Energy Conservation Standards for Commercial Refrigeration Equipment

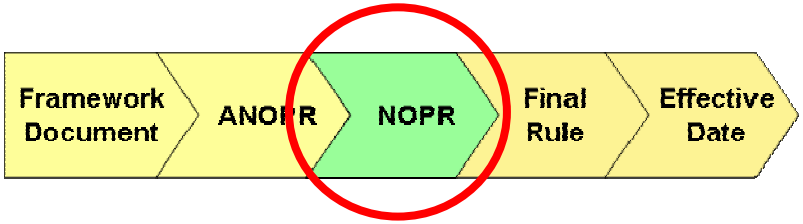
ANOPR Public Meeting

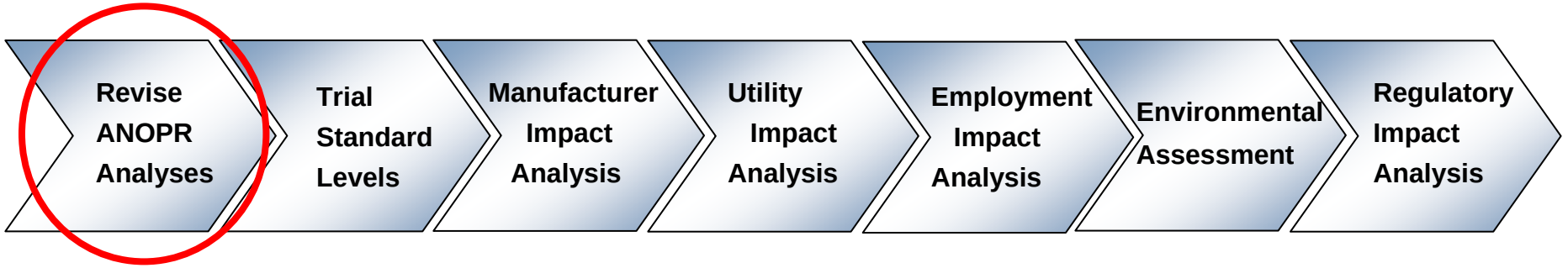
NOPR Analyses and Next Steps

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

August 23, 2007

NOPR Analyses Flow Diagram





ANOPR Issues for Public Comment

- **Selection of Candidate Standard Levels for Post-ANOPR Analysis (Issue #13)**
- **Approach to Characterizing Energy Conservation Standards (Issue #14)**
- **Standards for Commercial Refrigerator-Freezers (Issue #15)**

Revise ANOPR Analyses

ANOPR Analysis	Action
Engineering Analysis	• Consider ANOPR comments • Revise using latest data
Life-Cycle Cost and Payback Period Analyses	• Consider ANOPR comments • Revise using latest data • Conduct LCC Sub-Group Analysis
National Impacts Analysis	• Consider ANOPR comments • Revise using latest data

Selection of Candidate Standard Levels for Post-ANOPR Analysis (Issue #13)

- **DOE selects Candidate Standard Levels (CSLs) for individual equipment based on the broader set of levels analyzed in the ANOPR.**

- **DOE identified four efficiency levels plus the baseline level in each class based on levels showing:**
  - maximum LCC savings
  - maximum energy savings,
  - highest efficiency level with less than 3 year payback.
  - DOE also included additional levels between the baseline and these levels in its set of CSLs

DOE invites comments on the candidate standard levels selected for future analysis.

