U.S. Department of Energy

Energy Conservation Program for Consumer Products and Commercial and Industrial Equipment

Framework Document Public Meeting on Energy Conservation Standards for Residential Central Air Conditioners and Heat Pumps

June 12th, 2008

Washington, DC

http://eere.energy.gov/buildings/appliance_standards/residential/central_ac_hp.html

Welcome and Introduction

- Introductions
- Role of the Facilitator
- Ground Rules (norms)
  - Listen as an ally
  - Use short, succinct statements/keep to the point
  - Hold sidebar conversations outside the room
  - Focus on issues, not personalities
  - One person speaks at a time (raise hand to be recognized; state your name for the record)
  - Set cell phones to silent/vibrate
- Housekeeping Items
- Agenda Review
- Opening Remarks

Stakeholder Opening Statements

- Stakeholders who contacted the Department of Energy to request an opportunity to issue an opening statement should speak now

Public Meeting Agenda

1. Introduction
2. Rulemaking Overview
3. Test Procedure
4. ANOPR Analyses
5. NOPR Analyses
6. Closing Remarks

Purpose of the Framework Document Public Meeting

- Present the procedural and analytical approaches to evaluate energy conservation standards for residential central air conditioners and heat pumps
- Provide a forum for public discussion of rulemaking issues
- Encourage interested parties to submit data, information, and written comments

Requests for Comment

Issue Box Throughout the Framework document, specific issues are brought up for discussion and feedback. Throughout this presentation, these issues are brought up in comment boxes like this one. Comments concerning any part of the document or presentation are welcomed.

Feedback Is Requested

In all correspondence, please refer to this rulemaking by:

- Framework Document for Residential Central Air Conditioners and Heat Pumps
- Docket Number EERE-2008-BT-STD-0006, and
- Regulatory Identification Number (RIN) 1904-AB47

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Comment period closes at 4:00pm

July 7, 2008

Agenda

9:00 – 9:05am	Welcome
9:05 – 9:15am	Introduction and Agenda Review
9:15 – 10:15am	Opening Remarks from Interested Parties
10:15 – 10:30am	Rulemaking Overview
10:30 – 10:45am	Test Procedures
10:45 – 11:00am	BREAK
11:00 – 12:00pm	Market and Technology Assessment, Screening Analysis, Engineering Analysis and Preliminary Manufacturer Impact Analysis
12:00 – 1:00pm	LUNCH
1:00 – 2:00pm	Energy Use Analysis, Markups for Equipment Price Determination, and Life-Cycle Cost and Payback Period Analysis
2:00 – 2:30pm	Shipments Analysis and National Impact Analysis
2:30 – 2:45pm	BREAK
2:45 – 3:30pm	Notice of Proposed Rulemaking (NOPR) Analyses
3:30 – 4:00pm	Discussion of Issues and Closing Remarks

Background

- This energy conservation standard is a “backlog” rulemaking
- Addresses requirements from 42 USC 6295(d)(3)(A) and (B):

  Pursuant to 6295(d)(3)(A), the first review was completed in August 2004, with the publication of a Technical Amendment that established standards determined in the 2001 “13 SEER” final rule

  Pursuant to 6295(d)(3)(B), this rulemaking constitutes the second review of possible amendment to energy conservation standards for central air conditioners and heat pumps

[1] 42 U.S.C. 6317(b)(1)

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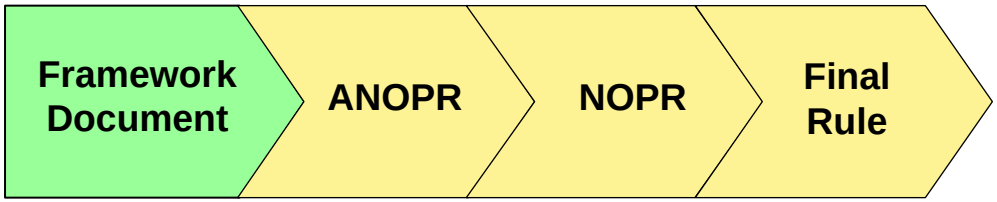
42 U.S.C. 6317(c) Directs DOE to Take into Consideration Seven Factors When Setting Energy Conservation Standards

EPCA Factors	DOE Analysis
1. Economic impact on consumers and manufacturers	Life-Cycle Cost Analysis Manufacturer Impact Analysis
2. Lifetime operating cost savings compared to increased cost for the product	Life-Cycle Cost Analysis
3. Total projected energy savings	National Impact Analysis
4. Impact on utility or performance	Engineering Analysis Screening 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

Framework Document



- Today's public meeting covers the Framework Document for this rulemaking.
- **Federal Register Notice of Public Meeting – (73 FR 32243, June 6, 2008)**
  - Gives notice of the public meeting and availability of the Framework Document being discussed today
  - Encourages interested parties to submit comments
- **Framework Document**
  - Provides an overview of the rulemaking process and encourages early participation by interested parties
  - Invites comments on proposed approach and issues
  - The Framework Document is available online: http://www.eere.energy.gov/buildings/appliance_standards/residential/central_ac_hp.html

Milestones for the Rulemaking Process

Milestone	*Date*
End of Framework Comment Period	*July 7, 2008*
ANOPR Published in Federal Register	*Fall of 2009*
NOPR Published in Federal Register	*Fall of 2010*
Final Rule Published in Federal Register	*June 2011*
Effective Date of Standard (5 years after FR)	*June 2016*

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Test Procedure

- DOE published a Final Rule for the central air conditioners and heat pumps test procedure on October 22, 2007 (72 FR 59906) and it is found in 10 CFR 430, Subpart B, Appendix M
- EISA 2007 amended EPCA to direct DOE to consider updated test procedures and to include standby mode and off mode energy consumption
- DOE understands that standby mode and off mode energy consumption for central air conditioners and heat pumps means the energy consumed by the equipment when the equipment is not providing cooling, heating, or ventilation
- DOE expects to propose an amendment to the test procedure for central air conditioners and heat pumps by October 2010

Request for Feedback

Item 1-1 What are the standby power modes and the magnitudes of the standby power consumption during those modes in the operation of the central air conditioners and heat pumps that DOE should consider in this rulemaking? For example, are crank case heaters still being used in the product designs and if so, what is their typical power consumption?

Item 1-2 DOE invites comments on whether it would be technically feasible to incorporate standby power consumption into the SEER metric or whether it instead should be considered as a stand-alone measure for this rulemaking.

Item 1-3 DOE also invites comments on the necessary changes to the existing DOE test procedure for central air conditioners and heat pumps to account for standby power consumption and its measurement.

Public Meeting Agenda

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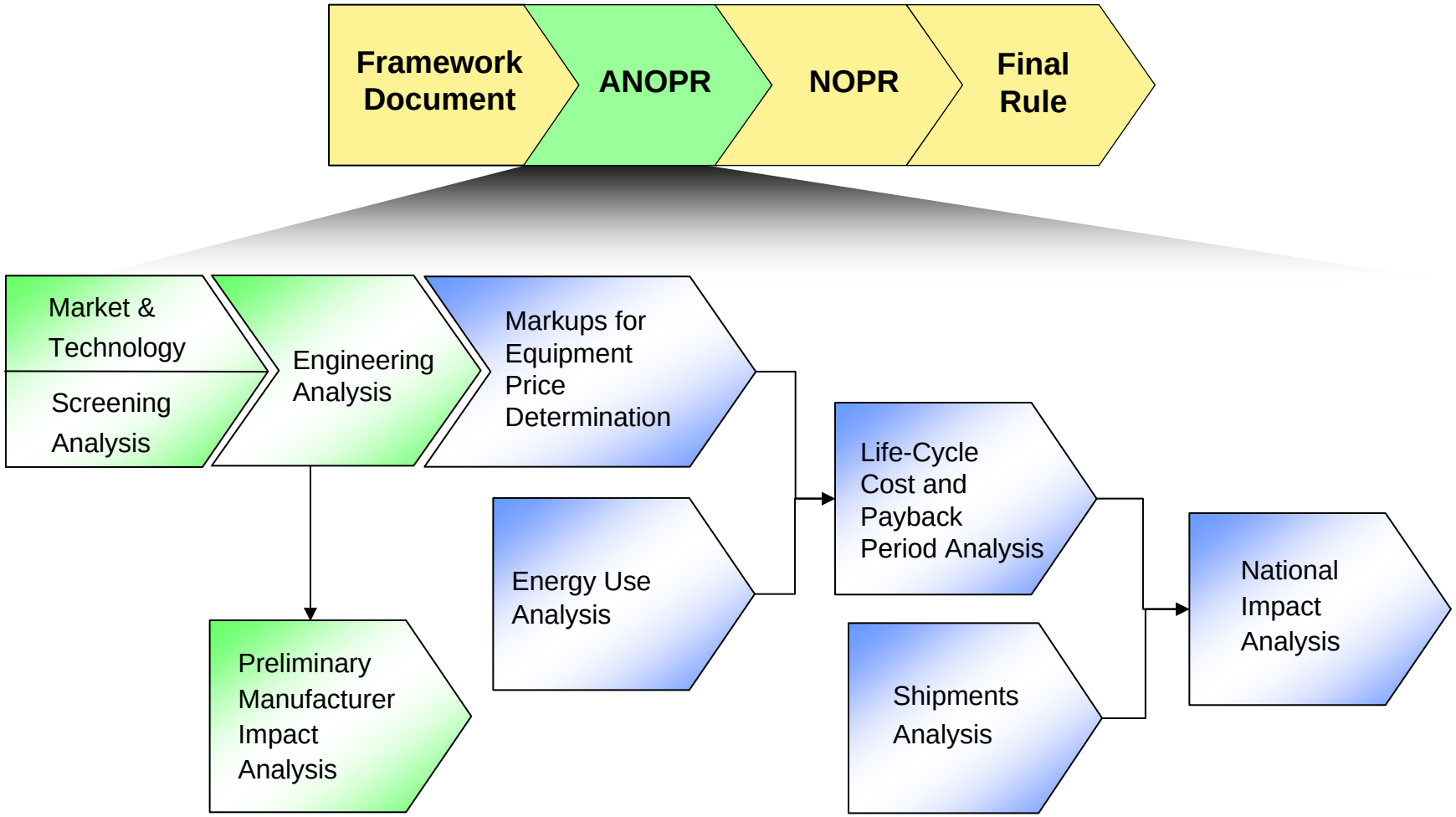
Steps in the Standards Rulemaking: ANOPR



Market and Technology Assessment

- Purpose:
  - Characterize the residential central air conditioners and heat pump market, industry, and measures to improve efficiency

- Method:
  - Identify and characterize manufacturers of residential central air conditioners and heat pumps
  - Estimate shipments and trends in the market
  - Identify technologies that could improve efficiency
  - Identify regulatory and non-regulatory initiatives intended to improve the efficiency of products covered under this rulemaking

Request for Feedback

Item 3-1 DOE seeks information that would contribute to the market assessment for residential central air conditioners and heat pumps, including information on manufacturers, market shares, trends in the market, and any other applicable information that is available.

