WELCOME

to the

DOE Webcast Presentation

for

Commercial Unitary Air Conditioners and Heat Pumps

Thursday, August 12, 2004, from 1:00 p.m. to 4:00 p.m. EDT

- **This webcast has been arranged through Microsoft Office Live Meeting 2003. If you need help, there is a web site that you can access in advance to test your system. The link is http://www.livemeeting.com/ then use customer support/browser check.**

- **For technical support with LiveMeeting, please call 1-866-493-2825.**

- **Audio for this webcast is accessible by dialing 1-202-287-5323 (Reservation #104883). If you have any questions about the audio, please contact the DOE Headquarters Operator at (301) 903-3000.**

DOE WEBCAST PRESENTATION:

Analyses and Advance Notice of Proposed Rulemaking Process for Commercial Unitary Air Conditioners and Heat Pumps

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

August 12, 2004

Preparing for the Public Meeting

- The DOE wants to assist stakeholders with understanding and interpreting the material developed for the Advance Notice of Proposed Rulemaking (ANOPR)
  - ANOPR Federal Register notice published July 29 at 69 FR 45460
  - Technical Support Document (TSD) appears on the DOE website at http://www.eere.energy.gov/buildings/appliance_standards/commercial/ac_hp.html
- How to use and apply the spreadsheet tools:
  - Life-cycle cost and payback periods analyses
  - National impact analysis (national energy savings and net present value)

Webcast Protocol

- Today's webcast is not part of the formal process, and there is no provision to capture comments for the record
- Purpose: Familiarize you with the ANOPR spreadsheet tools (education and clarification)
- Opportunity to ask clarification questions after each section
- This is not a forum to critique the ANOPR analysis
- The Department requests your comments:
  - Public meeting - September 30, 2004
  - Written comments not later than November 12, 2004

Agenda

1. Rulemaking Overview
2. Engineering Analysis
3. Building Energy Use and End-Use Load Characterization
4. Life-Cycle Cost and Payback Period Analysis
5. National Impact Analysis

Principal Procedural Steps for Commercial Unitary Air Conditioners and Heat Pumps

Stakeholder Participation

Previous Standards Rulemaking

- Notice of Preliminary Screening Analysis, March 1, 2000
- Standards Final Rule for Water-Source Air Conditioners, January 12, 2001

Test Procedure Rulemaking

- Public Meetings on Test Procedures: April 14, 1998 and October 18, 1998
- Test Procedure Proposed Rule, August 9, 2000
- Public Meeting, September 21, 2000
- Test Procedure Final Rule, Pending

Current Standards Rulemaking

- Public Meeting, October 1, 2001
- ANOPR, July 29, 2004
- ANOPR Public Meeting, September 30, 2004
- NOPR Analysis – to be completed
- NOPR Public Meeting – to be held
- Final Rule

Principal Procedural Steps for Commercial Unitary Air Conditioners and Heat Pumps

Stakeholder Participation

Previous Standards Rulemaking

- Notice of Preliminary Screening Analysis, March 1, 2000
- Standards Final Rule for Water-Source Air Conditioners, January 12, 2001

Test Procedure Rulemaking

- Public Meetings on Test Procedures: April 14, 1998 and October 18, 1998
- Test Procedure Proposed Rule, August 9, 2000
- Public Meeting, September 21, 2000
- Test Procedure Final Rule, Pending

Current Standards Rulemaking

- Public Meeting, October 1, 2001
- ANOPR, July 29, 2004
- ANOPR Public Meeting, September 30, 2004
- NOPR Analysis – to be completed
- NOPR Public Meeting – to be held
- Final Rule

Principal Procedural Steps for Commercial Unitary Air Conditioners and Heat Pumps

Stakeholder Participation

Previous Standards Rulemaking

- Notice of Preliminary Screening Analysis, March 1, 2000
- Standards Final Rule for Water-Source Air Conditioners, January 12, 2001

Test Procedure Rulemaking

- Public Meetings on Test Procedures: April 14, 1998 and October 18, 1998
- Test Procedure Proposed Rule, August 9, 2000
- Public Meeting, September 21, 2000
- Test Procedure Final Rule, Pending

Current Standards Rulemaking

- Public Meeting, October 1, 2001
- ANOPR, July 29, 2004
- ANOPR Public Meeting, September 30, 2004
- NOPR Analysis – to be completed
- NOPR Public Meeting – to be held
- Final Rule

Principal Procedural Steps for Commercial Unitary Air Conditioners and Heat Pumps

Stakeholder Participation

Previous Standards Rulemaking

- Notice of Preliminary Screening Analysis, March 1, 2000
- Standards Final Rule for Water-Source Air Conditioners, January 12, 2001

Test Procedure Rulemaking

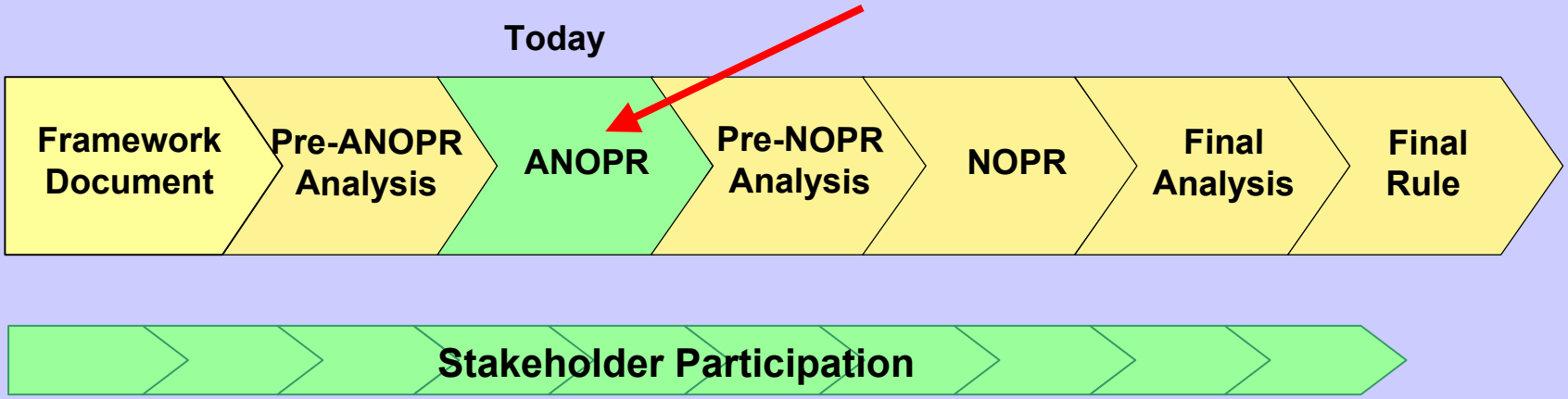
- Public Meetings on Test Procedures: April 14, 1998 and October 18, 1998
- Test Procedure Proposed Rule, August 9, 2000
- Public Meeting, September 21, 2000
- Test Procedure Final Rule, Pending

Current Standards Rulemaking

- Public Meeting, October 1, 2001
- ANOPR, July 29, 2004
- ANOPR Public Meeting, September 30, 2004
- NOPR Analysis – to be completed
- NOPR Public Meeting – to be held
- Final Rule

Stages of the Rulemaking Process

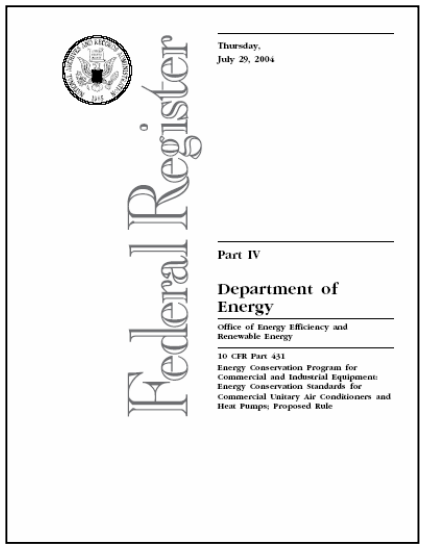
Standards Rulemaking



- ✓ Federal Register Notices
- ✓ Written Comments
- ✓ Meetings and Oral Comments
- ✓ Web-posting Draft Analysis
- ✓ Consultative Meetings
- ✓ Webcasts

ANOPR Documents and Material Published

- **Federal Register Notice**
- **Technical Support Document (ANOPR version)**
  - Engineering Analysis
  - Building Simulation Analysis
  - Life-Cycle Cost and Payback Period Analysis
  - National Impact Analysis


Federal Register

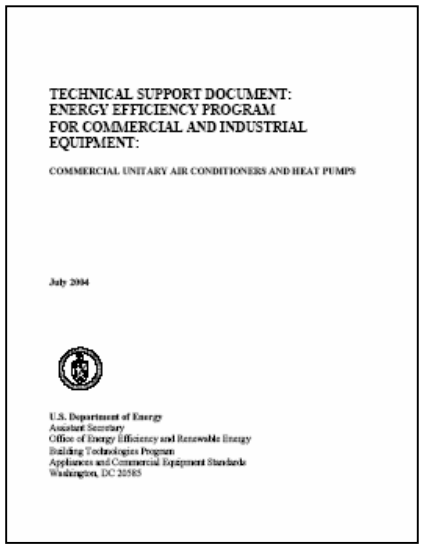
Thursday,
July 29, 2004

Part IV

Department of Energy

Office of Energy Efficiency and Renewable Energy

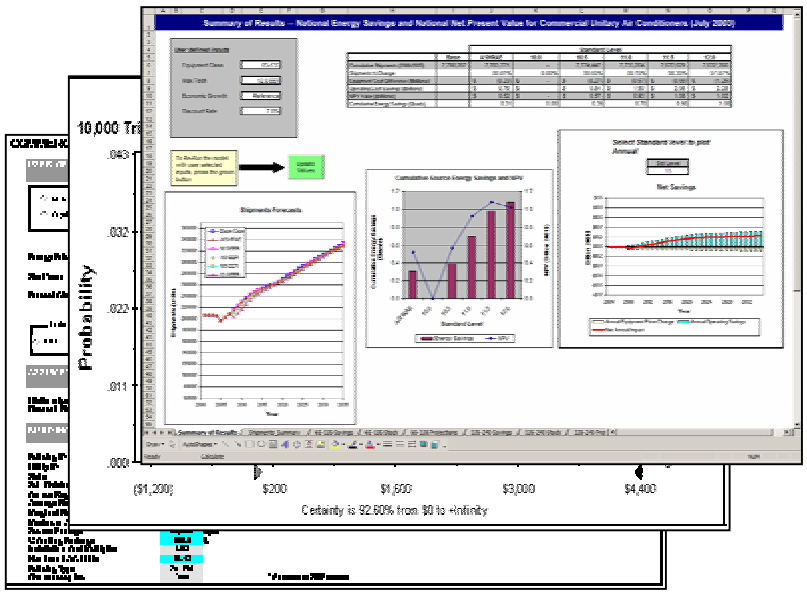
10 CFR Part 431
Energy Conservation Program for Commercial and Industrial Equipment: Energy Conservation Standards for Commercial Unitary Air Conditioners and Heat Pumps; Proposed Rule


TECHNICAL SUPPORT DOCUMENT:
ENERGY EFFICIENCY PROGRAM
FOR COMMERCIAL AND INDUSTRIAL
EQUIPMENT:

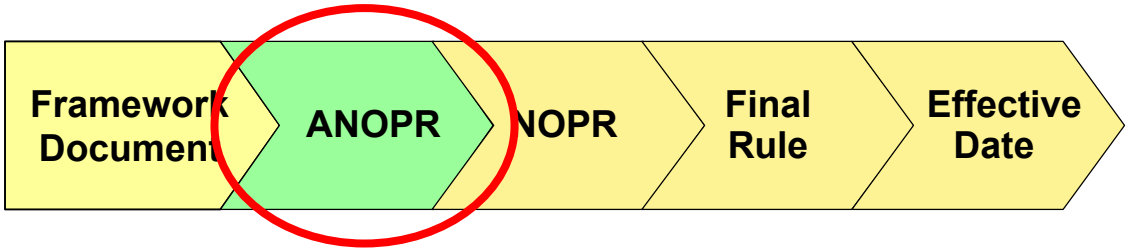
COMMERCIAL UNITARY AIR CONDITIONERS AND HEAT PUMPS

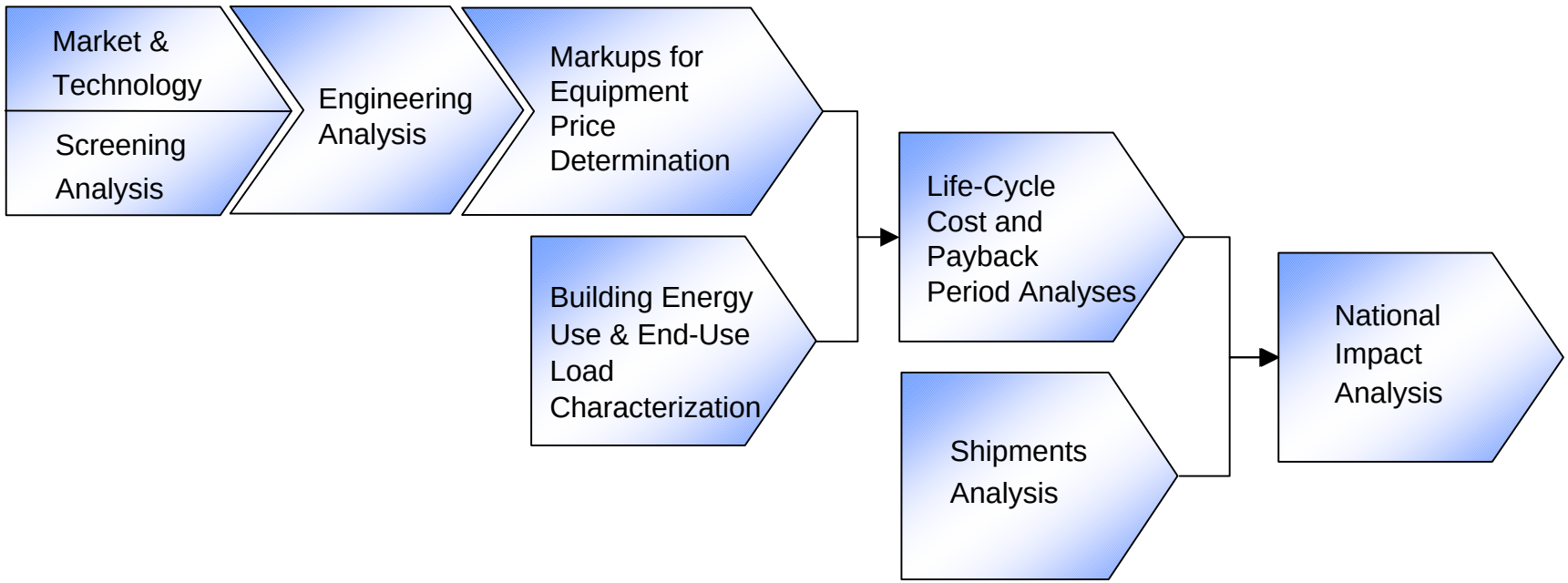
July 2004

U.S. Department of Energy
Assistant Secretary
Office of Energy Efficiency and Renewable Energy
Building Technologies Program
Appliances and Commercial Equipment Standards
Washington, DC 20585