Proposed Candidate Standard Levels

Equip-ment Class	Test Metric	Candidate Standard Level in Order of Efficiency					Candidate Standard Levels for Equipment Analyzed Expressed in Terms of the Test Metric				
		Baseline	CSL1	CSL2	CSL3	CSL4	Baseline	CSL1	CSL2	CSL3	CSL4
VOP.RC.M	CDEC/TDA kWh/day/ft^2	Level 1	Level 4	Level 6	Level 7	Level 8	1.08	0.90	0.75	0.70	0.64
VOP.RC.L	CDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 4	Level 5	Level 6	2.93	2.61	2.47	2.46	2.39
VOP.SC.M	TDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 5	Level 7	Level 8	2.55	2.23	2.07	1.84	1.65
VCT.RC.M	CDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 5	Level 6	Level 7	0.54	0.42	0.38	0.24	0.19
VCT.RC.L	CDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 5	Level 7	Level 8	1.06	0.90	0.75	0.65	0.55
VCT.SC.I	TDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 6	Level 7	Level 8	1.58	1.24	0.77	0.69	0.63
VCS.SC.I	TDEC/V kWh/day/ft^3	Level 1	Level 5	Level 6	Level 7	Level 8	0.27	0.19	0.18	0.17	0.17
SVO.RC.M	CDEC/TDA kWh/day/ft^2	Level 1	Level 2	Level 4	Level 6	Level 7	1.05	1.00	0.90	0.80	0.74
SVO.SC.M	TDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 5	Level 7	Level 8	2.24	1.99	1.87	1.62	1.54
SOC.RC.M	CDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 4	Level 5	Level 7	0.95	0.76	0.74	0.71	0.60
HZO.RC.M	CDEC/TDA kWh/day/ft^2	Level 1	Level 1	Level 2	Level 3	Level 4	0.16	0.16	0.14	0.11	0.10
HZO.RC.L	CDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 4	Level 5	Level 6	0.83	0.75	0.70	0.65	0.62
HZO.SC.M	TDEC/TDA kWh/day/ft^2	Level 1	Level 4	Level 6	Level 7	Level 8	0.78	0.61	0.56	0.54	0.48
HZO.SC.L	TDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 6	Level 7	Level 8	2.05	1.80	1.52	1.33	1.32
HCT.SC.I	TDEC/TDA kWh/day/ft^2	Level 1	Level 3	Level 4	Level 5	Level 6	1.63	1.28	0.73	0.61	0.57

Approach to Characterizing Energy Conservation Standards (Issue #14)

- **Standards will be based on the CDEC or TDEC as calculated by the test procedure**

- **DOE proposes the use of Total Display Area (TDA) as a normalizing factor for**
  - for remote condensing commercial equipment with transparent doors or without doors,
  - commercial ice-cream freezers with transparent doors
  - self-contained commercial equipment without doors

- **DOE proposes the use of Refrigerated Volume (V) as a normalizing factor for**
  - remote condensing commercial refrigerators, commercial freezers, and commercial refrigerators-freezers with solid doors
  - commercial ice-cream freezers with solid doors

Approach to Characterizing Energy Conservation Standards (Issue #14)

- **For equipment using TDA as the normalizing factor, DOE proposes that Maximum Energy Consumption Standards be described as**

  $$MEC_{SC} = A_{SC} \times TDA$$ **(self-contained equipment)**

  $$MEC_{RC} = A_{RC} \times TDA$$ **(remote condensing equipment)**

  - A_{RC}, A_{SC} *are* expressed in terms of kWh/day/ft^2 of rated volume

- **For equipment using V as the normalizing factor, DOE proposes that Maximum Energy Consumption Standards be described as**

  Maximum Energy Consumption (*M) (kWh/yr)* = $B \times V + K$

  - *B* is expressed in terms of kWh/day/ft^3 of rated volume,
  - *V* is the adjusted volume (ft^3) calculated for the equipment class, and
  - *K* is an offset factor expressed in kWh/day.

DOE invites comments on its approach for characterizing energy conservation standards as discussed in section III of the ANOPR and how it could develop appropriate offset factors.

