BUILDING TECHNOLOGIES PROGRAM

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

The Parker Ranch installation in Hawaii

Energy Conservation Standards Proposed Rulemaking for Residential Heating Products

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Mohammed Khan

Department of Energy
Energy Efficiency & Renewable Energy
ResWaterDirectPoolHtrs@ee.doe.gov

Purpose of the Public Meeting

- Purposes
  - To invite comment on the proposed energy conservation standards for residential water heaters, direct heating equipment, and pool heaters;
  - To present methodologies and characterize results for this rulemaking analyses;
  - To discuss specific issues related to each analysis;
  - To seek input from interested parties on methodologies, assumptions, data sources, and results from the analyses; and
  - To describe the next steps.

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

- EPCA sets forth provisions designed to improve energy efficiency of various consumer products, including the three types of heating products that are subject to this rulemaking. (42 U.S.C. 6292(a)(4), (9) and (11)) EPCA prescribes energy conservation standards for each of the three heating products. (42 U.S.C. 6295(e)(1)-(3)) The statute further directs DOE to conduct two cycles of rulemakings to determine whether to amend these standards. (42 U.S.C. 6295(e)(4))

- DOE is scheduled to publish a final rule for these products by March 31, 2010, pursuant to the consent decree in State of New York, et al. v. Bodman, and NRDC, Inc. et al. v. Bodman.

DOE Actions on Residential Heating Products

- Test Procedures
  - DOE established test procedures for residential water heaters, direct heating equipment, and pool heaters in Appendix E, Appendix O, and Appendix P to Subpart B of 10 CFR Part 430, respectively.

- Energy Conservation Standards
  - Framework Document published on November 24, 2006. 71 FR 67825.
  - Notice of Public Meeting and Availability of the Preliminary Technical Support Document published on January 13, 2009. 74 FR 1643.
  - Notice of Proposed Rulemaking published on December 11, 2009. 74 FR 65852.
  - Final Rule scheduled to be published by March 31, 2010.

EPCA Directs DOE to Consider Seven Factors when Setting Energy Conservation Standards

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

Proposed Amended Energy Conservation Standards for Residential Water Heaters (TSL 4)

Product Class	Proposed Energy Conservation Standards	
Gas-fired Storage	For tanks with a Rated Storage Volume at or below 60 gallons: EF = 0.675 – (0.0012 x Rated Storage Volume in gallons)	For tanks with a Rated Storage Volume above 60 gallons: EF = 0.717 – (0.0019 x Rated Storage Volume in gallons)
Electric Storage	For tanks with a Rated Storage Volume at or below 80 gallons: EF = 0.96 – (0.0003 x Rated Storage Volume in gallons)	For tanks with a Rated Storage Volume above 80 gallons: EF = 1.088 – (0.0019 x Rated Storage Volume in gallons)
Oil-fired Storage	EF = 0.68 – (0.0019 x Rated Storage Volume in gallons)	
Gas-fired Instantaneous	EF = 0.82 – (0.0019 x Rated Storage Volume in gallons)	

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Proposed Amended Energy Conservation Standards for Residential Direct Heating Equipment (TSL 3) and Pool Heaters (TSL 4)

Direct Heating Equipment Product Class	Proposed Energy Conservation Standards
Gas Wall Fan with Input Capacities up to 42,000 Btu/h	AFUE = 76%
Gas Wall Fan with Input Capacities over 42,000 Btu/h	AFUE = 77%
Gas Wall Gravity with Input Capacities up to 27,000 Btu/h	AFUE = 70%
Gas Wall Gravity with Input Capacities over 27,000 Btu/h up to 46, 000 Btu/h	AFUE = 71%
Gas Wall Gravity with Input Capacities over 46,000 Btu/h	AFUE = 72%
Gas Floor with Input Capacities up to 37,000 Btu/h	AFUE = 57%
Gas Floor with Input Capacities over 37,000 Btu/h	AFUE = 58%
Gas Room with Input Capacities up to 20,000 Btu/h	AFUE = 62%
Gas Room with Input Capacities over 20,000 Btu/h up to 27,000 Btu/h	AFUE = 67%
Gas Room with Input Capacities over 27,000 Btu/h up to 46,000 Btu/h	AFUE = 68%
Gas Room with Input Capacities over 46,000 Btu/h	AFUE = 69%
Gas Hearth with Input Capacities up to 20,000 Btu/h	AFUE = 61%
Gas Hearth with Input Capacities over 20,000 Btu/h and up to 27,000 Btu/h	AFUE = 66%
Gas Hearth with Input Capacities over 27,000 Btu/h and up to 46,000 Btu/h	AFUE = 67%
Gas Hearth with Input Capacities over 46,000 Btu/h	AFUE = 68%

Pool Heater Product Class	Proposed Energy Conservation Standards
Gas-fired	Thermal Efficiency = 84%

Opening Remarks and Comment

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Opening Remarks and Comments from Interested Parties on the NOPR and the Proposed Energy Conservation Standards for Residential Heating Products

- Opening Remarks
  - At this time, DOE welcomes opening remarks from interested parties on the heating products NOPR and the proposed energy conservation standards for residential water heaters, direct heating equipment, and pool heaters.

