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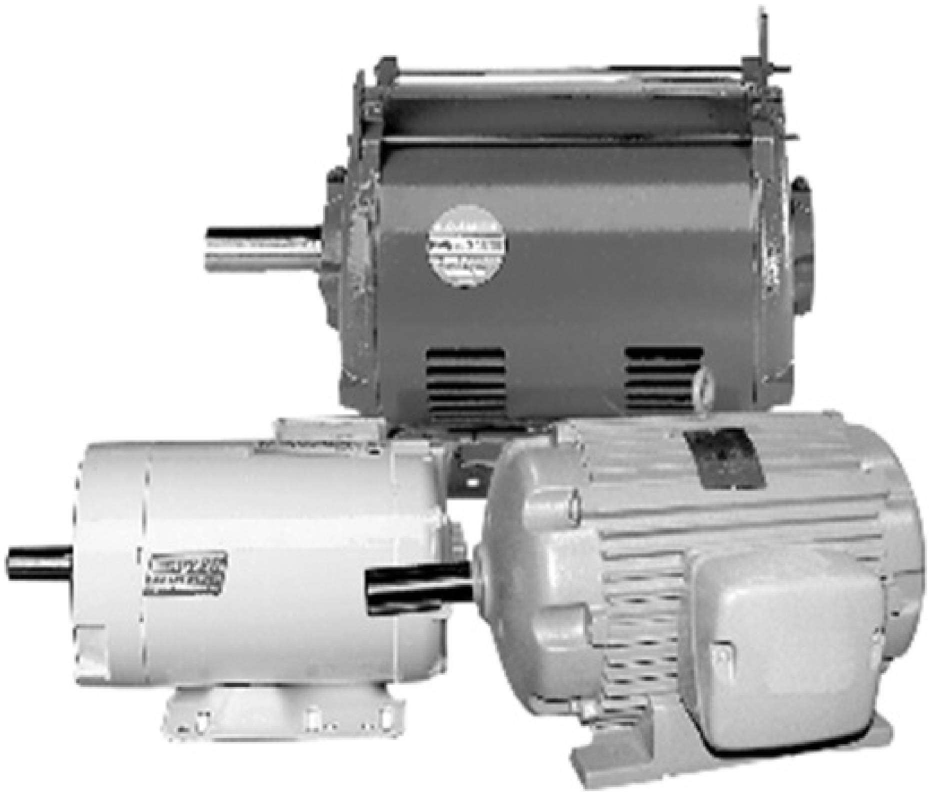

Preliminary Analysis Public Meeting on Energy Conservation Standards for Electric Motors

James Raba

Department of Energy
Energy Efficiency & Renewable Energy
ElecMotors-2010-STD-0027@ee.doe.gov

August 21, 2012

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 speak 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

Morning Agenda

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9:00 – 9:30 am	Welcome, Introductions, Agenda Review
9:30 – 10:00 am	Purpose of Public Meeting, Rulemaking Overview, and Opening Statements
10:00 – 10:45 am	Market and Technology Assessment and Screening Analysis
10:45 – 11:00 am	Break
11:00 – 11:45 am	Engineering Analysis
11:45 – 12:30 pm	Markups, Energy Use Characterization, and Life-Cycle Cost and Payback Period Analysis

Afternoon Agenda

1:30 – 2:15 pm	Life-Cycle Cost and Payback Period Analysis (continued)
2:15 – 2:45 pm	National Impacts Analysis
2:45 – 3:00 pm	Break
3:00 – 3:30 pm	Preliminary Manufacturer Impact Analysis
3:30 – 3:45 pm	Next Steps
3:45 – 4:00 pm	Closing Remarks

Public Meeting Agenda

1. **Overview**
2. **Test Procedure**
3. **Market & Tech; Screening; Engineering**
4. **Markups; Energy Use Characterization**
5. **Life-Cycle Cost and Payback Period Analysis**
6. **National Impact Analysis**
7. **Preliminary MIA; NOPR Analyses**

Purpose of the Preliminary Analysis Public Meeting

- Present the procedural and analytical approaches to evaluate energy conservation standards for electric motors.
- Provide a forum for public discussion of rulemaking issues.
- Encourage interested parties to submit data, information, and written comments.
- Inform interested parties and facilitate the rulemaking process.

Issue Box The Department welcomes comments, data, and information regarding electric motors energy conservation standards. Throughout this presentation, specific issues will be raised for discussion on slides such as this, ***with identifying numbers corresponding to issues for comment from section three in the executive summary of the preliminary TSD.*** Nonetheless, comments concerning any part of the document or presentation are welcome.

Feedback Is Requested

- In all correspondence, please refer to the Electric Motors rulemaking by:
  - Electric Motors Rulemaking,
  - Docket Number EERE–2010–BT–STD–0027, and
  - Regulatory Identification Number (RIN) 1904–AC28

- **Email**: ElecMotors-2010-STD-0027@ee.doe.gov

Postal:
Ms. Brenda Edwards
U.S. Department of Energy
Building Technologies Program, Mailstop EE-2J
1000 Independence Avenue, SW
Washington, DC 20585-0121

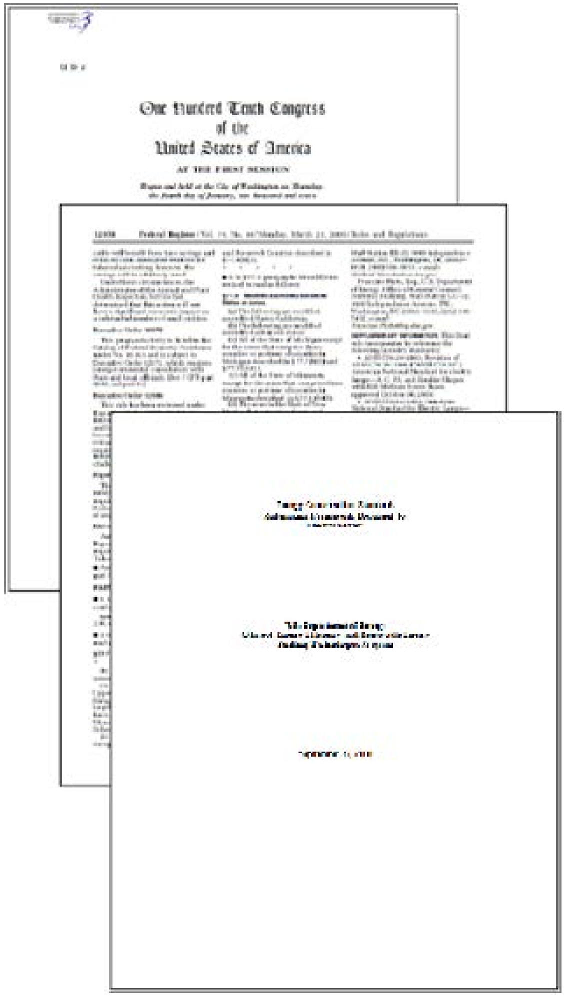
Hand Delivery/Courier:
Ms. Brenda Edwards
U.S. Department of Energy
Building Technologies Program, Suite 600
950 L'Enfant Plaza, SW
Washington, DC 20024
Tel: 202-586-2945

- **Comment period closes: September 7, 2012**

Regulatory History

- The Energy Policy and Conservation Act (EPCA) of 1975 (Public Law 94-163)
  – Established the "Energy Conservation Program for Consumer Products Other Than Automobiles."
  – Subsequent amendments to EPCA gave DOE the authority to regulate the energy efficiency of several types of equipment, including electric motors.

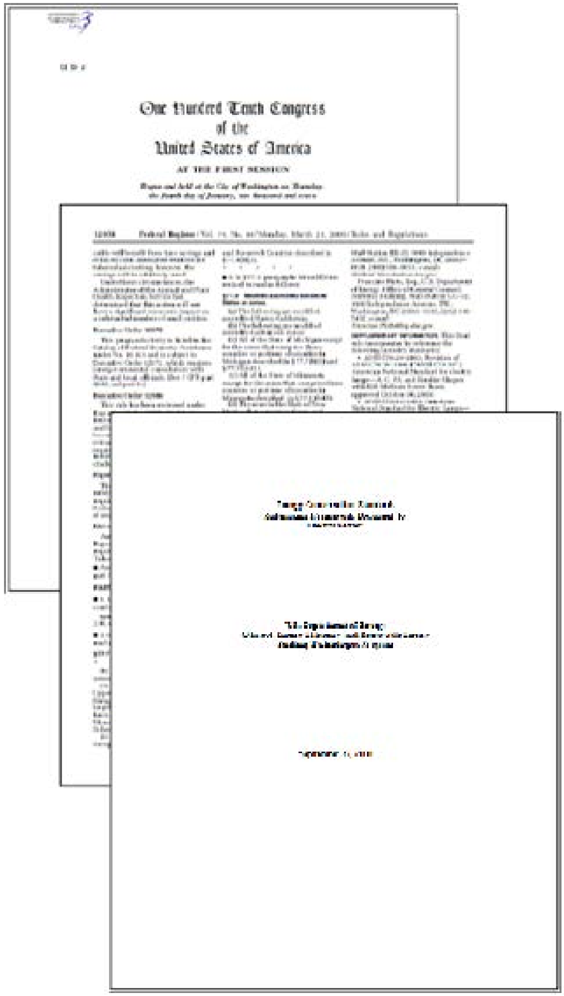
- Energy Policy Act (EPACT) of 1992 (Public Law 102-486)
  – Prescribed energy efficiency standards for certain commercial & industrial motors.



Regulatory History (Continued)

- Energy Independence and Security Act (EISA) of 2007 (Public Law 110-140)
  - Updated the energy efficiency standards for electric motors established in EPACT 1992.
  - Established energy efficiency standards for a larger scope of electric motors, not previously covered.
  - Compliance date for new standards was December 19, 2010.

- Current Rulemaking
  - EPCA requires DOE to determine by rule whether to amend energy conservation standards for electric motors.
  - Any standards that DOE establishes would have a compliance date no sooner than December 19, 2015.



EPCA Factors

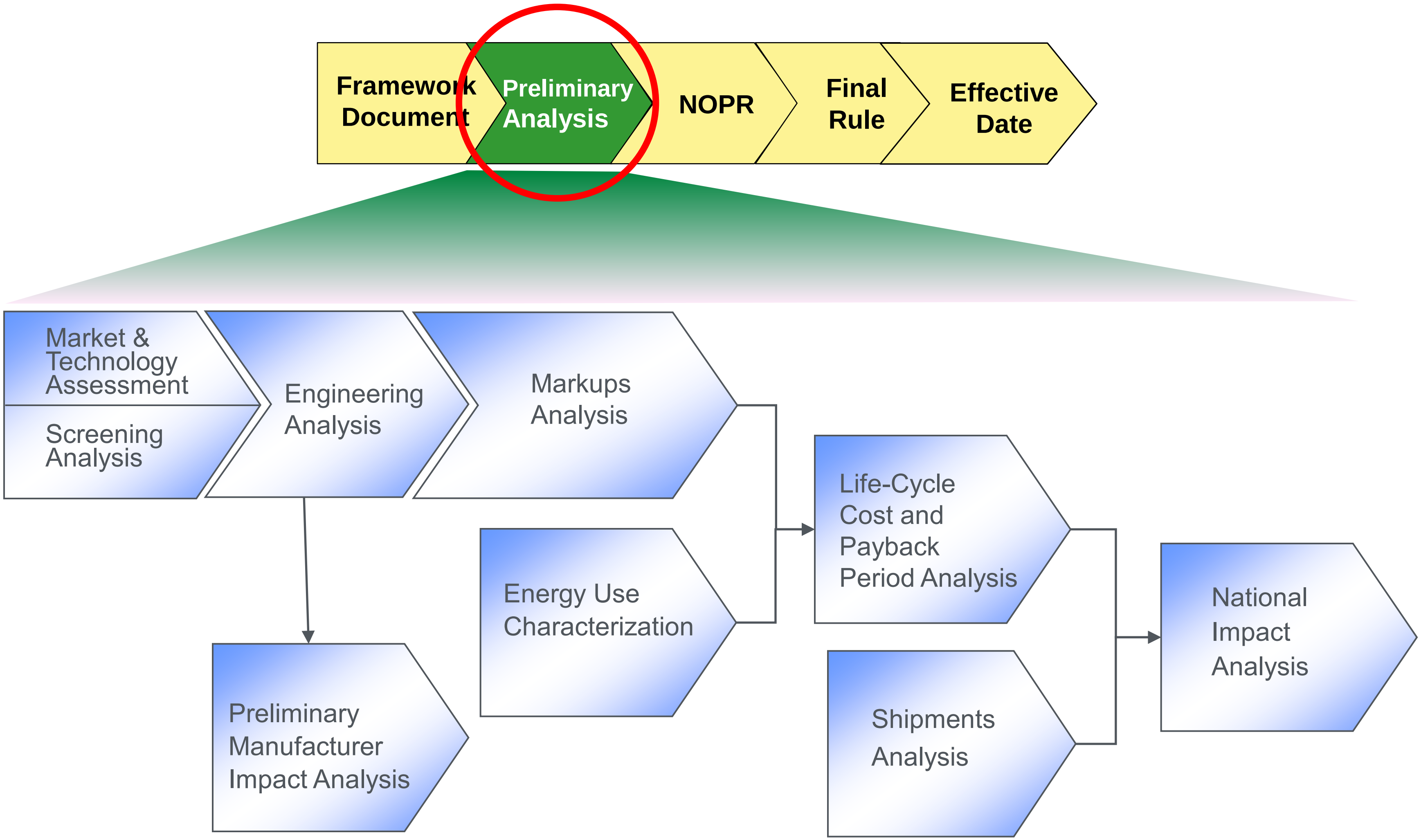
- EPCA specifies that any standard DOE prescribes for electric motors, must meet the following factors:
  - Technologically feasible. 42 U.S.C. 6295(o)(2)(A)
  - Economically justified. 42 U.S.C. 6295(o)(2)(A)
  - Establishment of the standard will result in significant conservation of energy. 42 U.S.C. 6295(o)(3)(B)

EPCA Factors (Continued)

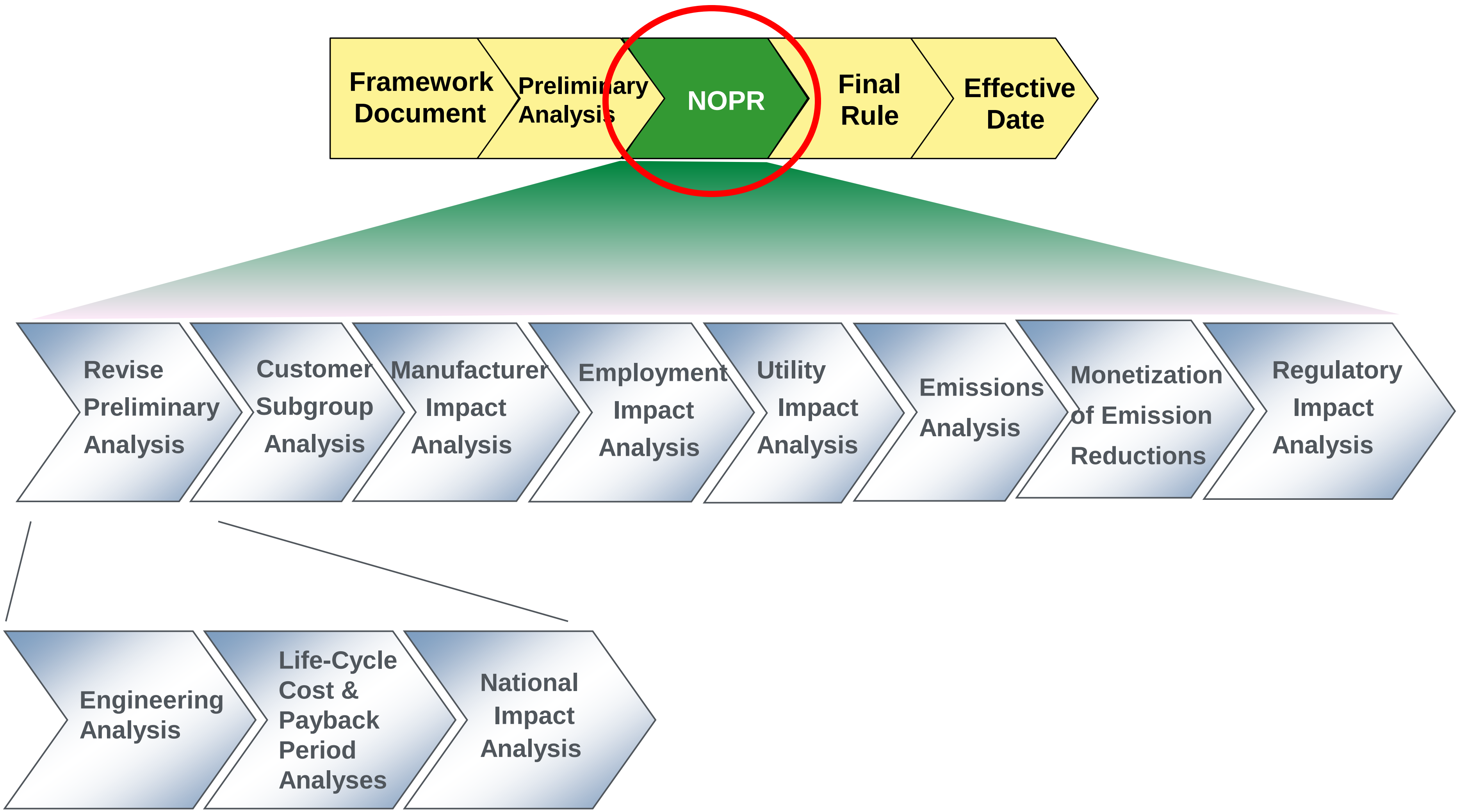
42 U.S.C. 6295(o)(2)(B)(i) directs DOE to consider seven factors when determining whether a standard is economically justified:

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

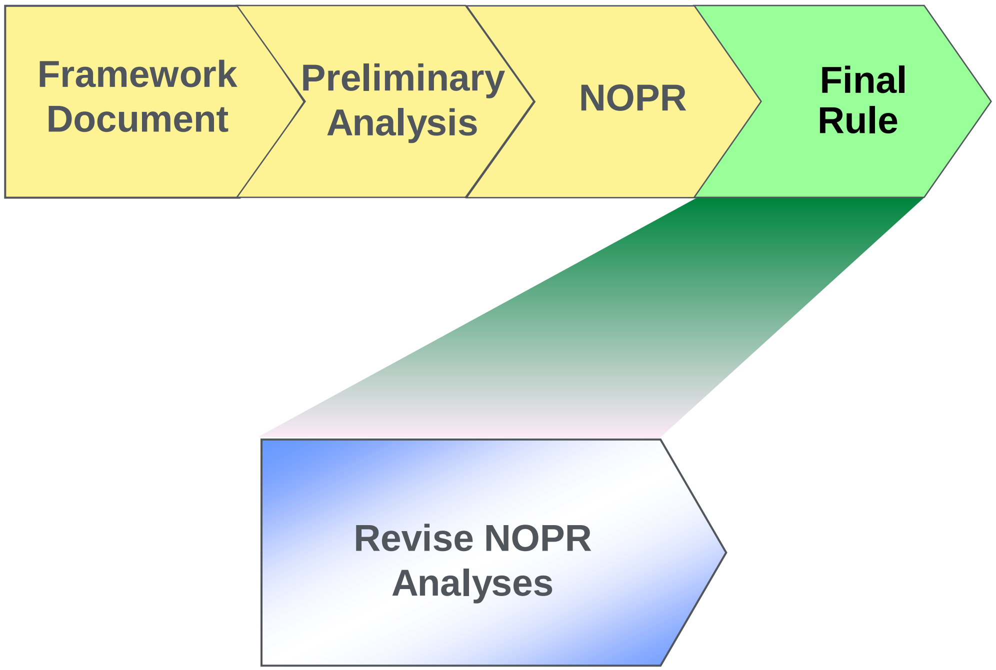
Steps in the Standards Rulemaking: Preliminary Analysis



Steps in the Standards Rulemaking: NOPR



Analyses for Final Rule



Electric Motors Rulemaking Schedule

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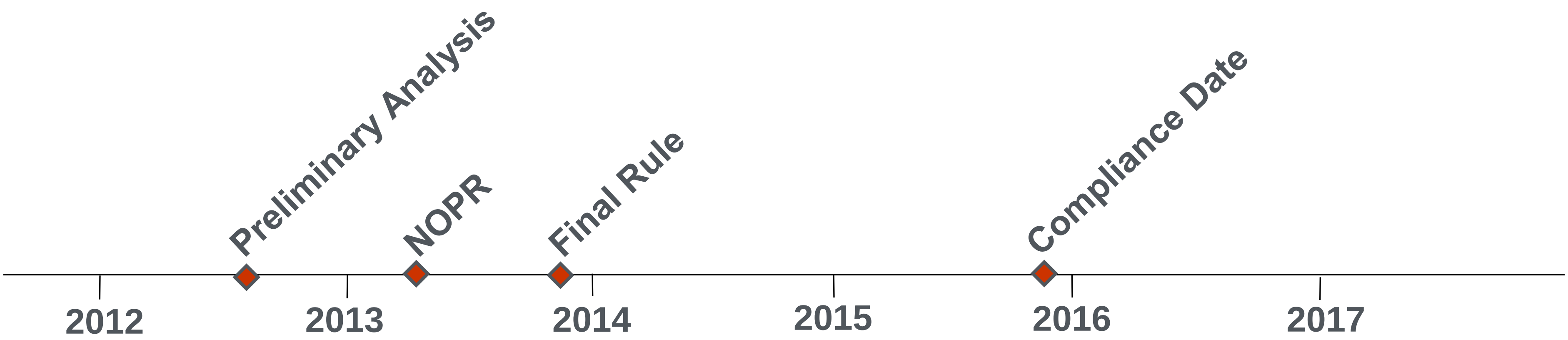


Milestone	Date
Federal Register Notice of Public Meeting and Availability of the Preliminary Technical Support Document	July, 2012
Issue NOPR	2013
Issue Final Rule	2013
Compliance Date	2015

Public Meeting Agenda

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

1. Overview
2. Test Procedure
3. Market & Tech; Screening; Engineering
4. Markup Analysis; Energy Use & End-Use Load
5. Life-Cycle Cost and Payback Period Analysis
6. National Impact Analysis
7. Preliminary MIA; NOPR Analyses

Test Procedure Regulatory History

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- On January 5, 2011, DOE published a Supplemental Notice of Proposed Rulemaking (SNOPR) test procedure. (76 FR 648)
  - Proposed updates to industry testing standards for electric motors.
  - Proposed clarifications to scope of coverage for electric motors.
  - Proposed revisions to definitions of terms related to electric motors.
  - Proposed revisions to guidance in Appendix A to Subpart B of 10 CFR 431.

- On May 4, 2012, DOE published a test procedure Final Rule for electric motors in which it finalized the issues proposed in the SNOPR. (77 FR 26608)
  - Adopted updates to industry testing standards.
  - Adopted clarifications to scope of coverage for electric motors.
  - Adopted definitions of terms related to electric motors, including a definition for the term ‘electric motor.’
  - DOE elected to remove Appendix A from the CFR and will post updated guidance on DOE’s electric motors website instead.