Current Product Classes & Standards

Current Product Classes:	Current Standard Levels:
• Split System Air Conditioners	13 SEER
• Split System Heat Pumps	13 SEER/7.7 HSPF
• Single Package Air Conditioners	13 SEER
• Single Package Heat Pumps	13 SEER/7.7 HSPF
• Small-Duct High-Velocity (SDHV) Air Conditioners and Heat Pumps	13 SEER/7.7 HSPF*
• Space-Constrained Air Conditioners	12 SEER
• Space-Constrained Heat Pumps	12 SEER/7.4 HSPF
• Through-the-Wall Split Air Conditioners and Heat Pumps**	10.9 SEER/7.1 HSPF
• Through-the-Wall Package Air Conditioners and Heat Pumps**	10.6 SEER/7.0 HSPF

* Exception relief has been granted for manufacturers of SDHV systems at 11 SEER/6.8 HSPF.
** The through-the-wall product class ceases to exist on 1/23/2010.

Planned Product Classes

- Split System Air Conditioners
- Split System Heat Pumps
- Single Package Air Conditioners
- Single Package Heat Pumps
- Small-Duct High-Velocity (SDHV) Air Conditioners and Heat Pumps
- Space-Constrained Air Conditioners
- Space-Constrained Heat Pumps

Item 3-2 DOE requests feedback on the planned product classes.

Item 3-3 Are there other product classes that should be considered? Should all of the identified product classes be considered?

SDHV Air Conditioners and Heat Pumps

- Manufacturers of SDHV systems have filed for, and received, exception relief
  - 11 SEER/6.8 HSPF
  - Effective January 23, 2006; effective until DOE establishes new standards
- DOE is considering maintaining a separate product class for SDHV systems and conducting a detailed analysis to determine appropriate standards

Item 3-4 DOE requests that stakeholders submit any available, applicable data to DOE concerning SDHV systems, including market shares, shipments, cost and performance data, and design specifications.

Through-the-Wall (TTW) Air Conditioners and Heat Pumps

- Two main types of TTW products
  - Split systems (condensers using conventional air handlers)
  - Package systems (similar to packaged terminal air conditioners and heat pumps (PTACs and PTHPs), but ducted to interior space)
- Current standards
  - Split: 10.9 SEER/7.1 HSPF
  - Package: 10.6 SEER/7.0 HSPF
- The TTW product class ceases to exist on January 23, 2010, but the space constrained product class remains
- DOE is assuming a 12 SEER/7.4 HSPF baseline for space constrained products, including TTW split and package

Item 3-45 DOE requests submission of any available, applicable data concerning TTW systems, including market shares, shipments, cost and performance data, and design specifications.

Ductless Split Systems

- Ductless split systems ("mini-splits" and "multi-splits") currently represent only a small fraction of the domestic market
- In the most recent test procedures final rule, DOE stated it believes ductless splits compete mainly with conventional systems, not room air conditioners
- In this rulemaking, DOE is considering maintaining the status of ductless split systems as part of the conventional split systems product class

Item 3-6 DOE requests submission of any available, applicable data concerning ductless split systems, including market shares, shipments, cost and performance data, and design specifications.

Technology Assessment

- In the technology assessment, DOE identifies technologies that can improve the efficiency of central air conditioners and heat pumps

Higher-efficiency expansion valves (e.g., dual-port TXVs, EEVs)
Higher-efficiency evaporator and condenser fan motors (e.g., brushless DC)
Increased evaporator and condenser coil surface area
Evaporator and condenser fan motor controllers
Higher-efficiency evaporator and condenser fan blades
Higher-efficiency compressors (e.g., variable-speed compressors)
Micro-channel heat exchangers
Liquid-to-suction heat exchangers
Flat tube heat exchangers
High-efficiency defrost mechanism (heat pumps only; e.g., “frostless” heat pumps)
Improved defrost timer control (heat pumps only; e.g., demand-based defrost)

Request for Comment

Item 3-7 What technologies or design options, if any, should DOE add to or remove from the above lists? Please provide rationale for any such recommendation.

Screening Analysis

- Purpose
  - Screen out technology options that will not be considered in the engineering analysis

- Method:
  - Each technology option will be evaluated based on the following criteria:

Technological feasibility

Practicability to manufacture, install and service

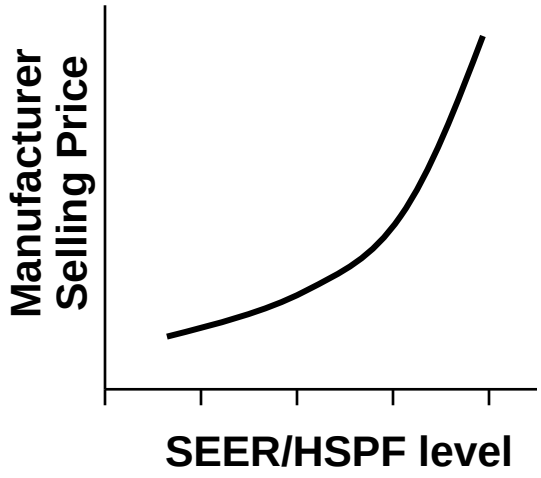
Impacts on product utility or availability to consumers

Impacts on health or safety

Engineering Analysis

- Purpose:
  - To characterize the relationship between manufacturer selling price and air conditioner and heat pump efficiency

Manufacturer Selling Price – Efficiency Relationship



Rulemaking Analyses

- **Life-Cycle Cost and Payback Period Analysis**
- **Manufacturer Impact Analysis**
- **Employment Impact Analysis**

Engineering Analysis Methodology

Establish Baseline

⇦ Determine baseline efficiency levels for each product class (current standard levels)

Estimate Cost of Baseline Units

⇦ Through reverse engineering analysis, estimate the cost of baseline units at a representative capacity for each product class

Estimate Cost of Units Above the Baseline

⇦ Estimate the cost of units at efficiency levels above the baseline for each product class (efficiency-level approach)

Document Results

⇦ Document the Engineering Analysis, supplementing the reverse engineering data with information from manufacturer catalogs, websites and trade publications

Request for Comment

Item 5-2 DOE requests feedback on the use of an efficiency level approach to determine the relationship between manufacturer production cost and energy efficiency levels for central air conditioners and heat pumps.

Item 5-3 For each product class, DOE seeks feedback on what representative cooling capacity to use (i.e., what is the most common, or most appropriate size air conditioner or heat pump to analyze).

Item 5-4 DOE seeks information on the limitations of products at very small and very large capacities, and how to consider these limitations in its analysis.

Efficiency Levels

Level	Split System Air Conditioners	Packaged Air Conditioners
EnergyStar & CEE Tier 1	14 SEER	14 SEER
CEE Tier 2	15 SEER	14 SEER or higher
CEE Tier 3	16 SEER or higher	N/A
Maximum available (3 ton)	21 SEER	16.6

Level	Split System Heat Pumps		Packaged Heat Pumps	
EnergyStar	14 SEER	8.2 HSPF	14 SEER	8 HSPF
CEE Tier 1	14 SEER	8.5 HSPF	14 SEER	8 HSPF
CEE Tier 2	15 SEER or higher	8.5 HSPF or higher	14 SEER or higher	8 HSPF or higher
Maximum Available (3 ton)	19.5 SEER	10.8 HSPF	16.4 SEER	9 HSPF

Efficiency Levels

- DOE will consider the above levels, but may analyze other levels not in these lists
- DOE will examine the "maximum technologically feasible" (max-tech) level, which is not necessarily the maximum available

Item 5-5 DOE seeks input from stakeholders concerning the efficiency levels is plans to use for collecting incremental cost data. DOE also seeks input from stakeholders on appropriate max-tech levels.

Item 5-6 DOE seeks input on appropriate levels to analyze for SDHV systems, and for space constrained products. DOE also seeks input from stakeholders on appropriate max tech levels for SDHV and space constrained products.

Regional Standards

- Section 306 of EISA 2007 – Regional Standards
  - Permits DOE to establish standards for one or two regions on top of a base national standard if regional standards would save a significant amount of energy compared to only a base national standard and are economically justified
  - Standards for the additional region(s) are intended to be more restrictive than the base national standard
  - The Secretary may define the boundaries of the regions by contiguous States only (AK and HI may be included in one of these regions)

Request for Feedback

Item 1-4 DOE seeks feedback from interested parties to help determine appropriate regions when considering potential regional standards for central air conditioners and heat pumps.

Item 1-5 For an analysis that uses regional standards, what regions (e.g., the hot and dry southwest, the hot and wet southeast) would be appropriate for setting standards above the base national standard? Which States would be included in such regions (keeping in mind the statutory directive to include contiguous States only)?

Item 1-6 How should DOE address impacts to other market participants (distributors, dealers, contractors, installers) of the potential adoption of regional standards for central air conditioners and heat pumps?