Scope of Coverage and Product Classes

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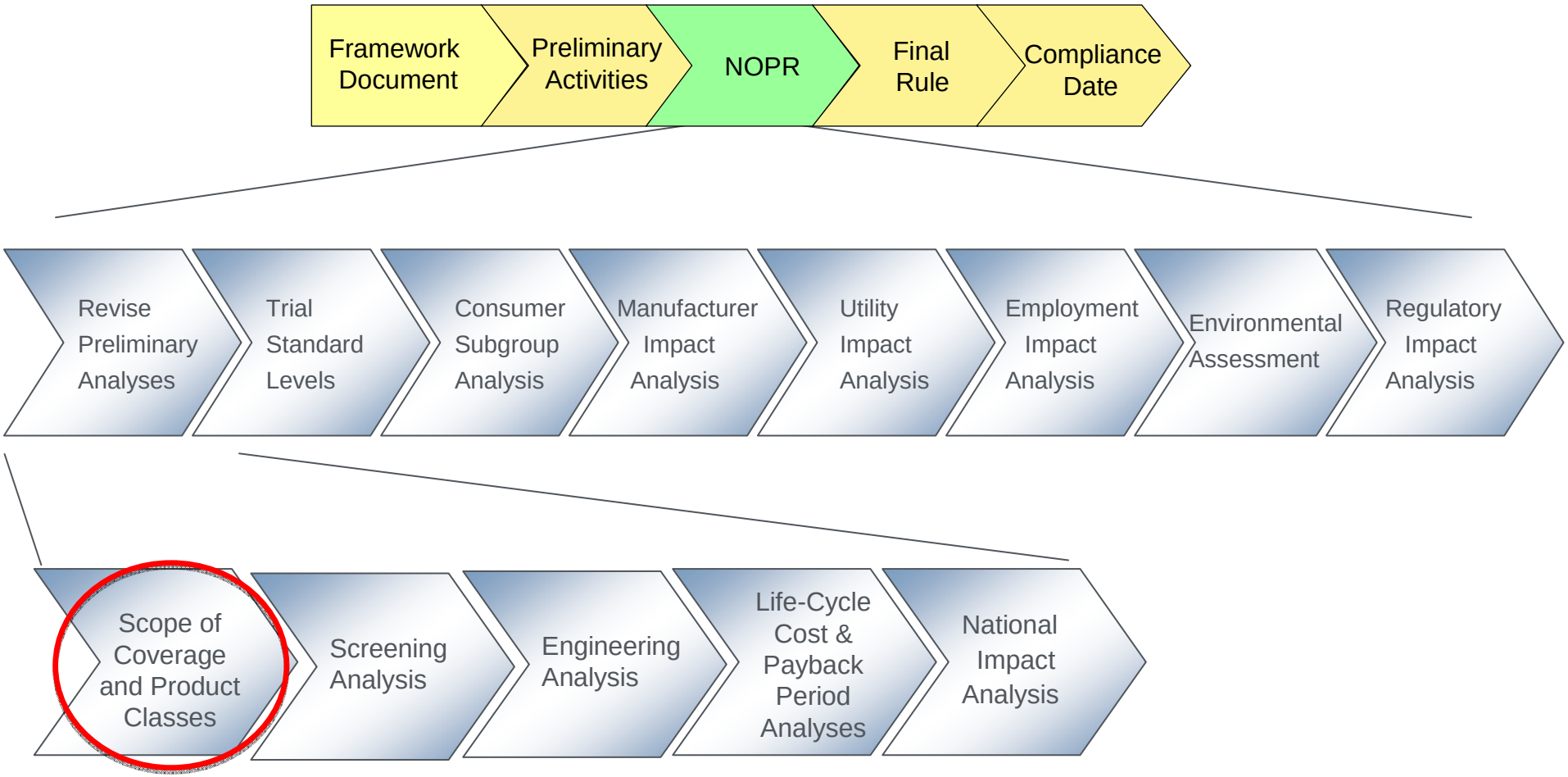
NOPR Analyses Flow Diagram



The NOPR analyses consist of revisions to the Preliminary Activities.

Scope of Coverage

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Overview

- DOE is analyzing the following products in this rulemaking:
  - Gas-fired storage water heaters;
  - Electric storage water heaters;
  - Oil-fired storage water heaters;
  - Gas-fired instantaneous water heaters;
  - Gas-fired wall gravity direct heating equipment;
  - Gas-fired wall fan direct heating equipment;
  - Gas-fired floor direct heating equipment;
  - Gas-fired room direct heating equipment;
  - Gas-fired hearth direct heating equipment; and
  - Gas-fired pool heaters.

Gas-fired Hearth Direct Heating Equipment

- For the NOPR, DOE is proposing to add a definition of gas-fired hearth direct heating equipment to 10 CFR Part 430.2 as follows:
  - Vented hearth heater means a vented, including freestanding or recessed, zero clearance fireplace heater, a gas fireplace insert or a gas-stove, which simulates a solid fuel fireplace and is designed to furnish warm air, without ducts to the space in which it is installed.

ISSUE 4. DOE seeks comment from interested parties on its proposed definition for vented hearth heaters.

Gas-fired Hearth Direct Heating Equipment

- If DOE finalizes this rulemaking as proposed for gas-fired hearth DHE, manufacturers of these products would be subject to all relevant provisions, including the test procedures, standards, certification, compliance, and enforcement provisions, that currently exists for the other four types of DHE.
  - These provisions are found in 10 CFR parts 430.23, 430.24, 430.27, 430.32, 430.33, 430.40 through 430.49, 430.50 through 430.57, 430.60 through 430.65, and 430.70 through 430.75.