Scope of Coverage for Electric Motors under EISA 2007

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Electric Motors

- General Purpose Electric Motors (Subtype I)
- General Purpose Electric Motors (Subtype II)
- NEMA Design B Electric Motors (>200 HP – 500 HP)
- Fire Pump Electric Motors

TP Final Rule Changes

- Clarified coverage
- Clarified coverage
- Added definition and clarified coverage
- Added definition and clarified coverage

Current Test Procedure

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- The test procedure has been updated to include more current versions of the referenced standards.

Efficiency and losses shall be determined in accordance with **NEMA MG1–2009**, paragraph 12.58.1, "*Determination of Motor Efficiency and Losses*," and either:

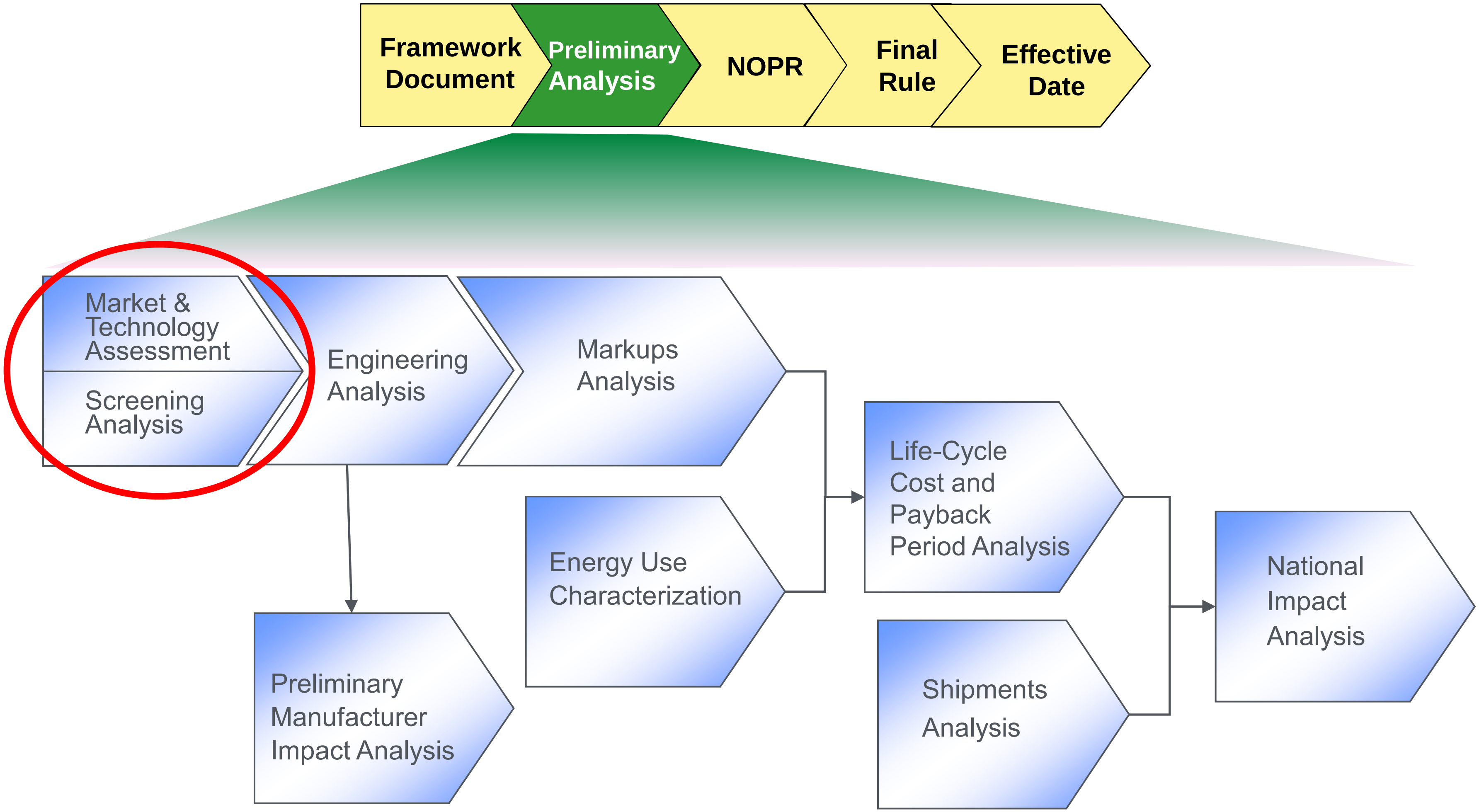
- **CSA Standard C390–10**, or
- **IEEE Standard 112–2004 Test Method B**, Input-Output With Loss Segregation.

Public Meeting Agenda

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

1. Overview
2. Test Procedure
3. **Market & Tech; Screening; Engineering**
4. Markups; Energy Use Characterization
5. Life-Cycle Cost and Payback Period Analysis
6. National Impact Analysis
7. Preliminary MIA; NOPR Analyses

Steps in the Standards Rulemaking: Preliminary Analysis



Purpose

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- Market and Technology Assessment
  - Characterize the electric motor market and industry.
    - Define the scope of coverage for energy conservation standards.
  - Identify the technology options to improve electric motor efficiency.
  - Establish equipment classes.

- Screening Analysis
  - Screen out technology options that DOE will not consider in the engineering analysis for electric motors based on several criteria.

Relationship of Market and Technology Assessment to other Analyses

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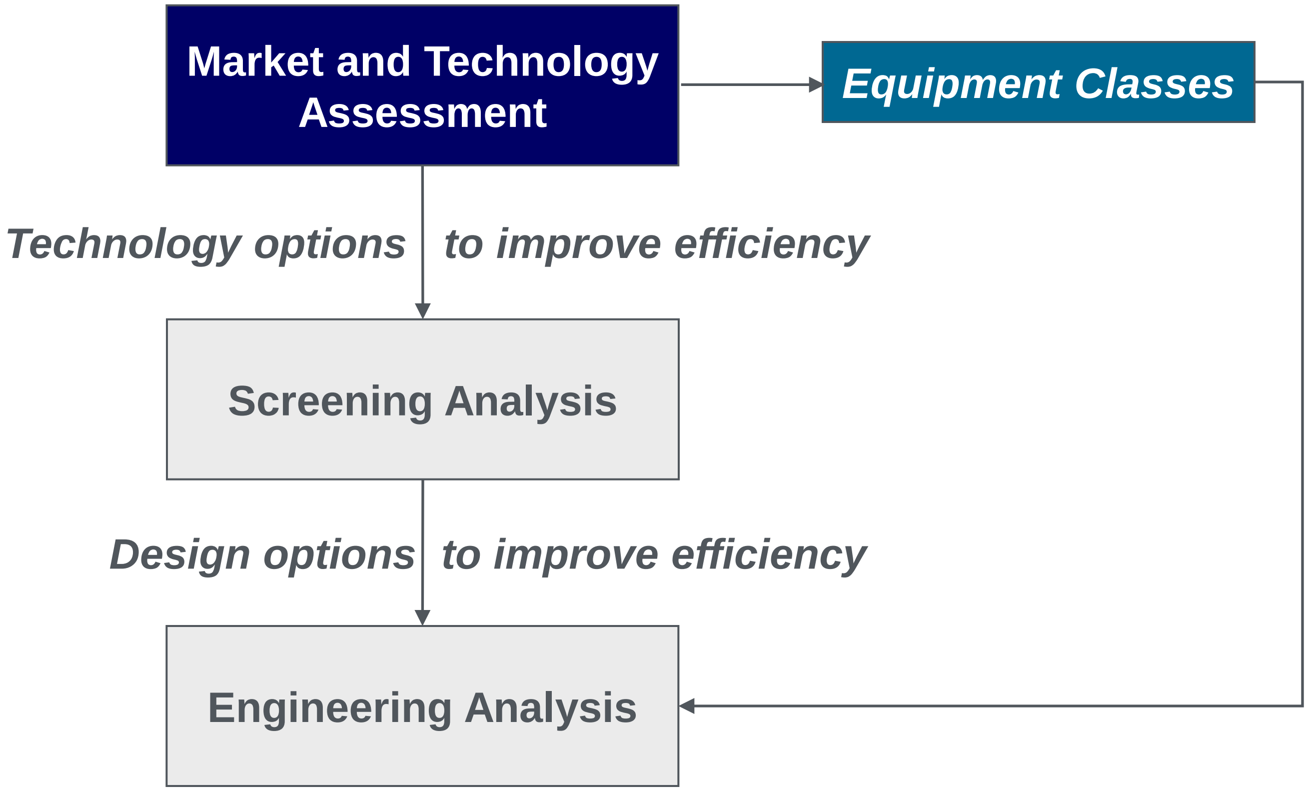

Current Electric Motors Scope of Coverage

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- Current energy conservation standards exist for the following groups of electric motors:
  - General-purpose electric motors (subtype I)
  - General-purpose electric motors (subtype II)
  - Fire pump electric motors
- Each of the above electric motor types has the following characteristics:
  - Is a single-speed, induction motor,
  - Contains a squirrel-cage (MG1) or cage (IEC) rotor,
  - Operates on polyphase alternating current (AC) 60-hertz sinusoidal line power,
  - Is rated 600 volts or less,
  - Has 2-, 4-, 6-, or 8-pole configuration,
  - Is rated for continuous duty (MG1) operation or for duty type S1 (IEC),
  - Is built in a three-digit NEMA frame size and is not greater than 500 horsepower, and
  - Is a NEMA Design A, B, or C electric motor (or an IEC equivalent)

Expanded Electric Motors Scope of Coverage

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- DOE is contemplating applying energy conservation standards to electric motor types that share similarities with those already covered.
- DOE is considering covering the following electric motor types:

Electric Motor Type	
1. Electric motors with customer defined endshields or special flanges	7. Immersible
2. Electric motors with single or double shafts of non-standard dimensions or additions	8. Integral brake
3. Electric motors with sleeve bearings	9. Partial or 3/4
4. Electric motors with non-standard base or mounting feet	10.Totally enclosed, non-ventilated
5. Electric motors with thrust bearings	11. Vertical hollow-shaft
6. Encapsulated electric motors	-

Request for Comment

Issue 1: DOE is open to comment regarding the list of motor types it is considering to include in the expanded scope. Should any additional motor types be included in this list? DOE also seeks comment on the definitions proposed in the supplementary handout.

Exemptions from Scope Expansion

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- Motor types DOE is considering to **not cover** with expanded energy conservation standards for this rulemaking:

Electric Motor Type	
1. Totally enclosed air-over (TEAO)	6. Liquid cooled
2. Component sets	7. Single phase
3. Inverter-only duty	8. Direct current
4. Multispeed	9. Intermittent duty
5. Submersible	-

Request for Comment

Issue 2: DOE seeks comment concerning the list of motor types it is not planning to include in the expanded scope of coverage, including definitions for some of these motor types in the supplementary handout. Should any additional motor types be added to this list of not-covered motors? DOE is also interested in comments regarding test procedures capable of testing these motor types.

Test Procedure Modifications

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- DOE is currently working on a test procedure rulemaking in parallel with this electric motor standards rulemaking.

- The new test procedure will look to:
  - Propose any necessary definitions to help clarify DOE's potential expansion of energy conservation standards for electric motors.
  - Propose any necessary modifications to the current DOE test procedures (not the IEEE or CSA test methodologies) that would facilitate the testing of any electric motors that may have special requirements, such as those electric motors that require special setup steps.

Request for Comment

Issue 3: DOE requests comment on the additional test procedure guidance language discussed in the supplementary handout.

Issue 4: DOE is also open to comment regarding alternative approaches to testing these motors, including other test methodologies or testing standards.

Electric Motors
Equipment Classes and Groups

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Generally, DOE divides covered equipment into classes by:
  - The type of energy used
  - Capacity of the equipment, or
  - Other performance-related features that justify different standard levels, such as features affecting consumer utility (42 U.S.C. 6295(q))

Electric Motors
Equipment Classes and Groups

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- DOE created 3 equipment class groups by dividing the population of electric motors based on the following motor designs:
  - NEMA Design A or B,
  - NEMA Design C, and
  - Fire pump electric motors

- Within these equipment class groups DOE further divided equipment into classes based on the combination of:
  - Horsepower rating,
  - Pole configuration, and
  - Enclosure type

Electric Motors
Equipment Classes and Groups

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- There are 514 discrete equipment classes (or unique motor configurations) across the three equipment class groups (ECG).

ECG	Motor Design	Horsepower Rating	Pole Configuration	Frame Enclosure	Equipment Classes
I	NEMA Design A or B	1-500	2, 4, 6, 8	Open or Enclosed	200
II	NEMA Design C	1-200	4, 6, 8	Open or Enclosed	114
III	Fire Pump	1-500	2, 4, 6, 8	Open or Enclosed	200

2011 Electric Motors Shipments

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- 2011 electric motor shipments, including motors covered by the planned expansion of standards.

ECG	Motor Design	Horsepower Rating	Pole Configuration	Frame Enclosure	Units Shipped
I	NEMA Design A	1-500	2, 4, 6, 8	Open or Enclosed	46,512
I	NEMA Design B	1-500	2,4, 6, 8	Open or Enclosed	4,498,896
II	NEMA Design C	1-200	4, 6, 8	Open or Enclosed	9,120
III	Fire Pump	1-500	2, 4, 6, 8	Open or Enclosed	5,472
Total					4,560,000

Technology Assessment

Type of Motor Losses	Technology Options
Stator I^2R Losses	Increase copper wire diameter to maximize slot fill, reduce end turn length, or increase stator slot size
Rotor I^2R Losses	Replace rotor aluminum with copper, increase rotor slot size, manipulate rotor slot configuration
Core Losses	Select lamination with less watts loss/pound, amorphous steels, plastic bonded iron powder, add stack height (*i.e.*, add electrical steel)
Friction and Windage Losses	Optimize bearing or lubrication selection, or improve cooling fan design
Stray Load Losses	Optimize selection of rotor/stator slot selection, improve rotor surface machining, optimize air gap

Screening Analysis

Purpose

- Screen out technology options that DOE will not consider in the engineering analysis for electric motors.

Approach

- DOE will evaluate each technology option based on the following criteria:

Technological feasibility
Practicability to manufacture, install, and service
Adverse impacts on equipment utility or availability to consumers
Impacts on health or safety

Technology Options Screened Out of the Analysis

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Technology Option	Screening Criteria
Amorphous Metals	Technological feasibility
Plastic Bonded Iron Powder (PBIP)	Technological feasibility

Request for Comment

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Issue 5: DOE knows of no current commercial efforts or prototype designs that employ PBIP or amorphous steels in electric motors. Are there any such efforts underway or prototypes under development? What implications, if any, should DOE consider if these types of materials are used in electric motor designs?

Issue 6: DOE invites comment on the technology options tentatively eliminated during the screening analysis. DOE also welcomes comment on any proprietary concerns relevant to the design options considered in the analysis.

Steps in the Standards Rulemaking: Preliminary Analysis

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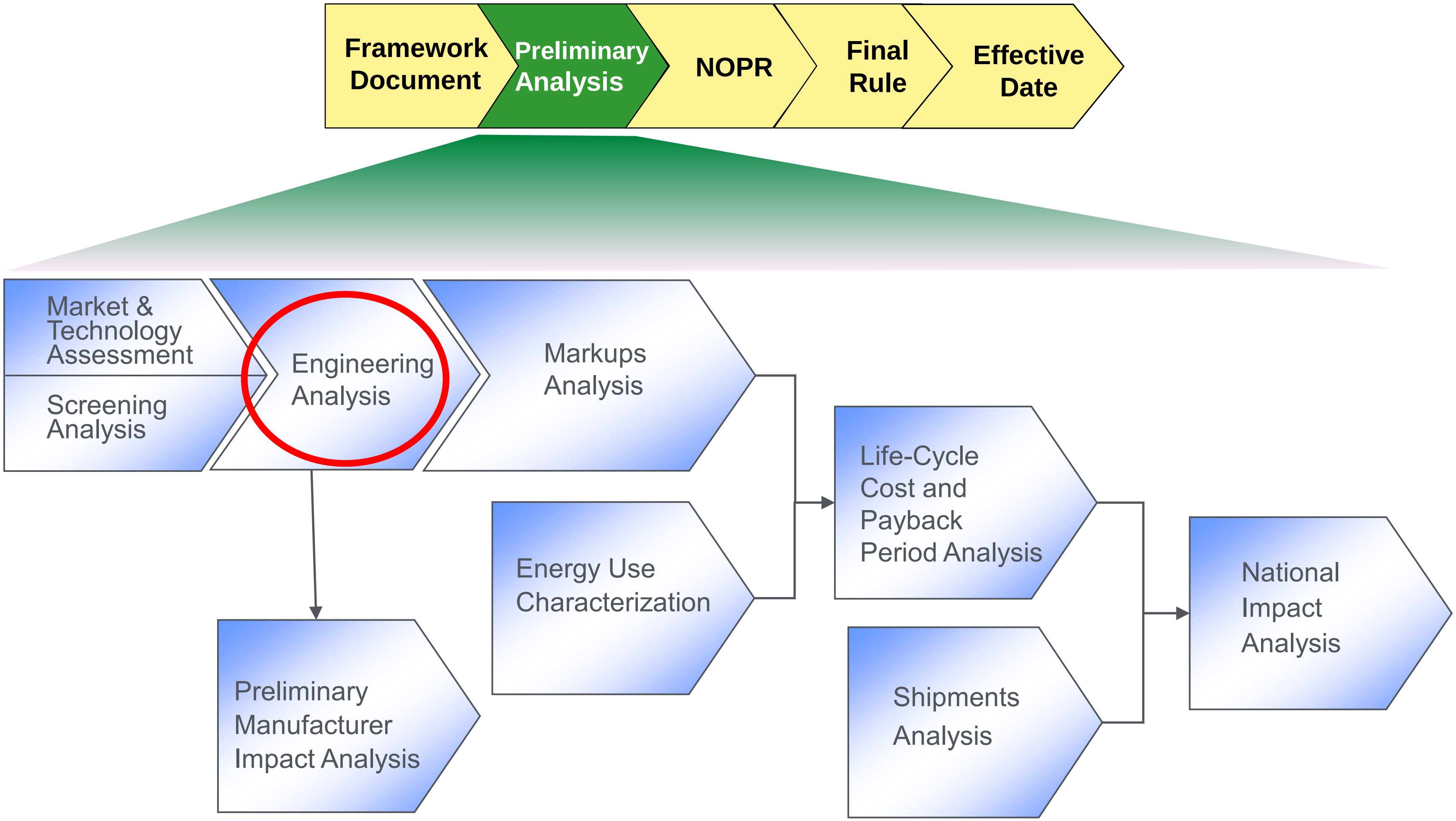
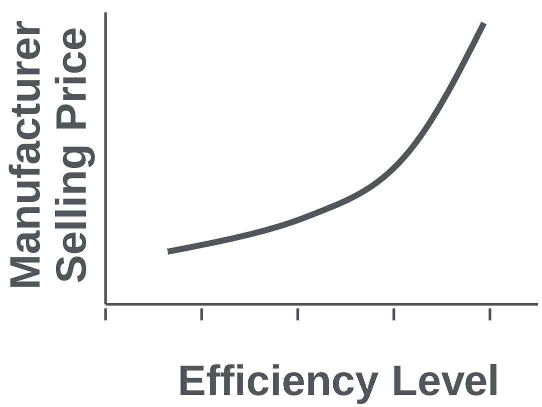


Engineering Analysis

- Purpose
  - To evaluate design options that improve efficiency.
  - To characterize manufacturer selling price (MSP) versus efficiency for higher-efficiency electric motors.

Manufacturer Selling Price – Efficiency Relationship



Downstream Analyses

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

Engineering Analysis: Methodology

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Choose Representative Units	Divide covered equipment into classes and identify representative units.
Conduct Test and Teardown Analyses	For each representative unit, conduct tests and teardowns of motors across the spectrum of efficiency performance.
Model High Efficiency Designs	Use software modeling to create designs with efficiency levels above the highest efficiencies of the purchased units.
Develop CSLs	Develop candidate standard levels (CSLs) that span the range of efficiency from the baseline to the maximum technologically feasible level.
Develop Manufacturer Selling Prices	Identify materials prices, markups, labor requirements, and other costs for each design torn down and modeled.
Scale to Equipment Classes Not Analyzed	Scale results to other equipment classes not analyzed.

Engineering Analysis: Choose Representative Units

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Choose Representative Units

Conduct Test and Teardown Analyses

Model High Efficiency Designs

Develop CSLs

Develop Manufacturer Selling Prices

Scale to Equipment Classes Not Analyzed

- DOE selected representative units for each equipment class group.
- Analysis for all covered motors was based on these selected representative units.