Standards for Commercial Refrigerator-Freezers (Issue #15)

- **For remote-condensing refrigerator-freezers with independent remote condensing units for refrigerator and freezer compartments**
  - Determine the maximum allowable energy consumption for each compartment individually based on each compartment's respective equipment class and TDA or Volume
  - Maximum allowable energy consumption for a display case is based on the sum of the maximum allowable consumption for each compartment calculated separately.
- **Self-contained refrigerator-freezers w/o doors but with separate compressor/condensers for refrigerator and freezer compartment treated similarly using TDEC for each compartment**

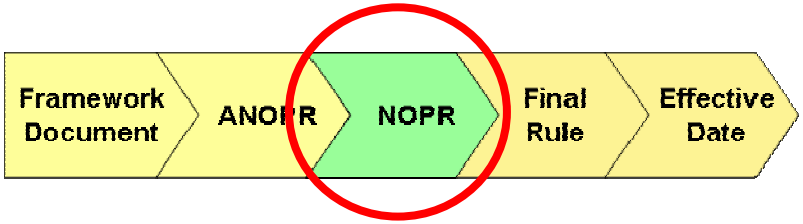
Standards for Commercial Refrigerator-Freezers (Issue #15)

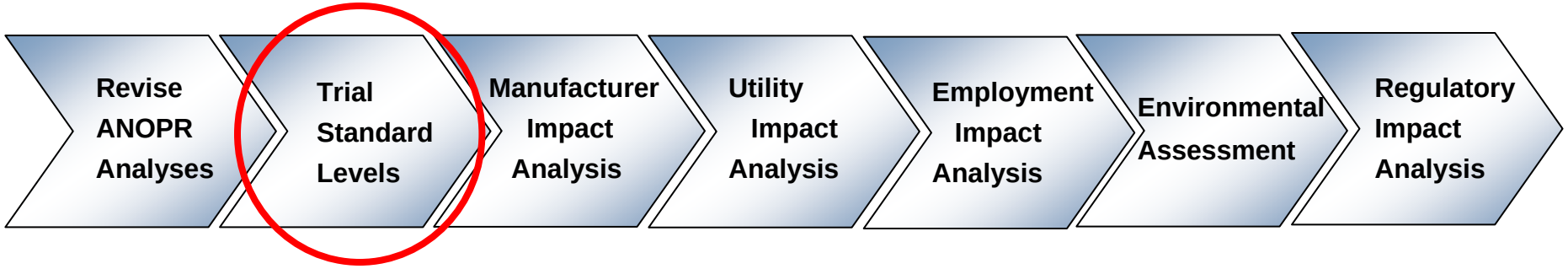
- **For remote condensing refrigerator freezers where a single condensing unit serves both refrigerator and freezer compartments**
  - Measure total refrigeration load according to ASHRAE 72 for all compartments
  - Use ARI 1200-2006 and calculate CEC using lowest evaporator temperature
  - Determine CDEC as sum of CEC, FEC, LEC, AEC, DEC, and PEC for case
  - Determine maximum-allowable energy consumption as the maximum allowable normalized energy consumption (MEC/ TDA or MEC / V) for the compartment with the lower evaporator temperature times total case refrigerator TDA or volume as appropriate

- **Self-contained refrigerator-freezers with a single condensing unit serves both refrigerator and freezer compartment treated similarly using TDEC for compartment with the lowest temperature**

DOE invites comments on this approach to implementing standards for commercial refrigerator-freezers.

NOPR Analyses Flow Diagram





Selection of Trial Standard Levels

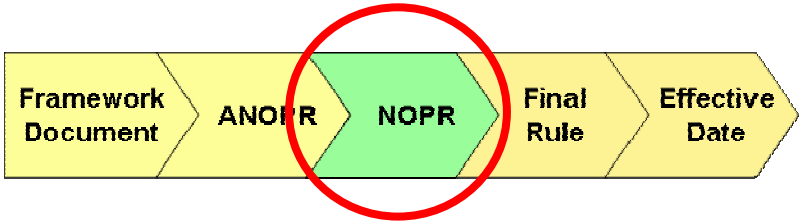
- **Purpose**
  - To develop a list of standard levels from which impacts are weighed and a proposed standard level is selected
    - Each trial standard level consists of a set of potential minimum efficiency levels covering all equipment classes, and may vary between equipment classes
    - NOPR analyses assess impacts for trial standard levels (not equipment classes)
- **Method**
  - Trial standard levels are assembled from the equipment classes identified in the ANOPR
    - Candidate standard levels cover a range of efficiencies and can include:
      - Most energy efficient level (max tech)
      - Efficiency level with the lowest life-cycle cost
      - Efficiency level with a payback period of three years or less
      - Efficiency levels with noteworthy technologies
      - Efficiency levels that fill in large gaps between candidate standard levels
    - Each trial standard level consists of the candidate standard level from each equipment class that meets one of the above criteria