ISSUE 2. DOE seeks comment from interested parties on the potential burdens to manufacturers of gas-fired hearth DHE as a result of the testing, certification, reporting, and enforcement provisions in these sections.

Water Heater Product Classes

Residential Water Heater	Characteristics
Gas-Fired Storage	Nominal input of 75,000 Btu/h or less; rated storage volume from 20 to 100 gallons
Oil-Fired Storage	Nominal input of 105,000 Btu/h or less; rated storage volume of 50 gallons or less
Electric Storage	Nominal input of 12 kW (40,956 Btu/h) or less; rated storage volume from 20 to 120 gallons
Gas-Fired Instantaneous	Nominal input of over 50,000 Btu/h up to 200,000 Btu/h; rated storage volume of 2 gallons or less

ISSUE 5. DOE seeks comment from interested parties on the need for a separate product class for low-boy heaters.

ISSUE 6. DOE seeks comments from interested parties on the analysis approach and the need for a separate product class for ultra-low NO_X water heaters.

Water Heater Product Classes

- DOE is not proposing to create a separate product class for heat pump water heaters.
- Instead, DOE is treating heat pump water heaters as a design option for electric storage water heaters.
  - They do not provide a different utility from traditional electric resistance water heaters;
  - They use electricity as the primary fuel source;
  - They can replace traditional electric resistance storage water heaters in most residences, although the installation requirements may be quite costly.

ISSUE 8. DOE seeks comment from interested parties on the need for a separate product class for heat pump water heaters. In particular, DOE is interested in receiving comments and data on whether a heat pump water heater can be used as a direct replacement for an electric resistance water heater, and the types and frequency of installations where a heat pump water heater cannot be used as a direct replacement for an electric resistance water heater.

Direct Heating Equipment Product Classes

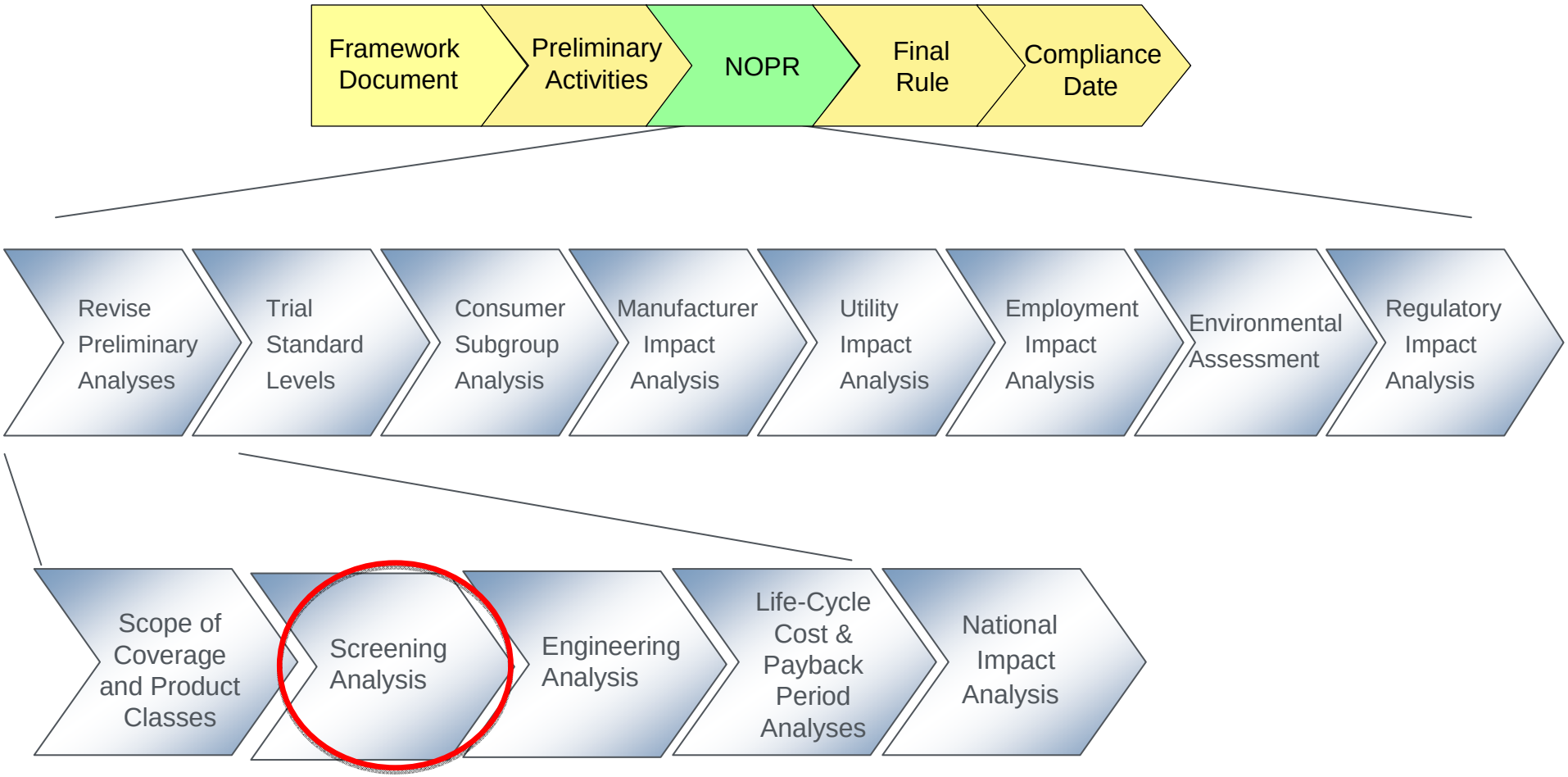
Direct Heating Equipment	Input Heating Capacity Btu/h
Gas Wall Fan	Up to 42,000
	Over 42,000
Gas Wall Gravity	Up to 27,000
	Over 27,000 and up to 46,000
	Over 46,000
Gas Floor	Up to 37,000
	Over 37,000
Gas Room	Up to 20,000
	Over 20,000 and up to 27,000
	Over 27,000 and up to 46,000
	Over 46,000
Gas Hearth	Up to 20,000
	Over 20,000 and up to 27,000
	Over 27,000 and up to 46,000
	Over 46,000

