loaders unchanged from TSL 3 (already at max-tech level).
    - TSL 5: Max-tech level from each equipment class.



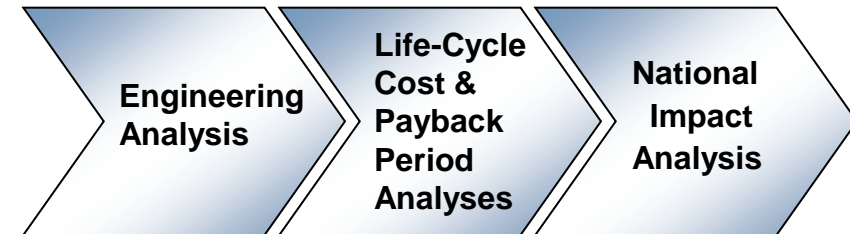
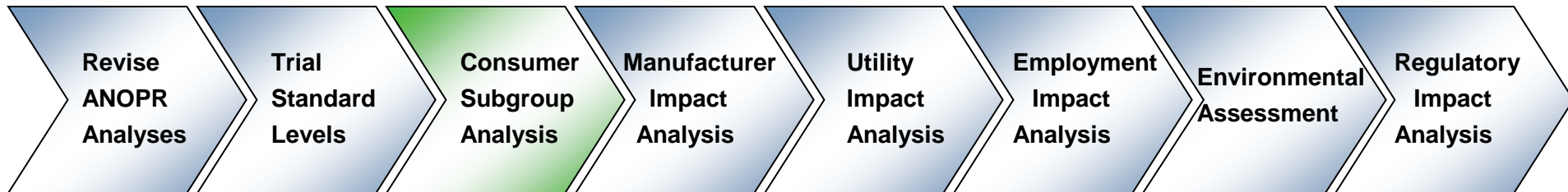
## Trial Standard Levels for the SNO PR

<b>Commercial Clothes Washers</b>					
	<b>Trial Standard Levels</b>				
	<b>TSL 1</b>	<b>TSL 2</b>	<b>TSL 3</b>	<b>TSL 4</b>	<b>TSL 5</b>
<b>Top-Loading</b>					
<b>MEF</b>	1.42	1.42	1.60	1.60	1.60
<b>WF</b>	9.5	9.5	8.5	8.5	8.5
<b>Front-Loading</b>					
<b>MEF</b>	1.80	2.00	2.00	2.20	2.35
<b>WF</b>	7.5	5.5	5.5	5.1	4.4

- TSLs 1 through 5 provide a positive NPV ranging from \$0.01 billion to \$0.51 billion at 7-percent discount rate.



# NOPR Analyses Flow Diagram





## Consumer Subgroup Analysis

### ■ Purpose

- To evaluate the economic impacts of standards on consumer subgroups who may be disproportionately impacted compared with the general user population.

### ■ Method

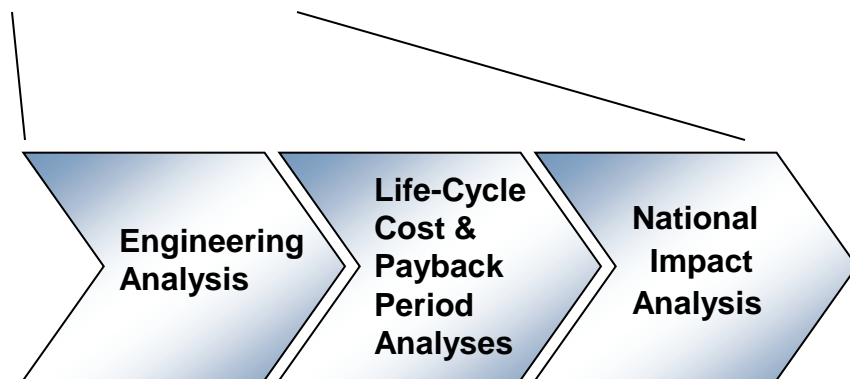
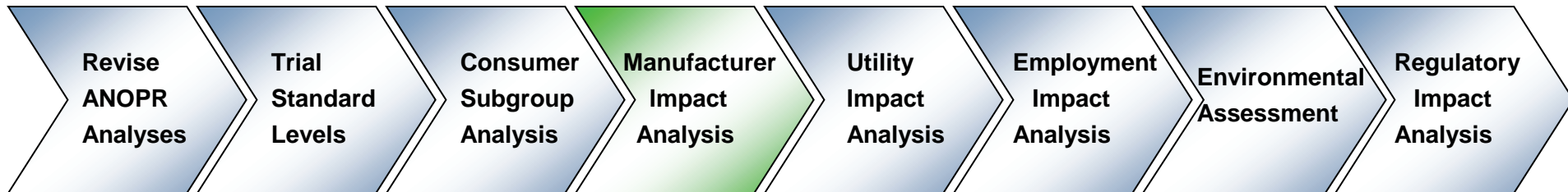
- DOE identified small businesses and consumers without municipal water and sewer that could be disproportionately affected, and examined the impact of proposed standards on this them.
- DOE used the LCC spreadsheet model to determine the impact on these subgroups.

### ■ Output

- LCC savings and simple payback period (in years) for the identified customer subgroups.
- Determined that the subgroups were not disproportionately impacted by the standard.



# NOPR Analyses Flow Diagram





# Manufacturer Impact Analysis

## ■ Purpose

- To assess the impacts of standards on commercial clothes washer manufacturers;
- To identify and estimate impacts on manufacturer subgroups that may be more severely impacted than the industry as a whole;
  - One “Low-Volume Manufacturer” (LVM) is focused on the commercial laundry business and has much lower revenues than its larger competitors in the commercial clothes washer market.
- To examine the impact of cumulative regulatory burdens on the industry.