Manufacturer Markup

Manufacturer Production Cost + **Manufacturer Markup** (Non-Production Costs) = **Manufacturer Selling Price**

- **Direct material**
- **Direct labor**
- **Factory overhead**
- **Depreciation**

- Sales, general & admin.
- Research & development
- Interest
- Profit

- Manufacturer Production Cost
  - Reverse engineering analysis
  - Interviews with technical experts
  - Interviews with manufacturers
  - Manufacturer catalogs and specification sheets

Manufacturer Markup

Manufacturer Production Cost + **Manufacturer Markup** (Non-Production Costs) = **Manufacturer Selling Price**

- Direct material
- Direct labor
- Factory overhead
- Depreciation

- **Sales, general & admin.**
- **Research & development**
- **Interest**
- **Profit**

- Manufacturer Markup
  - SEC 10-K reports
  - Company annual reports
  - Dun and Bradstreet reports
  - Value Line industry statistics
  - Standard and Poor's industry statistics
  - Ibbotson Associates reports

Request for Comment

Item 5-7 DOE seeks comment on the planned markup approach for developing estimates of manufacturer selling prices.

Proprietary Designs

- The Department will evaluate all design options that are commercially available or present in a working prototype, including proprietary designs
- Proprietary designs will only be considered if they do not present a unique path to a given efficiency level
- The confidentiality of manufacturers will be maintained

Item 5-8 Are there proprietary designs or technologies that DOE should consider for any of the products under consideration by this rulemaking? If so, how should DOE acquire the cost data necessary for evaluating these designs?

Outside Regulatory Changes

- DOE will consider the effects of regulatory changes outside DOE's statutory rulemaking process
- The Environmental Protection Agency has mandated the phase-out of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs)
- Notably, R-22 will be phased out, beginning with a ban on production and importation on January 1, 2010
- This ban falls *before* the final rule (2011) and effective date (2016) of this rulemaking
- DOE intends to conduct the analysis under the assumption that R-410A will be the refrigerant of choice to replace R-22
- DOE also understands that reduced availability of R-22 would likely result in increased prices

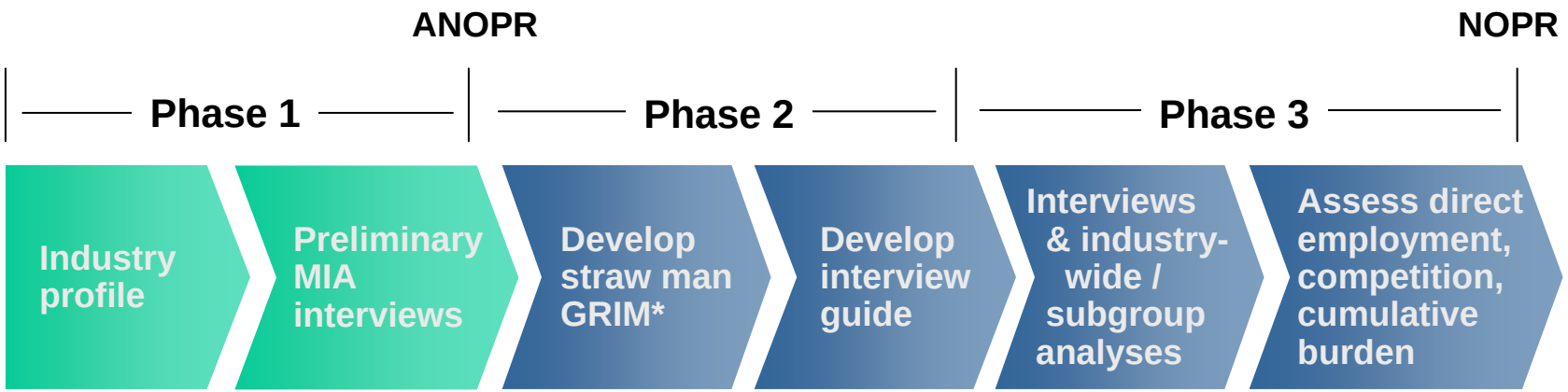
Request for Comment

Item 5-9 DOE seeks feedback from interested parties on the potential impacts of reduced availability of R-22.

Item 5-10 Are there additional outside regulatory issues that DOE should consider in its analysis of air conditioners and heat pumps?

Preliminary Manufacturer Impact Analysis Methodology

- The MIA consists of three main phases. In the ANOPR, the preliminary MIA focuses on Phase 1



* Government Regulatory Impact Model (GRIM)

Methodology: Phase 1

- Consists of the industry profile and preliminary manufacturer impact analysis interviews

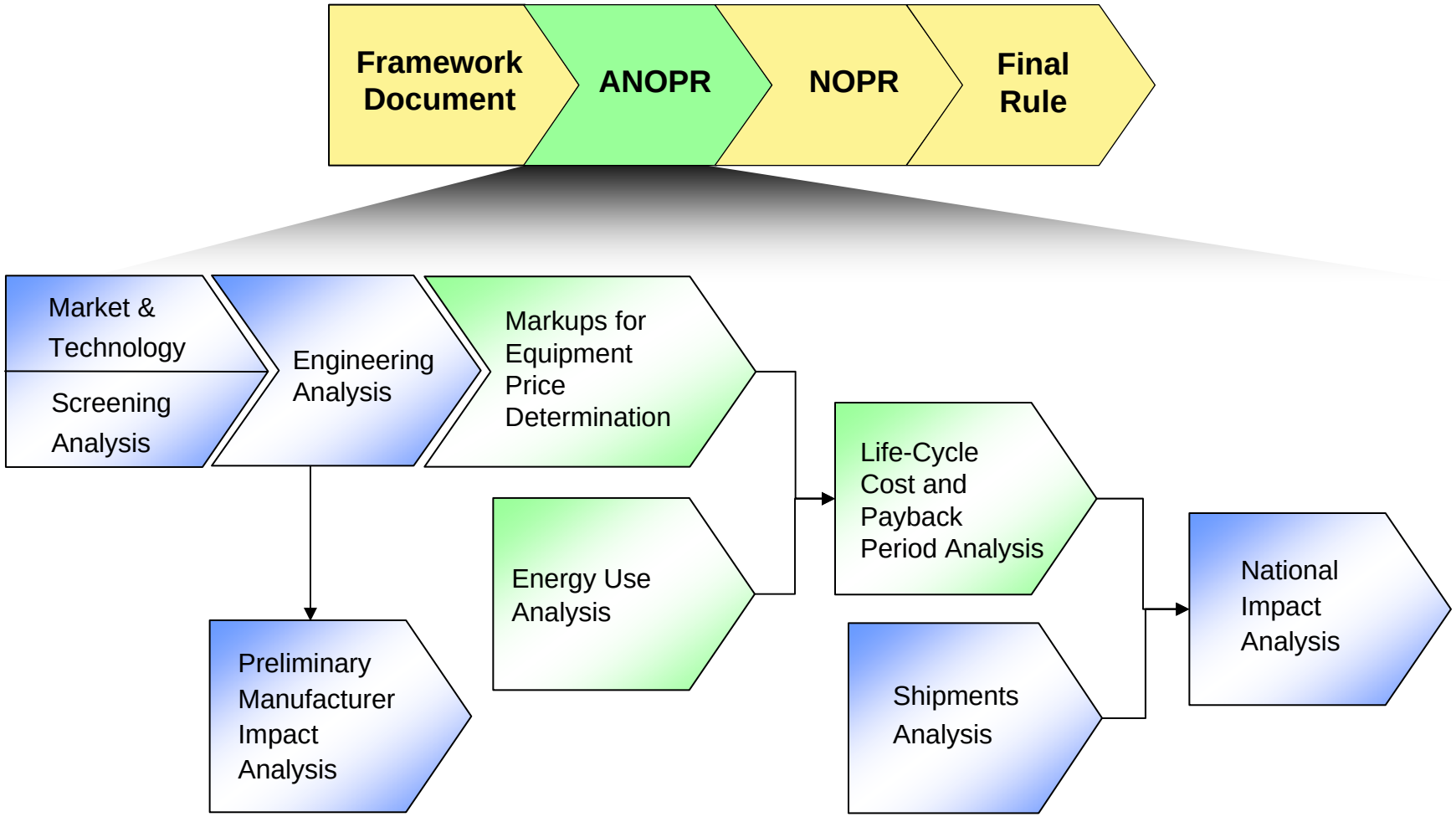
Industry Profile

- Evaluate 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

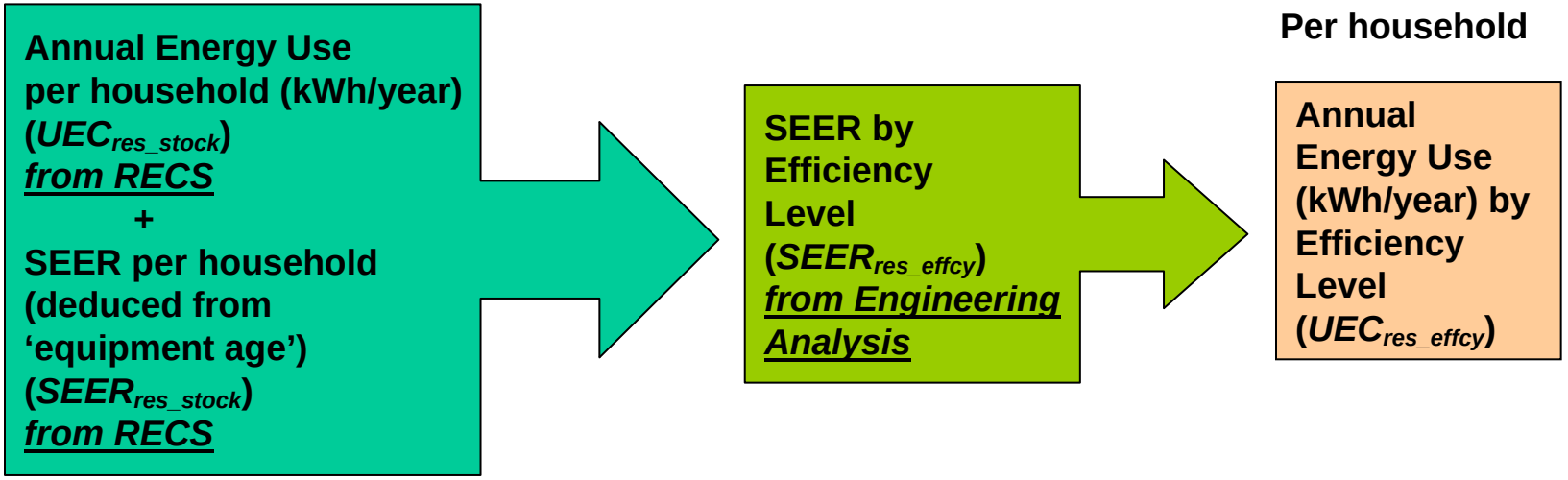
Steps in the Standards Rulemaking: ANOPR