ECG	Rep. Unit Motor Design	Rep. Unit Frame Enclosure	Rep. Unit Horsepower	Rep. Unit Pole Configuration
I (NEMA Design A & B Motors)	NEMA Design B	Enclosed	5	4
			30	
			75	
II (NEMA Design C Motors)	NEMA Design C	Enclosed	5	4
			50	
III (Fire Pump Motors)	NEMA Design B	Enclosed	5	4
			30	
			75	

Engineering Analysis: Choose Representative Units

Choose Representative Units

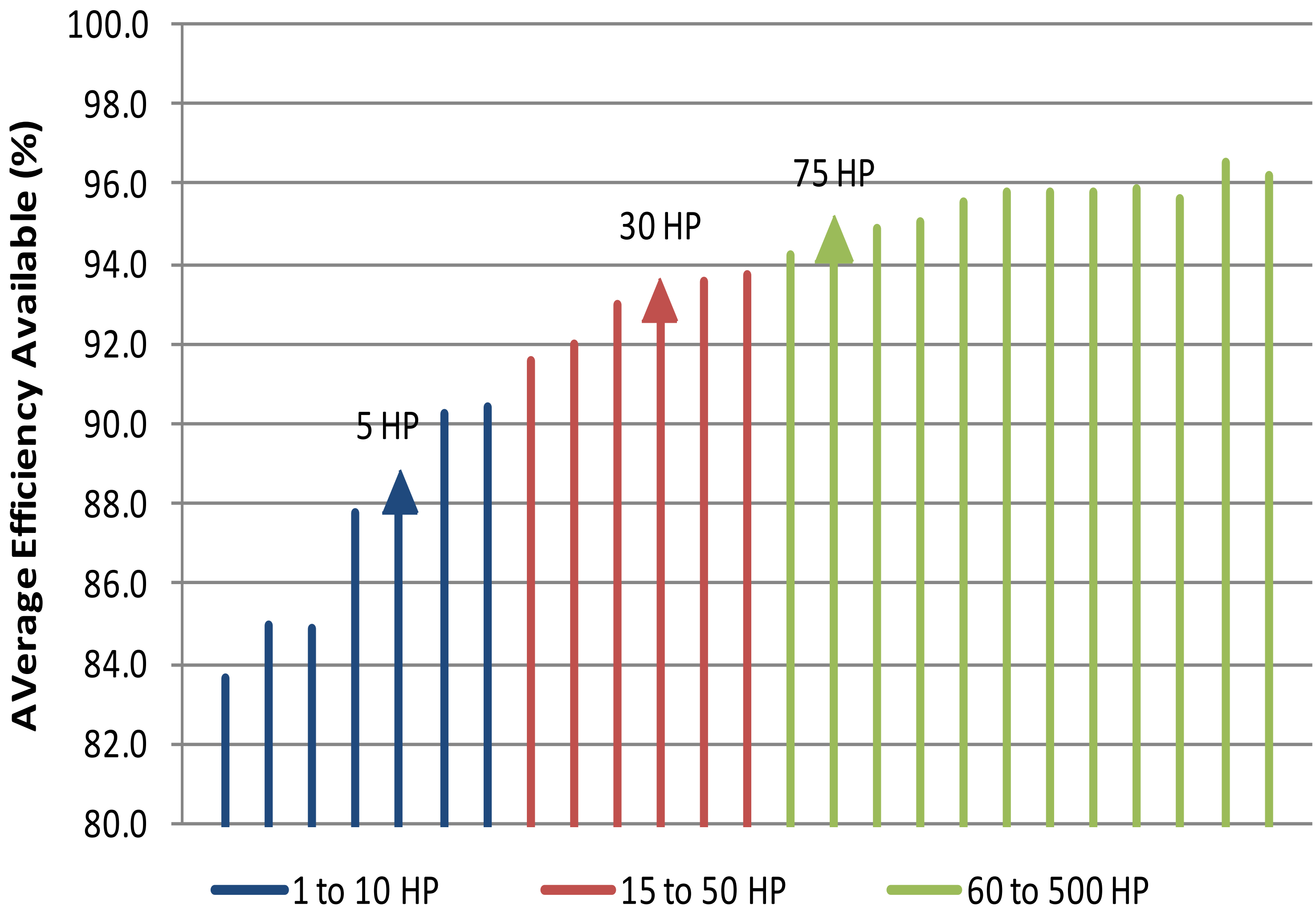
Conduct Test and Teardown Analyses

Model High Efficiency Designs

Develop CSLs

Develop Manufacturer Selling Prices

Scale to Equipment Classes Not Analyzed



Engineering Analysis: Choose Representative Units

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Choose Representative Units

Conduct Test and Teardown Analyses

Model High Efficiency Designs

Develop CSLs

Develop Manufacturer Selling Prices

Scale to Equipment Classes Not Analyzed

4-Pole NEMA Design B Motors		
HP	Frame Designation	D Dimension (In)
1	143T	3.50
1.5	145T	3.50
2	145T	3.50
3	182T	4.50
5	184T	4.50
7.5	213T	5.25
10	215T	5.25
15	254T	6.25
20	256T	6.25
25	284TS	7.00
30	286T	7.00
40	324T	8.00
50	326T	8.00
60	364TS	9.00
75	365TS	9.00
100	405TS	10.00
125	444TS	11.00
...	...	...
500	Undefined	Undefined

4-Pole NEMA Design C Motors		
HP	Frame Designation	D Dimension (In)
1	143T	3.50
1.5	145T	3.50
2	145T	3.50
3	182T	4.50
5	184T	4.50
7.5	213T	5.25
10	215T	5.25
15	254T	6.25
20	256T	6.25
25	284TS	7.00
30	286T	7.00
40	324T	8.00
50	326T	8.00
60	364TS	9.00
75	365TS	9.00
100	405TS	10.00
125	444TS	11.00
150	445TS	11.00
200	447TS	11.00

Request for Comment

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- **Choose Representative Units**
- Conduct Test and Teardown Analyses
- Model High Efficiency Designs
- Develop CSLs
- Develop Manufacturer Selling Prices
- Scale to Equipment Classes Not Analyzed

Issue 7: DOE welcomes comment on the representative units that it considered in its analysis. DOE is also open to comment on all aspects of the representative units selected.

Engineering Analysis: Test and Teardown Analysis

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Choose Representative Units
- **Conduct Test and Teardown Analyses**
- Model High Efficiency Designs
- Develop CSLs
- Develop Manufacturer Selling Prices
- Scale to Equipment Classes Not Analyzed

- DOE purchased and tested four motors at increasing efficiency levels for each representative unit in equipment class group I.

Horsepower Rating	Nameplate Nominal Full-Load Efficiency	Energy Efficiency Level
5	82.5%	Lowest in Catalogs
5	87.5%	EPACT1992*
5	89.5%	EISA 2007**
5	90.2%	Best-in-Market
30	89.5%	Lowest in Catalogs
30	92.4%	EPACT1992*
30	93.6%	EISA 2007**
30	94.1%	Best-in-Market
75	93.0%	Lowest in Catalogs
75	94.1%	EPACT1992*
75	95.4%	EISA 2007**
75	95.8%	Best-in-Market

* EPACT 1992 energy efficiency levels are equivalent to those in NEMA MG1-2009 Table 12-11.

** EISA 2007 energy efficiency levels are equivalent to those in NEMA MG1-2009 Table 12-12.

Engineering Analysis: Test and Teardown Analysis

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- Choose Representative Units
- **Conduct Test and Teardown Analyses**
- Model High Efficiency Designs
- Develop CSLs
- Develop Manufacturer Selling Prices
- Scale to Equipment Classes Not Analyzed

- DOE conducted teardowns on the tested motors to develop a bill of materials, including components and weights.
- A sample bill of materials for a NEMA Design B, 4-pole, 5 horsepower, enclosed frame motor:

Component	Weight (lbs)
Stator Steel (M47)	22.1
Rotor Steel (M47)	12.4
Stator Copper Wire	10.1
Rotor Aluminum	2.9
Shaft	4.8
Frame Steel and Mounting Base	8.6
Bearings*	-
Aggregate Frame Materials*	-
Aggregate Hardware*	-
Aggregate Insulation*	-

* These components were not priced according to weight.

Request for Comment

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Choose Representative Units
- **Conduct Test and Teardown Analyses**
- Model High Efficiency Designs
- Develop CSLs
- Develop Manufacturer Selling Prices
- Scale to Equipment Classes Not Analyzed

Issue 8: DOE requests comment on the approach it used to develop the materials cost input. Does hardware material, frame material, or insulation impact the efficiency of a motor?

Engineering Analysis: Modeling High Efficiency Designs

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Choose Representative Units
- Conduct Test and Teardown Analyses
- **Model High Efficiency Designs**
- Develop CSLs
- Develop Manufacturer Selling Prices
- Scale to Equipment Classes Not Analyzed

- DOE had software modeling conducted.
- The modeling used different design options to create new designs with incrementally improved efficiency levels above the best-in-market teardowns.

Design Option	Changes Considered
Stator Changes	Increase stack length of stator Increase copper percentage fill of stator slots Change number of windings around stator slots
Rotor Changes	Increase stack length of rotor Change geometry of rotor teeth
Material Changes	Use copper as the primary conductor in rotor Improve grade of electrical steel

Request for Comment

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Choose Representative Units
- Conduct Test and Teardown Analyses
- **Model High Efficiency Designs**
- Develop CSLs
- Develop Manufacturer Selling Prices
- Scale to Equipment Classes Not Analyzed

Issue 9: DOE seeks comment on the design option combinations selected for increasing the efficiency levels of representative units. DOE would like to request comment on any additional design option combinations that would increase energy conservation levels.

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Choose Representative Units
- Conduct Test and Teardown Analyses
- **Model High Efficiency Designs**
- Develop CSLs
- Develop Manufacturer Selling Prices
- Scale to Equipment Classes Not Analyzed

Example of Design Option Combinations Analyzed

NEMA Design B, 4-pole, 75-HP, Enclosed Frame

Parameter	Units	CSL 0	CSL 1	CSL 2	CSL 3	CSL 4	CSL 5
Efficiency	%	93.0	94.1	95.4	95.8	96.2	96.5
Line Voltage	V	460	460	460	460	460	460
Full Load Speed	RPM	1,775	1,785	1,781	1,785	1,788	1,789
Full Load Torque	Nm	299.8	299.8	302.3	300.8	299.6	299.6
Steel	-	M56	M47	M47	M47	M36	M36
Rotor Conductor Material	-	Aluminum	Aluminum	Aluminum	Aluminum	Copper	Copper
Approximate Slot Fill	%	48.0	44.5	70.0	70.0	85.1	83.4
Stator Wire Gauge	AWG	17	12	12	15	14	14
Stator Copper Weight	lbs	77.8	71	82	136	127	160
Rotor Conductor Weight	lbs	31.0	20.7	27.3	38.5	79	84.3
Stack Length	In	8.15	10.23	10.58	11.37	12.00	13.00

Engineering Analysis: Develop CSLs

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Choose Representative Units
- Conduct Test and Teardown Analyses
- Model High Efficiency Designs
- **Develop CSLs**
- Develop Manufacturer Selling Prices
- Scale to Equipment Classes Not Analyzed

- DOE identified CSLs that span the range of electric motor efficiencies from the baseline to the maximum technologically feasible efficiency.
- Factors DOE considered in setting CSLs:

Commercially available and software modeled efficiencies

NEMA standard nominal efficiencies (e.g. Table 12-10)

Benchmark efficiency levels (e.g. NEMA Premium)

Engineering Analysis: Develop CSLs

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Choose Representative Units
- Conduct Test and Teardown Analyses
- Model High Efficiency Designs
- **Develop CSLs**
- Develop Manufacturer Selling Prices
- Scale to Equipment Classes Not Analyzed

NEMA Design B 5-Horsepower Rep. Unit					
CSL 0	CSL 1	CSL 2	CSL 3	CSL 4	CSL 5
Lowest Efficiency (82.5%)	Table 12-11 (87.5%)	Table 12-12 (89.5%)	Table 12-12 +1 band (90.2%)	Table 12-12 +2 bands (91.0%)	Table 12-12 +3 bands (91.7%)

NEMA Design B 30-Horsepower Rep. Unit					
CSL 0	CSL 1	CSL 2	CSL 3	CSL 4	CSL 5
Lowest Efficiency (89.5%)	Table 12-11 (92.4%)	Table 12-12 (93.6%)	Table 12-12 +1 band (94.1%)	Table 12-12 +2 bands (94.5%)	Table 12-12 +2 bands (94.5%)

NEMA Design B 75-Horsepower Rep. Unit					
CSL 0	CSL 1	CSL 2	CSL 3	CSL 4	CSL 5
Lowest Efficiency (93.0%)	Table 12-11 (94.1%)	Table 12-12 (95.4%)	Table 12-12 +1 band (95.8%)	Table 12-12 +2 bands (96.2%)	Table 12-12 +3 bands (96.5%)

Request for Comment

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Choose Representative Units
- Conduct Test and Teardown Analyses
- Model High Efficiency Designs
- **Develop CSLs**
- Develop Manufacturer Selling Prices
- Scale to Equipment Classes Not Analyzed

Issue 10: DOE seeks comment on the tentative Candidate Standard Levels, or CSLs, selected for its representative units.

Engineering Analysis: Develop Material Cost Inputs

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Choose Representative Units
- Conduct Test and Teardown Analyses
- Model High Efficiency Designs
- Develop CSLs
- **Develop Manufacturer Selling Prices**
- Scale to Equipment Classes Not Analyzed

- DOE calculated manufacturer production costs (MPCs) by disassembling electric motors from multiple manufacturers and creating bills of materials (BOMs).
- BOMs describe the product components in detail, including labor hour estimates based on subject matter expert feedback and a stator winding analysis to determine whether it was hand or machine wound.
- DOE determined materials prices and labor requirements through conversations with manufacturers and industry experts.
- DOE determined markups and labor rates from census data, SEC filings, and manufacturer interviews.

Engineering Analysis: Develop Material Cost Inputs

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Choose Representative Units
- Conduct Test and Teardown Analyses
- Model High Efficiency Designs
- Develop CSLs
- **Develop Manufacturer Selling Prices**
- Scale to Equipment Classes Not Analyzed

- DOE then applied manufacturer markups to the MPCs to obtain MSPs.

Markup / Cost Input	Markup Percent	Notes
Scrap and handling	2.5 %	Standard scrap and handling; applied to materials
Factory overhead	17.5 %	Aluminum die-cast rotors; applied to materials only
	18.0 %	Copper die-cast rotors ; applied to materials only
Fully-burdened hourly labor rate	$33.46	Aggregate cost of domestic and offshore rates; applied to total labor hours
Non-production	37.0 %	Accounts for SG&A, R&D, warranty/risk provisions, and profit factor; applied to labor cost and materials (5 horsepower rep. unit)
	45.0 %	Accounts for SG&A, R&D, warranty/risk provisions, and profit factor; applied to labor cost and materials (30 and 75 horsepower rep units)

Request for Comment

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Choose Representative Units
- Conduct Test and Teardown Analyses
- Model High Efficiency Designs
- Develop CSLs
- **Develop Manufacturer Selling Prices**
- Scale to Equipment Classes Not Analyzed

Issue 11: Due to copper's large price fluctuations, DOE used a 5-year average from 2007-2011 when pricing copper, and 2011 prices for all other materials. DOE requests comment on its tentative decision to use a 5-year average price for copper and the current (2011) materials pricing for all other materials.

Issue 12: DOE welcomes comment on its use of a higher non-production markup for its 30 and 75 horsepower representative units.

Issue 13: DOE welcomes comment on its tentative decision to use an aggregate domestic and foreign fully-burdened labor rate. The balance of each rate is based on estimated percentages of foreign and domestic manufacturing practices of U.S. manufacturers.

Engineering Analysis: Scale to Equipment Classes Not Analyzed

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Choose Representative Units
- Conduct Test and Teardown Analyses
- Model High Efficiency Designs
- Develop CSLs
- Develop Manufacturer Selling Prices
- **Scale to Equipment Classes Not Analyzed**

Equipment Class Group I

- Efficiency levels are derived from the analysis of the NEMA Design B, 4-pole, 5, 30, and 75 horsepower, enclosed frame motors.

Equipment Class Group II

- Efficiency levels are derived from the analysis of the NEMA Design C, 4-pole, 5, and 50 horsepower, enclosed frame motors.

Equipment Class Group III

- Fire pump electric motors have low shipments and low run time.
- Efficiency levels for these motors are derived from the analysis of the NEMA Design B, 4-pole, 5, 30, and 75 horsepower, enclosed frame motors (equipment class group I).

Engineering Analysis: Scale to Equipment Classes Not Analyzed

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Choose Representative Units
- Conduct Test and Teardown Analyses
- Model High Efficiency Designs
- Develop CSLs
- Develop Manufacturer Selling Prices
- **Scale to Equipment Classes Not Analyzed**

- DOE considered two scaling methods:
  1. Regression equations developed from the efficiency values in NEMA MG1-2009 Table 12-11 and 12-12.
  2. NEMA band increases based on NEMA MG1-2011 "Energy Efficient" and "Premium Efficient" tables as well as commercially available efficiencies and software modeled efficiencies.
- In each scenario, efficiency levels were based on NEMA nominal efficiency values taken from NEMA MG1 Table 12-10.
- Ultimately, DOE decided to use the second scaling method of incremental improvements of motor losses.
  - Based on NEMA "Energy Efficient" (NEMA MG1-2011 Tables 12-11 & 20-A) and "Premium Efficient (NEMA MG1-2011 Tables 12-11 & 20-A) values.
  - Incremental improvements of one NEMA band at higher CSLs.

Engineering Analysis: Scale to Equipment Classes Not Analyzed

- Choose Representative Units
- Conduct Test and Teardown Analyses
- Model High Efficiency Designs
- Develop CSLs
- Develop Manufacturer Selling Prices
- **Scale to Equipment Classes Not Analyzed**

- For ECG I (NEMA Design A&B):
  - CSL 0: Lowest-in-scope efficiencies for all equipment classes
  - CSL 1: NEMA MG1-2011 Tables 12-11 and 20-A for all equipment classes
  - CSL 2: NEMA MG1-2011 Tables 12-12 and 20-B for all equipment classes
  - CSL 3: One NEMA band above CSL 2 for all equipment classes
  - CSL 4: One NEMA band above CSL 3 for all equipment classes
  - CSL 5*: One NEMA band above CSL 4 for all equipment classes

- For ECG II (NEMA Design C):
  - CSL 0: NEMA MG1-2011 Table 12-11 for all equipment classes
  - CSL 1: Two NEMA bands above CSL 0 for all equipment classes
  - CSL 2: One NEMA band above CSL 1 for all equipment classes
  - CSL 3: One NEMA band above CSL 2 for all equipment classes

**For equipment classes based on 30-horsepower representative unit, CSL 5 is equal to CSL 4.*

Engineering Analysis: Scale to Equipment Classes Not Analyzed

- Choose Representative Units
- Conduct Test and Teardown Analyses
- Model High Efficiency Designs
- Develop CSLs
- Develop Manufacturer Selling Prices
- **Scale to Equipment Classes Not Analyzed**

Equipment Class Group I & III Scaling

Open and Enclosed Frame		Poles 2	Poles 4	Poles 6	Poles 8
Horsepower	1				
	1.5				
	2				
	3				
	5				
	7.5				
	10				
	15				
	20				
	25				
	30				
	40				
	50				
	60				
	75				
	100				
	125				
	150				
	200				
	250				
	300				
	350				
	400				
	450				
	500				

Scaled from NEMA Design B, 5HP, 4-pole, enclosed motor.

Scaled from NEMA Design B, 30HP, 4-pole, enclosed motor.

Scaled from NEMA Design B, 75HP, 4-pole, enclosed motor.

Equipment Class Group II Scaling

Open and Enclosed Frame		Poles 4	Poles 6	Poles 8
Horsepower	1			
	1.5			
	2			
	3			
	5			
	7.5			
	10			
	15			
	20			
	25			
	30			
	40			
	50			
	60			
	75			
	100			
	125			
	150			
	200			

Scaled from NEMA Design C, 5HP, 4-pole, enclosed motor.

Scaled from NEMA Design C, 50HP, 4-pole, enclosed motor.

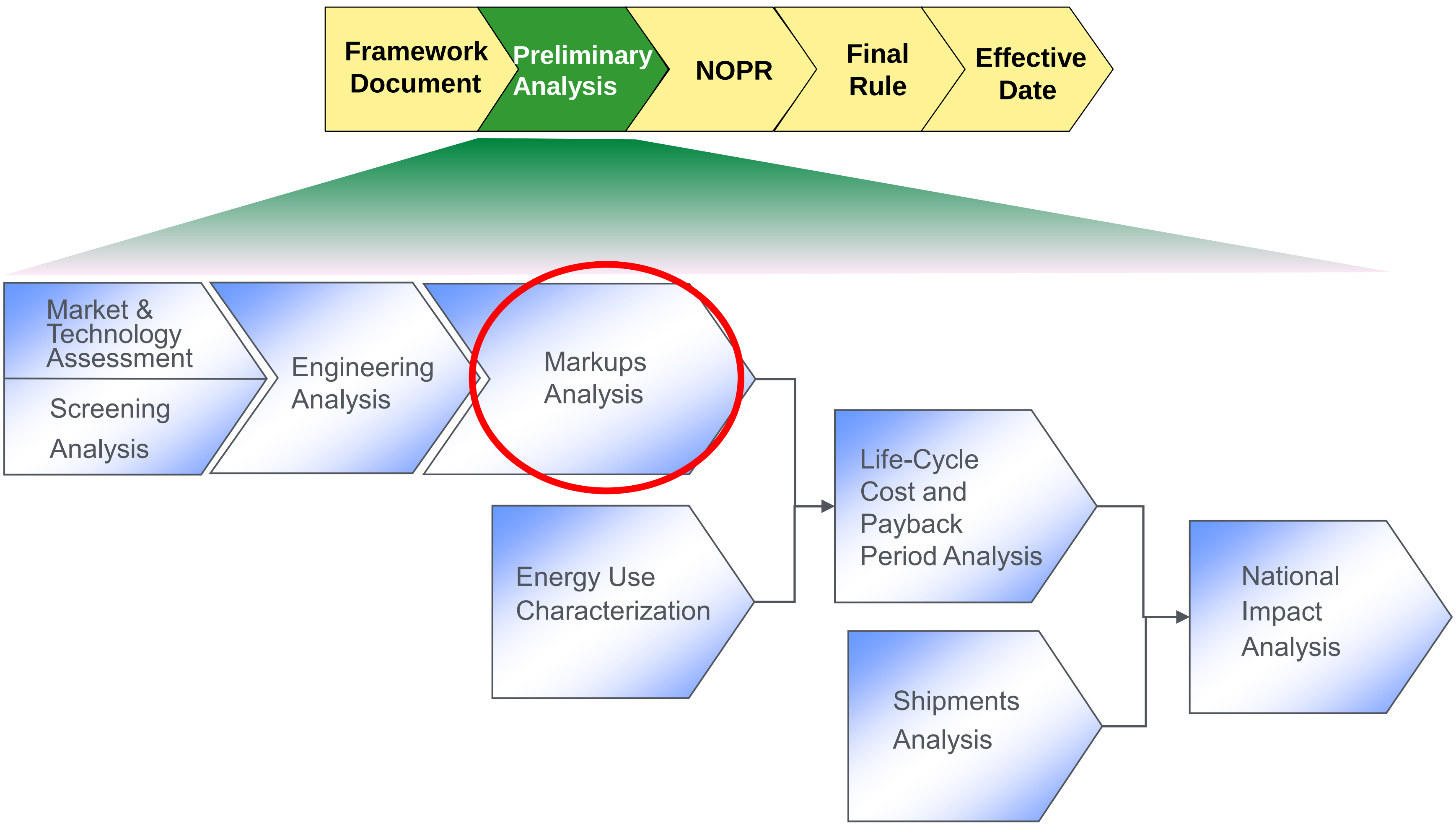
Issue 14: DOE welcomes comment on the scaling methodology it has elected to use to generate efficiencies for the equipment classes not analyzed.