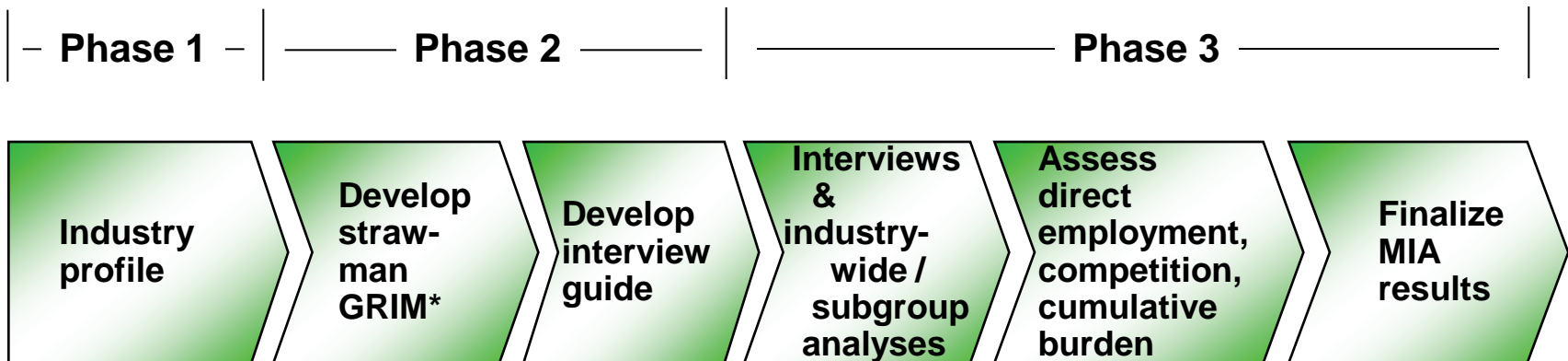
## ■ Method

- Analyze industry cash flow and net present value through use of the Government Regulatory Impact Model (GRIM); and
- Interview manufacturers to refine inputs to the GRIM, develop subgroup analyses, and address qualitative issues.
- For the SNOPR, the GRIM was updated for a 2009 base year, with the results expressed in \$2008.
- The SNOPR MIA also considered the impacts of manufacturer tax credits.



## Manufacturer Impact Analysis Process

- The MIA consists of three phases:



\* *Government Regulatory Impact Model (GRIM)*



## Updated INPV Results by TSL

- **Change in INPV analyzed for two scenarios:**
  - Preservation of Gross Margin Percentage Markup with Base-Case Shipments
  - Preservation of Gross Margin Percentage Markup with Price Elasticity of Demand Shipments

	Trial Standard Levels					
	Base Case	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
<b>Preservation of Gross Margin Percentage Markup with Base-Case Shipments</b>						
INPV (2008\$ million)	62	65	63	57	54	41
Change in INPV (2008\$ million)	—	4	1	(5)	(8)	(20)
Change in INPV (%)	—	5.97%	2.24%	-7.81%	-12.73%	-33.09%
<b>Preservation of Gross Margin Percentage Markup with Price Elasticity of Demand Shipments</b>						
INPV (2008\$ million)	62	64	62	55	51	39
Change in INPV (2008\$ million)	—	2.8	0.5	(7.0)	(10.2)	(23.0)
Change in INPV (%)	—	4.50%	0.76%	-11.39%	-16.57%	-37.30%



## Manufacturer Production Tax Credits

- **The Energy Improvement and Extension Act (EIEA 2008) provides credits to manufacturers of qualifying equipment.**
  - Manufacturers qualify for a \$150 credit for each CCW that has a minimum 2.0 MEF and maximum 8.0 WF.
  - Manufacturers qualify for a \$250 credit for each CCW that has a minimum 2.2 MEF and maximum 4.5 WF.
  - Qualifying washers must be produced in the United States.
  - Manufacturers also must increase production of qualifying washers to earn the credit. The EIEA tax credits are only earned on qualifying washers that exceed the average number of qualifying washers produced by the manufacturer over the previous two years.



## Manufacturer Production Tax Credits - Continued

- **In its analysis, DOE found that the EIEA 2008 tax credits do not greatly mitigate the negative industry impacts.**
  - The LVM is the only manufacturer that produces qualifying CCWs.
  - Most of the potential benefit from the EIEA 2008 tax credits occur outside the analysis period.
    - Manufacturers are eligible for these tax credits in 2008, 2009, and 2010.
    - The base year in the MIA is 2009.
  - The LVM did qualify for a substantial benefit in 2008 (\$2.4 million). However, since then it has not increased the production of qualifying washers to continue to receive a large production tax credit from the program.
    - DOE estimated that the LVM will collect a total of \$385,000 in production tax credits in 2009 and 2010.
    - Thus, the total income from producer tax credits for the LVM is projected to be about \$2.8 million.



## Department of Justice Review

- The DOJ review of the TSL proposed in the NOPR (1.76 MEF/8.3 WF) stated:

**“... it appears that meeting the proposed standards may require substantial investment in the development of new technology that some suppliers of top loading CCWs may not find it economical to make. CCWs are used primarily in multi-housing laundries, with top loading machines accounting for approximately 80 percent of machines in these locations. The remaining 20 percent are front loading machines, which are more energy efficient but significantly more expensive than top loading models. There are only three manufacturers of top loading CCWs selling in the United States. It appears that there is a real risk that one or more of these manufacturers cannot meet the proposed standard. In such a case, CCW purchasers would have fewer competitive alternatives for top loading machines, potentially resulting in purchasers facing higher prices from the remaining top loading manufacturer or manufacturers.**

**... To maintain competition, the Department of Energy should consider keeping the existing standard in place for top loading CCWs.”**