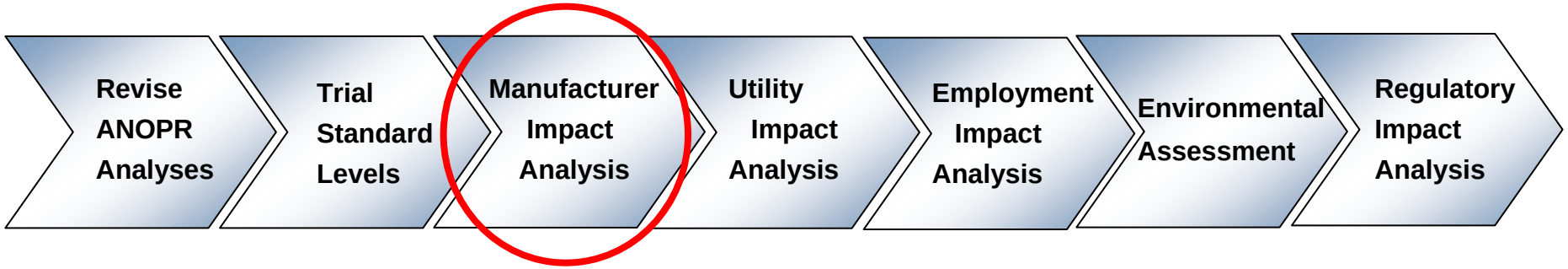
Trial Standard Level Criteria

- **A critical part of the NOPR analysis on which DOE is seeking early guidance and input.**
  - **Trial standard levels are created from combinations of candidate standard levels at an equipment class level.**
  - **Based around a consistent theme, such as lowest life-cycle cost or payback in 3-years or less.**

DOE invites comments on the criteria for selecting trial standard levels.