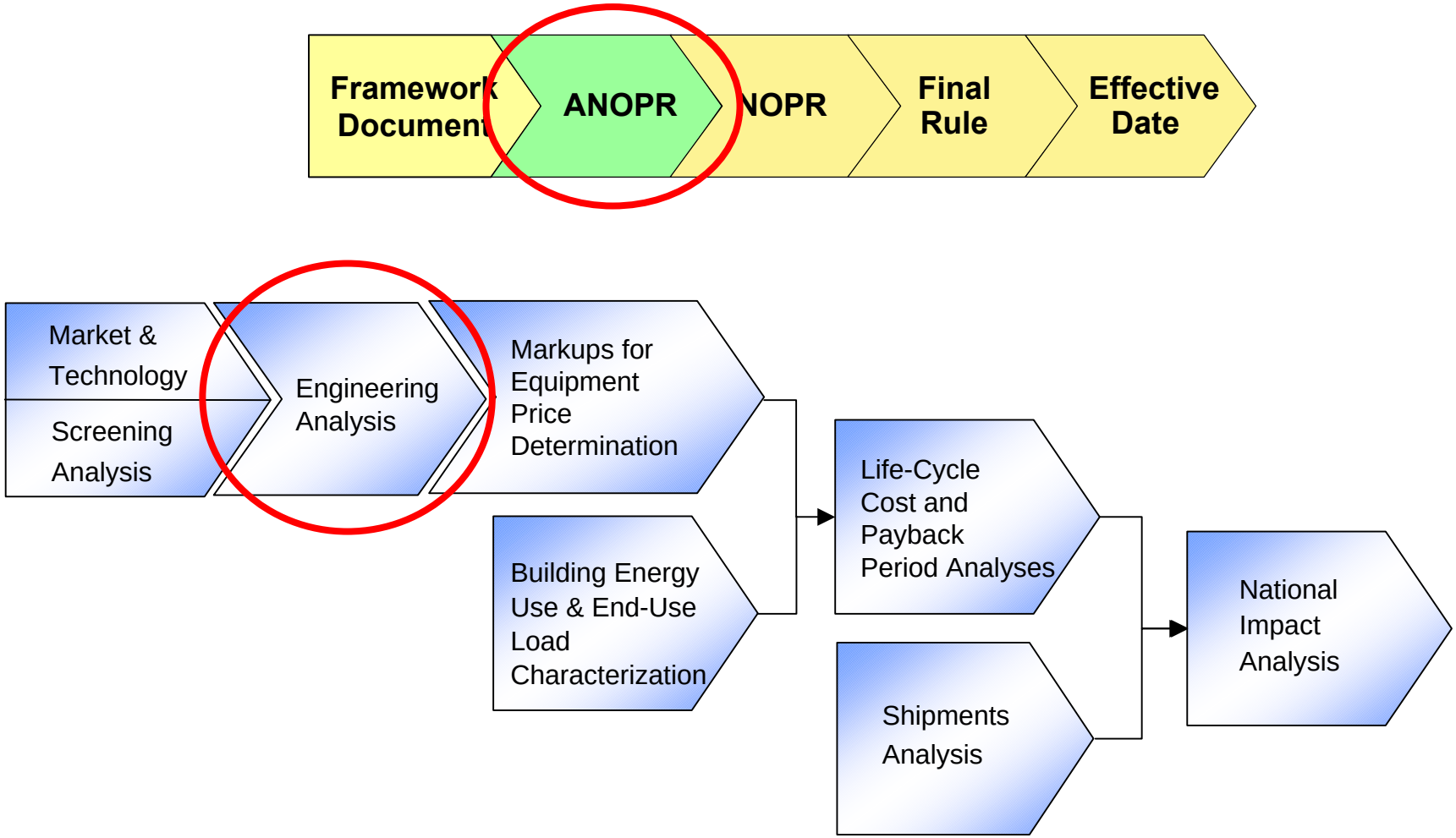


ANOPR Analyses Flow Diagram

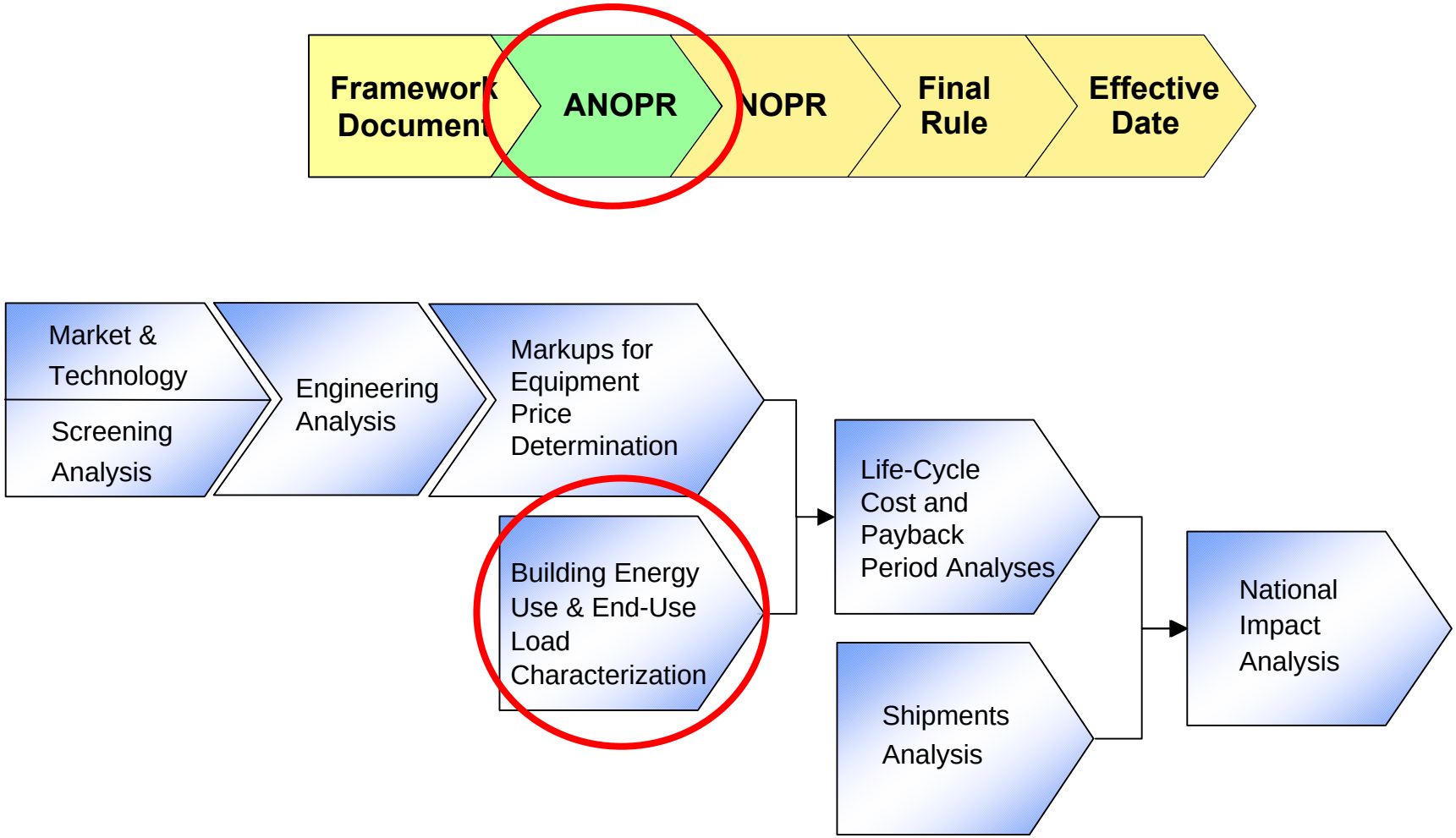




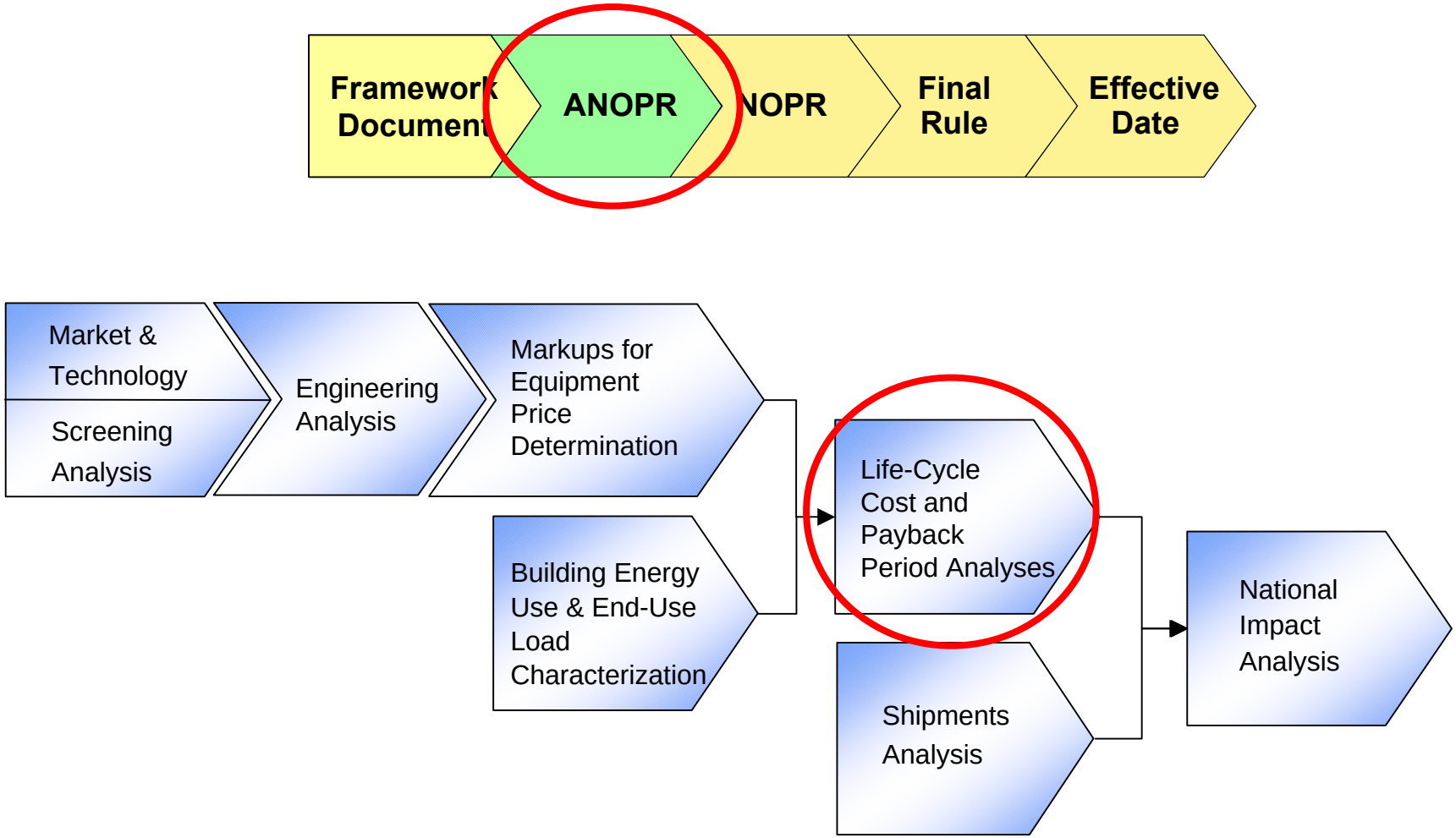
ANOPR Analyses Flow Diagram



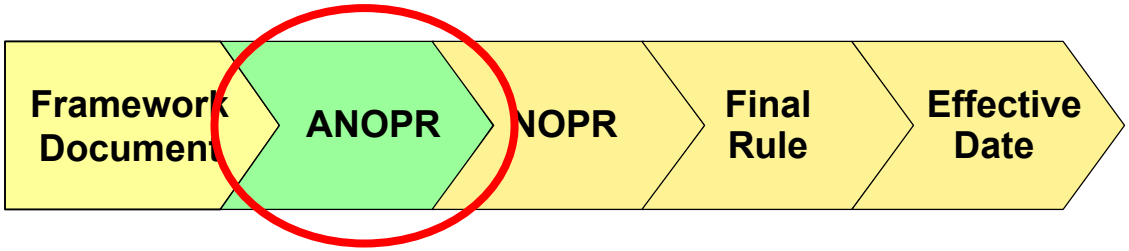
ANOPR Analyses Flow Diagram

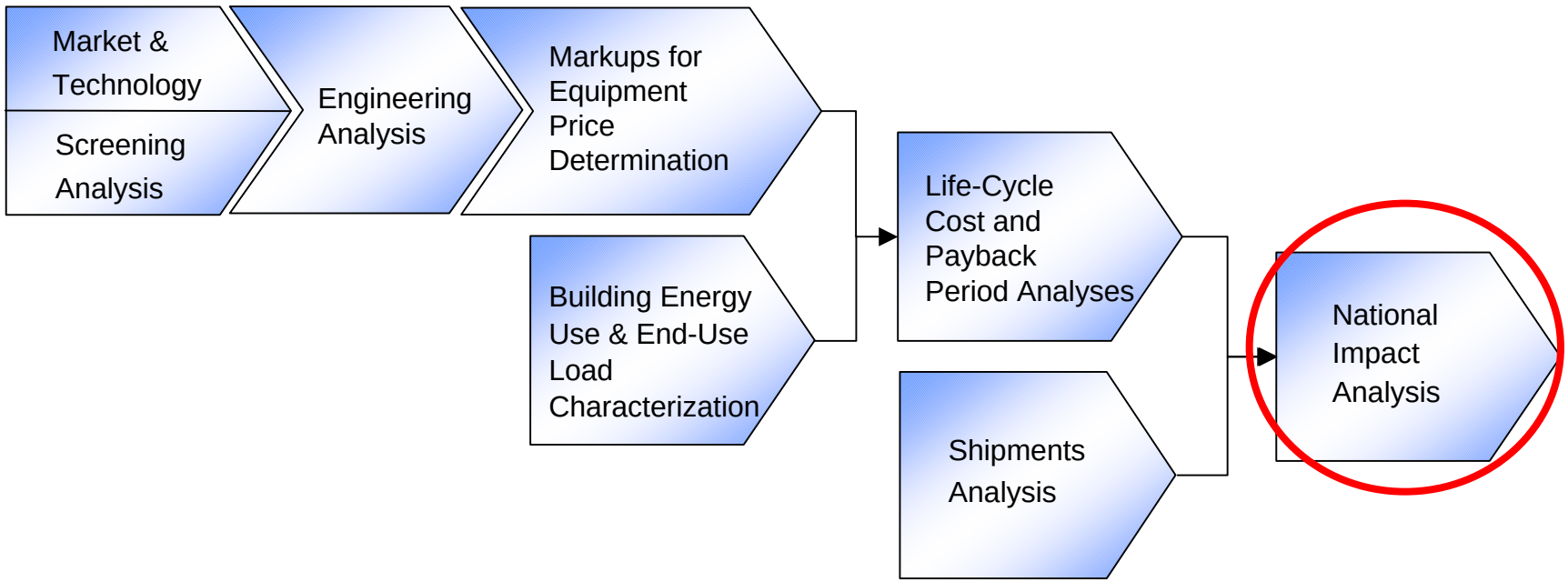


ANOPR Analyses Flow Diagram



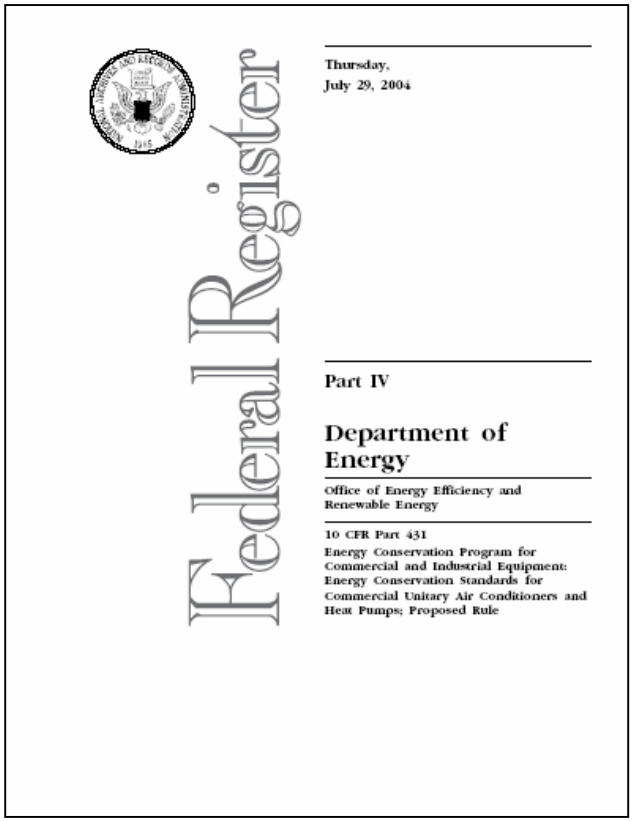
ANOPR Analyses Flow Diagram





Next Steps

- Webcast today to focus on explaining the spreadsheets posted on the web
- ANOPR public meeting on Thursday, September 30, 2004
- ANOPR - submit comments by Friday, November 12, 2004
- Please reserve your comments on the analysis for either the public meeting or submit written comments for the record
- Federal Register Notice, Technical Support Document and Spreadsheets published to the DOE website


Federal Register

Thursday,
July 29, 2004

Part IV

Department of Energy

Office of Energy Efficiency and Renewable Energy

10 CFR Part 431

Energy Conservation Program for Commercial and Industrial Equipment: Energy Conservation Standards for Commercial Unitary Air Conditioners and Heat Pumps; Proposed Rule

- http://www.eere.energy.gov/buildings/appliance_standards/commercial/ac_hp.html

How to Submit Comments…

- Public Meeting – oral comments will be captured in the transcript and become part of the public record.

- Written comments – comment period open until November 12, 20003
  Reference docket #: EE-RM/STD-01-375 and/or RIN #: 1904-AB09

Email: commercialairconditioner.anopr@ee.doe.gov

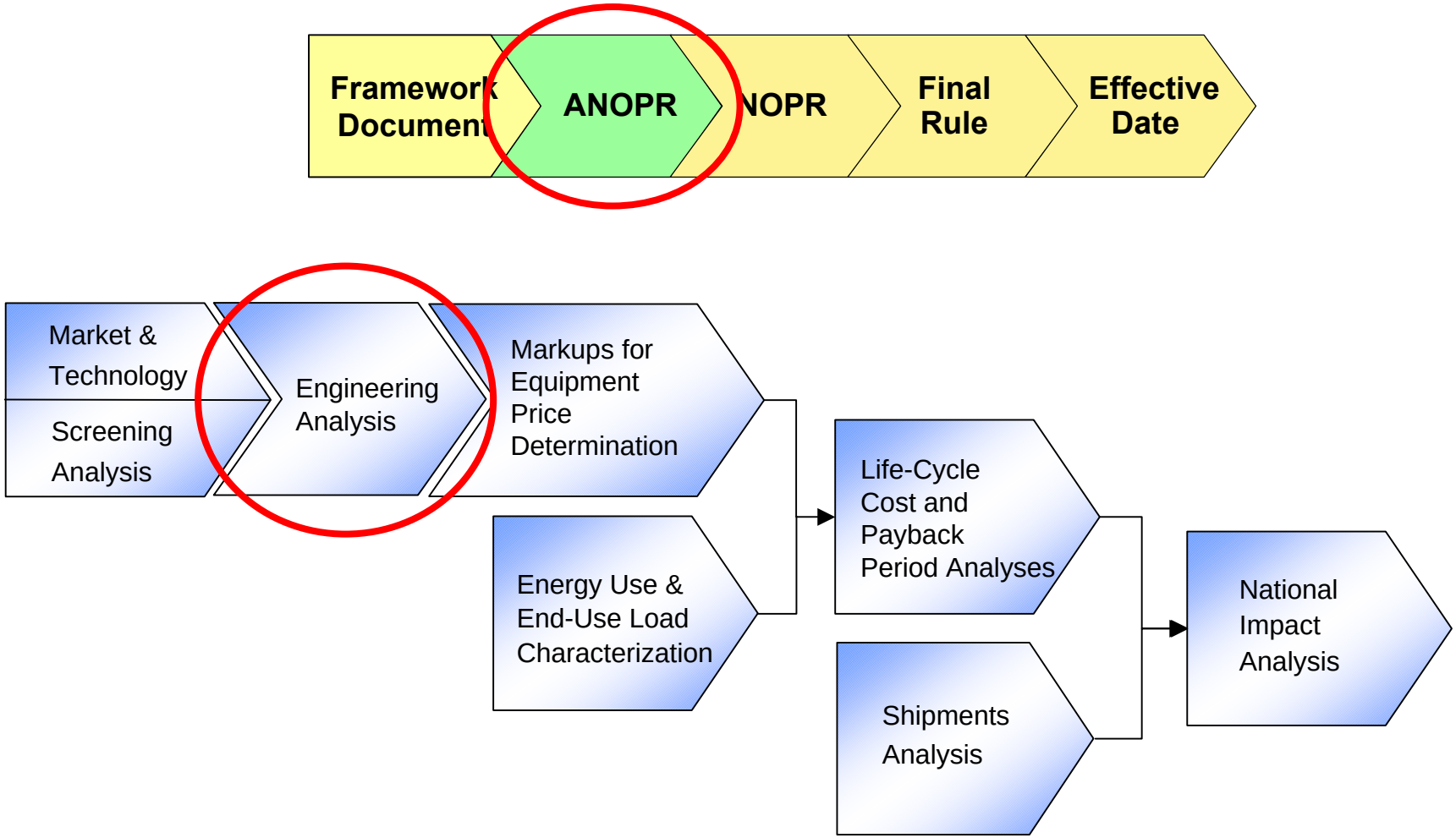
Mail: Ms. Brenda Edwards-Jones
U.S. Department of Energy
Building Technologies Program, Mail stop EE-2J
ANOPR for Commercial Unitary Air Conditioners and Heat Pumps, EE-RM/STD-01-375
1000 Independence Avenue, SW
Washington DC, 20585-0121

Courier: Ms. Brenda Edwards-Jones
U.S. Department of Energy
Building Technologies Program, 1J-018
1000 Independence Avenue, SW
Washington DC, 20585-0121

Agenda

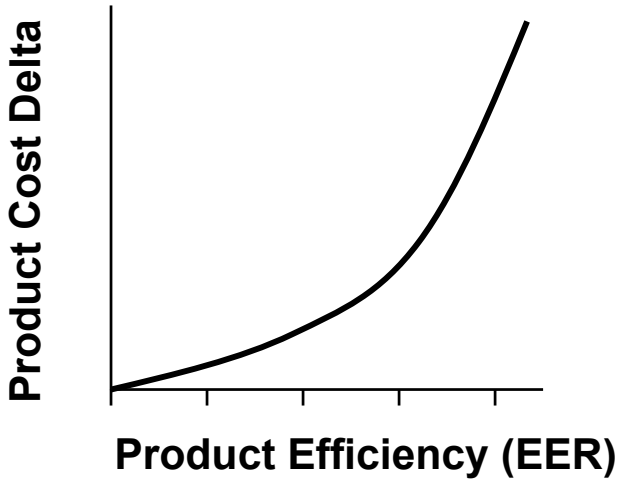
1. Rulemaking Overview
2. Engineering Analysis
3. Building Energy Use and End-Use Load Characterization
4. Life-Cycle Cost and Payback Period Analysis
5. National Impact Analysis

ANOPR Analyses Flow Diagram



Cost-Efficiency Curves

Cost - Efficiency Relationship



Rulemaking Analyses

- Life-Cycle Cost
- Manufacturer Impact
- Employment Impact

Early Consultation and Refinement

- Framework document posted online on June 13, 2001.
- Informal public workshop held to discuss issues and data collection on October 1, 2001.
- Meeting with ARI and member companies held in November, 2002.
- Engineering Analysis summary presentation posted on the BT website in January, 2003.

Commercial Unitary Air Conditioner and Heat Pump Rulemaking Framework

U.S. Department of Energy
Office of Codes and Standards
1000 Independence Ave., SW
Washington, DC

June 13, 2001

Engineering Analysis Process

Product Selection

- Define Equipment Classes and Baseline Units

Cost Model Development

- Select Teardown Units, Perform Teardowns, Develop Bill of Materials, Develop Cost Model, Validate Cost Model

Cost-Efficiency Curve Development

- Develop Manufacturers' Cost-Efficiency Curves, Normalize Curves, Aggregate Curves to an Industry Curve

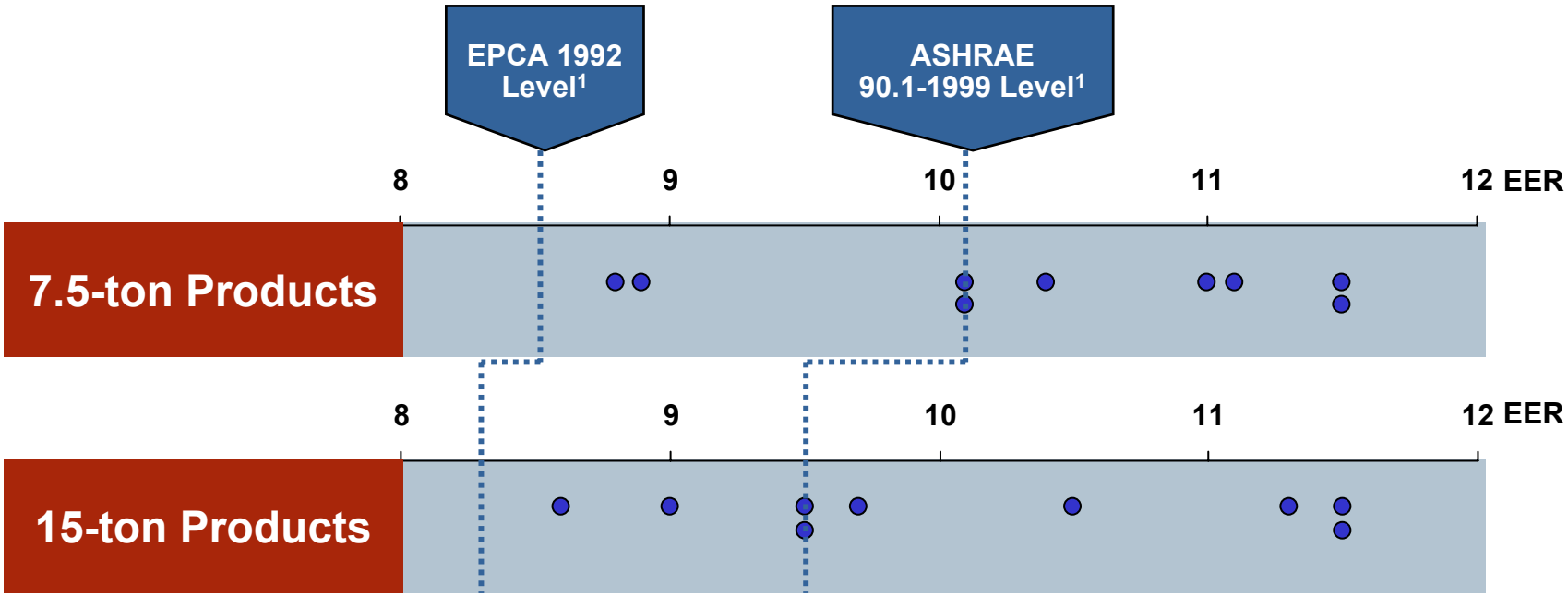
Design Option Analysis

- Identify Design Options, Develop Performance Model, Apply Cost Model to Design Options, Validate Cost-Efficiency Relationship

Additional Analyses

- Conduct R-410a Analysis, Incorporate Stakeholder Feedback

Product Selection



[1] Based on ASHRAE 90.1-1999 Mandatory Minimum EER, including a reduction of 0.2 for units having a heating section other than electric resistance heat.

Manufacturing Cost Components

Manufacturing Cost

Corporate Expenses
- Research and Development
- Profit
- General & Administration
- Warranty
- Taxes
- Sales and Marketing

Fixed Costs
- Equipment and Plant Depreciation
- Tooling Amortization
- Equipment Maintenance
- Utilities
- Indirect Labor
- Cost of Capital
- Overhead Labor

Variable Costs
- Manufactured Materials
- Purchased Materials
- Fabrication Labor
- Assembly Labor
- Shipping
- Indirect Materials

Profit

General Expense

Sales Expense

Shipping

Factory Expense

Direct Labor

Direct Materials

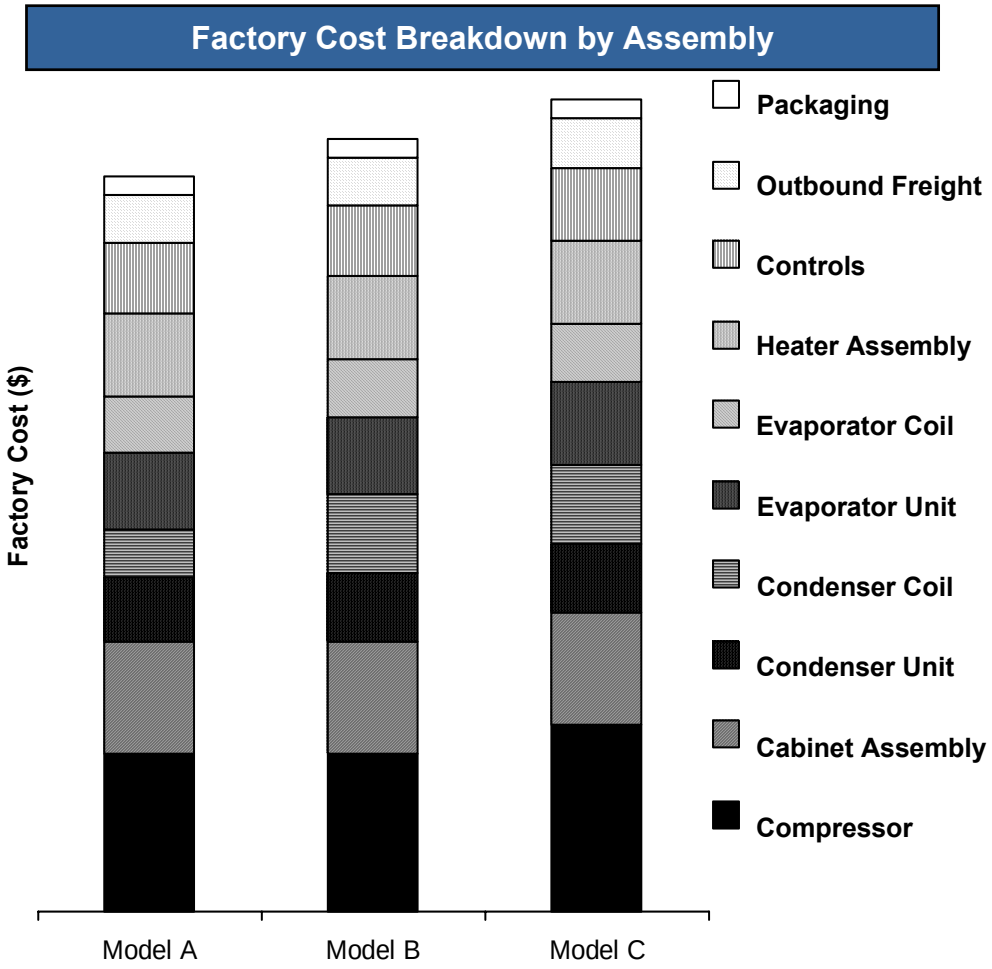
Total Product Cost

Total Product Cost + Distribution Markups = Consumer Price

Cost Model Validation

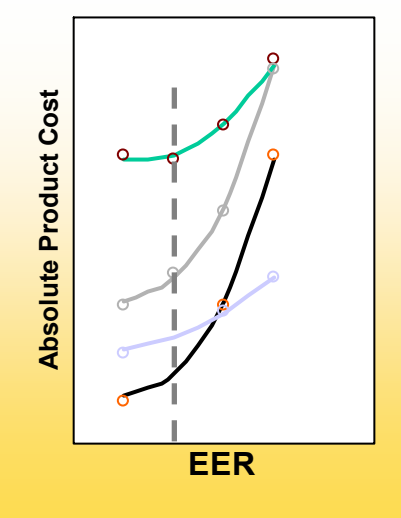
Factory Cost Breakdown			
	Model A	Model B	Model C
Labor	$	$	$
Material	$	$	$
Overhead & Ship	$	$	$
Depreciation	$	$	$
TOTAL factory cost	**$**	**$**	**$**

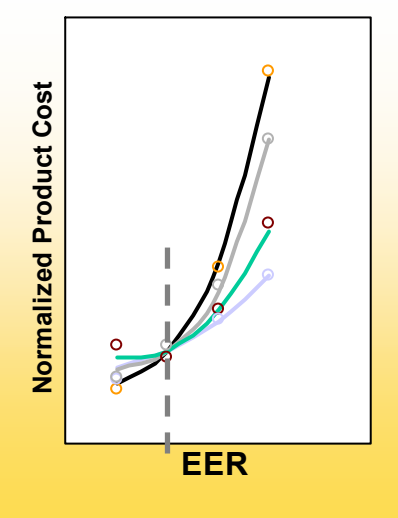
ILLUSTRATIVE EXAMPLE

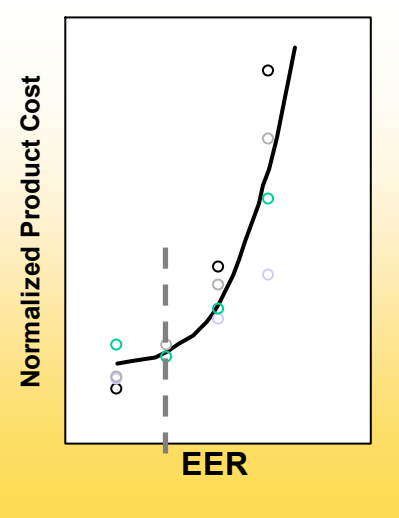


Cost-Efficiency Curve Development

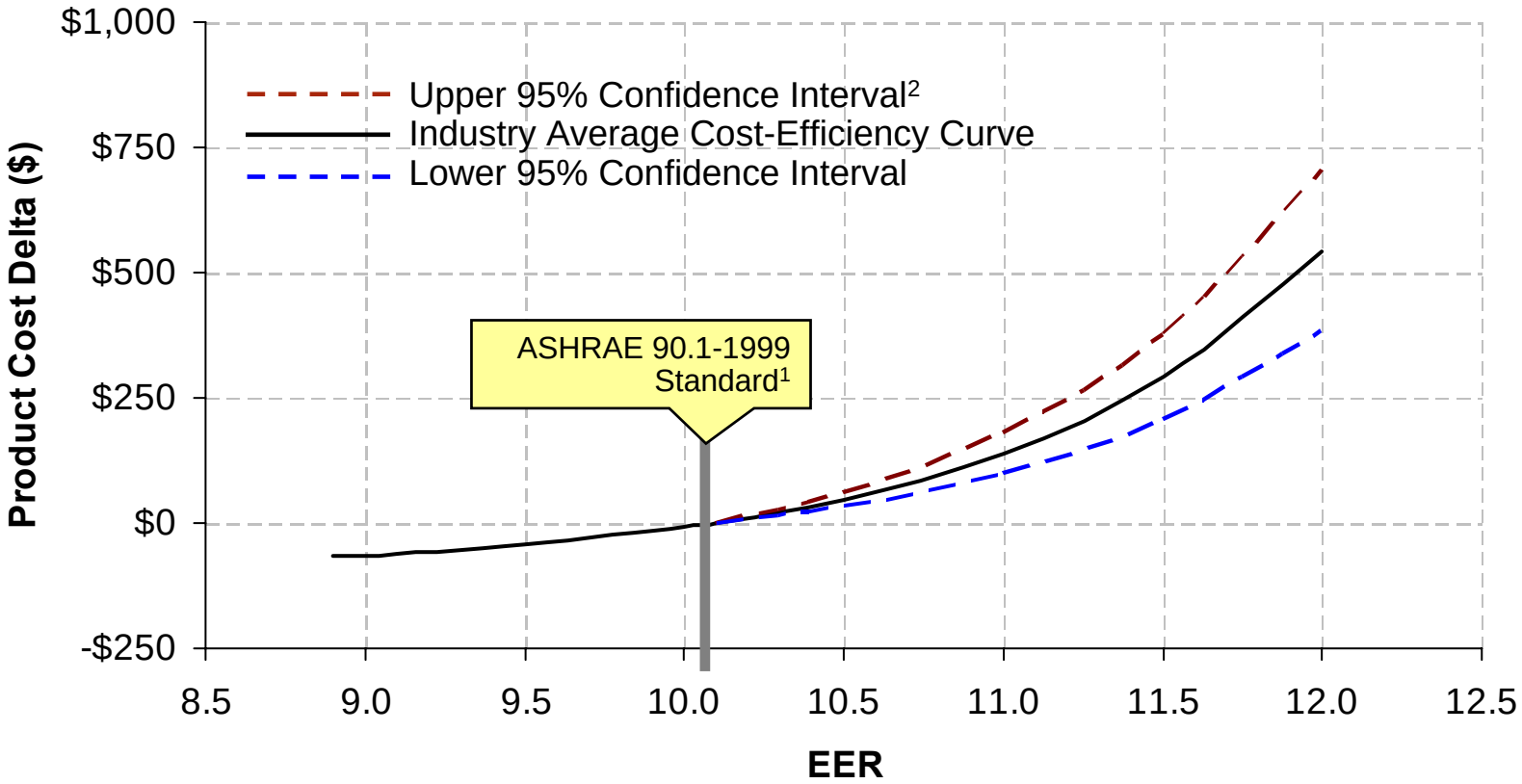
1. An exponential curve was fit to each manufacturer's cost-efficiency points individually.
2. The data points were then normalized so that each manufacturer curve intersected at the ASHRAE 90.1-1999 EER level.
3. Next, an exponential curve was fit to the normalized data points (all manufacturers), extrapolating the curve slightly to 12 EER.