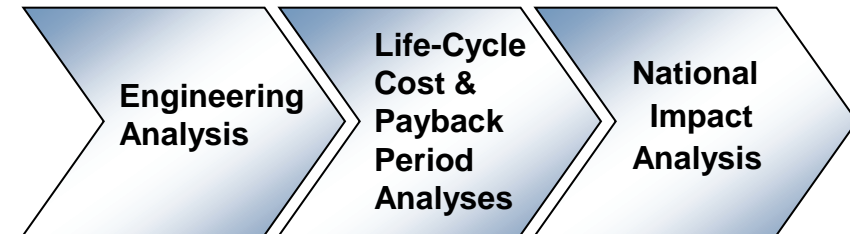
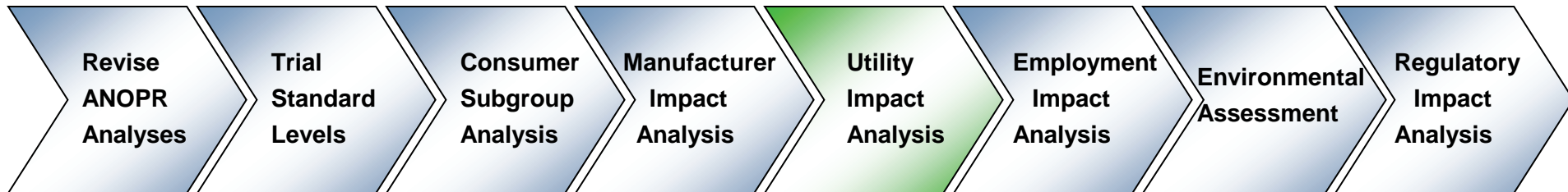


## Manufacturer Impacts (Issue #5)

*DOE invites comments on the determination of manufacturer impacts, including the effects of manufacturer tax credits and competitive concerns.*



# NOPR Analyses Flow Diagram





# Utility Impact Analysis

## ■ Purpose

- To investigate the effects on utilities from reduced energy sales and peak load demand due to potential standards.

## ■ Method

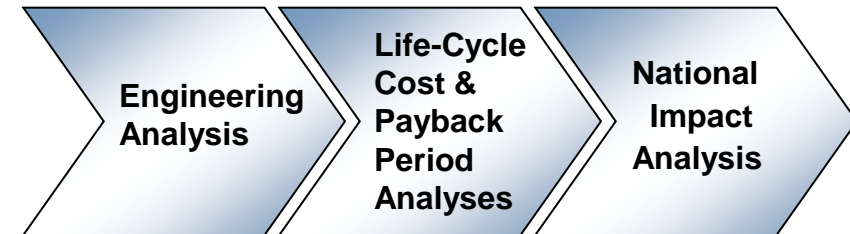
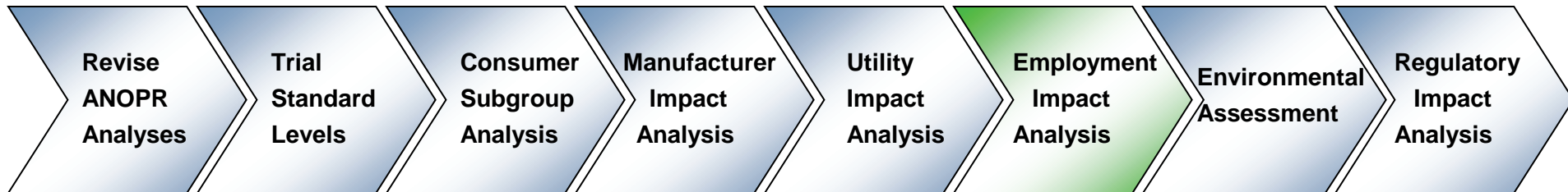
- Use National Energy Savings Results; and
- Use the EIA's National Energy Modeling System (NEMS-BT) tailored for DOE's Building Technologies Program.

## ■ Output

- Change in electricity and gas sales and price by region;
- Change in the mix of electricity generation; and
- Change in installed capacity and generation.
  - TSLs 1 through 5 resulted in very small installed generation capacity reductions ranging from 5 to 12 MW.



# NOPR Analyses Flow Diagram





# Employment Impact Analysis

## ■ Purpose

- To report net jobs created or eliminated nationally as a consequence of new or amended energy conservation standards. Employment impacts include direct and indirect impacts.

## ■ Method

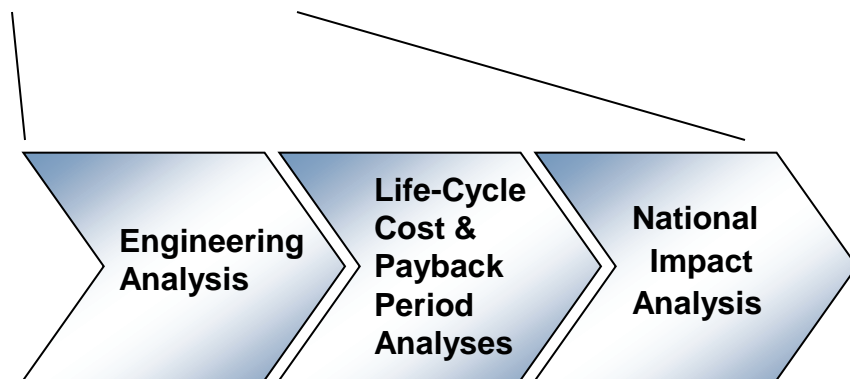
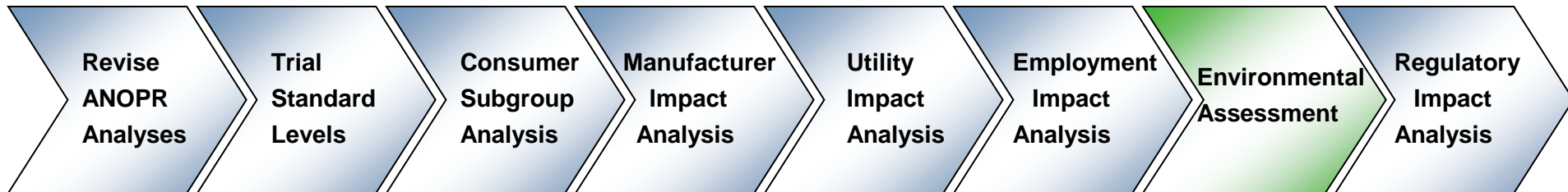
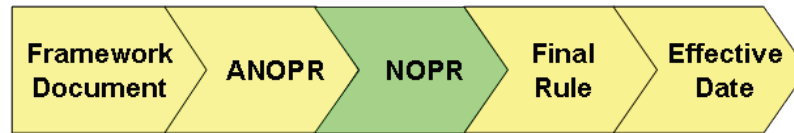
- Uses the Impact of Sector Energy Technologies (ImSET) model to assess the indirect employment impacts;
- Estimate changes in employment, industry output, and wage income in the overall United States economy resulting from changes in expenditures in the various sectors of the economy;
- Estimate changes in costs and benefits using the NIA analysis; and
- Direct employment impacts are addressed in the MIA.