Energy Use Analysis for Residential Buildings

- Purpose:
  - Determine annual energy consumption to calculate annual operating costs for the life-cycle cost (LCC) and payback period (PBP) analyses
  - Access the energy-savings potential of increased product efficiencies
- Method:
  - Develop residential building samples for each product class from DOE-EIA's Residential Energy Consumption Survey (RECS)
    - RECS 2001 data is currently available but RECS 2005 data may not be available in time for the ANOPR
  - Use RECS data along with Engineering Analysis data to develop annual energy use

Energy Use Analysis Approach for Residential Buildings



$$UEC_{res\_effcy} = UEC_{res\_stock} \times \frac{SEER_{res\_stock}}{SEER_{res\_effcy}}$$

Request for Comment

Item 6-1 DOE seeks comments on the accuracy and additional specificity of the annual shipped efficiency (SEER) data by vintage as published in the HVAC&R News. Also, are there regional distributions of the SEER data by vintage available? If so, where can these data be found?

Item 6-2 DOE seeks input on the planned approach of using RECS data for determining the energy consumption of central air conditioners and heat pumps in residential buildings.

Rebound Effect

- Purpose:
  - DOE will consider the “rebound effect” in its determination of annual energy consumption

- Assumptions:
  - Rebound effect occurs when a more efficient appliance or equipment is used more intensively so the expected savings may not fully materialize
  - Rebound effect for residential space-cooling equipment appears to be highly variable (0% to 50% according to existing literature)

Request for Comment

Item 6-3 Because the rebound effect for residential space-cooling equipment appears to be highly variable, DOE seeks comments on the rebound effect that may be associated with more efficient central air conditioners and heat pumps.

Energy Use Analysis for Commercial Buildings

- Purpose:
  - Determine annual energy consumption and peak demand impacts associated with the estimated ten percent of central air conditioners and heat pumps that are installed in commercial buildings. The annual energy consumption and peak demand will be used in LCC and PBP analyses

- Method:
  - Use a whole-building simulation-based analysis for a representative commercial building type in different climate regions
  - Consider the small office as the most representative commercial building type where the covered products are installed
  - Characterize the small office building prototype model from DOE-EIA's Commercial Building Energy Consumption Survey (CBECS)

Request for Comment

Item 6-4 DOE specifically requests comment on whether ten percent is an accurate estimate of the fraction of single-phase central air conditioners and heat pumps installed in commercial buildings.

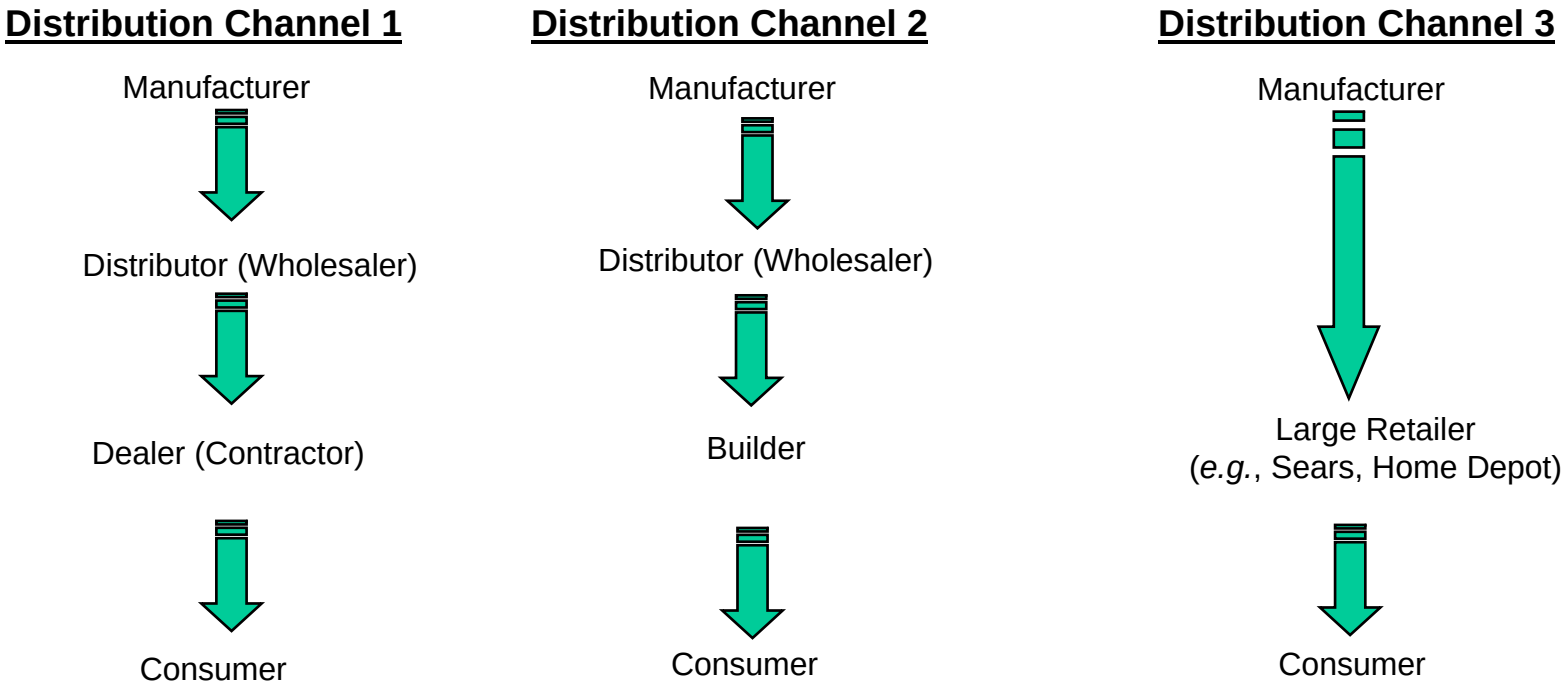
Item 6-5 DOE requests input on whether, as defined by CBECS, the "small office building" is the appropriate commercial building type to use for this analysis. If so, DOE further requests comment on its planned approach to use a small office building prototype to estimate the annual energy consumption and peak-demand impacts of the covered equipment installed in commercial buildings.

Markups for Equipment Price Determination

- DOE uses markups to convert manufacturer costs from the engineering analysis into consumer retail prices
- DOE needs retail prices for the life-cycle cost and payback period analyses
- DOE will characterize distribution channels for both baseline product and product with higher efficiency levels
- DOE develops markups for each party involved in product distribution
- SEC 10-K reports provide data for calculating manufacturer markups
- U.S. Census Bureau provides data for calculating retailer markups
- DOE may collect retail price data for validation purposes
- DOE will investigate the variability of retail prices

Markups for Equipment Price Determination

DOE Proposed Distribution Channels



Request for Comment

Item 7-1 DOE requests information from stakeholders on whether the distribution channels for the central air conditioners and heat pumps would be similar to those described above and, if not, how they might be different. Also, what might be the differences in the distribution channels for the new versus replacement market? And are there any regional differences in the distribution channels?

Item 7-2 DOE also requests information on the relative fractions of shipments expected for each distribution channel for new and replacement central air conditioners and heat pumps. Are there any regional differences in the relative fractions of shipments?

Request for Comment

Item 7-3 DOE requests feedback on its plan to use baseline and incremental distribution channel markups for the LCC and PBP analysis.

Item 7-4 DOE seeks comment on other sources of relevant data that could be used to characterize markups for the central air conditioners and heat pumps covered under this rulemaking.