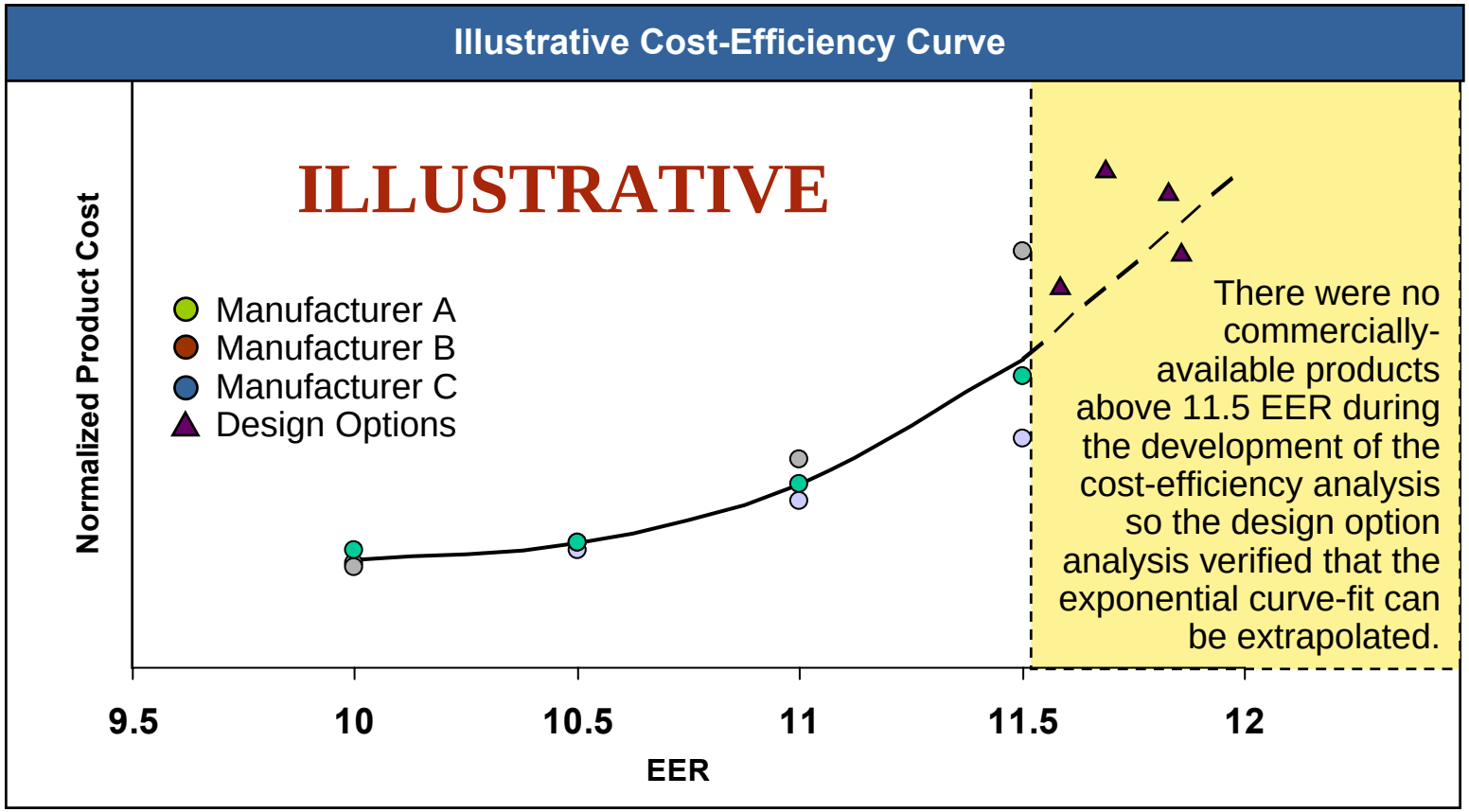


7.5 Ton Cost-Efficiency Results

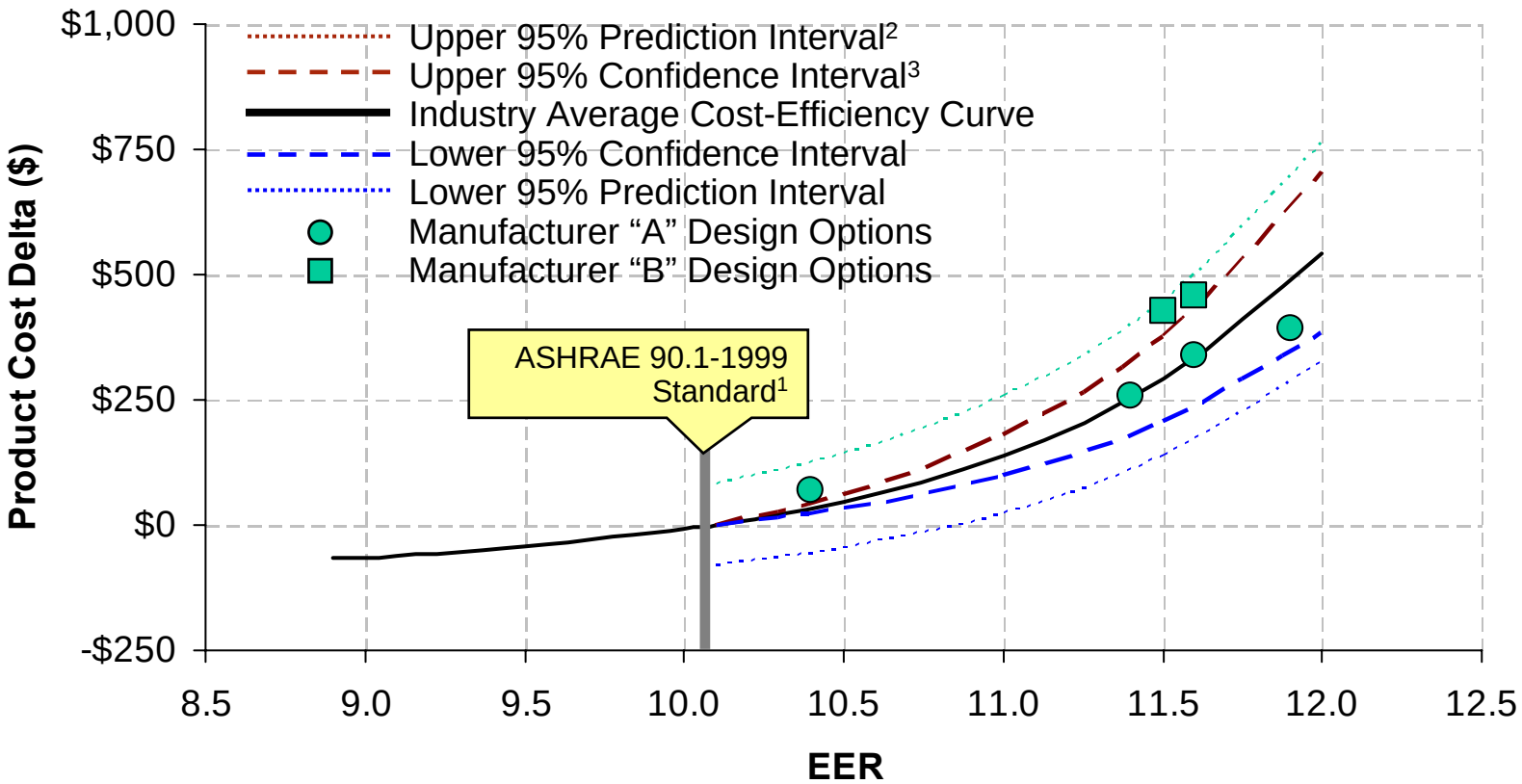


[1] Based on ASHRAE 90.1-1999 Mandatory Minimum EER, including a reduction of 0.2 for units having a heating section other than electric resistance heat.
[2] Confidence Interval represents the accuracy of the mean regression curve-fit (i.e., There is a 95% probability that the mean cost of a sample of products at a given EER level would fall within the confidence interval).

Design Option Analysis



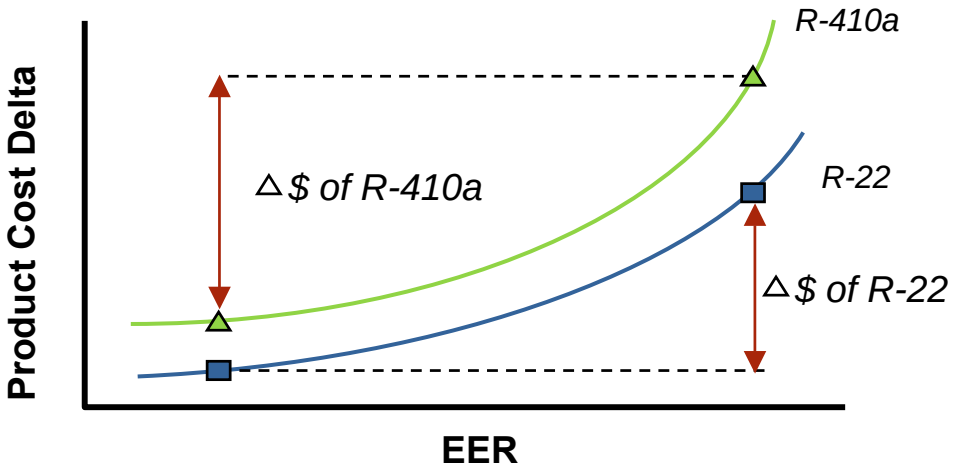
Validation of Cost-Efficiency Curves



[1] Based on ASHRAE 90.1-1999 Mandatory Minimum EER, including a reduction of 0.2 for units having a heating section other than electric resistance heat.
[2] Prediction Interval represents the accuracy of predicting the cost of any single unit given its EER.
[3] Confidence Interval represents the accuracy of the mean regression curve-fit (i.e., There is a 95% probability that the mean cost of a sample of products at a given EER level would fall within the confidence interval).

R-410a Analysis

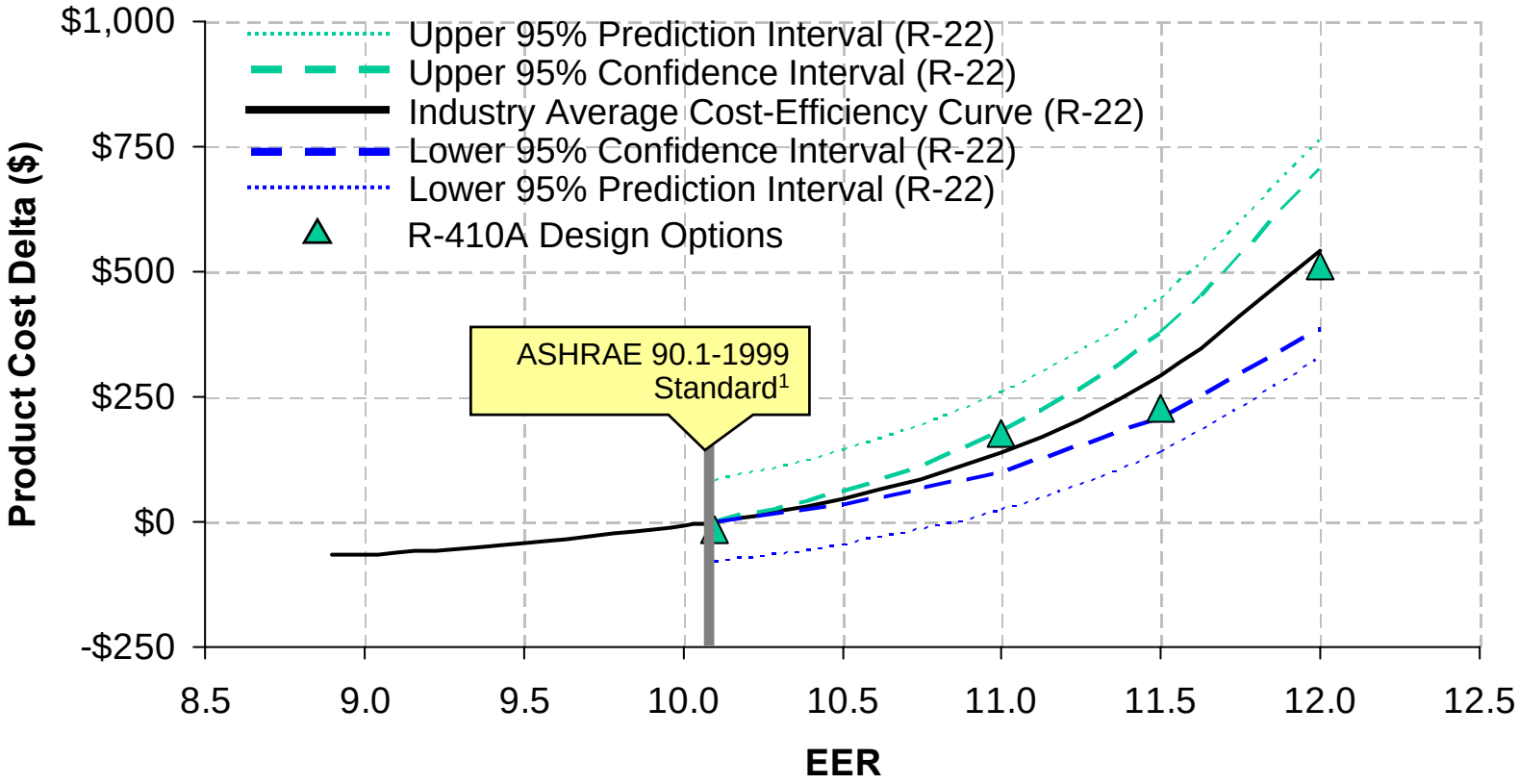
- Because of the phase-out of CFC refrigerants, the engineering analysis considers how the cost-efficiency relationship of R-410a systems differ from R-22.
- The properties of R-410a are different from those of R-22.
- The critical parameters in the analysis are the cost differential between baseline and high efficiency units (rather than absolute cost) and whether this cost delta differs for R-410a vs. R-22 products.



- The 7.5-ton R-410a design option points based on a representative design appear to follow a trend that is similar to the R-22 cost-efficiency curve. This trend will be validated in the post ANOPR phase.

7.5 Ton R-410a Analysis Results

- The R-410a points fall within the prediction interval of the R-22 curve.

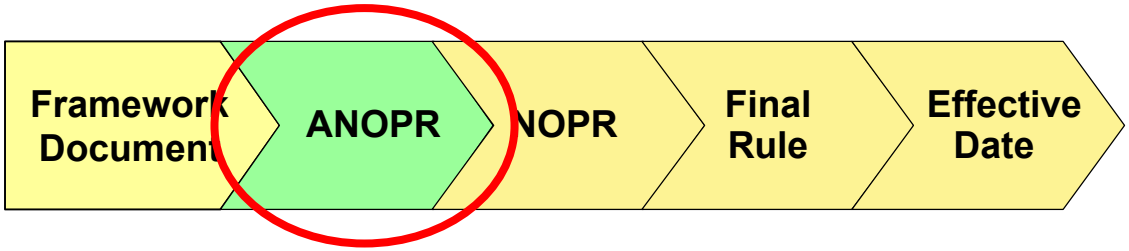


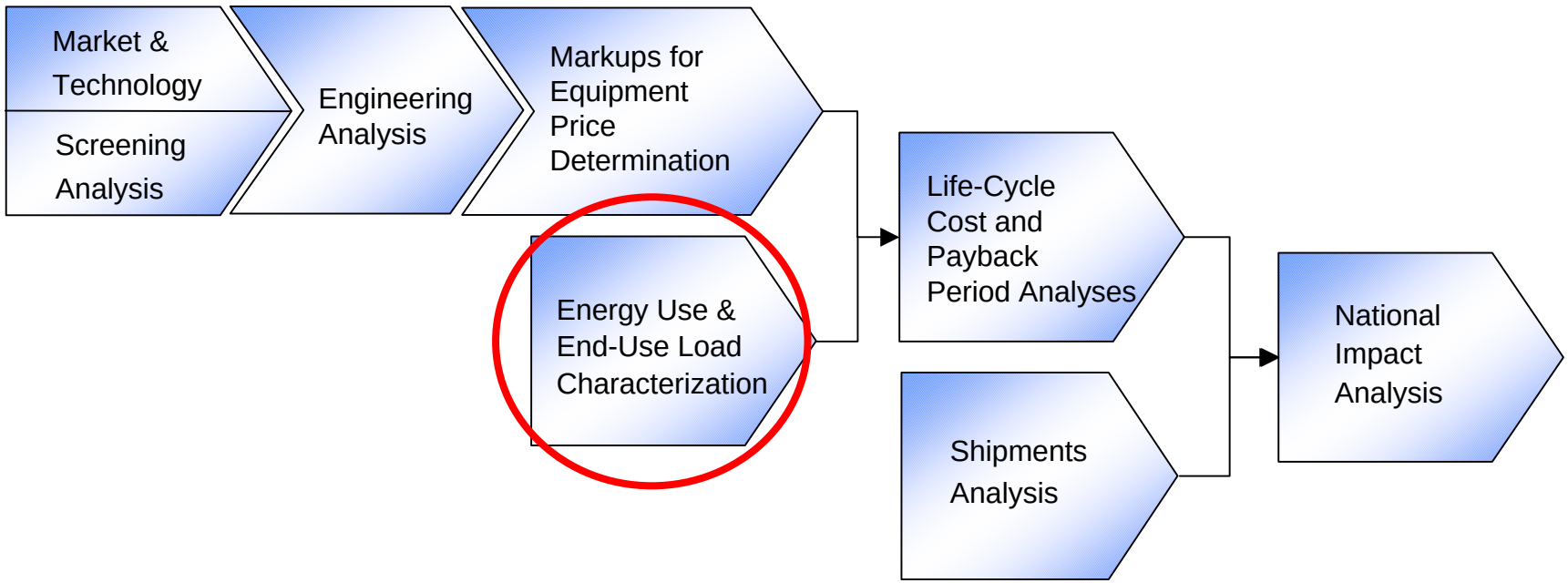
[1] Based on ASHRAE 90.1-1999 Mandatory Minimum EER, including a reduction of 0.2 for units having a heating section other than electric resistance heat.

Agenda

1. Rulemaking Overview
2. Engineering Analysis
3. **Building Energy Use and End-Use Load Characterization**
4. Life-Cycle Cost and Payback Period Analysis
5. National Impact Analysis

ANOPR Analyses Flow Diagram

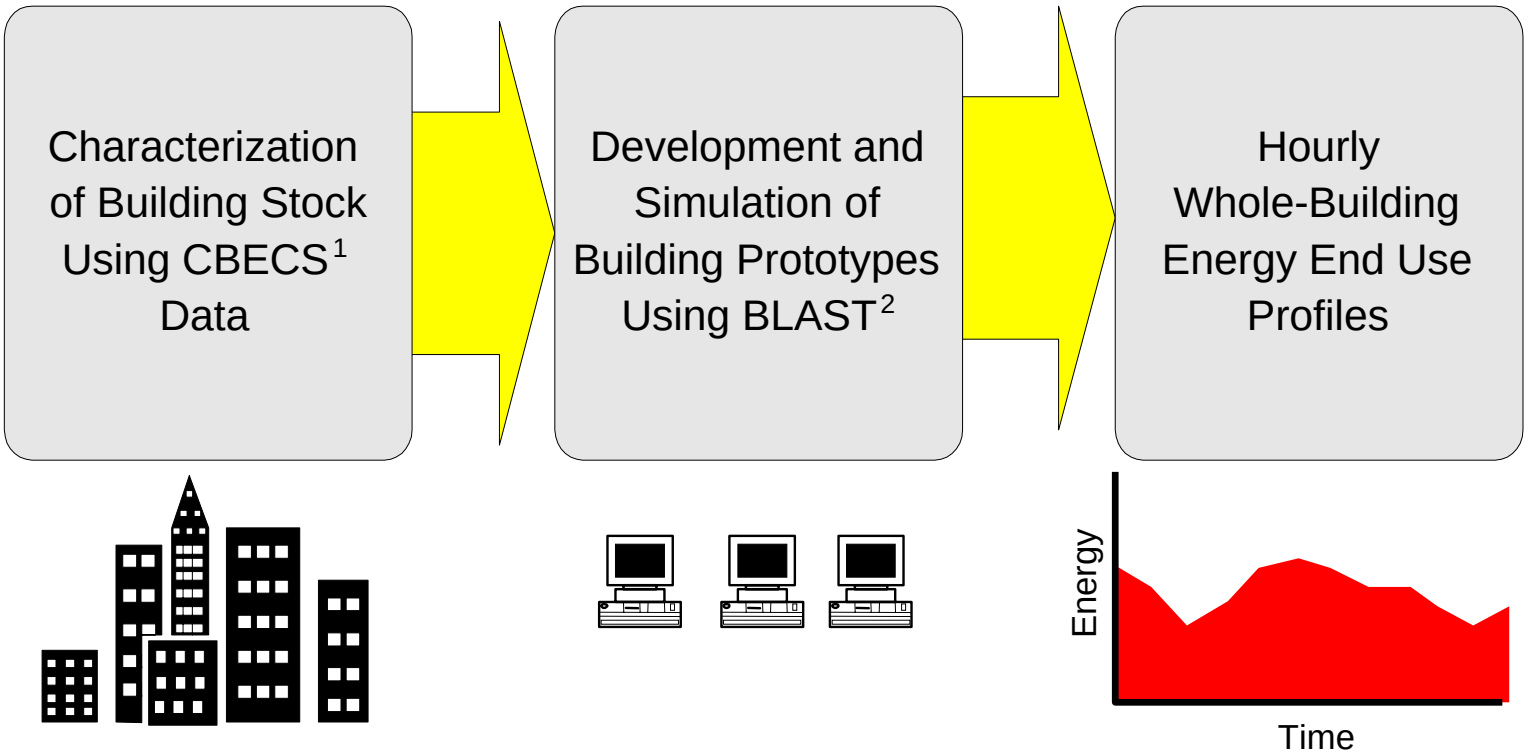




Purpose

- The purpose of the Energy Use and End-Use Load Characterization Analysis is to develop electrical energy use and peak electricity demand characteristics for buildings that use commercial unitary air-conditioning equipment.
- These characteristics are developed for selected equipment efficiency levels, and for a diverse set of commercial buildings and climates
- The results of this analysis provide the basis for the energy cost calculations used in the Life-Cycle Cost Analysis.

Simulation Overview



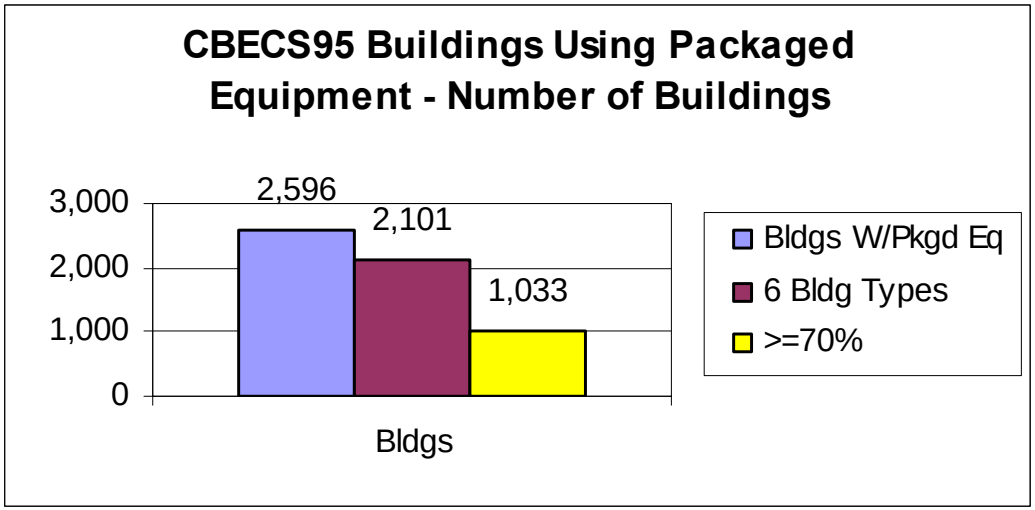
[1] CBECS: *Commercial Building Energy Consumption Survey* conducted by DOE's Energy Information Administration (EIA)

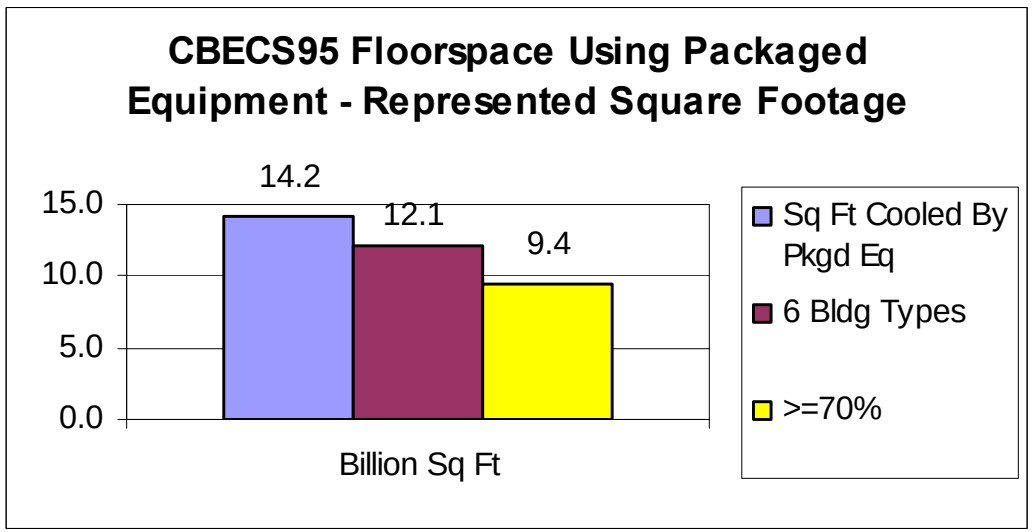
2 BLAST: *Building Loads and System Thermodynamics* energy simulation tool

Developing a Representative Set of Buildings

- **Based on 1995* CBECS Data**
- **Six Building Categories**
- **Minimum of 70% Floor Space In Each Building Cooled by Packaged Equipment**
- **1033 Buildings Selected**

*1995 was the last CBECS survey with new information on small buildings





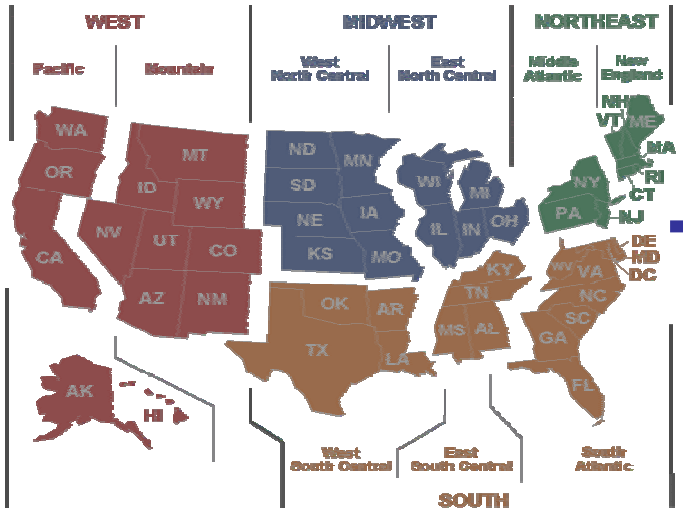
Key Simulation Inputs

- **Building schedules**
- **Lighting loads**
- **Plug loads**
- **Occupancy**
- **Other Building characteristics such as:**
  - Roof construction
  - Wall construction
  - Windows
  - Aspect Ratio (ratio of building length to building width)
  - Window-to-Wall Ratio (WWR)

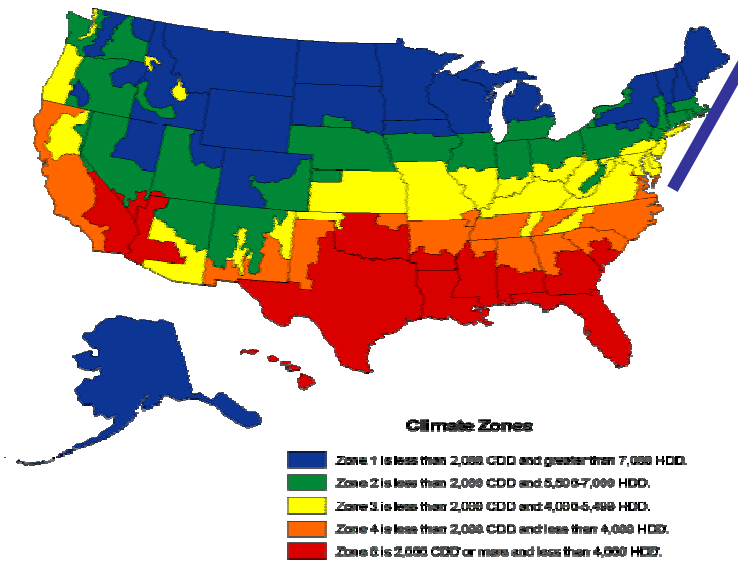
Developing Parameters for Mechanical Systems