## ■ Output

- Change in employment in national economy, other than in the manufacturing sector being regulated, as a consequence of the amended energy conservation standards.
- TSLs 1 through 5 result in a net increase in jobs but so small that it would be imperceptible in national labor statistics and might be offset by other, unanticipated effects on employment.



# NOPR Analyses Flow Diagram





## Environmental Assessment

### ■ Purpose

- To report environmental impacts as a consequence of the amended energy conservation standards, including changes in power plant emissions.

### ■ Method

- Use National Energy Savings Results; and
- Use the EIA's National Energy Modeling System (NEMS-BT) tailored for DOE's Building Technologies Program.

### ■ Output

- Calculated the reduction in power plant emissions of carbon dioxide (CO<sub>2</sub>), oxides of nitrogen (NO<sub>x</sub>) and mercury (Hg), using the NEMS-BT computer model.
- Calculated the reduction in on-site emissions (CO<sub>2</sub> and NO<sub>x</sub>) where gas appliances are used (i.e., gas water heating and drying for commercial clothes washers)
- Sulfur dioxide (SO<sub>2</sub>) emissions were not included due to the emissions cap set by the Clean Air Act Amendments of 1990. Impact on SO<sub>2</sub> emissions changes was estimated as too small to affect value of emissions allowances under the cap.
- Monetized value of reductions in CO<sub>2</sub>, NO<sub>x</sub>, and Hg.
- Assessed impact to SO<sub>2</sub> allowance prices.

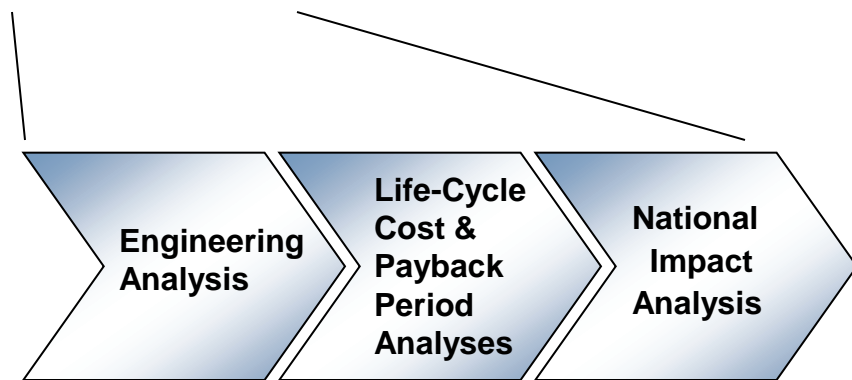
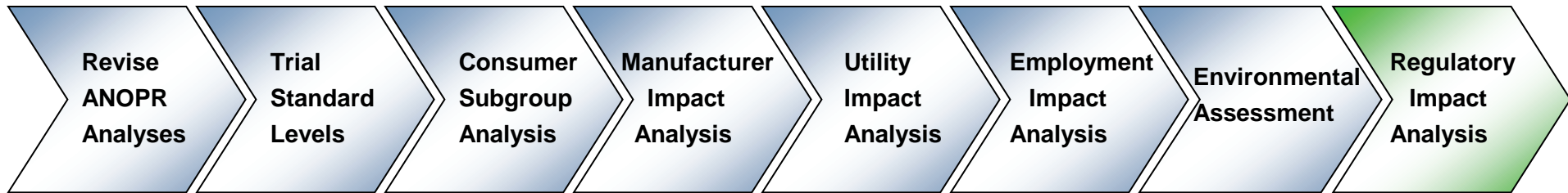


## Determination of Environmental Impacts (Issue #6)

*DOE seeks comment on the determination of the anticipated environmental impacts of the supplemental proposed rule, including the methods for valuing the expected CO<sub>2</sub>, NO<sub>x</sub>, and Hg emissions savings due to the proposed standards.*



# NOPR Analyses Flow Diagram





# Regulatory Impact Analysis

## ■ Purpose

- To investigate the national impacts due to non-regulatory alternatives compared with mandatory energy conservation standards.
- The non-regulatory alternatives that DOE analyzed include:
  - No New Regulatory Action;
  - Consumer Rebates;
  - Commercial Customer Tax Credits;
  - Voluntary Energy-Efficiency Targets—ENERGY STAR;
  - Manufacturer Tax Credits;
  - Early Replacement; and
  - Bulk Government Purchases.

## ■ Method

- Modify NIA spreadsheet model to consider the above scenarios and assess their effect on adoption of equipment at the proposed standard levels.

## ■ Output

- National Energy Savings and Net Present Value of the non-regulatory alternatives.