Life-Cycle Cost and Payback Period Analysis

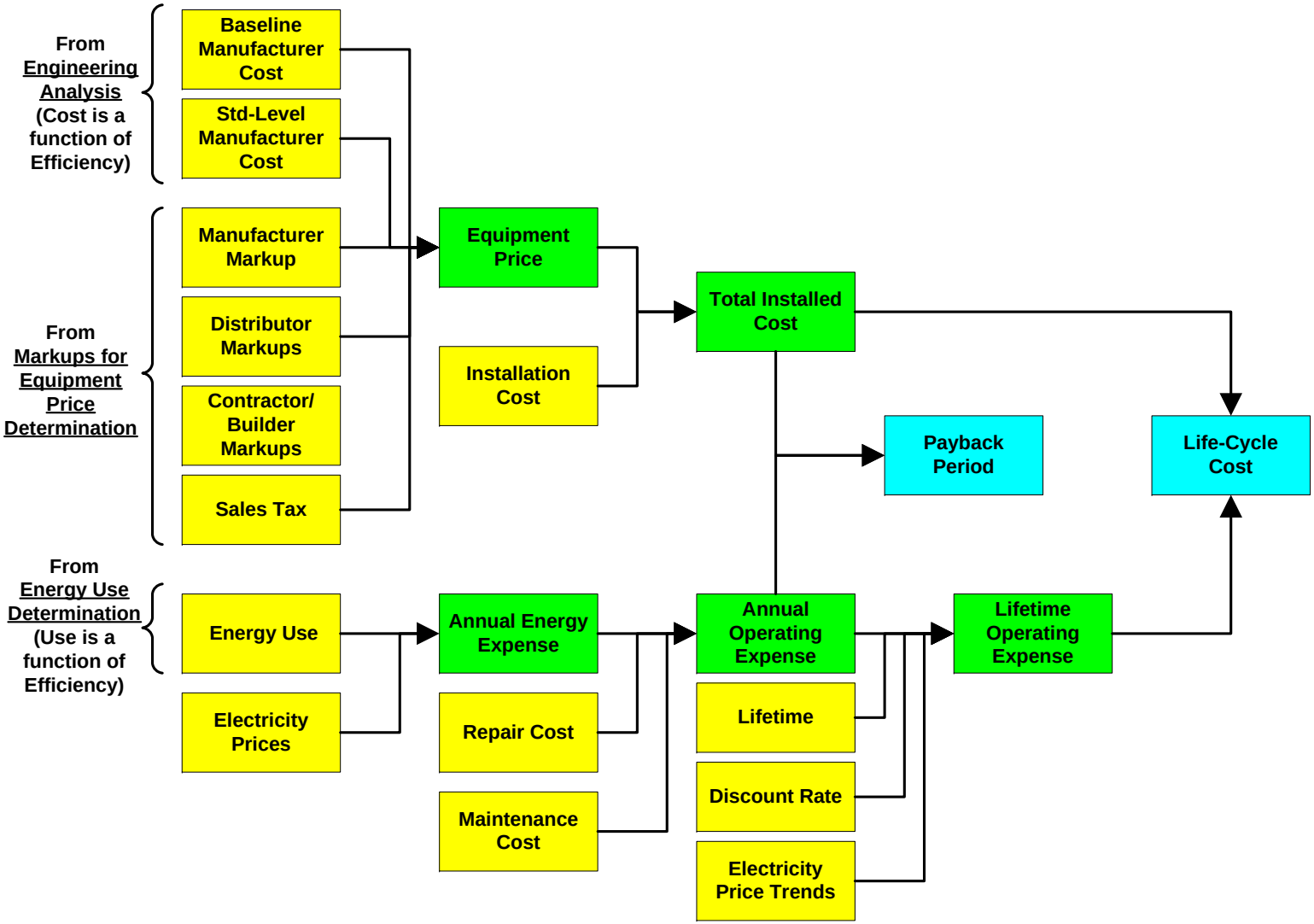
- Purpose:
  - Assess the net life-cycle cost (LCC) impacts of differing energy conservation standards for central air conditioners and heat pumps on the consumer
- Method:
  - LCC equals product installed price plus the sum of annual operating, maintenance and repair costs discounted to a particular base year
  - Economic evaluation is from the consumer perspective
  - Analysis implemented using an Excel® spreadsheet
  - Results are expressed as LCC difference (baseline minus standard level)
  - Simple payback period (years) is also calculated and reported in this analysis

Approach

- Monte Carlo analysis will allow DOE to consider end-user variability and conduct sensitivity analyses
  - Consider different end-use sectors by weighting input distributions
  - Correlate inputs where necessary (e.g., electricity price and sector)

- One LCC and PBP analysis result per product class

LCC and PBP Analysis Inputs



Electricity Prices

- Electricity prices are used to convert energy use to energy costs.
- DOE intends to use marginal prices to determine energy cost savings
  - Marginal price is the charge for the last increment of consumer energy use

Residential Electricity Prices

- No demand charges means simpler methods are sufficiently accurate
- Two possible approaches, based on two data sources
  - Residential Energy Consumption Survey (RECS) utility bill data by household where marginal prices are estimated by plotting monthly expenditures ($) against monthly consumption (kWh); the slope ($/kWh) is the marginal price
    - RECS 2001 data is currently available but RECS 2005 data may not be available in time for the ANOPR
  - Edison Electric Institute (EEI) data consists of monthly bills for three levels of consumer usage (500, 750 and 1000 kWh) for ~180 utilities, summer and winter; the marginal price can be estimated from the difference in the bill (published annually, most recently for 2007)
- EEI 2007 data could alternatively be used to adjust RECS 2001 data

Commercial Electricity Prices

- Commercial electricity prices will need to be developed if commercial building applications are considered
- Commercial prices are more complex because of demand ($/kW) charges and so-called *hours* charges (where energy block sizes depend on demand)
- Electric utility tariffs can be used to accurately calculate these charges
  - A tariff is the set of rules used by the utility to calculate a consumer's bill
  - Marginal cost savings are equal to the marginal energy price times the energy savings plus the marginal demand price times the demand reduction
- This relationship has been summarized in a simple two-parameter formula to estimate a consumer's marginal price as a function of marginal load factor
  - The marginal load factor is the ratio of the demand savings to the average energy savings

Request for Comment

Item 8-1 DOE seeks comments on which data source (RECS or electric utility tariffs) should be used to estimate marginal electricity prices.

Electricity Price Forecasts

- DOE will use the Energy Information Administration (EIA) *Annual Energy Outlook* (*AEO*) for projections of future marginal electricity prices (reference, high, and low scenarios)

Item 8-2 DOE seeks comments on its planned use of EIA's AEO to project future marginal electricity prices.

Discount Rate

- Discount rates are used to convert streams of annual operating expenses to present value in the LCC analysis
- Residential discount rates – DOE will use similar approach as for other residential product standards rulemakings
  - Derived from estimates of the "finance cost" to purchase residential products
  - "Finance cost" based on: (1) cost of any debt incurred to purchase products (e.g., credit cards, home equity loans) and (2) opportunity cost of any equity to purchase products (e.g., stocks, bonds, savings accounts)
  - Federal Reserve Board's *Survey of Consumer Finances* is a source of much of the equity and debt data
- Commercial discount rates (if necessary) – DOE will use similar approach as for other commercial product standards rulemakings
  - Calculated from the weighted-average cost of capital to the firm (WACC) to obtain equity and debt financing

Item 8-3 DOE seeks comment on the planned approaches for estimating discount rates for residential consumers and commercial customers of central air conditioners and heat pumps.

Maintenance, Repair and Installation Costs

- DOE believes that routine repair and maintenance costs may increase with more efficient central air conditioners and heat pumps because of technologies that are not currently widely available
- DOE expects that installation costs will not change for more and less efficient central air conditioners and heat pumps

Item 8-4 DOE seeks feedback on whether it is correct to assume that changes in maintenance, repair, and installation costs will be negligible for more efficient equipment.

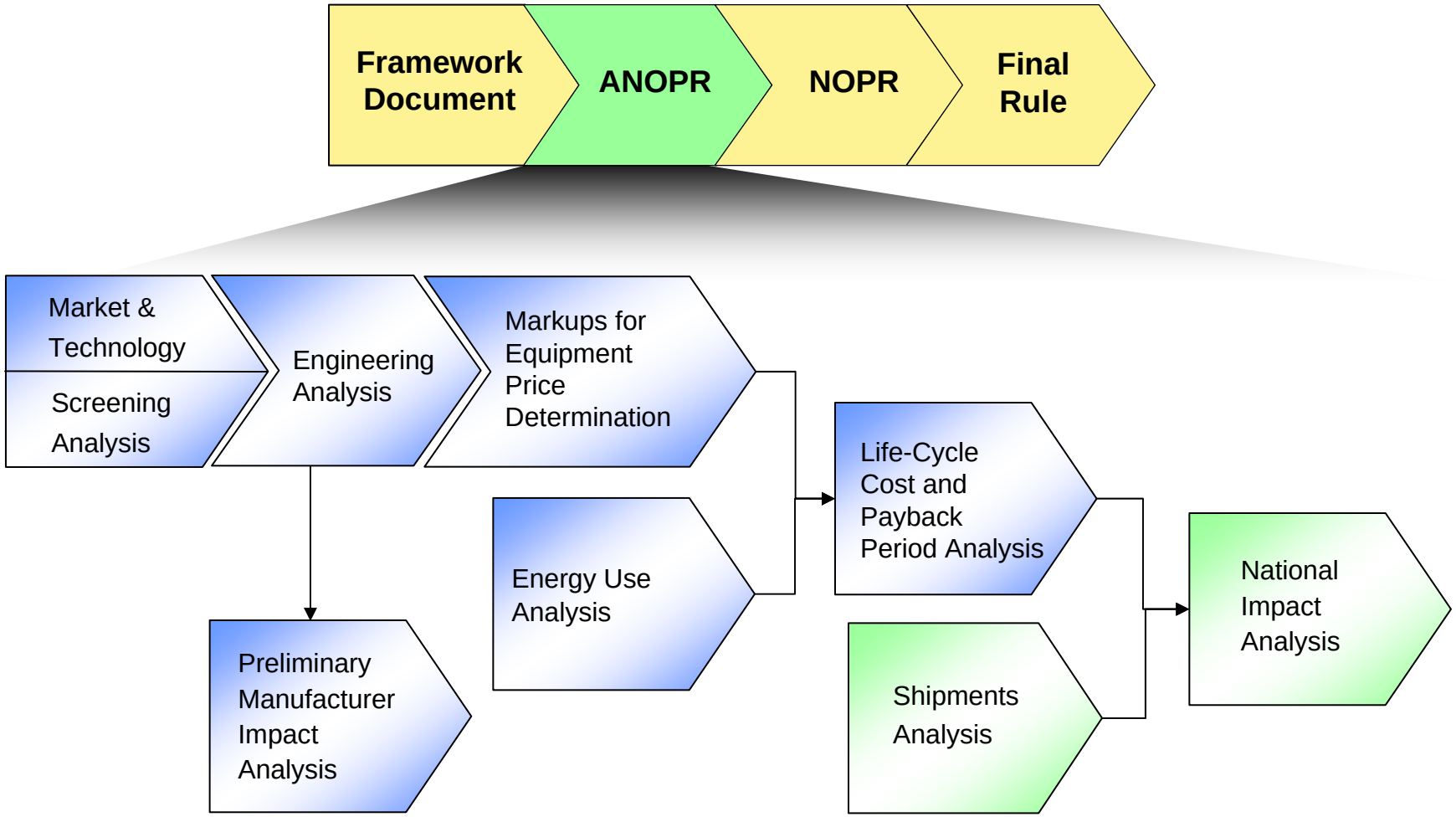
Item 8-5 If it is not appropriate to assume that changes in maintenance, repair, or installation costs would be negligible for more efficient equipment, DOE seeks comment on appropriate methodologies for assessing changes to each of these costs.