Public Meeting Agenda

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

1	Overview
2	Test Procedure
3	Market & Tech; Screening; Engineering
4	Markups; Energy Characterization
5	Life-Cycle Cost and Payback Period Analysis
6	National Impact Analysis
7	Preliminary MIA; NOPR Analyses

Steps in the Standards Rulemaking: Preliminary Analysis



Markups Analysis

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

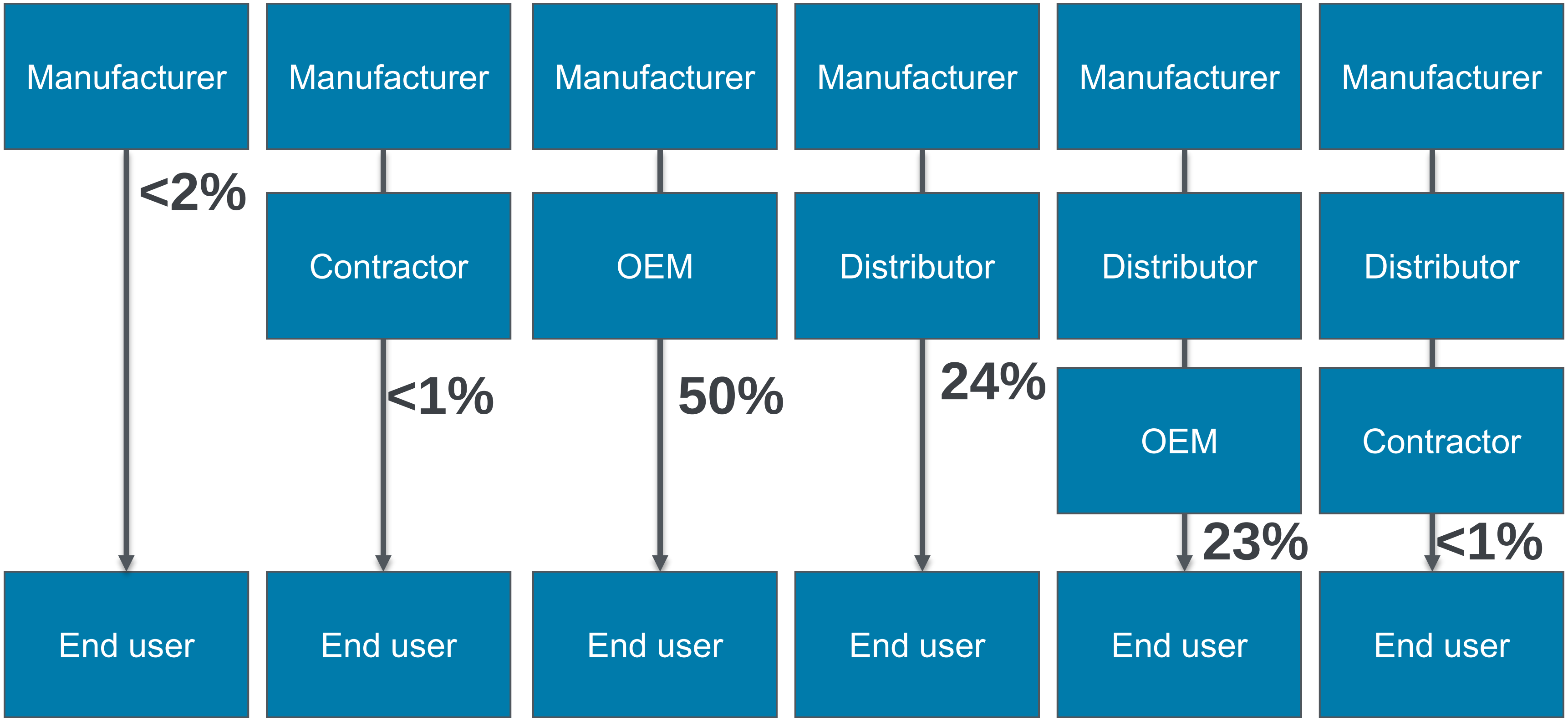
Purpose

- Determine consumer motor prices based on manufacturer costs, both for baseline and higher efficiency equipment
- Characterize motor distribution channels

Method

- Identify distribution channels
- Estimate the consumer prices by applying markups to manufacturer selling price

- Primary Distribution Channels



Other distribution channels exist (e.g. from manufacturer to OEMs, to end-users through distributors) but are estimated to account for a minor share of the motor sales (less than one percent).

Markups Analysis

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Sources:
  - Original equipment manufacturer (OEM) markups: U.S. Census Bureau, Manufacturing Industry Series data
  - Distributor markups: U.S. Census Bureau, Business Expenditure Survey
  - Contractor markups: RS Mean Electrical Cost Data
  - Sales tax rates: 2011 Sales Tax Clearinghouse

- Outputs
  - Baseline and incremental markups.

Markups Analysis

- Markups relate consumer price to cost of goods sold (CGS).

- Baseline markups relate price to cost prior to a change in efficiency.
  - Baseline markups indicate a consumer price that covers all of a retailer's or distributor's expenses plus profit.
  - Direct labor costs (salaries, payroll, rental and occupancy) are included.

- Incremental markups relate the incremental change in consumer price to the incremental change in CGS.
  - Some costs remain constant with CGS increases.
  - Incremental markups cover only expenses that vary with CGS – in this case, expenses that increase due to an increase in product efficiency.
    - For example, direct labor costs (salaries, payroll, rental and occupancy) do not vary with efficiency-induced changes in CGS.
  - DOE assumes other operating costs and profit scale proportionally with CGS.

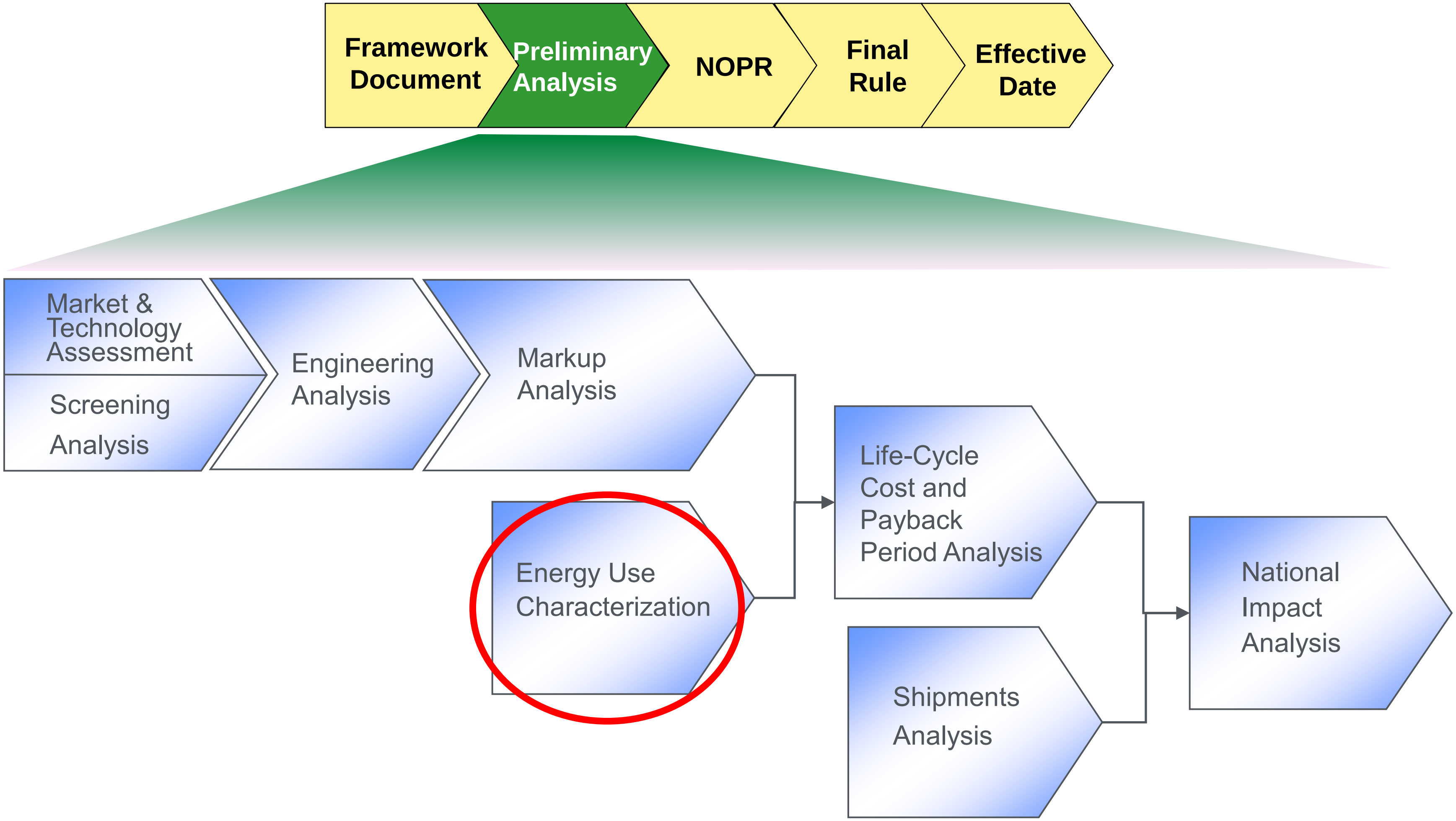
Markups Analysis

- Weighting the values by the respective shares of each channel yields an average overall baseline markup of 1.63 and an overall incremental markup of 1.50.

Issue 15: DOE requests comments about viable alternative approaches or source of information that could be used to develop product prices.

Steps in the Standards Rulemaking: Preliminary Analysis

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



Energy Use Characterization

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Purpose

- Develop annual energy use data for electric motors based on field operating conditions

Method

- DOE developed average energy use values by using typical motor operating profiles associated to different applications (e.g., compressors, fans, and pumps)
- Developed distributions of electric motor operating hours and motor loading data to account for variability in the field
- Include power factor effects on local power circuit
- Focus on representative units

Energy Use Characterization

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- For electric motors, the energy used by the motors refers to the "energy losses", the rest is converted to useful mechanical shaft power.
- Annual energy use (motors losses and mechanical power), in kWh:

$$E = \frac{HP \times L \times 0.746}{\eta(L)} \times H_{op}$$

Where:

- E: Annual energy use (kWh/yr);
- HP: Motor capacity (hp);
- L: Motor load (%);
- H_{op}: Annual operating hours (hr/yr); and
- $\eta(L)$: efficiency at load L (%).

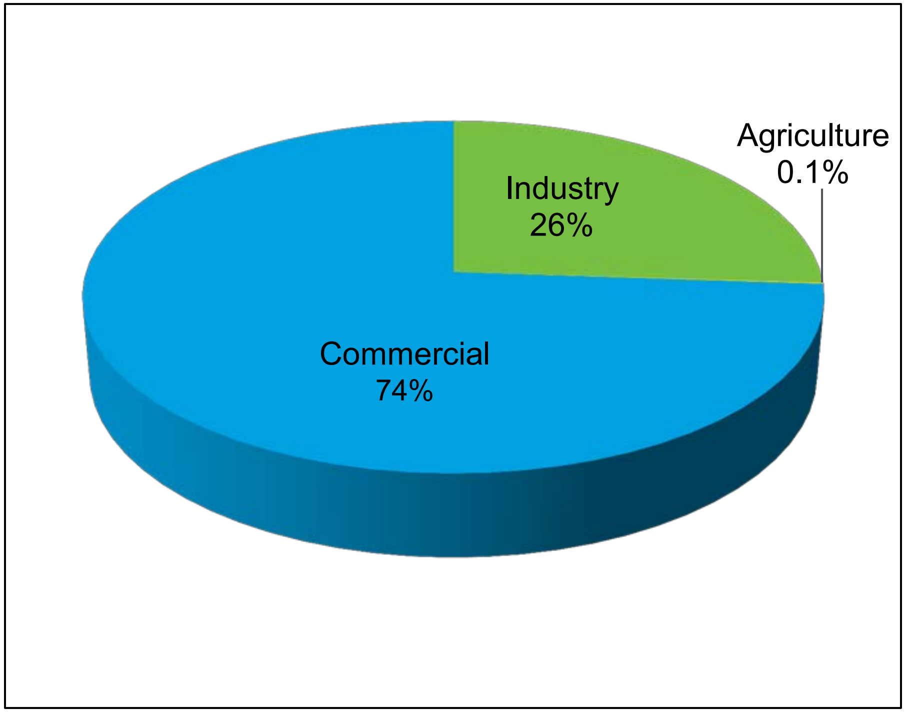
- Motor annual losses, in kWh:

$$E_{losses} = E \times (1 - \eta(L))$$

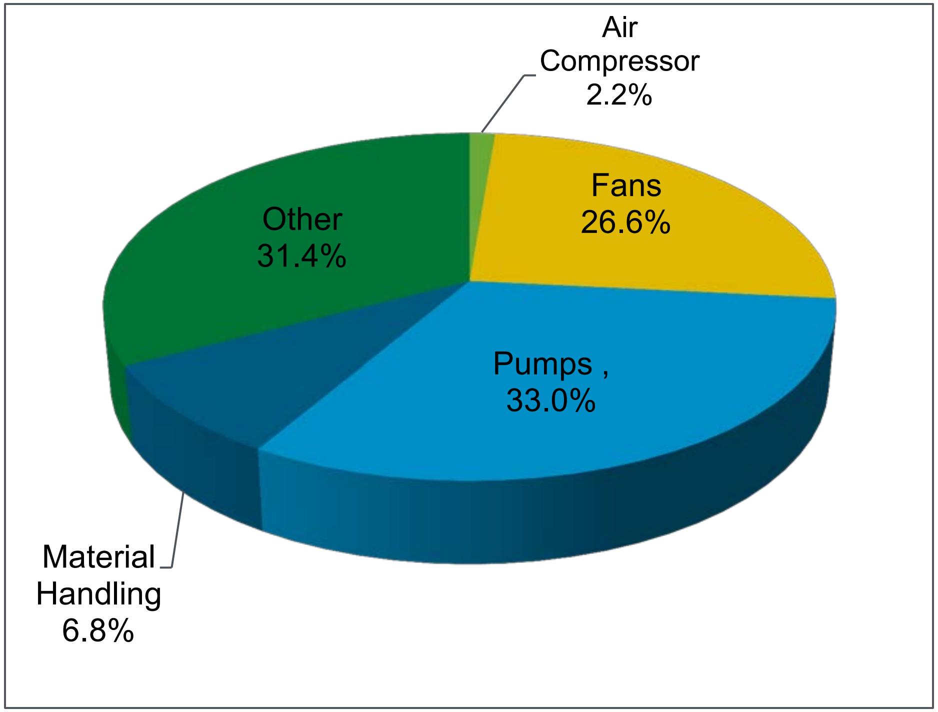
Energy Use Characterization

- DOE developed a model of motor population based on literature review and 123 field assessment data*:
  - Established distributions across sectors and applications.

Distribution by Sector (example): All equipment class groups, 6-20 HP Motors



Distribution by Application (example): Equipment class group 1, 6-20 HP Motors



*Database of motor nameplate and field measurement data compiled by the Washington State University Extension Energy Program (WSU) and Applied Proactive Technologies (APT) under contract with the New York State Energy Research and Development Authority (NYSERDA). 2011.

Energy Use Characterization

- Determined average values for annual operating hours by application, sector, and horsepower range.

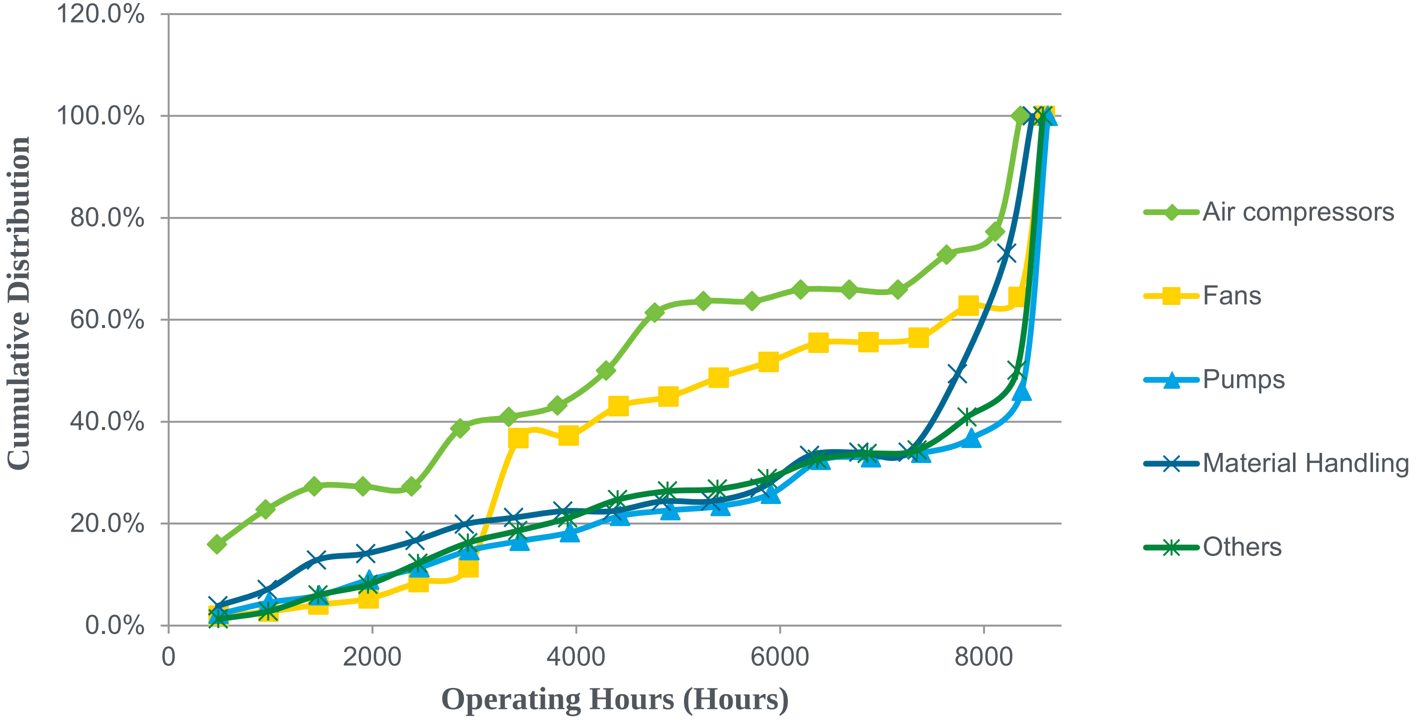
Average Operating Hours (Industry sector)

Application	1-5 hp	6-20 hp	21-50 hp	51-100 hp	101-200 hp	201-500 hp
Air Compressors	4,647	5,033	4,578	5,337	6,226	6,349
Fans	6,193	6,490	5,849	6,975	7,163	8,015
Pumps	6,028	6,773	6,972	6,869	6,985	6,934
Material Handling	6,486	6,284	6,518	6,315	7,172	6,116
Other	6,571	6,274	6,814	7,128	7,337	7,528

Energy Use Characterization

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

– Developed statistical distributions to account for variability in the field.



Operating Hours Cumulative Distribution. Example: Equipment class group 1, 21-50 hp, Industry sector.

Energy Use Characterization

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

– Determined average values for motor load by application.

Average motor load (all equipment classes)

Application	Average Annual Load in Percentage
Air Compressors	69.6
Fans	60.4
Pumps	68.3
Material Handling	48.3
Other	70.5

Energy Use Characterization

- Used engineering test data which provides efficiency vs. load measurements for each CSL to develop losses vs. load relationships.

Example of Losses (watts) vs. Load (percent) for Representative Unit 1

Representative Unit 1	CSL	Operating Load						
		0%	25%	50%	75%	100%	125%	150%
NEMA Design A and B, 5 HP, 4 Poles, Enclosed Motor	0	234.2	282.8	381.4	545.6	791.2	1134.0	1589.7
	1	169.6	197.0	260.3	369.0	532.9	761.6	1064.9
	2	158.0	183.8	230.6	311.1	437.6	622.8	879.1
	3	150.3	167.9	213.2	290.7	405.3	561.6	764.4
	4	143.5	167.0	209.2	274.8	368.9	496.2	661.6
	5	135.3	152.3	190.1	251.0	337.6	452.1	596.9

Energy Use Characterization

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Average Annual Energy Consumption by Efficiency Level

Representative Unit	Description	hp	kilowatt-hours per year					
			CSL 0	CSL 1	CSL 2	CSL 3	CSL 4	CSL 5
1	NEMA Design B, T-frame, 4 poles, enclosed	5	10,448	9,869	9,691	9,616	9,567	9,487
2		30	57,642	55,912	55,021	54,492	54,326	
3		75	204,834	202,540	198,496	197,697	197,194	196,604

Representative Unit	Description	hp	kilowatt-hours per year					
			CSL 0	CSL 1	CSL 2	CSL 3	CSL 4	CSL 5
4	NEMA Design C, T-frame, 4 poles, enclosed	5	9,987	9,808	9,738	9,630		
5		50	89,523	88,507	88,119	87,444		

Representative Unit	Description	hp	kilowatt-hours per year					
			CSL 0	CSL 1	CSL 2	CSL 3	CSL 4	CSL 5
6	Fire pump, 4 poles, enclosed	5	19.6	19.2	19.1	19.0	18.8	
7		30	1,601	1,577	1,562	1,558	1,558	
8		75	97,791	95,934	95,554	95,313	95,033	

Request for Comments

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Issue 16: DOE seeks comment on any additional sources of data that could be used to establish the distribution of motors across sectors by horsepower range.

Issue 17: DOE seeks comment on any additional sources of data that could be used to establish the sector-specific distribution of motors across applications.

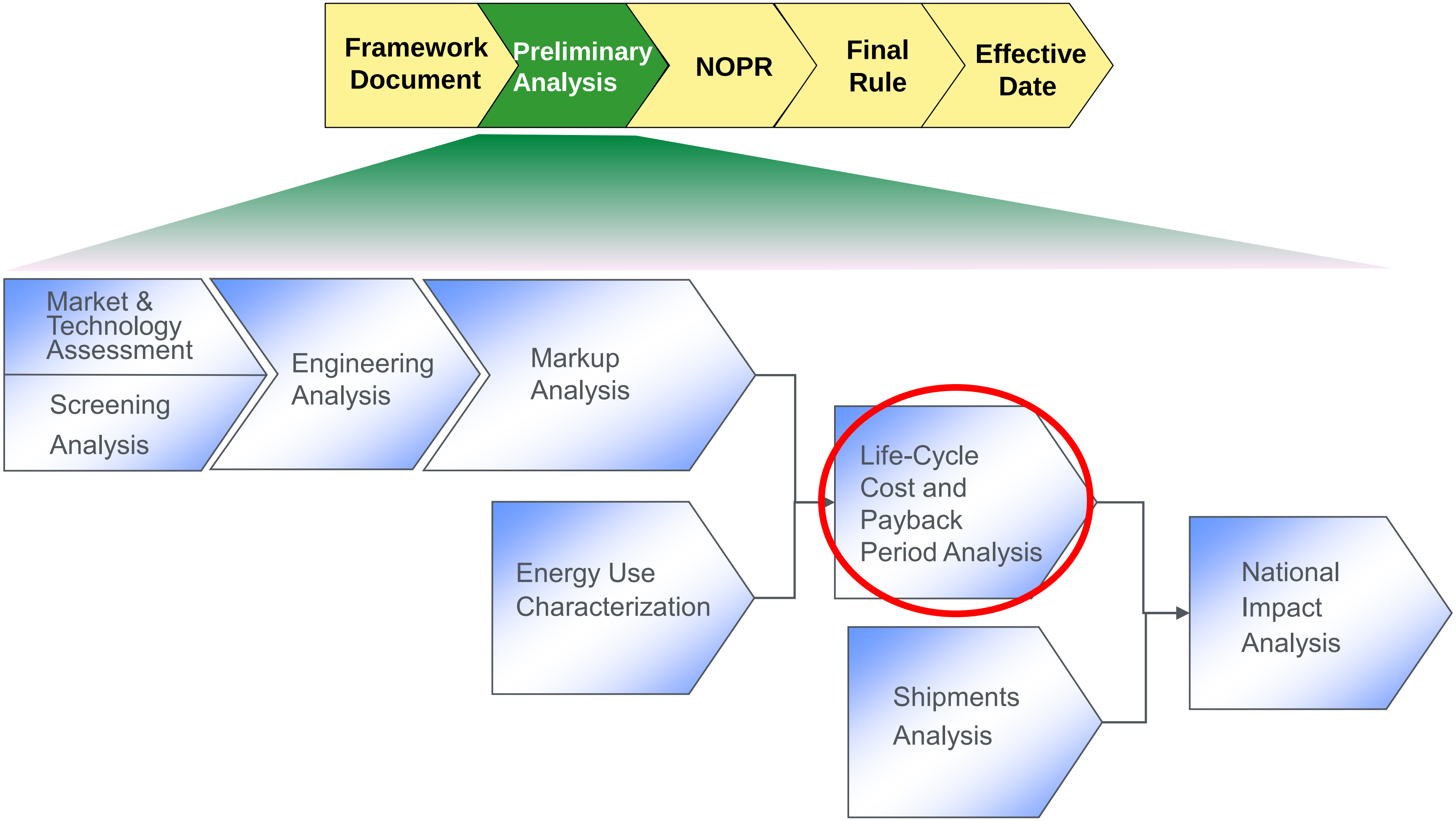
Issue 18: DOE seeks comment on any additional sources of field data on motor operating hours and loading that could be used to improve field use characterization in the commercial and agricultural sectors.