ISSUE 9. DOE seeks comments from interested parties on the reduction in product classes for direct heating equipment.

ISSUE 10. DOE seeks comment on the proposed product classes for gas hearth direct heating equipment.

Screening Analysis

NOPR Analyses Flow Diagram



The NOPR analyses consist of revisions to the Preliminary Activities.

Heat Pump Water Heaters

- DOE is screening in heat pump water heater technologies as a design option for improving the efficiency of electric storage water heaters.
- Issues Associated with the Consumer Utility
  - Cold Air Production
    - The increased installation costs of venting cold air away from a conditioned space, along with the increased cost of space heating for consumers who choose not to vent cold air away from the conditioned space, are accounted for in DOE's analysis for certain percentages of consumers.
  - Noise
    - Water heaters are typically not installed in consumers' bedrooms or living spaces, but instead are usually installed in garages, closets, basements, attics, or other locations away from the living space. Thus, DOE believes that noise created by a compressor would not significantly impact consumer utility.
- Production, Installation, and Servicing Issues
  - DOE believes with the lead-time associated with amended standards and the development of current products, it is unclear whether manufacturers would be able to retrain installers and service technicians to install and service heat pump water heaters.

Heat Pump Water Heaters

- DOE estimated the additional costs that would be incurred as a result of increased certification requirements to install and service heat pump water heaters in its analyses. (See Slide 41 and 45 for additional details.)
- Given the 5-year delay for compliance and the fact that many manufacturers are already developing heat pump water heaters, DOE believes manufacturers may be able to convert their entire product lines before the compliance date.

ISSUE 11. DOE is seeking comment on the manufacturability of heat pump water heaters and the capability of manufacturers to ramp up production. DOE is specifically seeking comment on how long it would take, and how much it would cost, for manufacturers to convert all product lines to heat pump water heaters if it were required by an amended energy conservation standard. Additionally, DOE is seeking comment about the capability of water heater installers and servicers to meet the unique demands created by heat pump water heaters. DOE is requesting comment about how long it would take to train installers and servicers to be able to serve the market if heat pump water heaters were required by an amended energy conservation standard.

Engineering Analysis

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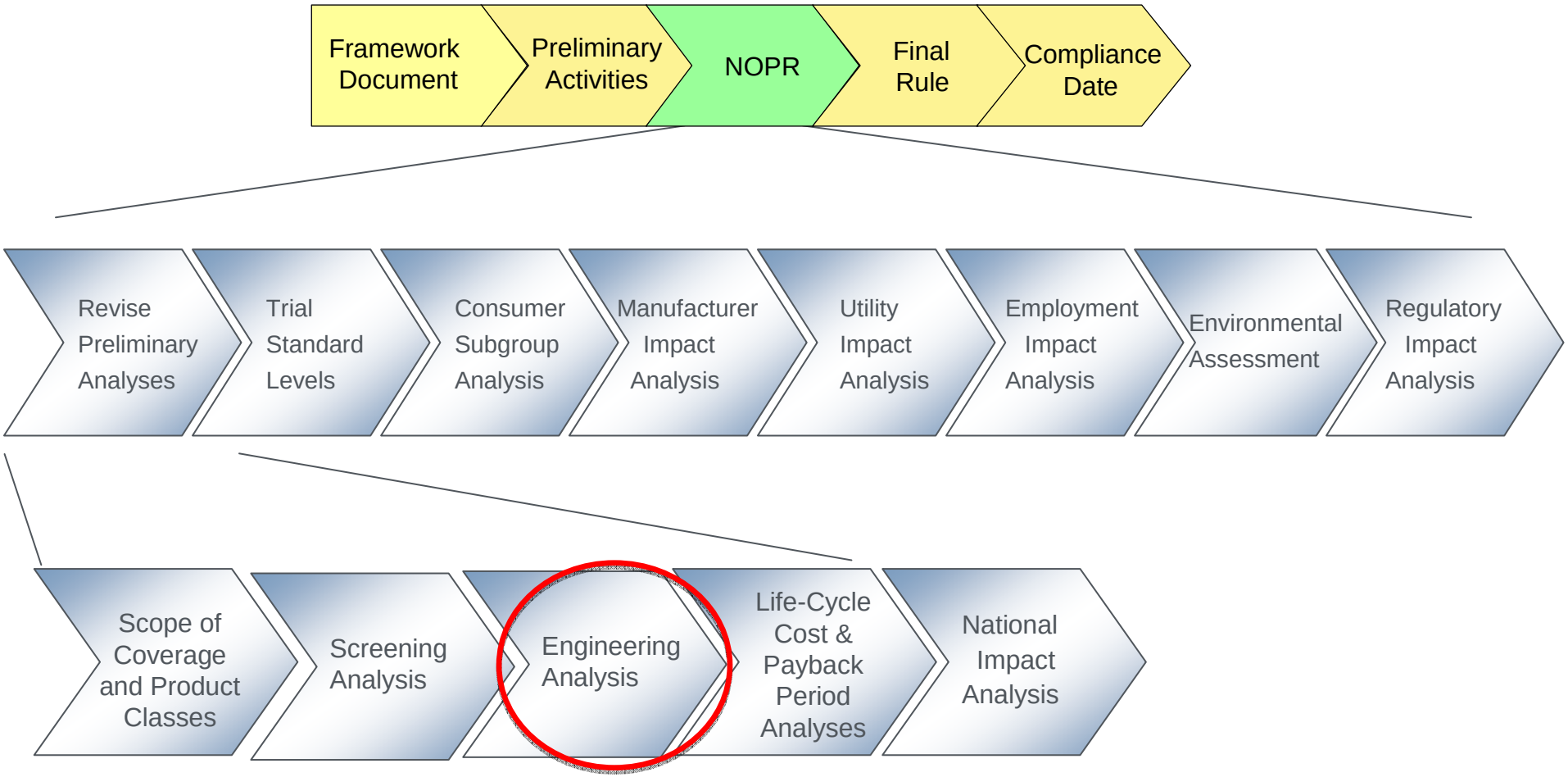
NOPR Analyses Flow Diagram