Equipment Lifetime

- DOE proposes to use an analysis where equipment lifetimes for the base case and standards case are the same
- In the previous rulemaking for these covered products, DOE used an average lifetime of 18.4 years

Item 8-6 DOE seeks comments on appropriate equipment lifetimes for the central air conditioners and heat pumps.

Steps in the Standards Rulemaking: ANOPR



Shipments Analysis

- **Purpose:**
  - Quantify changes in product's shipments due to potential new energy efficiency standards

- **Method:**
  - The shipments model will rely on a range of data sources
  - The model will only consider shipments of covered products

Base-Case Shipments Forecast Approach

- Depicts the situation where new standards are not adopted
- Residential shipments forecast will account for: (1) product sales to new construction and (2) replacements for failed units
- DOE will use approach to determine split-system and single-package annual shipments
- New construction shipments estimated with forecasts of new housing and historical rates of product ownership (saturation rates)
- Replacement shipments estimated with product retirement function applied to existing units in housing stock
- Historical forecasts ('backcasts') will be calibrated to historical shipments
  - Calibration performed by accounting for product sales to existing households that do not already own a covered product
  - DOE will derive a historical rate of adoption for the "existing" market

Base-Case Shipments Forecast Approach (cont.)

- Commercial shipments forecast will need to be developed if commercial building applications are considered
- Commercial shipments forecast will account for: (1) product sales to new construction and (2) replacements for failed units
- New construction commercial shipments estimated with forecasts of new construction and historical rates of product ownership (saturation rates)
- Replacement commercial shipments estimated with product retirement function applied to existing units in building stock
- Historical commercial forecasts ('backcasts') will be calibrated to historical shipments. Calibration performed by accounting for product sales to existing buildings that do not already own the product

Base-Case Shipments Forecast Approach (cont.)

- DOE intends to estimate SDHV and Space-Constrained shipments forecasts from extrapolations of historical shipments trends
  - Simplified approach will require historical shipments from stakeholders

Request for Comment

Item 9-1 DOE seeks historical shipments data for each of the following product classes: (1) split-system air conditioners; (2) split-system heat pumps; (3) single-package air conditioners; (4) single-package heat pumps; (5) SDHV systems; (6) through-the-wall air conditioners; and (7) through-the-wall heat pumps. Within each product class, DOE also requests shipments data disaggregated regionally by Census Region.

Standards Impacts on 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)
- DOE will consider impacts from market-pull programs (e.g., Energy Star)
- For heat pumps, DOE will consider fuel and equipment switching
  - Any forecasted drop in heat pump shipments will be allocated to increased sales of gas-fired and electric-resistance forced-air furnaces
  - Reflects a “maximum” scenario that will indicate the maximum amount of fuel and equipment switching

Request for Comment

Item 9-2 As part of its preliminary manufacturer impact analysis, DOE seeks input from manufacturers on the potential impact of new energy conservation standards on central air conditioner and heat pump shipments. DOE also seeks input from other stakeholders on the potential impact of standards on product shipments.

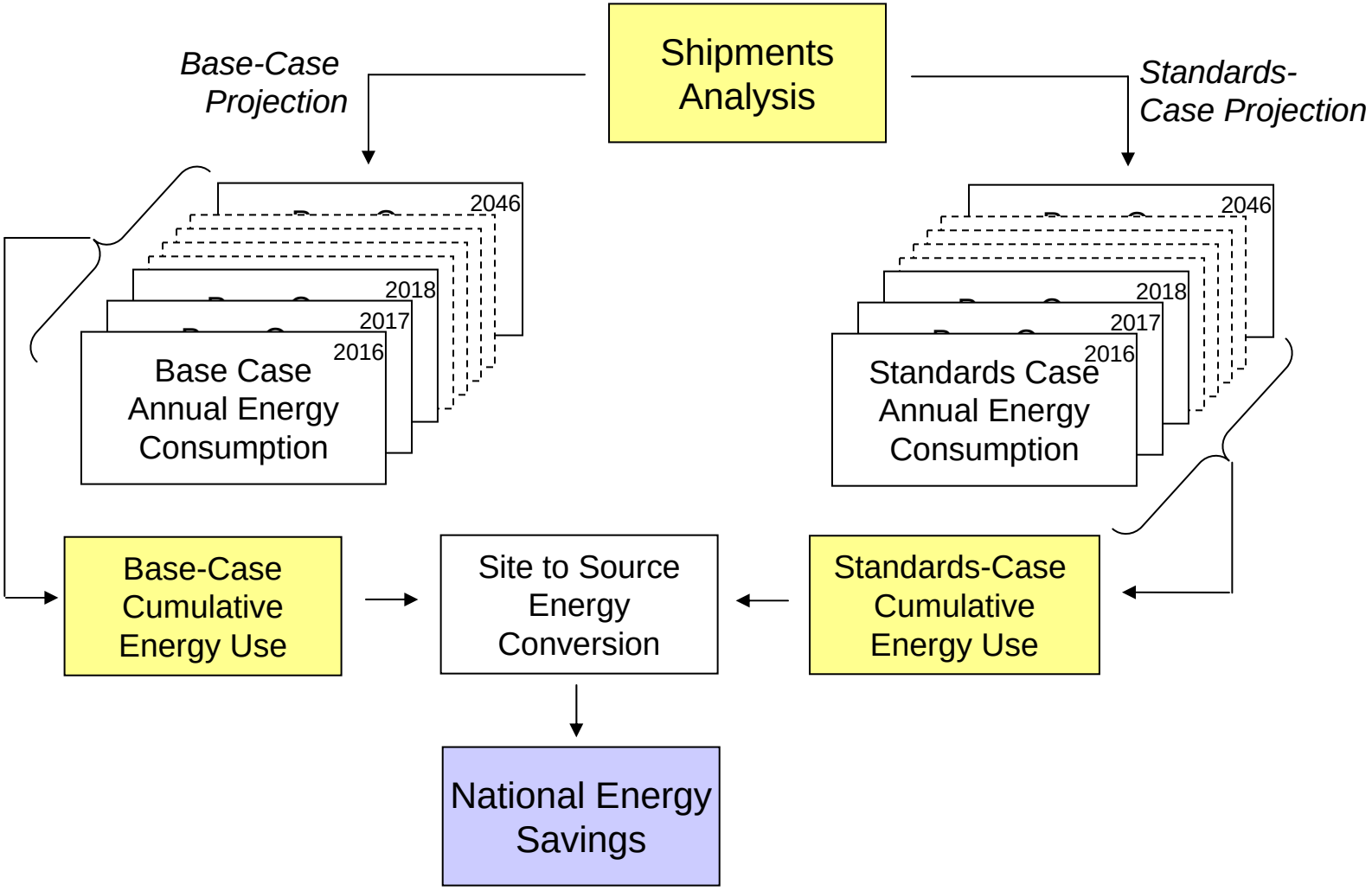
Item 9-3 DOE also requests input on any market-pull programs that currently exist to promote the purchase or manufacture of more efficient central air conditioner and heat pump equipment.

National Impact Analysis

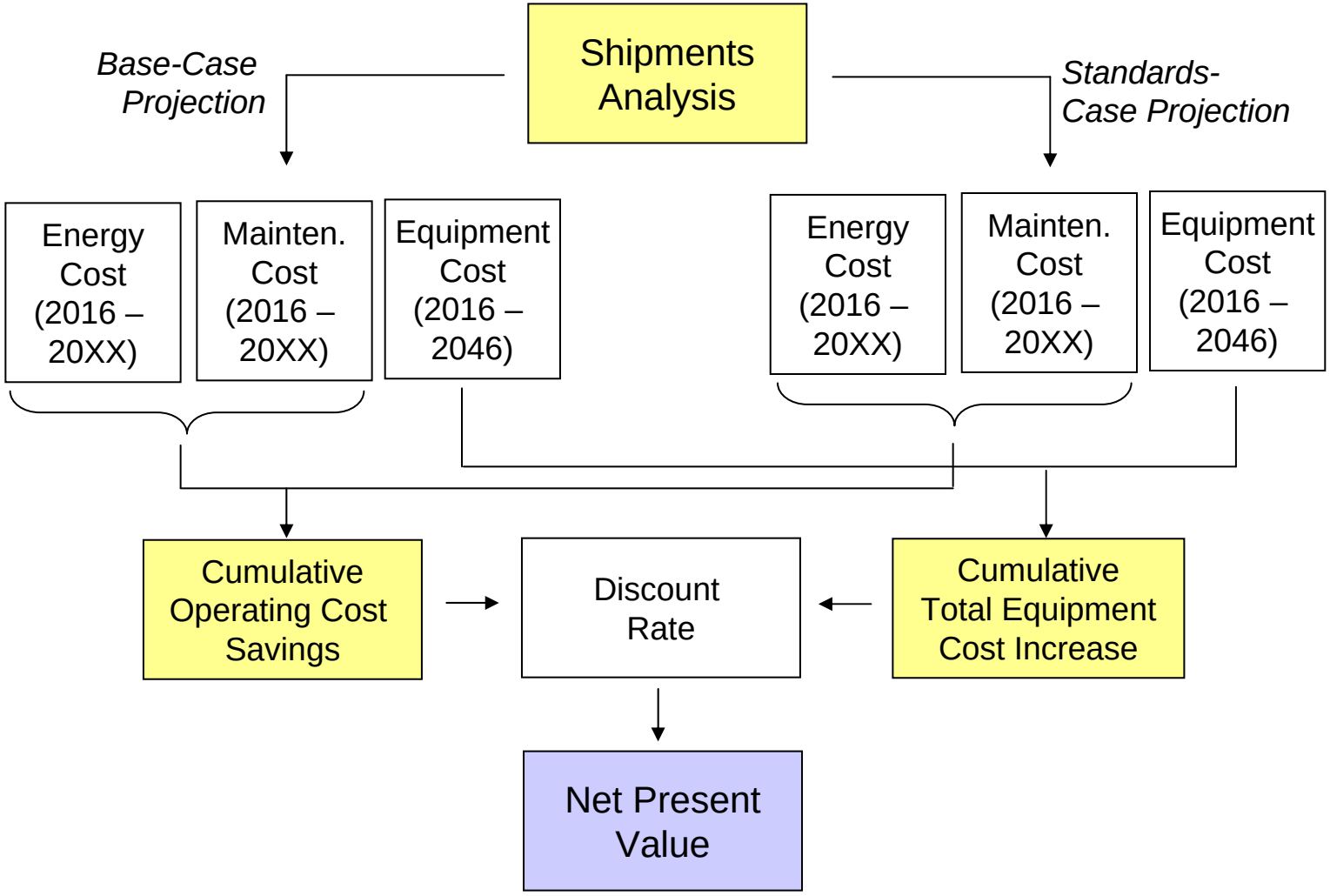
- **Purpose:**
  - Determine the projected national energy savings and consumer national net present value