Public Meeting Agenda

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

1. Overview
2. Test Procedure
3. Market & Tech; Screening; Engineering
4. Markups; Energy Characterization
5. **Life-Cycle Cost and Payback Period Analysis**
6. National Impact Analysis
7. Preliminary MIA; NOPR Analyses

Steps in the Standards Rulemaking: Preliminary Analysis



Life-Cycle Cost and Payback Period Analysis

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

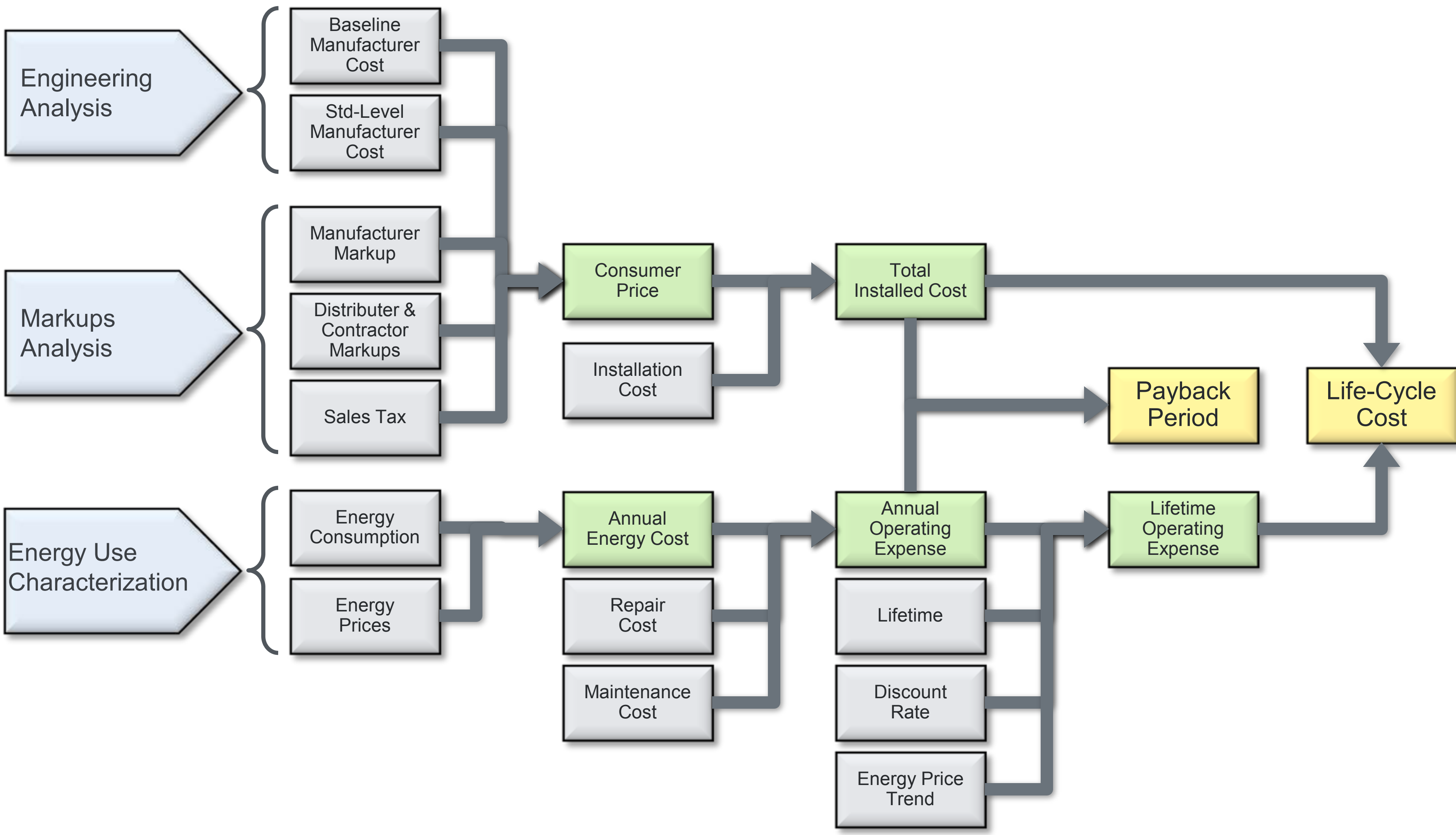
Purpose

- Assess the LCC impacts and PBP for the consumers of electric motors under the considered efficiency levels

Method

- LCC equals total installed costs plus the sum of annual operating costs discounted to a particular base year
- Analysis will model the uncertainty and variability of inputs using Monte Carlo approach and probability distributions
- Analysis will be implemented in MS Excel® spreadsheet combined with Crystal Ball®

Life-Cycle Cost and Payback Period Analysis



Energy Prices

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

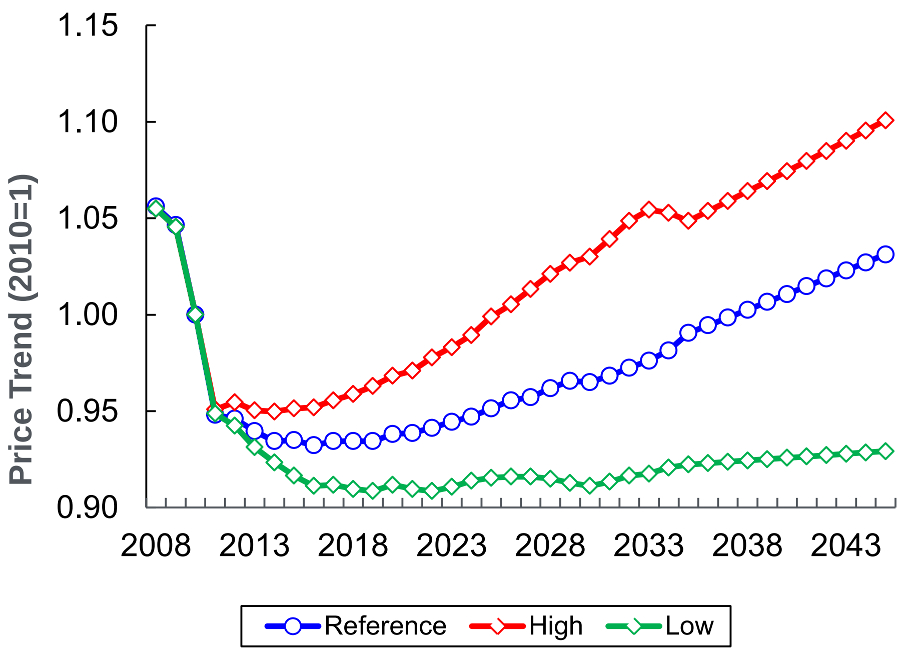
- Electricity prices are used to convert energy use to energy costs.
- DOE considered regional electricity prices by sector.
- DOE uses projections of national average energy prices for commercial and industrial customers – from the most recent EIA Annual Energy Outlook (AEO) – to project future energy prices for the LCC analysis.
- DOE also surveyed reactive power prices.

Energy Prices

Average Electricity Prices in 2010

Census Region	Industry/Agriculture	Commercial sector
	20011$/kWh	*2011$/kWh*
Northeast	0.103	0.149
Midwest	0.084	0.095
South	0.078	0.100
West	0.094	0.120
Average (weighted)	0.087	0.111

Source: *EIA Form 861*



Industrial Electricity Price Trends

Source: *AEO 2011*

Life-Cycle Cost Discount Rates

- DOE uses the discount rate to determine the present value of lifetime operating expenses.
- DOE derived a distribution of discount rates for the commercial and industrial sectors.
  - These distributions were developed by estimating the weighted average cost of capital (WACC) for commercial and industrial consumers of electric motors.
  - WACC includes:
    - Financial cost of any debt incurred to purchase equipment.
    - Opportunity cost of any equity to purchase equipment.

Installation, Maintenance, and Repair Costs

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- DOE evaluated how installation, maintenance, and repair costs change with increased efficiency. Data sources included:
  - RS Means;
  - Vaughens;
  - Manufacturer literature; and,
  - Expert consultants.
- Installation costs: DOE assumed no changes in installation costs with increased efficiency (no changes in motor frame designation with increased efficiency)
- Repair costs : DOE developed a repair cost model based on Vaughens data.
- Maintenance costs: DOE assumed no changes with increased efficiency

Impact of Repair

- Impact of repair on efficiency:
  - One-third of repairs are performed following industry recommended practice and do not affect the efficiency of the motor.
  - Two-thirds of repairs do not follow industry recommended practice:
    - Efficiency drops by 1 percent (<40 hp),
    - Efficiency drops by 0.5 percent (>=40 hp).

- Average repair frequency:
  - For NEMA Design A, B, and C medium motors, repair occurs after 32,000 hours operation, or 5, 16, and 15 years in the industrial, commercial, and agricultural sectors, respectively.
  - For fire pump electric motors, assumed there is no repair due to the low operating hours.

Request for Comments

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Issue 19: DOE welcomes comments on the current method used to determine motor repair costs.

Issue 20: DOE seeks comment on any additional sources for determining the frequency of motor repair depending on equipment class, sector, and application.

Issue 21: DOE seeks comment on any additional sources of data on motor maintenance costs. Specifically, DOE invites comment on how amended efficiency requirements may affect maintenance costs.

Issue 22: DOE may consider technology options that could affect a motor's mechanical configuration. DOE invites comment on how changes in motor mechanical configurations that may accompany more efficient motors may affect installation costs.

Electric Motors Lifetimes

- DOE used information from various literature sources and expert estimates to establish motor lifetimes in hours by horsepower range.

Motor Mechanical Lifetime by Horsepower Range Across All Sectors

Horsepower Range *hp*	Mechanical Lifetime *hours*
1 – 5	31,505
6 – 20	32,850
21 – 50	64,881
51 – 100	67,819
101 – 200	106,424
201 – 500	108,398

- In the LCC, DOE considered a negative correlation between motor lifetime (in years) and operating hours.

Electric Motors Lifetimes

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Estimated Average Lifetime for Equipment Class Group 1

Horsepower Range	Weighted Average Lifetime *yr*		
hp	**Industrial**	**Commercial**	**Agricultural**
1-5	5	15	13
6-20	5	14	13
21-50	10	26	25
51-100	10	26	26
101-200	15	29	29
201-500	15	29	29

Electric Motors Lifetimes

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- For motors below 75 horsepower which are most often embedded in a larger equipment, DOE assumed that the motor is retired when it reached its lifetime or when the equipment of which it is a part reaches its lifetime, whichever happens first.

Issue 23: DOE seeks comment on any additional sources of data on motor lifetime that could be used to validate DOE's estimates of motor mechanical lifetime and its method of estimating lifetimes.

Base-Case Efficiency Distribution

- Base case efficiency assignment accounts for the projected market share of motors at different efficiency levels.
  - Not all motors considered in the analysis are covered by the current standards,
  - Not all consumers purchase motors meeting the current minimum standard,
  - LCC analysis recognizes that consumers already purchasing motors at efficiencies greater than or equal to a prospective standard level are not impacted by the standard.

Base-Case Efficiency Distribution

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- DOE established the base case efficiency distribution using data from major motor manufacturers and distributor's 2011 catalog (model counts).
- DOE used these data to establish efficiency distributions by equipment class group and horsepower range.

Efficiency Distribution for Equipment Class Group 1, 1-5 HP

Level	Note	Label	Share (%)
0	Lowest observed efficiency under expanded scope	Minimum Commercially Available	5.5%
1	EPACT 1992 requirement, with additional efficiency levels added in NEMA MG1-2011	Standard	38.4%
2	EISA 2007 requirement for general purpose electric motors (subtype I), with additional efficiency values added in NEMA MG1-2011	Premium	44.4%
3	One NEMA nominal efficiency level improvement relative to the Premium level	Best-in-Market	7.6%
4	One NEMA nominal efficiency level improvement relative to CSL 3	Incremental	3.0%
5	One NEMA nominal efficiency level improvement relative to CSL 4	Maximum Technology	1.1%

Base-Case Efficiency Distribution

Issue 24: DOE seeks comment on the estimated base case distribution of equipment efficiencies and on any additional sources of data.

Example of LCC and Payback Results for NEMA Design B, T Frame, 5 HP, Four Poles, Enclosed Motor

Efficiency Level	Full Load Nominal Efficiency %	Life-Cycle Cost *(2010$)*				Life-Cycle Cost Savings			Payback Period *years*	
		Average Installed Price *$*	Average Energy Use *kWh/yr*	Average Operating Cost *$*	Average LCC *$*	Average Savings *(2010$)* *$*	Customers with Net Cost *%*	Customers with Net Benefit *%*	Average	Median
0	82.5	584	10,448	1,006	5,926					
1	87.5	588	9,869	969	5,649	16	0.1	5.8	0.4	0.1
2	89.5	651	9,691	963	5,631	25	18.9	26.4	33.7	5.1
3	90.2	665	9,616	960	5,608	45	20.5	67.8	59.0	4.7
4	91.0	909	9,567	960	5,831	-169	89.3	6.5	361.4	28.2
5	91.7	998	9,487	958	5,883	-220	93.3	5.4	162.7	26.9

Example of LCC and Payback Results for NEMA Design B, T Frame, 75 HP, Four Poles, Enclosed Motor

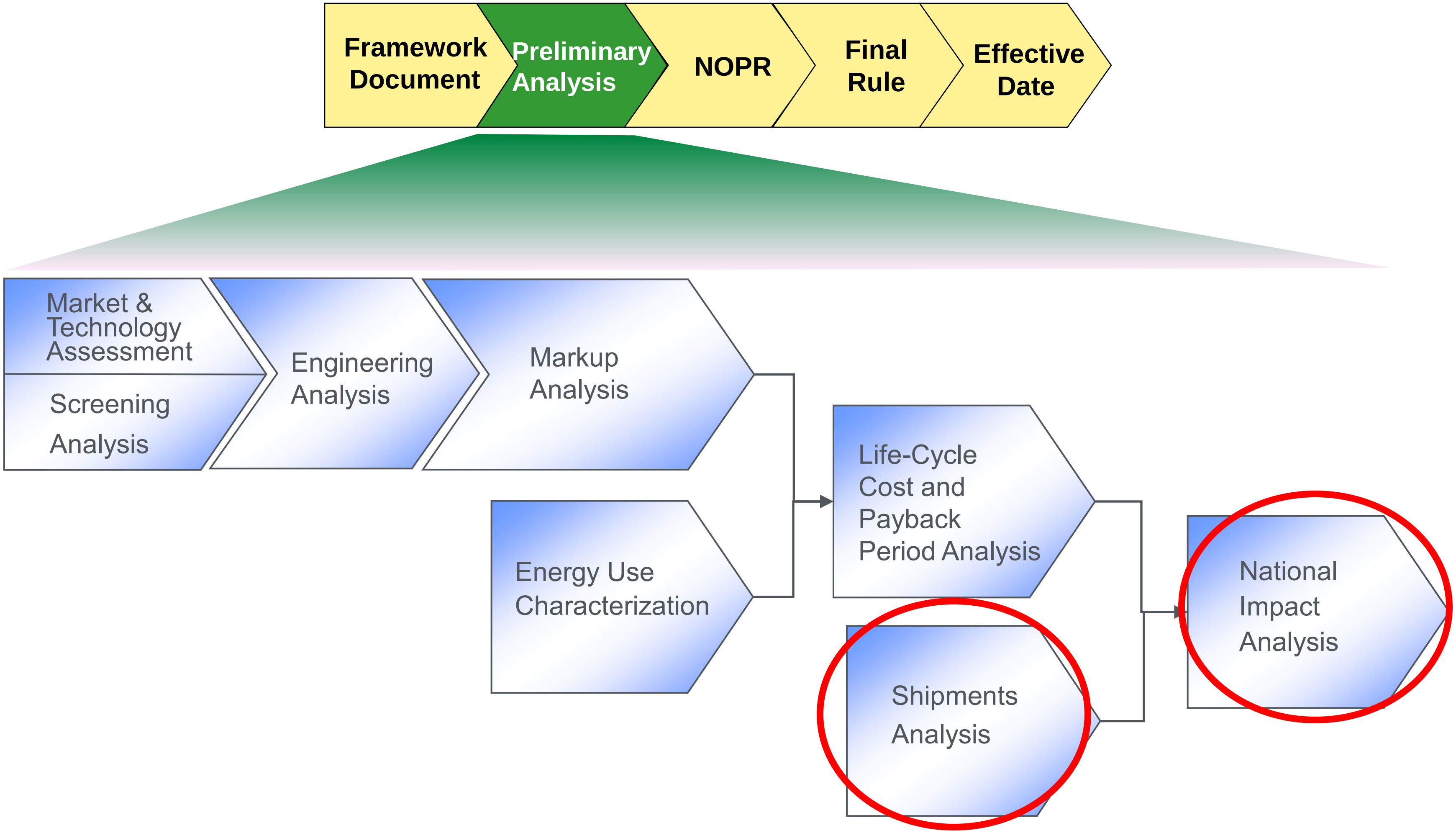
Efficiency Level	Full Load Nominal Efficiency *%*	Life-Cycle Cost *(2010$)*				Life-Cycle Cost Savings			Payback Period *years*	
		Average Installed Price *$*	Average Energy Use *kWh/yr*	Average Operating Cost *$*	Average LCC *$*	Average Savings *(2010$)* *$*	Customers with: Net Cost *%*	Customers with: Net Benefit *%*	Average	Median
0	93.0	3,463	204,834	17,168	124,170					
1	94.1	3,831	202,540	17,033	123,348	40	0.8	4.5	24.3	2.9
2	95.4	4,296	198,496	16,733	121,510	663	1.4	32.9	6.6	1.5
3	95.8	4,776	197,697	16,687	121,590	597	35.1	47.5	38.3	6.5
4	96.2	6,044	197,194	16,661	122,598	-340	66.9	25.9	162.7	15.5
5	96.5	6,640	196,604	16,631	122,905	-639	73.6	23.7	136.2	16.0

Public Meeting Agenda

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

1. Overview
2. Test Procedure
3. Market & Tech; Screening; Engineering
4. Markups; Energy Characterization
5. Life-Cycle Cost and Payback Period Analysis
6. National Impact Analysis
7. Preliminary MIA; NOPR Analyses

Steps in the Standards Rulemaking: Preliminary Analysis



National Impact Analysis
Shipments Analysis

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Purpose

- To estimate electric motor shipments in the base case and standards cases

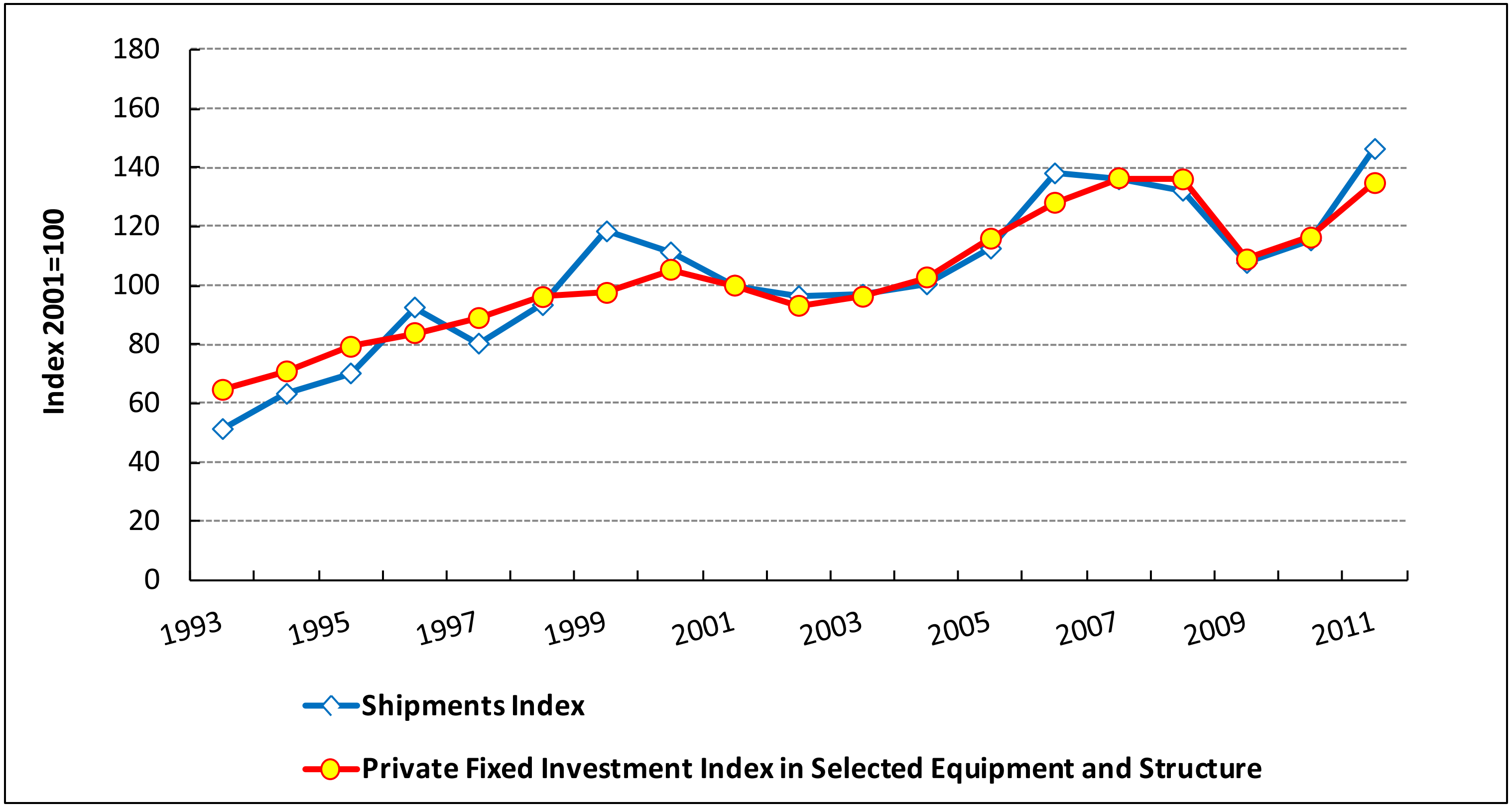
Method

- The shipments model relies on two main sources:
  - Current and historical shipments data (Market research report, inputs from interested parties, U.S. Census, NEMA)
  - Fixed investment data (Bureau of Economic Analysis)
  - Gross Domestic Product projections (AEO 2011)
- Assuming shipments are driven by economic growth and fixed investments in equipment including motors.

National Impact Analysis
Shipments Analysis

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- DOE uses a shipments model driven by fixed investments in selected equipment



National Impact Analysis Shipments Analysis

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Shipments index vs. Private fixed investment index:

$$Shipments_{index}(y) = 1.15126 \cdot FixInvest_{index}(y) - 15.17265$$

Where,

$$Shipments_{index}(y) = Shipments(y) / Shipments(2001)$$
$$FixInvest_{index}(y) = FixInvest(y) / FixInvest(2001)$$

- Shipments projections (in units) based on private fixed investment projections using:
  - 2011 Annual Energy Outlook (2015 – 2035),
  - Extrapolations (2036 – 2044).