### Summary of Issues on Which DOE Seeks Comment - SNOPR Issues #1-7

1. Whether the method of “loading” clothes washers, or any other characteristic commonly associated with traditional “top-loading” or “front-loading” clothes washers, are “features” within the meaning of 42 U.S.C. 6295(o)(4) in EPCA and whether the availability of such feature(s) would likely be affected by eliminating the separate classes for these equipment types previously established by DOE.
2. The revised efficiency levels, including the revised max-tech level for top-loading CCWs.
3. Technological feasibility of the proposed max-tech CCW, including washing and rinsing performance measures for CCWs and population data for water heating CCWs.
4. The determination of short- and long-run price elasticities of demand and cross price elasticities for top-loading vs. front-loading CCWs and used vs. front-loading CCWs.
5. The determination of manufacturer impacts, including the effects of manufacturer tax credits and competitive concerns.
6. The determination of environmental impacts.
7. The newly proposed energy conservation standards.



## Request for Additional Comments

*DOE invites comments on any remaining issues pertaining to this SNOPR.*



## How to Submit Comments...

- Public Meeting – Oral comments will be captured in the transcript and become part of the public record.
- Written comments – NOPR comment period open until December 9, 2009.  
Reference docket #: EE-2006-STD-0127 and/or RIN #: 1904-AB49.

Email: home\_appliance.rulemaking@ee.doe.gov

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1000 Independence Avenue, SW.  
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Telephone: (202) 586-2945.

Courier: Ms. Brenda Edwards  
U.S. Department of Energy  
Building Technologies Program  
950 L'Enfant Plaza, SW., 6th Floor,  
Washington, DC 20024.



# Backup Slides



## Summary of Results For Commercial Clothes Washers

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Primary Energy Saved (quads)	0.04	0.04	0.10	0.11	0.12
7% Discount Rate	0.01	0.01	0.03	0.03	0.03
3% Discount Rate	0.02	0.02	0.06	0.06	0.07
Primary Water Saved (trillion gallons)	0.00	0.01	0.14	0.16	0.21
7% Discount Rate	0.00	0.00	0.04	0.04	0.06
3% Discount Rate	0.00	0.00	0.08	0.09	0.11
Generation Capacity Reduction (GW)**	0.005	0.005	0.010	0.011	0.012
NPV (2008\$ billion):					
7% Discount Rate	0.01	0.02	0.36	0.41	0.51
3% Discount Rate	0.08	0.10	0.89	1.03	1.25
Industry Impacts:					
Industry NPV (2008\$ million)	4 – 3	1 – 0	(5) – (7)	(8) – (10)	(20) – (23)
Industry NPV (% Change)	6.0 – 4.5	2.2– 0.8	(7.8) – (11.4)	(12.7) – (16.6)	(33.1) – (37.3)
Cumulative Emissions Impacts†:					
CO <sub>2</sub> (Mt)	2.36	2.39	5.07	5.66	6.11
NO <sub>x</sub> (kt)	1.43	1.45	3.04	3.39	3.66
Hg (t)	0 – 0.01	0 – 0.01	0 – 0.03	0 – 0.03	0 – 0.03
Wastewater Discharge Impacts (trillion gallons)	0.00	0.01	0.14	0.16	0.21



## Summary of Results For Commercial Clothes Washers – Continued

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
<b>Mean LCC Savings* (2008\$):</b>					
Top-Loading, Multi-Family	(8.1)	(8.1)	179	179	179
Top-Loading, Laundromat	(17.7)	(17.7)	190	190	190
Front-Loading, Multi-Family	4.7	19.5	19.5	91	203
Front-Loading, Laundromat	5.2	22.0	22.0	93	216
<b>Median PBP (years):</b>					
Top-Loading, Multi-Family	11.7	11.7	4.6	4.6	4.6
Top-Loading, Laundromat	7.9	7.9	2.8	2.8	2.8
Front-Loading, Multi-Family	0.0	0.4	0.4	3.0	2.9
Front-Loading, Laundromat	0.0	0.2	0.2	1.8	1.6
<b>LCC Results:</b>					
<b>Top-Loading</b>					
<b>Multi-Family</b>					
Net Cost (%)	43.3	43.3	13.8	13.8	13.8
No Impact (%)	35.3	35.3	1.2	1.2	1.2
Net Benefit (%)	21.5	21.5	85.0	85.0	85.0
<b>Laundromat</b>					
Net Cost (%)	51.4	51.4	2.9	2.9	2.9
No Impact (%)	35.3	35.3	1.2	1.2	1.2
Net Benefit (%)	13.3	13.3	95.9	95.9	95.9



## Summary of Results For Commercial Clothes Washers – Continued

Category	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
<b>LCC Results:</b>					
<b>Front-Loading</b>					
<b>Multi-Family</b>					
<b>Net Cost (%)</b>	0.0	0.0	0.0	1.4	1.1
<b>No Impact (%)</b>	96.3	96.3	96.3	23.1	0.0
<b>Net Benefit (%)</b>	3.7	3.7	3.7	75.5	98.9
<b>Laundromat</b>					
<b>Net Cost (%)</b>	0.0	0.0	0.0	0.0	0.0
<b>No Impact (%)</b>	96.3	96.3	96.3	23.1	0.0
<b>Net Benefit (%)</b>	3.7	3.7	3.7	76.9	100.0
* Parentheses indicate negative (-) values. For LCCs, a negative value means an increase in LCC by the amount indicated.					
** Changes in installed generation capacity by 2043 based on AEO 2009 Reference Case.					
† CO <sub>2</sub> emissions impacts include physical reductions at power plants and at buildings where the appliance is being used. NO <sub>x</sub> emissions impacts include physical reductions at power plants and at buildings where the appliance is being used.					



## Market Characteristics – Commercial Clothes Washers

- Three manufacturers account for nearly 100% of the domestic market share for commercial clothes washers.

Major Manufacturers	Other Manufacturers
Alliance	Electrolux
Whirlpool/Maytag*	Continental
GE	LG
	Wascomat

\* In 2006, Whirlpool and Maytag merged, but have continued to maintain both CCW product lines to date.