NOPR Analyses Flow Diagram



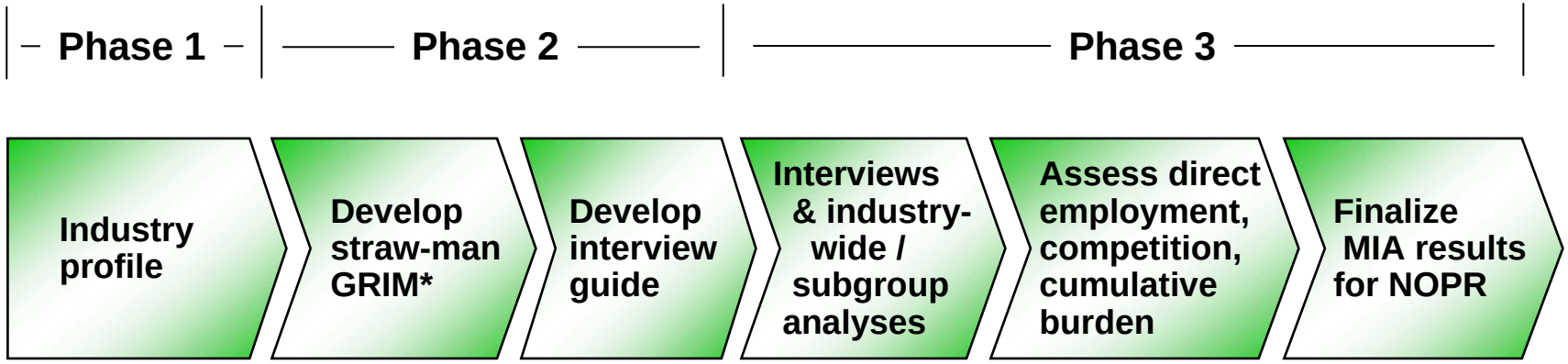


Manufacturer Impact Analysis

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

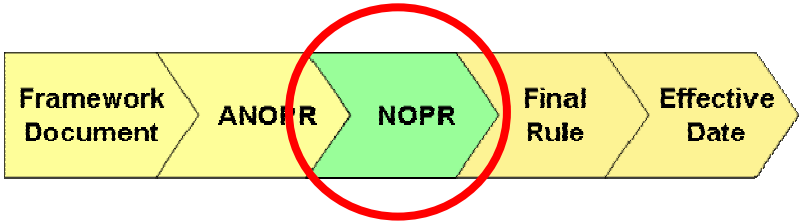
Manufacturer Impact Analysis Process

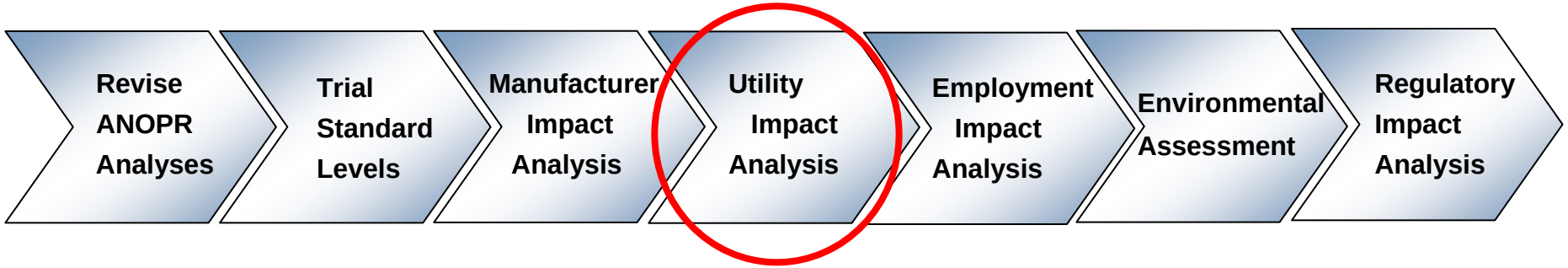
- **The MIA consists of three phases**



** Government Regulatory Impact Model (GRIM)*

NOPR Analyses Flow Diagram

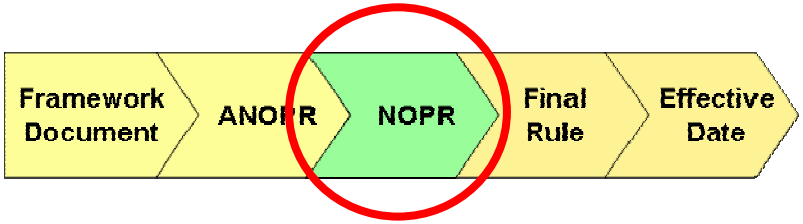


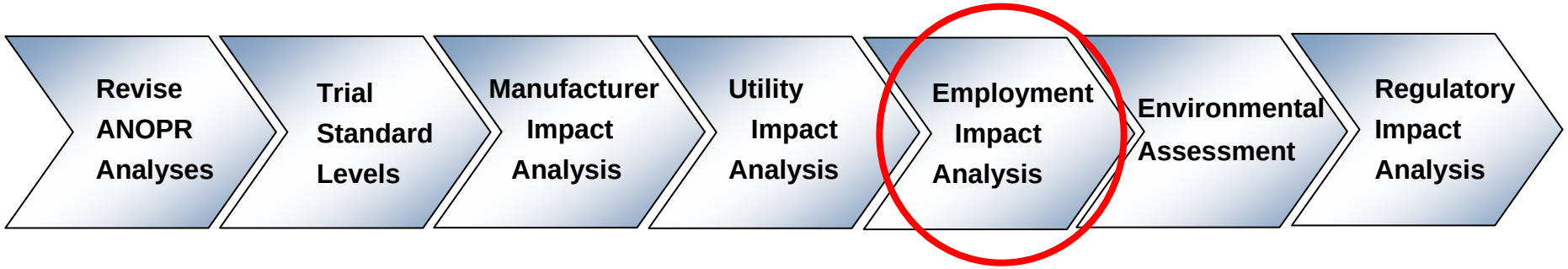


Utility Impact Analysis

- **Purpose**
  - To investigate the effects on utilities from reduced energy sales and peak load demand due to potential standards
- **Method**
  - Uses national energy savings results
  - Uses the Energy Information Administration's National Energy Modeling System (NEMS) tailored for DOE's Building Technologies Program (NEMS-BT)