- Sizing of the equipment – based on ASHRAE 1% design day condition
- Over-sizing Factor: 0% - 25% over design day sizing
- Economizer (based on reported CBECS usage for each building, enthalpy control assumed)
- Thermostat set points and setback
- Total Fan Pressure = Internal fan static pressure + External fan static pressure (by building type)
- Ventilation rates – based on ASHRAE Standard 62.1-2001 (prescriptive ventilation rate tables)

Assigning Climate Stations



+



- Nine census divisions overlaid with 5 Climate Zones results in 26 GeoClimate Zones
- Within each GeoClimate zone buildings were assigned to a TMY2 station using population weights. 154 of the 239 TMY2 stations were used in the simulations

EER Levels Used in Building Simulations

EER Levels Used in Building Simulations		
Case	**EER Level**	**Source**
1	8.5	Existing EPCA Level for 135-240 kBtu/h
2	8.9	Existing EPCA Level for 65-135 kBtu/h
3	9.5	ASHRAE 90.1-1999 Level 135-240 kBtu/h
4	10.0	0.5 EER increment
5	10.1	ASHRAE 90.1-1999 Level 65-135 kBtu/h
6	10.5	0.5 EER increment
7	11.0	0.5 EER increment
8	11.5	Highest reported EER for 135-240 kBtu/h*
9	11.8	Highest reported EER for 65-135 kBtu/h*
10	12.0	0.5 EER increment

Statutory Baseline Levels

*As of Dec, 2001

Simulation Methodology

15-zone, 3-story Prototype (48,000 sf)

Size equipment with BLAST design-day run

Simulate annual energy use with BLAST

Scale results to match actual building geometry

CBECS – inferred size and geometry

Adjust cooling and fan energy use for less than 100% packaged cooling

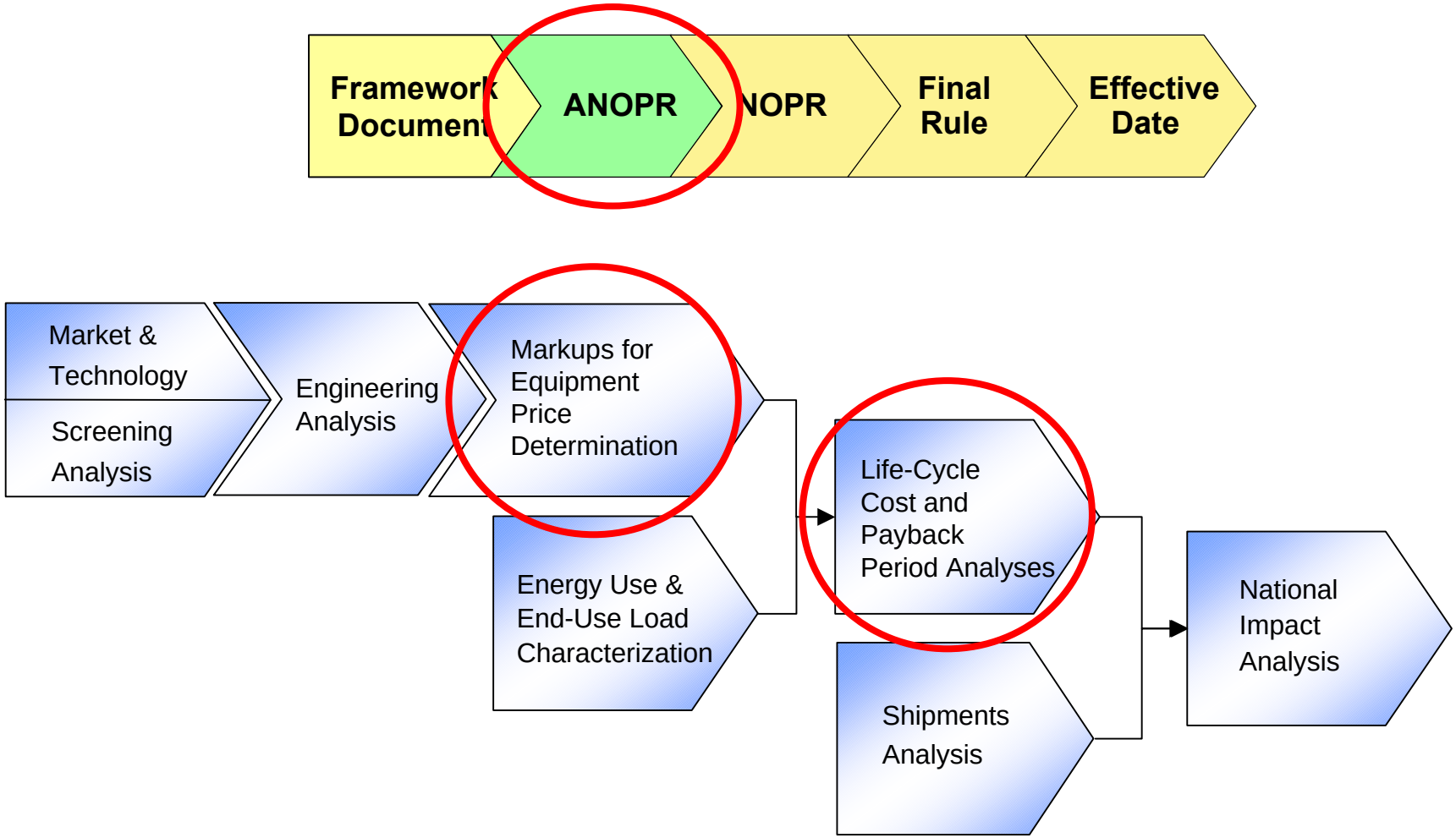
Simulation Output

- Each of the 1033 buildings was simulated for each of the 10 efficiency levels. The results provided from this analysis are:
  - A stream of hourly electrical consumption for each building end use (including cooling)
  - The number of 7.5 ton or 15 ton air conditioning units that would be installed in the building to meet the peak loads

Agenda

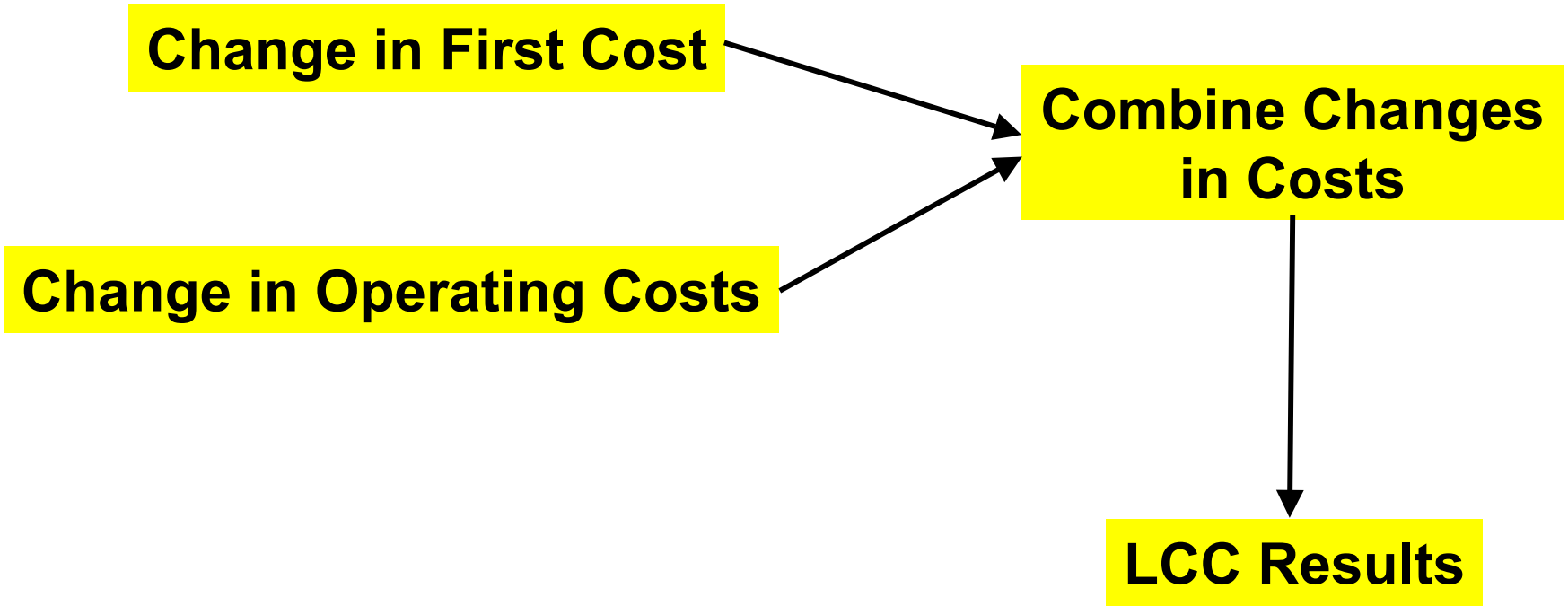
1. Rulemaking Overview
2. Engineering Analysis
3. Building Energy Use and End-Use Load Characterization
4. Life-Cycle Cost and Payback Period Analysis
5. National Impact Analysis

ANOPR Analyses Flow Diagram



Basic LCC Process Diagram

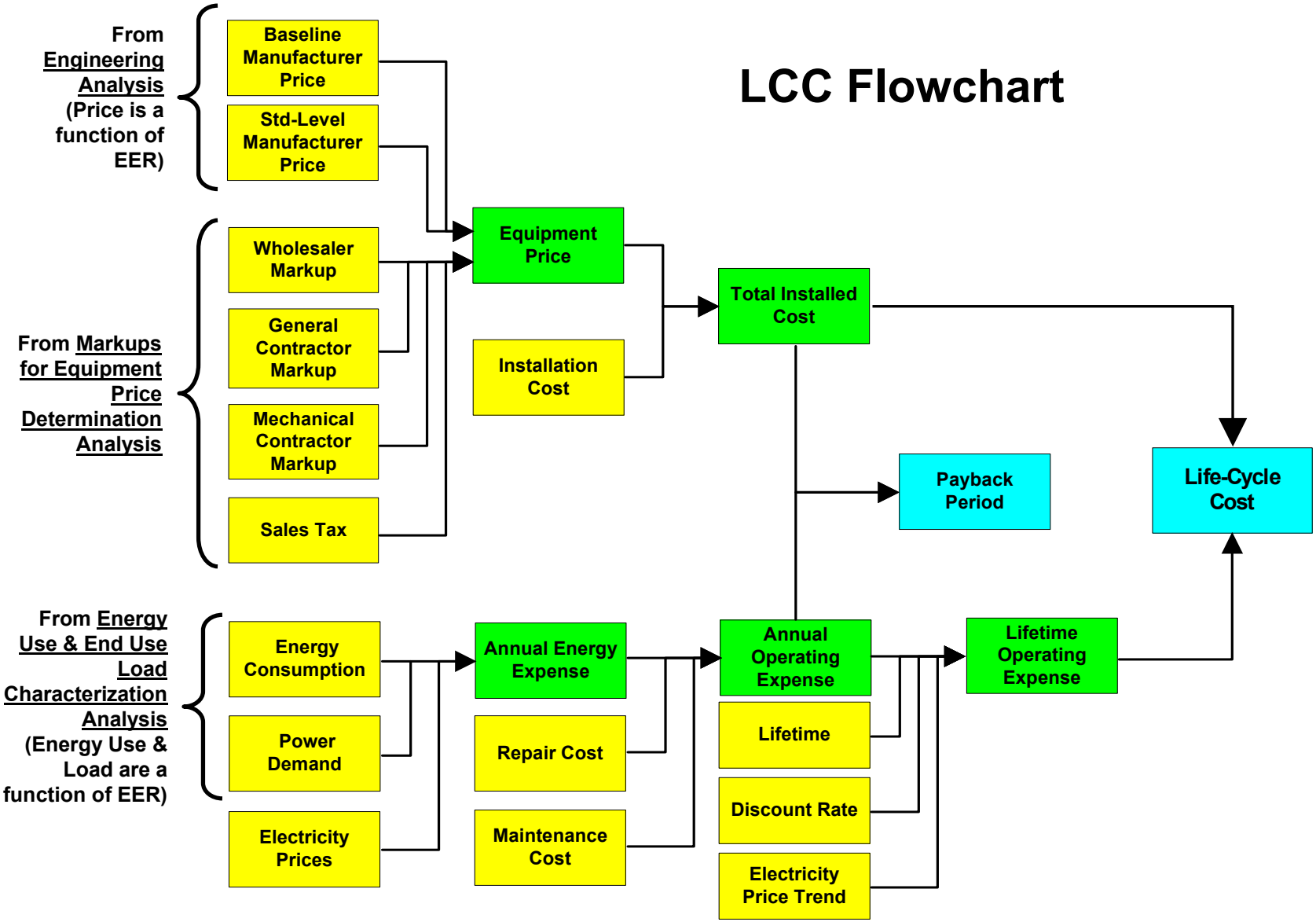
Economic evaluation from the customer perspective



Basic LCC Process

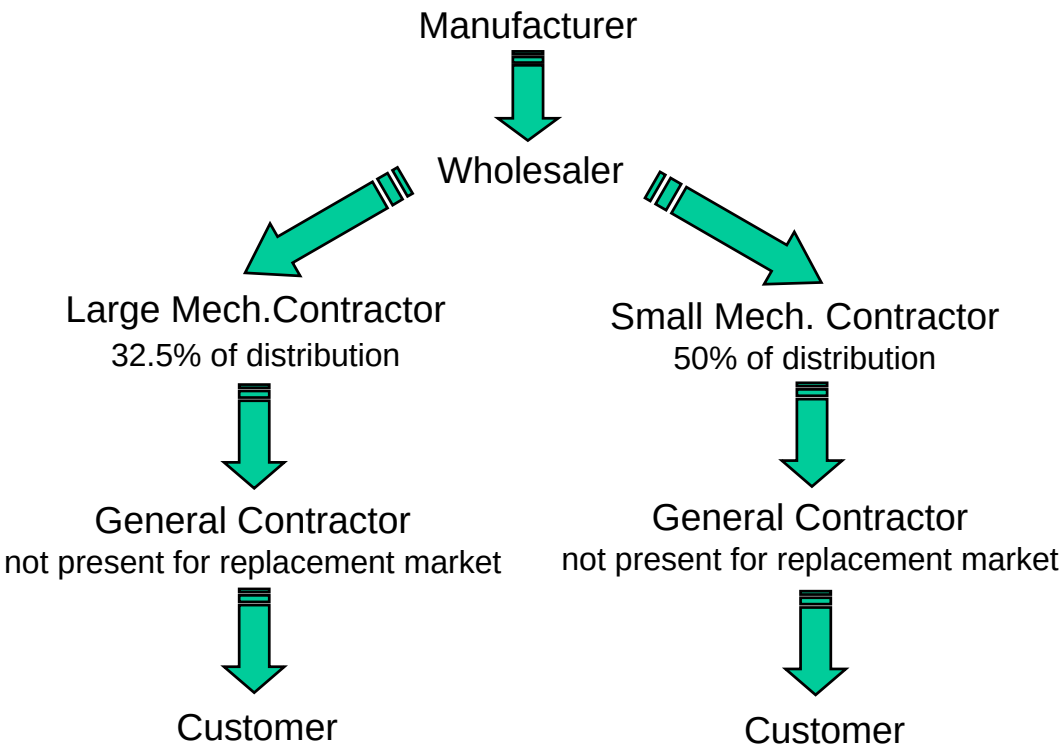
- LCC equals first cost plus the sum of operating costs discounted to a particular base year
- Implemented in an Excel® spreadsheet
- Key sensitivities can be tested
- Results are expressed as LCC difference (baseline minus candidate standard)
- One LCC spreadsheet for both equipment classes

LCC Flowchart

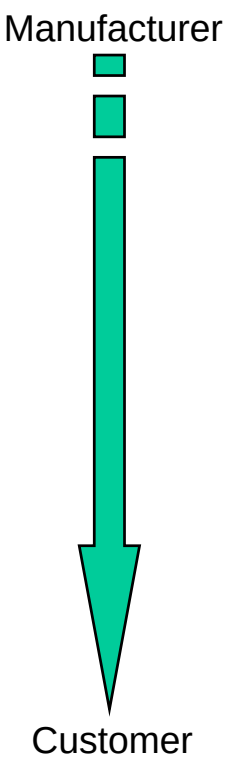


Markups: Distribution Channels

Distribution Channels 1 & 2
represents 82.5% of distribution



Distribution Channel 3 (Nat'l Acct)
represents 17.5% of distribution



- Two construction types: Replacement (70%) and New Construction (30%)

Two Types of Markups: Baseline and Incremental

- 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 Wholesaler's or Contractor's expenses plus profit
  - Direct labor costs (salaries, payroll, rental and occupancy) are included
- But some costs remain constant when CGS increases
- Incremental markups relate the incremental change in customer price to the incremental change in CGS
  - 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

Example: Using Baseline and Incremental Markups to Calculate Customer Prices from Manufacturer Prices

BASELINE CUSTOMER PRICE

Baseline Manufacturer Price		$2000
Overall Baseline Markup	x	2.31
Baseline Customer Price		$4620

CUSTOMER PRICE – MORE EFFICIENT UNIT

Baseline Manufacturer Price		$2000
Overall Baseline Markup	x	2.31
Baseline Customer Price		$4620

+

Incremental Manufacturer Price		$325
Overall Incremental Markup	x	1.56
Incremental Customer Price		$507

=

Total Customer Price	$5127

divide by

Total Manufacturer Price	$2325
Overall Markup	2.21

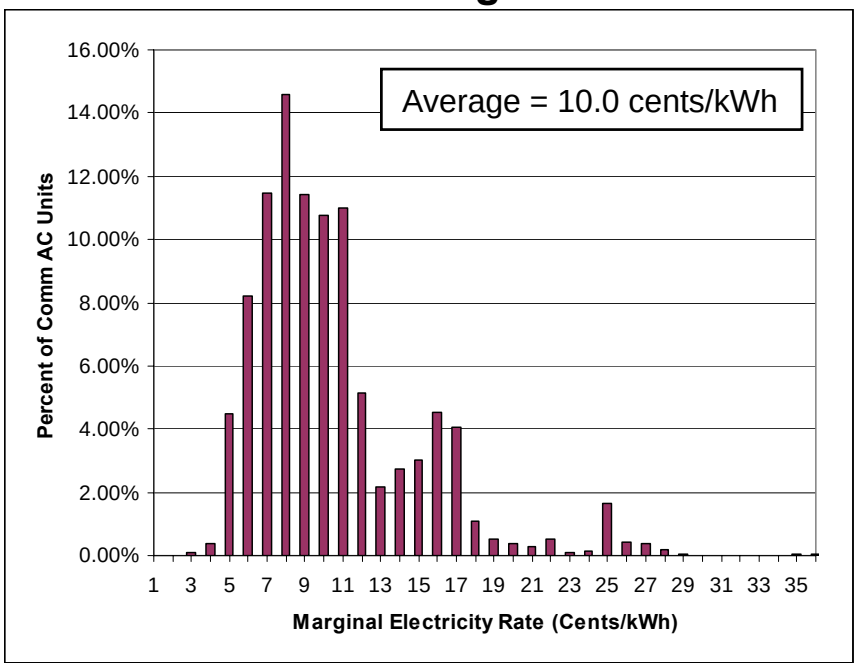
Electricity Prices Based on Two Approaches: Tariff-Based and Hourly-Based

- **Tariff-based**
  - Primary approach
  - Based upon non-residential electric utility tariffs collected in 2001
- **Hourly-based**
  - Secondary approach
  - Prices that might exist assuming all electricity markets are deregulated
  - Based upon the premise that an electricity provider charges customers
  - for what it costs to supply energy for air conditioning
- **Marginal prices developed from both approaches**
  - Tariffs or Hourly Costs applied to building energy use and demand data
  - Electricity bill savings and marginal prices calculated from an efficiency improvement to air-conditioning equipment
- **Electricity price forecasts are used to estimate future marginal prices**
  - Based on trends from the 2003 Annual Energy Outlook

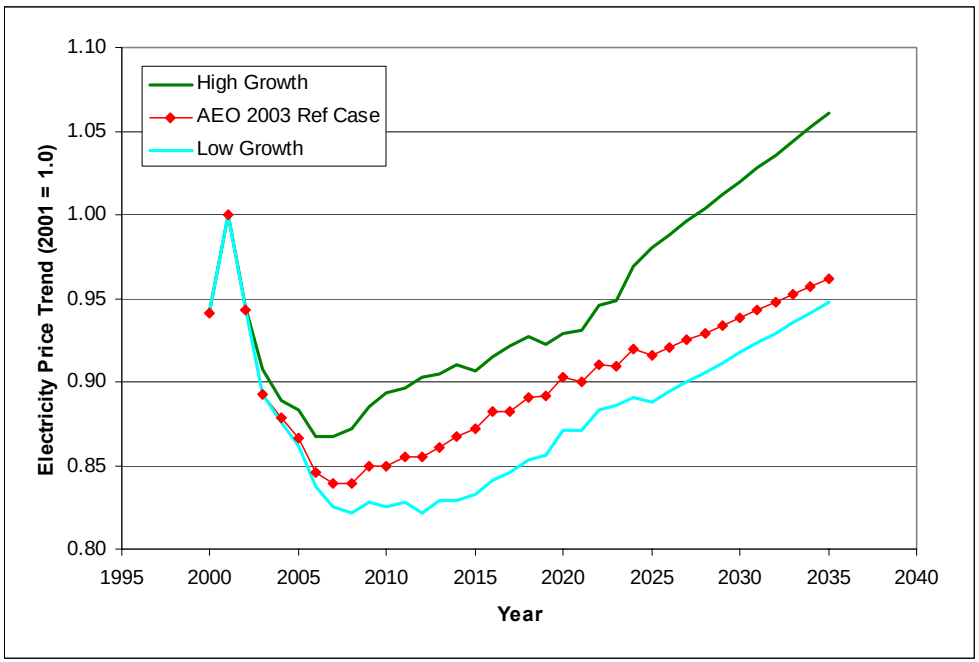
LCC Input: Electricity Price Charts

National average marginal price is high in the year 2001 but price trends decrease future prices

Tariff-Based Marginal Prices



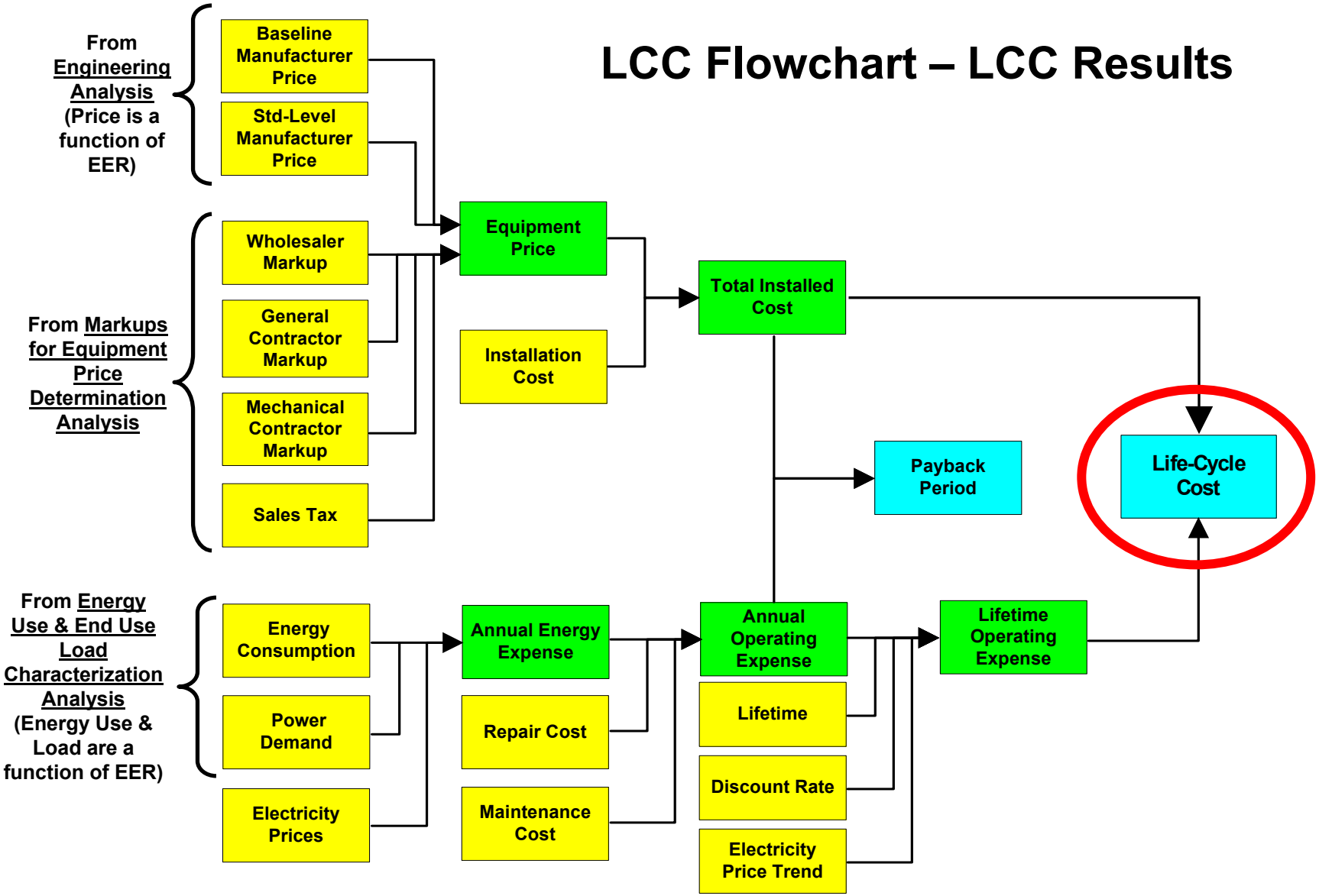
AEO 2003 Price Trends



Summary of other LCC and PBP inputs

- **Installation Costs**
  - Based on RS Means data: $1585 for baseline 7.5 ton unit, $2142 for 15 ton unit
  - Costs vary in direct proportion to equipment weight
- **Discount Rates**
  - Derived from estimates of the cost of capital of companies that purchase unitary a/c
  - Cost of capital is calculated from the weighted-average cost to the firm (WACC) to obtain equity and debt financing
  - Weighted-average value equals 6.1% real
- **Equipment Lifetime**
  - Median age of 15 years based upon *1999 ASHRAE HVAC Applications Handbook*
  - Survival function based upon Weibull probability distribution
- **Repair Costs**
  - Baseline annual repair cost: $158 for 7.5 ton unit, $291 for 15 ton unit
  - Increases in direct proportion to equipment manufacturing price
- **Maintenance Costs**
  - Based upon RS Means data for 3 to 24 ton roof top air conditioners
  - Annual maintenance cost equals $200 and does not vary with capacity or efficiency

LCC Flowchart – LCC Results



Customer Variation

- A customer sample is developed where every customer is unique
- We represent the variability among customers using input variables defined with probability distributions
- Monte Carlo simulation is a statistical technique that samples from input variable distributions
- LCC results produced as 10,000-iterations
  - Implemented with Crystal Ball ®, supplement to Excel

Summary Sheet from LCC Spreadsheet

COMMERCIAL UNITARY AIR CONDITIONERS

LIFE CYCLE COST CALCULATION: TARIFF-BASED ELECTRICITY

USER OPTIONS:

- Sample Calculation
- Crystal Ball Simulation

Energy Price Projection	AEO 2003 - Reference Case
Start Year	2008
Product Class	7.5 tons