National Impact Analysis
Shipments Analysis

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Annual shipments of covered motors were estimated to total 4.56 million units in 2011.

Range (hp)	2011 Shipments (thousand units)	Percentage of Total (%)
1-5	2,688	58.5
6-20	1,368	30.0
21-50	342	7.5
51-100	114	2.5
101-200	46	1.0
201-500	23	0.5
Total	**4,560**	**100**

National Impact Analysis
Shipments Analysis

- Shipments projection

	Annual Shipments (thousand units)				
Equipment Class Group	2015	2025	2035	2044	Cumulative 2015-2044
NEMA Design A and B	5,072	7,254	9,958	13,005	256,846
NEMA Design C	10	15	20	26	515
Fire Pump Electric Motors	6	9	12	16	309
Total	5,098	7,278	9,990	13,047	257,671

National Impact Analysis
Shipments Analysis

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- DOE used a wide range of sources to establish the distribution across equipment class groups and equipment classes:
  - Current and historical shipments data (Market research report, inputs from interested parties, U.S. Census),
  - A database of 123 plant assessments*.

Issue 25: DOE seeks comment on any additional sources of data on motor shipments that could be used to validate its shipments model and estimates.

*Database of motor nameplate and field measurement data compiled by the Washington State University Extension Energy Program (WSU) and Applied Proactive Technologies (APT) under contract with the New York State Energy Research and Development Authority (NYSERDA). 2011.

Base-Case Shipments Projection Approach

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Provides the basis to compare projections for higher efficiency levels (standards case).
- Depicts the situation where new or amended standards are not adopted.
- Depicts the current and projected mix of electric motor efficiencies sold in the absence of new regulation.
  - DOE assumed no changes in motor shipment efficiencies in the absence of new regulation (constant and equal to 2011 levels).

Issue 26: DOE seeks further comment on its tentative decision to use constant efficiencies for the analysis period. Specifically, DOE seeks comments on additional sources of data on trends in efficiency improvement.

Standards Impacts on Motor Shipments

- Increased electric motor prices could affect the repair vs. replace decision that the user makes and could lead to increasing the longevity of less efficient electric motors and decreased shipments.
- No data to quantitatively estimate the impact of increased motor prices (from higher efficiency standard levels) on shipments.
- Used a price elasticity equal to zero as a default.

Request for comment

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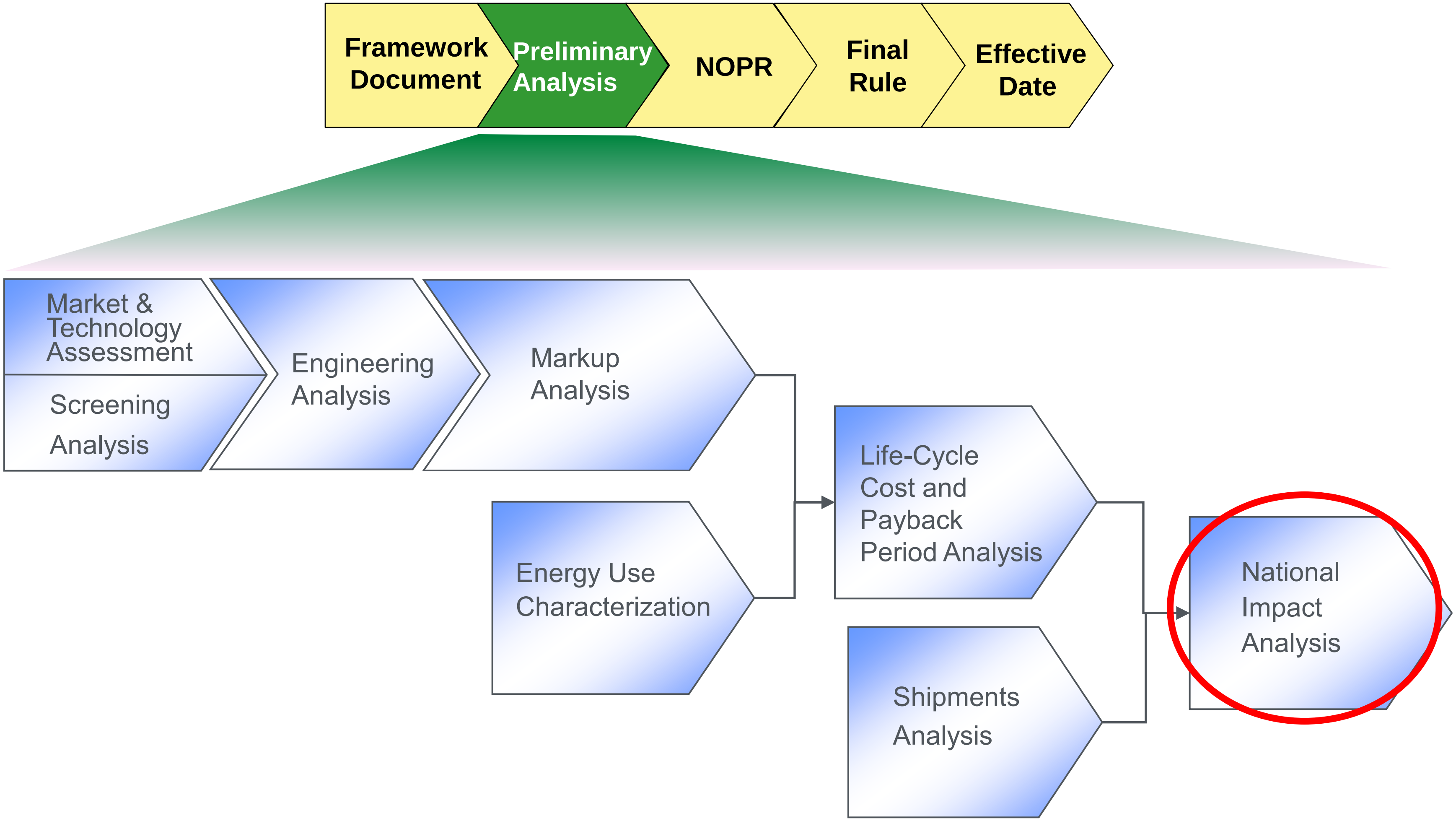
Issue 27: DOE seeks comment on any sources of data that could be used to quantitatively estimate motor price elasticity. DOE also seeks comments on any additional sources of data on the share of motor shipments which are for new installation, and the share of shipments which are for replacement.

Steps in the Standards Rulemaking: Preliminary Analysis

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



National Impact Analysis

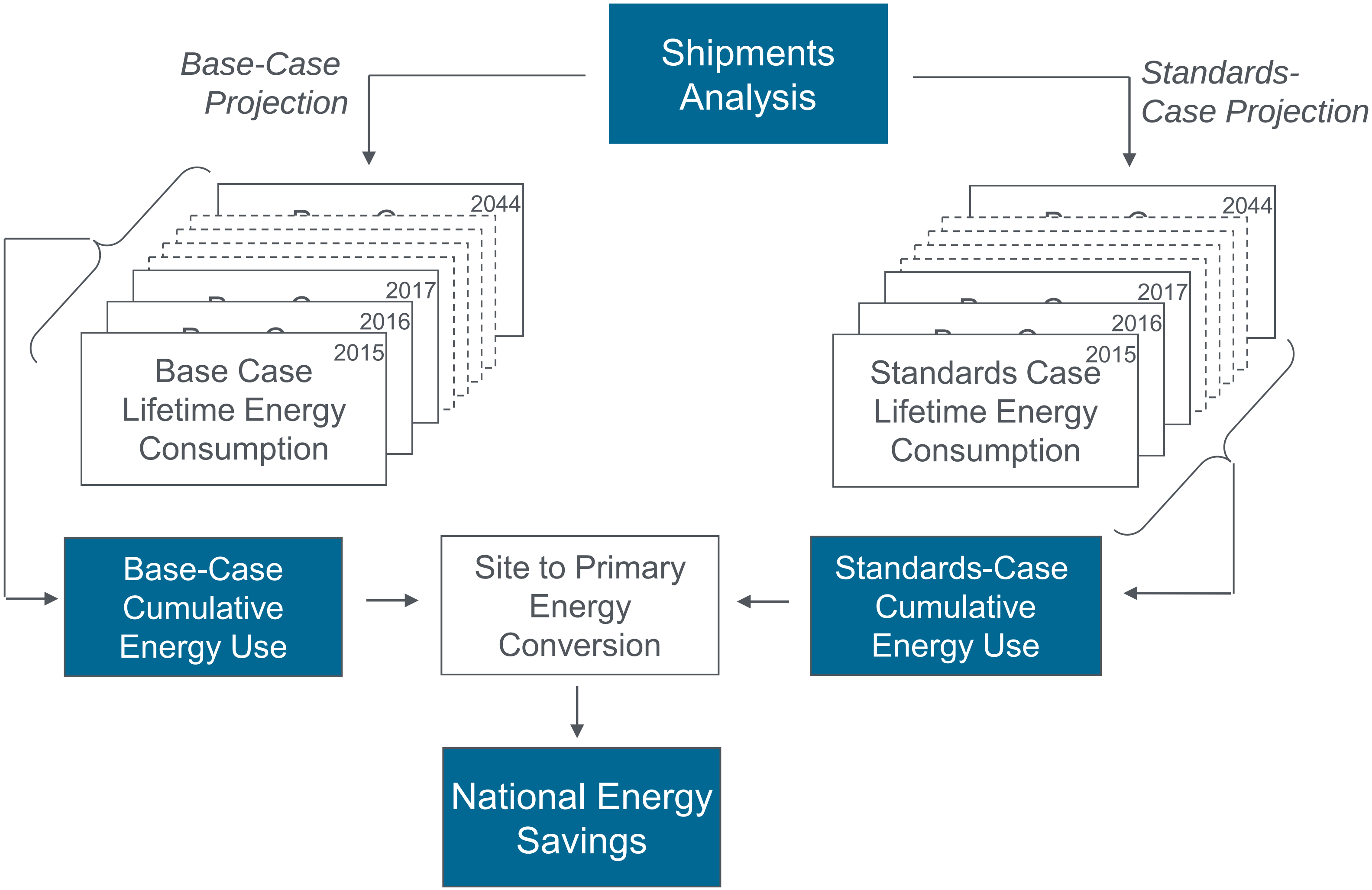
Purpose

- For equipment shipped from 2015 to 2044:
  - To estimate the National Energy Savings (NES) from new and amended energy conservation standards at different efficiency levels
  - To estimate the national economic impact electric motor users (or the Net Present Value (NPV)) from energy conservation standards at different efficiency levels

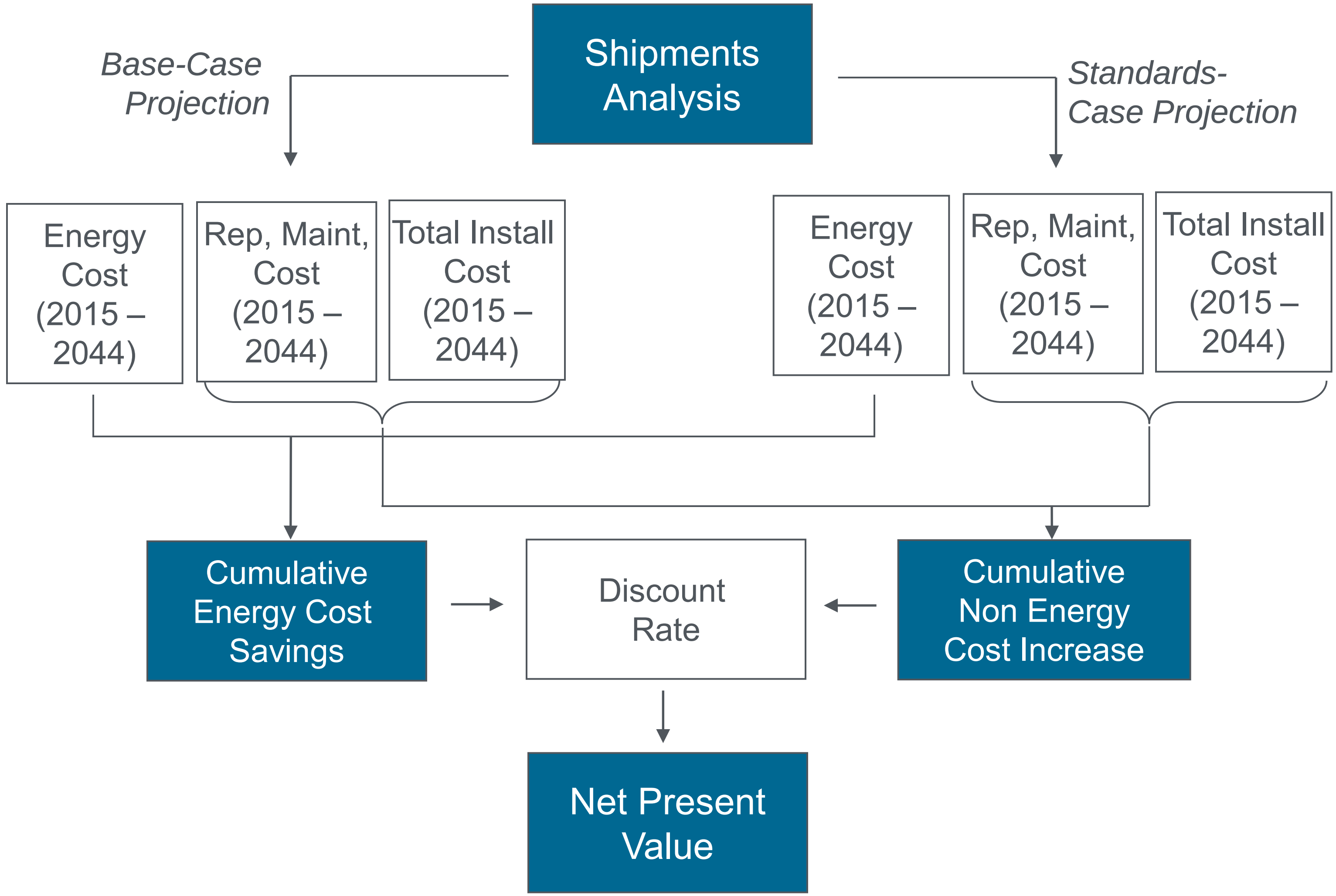
Method

- DOE calculates national energy savings by multiplying unit lifetime energy savings by projected shipments and accumulating this projected value over the 30 years
- DOE calculates the NPV by accumulating the difference each year between energy bill savings and increased equipment expenditures for all motors shipped over the 30 year period

National Energy Savings Flow Diagram



National Consumer Net Present Value Flow Diagram



National Impact Analysis Inputs

Total Installed Cost	Scaled across equipment classes based on the engineering outputs and depending on the efficiency level.
Repair and Maintenance Costs	Repair costs are a function of motor configuration and efficiency level. Assumed constant maintenance costs across efficiency levels.
Weight	Scaled (same method used for Total Installed Cost)
Annual Energy Use	Annual average values per equipment class and efficiency level calculated based on inputs from the Energy Use Characterization.
Base-Case Efficiencies	Shipments-weighted efficiencies based on base case efficiency distributions as presented in the LCC analysis. Frozen at the effective year and constant across the analysis period.
Standards-Case Projected Efficiencies	Roll-up scenario assumed for determining shipment-weighted efficiency for each standards case. Frozen at the effective year and constant across the analysis period.
Energy Prices	Average prices and projected energy prices from EIA AEO2011 forecasts (to 2030) and extrapolation to 2044.
Electricity Site-to-Primary Conversion Factors	Conversion factors based on NEMS corresponding to AEO 2011. Factors vary annually and account for generation, distribution, and transmission losses.
Discount Rate	7 percent and 3 percent real from OMB's Regulatory Analysis Guideline A-4.
Present Year	Future expenses are discounted to the year 2011.

Total Installed Cost

- Includes direct equipment costs and shipping costs.
- Developed MSP and weight data from engineering analysis for all equipment classes:
  - At each CSL, for 4 poles, enclosed motors, DOE developed a relationship between MSP (/weight) and horsepower for each equipment class group, based on the data for the representative units. (power law regressions).

CSL 2/MSP	Open				Enclosed			
	2	4	6	8	2	4	6	8
1								
1.5								
2								
3								
5						358		
7.5								
10								
15								
20								
25								
30						1,193		
40								
50								
60								
75						2,270		
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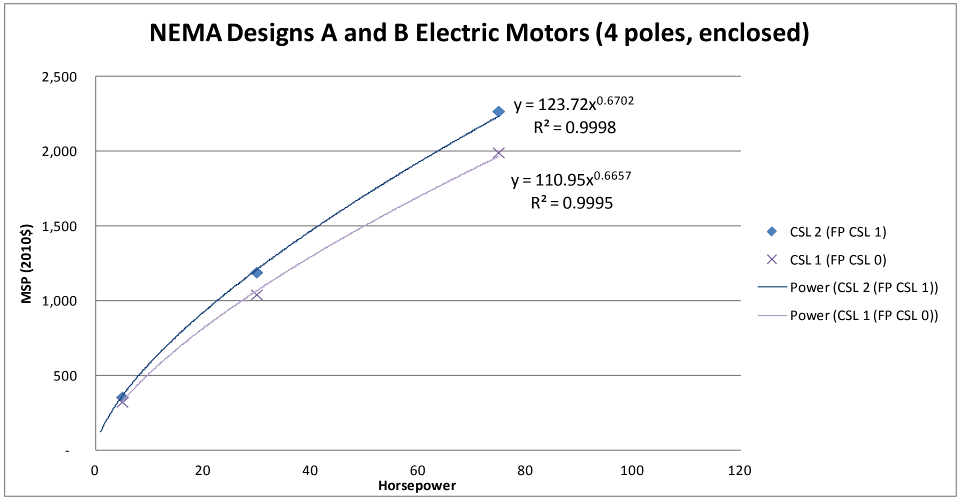
350								
400								
450								
500								



Total Installed Cost

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Developed MSP and weight data from engineering analysis for all equipment classes:
  - At each CSL and horsepower rating, DOE established an index to describe how MSP (/weight) varies by pole and enclosure using statistical estimates derived from a database of motor specifications.

CSL	Open				Encl			
2	2	4	6	8	2	4	6	8
1	0.957	0.972	0.987	1.002	0.985	1.000	1.015	1.030
1.5	0.939	0.960	0.981	1.002	0.979	1.000	1.021	1.042
2	0.922	0.949						
3	0.891	0.929						
5	0.842	0.897						
7.5	0.796	0.867						
10	0.762	0.844						
15	0.713	0.813						
20	0.681	0.791						
25	0.658	0.776						
30	0.640	0.764						
40	0.615	0.748						
50	0.599	0.738						
60	0.587	0.730						
75	0.574	0.722						
100	0.561	0.713	0.865	1.017	0.848	1.000	1.152	1.304
125	0.553	0.707	0.862	1.017	0.845	1.000	1.155	1.309
150	0.547	0.704	0.860	1.017	0.843	1.000	1.157	1.313
200	0.540	0.699	0.858	1.017	0.841	1.000	1.159	1.319
250	0.535	0.696	0.857	1.018	0.839	1.000	1.161	1.322
300	0.532	0.694	0.856	1.018	0.838	1.000	1.162	1.324
350	0.530	0.692	0.855	1.018	0.837	1.000	1.163	1.325
400	0.528	0.691	0.855	1.018	0.837	1.000	1.163	1.327
450	0.527	0.690	0.854	1.018	0.836	1.000	1.164	1.327
500	0.526	0.690	0.854	1.018	0.836	1.000	1.164	1.328

CSL	Open				Encl			
2	2	4	6	8	2	4	6	8
1	0.957	0.972	0.987	1.002	0.985	1.000	1.015	1.030
1.5	0.939	0.960	0.981	1.002	0.979	1.000	1.021	1.042
2	0.922	0.949	0.976	1.003	0.973	1.000	1.027	1.054
3	0.891	0.929	0.966	1.004	0.962	1.000	1.038	1.075
5	0.842	0.897	0.951	1.006	0.945	1.000	1.055	1.109

Request for comment

Issue 28: DOE seeks comment on its scaled values for MSPs. In particular, DOE seeks comments on its methodology for scaling MSP data from the representative equipment classes to the remaining equipment classes.

Issue 29: DOE seeks comment on the scaled values for motor weights. In particular, DOE seeks comments on its methodology for scaling weight data from the representative equipment classes to the remaining equipment classes.