The NOPR analyses consist of revisions to the Preliminary Activities.

Engineering Analysis

- Purpose
  - To evaluate design options that improve efficiency relative to the baseline models.
  - To characterize manufacturer cost-efficiency relationships for higher efficiency equipment.

- General Methodology for All Three Products
  1. Select representative products to analyze.
  2. Develop baseline models.
  3. Teardown models at higher efficiency levels.
  4. Use a bill of materials and markups to generate cost-efficiency curves.
  5. Scale to unanalyzed product classes.

NOPR Updates for Water Heaters

- Several changes were made for the NOPR engineering analysis:
  - The efficiency levels analyzed for gas-fired storage and electric storage water heaters were modified.
  - A separate analysis was performed on ultra-low NO_X gas-fired storage water heaters.
  - DOE further investigated heat pump water heaters.
  - Scaling equations for gas-fired and electric storage water heaters were revised and scaling methodology was updated.
  - Shipping costs were separated from manufacturer markup for storage water heaters.

Gas-Fired and Electric Storage Water Heater Efficiency Levels

- Max-Tech Efficiency Levels
  - For gas-fired storage water heaters at 40 gallons:
    - DOE used a 0.77 EF for the preliminary analysis.
    - DOE is using a 0.80 EF for the NOPR analysis.
- Intermediate Efficiency Levels
  - For electric storage water heaters at 50 gallons:
    - DOE is analyzing a 2.0 EF efficiency level .
    - DOE maintained 2.2 EF as the max-tech level.

ISSUE 1. DOE seeks comment from interested parties on the max-tech efficiency levels identified for the analyses, especially those for gas-fired water heaters. DOE is particularly interested in comments pertaining to the maximum technologically feasible efficiency levels, including whether the efficiency levels identified by DOE can be achieved using the technologies screened-in during the screening analysis, and whether higher efficiencies are achievable using technologies that were screened-in during the screening analysis.

Ultra-Low NO_X Gas-Fired Storage Water Heaters

- DOE developed a separate cost-efficiency relationship for ultra-low NO_X gas-fired water heaters.
  - DOE used the same methodology as for gas-fired storage water heaters.
    - Analyzed the same efficiency levels and representative rated storage volume (40 gallons);
    - Performed teardowns and developed MPCs at each efficiency level;
  - DOE estimated the costs to account for differences in burners, flue baffling, power venting, and other changes required for ultra-low NO_X products.
  - Results were used downstream in the LCC analysis and applied to the fraction of consumers who live in jurisdictions with ultra-low NO_X regulations.

ISSUE 6. DOE seeks comments on it's assumptions about ultra-low NOX gas-fired storage water heaters and the manufacturer production cost estimates.

Ultra-Low NO_X Gas-Fired Storage Water Heaters

Efficiency Level	MPC *2008$*	MSP *2008$*
Baseline (EF* = 0.59**)	247	343
1 (EF = 0.62)	262	371
2 (EF = 0.63)	374	509
3 (EF = 0.64)	381	520
4 (EF = 0.65)	388	537
5 (EF = 0.67)	N/A***	N/A***
6 – Max-Tech (EF = 0.80)	521	710

* EF is energy factor.

** The energy factor requirements are given for the representative rated storage volume (*i.e.*, 40 gallons)

*** DOE assumed that manufacturers would not be able to achieve this efficiency level for ultra-low NO_X products using existing "screened-in" technologies.