- **Method:**
  - Develops annual series of national energy and economic impacts
  - Utilizes the shipments model to estimate the total stock residential central air conditioners in service each year
  - Utilizes the LCC to estimate cost and energy use per unit in any given year
  - Aggregates the costs and energy use for all years in the analysis period
  - Reports energy savings in Quads of primary energy consumption (One Quad = 1 quadrillion Btus = 293 terawatt hours)
  - Reports estimates for economic impact as change in consumer National Net Present Value (in constant year dollars)
  - Accounts for the time-value of money though defined discount rates

National Energy Savings Flow Diagram

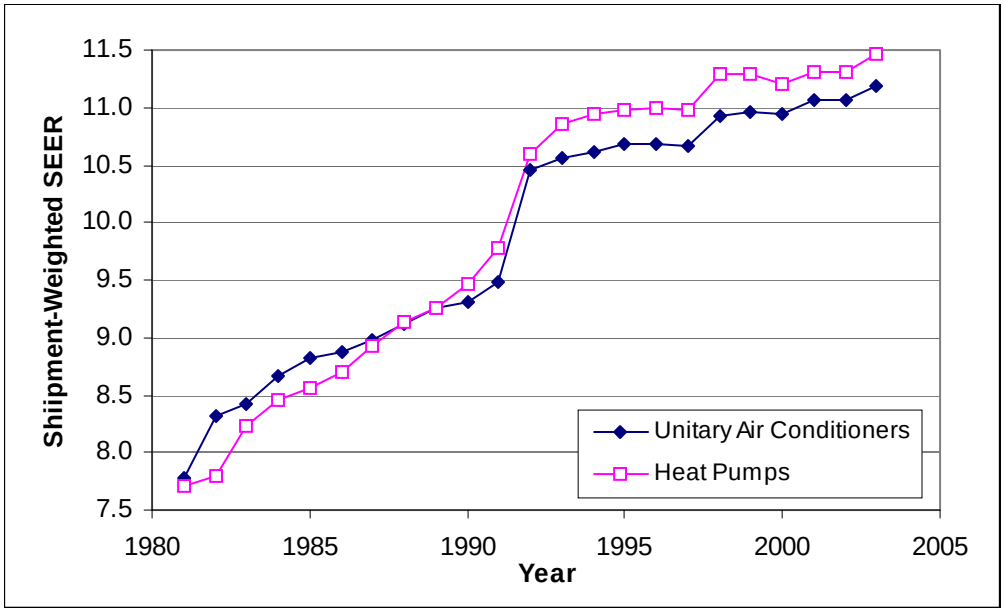


National Consumer Net Present Value Flow Diagram



Shipment-Weighted Efficiency Data

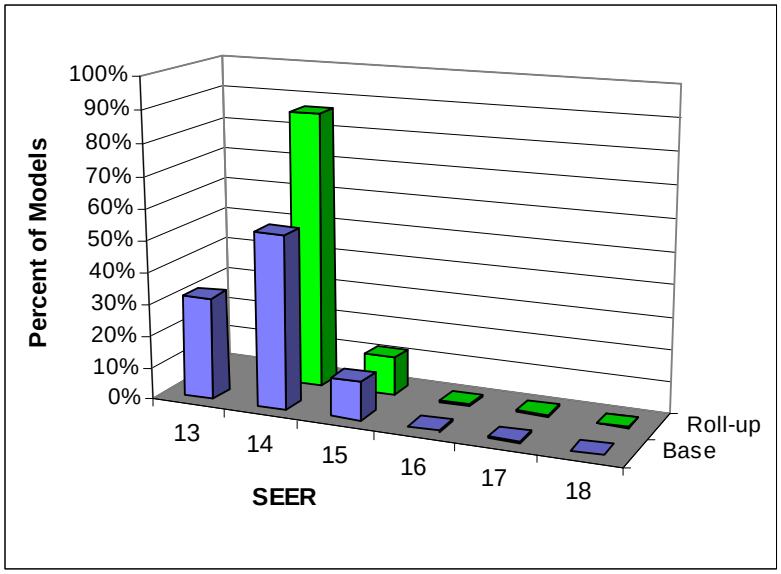
- Key components of the national impact analysis are dependent on shipment-weighted efficiencies
  - Per-unit annual energy consumption—needed to determine NES
  - Retail equipment price and per-unit annual operating costs—needed to determine NPV
- Historical trends in product efficiency help project future product efficiencies for the base-case



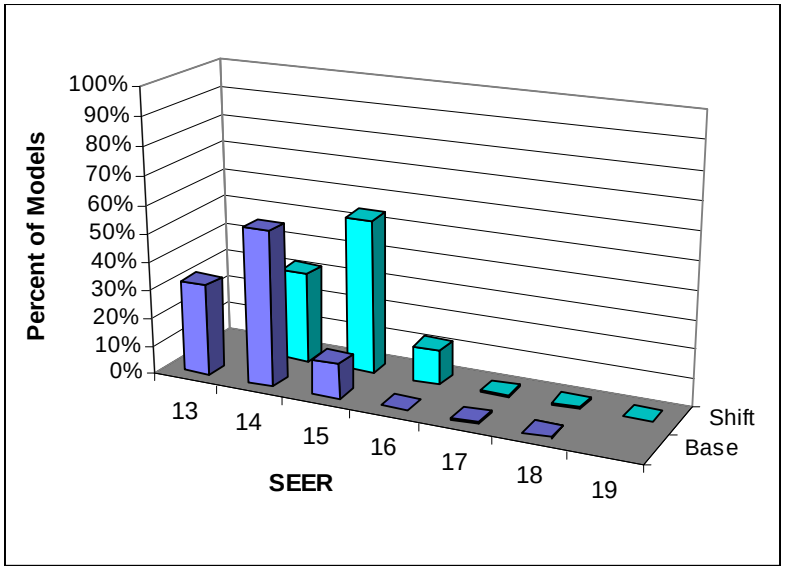
- AHRI's *Statistical Profile* provides historical efficiency trends but not disaggregated by product class
- Because DOE is conducting its analysis by product class (and possibly by region), DOE will make a request to stakeholders for shipments broken down by product class and Census Region.

Market Share Efficiency Data and Standards Impacts on Product Efficiencies

- Historical market share efficiency data helps estimate how standards will impact base-case efficiencies
  - Market share data reveals the distribution of product efficiencies for a given year by product class
  - If product efficiency distributions are significantly different by region, DOE could capture regional effects if stakeholders provide data
- DOE has assumed "roll up" and "shift" scenarios to forecast standards impacts in past standards rulemakings



– **"Roll-up":** Products in the base-case that do not meet the standard "roll up" to meet new standard; products above standard are not affected



– **"Shift":** Retains the pattern of the base-case efficiency distribution but re-orients the distribution at and above the new standard

Request for Comment

Item 10-1 DOE seeks historical shipment-weighted efficiency data by product class and by the four Census Regions. DOE also seeks historical market share data showing the percentage of product shipments by efficiency level for as many product classes as possible.