National Impact Assessment

- NES Summary (quads) primary energy

Motor Size *hp*	All hp	1-5	6-20	21-50	51-100	101-200	201-500
Equipment Class Group 1 – NEMA Designs A & B							
CSL 1	**0.972**	0.270	0.284	0.161	0.108	0.078	0.071
CSL 2	**4.414**	0.954	1.211	0.668	0.527	0.410	0.644
CSL 3	**7.527**	1.509	1.980	1.179	0.937	0.831	1.090
CSL 4	**10.836**	2.123	2.855	1.704	1.378	1.265	1.511
CSL 5	**13.005**	2.701	3.201	1.704	1.789	1.680	1.929
Equipment Class Group 2 – NEMA Design C							
CSL 1	**0.012**	0.003	0.004	0.002	0.001	0.001	-
CSL 2	**0.018**	0.004	0.006	0.003	0.002	0.002	-
CSL 3	**0.024**	0.006	0.008	0.004	0.003	0.003	-
Equipment Class Group 3 – Fire Pumps							
CSL 1	**0.003**	0.000	0.000	0.000	0.001	0.001	0.001
CSL 2	**0.005**	0.000	0.000	0.000	0.002	0.001	0.001
CSL 3	**0.006**	0.000	0.000	0.000	0.002	0.002	0.002
CSL 4	**0.008**	0.000	0.000	0.000	0.003	0.002	0.002

National Impact Assessment

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Equipment class group 1 - NPV Summary (billion 2011$)

	Discount Rate %	ALL *hp*	1-5 *hp*	6-21 *hp*	21-50 *hp*	51-100 *hp*	101-200 *hp*	201-500 *hp*
Equipment Class Group 1 – NEMA Designs A & B								
CSL 1	3	**5.53**	1.67	1.78	0.94	0.54	0.35	0.25
	7	**2.32**	0.73	0.76	0.38	0.22	0.13	0.09
CSL 2	3	**18.42**	3.57	5.52	2.98	2.27	1.68	2.41
	7	**7.07**	1.39	2.15	1.13	0.90	0.63	0.87
CSL 3	3	**30.19**	5.65	8.50	4.91	3.71	3.25	4.16
	7	**11.42**	2.24	3.25	1.80	1.43	1.20	1.50
CSL 4	3	**-6.63**	-6.29	-4.67	-1.32	0.57	1.73	3.34
	7	**-10.37**	-4.47	-4.37	-1.90	-0.50	0.10	0.77
CSL 5	3	**-8.63**	-8.81	-5.92	-1.32	0.64	2.38	4.40
	7	**-12.71**	-6.09	-5.26	-1.90	-0.70	0.19	1.05

National Impact Assessment

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Equipment class group 2 - NPV Summary (billion 2011$)

	Discount Rate %	ALL *hp*	1-5 *hp*	6-21 *hp*	21-50 *hp*	51-100 *hp*	101-200 *hp*	201-500 *hp*
Equipment Class Group 2 – NEMA Designs C								
CSL 1	3	**0.05**	0.01	0.02	0.01	0.00	0.00	-
	7	**0.02**	0.01	0.01	0.00	0.00	0.00	-
CSL 2	3	**0.01**	-0.01	0.00	0.01	0.01	0.01	-
	7	**-0.01**	-0.01	0.00	0.00	0.00	0.00	-
CSL 3	3	**0.02**	-0.01	0.00	0.01	0.01	0.01	-
	7	**-0.01**	-0.01	0.00	0.00	0.00	0.00	-

National Impact Assessment

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Equipment class group 3 - NPV Summary (billion 2011$)

	Discount Rate %	ALL *hp*	1-5 *hp*	6-21 *hp*	21-50 *hp*	51-100 *hp*	101-200 *hp*	201-500 *hp*
Equipment Class Group 3 – Fire Pump Electric motors								
CSL 1	3	**-0.02**	-0.01	-0.01	0.00	0.00	0.00	0.00
	7	**-0.01**	0.00	0.00	0.00	0.00	0.00	0.00
CSL 2	3	**-0.03**	-0.02	-0.01	-0.01	0.00	0.00	0.00
	7	**-0.01**	-0.01	-0.01	0.00	0.00	0.00	0.00
CSL 3	3	**-0.10**	-0.04	-0.04	-0.02	0.00	0.00	0.00
	7	**-0.05**	-0.02	-0.02	-0.01	0.00	0.00	0.00
CSL 4	3	**-0.11**	-0.05	-0.05	-0.02	0.00	0.00	0.00
	7	**-0.06**	-0.02	-0.02	-0.01	0.00	0.00	0.00

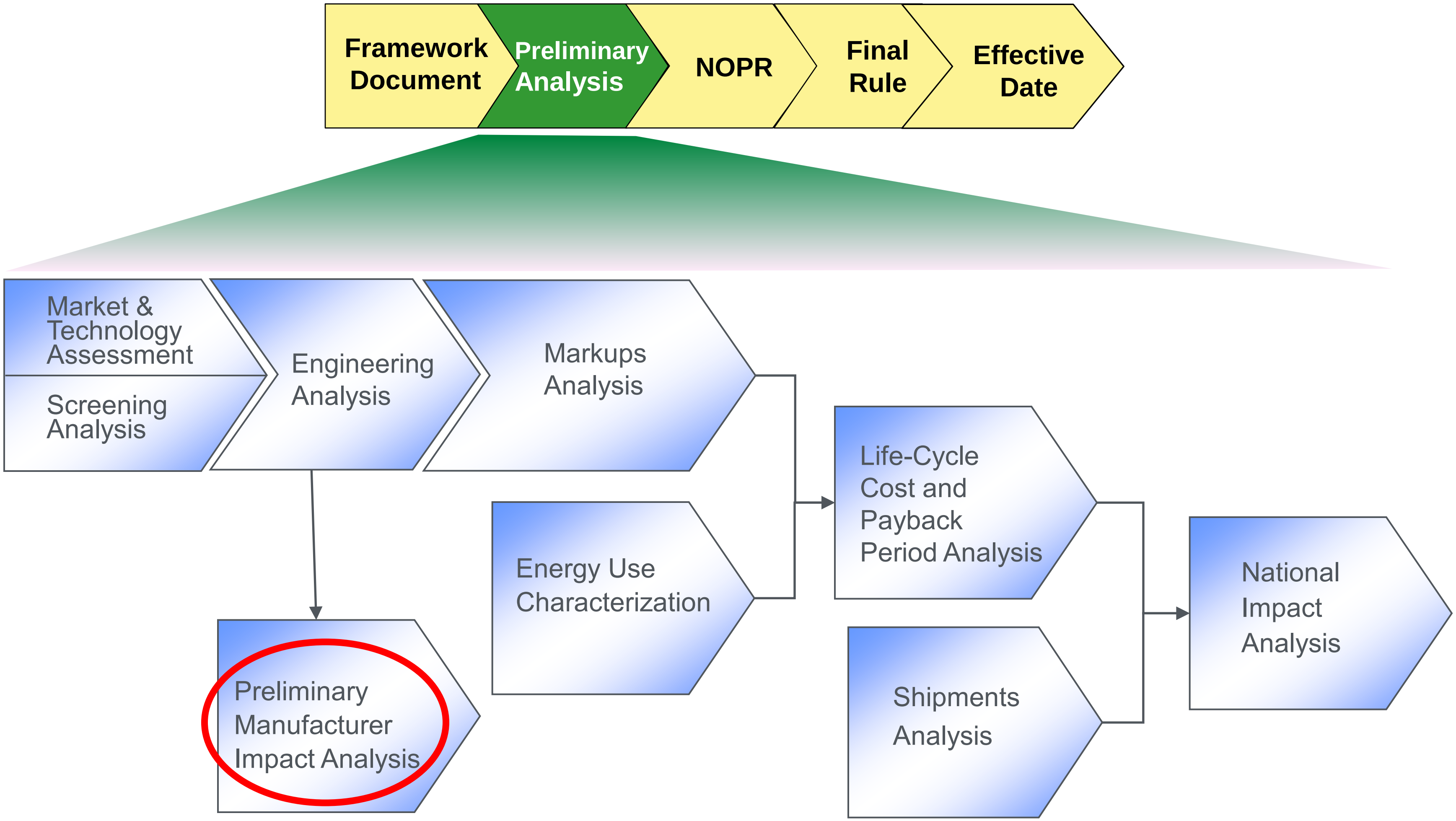
Public Meeting Agenda

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

1. Overview
2. Test Procedure
3. Market & Tech; Screening; Engineering
4. Markups; Energy Characterization
5. Life-Cycle Cost and Payback Period Analysis
6. National Impact Analysis
7. **Preliminary MIA; NOPR Analyses**

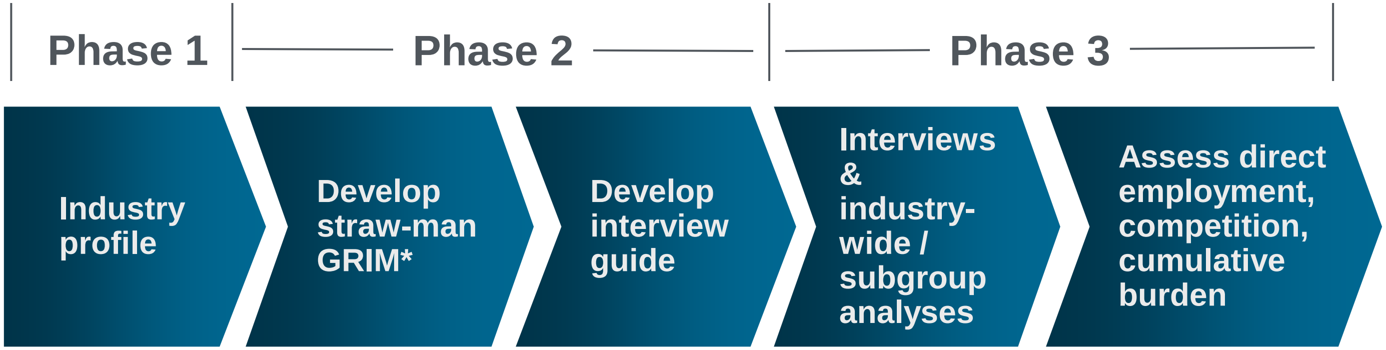
Steps in the Standards Rulemaking: Preliminary Analysis

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



Purpose

- To identify the impacts of amended energy conservation standards on manufacturers.
- Key output of MIA is the *change in industry net present value (INPV)* due to amended standards.
- The MIA consists of three phases:



Manufacturer Impact Analysis Overview

Phase 1

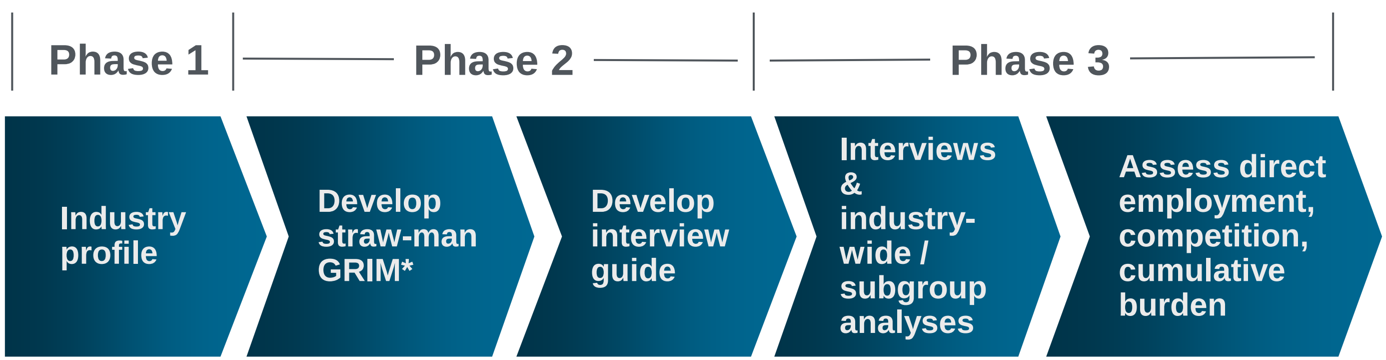
- DOE creates an industry profile to characterize the industry and identify important issues that require consideration.

Phase 2

- DOE prepares an industry cash-flow model and an interview questionnaire to guide subsequent discussions.

Phase 3

- DOE interviews manufacturers and assesses the impacts of amended standards both quantitatively (using the Government Regulatory Impact Model) and qualitatively (impacts on competition, manufacturing capacity, employment, and regulatory burden).



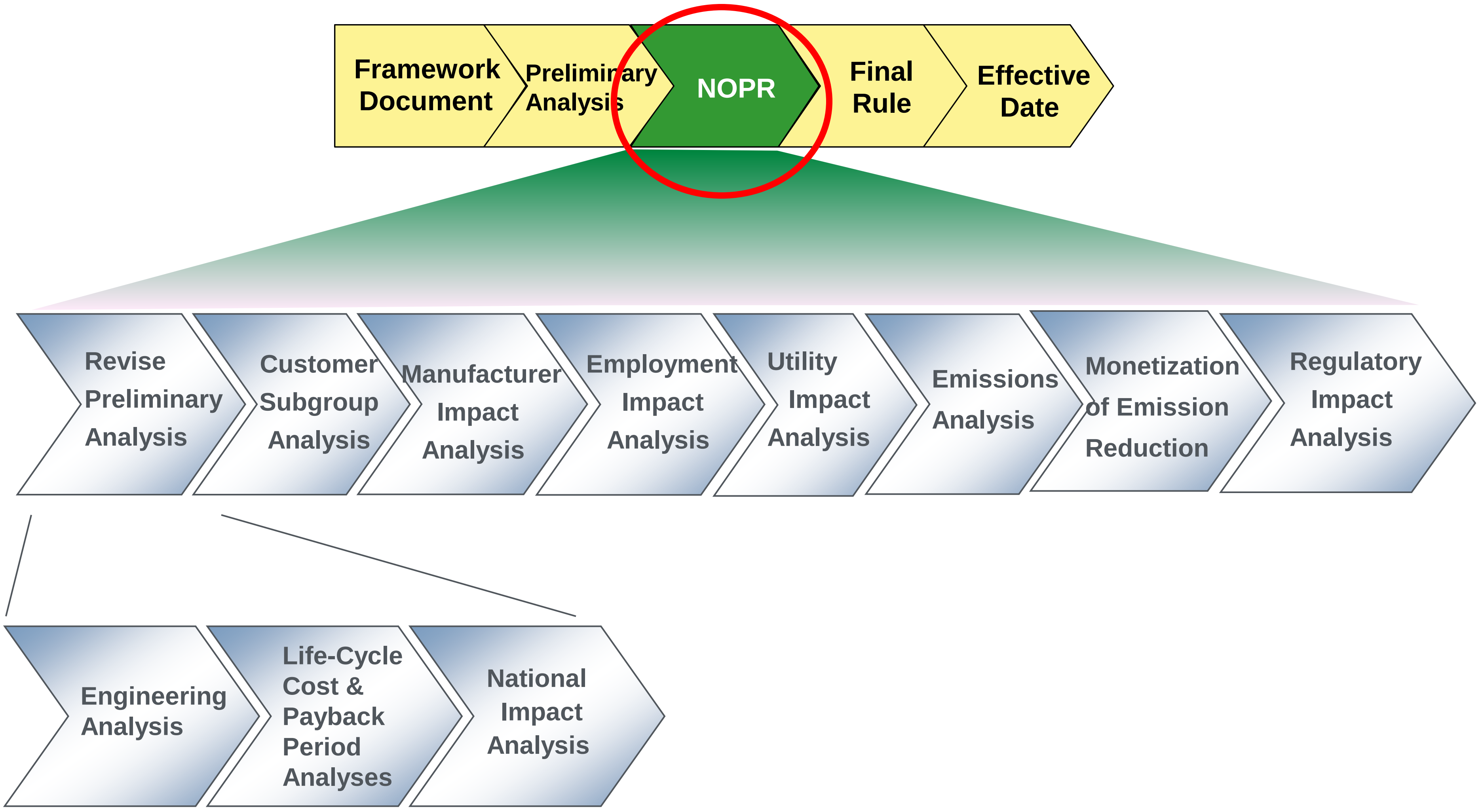
Preliminary Manufacturer Impact Analysis – Key Issues

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

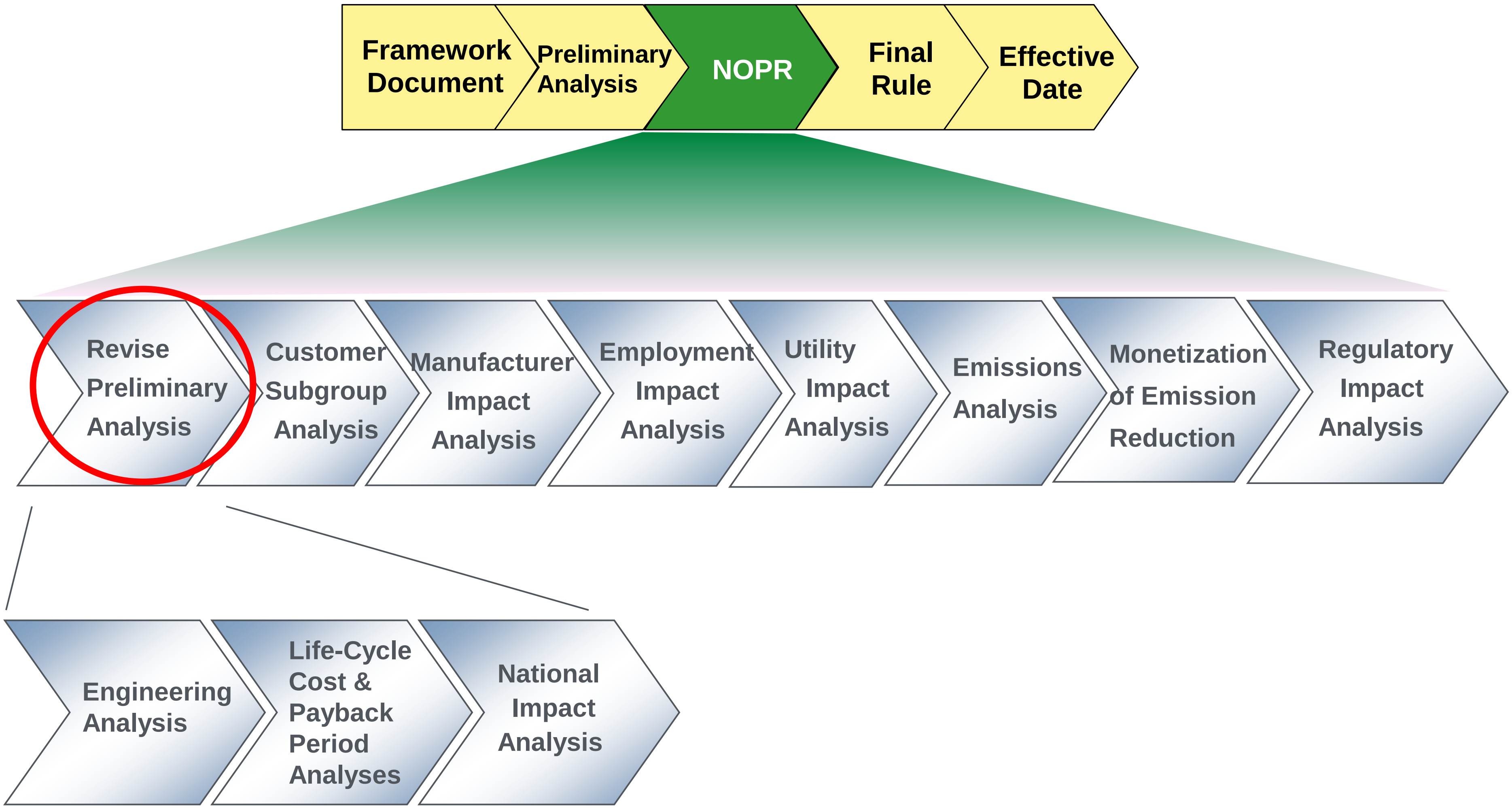
- Increase in equipment repair
  - Higher efficiency standards may drive consumers to rewind older, less efficient motors rather than buy new, more expensive electric motors.
- Copper rotor motors
  - With a higher melting point than aluminum, copper can be more dangerous to fabricate. The higher temperatures required for copper rotors also increase energy costs and reduce tooling life during fabrication.
  - Reduced starting performance (higher inrush current and lower locked-rotor torque).
  - Significant increases in material and fabrication costs.
- Enforcement
  - Domestic manufacturers may be disproportionately affected by new standards if DOE does not broadly enforce energy efficiency requirements for all covered motors, including imports from foreign countries.

Issue 30: DOE requests comment on additional key manufacturer impact issues.

Steps in the Standards Rulemaking: NOPR



Steps in the Standards Rulemaking: NOPR



Revised Preliminary Analysis

Analysis	Action
Engineering Analysis	• Consider comments • Revise using latest data
Life-Cycle Cost and Payback Period Analyses	• Consider comments • Revise using latest data • Conduct LCC sub-group analysis
National Impacts Analysis	• Consider comments • Revise using latest data

Steps in the Standards Rulemaking: NOPR

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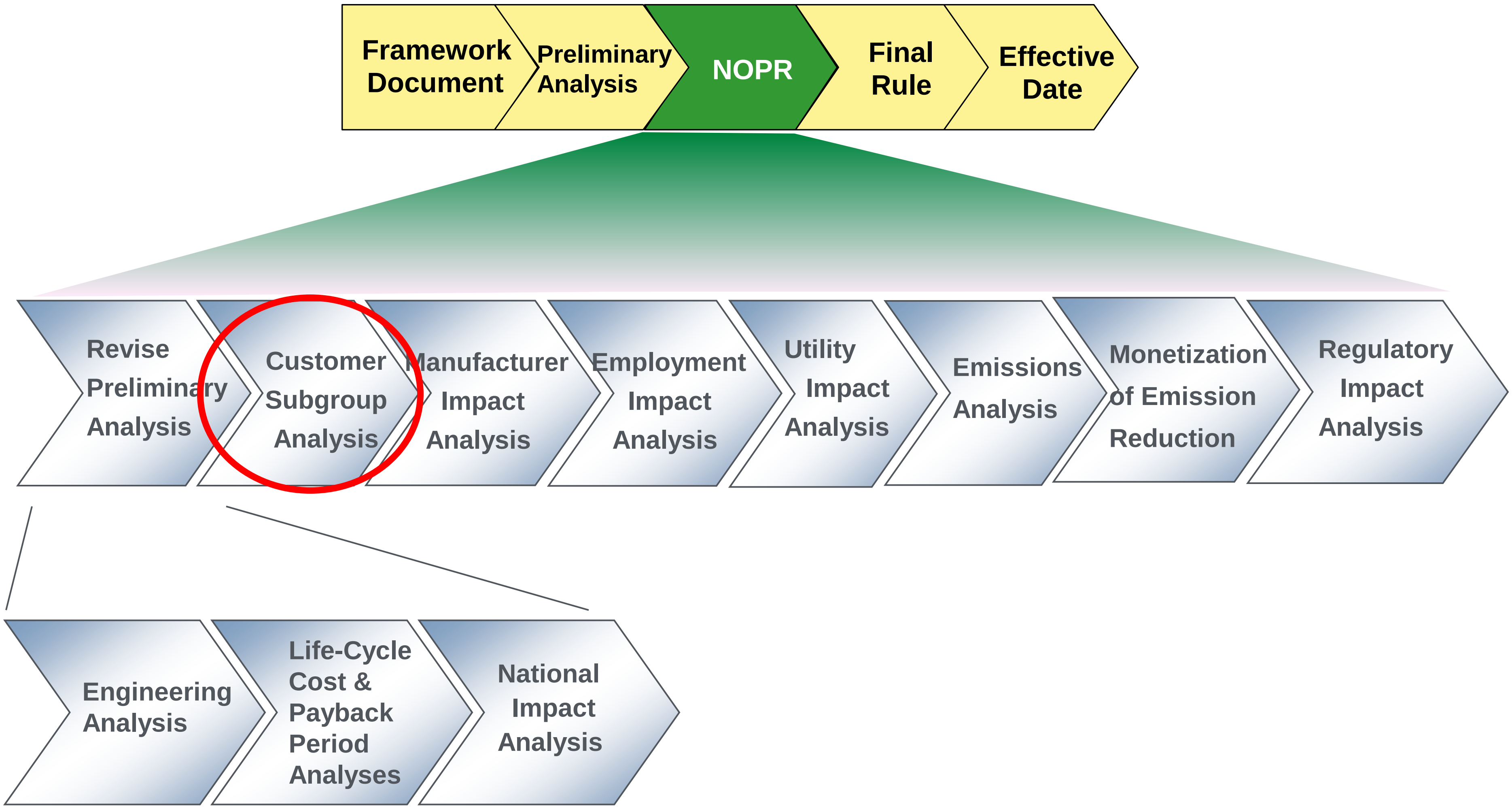


Customer Subgroup Analysis

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Purpose

- Analyze the economic impacts of standards on consumers, including subgroups who may be disproportionately impacted compared with the general user population
  - A subgroup comprises a subset of the population likely to be disaffected disproportionately by new or revised energy conservation standards (e.g., small businesses)

Method

- Extend the LCC analysis to examine the impacts for defined subgroups
- DOE will use inputs specific to each of the considered consumer subgroups

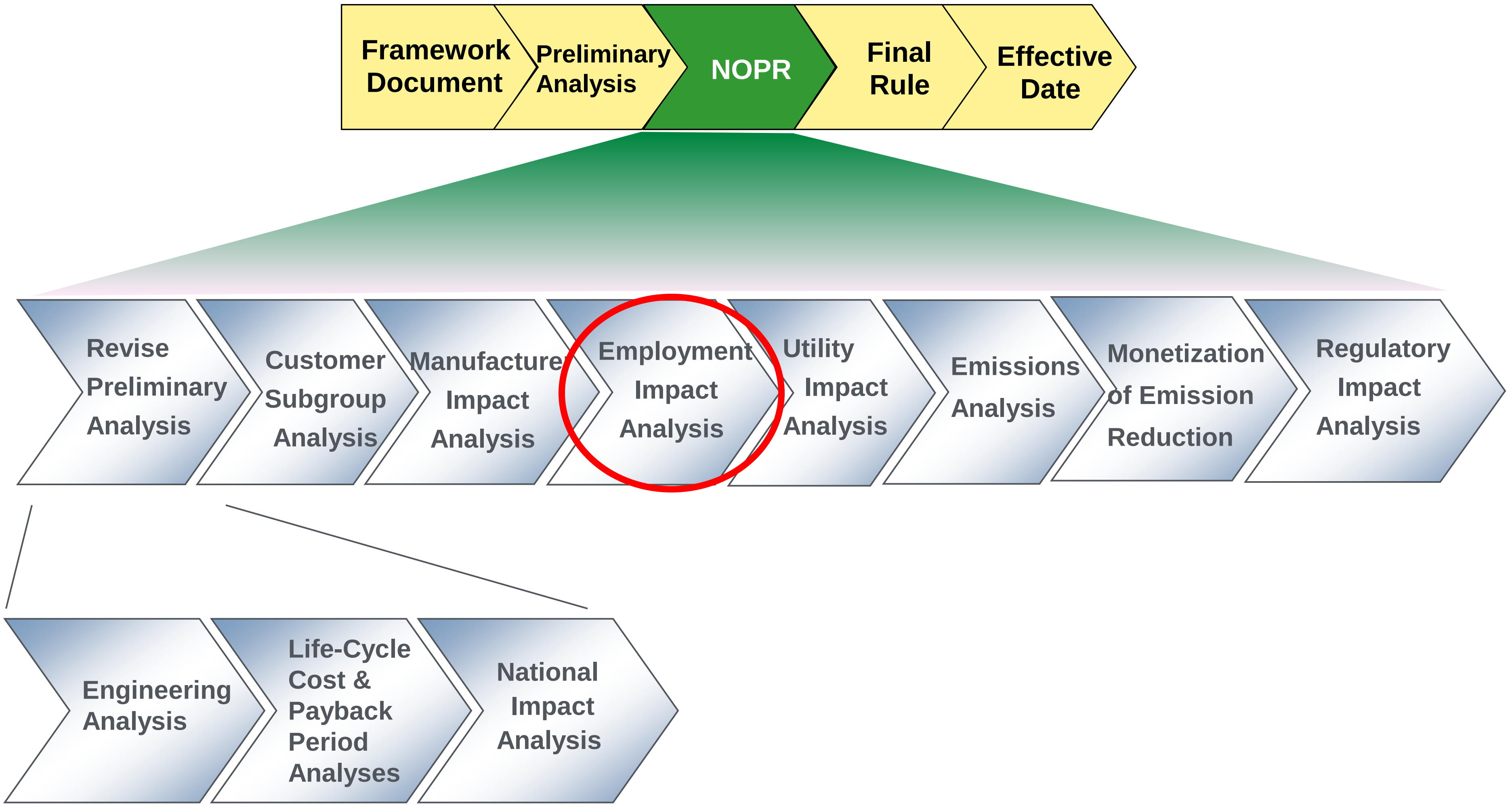
Request for Comment

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Issue 31: DOE welcomes comment on what, if any, customer subgroups are appropriate in considering standards for electric motors.