Integrated Heat Pump Water Heater Engineering Update

- Since the NOPR engineering analysis was finalized, DOE tore down commercially available units on the US market.
- DOE compared the commercially available units to DOE's prototype unit in the cost model.
- DOE found the commercially available units show different design philosophies:
  - Design A is a quasi-retrofit design featuring a lightly-modified electric storage water heater tank and shell assembly mated to a heat pump.
  - Design B is heavily integrated featuring a tank wrapped with the condenser (foamed in place) brazed to the heat pump assembly.

Integrated Heat Pump Water Heater Engineering Update

- The commercially available units have similar efficiencies and are about seven feet tall.
- DOE found the following differences between its prototypical unit and the commercially available units:
  - Design A uses an external heat exchanger, a water pump, a ECM blower assembly, and a much more sophisticated control system.
  - Design B features a different condenser heat exchanger implementation, fewer resistance heaters, and a shaded-pole fan motor.
  - Design A and B rely on a gravity drain for condensate, feature only one fan motor, and have unique shipment packaging.

Integrated Heat Pump Water Heater Engineering Update

- While the design strategies of the commercially available units differ, DOE was able to affirm its high-volume prototypical unit and associated MPCs in its cost model.
  - DOE estimated the MPC of a prototypical unit for the NOPR prior to its teardown analysis at two efficiency levels (2.0 and 2.2).
  - DOE research suggests that both Design A and B achieve an EF of approximately 2.0 at the representative storage volume.
  - DOE's 2.0 EF prototypical unit MPC estimate is between the MPCs of Designs A and B at the representative storage volume.

Scaling of Manufacturer Production Costs for Storage Water Heaters

- DOE scaled costs to rated storage volumes outside of the "representative" storage volume to account for large variations in first costs and usage patterns of different size products.
- The scaled production costs are used in the downstream analysis.
- DOE performed teardowns of models at rated storage volumes other than the "representative" rated storage volume (*i.e.*, 40 gallons for gas-fired, 50 gallons for electric storage water heaters).
  - These teardowns allowed DOE to determine which components scale with rated storage volume and exactly how they scale.
  - Components that will change with tank size (*e.g.*, tank dimensions, wrapper dimensions, wall thicknesses, insulation thickness, anode rod(s), flue pipe(s)) were scaled based on teardown results.
  - Components that do not change with tank size (*e.g.*, gas valves, thermostats, controls) were assumed to remain largely the same across the different storage volume sizes.

Scaling of Manufacturer Production Costs for Storage Water Heaters

Efficiency Level	Gas-Fired Storage, Standard Burner Manufacturing Production Cost			
	30 Gallon	50 Gallon	65 Gallon	75 Gallon
Baseline	$166	$191	$220	$237
1	$172	$199	$229	$246
2	$179	$207	$239	$256
3	$293	$319	$349	$367
4	$299	$327	$359	$376
5	$306	$335	$369	$387
6	$432	$468	$513	$538

Efficiency Level	Electric Storage Manufacturing Production Cost				
	30 Gal	40 Gallon	66 Gallon	80 Gallon	119 Gallon
Baseline	$109	$122	$142	$164	$204
1	$115	$128	$150	$172	$214
2	$118	$133	$155	$179	$222
3	$121	$136	$158	$183	$227
4	$128	$143	$168	$192	$237
5	$142	$160	$188	$214	$263
6	$512	$529	$554	$580	$628
7	$556	$574	$601	$629	$666

Scaling of Manufacturer Production Costs for Storage Water Heaters

Efficiency Level	Oil-Fired Storage Manufacturing Production Cost
	50 Gal
Baseline	$631
1	$639
2	$645
3	$654
4	$653
5	$664
6	$733
7	$738

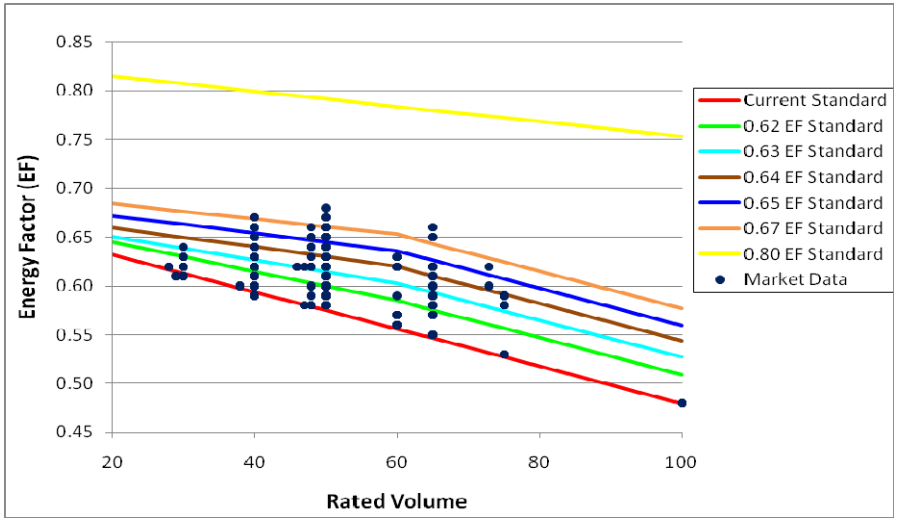
ISSUE 12. DOE requests comments on its approach to scaling the manufacturer production costs from the representative storage volumes to other storage volumes. DOE also requests comments on the estimated manufacturer production costs for storage water heaters at storage volumes outside of the representative volume, which are shown in Chapter 5 of the heating products TSD.