- **Output**
  - Change in electricity sales and price by region
  - Change in the mix of electricity generation
  - Change in new capacity construction

NOPR Analyses Flow Diagram

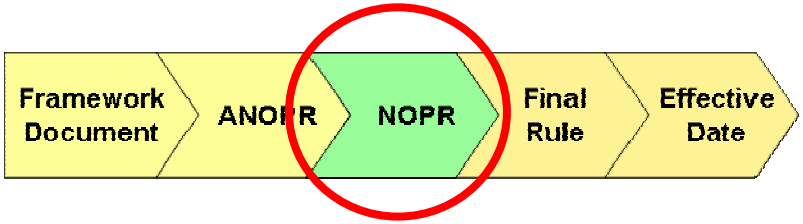


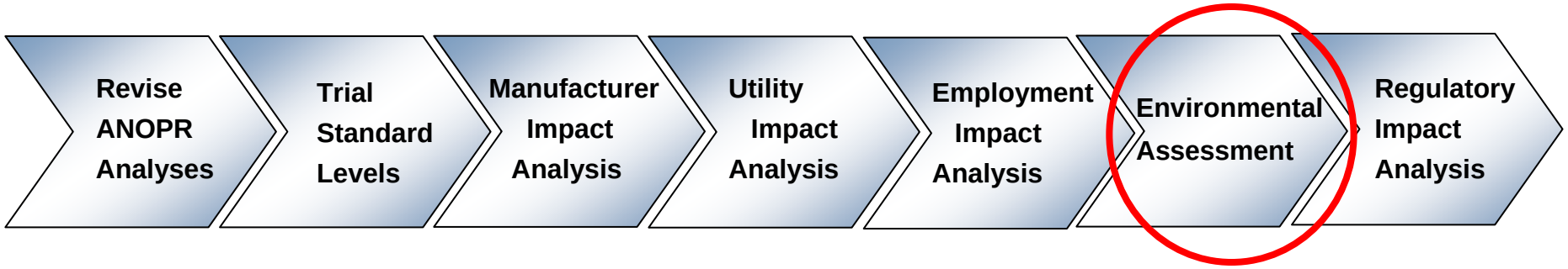


Employment Impact Analysis

- **Purpose**
  - To report net jobs created or eliminated nationally as a consequence of new energy efficiency standards
- **Method**
  - Uses the IMSET tool, a buildings-sector version of the IMPLAN national input-output model
  - Changes in equipment and energy expenditures taken from the National Energy Savings Analysis
  - Direct employment impacts taken from the Manufacturer Impact Analysis
- **Output**
  - Change in employment by sector as a consequence of new standards