Steps in the Standards Rulemaking: NOPR

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



Employment Impact Analysis

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Purpose

- Assess the overall impact on national employment from the imposition of energy conservation standards at differing levels
- 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”)

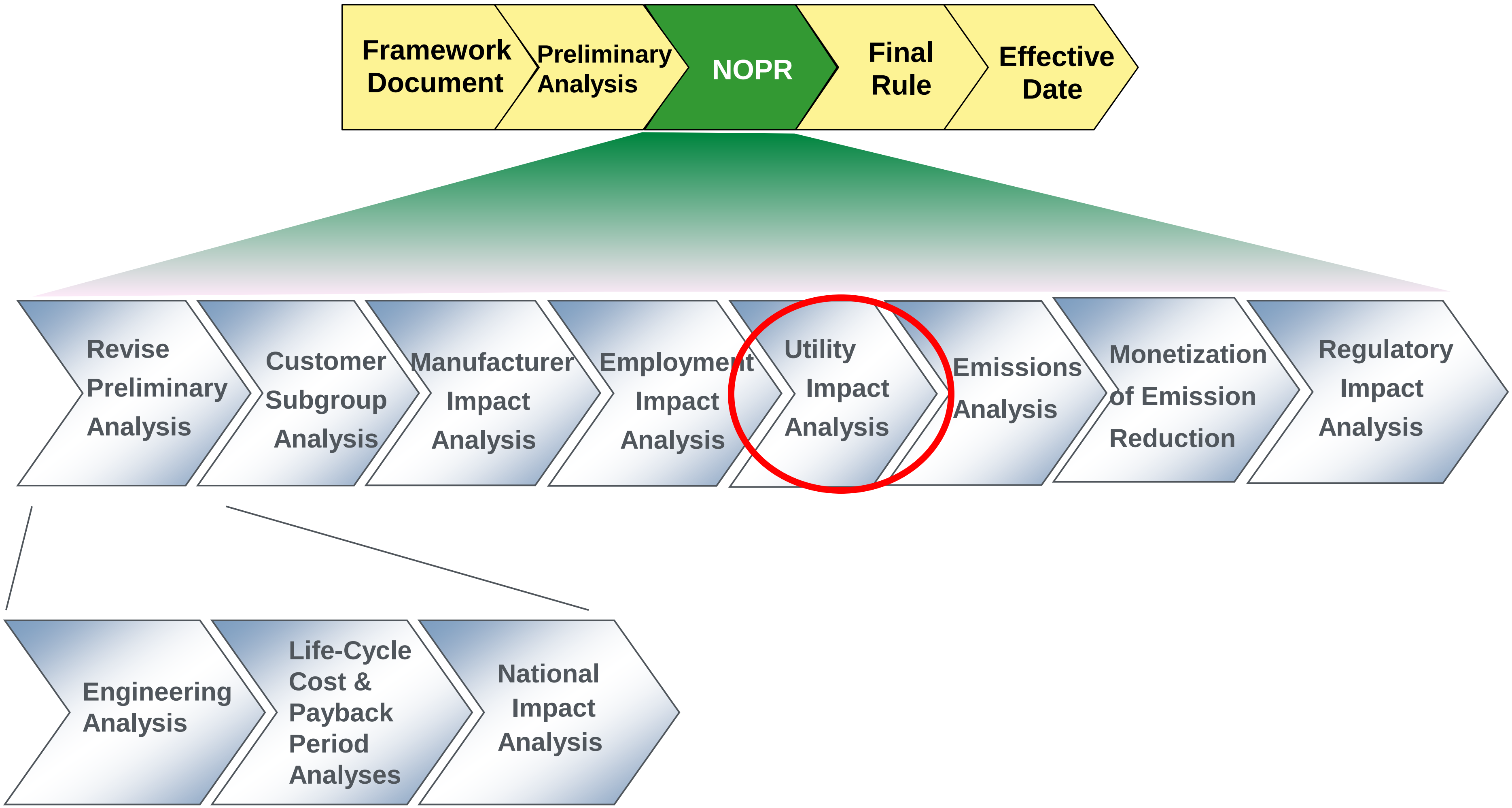
Method

- DOE intends to use the Impact of Sector Energy Technologies (ImSET) model for the evaluation of indirect employment impacts.

Issue 30: DOE welcomes feedback on its proposed approach to assessing national employment impacts, both direct and indirect.

Steps in the Standards Rulemaking: NOPR

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



Utility Impact Analysis

Purpose

- Assess the overall impacts on domestic energy supplies that would result from the imposition of standards

Method

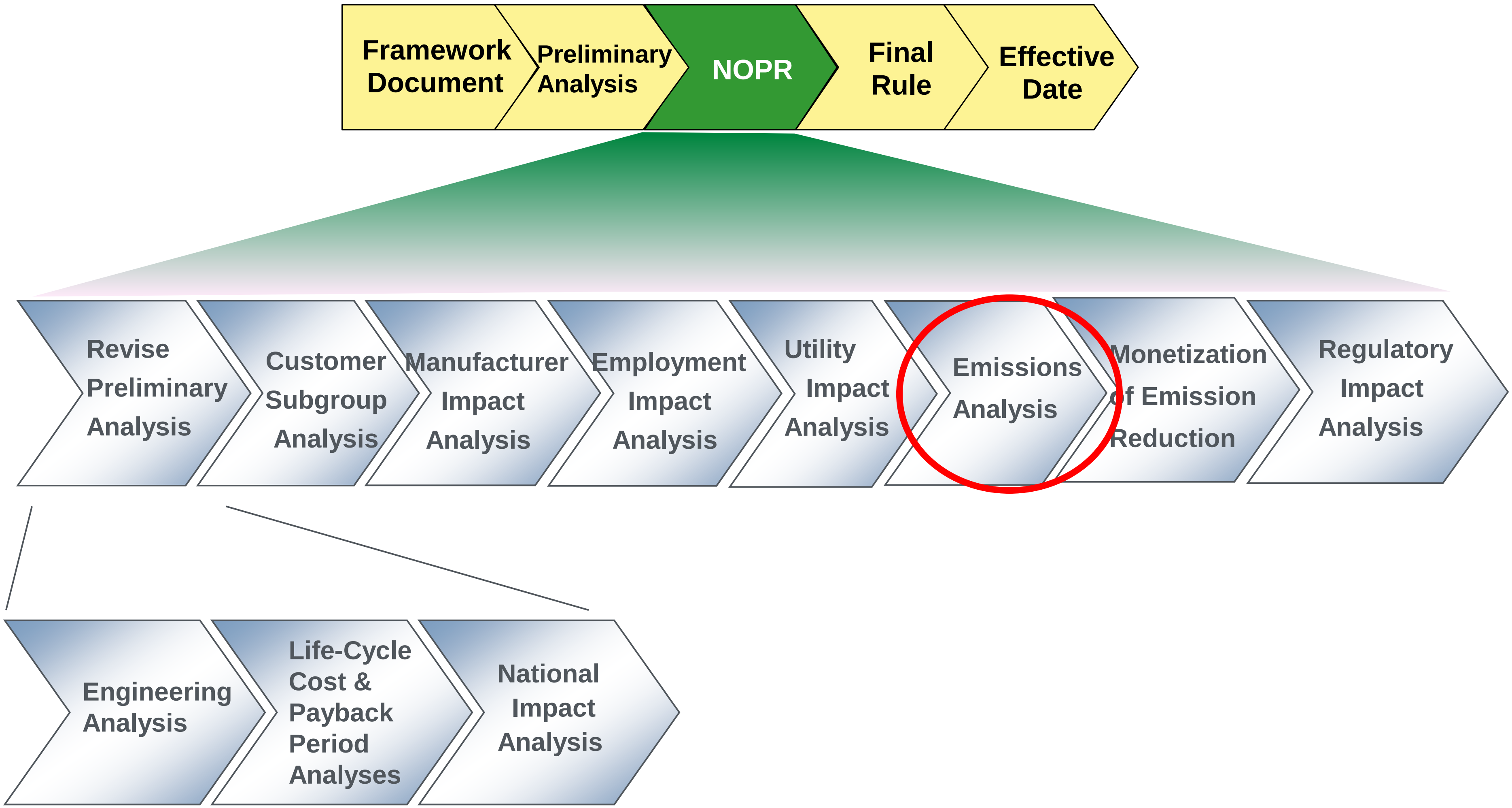
- Uses the Energy Information Administration's National Energy Modeling System (NEMS) tailored for DOE's Building Technologies Program (NEMS-BT)
- DOE will model the energy savings impacts from amended energy conservation standards using NEMS-BT to generate projections that deviate from the AEO reference case
- Outputs of the utility impact analysis include projections of electricity generation, and avoided capacity resulting from a comparison of base and standards cases

Request for Comments

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Issue 32: DOE welcomes input from interested parties on its proposed use of NEMS-BT to conduct the utility impact analysis.

Steps in the Standards Rulemaking: NOPR



Emissions Analysis

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Purpose

- To report emission impacts resulting from amended energy conservation standards, including changes in power plant emissions and full fuel cycle emissions.

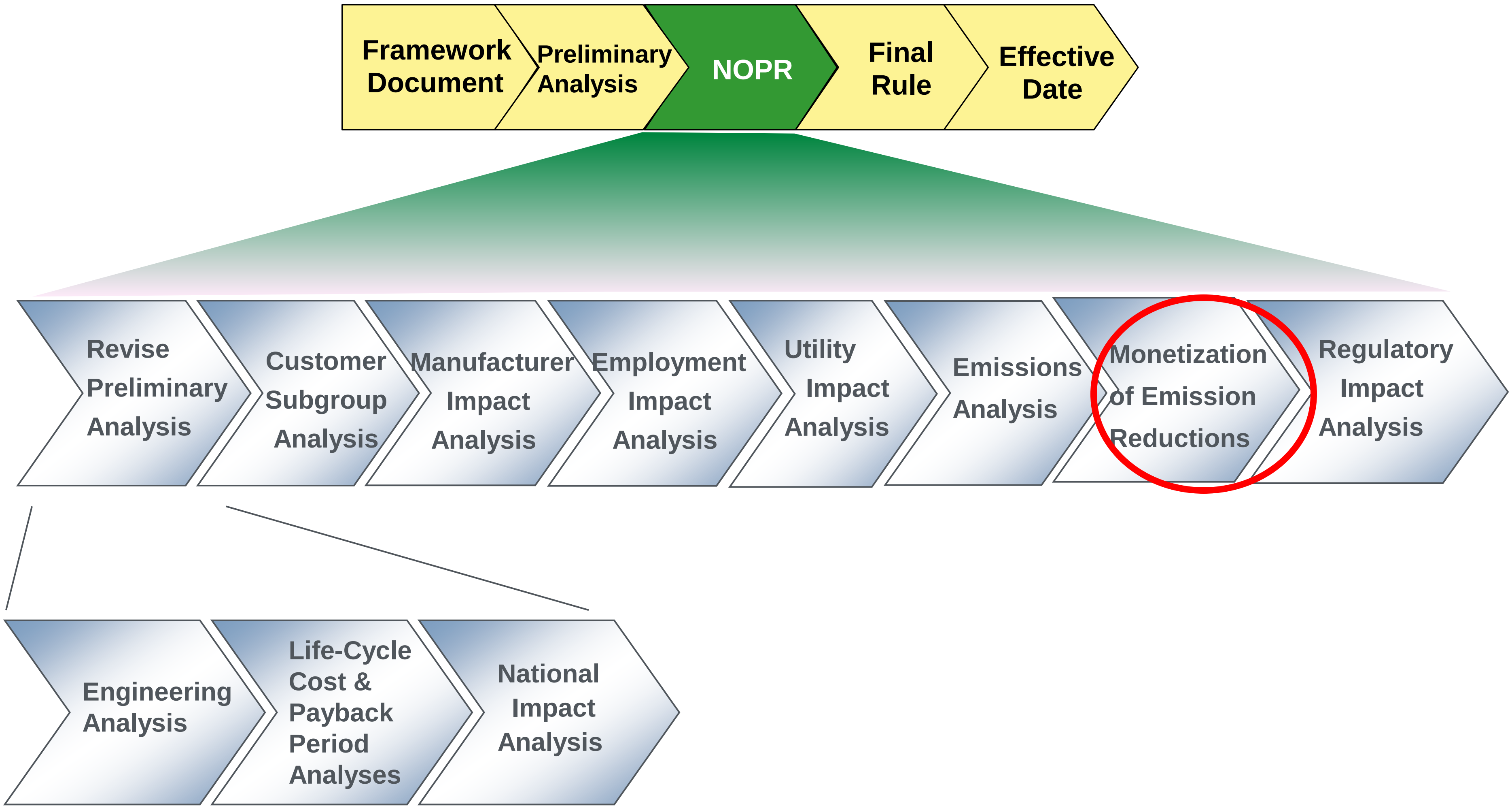
Method

- Energy Information Administration's National Energy Modeling System (NEMS) provides power-plant emissions
  - Carbon dioxide (CO_2) will be the primary emissions reported.
  - Mercury (Hg) emissions will also be reported
  - Nitrogen Oxide (NO_x) emissions will be reported for the 22 states where emissions are not capped
  - Existing legislation cap Sulfur Dioxide (SO_2), so physical emission reductions will be nearly zero from any single energy conservation standard

Request for Comment

Issue 33: DOE seeks input on its plan to use NEMS-BT to conduct the emissions analysis for the products covered by this rulemaking.

Steps in the Standards Rulemaking: NOPR



Monetization of Emission Reductions

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- DOE intends to use the most current Social Cost of Carbon (SCC) values developed by interagency reviews.
  - SCC is intended to be a monetary measure of the incremental damage resulting from greenhouse gas (GHG) emissions, including but not limited to agricultural productivity loss, human health effects, property damage from rising sea level, and changes in the ecosystem.

- At present, the most recent interagency estimates of the potential global benefits resulting from reduced CO_2 emissions in 2010 are $5.0, $22.5, $37.0, and $68.4 per metric ton in 2011 dollars.
  - For emission reductions that occur in later years, these values grow in real terms over time.

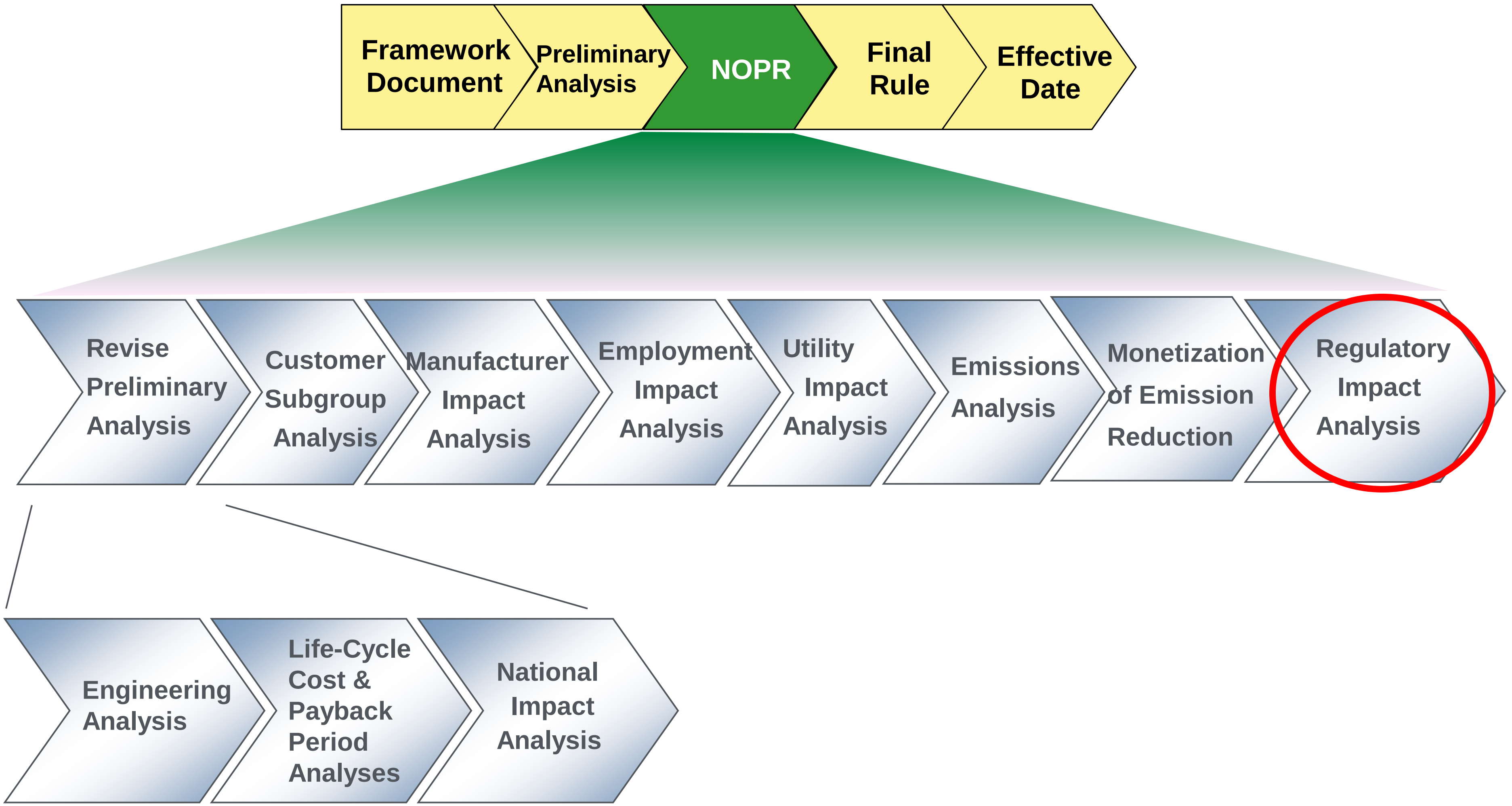
- DOE will also estimate the potential monetary benefit of reduced NO_x emissions resulting from the considered standard levels.

Request for Comment

Issue 34: DOE requests comments on the approach it plans to use for estimating monetary values associated with emissions reductions, or any widely-accepted values that could be used in DOE's analyses.

Steps in the Standards Rulemaking: NOPR

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



Regulatory Impact Analysis

Purpose

- To investigate the national impacts of non-regulatory alternatives compared with mandatory energy conservation standards
- The non-regulatory alternatives that may be considered include: consumer rebates; consumer tax credits; manufacturer tax credits; voluntary efficiency levels; early replacement; and bulk government procurement

Method

- Modify NES spreadsheet model to consider non-regulatory scenarios.
- NPV calculated for non-regulatory alternatives in the same way as for the standard case
- Each non-regulatory scenario will decrease national operating costs and increase equipment prices.
- Output will include National Energy Savings and Net Present Value of the non-regulatory alternatives

Request for Comment

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Issue 35: DOE invites comments on the ability of voluntary initiatives or other non-regulatory efforts by manufacturers to achieve significant energy savings and reasonable costs.

How to Submit Written Comments

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- **In all correspondence, please refer to the Electric Motors rulemaking by:**
  - Electric Motors Rulemaking,
  - Docket Number EERE–2010–BT–STD–0027, and
  - Regulatory Identification Number (RIN) 1904-AC28

- **Email**: *ElecMotors-2010-STD-0027@ee.doe.gov*

Postal:

Ms. Brenda Edwards
U.S. Department of Energy
Building Technologies Program, Mailstop EE-2J
1000 Independence Avenue, SW
Washington, DC 20585-0121

Courier:

Ms. Brenda Edwards
U.S. Department of Energy
Building Technologies Program, Suite 600
950 L'Enfant Plaza, SW
Washington, DC 20024
Tel: 202 586-2945

- **Comment period closes: September 7, 2012**

Relevant URLs

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- **DOE Appliance Standards**
  - http://www1.eere.energy.gov/buildings/appliance_standards/
- **Electric Motors Rule**
  - http://www1.eere.energy.gov/buildings/appliance_standards/commercial/electric_motors.html
- **Electric Motors Test Procedure**
  - http://www1.eere.energy.gov/buildings/appliance_standards/commercial/electric_motors.html