Energy Efficiency Equations

- Energy efficiency equations are used to characterize the relationship between rated storage volume and energy factor.
- For the NOPR analysis, DOE revised the energy efficiency equations that were presented in the preliminary analysis based on:
  - Review of a comprehensive water heater database created by DOE, which includes water heater models on the market at the time of the analysis (Spring 2009); and
  - Results of independent EF testing performed on variety of water heaters across a range of efficiencies and storage volumes.

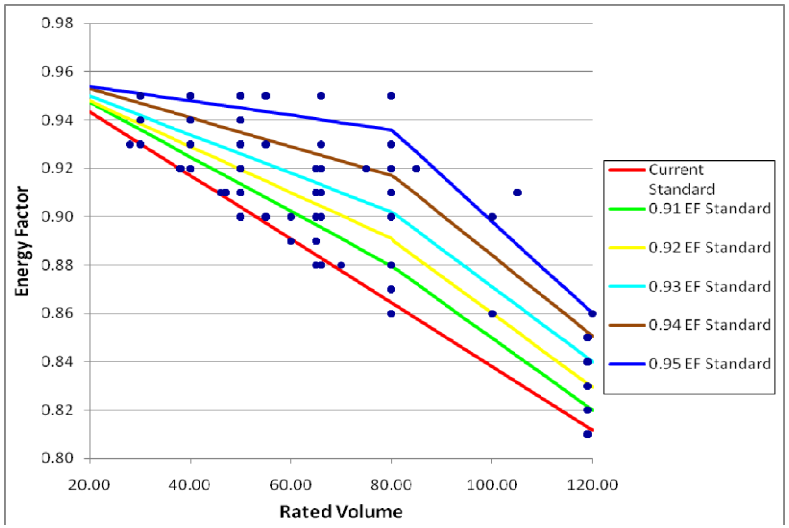
Energy Efficiency Equations – Gas-Fired Storage Water Heaters

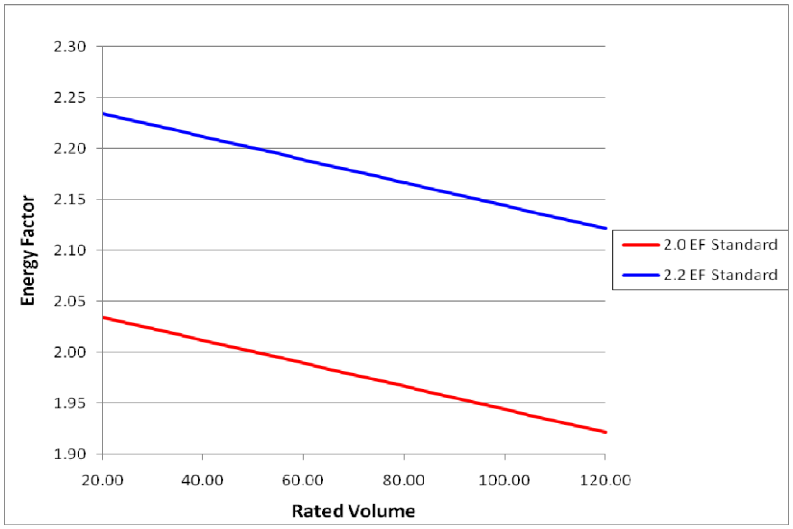
Efficiency Level	20 to 60 Gallons	Over 60 and up to 100 Gallons
Baseline Energy Efficiency Equation	EF = -0.00190(V_R)+0.670	
EL 1 Energy Efficiency Equation	EF = -0.00150(V_R)+0.675	EF = -0.00190(V_R)+0.699
EL 2 Energy Efficiency Equation	EF = -0.00120(V_R)+0.675	EF = -0.00190(V_R)+0.717
EL 3 Energy Efficiency Equation	EF = -0.00100(V_R)+0.680	EF = -0.00190(V_R)+0.734
EL 4 Energy Efficiency Equation	EF = -0.00090(V_R)+0.690	EF = -0.00190(V_R)+0.750
EL 5 Energy Efficiency Equation	EF = -0.00078(V_R)+0.700	EF = -0.00190(V_R)+0.767
EL 6 Energy Efficiency Equation	EF = -0.00078(V_R)+0.8312	



Energy Efficiency Equations – Electric Storage Water Heaters

Efficiency Level	20 to 80 Gallons	Over 80 and up to 120 Gallons
Baseline Energy Efficiency Equation	EF = -0.00132(V_R)+0.97	
EL 1 Energy Efficiency Equation	EF = -0.00113(V_R)+0.97	EF = -0.00149(V_R)+0.999
EL 2 Energy Efficiency Equation	EF = -0.00095(V_R)+0.967	EF = -0.00153(V_R)+1.013
EL 3 Energy Efficiency Equation	EF = -0.00080(V_R)+0.966	EF = -0.00155(V_R)+1.026
EL 4 Energy Efficiency Equation	EF = -0.00060(V_R)+0.965	EF = -0.00168(V_R)+1.051
EL 5 Energy Efficiency Equation	EF = -0.00030(V_R)+0.960	EF = -0.00190(V_R)+1.088
EL 6 Energy Efficiency Equation	EF = -0.00113(V_R)+2.057	
EL 7 Energy Efficiency Equation	EF = -0.00113(V_R)+2.257	





Energy-Efficiency Equations (Issue # 7)

ISSUE 7. DOE requests comments on the approach for developing the energy efficiency equations, the appropriate slope of energy efficiency equations at each efficiency level analyzed, and the appropriate storage volumes for changing the slope of the line. DOE is also interested in any alternatives to the energy efficiency equations that DOE should consider for the final rule.