NOPR Analyses Flow Diagram

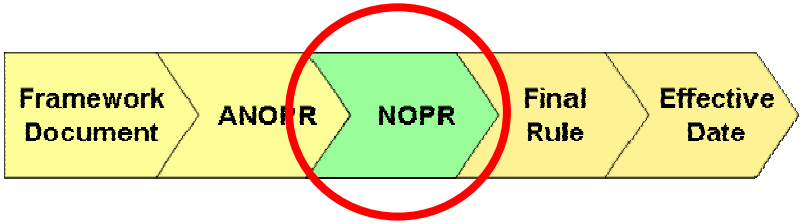


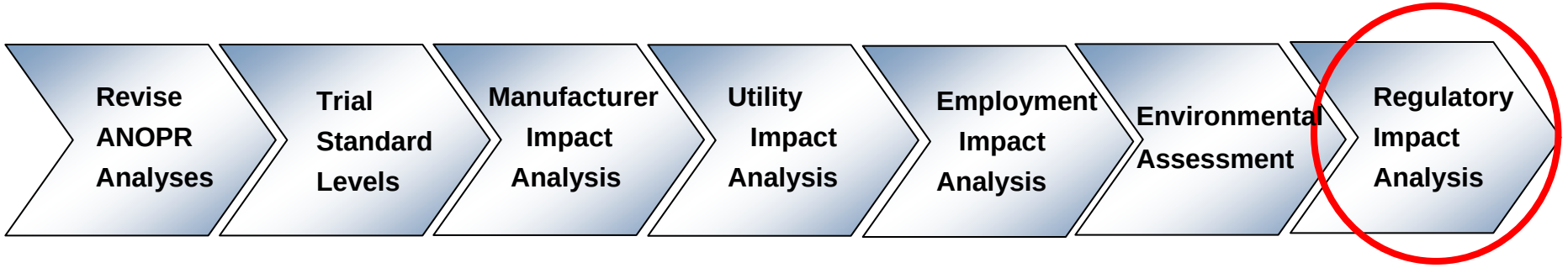


Environmental Assessment

- **Purpose**
  - To report environmental impacts as a consequence of new energy efficiency standards, including changes in power plant emissions
- **Method**
  - Energy savings results taken from the National Energy Savings Analysis
  - Energy Information Administration's National Energy Modeling System (NEMS) provides power-plant emissions
- **Output**
  - Estimate of national emission reductions of SO_2, NO_x, CO_2 and Mercury

NOPR Analyses Flow Diagram





Regulatory Impact Analysis

- **Purpose**
  - To investigate the national impacts due to non-regulatory alternatives compared with mandatory energy efficiency standards
  - The non-regulatory alternatives that may be considered:
    - No new regulatory action; early replacement; prescriptive standards; customer tax credits; manufacturer tax credits; customer rebates; voluntary efficiency targets; bulk government procurement
- **Method**
  - Modify NES spreadsheet model to consider scenarios. Changes may include: energy prices and escalation factors; implicit market discount rates; customer purchase price, operating cost, and income elasticities; and equipment stock data
- **Output**
  - National Energy Savings and Net Present Value of the non-regulatory alternatives
  - Impact of non-regulatory alternatives on purchase price and use of energy-efficient equipment

The Energy Policy and Conservation Act (EPCA) directs DOE to consider seven factors when setting energy conservation standards

Factor	Analysis
1. Economic impact on consumers and manufacturers	Life-cycle cost analysis Manufacturer impacts analysis
2. Lifetime operating cost savings	Life-cycle cost analysis
3. Total projected energy savings	National impact analysis
4. Impact on utility or performance	Screening analysis Engineering analysis
5. Impact of any lessening of competition	Manufacturer impacts 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

How to Submit Comments…

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

- Written comments – ANOPR comment period open until **October 9, 2007**
  Reference docket #: EE-2006-STD-0126 and/or RIN #: 1904-AB59

  Email: commercialrefrigeration.rulemaking@ee.doe.gov

  Mail: Ms. Brenda Edwards-Jones
  U.S. Department of Energy
  Building Technologies Program, Mail stop EE-2J
  ANOPR for Commercial Refrigeration Equipment
  EE-2006-STD-0126
  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