## Screening Analysis Method

- **Design options screened using the following criteria:**
  - Technological feasibility;
  - Practicability to manufacture, install and service;
  - Adverse impacts on equipment utility or equipment availability; and
  - Adverse impacts on health or safety.



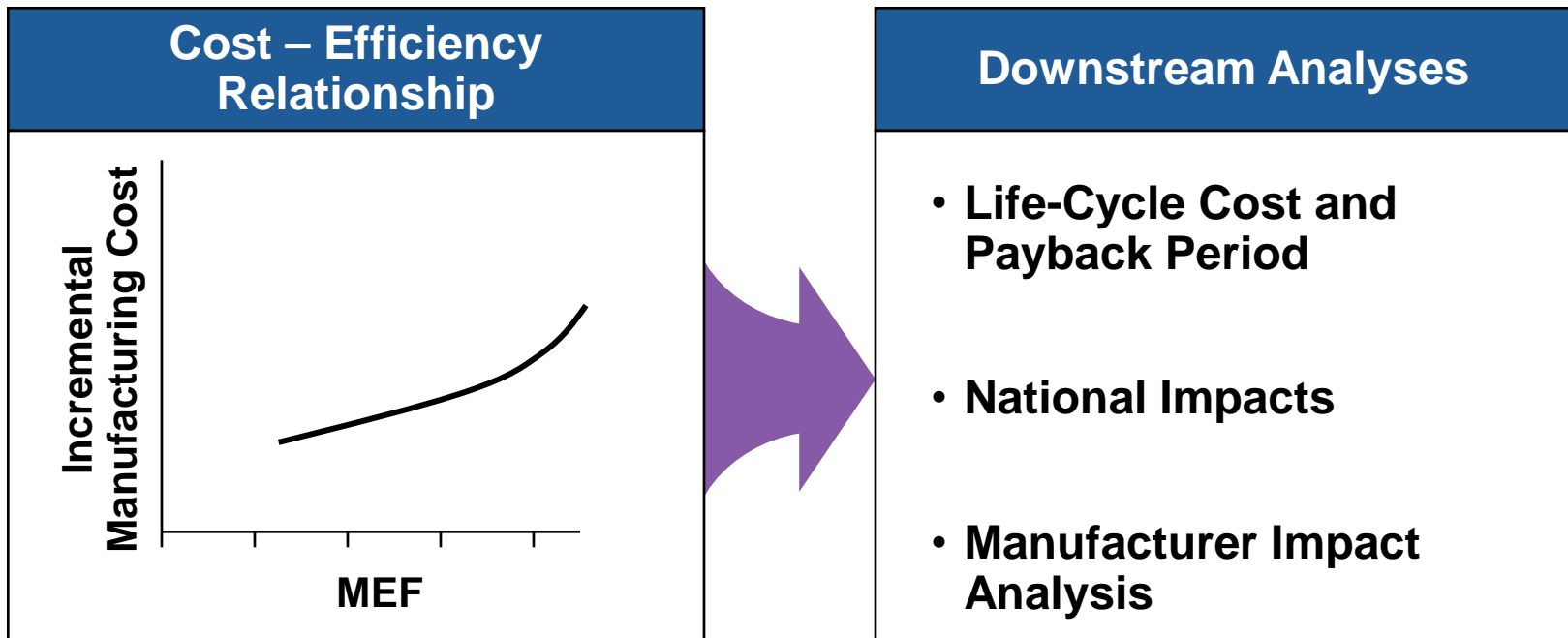
## Technologies Selected for Further Consideration

<b>Commercial Clothes Washers</b>
<b>1. Adaptive control systems</b>
<b>2. Added insulation</b>
<b>3. Advanced agitation concepts for top-loading machines</b>
<b>4. Automatic water fill control</b>
<b>5. Direct-drive motor</b>
<b>6. Front-loading design with recirculation</b>
<b>7. Improved fill control</b>
<b>8. Improved front-loading-washer drum design</b>
<b>9. Improved water extraction to lower remaining moisture content</b>
<b>10. Increased motor efficiency</b>
<b>11. Low-standby-power electronic controls</b>
<b>12. Spray rinse or similar water-reducing rinse technology</b>
<b>13. Steam washing</b>
<b>14. Thermostatically controlled mixing valves</b>
<b>15. Tighter tub tolerance</b>



## Purpose of the Engineering Analysis

- Characterize the relationship between manufacturer cost and efficiency (MEF/WF)





## Commercial Clothes Washers: Annual Energy and Water Use

- **Annual Energy & Water Use = Per-Cycle Use x Cycles per year**
- **Per-cycle energy use components**
  - Water-heating
  - Drying
  - Machine
- **Drying energy use (RMC) and machine energy use are a function of MEF**
  - Based on residential clothes washer data
- **Number of cycles per day**
  - Multi-Family: Average = 3.4; Range = 1 to 10.9
  - Laundromats: Average = 6; Range = 3 to 8
- **Annual energy and water use of baseline top-loading clothes washer (1.26 MEF, 9.50 WF)**
  - **Multi-Family**
    - Energy use = 2769 kWh/year (1020 kWh WH; 1583 kWh drying; 166 kWh machine)
    - Water use = 33 1000-gallons/year
  - **Laundromats**
    - Energy use = 4866 kWh/year (1793 kWh WH; 2782 kWh drying; 291 kWh machine)
    - Water use = 58 1000-gallons/year



## Baseline and Incremental Markups

- **Markups relate customer price to cost of goods sold (CGS)**
- **Baseline markups relate price to cost prior to a change in efficiency**
  - Baseline markups indicate a customer price that covers all of a retailer's or distributor's expenses plus profit
  - Direct labor costs (salaries, payroll, rental and occupancy) are included
- **Incremental markups relate the incremental change in customer price to the incremental change in CGS**
  - Some costs remain constant with CGS increases
  - Incremental markups cover only expenses that vary with CGS – in this case, expenses that increase due to an increase in equipment efficiency
    - For example, direct labor costs (salaries, payroll, rental and occupancy) do not vary with efficiency-induced changes in CGS
  - DOE assumes other operating costs and profit will scale proportionally with CGS