Installation Cost: Flat / Increasing

Repair Cost: Flat / Increasing

ASSUMPTIONS:

Lifetime *(years)*	15.4
Discount Rate	7.1%

BUILDING INFORMATION:

Building ID	11	
Utility ID	733	
State	DE	
Sub-Division	5.1	
Census Region	3	
Average Electricity Price	5.2	*cents/kWh*
Marginal Electricity Price	5.8	*cents/kWh*
Maximum Annual Demand	163.5	*kW*
Square Footage	25,000	*sq.ft.*
% Cooling Package	100.0	*%*
Installation Cost Multiplier	1.08	
Number of A/C Units	10.48	
Building Type	SmRet	
Owner-occupied	Yes	

LIFE CYCLE COSTS RESULTS:

Year of Purchase	2008
Year Equipment Retires	2022
Baseline Efficiency Level	2

			Total Installed Price	Annual Repair & Maint. Cost	Annual Elec. Bill 2008	Cumul. Cash Flow	Life Cycle Cost	LCC Savings	Payback
			($)	*($/yr)*	*($/yr)*	*($)*	*($)*	*($)*	*(year)*
	0	EER=9.5	$7,251	$381	$612	$20,989	$15,510		
	1	EER=10.0	$7,290	$381	$581	$20,622	$15,306	$0	0.0
Baseline >>	2	EER=10.1	$7,298	$381	$575	$20,552	$15,267	$0	0.0
	3	EER=10.5	$7,408	$385	$553	$20,434	$15,241	$27	6.1
	4	EER=11.0	$7,603	$393	$528	$20,419	$15,310	-$43	8.7
	5	EER=11.5	$7,898	$407	$504	$20,608	$15,543	-$275	13.3
	6	EER=11.8	$8,149	$418	$492	$20,869	$15,801	-$533	18.5
	7	EER=12.0	$8,359	$428	$483	$21,121	$16,036	-$769	23.9

** All costs in 2001 dollars*

User Options: Calculations

COMMERCIAL UNITARY AIR CONDITIONERS

USER OPTIONS:

- Sample Calculation
- Crystal Ball Simulation

Energy Price Projection	AEO 2003 - Reference Case
Start Year	2008
Product Class	7.5 tons

Installation Cost: Flat / Increasing

Repair Cost: Flat / Increasi

ASSUMPTIONS:

Lifetime *(years)*	15.4
Discount Rate	7.1%

BUILDING INFORMATION:

Building ID	11	
Utility ID	733	
State	DE	
Sub-Division	5.1	
Census Region	3	
Average Electricity Price	5.2	*cents/kWh*
Marginal Electricity Price	5.8	*cents/kWh*
Maximum Annual Demand	163.5	*kW*
Square Footage	25,000	*sq.ft.*
% Cooling Package	100.0	%
Installation Cost Multiplier	1.08	
Number of A/C Units	10.48	
Building Type	SmRet	
Owner-occupied	Yes	

LIFE CYCLE COST CALCULATION: TARIFF-BASED ELECTRICITY

LIFE CYCLE COSTS RESULTS:

Year of Purchase	2008
Year Equipment Retires	2022
Baseline Efficiency Level	2

Total Installed Price	Annual Repair & Maint. Cost	Annual Elec. Bill 2008	Cumul. Cash Flow	Life Cycle Cost	LCC Savings	Payback

- Sample Calculation
- Crystal Ball Simulation

** All costs in 2001 dollars*

User Options: Energy Price Projection

COMMERCIAL UNITARY AIR CONDITIONERS — **LIFE CYCLE COST CALCULATION: TARIFF-BASED ELECTRICITY**

USER OPTIONS:

- Sample Calculation
- Crystal Ball Simulation

Energy Price Projection	AEO 2003 - Reference Case
Start Year	2008
Product Class	7.5 tons

Installation Cost: Flat / Increasing

Repair Cost: Flat / Increasing

ASSUMPTIONS:

Lifetime *(years)*	15.4
Discount Rate	7.1%

BUILDING INFORMATION:

Building ID	11	
Utility ID	733	
State	DE	
Sub-Division	5.1	
Census Region	3	
Average Electricity Price	5.2	*cents/kWh*
Marginal Electricity Price	5.8	*cents/kWh*
Maximum Annual Demand	163.5	*kW*
Square Footage	25,000	*sq.ft.*
% Cooling Package	100.0	*%*
Installation Cost Multiplier	1.08	
Number of A/C Units	10.48	
Building Type	SmRet	
Owner-occupied	Yes	

LIFE CYCLE COSTS RESULTS:

Year of Purchase	2008
Year Equipment Retires	2022
Baseline Efficiency Level	2

Total Installed Price ($)	Annual Repair & Maint. Cost ($/yr)	Annual Elec. Bill 2008 ($/yr)	Cumul. Cash Flow ($)	Life Cycle Cost ($)	LCC Savings ($)	Payback (year)

AEO 2003 - Reference Case

- Constant 2001
- AEO 2003 - Reference Case
- AEO 2003 - High Growth Case
- AEO 2003 - Low Growth Case

** All costs in 2001 dollars*

User Options: Start Year

COMMERCIAL UNITARY AIR CONDITIONERS

USER OPTIONS:

- Sample Calculation
- Crystal Ball Simulation

Energy Price Projection	AEO 2003 - Reference Case
Start Year	2008
Product Class	7.5 tons

Installation Cost: Flat / Increasing

Repair Cost: Flat / Increasing

ASSUMPTIONS:

Lifetime *(years)*	15.4
Discount Rate	7.1%

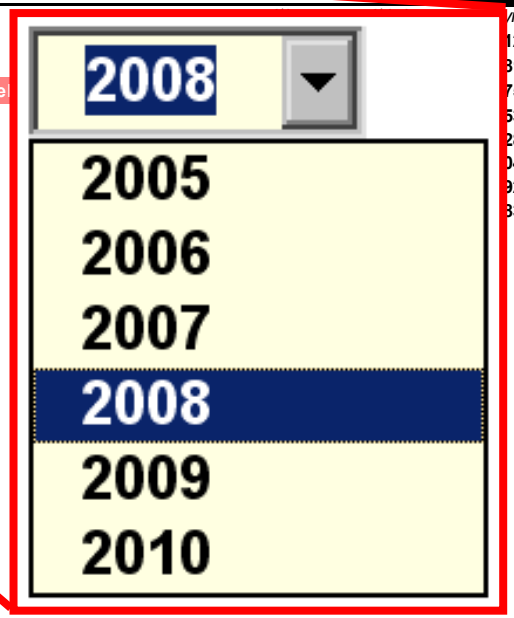
BUILDING INFORMATION:

Building ID	11	
Utility ID	733	
State	DE	
Sub-Division	5.1	
Census Region	3	
Average Electricity Price	5.2	*cents/kWh*
Marginal Electricity Price	5.8	*cents/kWh*
Maximum Annual Demand	163.5	*kW*
Square Footage	25,000	*sq.ft.*
% Cooling Package	100.0	*%*
Installation Cost Multiplier	1.08	
Number of A/C Units	10.48	
Building Type	SmRet	
Owner-occupied	Yes	

LIFE CYCLE COST CALCULATION: TARIFF-BASED ELECTRICITY

LIFE CYCLE COSTS RESULTS:

Year of Purchase	2008
Year Equipment Retires	2022
Baseline Efficiency Level	2



	Total Installed Price	Annual Repair & Maint. Cost	Annual Elec. Bill 2008	Cumul. Cash Flow	Life Cycle Cost	LCC Savings	Payback
			(yr)	*($)*	*($)*	*($)*	*(year)*
			12	$20,989	$15,510		
			31	$20,622	$15,306	$0	0.0
Base			75	$20,552	$15,267	$0	0.0
			53	$20,434	$15,241	$27	6.1
			28	$20,419	$15,310	-$43	8.7
			04	$20,608	$15,543	-$275	13.3
			92	$20,869	$15,801	-$533	18.5
			33	$21,121	$16,036	-$769	23.9

** All costs in 2001 dollars*

User Options: Product Class

COMMERCIAL UNITARY AIR CONDITIONERS

USER OPTIONS:

- Sample Calculation
- Crystal Ball Simulation

Energy Price Projection	AEO 2003 - Reference Case
Start Year	2008
Product Class	7.5 tons

Installation Cost: Flat / Increasing

Repair Cost: Flat / Increasing

ASSUMPTIONS:

Lifetime *(years)*	15.4
Discount Rate	7.1%

BUILDING INFORMATION:

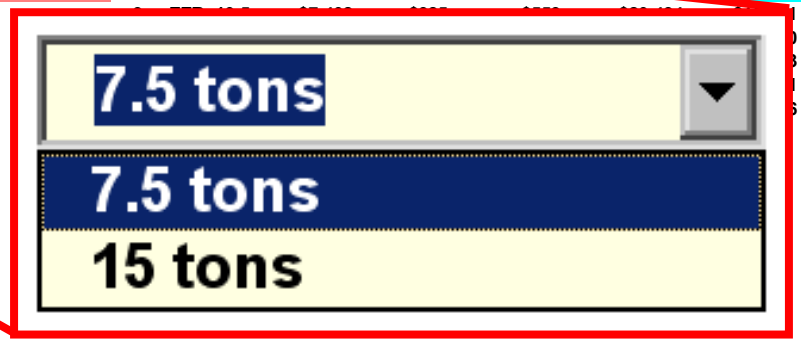
Building ID	11	
Utility ID	733	
State	DE	
Sub-Division	5.1	
Census Region	3	
Average Electricity Price	5.2	*cents/kWh*
Marginal Electricity Price	5.8	*cents/kWh*
Maximum Annual Demand	163.5	*kW*
Square Footage	25,000	*sq.ft.*
% Cooling Package	100.0	*%*
Installation Cost Multiplier	1.08	
Number of A/C Units	10.48	
Building Type	SmRet	
Owner-occupied	Yes	

LIFE CYCLE COST CALCULATION: TARIFF-BASED ELECTRICITY

LIFE CYCLE COSTS RESULTS:

Year of Purchase	2008
Year Equipment Retires	2022
Baseline Efficiency Level	2

		Total Installed Price	Annual Repair & Maint. Cost	Annual Elec. Bill 2008	Cumul. Cash Flow	Life Cycle Cost	LCC Savings	Payback
		($)	*($/yr)*	*($/yr)*	*($)*	*($)*	*($)*	*(year)*
0	EER=9.5	$7,251	$381	$612	$20,989	$15,510		
1	EER=10.0	$7,290	$381	$581	$20,622	$15,306	$0	0.0
Baseline >> 2	EER=10.1	$7,298	$381	$575	$20,552	$15,267	$0	0.0
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$27	6.1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-$43	8.7
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-$275	13.3
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-$533	18.5
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-$769	23.9



** All costs in 2001 dollars*

User Options: Installation & Repair Costs

COMMERCIAL UNITARY AIR CONDITIONERS

USER OPTIONS:

- Sample Calculation
- Crystal Ball Simulation

Energy Price Projection	AEO 2003 - Reference Case
Start Year	2008
Product Class	7.5 tons

Installation Cost: Flat / Increasing

Repair Cost: Flat / Increasing

ASSUMPTIONS:

Lifetime *(years)*		
Discount Rate		

BUILDING INFORMATION:

Building ID		
Utility ID		
State		
Sub-Division	5.1	
Census Region	3	
Average Electricity Price	5.2	*cents/kWh*
Marginal Electricity Price	5.8	*cents/kWh*
Maximum Annual Demand	163.5	*kW*
Square Footage	25,000	*sq.ft.*
% Cooling Package	100.0	%
Installation Cost Multiplier	1.08	
Number of A/C Units	10.48	
Building Type	SmRet	
Owner-occupied	Yes	

LIFE CYCLE COST CALCULATION: TARIFF-BASED ELECTRICITY

LIFE CYCLE COSTS RESULTS:

Year of Purchase	2008
Year Equipment Retires	2022
Baseline Efficiency Level	2

			Total Installed Price	Annual Repair & Maint. Cost	Annual Elec. Bill 2008	Cumul. Cash Flow	Life Cycle Cost	LCC Savings	Payback
			($)	*($/yr)*	*($/yr)*	*($)*	*($)*	*($)*	*(year)*
	0	EER=9.5	$7,251	$381	$612	$20,989	$15,510		
	1	EER=10.0	$7,290	$381	$581	$20,622	$15,306	$0	0.0
Baseline >>	2	EER=10.1	$7,298	$381	$575	$20,552	$15,267	$0	0.0
	3	EER=10.5	$7,408	$385	$553	$20,434	$15,241	$27	6.1
	4	EER=11.0	$7,603	$393	$528	$20,419	$15,310	-$43	8.7
	5	EER=11.5	$7,850	$407	$504	$20,608	$15,543	-$275	13.3
	6	EER=11.8	$8,149	$418	$492	$20,869	$15,801	-$533	18.5
	7	EER=12.0	$8,359	$428	$483	$21,121	$16,036	-$769	23.9

Installation Cost: Flat / Increasing

Repair Cost: Flat / Increasing

** All costs in 2001 dollars*

Assumptions

COMMERCIAL UNITARY AIR CONDITIONERS

USER OPTIONS:

- Sample Calculation
- Crystal Ball Simulation

Energy Price Projection	AEO 2003 - Reference Case
Start Year	2008
Product Class	7.5 tons

Installation Cost: Flat / Increasing

Repair Cost: Flat / Increasing

ASSUMPTIONS:

Lifetime *(years)*	15.4
Discount Rate	7.1%

BUILDING INFORMATION:

Building ID	11	
Utility ID	733	
State	DE	
Sub-Division	5.1	
Census Region	3	
Average Electricity Price	5.2	*cents/kWh*
Marginal Electricity Price	5.8	*cents/kWh*
Maximum Annual Demand	163.5	*kW*
Square Footage	25,000	*sq.ft.*
% Cooling Package	100.0	*%*
Installation Cost Multiplier	1.08	
Number of A/C Units	10.48	
Building Type	SmRet	
Owner-occupied	Yes	

LIFE CYCLE COST CALCULATION: TARIFF-BASED ELECTRICITY

LIFE CYCLE COSTS RESULTS:

Year of Purchase	2008
Year Equipment Retires	2022
Baseline Efficiency Level	2

6	EER=11.8	$8,149	$418	$492	$20,869	$15,801	-$533	[illegible]
7	EER=12.0	$8,359	$428	$483	$21,121	$16,036	-$769	23.9

Lifetime *(years)*	**15.4**
Discount Rate	**7.1%**

** All costs in 2001 dollars*

Building Information

COMMERCIAL UNITARY AIR CONDITIONERS

LIFE CYCLE COST CALCULATION: TARIFF-BASED ELECTRICITY

USER OPTIONS:

Sample Calculation

Crystal Ball Simulation

Energy Price Projection: AEO 2003 - Refer

Start Year: 2008

Product Class: 7.5 tons

Installation Cost: Flat, Increasing

Repa: Flat

ASSUMPTIONS:

Lifetime *(years)*: 15

Discount Rate: 7.1

BUILDING INFORMATION:

Building ID	1	
Utility ID	73	
State	D	
Sub-Division	5.	
Census Region	3	
Average Electricity Price	5.2	*cents/kWh*
Marginal Electricity Price	5.8	*cents/kWh*
Maximum Annual Demand	163.5	*kW*
Square Footage	25,000	*sq.ft.*
% Cooling Package	100.0	%
Installation Cost Multiplier	1.08	
Number of A/C Units	10.48	
Building Type	SmRet	
Owner-occupied	Yes	

LIFE CYCLE COSTS RESULTS:

Building ID	11	
Utility ID	733	
State	DE	
Sub-Division	5.1	
Census Region	3	
Average Electricity Price	5.2	*cents/kWh*
Marginal Electricity Price	5.8	*cents/kWh*
Maximum Annual Demand	163.5	*kW*
Square Footage	25,000	*sq.ft.*
% Cooling Package	100.0	%
Installation Cost Multiplier	1.08	
Number of A/C Units	10.48	
Building Type	SmRet	
Owner-occupied	Yes	

All costs in 2001 dollars

LCC Results (highlighted)

COMMERCIAL UNITARY AIR CONDITIONERS

USER OPTIONS:

- Sample Calculation
- Crystal Ball Simulation

Energy Price Projection	AEO 2003 - Reference Case
Start Year	2008
Product Class	7.5 tons

Installation Cost: Flat / Increasing

Repair Cost: Flat / Increasing

ASSUMPTIONS:

Lifetime *(years)*	15.4
Discount Rate	7.1%

BUILDING INFORMATION:

Building ID	11	
Utility ID	733	
State	DE	
Sub-Division	5.1	
Census Region	3	
Average Electricity Price	5.2	*cents/kWh*
Marginal Electricity Price	5.8	*cents/kWh*
Maximum Annual Demand	163.5	*kW*
Square Footage	25,000	*sq.ft.*
% Cooling Package	100.0	*%*
Installation Cost Multiplier	1.08	
Number of A/C Units	10.48	
Building Type	SmRet	
Owner-occupied	Yes	

LIFE CYCLE COST CALCULATION: TARIFF-BASED ELECTRICITY

LIFE CYCLE COSTS RESULTS:

Year of Purchase	2008
Year Equipment Retires	2022
Baseline Efficiency Level	2

			Total Installed Price	Annual Repair & Maint. Cost	Annual Elec. Bill 2008	Cumul. Cash Flow	Life Cycle Cost	LCC Savings	Payback
			($)	*($/yr)*	*($/yr)*	*($)*	*($)*	*($)*	*(year)*
	0	EER=9.5	$7,251	$381	$612	$20,989	$15,510		
	1	EER=10.0	$7,290	$381	$581	$20,622	$15,306	$0	0.0
Baseline >>	2	EER=10.1	$7,298	$381	$575	$20,552	$15,267	$0	0.0
	3	EER=10.5	$7,408	$385	$553	$20,434	$15,241	$27	6.1
	4	EER=11.0	$7,603	$393	$528	$20,419	$15,310	-$43	8.7
	5	EER=11.5	$7,898	$407	$504	$20,608	$15,543	-$275	13.3
	6	EER=11.8	$8,149	$418	$492	$20,869	$15,801	-$533	18.5
	7	EER=12.0	$8,359	$428	$483	$21,121	$16,036	-$769	23.9

** All costs in 2001 dollars*

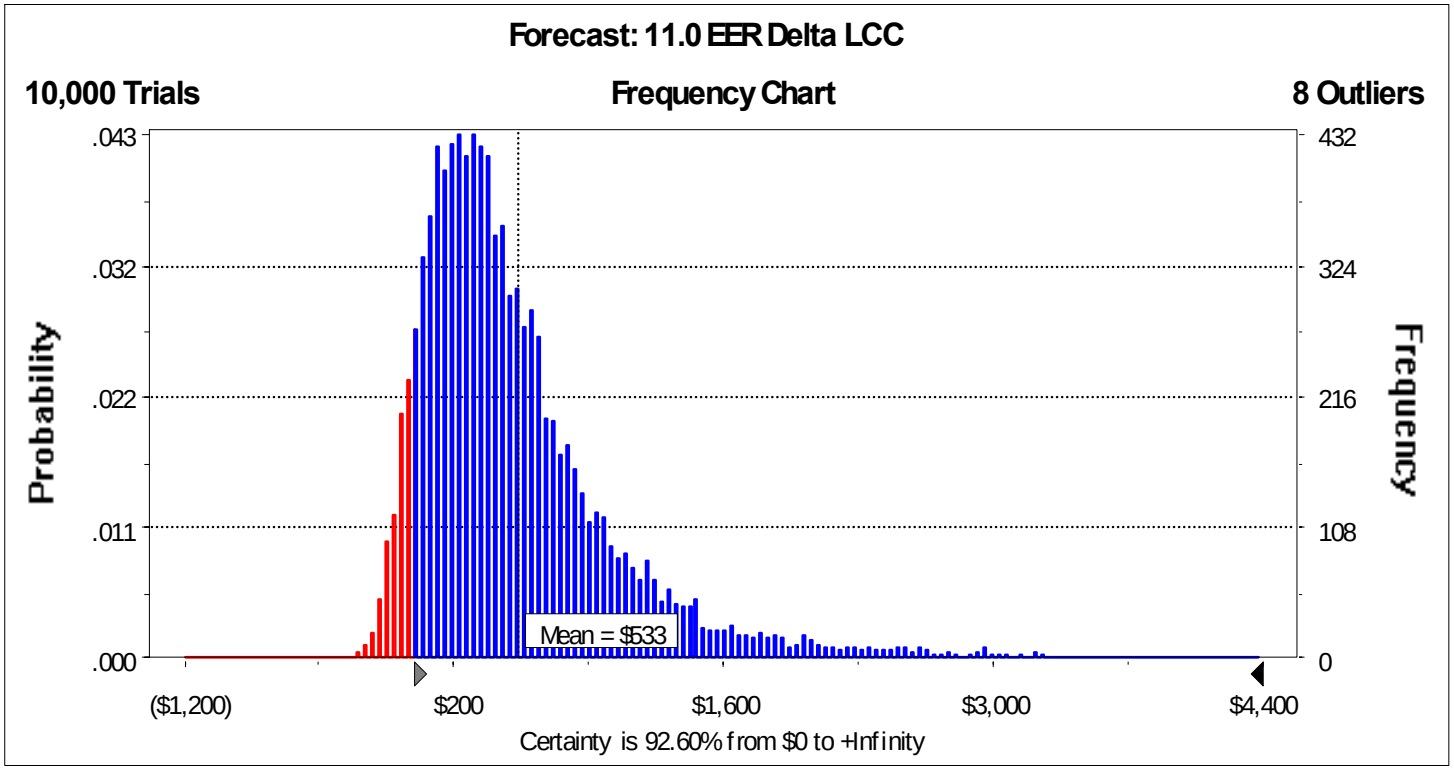
7.5 Ton (≥65,000 Btu/h and <135,000 Btu/h) Sample Results

LIFE CYCLE COSTS RESULTS:

Year of Purchase	2008
Year Equipment Retires	2022
Baseline Efficiency Level	2

			Total Installed Price	Annual Repair & Maint. Cost	Annual Elec. Bill 2008	Cumul. Cash Flow	Life Cycle Cost	LCC Savings	Payback	Internal Rate of Return
			($)	($/yr)	($/yr)	($)	($)	($)	(year)	
	0	EER=9.5	$6,397	$358	$1,426	$30,457	$21,795			
	1	EER=10.0	$6,433	$358	$1,353	$29,537	$21,220	$0	0.0	
Baseline >>	2	EER=10.1	$6,440	$358	$1,340	$29,364	$21,113	$0	0.0	
	3	EER=10.5	$6,542	$361	$1,288	$28,841	$20,815	$298	2.1	78%
	4	EER=11.0	$6,722	$368	$1,228	$28,346	$20,564	$548	2.8	48%
	5	EER=11.5	$6,995	$380	$1,174	$28,082	$20,495	$618	3.9	32%
	6	EER=11.8	$7,228	$390	$1,144	$28,074	$20,574	$538	4.8	24%
	7	EER=12.0	$7,422	$398	$1,125	$28,149	$20,693	$420	5.7	20%

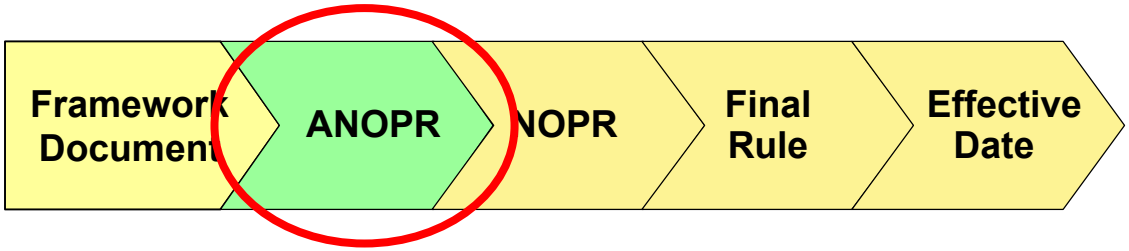
Crystal Ball Results for 10,000 iterations: 7.5 ton, 11.0 EER

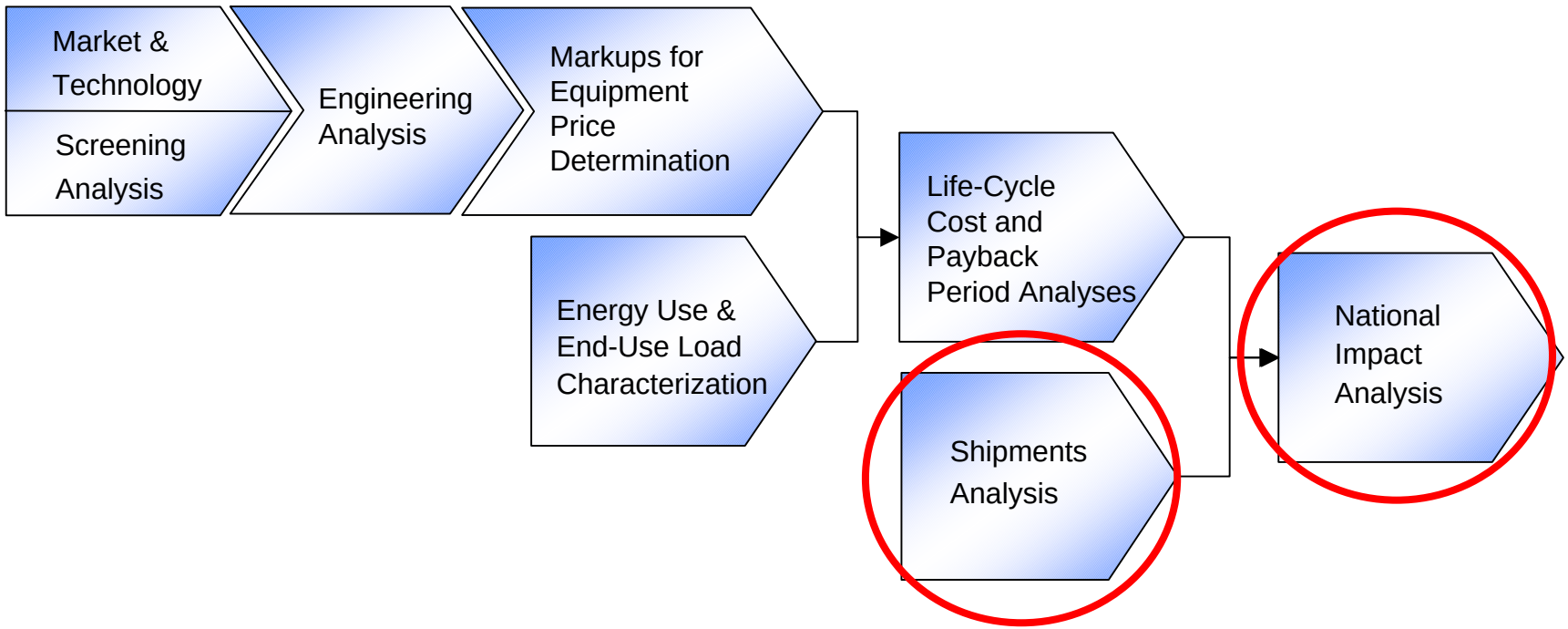


Agenda

1. Rulemaking Overview
2. Engineering Analysis
3. Building Energy Use and End-Use Load Characterization
4. Life-Cycle Cost and Payback Period Analysis
5. National Impact Analysis

ANOPR Analyses Flow Diagram





The Need for National Impact Analysis

Q. Why isn't the LCC the end of the economic analysis for the nation?

- Briefly, the LCC is performed from the perspective of commercial unitary air conditioner customers and is not the sole expression of national impacts.
- Total National Energy Savings is not estimated by LCC
- Manufacturers impacts are not estimated by LCC

The Need for National Impact Analysis (cont.)