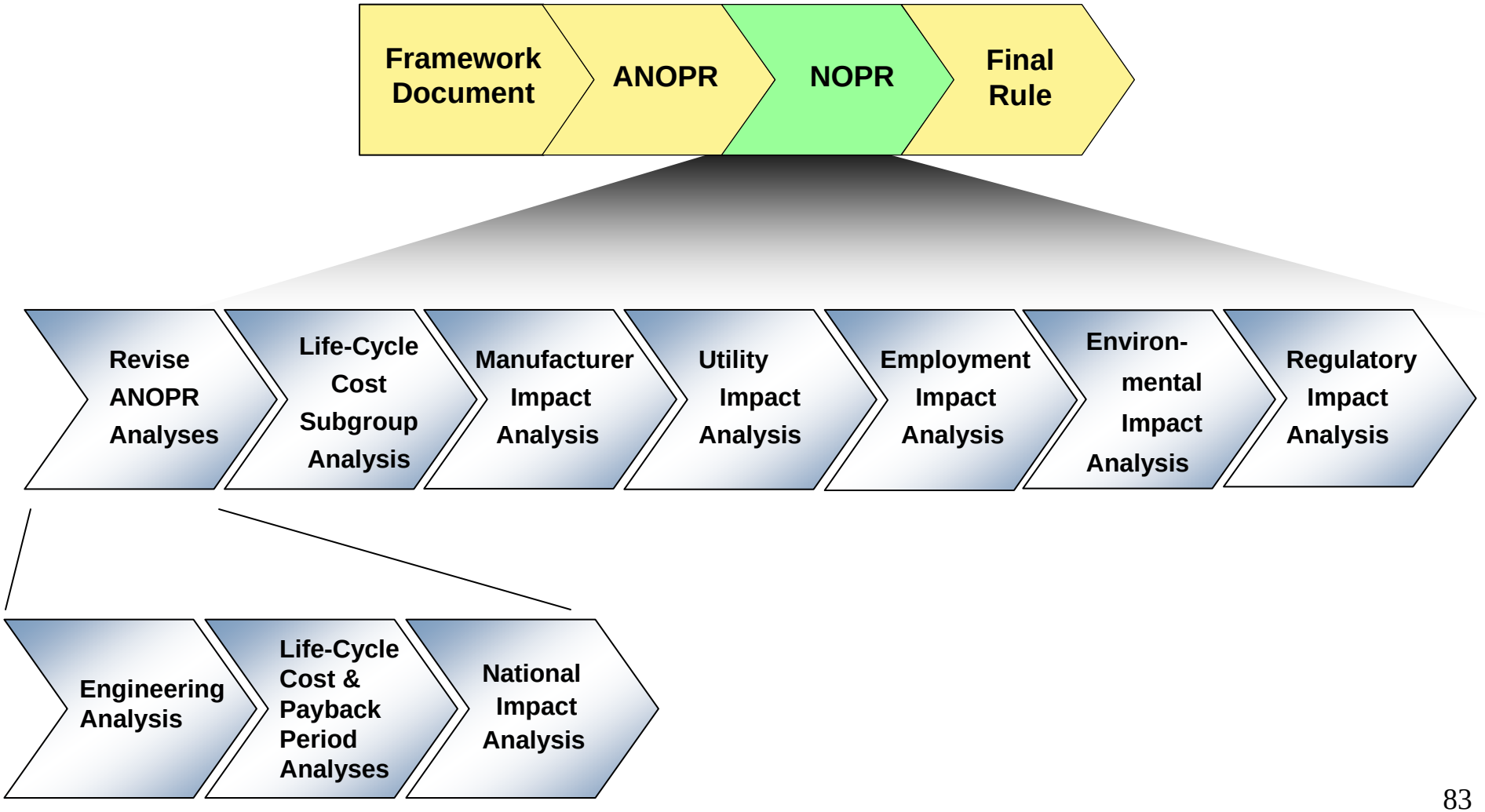
Item 10-2 DOE seeks comments on the use of the "roll-up" and "shift" efficiency scenarios to characterize the impact that potential standards will have on the product distributions.

Item 10-3 DOE seeks comment on its plan to develop NIA spreadsheet models for estimating national impacts of amended energy conservation standards for residential central air conditioners and heat pumps.

Public Meeting Agenda

1. Introduction
2. Rulemaking Overview
3. Test Procedure
4. ANOPR Analyses
5. **NOPR Analyses**
6. Closing Remarks

Steps in the Standards Rulemaking: NOPR



Life-Cycle Cost Subgroup Analysis

- **Purpose:**
  - Analyze the economic impacts of energy conservation standards for central air conditioners and heat pumps on consumers, including subgroups who may be disproportionately impacted compared with the general user population

- **Method:**
  - Extend the LCC analysis to examine the economic impacts for defined subgroups

Item 11-1 DOE seeks input on which of the consumer subgroups DOE should consider in this rulemaking. Examples of possible subgroups DOE could consider for this rulemaking include low-income consumers, senior citizens, or persons living in different climate zones that might be subject to the same standards.

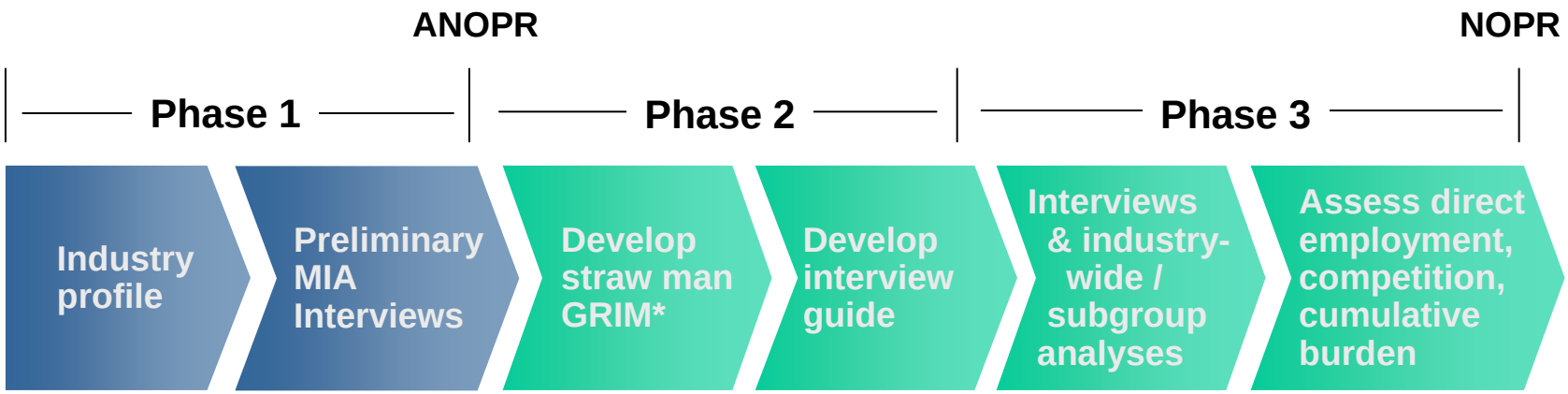
Manufacturer Impact Analysis

- Purpose:
  - Assess the impacts of standards on manufacturers
  - Identify and estimate impacts on manufacturer subgroups that may be more severely impacted than the industry as a whole
  - 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

Methodology

- In the NOPR phase, the MIA will consist of phase 2 and 3



* Government Regulatory Impact Model (GRIM)

Methodology: 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

Methodology: 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

Request for Comment

Item 12-1 DOE seeks comment on appropriate manufacturer subgroups - if any - that DOE should consider in a manufacturer subgroup analysis.

Item 12-2 What regulations or pending regulations should DOE consider in the analysis of cumulative regulatory burdens on manufacturers of covered equipment for this rulemaking?

Utility Impact Analysis

- **Purpose:**
  - Assess the overall impacts on domestic energy supplies that would result from the imposition of standards
- **Method:**
  - The Department proposes to use NEMS-BT, a variant of the NEMS (National Energy Modeling System) developed and used by DOE/EIA for their Annual Energy Outlook report, as the basis of the Utility Impact Analysis
  - Use the energy savings calculated from the NES spreadsheet analysis to reduce the sector electrical loads from the Building Demand Modules in NEMS-BT
  - Energy savings translated to a reduction in the electrical demand faced by the utility system over time

Item 13-1 DOE seeks input from stakeholders on its plans to use NEMS-BT to conduct the utility impact analysis on the equipment covered under this rulemaking.

Employment Impact Analysis

- **Purpose:**
  - Assess the overall impact on national employment from the imposition of energy conservation standards
- **Method:**
  - Include both direct and indirect employment impacts
    - Direct employment impacts are estimated in the manufacturer impact analysis
    - Indirect employment impacts result from shifting consumer expenditures among goods and services ("substitution effect") and changing equipment and energy costs ("income effect")
  - DOE proposes to use the ImSET (Impact of Sector Energy Technologies) model for the evaluation of indirect employment impacts

Item 14-1 DOE requests feedback on this approach to assessing employment impacts on the equipment covered under this rulemaking.

Environmental Impact Analysis

- **Purpose:**
  - Estimate national environmental impacts from new energy efficiency standards for central air conditioners and heat pumps covered under this rule
- **Method:**
  - DOE intends to use the environmental impacts predicted from the NEMS-BT modeling analysis used for the Utility Impacts Analysis. The following emissions are assessed:
    - Carbon dioxide (CO_2)
      - NEMS calculates quantities of U.S. emissions of CO_2 from power plants
      - DOE will consider the use of monetary values to represent the value of CO_2 emissions
    - Sulfur dioxide (SO_2)
      - Clean Air Act amendments of 1990 cap SO_2 emissions
      - Any measurable impact from NEMS in terms of the trading price of SO_2 in the utility sector
    - Nitrogen oxides (NO_x)
      - Clean Air Interstate Rule (CAIR) permanently caps NO_x emissions in 28 eastern States and DC
      - NEMS calculates quantities of U.S. emissions of NO_x from power plants in 22 “non-capped” States
      - For the 28 “capped” States and DC, NEMS will determine any measurable impact in terms of the trading price of NO_x in the utility sector
    - Mercury (Hg)
      - Court actions vacated the Clean Air Mercury Rule (CAMR), which would have capped Hg emissions
      - DOE is considering approaches to address the issue of Hg emissions in light of the court’s decision

Request for Comment

Item 15-1 DOE invites comments on how to estimate such monetary values associated with CO_2 emissions reductions or on any widely accepted values which might be used in DOE's analyses.

Item 15-2 Because court actions have vacated the CAMR, DOE seeks stakeholder input on how it should address Hg emissions in this rulemaking. In addition, DOE seeks comment on how it might value NOx emissions for the 22 States not covered by the CAIR.

Item 15-3 DOE seeks input from stakeholders on its plans to use NEMS-BT to conduct the environmental impact analysis on the equipment covered by this rulemaking. Are there any other approaches to the environmental impact analysis that DOE should consider?

Item 15-4 Are there any other environmental factors DOE should consider in this rulemaking?

Regulatory Impact Analysis

- **Purpose:**
  - Explore the potential for non-regulatory alternatives to new energy conservation standards

- **Method:**
  - Base the assessment on the actual impacts of any such initiatives to date, but consider information presented regarding the impacts that any existing initiative might have in the future

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How to Submit Written Comments

In all correspondence, please refer to this rulemaking by:

- Framework Document for Residential Central Air Conditioners and Heat Pumps
- Docket Number EERE-2008-BT-STD-0006, and
- Regulatory Identification Number (RIN) 1904-AB47

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Comment period closes at 4:00pm

July 7, 2008