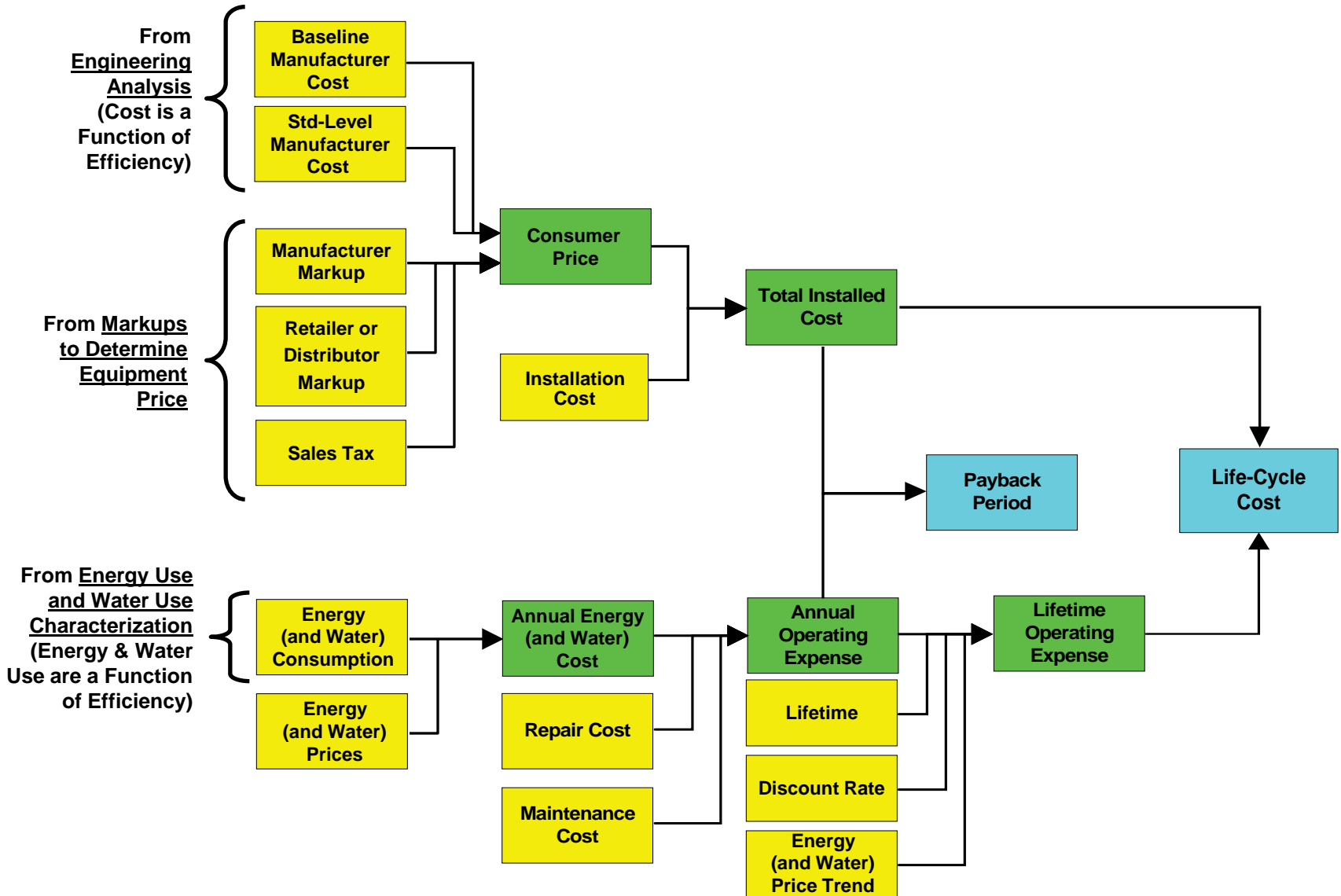


### Resulting Markups

<b>Markup</b>	Baseline	Incr.
Manufacturer	1.26	
Retailer	-	-
Distributor	1.43	1.18
Sales Tax	1.069	
<b>Overall</b>	1.93	1.59