Q. How does the national impact analysis extend the LCC results?

A. Specifically the National Impact analysis …

- Utilizes a shipments model to estimate the total stock of air-conditioning units in service in any year.
- Utilizes the LCC to estimate the cost and energy use per unit in any given year.
- Aggregates the costs and energy use, by vintage, for all years that the proposed standard is in effect.
- Accounts for energy at the source of production not the site of consumption.
- Accounts for the time value of money though discount rate.

Purpose

- Estimate national energy savings (NES) (Quads source)
- Estimate national economic impacts (national NPV)

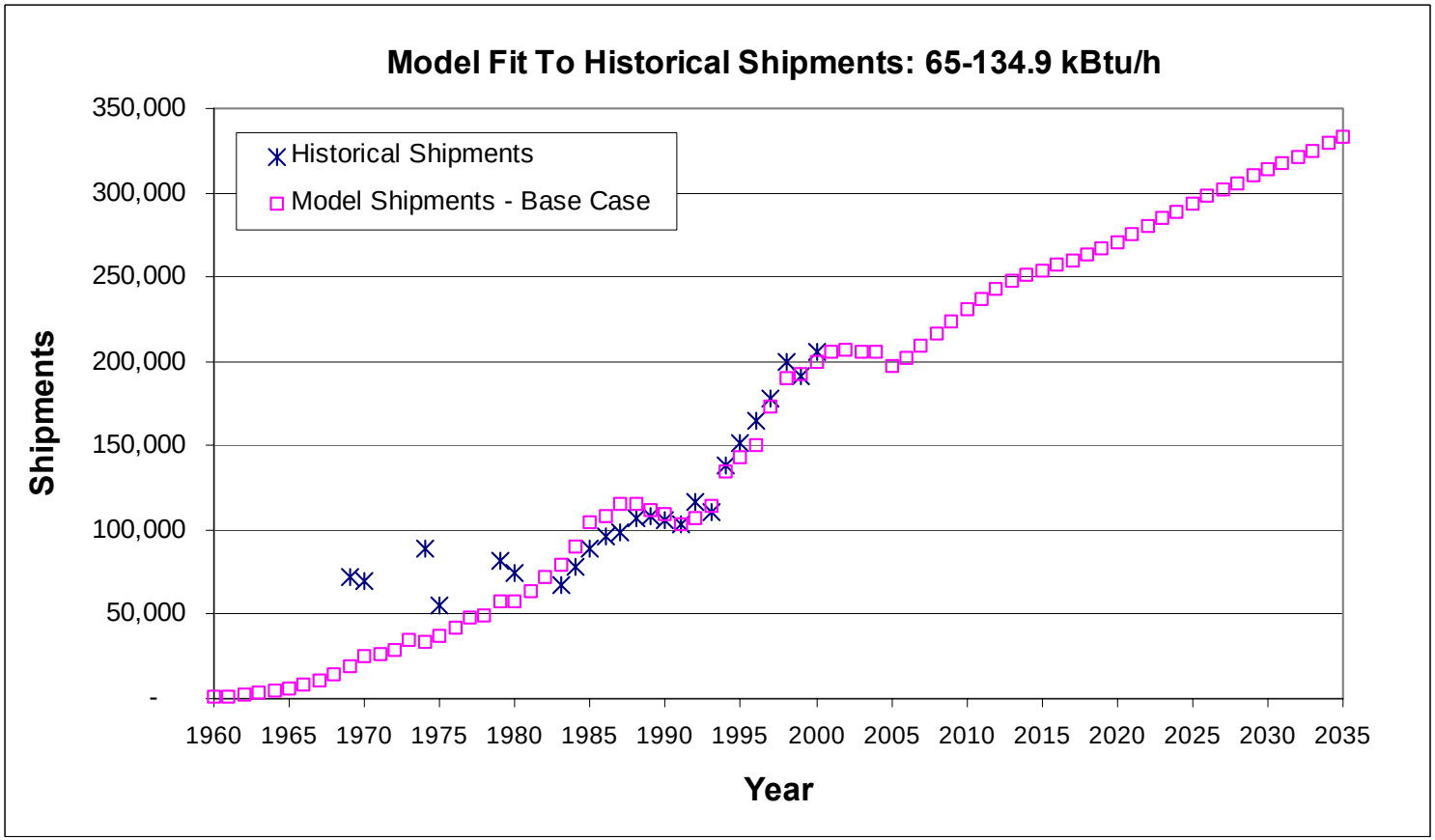
Method

- Spreadsheet-based tool
- Annual time series
- National summations with projections to the future
  - Purchases to 2035
  - Energy Impact to 2035 (source)
  - Economic impact to 2065

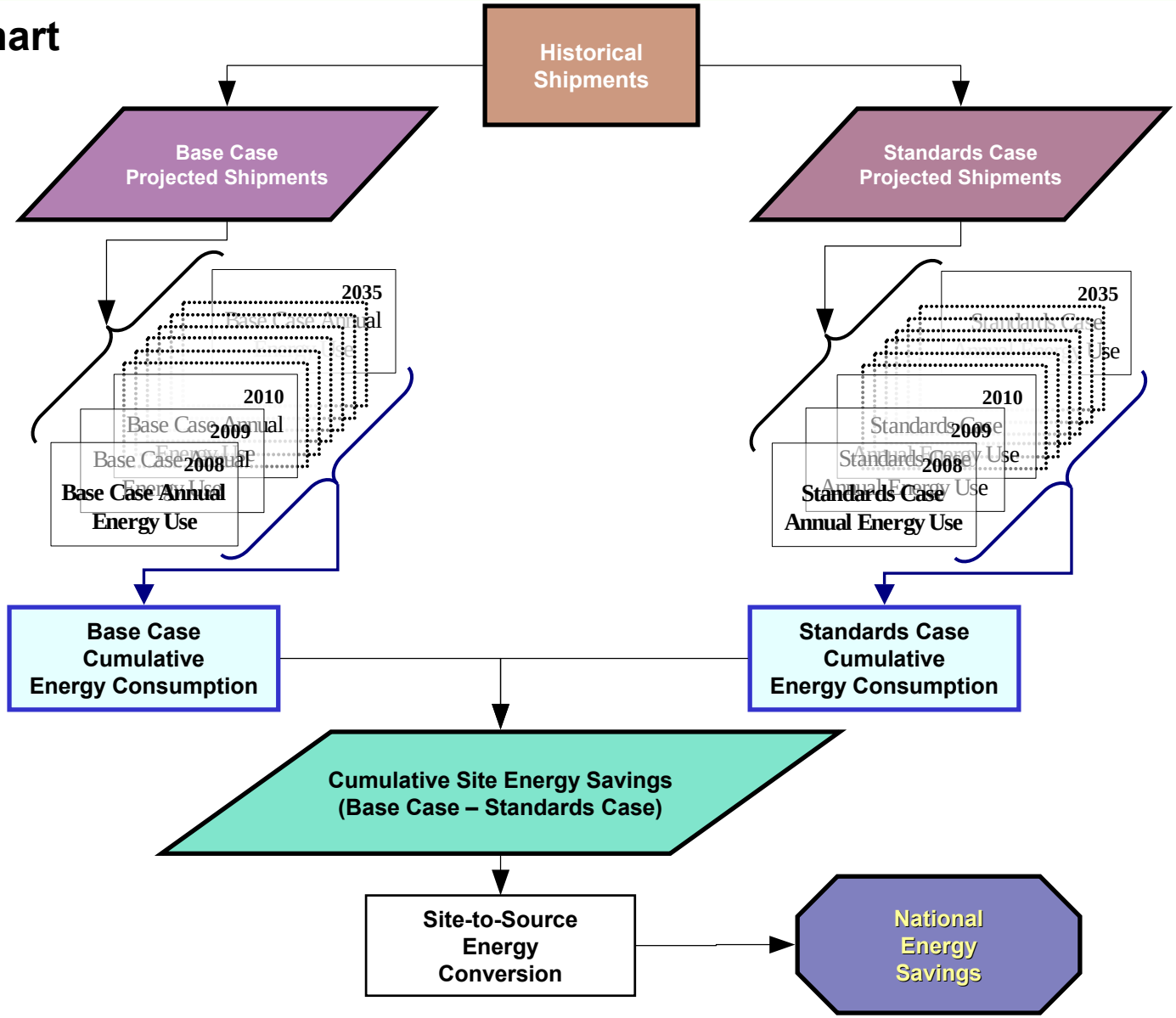
Shipments Model

- **Purpose**
  - Project the rate of new equipment shipments under a proposed standard
  - Track the CUAC stock of equipment, by vintage, over the time frame of the standard
- **The life cycle of equipment is modeled as a "birth–death" process in which equipment moves from one state to another**
  - New equipment is purchased and shipped to a building
  - Equipment operates for some number of years in a building
  - The equipment is retired
- **The model is probabilistic**
  - The change from one state to another is determined by a probability function
- **A new purchase is influenced by several factors**
  - Economics (e.g. equipment price and operating costs)
  - Equipment failures
  - New building construction rates
- **The model is calibrated to historical shipments and market saturation data**

Shipments Model: Fit to Historical Data



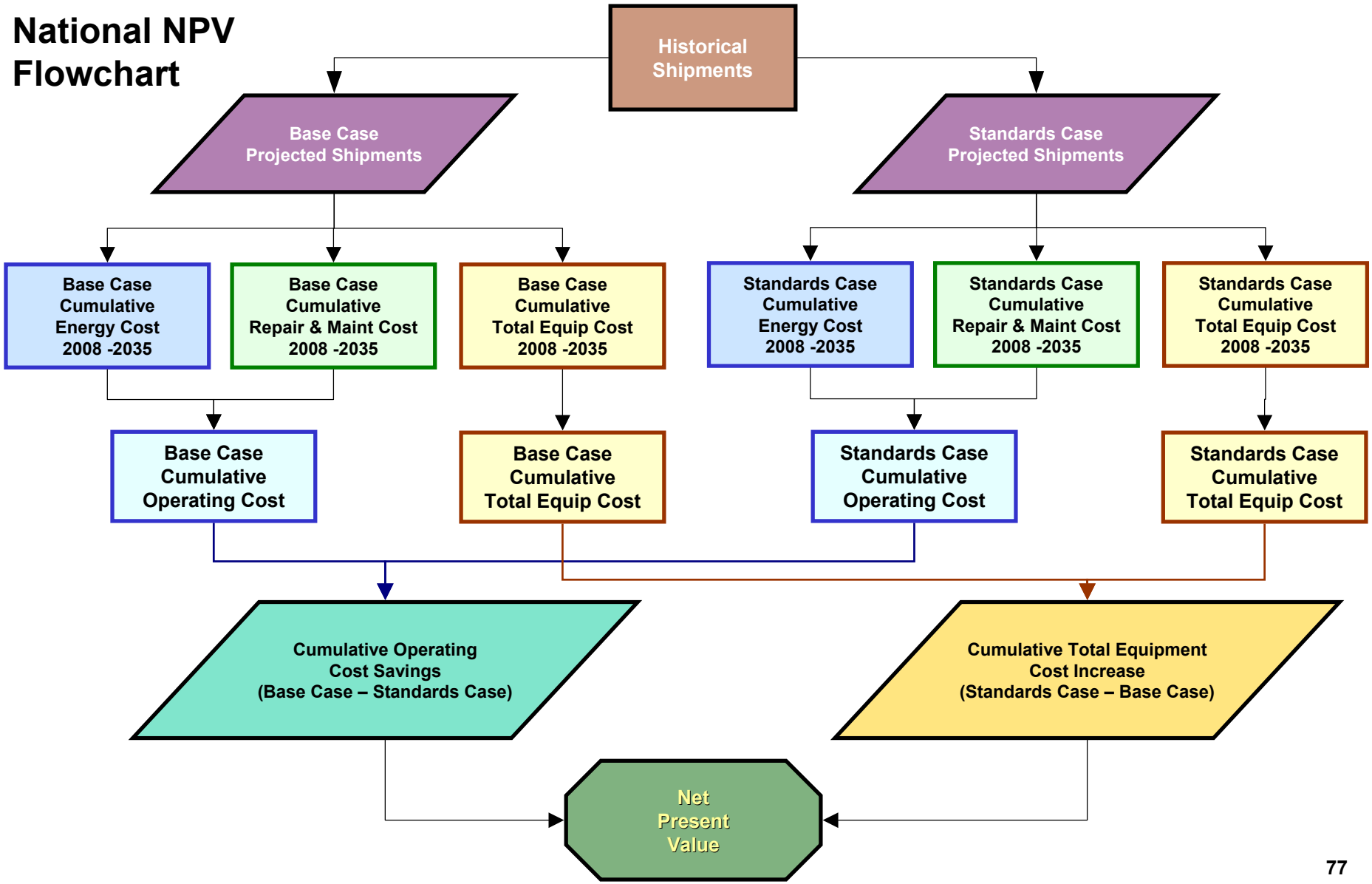
NES Flowchart



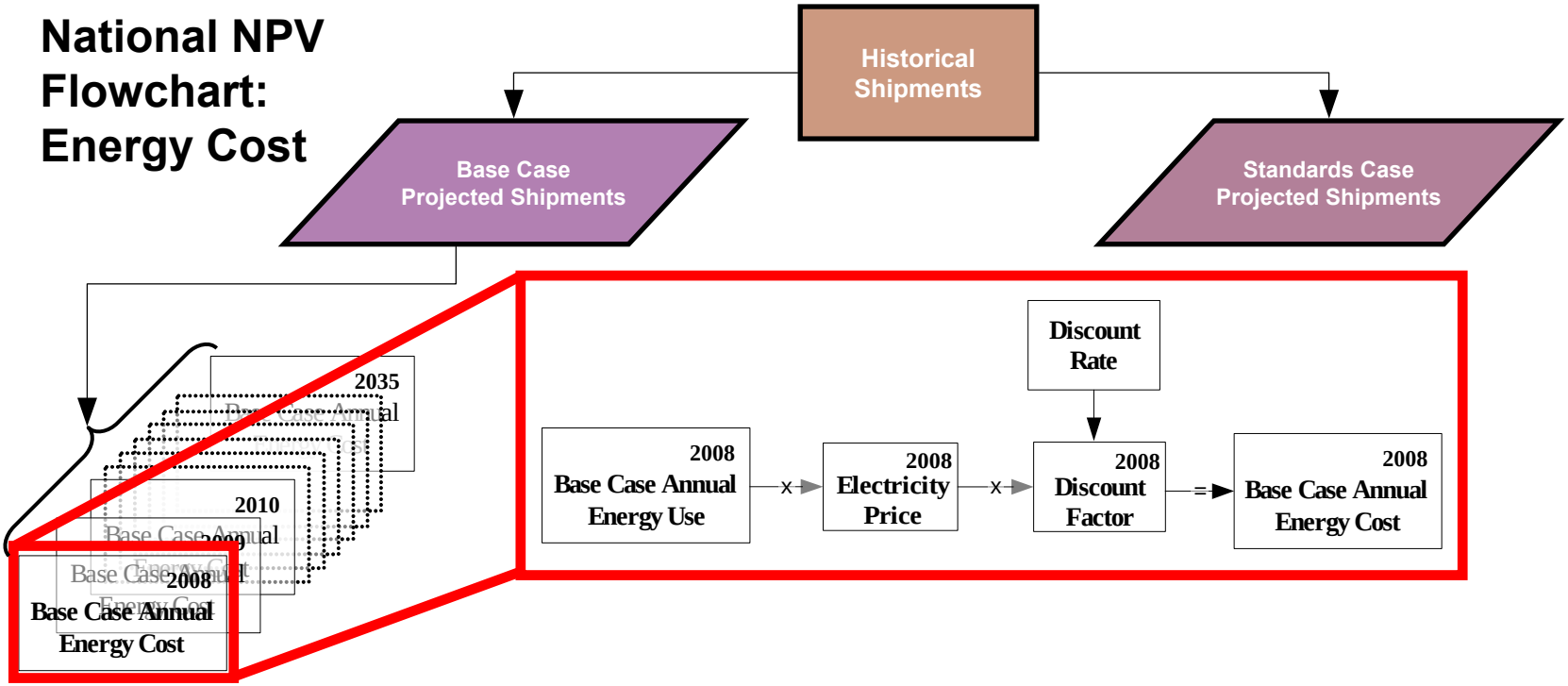
Site-to-Source Conversion

- Energy consumed at the site does not equal energy at the power plant
  - Conversion losses
  - Transmission and distribution losses
  - Generation fuel mix
  - Generation plant mix change over time
- Conversion factors provided by DOE's National Energy Modeling System (NEMS)

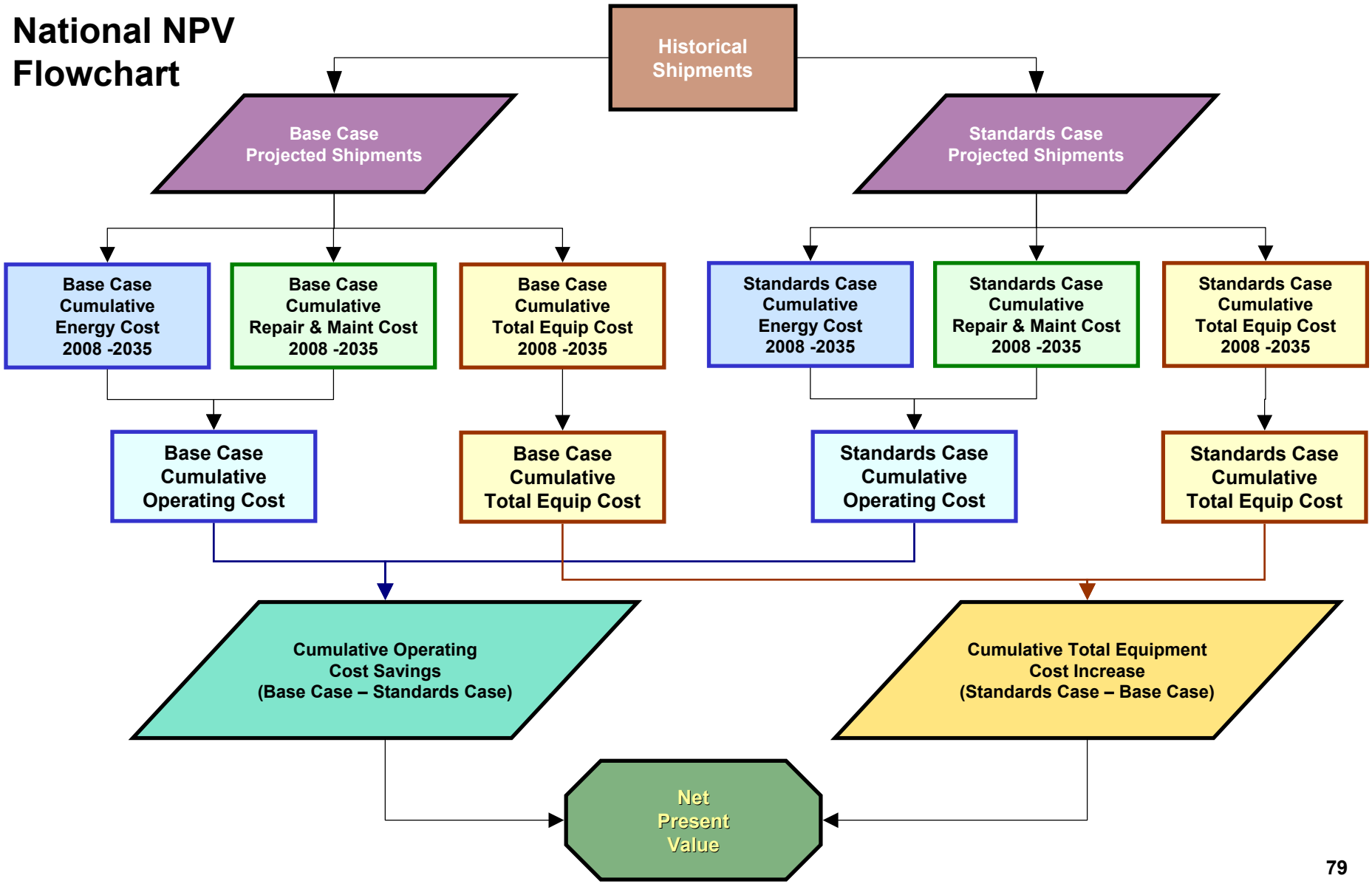
National NPV Flowchart



National NPV Flowchart: Energy Cost



National NPV Flowchart



National Impact Analysis

Summary of Results -- National Energy Savings and National Net Present Value for Commercial Unitary Air Conditioners (July 2003)

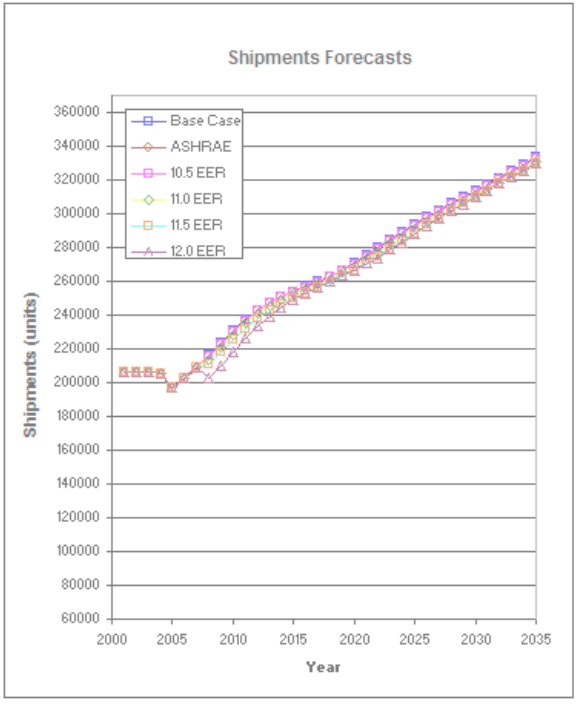
User defined inputs

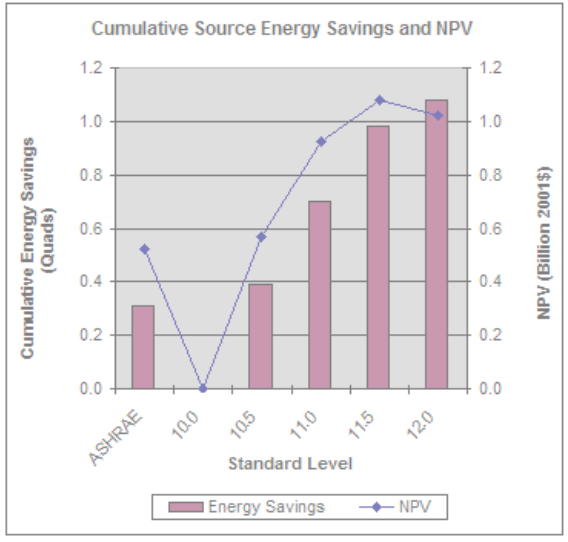
Equipment Class	65-135
Max Tech	12.0 EER
Economic Growth	Reference
Discount Rate	7.0%

		Standard Level					
	Base	ASHRAE	10.0	10.5	11.0	11.5	12.0
Cumulative Shipments (2008-2035)	7,798,287	7,783,771	-	7,774,447	7,735,264	7,672,629	7,632,366
Shipments % Change		99.81%	0.00%	99.69%	99.19%	98.39%	97.87%
Equipment Cost Difference ($billions)		$ (0.23)	$ -	$ (0.27)	$ (0.57)	$ (0.99)	$ (1.26)
Operating Cost Savings ($billions)		$ 0.75	$ -	$ 0.84	$ 1.50	$ 2.06	$ 2.28
NPV Value ($billions)		$ 0.52	$ -	$ 0.57	$ 0.93	$ 1.08	$ 1.02
Cumulative Energy Savings (Quads)		0.31	0.00	0.39	0.70	0.98	1.08

To Re-Run the model with user selected inputs, press the green button

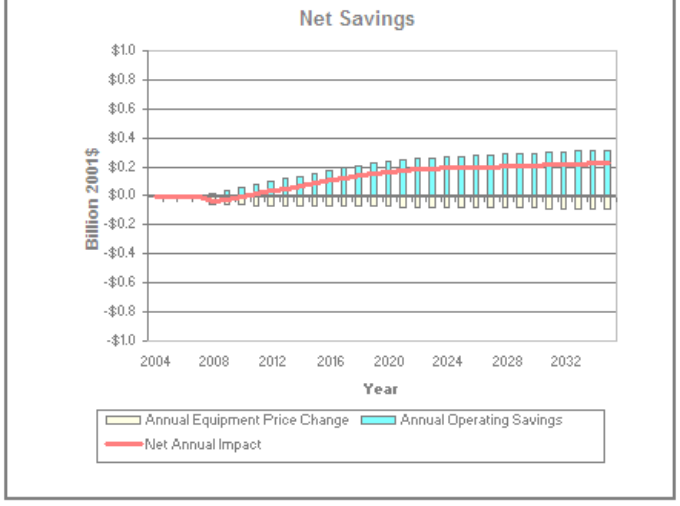
Update Values





Select Standard level to plot Annual

Std Level
11



National Impact Analysis

Summary of Results -- National Energy Savings and National Net Present Value for Commercial Unitary Air Conditioners (July 2003)

User defined inputs

Equipment Class	65-135
Max Tech	12.0 EER
Economic Growth	Reference
Discount Rate	7.0%

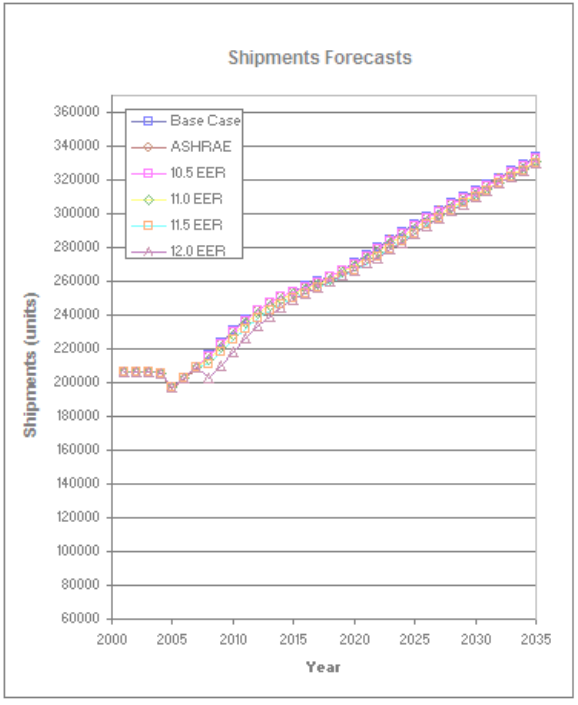
	Standard Level				
	10.0	10.5	11.0	11.5	12.0
Cumulative	-	7,774,447			7,632,366
Shipments	0.00%	99.69%			97.87%
Equipment	$ -	$ (0.27)			(1.26)
Operating					2.28
NPV Value	$ -	$ 0.57			1.02
Cumulative	0.00	0.39			1.08