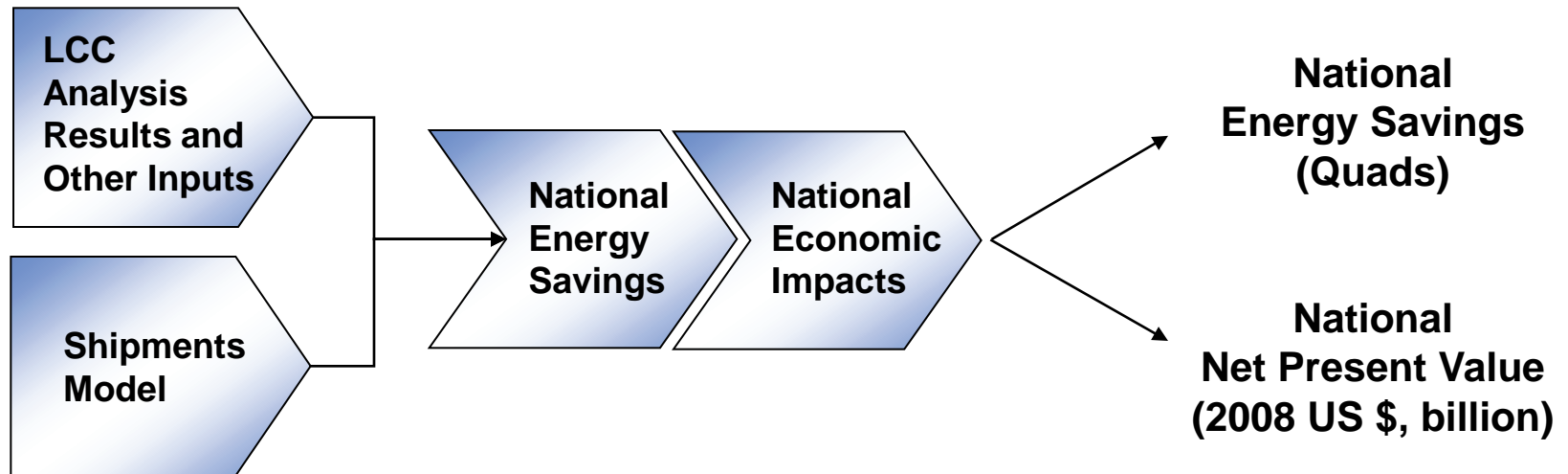


## LCC Calculation Flowchart





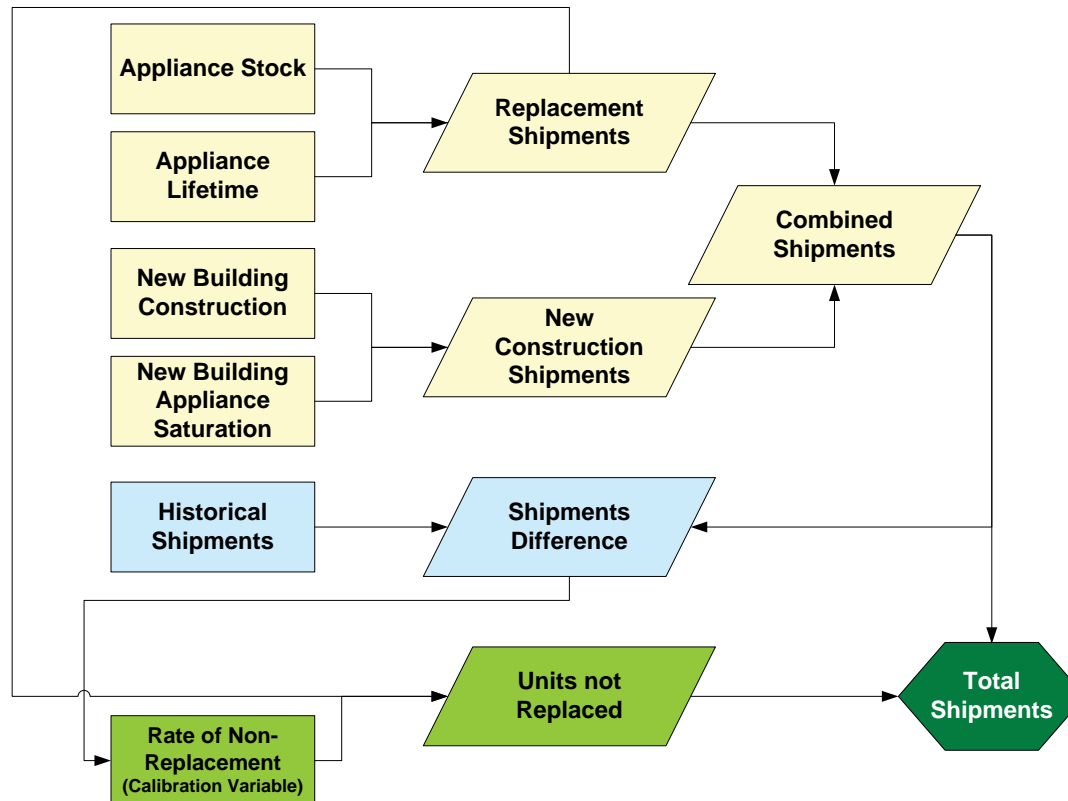
## National Impact Analysis Process



- National energy savings calculated for period from 2013-2043 (30 years)
- NPV calculated for period from 2013-2062



# Shipments Model





## Purchase Price and Operating Cost Impacts

- Shipments impacts due to purchase price and operating cost changes are accounted for when forecasting standards case shipments
- Shipments Model used Relative Price (RP) elasticity to estimate the impacts from purchase price (*PP*) and the present value of operating cost (*PVOC*) changes

$$RP = \frac{PP + PVOC}{Income}$$

- Purchase price effects dominate but mitigated by household income
- Based on historical shipments, retail price, efficiency, and income data for home appliances, *RP* elasticity = -0.34
  - 10% increase in *RP* results in a 3.4% drop in shipments
  - Consumers become less sensitive to initial changes in purchase price
    - Based on economic literature, *RP* elasticity drops 65% in ten years



## Inputs

- **Total Installed Cost**
  - Average per unit values as a function of efficiency level taken from LCC analysis
- **Repair and Maintenance Costs**
  - No increase in repair and maintenance costs with efficiency
- **Annual Energy Use**
  - Average per unit values as a function of efficiency level taken from LCC analysis
- **Base-Case and Standards-Case Forecasted Efficiencies**
  - Base-Case efficiencies 2005-2013: Based on base case efficiency distributions from LCC analysis
  - Standards-Case efficiencies 2013: Based on “Roll-up” scenario
  - Forecasted efficiencies: Frozen at 2013 levels
- **Energy and Water Prices**
  - Average prices taken from LCC analysis
  - Future energy prices adjusted according to trend forecasted by the *2009 Annual Energy Outlook*
  - Future water prices forecasted on linear extrapolation of CPI national water price index from 1970-2008
- **Electricity Site-to-Source Conversion Factors**
  - Conversion factors based on marginal heat rates from NEMS corresponding to *2008 Annual Energy Outlook*
  - Factors vary annually and account for generation, distribution, and transmission losses
- **Discount Rate**
  - 7% and 3% real from OMB’s Regulatory Analysis Guideline A-4
- **Present Year**
  - Future expenses are discounted to the year 2009