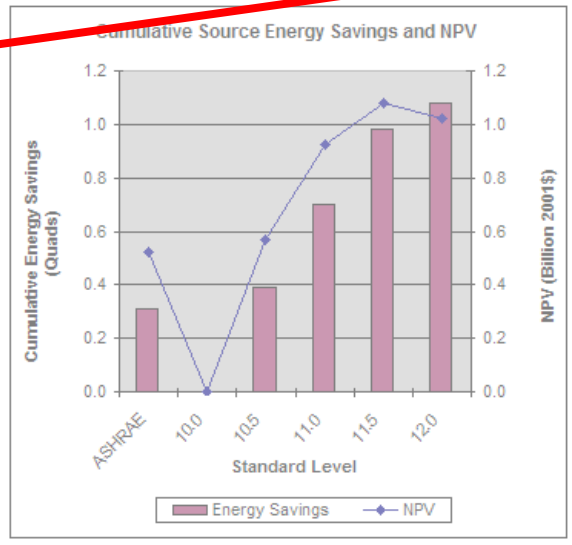
To Re-Run the model with user selected inputs, press the green button

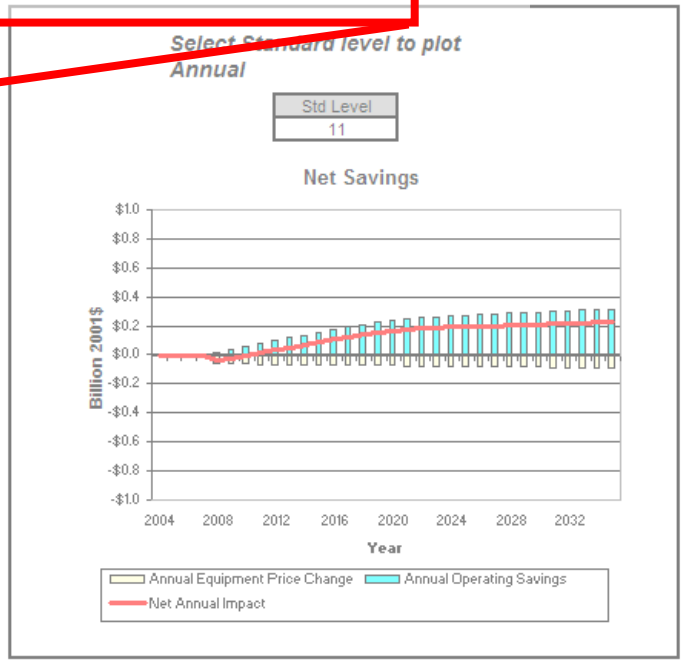
Update Values

To Re-Run the model with user selected inputs, press the green button

Update Values







National Impact Analysis

Summary of Results -- National Energy Savings and National Net Present Value for Commercial Unitary Air Conditioners (July 2003)

User defined inputs

Equipment Class	65-135
Max Tech	12.0 EER
Economic Growth	Reference
Discount Rate	7.0%

To Re-Run the model with user selected inputs press the green button

Update Values

	Base	Standard Level					
		ASHRAE	10.0	10.5	11.0	11.5	12.0
Cumulative Shipments (2008-2035)	7,798,287	7,783,771	[illegible]	[illegible]	7,735,264	7,672,629	7,632,366
Shipments % Change		99.81%	0.00%	99.69%	99.19%	98.39%	97.87%
Equipment Cost Difference ($billions)		$ (0.23)	$ -	$ (0.27)	$ (0.57)	$ (0.99)	$ (1.26)
Operating Cost Savings ($billions)		$ 0.75	$ -	$ 0.84	$ 1.50	$ 2.06	$ 2.28
NPV Value ($billions)		$ 0.52	$ -	$ 0.57	$ 0.93	$ 1.08	$ 1.02
Cumulative Energy Savings (Quads)		0.31	0.00	0.39	0.70	0.98	1.08

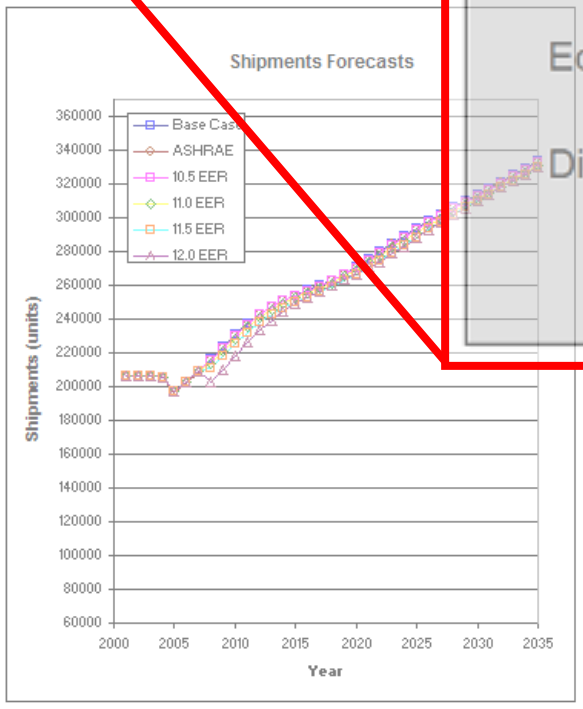
User defined inputs

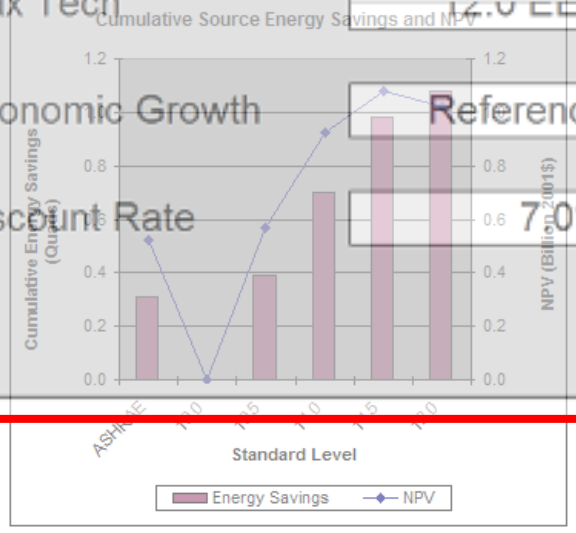
Equipment Class: 65-135 (65-135, 135-240)

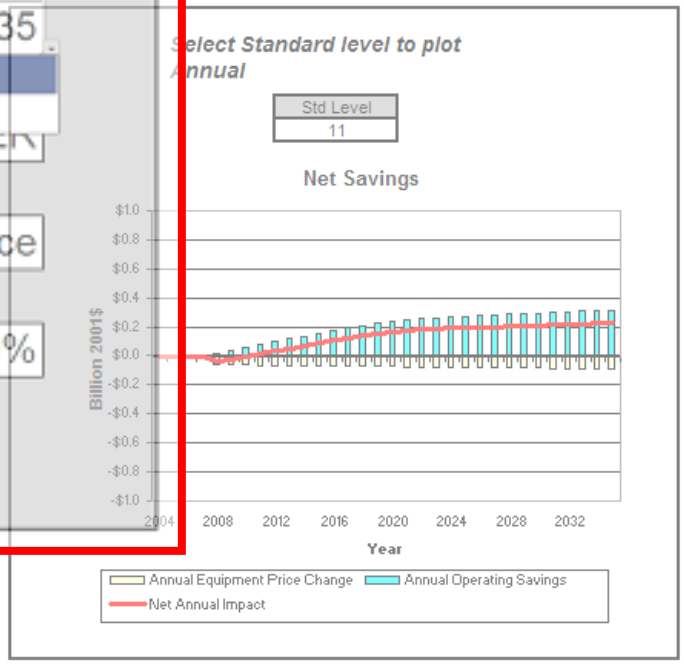
Max Tech: 12.0 EER

Economic Growth: Reference

Discount Rate: 7.0%







National Impact Analysis

Summary of Results -- National Energy Savings and National Net Present Value for Commercial Unitary Air Conditioners (July 2003)

User defined inputs

Equipment Class	65-135
Max Tech	12.0 EER
Economic Growth	Reference
Discount Rate	7.0%

To Re-Run the model with user selected inputs, press the green button

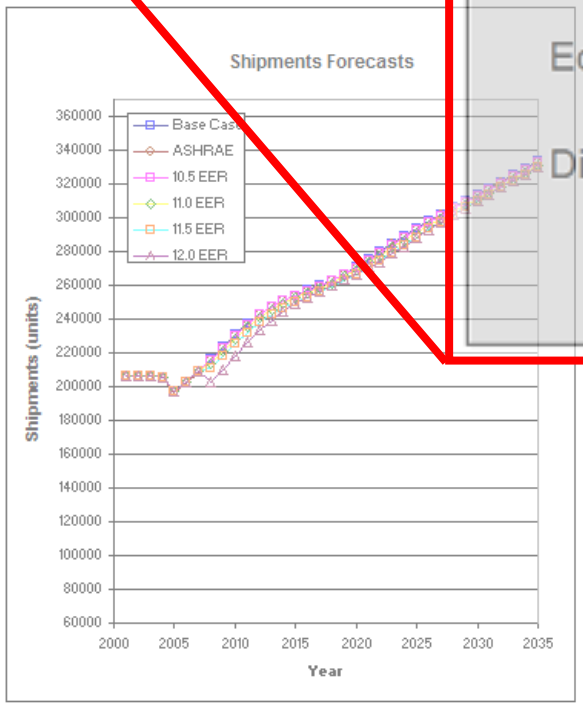
Updat Value

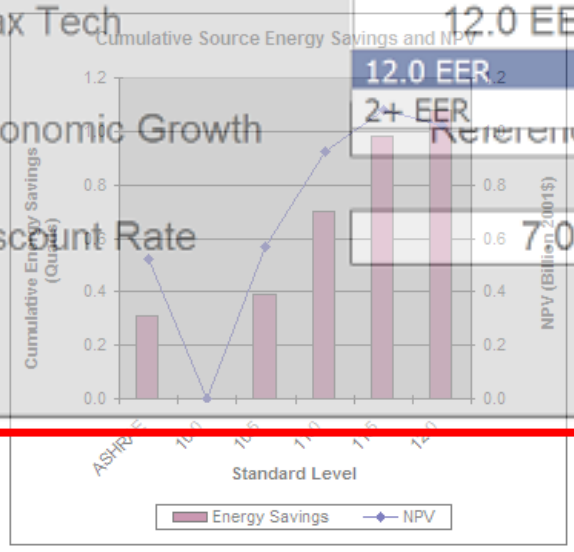
	Base	Standard Level					
		ASHRAE	10.0	10.5	11.0	11.5	12.0
Cumulative Shipments (2008-2035)	7,798,287	7,783,771	-	[illegible]	7,735,264	7,672,629	7,632,366
Shipments % Change		99.81%	0.00%	99.69%	99.19%	98.39%	97.87%
Equipment Cost Difference ($billions)		$ (0.23)	$ -	$ (0.27)	$ (0.57)	$ (0.99)	$ (1.26)
Operating Cost Savings ($billions)		$ 0.75	$ -	$ 0.84	$ 1.50	$ 2.06	$ 2.28
NPV Value ($billions)		$ 0.52	$ -	$ 0.57	$ 0.93	$ 1.08	$ 1.02
Cumulative Energy Savings (Quads)		0.31	0.00	0.39	0.70	0.98	1.08

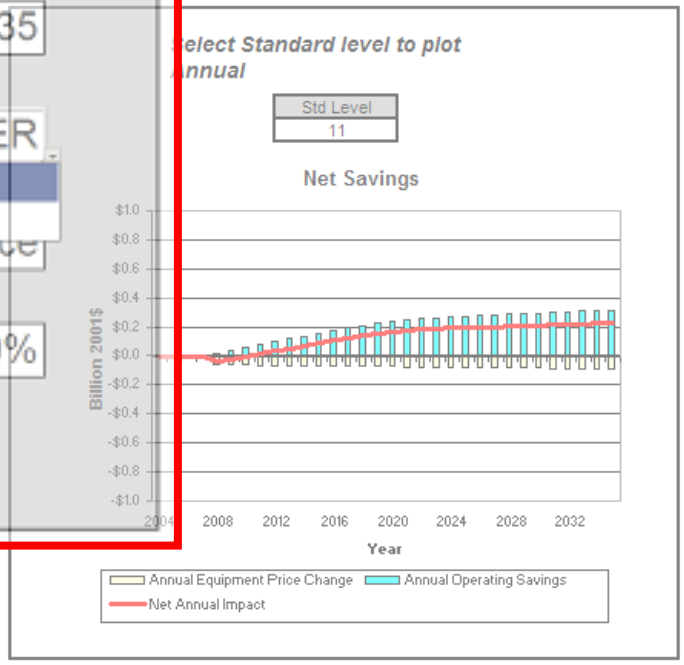
User defined inputs

Equipment Class	65-135
Max Tech	12.0 EER
Economic Growth	Reference
Discount Rate	7.0%

12.0 EER
2+ EER







National Impact Analysis

Summary of Results -- National Energy Savings and National Net Present Value for Commercial Unitary Air Conditioners (July 2003)

User defined inputs

Equipment Class	65-135
Max Tech	12.0 EER
Economic Growth	Reference
Discount Rate	7.0%

To Re-Run the model with user selected inputs, press the green button

Updat Value

	Base	Standard Level					
		ASHRAE	10.0	10.5	11.0	11.5	12.0
Cumulative Shipments (2008-2035)	7,798,287	7,783,771	-	[illegible]	7,735,264	7,672,629	7,632,366
Shipments % Change		99.81%	0.00%	99.69%	99.19%	98.39%	97.87%
Equipment Cost Difference ($billions)		$ (0.23)	$ -	$ (0.27)	$ (0.57)	$ (0.99)	$ (1.26)
Operating Cost Savings ($billions)		$ 0.75	$ -	$ 0.84	$ 1.50	$ 2.06	$ 2.28
NPV Value ($billions)		$ 0.52	$ -	$ 0.57	$ 0.93	$ 1.08	$ 1.02
Cumulative Energy Savings (Quads)		0.31	0.00	0.39	0.70	0.98	1.08

User defined inputs

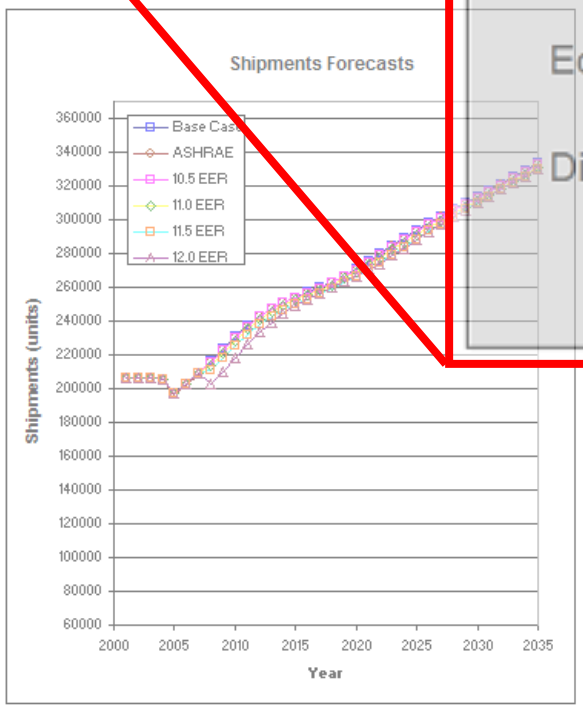
Equipment Class 65-135

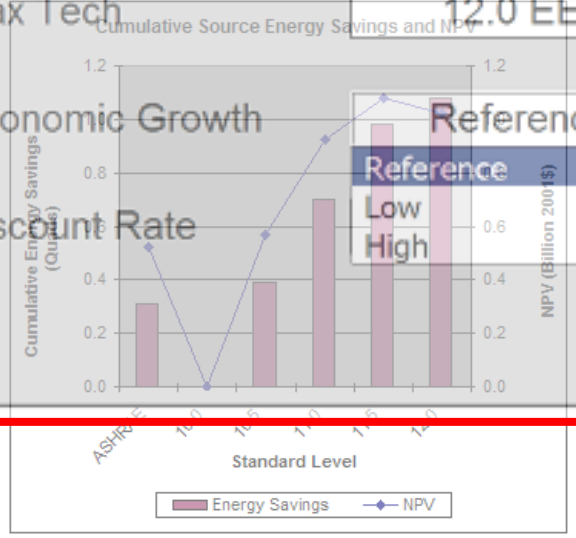
Max Tech 12.0 EER

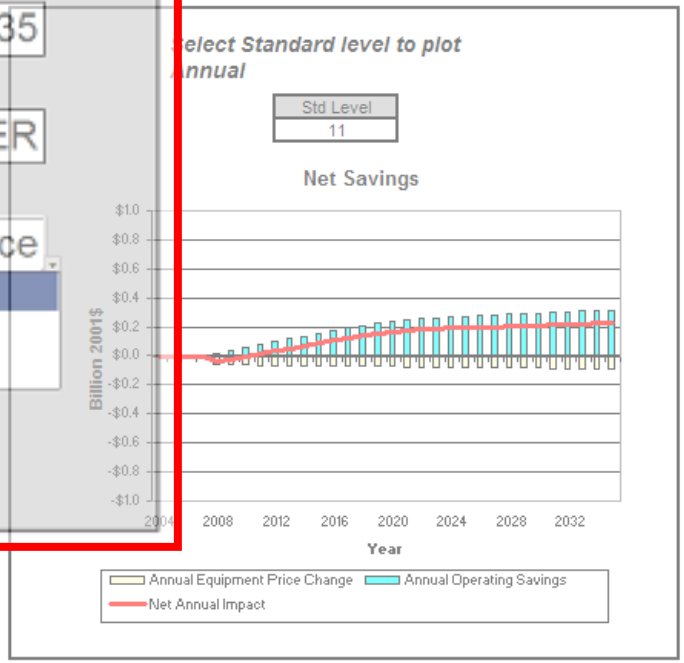
Economic Growth Reference

Discount Rate

Reference
Low
High







National Impact Analysis

Summary of Results -- National Energy Savings and National Net Present Value for Commercial Unitary Air Conditioners (July 2003)

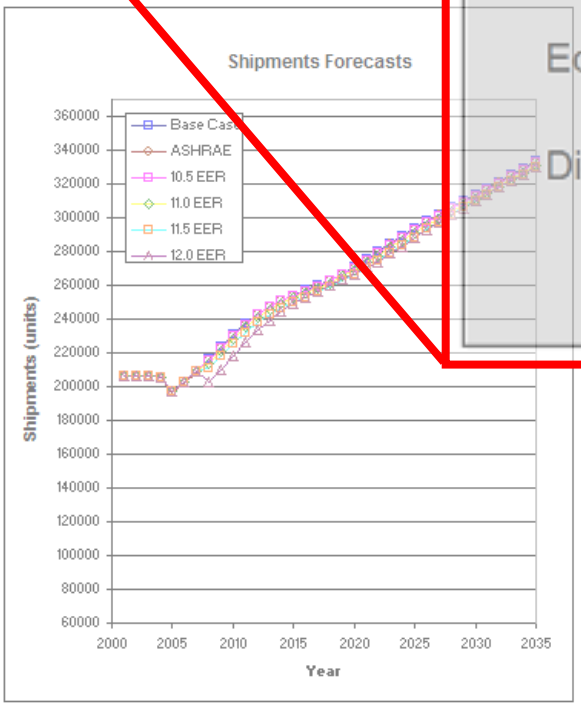
User defined inputs

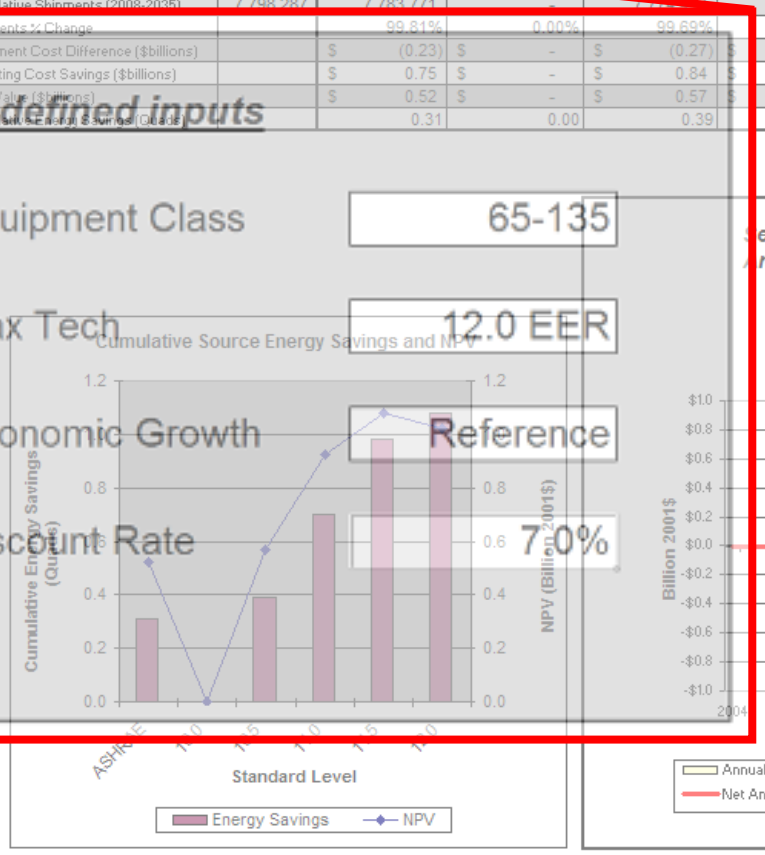
Equipment Class	65-135
Max Tech	12.0 EER
Economic Growth	Reference
Discount Rate	7.0%

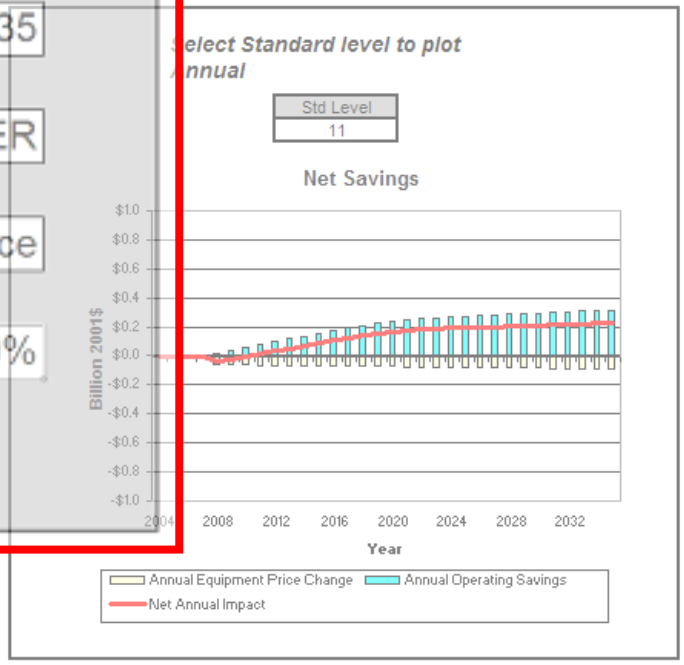
To Re-Run the model with user selected inputs, press the green button

Updat Value

	Base	Standard Level					
		ASHRAE	10.0	10.5	11.0	11.5	12.0
Cumulative Shipments (2008-2035)	7,798,287	7,783,771	-	[illegible]	7,735,264	7,672,629	7,632,366
Shipments % Change		99.81%	0.00%	99.69%	99.19%	98.39%	97.87%
Equipment Cost Difference ($billions)		$ (0.23)	$ -	$ (0.27)	$ (0.57)	$ (0.99)	$ (1.26)
Operating Cost Savings ($billions)		$ 0.75	$ -	$ 0.84	$ 1.50	$ 2.06	$ 2.28
NPV Value ($billions)		$ 0.52	$ -	$ 0.57	$ 0.93	$ 1.08	$ 1.02
Cumulative Energy Savings (Quads)		0.31	0.00	0.39	0.70	0.98	1.08







National Impact Analysis

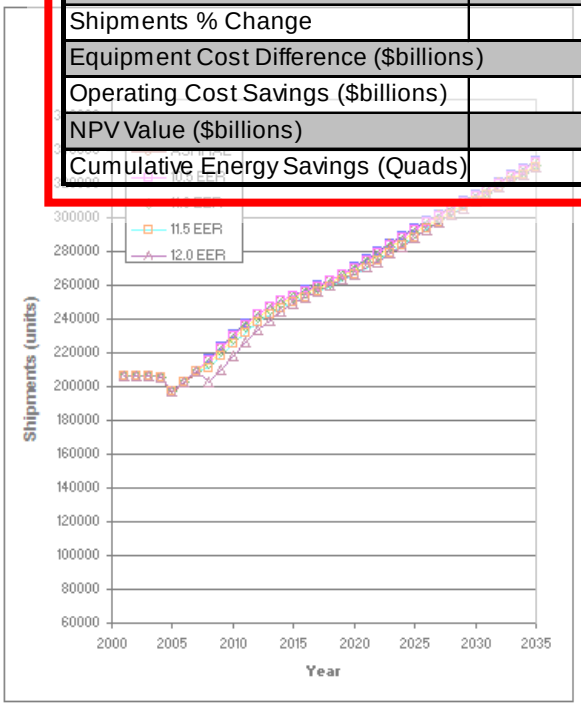
Summary of Results -- National Energy Savings and National Net Present Value for Commercial Unitary Air Conditioners (July 2003)

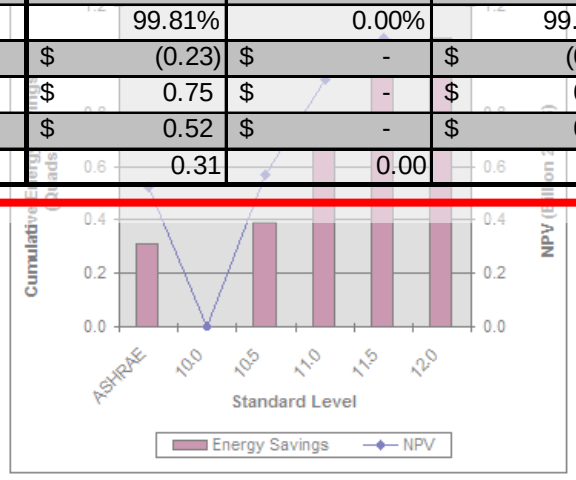
User defined inputs

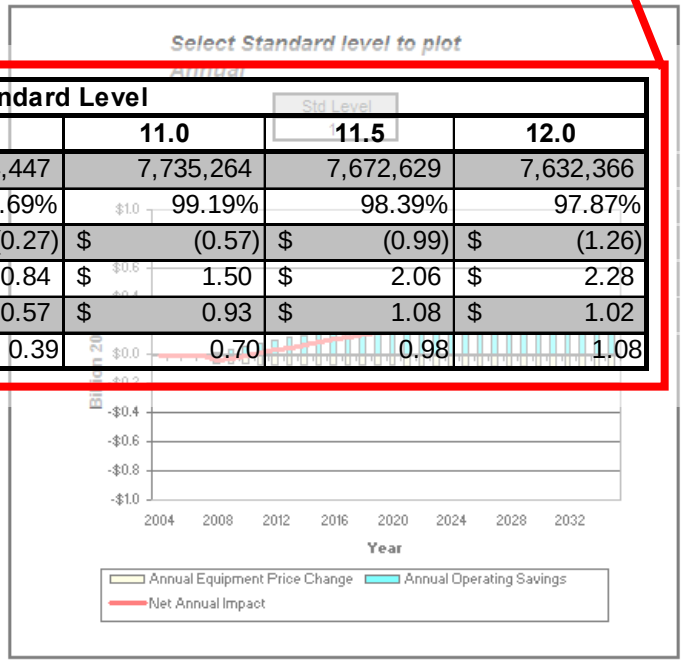
Equipment Class	65-135
Max Tech	12.0 EER
Economic Growth	Reference
Discount Rate	7.0%

		Standard Level					
	Base	ASHRAE	10.0	10.5	11.0	11.5	12.0
Cumulative Shipments (2008-2035)	7,798,287	7,783,771	-	7,774,447	7,735,264	7,672,629	7,632,366
Shipments % Change		99.81%	0.00%	99.69%	99.19%	98.39%	97.87%
Equipment Cost Difference ($billions)		$ (0.23)	$ -	$ (0.27)	$ (0.57)	$ (0.99)	$ (1.26)
Operating Cost Savings ($billions)		$ 0.75	$ -	$ 0.84	$ 1.50	$ 2.06	$ 2.28
NPV Value ($billions)		$ 0.52	$ -	$ 0.57	$ 0.93	$ 1.08	$ 1.02
Cumulative Energy Savings (Quads)		0.31	0.00	0.39	0.70	0.98	1.08

		Standard Level					
	Base	ASHRAE	10.0	10.5	11.0	11.5	12.0
Cumulative Shipments (2008-2035)	7,798,287	7,783,771	-	7,774,447	7,735,264	7,672,629	7,632,366
Shipments % Change		99.81%	0.00%	99.69%	99.19%	98.39%	97.87%
Equipment Cost Difference ($billions)		$ (0.23)	$ -	$ (0.27)	$ (0.57)	$ (0.99)	$ (1.26)
Operating Cost Savings ($billions)		$ 0.75	$ -	$ 0.84	$ 1.50	$ 2.06	$ 2.28
NPV Value ($billions)		$ 0.52	$ -	$ 0.57	$ 0.93	$ 1.08	$ 1.02
Cumulative Energy Savings (Quads)		0.31	0.00	0.39	0.70	0.98	1.08







National Impact Analysis

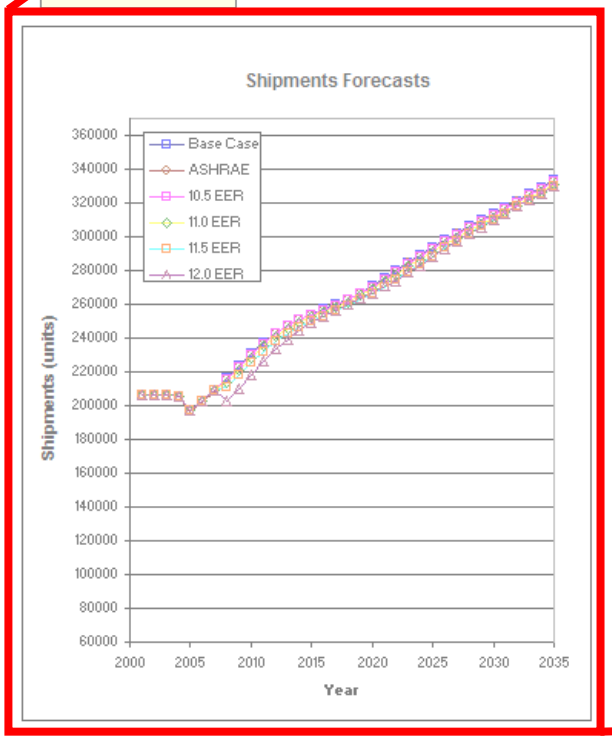
Summary of Results -- National Energy Savings and National Net Present Value for Commercial Unitary Air Conditioners (July 2003)

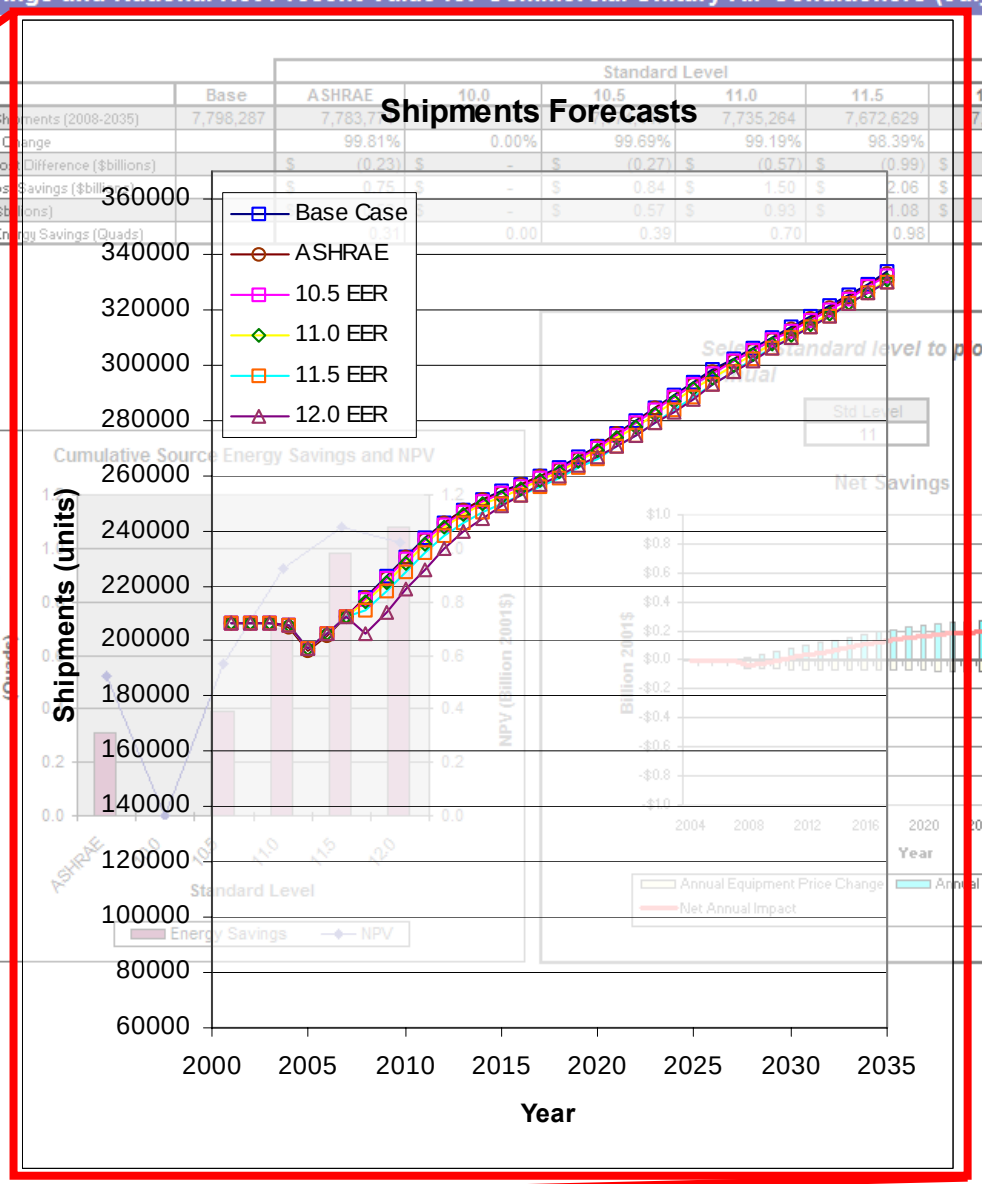
User defined inputs

Equipment Class	65-135
Max Tech	12.0 EER
Economic Growth	Reference
Discount Rate	7.0%

To Re-Run the model with user selected inputs, press the green button → Update Values

	Base	Standard Level					
		ASHRAE	10.0	10.5	11.0	11.5	12.0
Cumulative Shipments (2008-2035)	7,798,287	7,783,77[illegible]			7,735,264	7,672,629	7,632,366
Shipments % Change		99.81%	0.00%	99.69%	99.19%	98.39%	97.87%
Equipment Cost Difference ($billions)		$ (0.23)	$ -	$ (0.27)	$ (0.57)	$ (0.99)	$ (1.26)
Operating Cost Savings ($billions)		$ 0.75	$ -	$ 0.84	$ 1.50	$ 2.06	$ 2.28
NPV Value ($billions)		$ [illegible]	$ -	$ 0.57	$ 0.93	$ 1.08	$ 1.02
Cumulative Energy Savings (Quads)		[illegible]	0.00	0.39	0.70	0.98	1.08





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

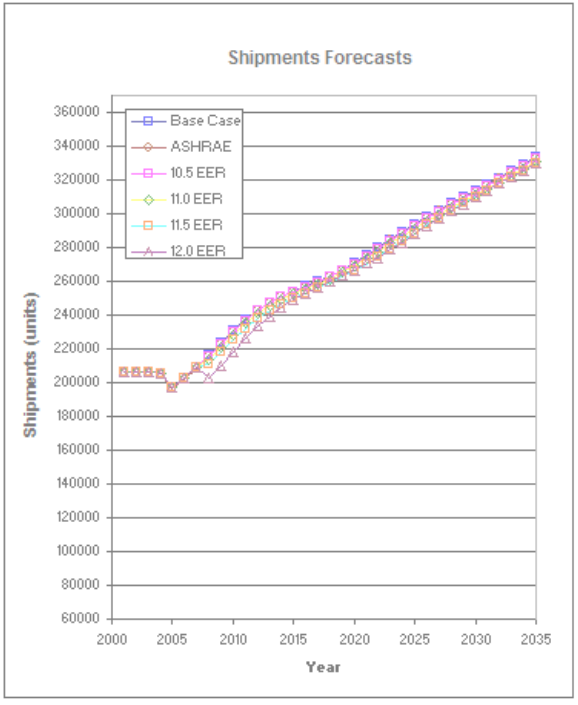
Summary of Results -- National Energy Savings and National Net Present Value for Commercial Unitary Air Conditioners (July 2003)

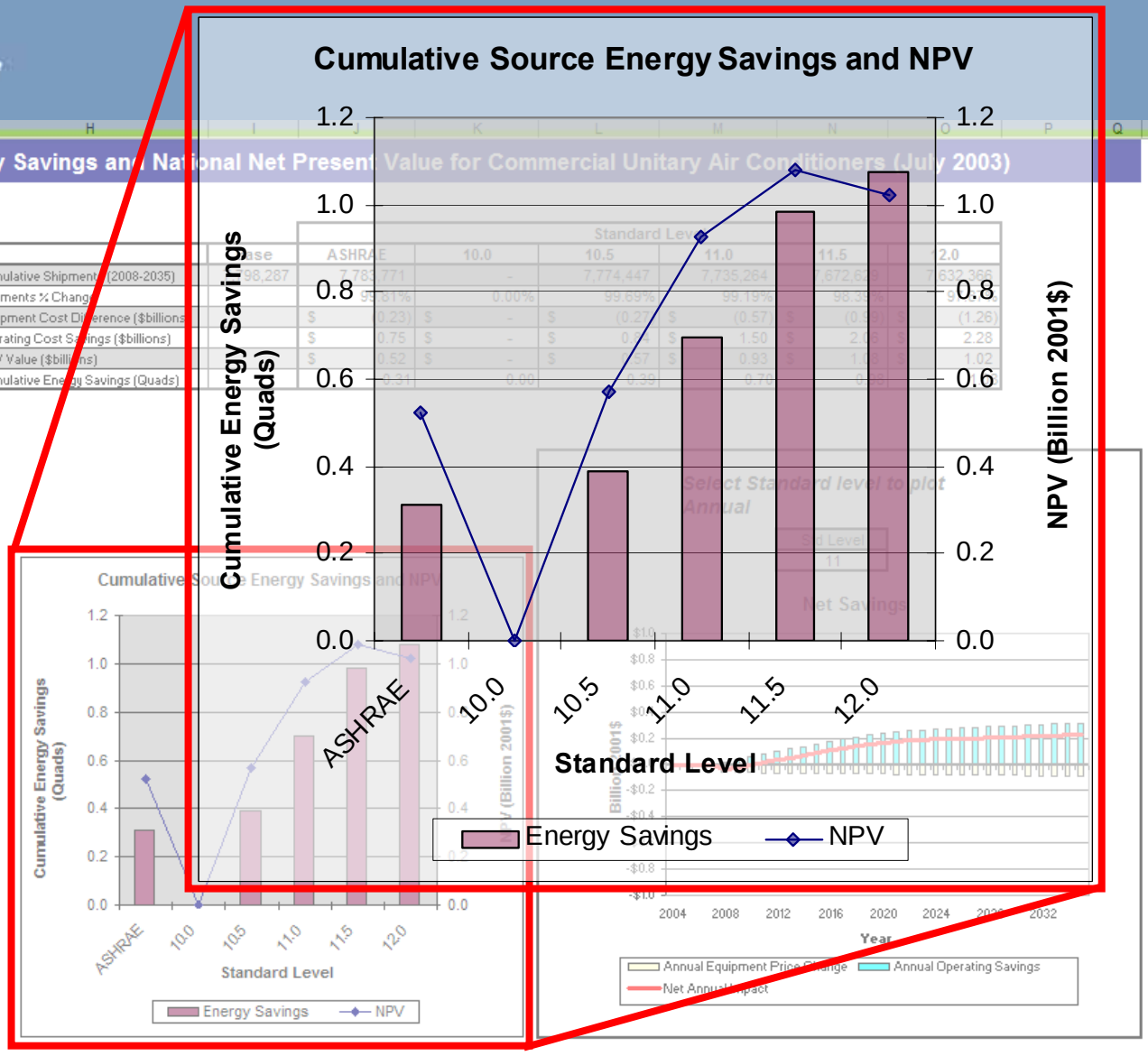
User defined inputs

Equipment Class	65-135
Max Tech	12.0 EER
Economic Growth	Reference
Discount Rate	7.0%

To Re-Run the model with user selected inputs, press the green button → Update Values

	Base	ASHRAE	10.0	10.5	11.0	11.5	12.0
Cumulative Shipments (2008-2035)	98,287	7,783,771	-	7,774,447	7,735,264	7,672,629	7,632,366
Shipments % Change		99.81%	0.00%	99.69%	99.19%	98.39%	[illegible]
Equipment Cost Difference ($billions)		$ (0.23)	$ -	$ (0.27)	$ (0.57)	$ (0.99)	$ (1.26)
Operating Cost Savings ($billions)		$ 0.75	$ -	$ 0.24	$ 1.50	$ 2.06	$ 2.28
NPV Value ($billions)		$ 0.52	$ -	$ 0.57	$ 0.93	$ 1.08	$ 1.02
Cumulative Energy Savings (Quads)		0.31	0.00	0.39	0.70	0.98	[illegible]





National Impact Analysis

Summary of Results -- National Energy Savings and National Net Present Value for Commercial Unitary Air Conditioners (July 2003)

User defined inputs

Equipment Class	65-135
Max Tech	12.0 EER
Economic Growth	Reference
Discount Rate	7.0%

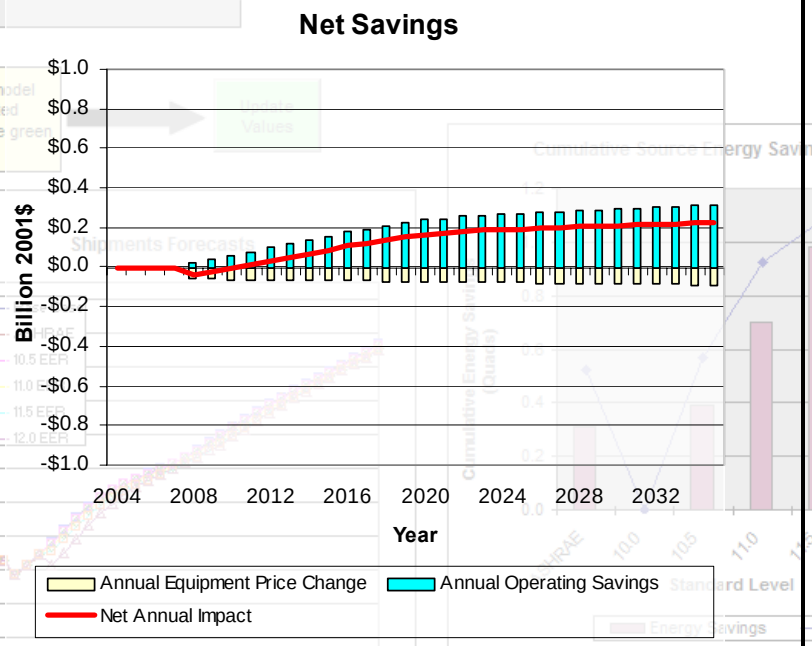
To Re-Run the model with user selected inputs, press the green button

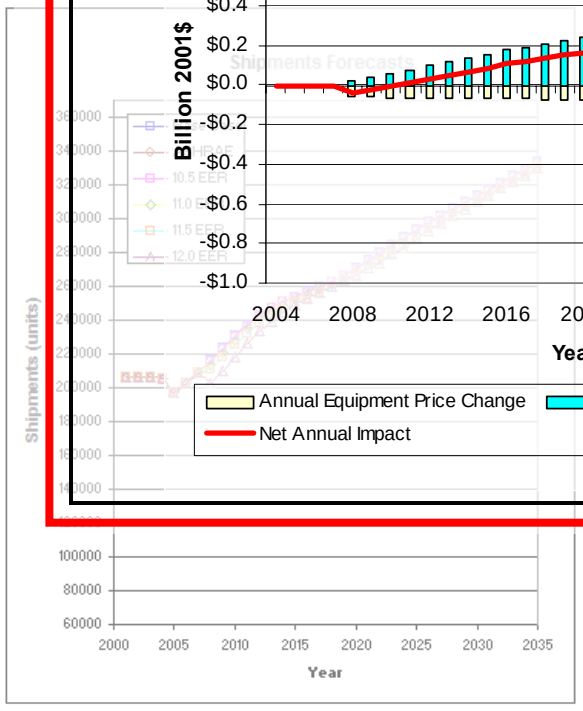
Update Values

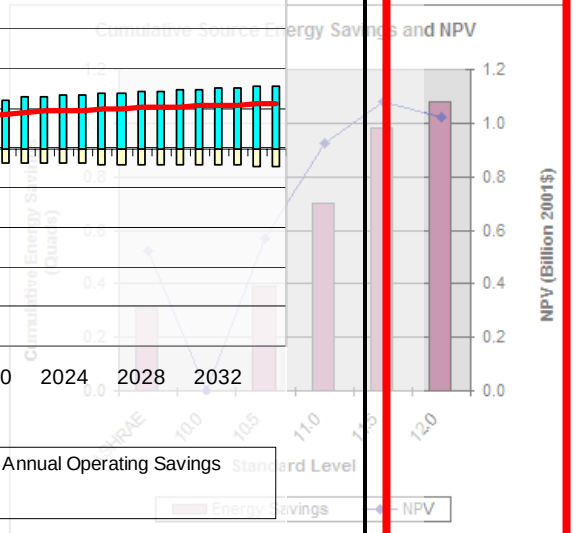
	Base	ASHRAE	Standard Level 10.0	10.5	11.0	11.5	12.0
Cumulative Shipments (2008-2035)	7,798,287	7,783,771		7,774,447	7,735,264	7,672,629	7,632,366
		99.81%	0.00%	99.69%	99.19%	98.39%	97.87%
Equipment Cost Difference ($billions)		$ (0.23)	$ -	$ (0.27)	$ (0.57)	$ (0.99)	$ (1.26)
Operating Cost Savings ($billions)		$ 0.75	$ -	$ 0.84	$ 1.50	$ 2.06	$ 2.28
NPV Value ($billions)		$ 0.52	$ -	$ 0.57	$ 0.93	$ 1.08	$ 1.02
Cumulative Energy Savings (Quads)		0.31	0.00	0.39	0.70	0.98	1.08

Select Standard level to plot Annual Non-Discounted Net Impacts trend.

Std Level
11

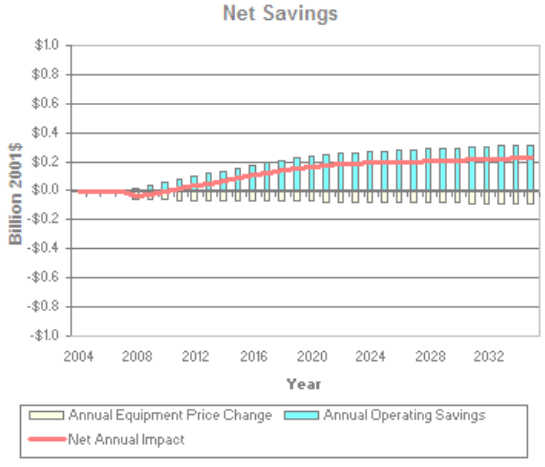






Select Standard level to plot Annual

Std Level
11



National Impact Analysis

Summary of Results -- National Energy Savings and National Net Present Value for Commercial Unitary Air Conditioners (July 2003)

Select Standard level to plot Annual Non-Discounted Net Impacts trend.

User defined inputs

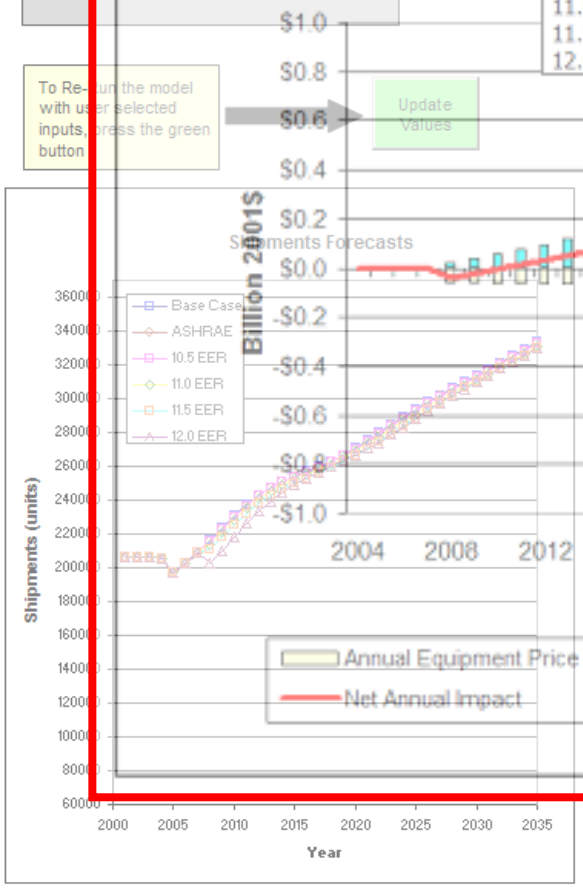
Equipment Class	65-135
Max Tech	12.0 EER
Economic Growth	Reference
Discount Rate	7.0%

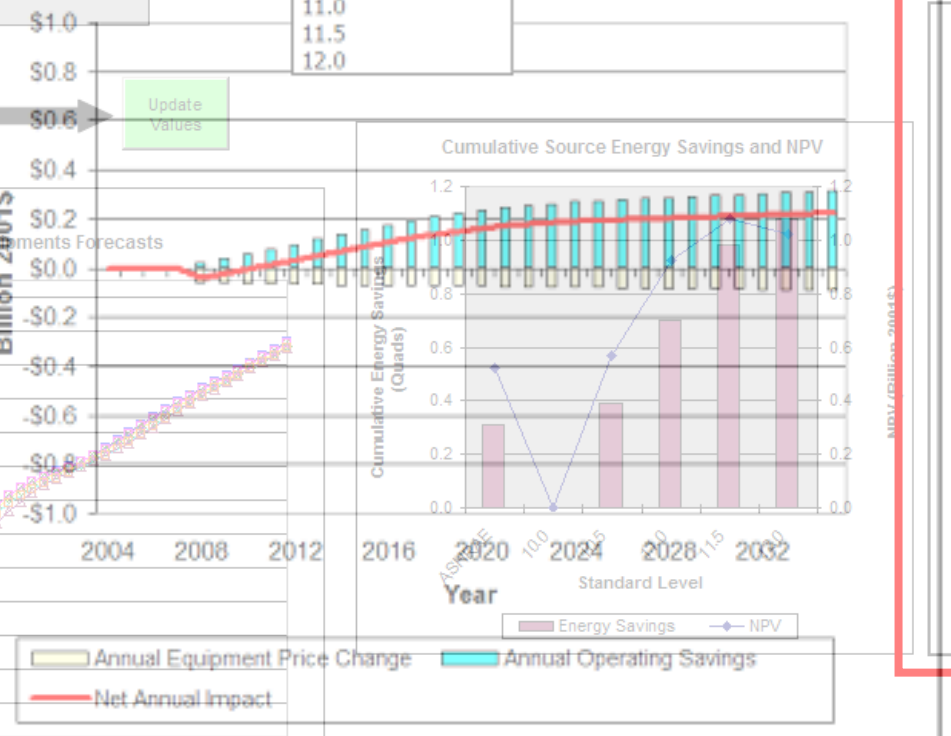
To Re-run the model with user selected inputs, press the green button

Update Values

Std Level
ASHRAE
10.0
10.5
11.0
11.5
12.0

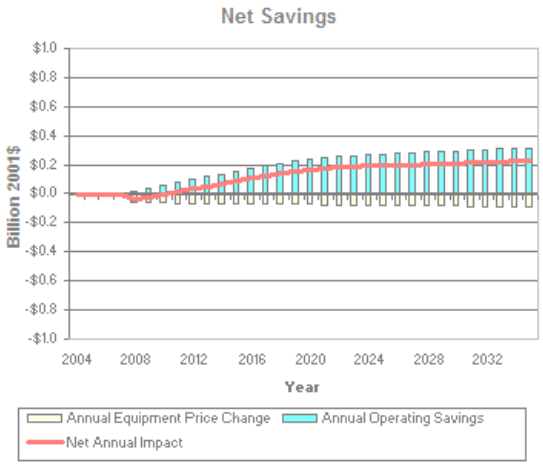
		Standard Level						
		ASHRAE	10.0	10.5	11.0	11.5	12.0
Cumulative Shipments (2008-2035)	7,798,287	7,783,771	-	7,774,447	7,735,264	7,672,629	7,632,366
Shipments % Change		99.81%	0.00%	99.69%	99.19%	98.39%	97.87%
Equipment Cost Difference ($billions)		$ (0.23)	$ -	$ (0.27)	$ (0.57)	$ (0.99)	$ (1.26)
Operating Cost Savings ($billions)		$ 0.75	$ -	$ 0.84	$ 1.50	$ 2.06	$ 2.28
NPV Value ($billions)		$ 0.52	$ -	$ 0.57	$ 0.93	$ 1.08	$ 1.02
Cumulative Energy Savings (Quads)		0.31	0.00	0.39	0.70	0.98	1.08





Select Standard level to plot Annual

Std Level
11



Thank you, and for more information …

- **Website -** http://www.eere.energy.gov/buildings/appliance_standards/commercial/ac_hp.html
- **Public Meeting -** Thursday, September 30, 2004, from 9 a.m. to 5 p.m. EDT, in Washington, DC.
  - If you would like to participate in the public meeting, please contact Ms. Brenda.Edwards-Jones@ee.doe.gov by e-mail or by telephone at (202) 586-2945.
- **Comment Submission:**
  - E-mail: commercialairconditioner.anopr@ee.doe.gov
  - Mail: Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Mail Stop EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121.
  - Courier: Ms. Brenda Edwards-Jones, U.S. Department of Energy, Building Technologies Program, Room 1J-018, 1000 Independence Avenue, SW, Washington, DC, 20585-0121. Telephone: (202) 586-2945.
  - All comments (electronic and hardcopy) should clearly identify the Docket number, which is EE-RM/STD-01-375. The deadline for submitting comments is November 12, 2004.
- **Contact -** Mr. James Raba, telephone: (202) 586-8654, or e-mail: jim.raba@ee.doe.gov