Request for Additional Comments

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

Life-Cycle Cost and Payback Period Analyses

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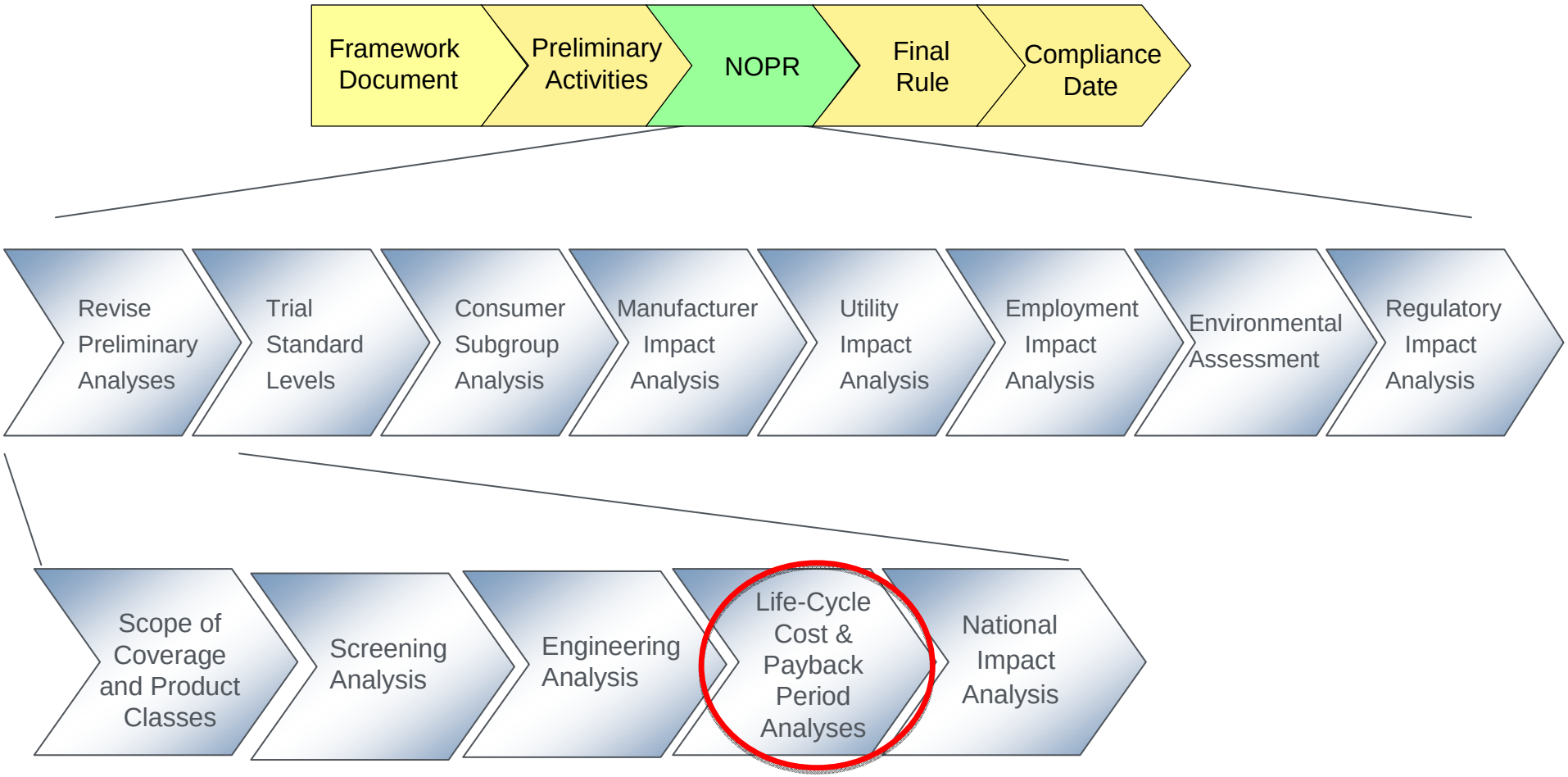
NOPR Analyses Flow Diagram



The NOPR analyses consist of revisions to the Preliminary Activities.

Purpose

- Markups for Product Price Determination
  - To characterize the channels for how products are distributed from the manufacturer to the customer.
  - To determine prices paid by customers based on manufacturer selling prices for baseline and higher efficiency products.

- Energy Use Characterization

–To develop energy savings estimates for selected product efficiency levels.

- Life-Cycle Cost and Payback Period Analyses
  - To develop the customer life-cycle cost savings and payback period for higher efficiency products.

Markups for Product Price Determination

- Method
  - Markups relate consumer price to cost of goods sold (CGS).
    - Baseline markups relate price to cost prior to a change in efficiency.
    - Incremental markups relate the incremental change in consumer price to the incremental change in CGS.
  - National distribution of sales taxes.
- Sources
  - U.S. Census Bureau data (2002) from the *2002 Economic Census, Construction Industry Series* and *Geographic Area Series for Construction*
  - U.S. Census Bureau data (1997) from the *1997 Economic Census, Business Expenses*
  - Air Conditioning Contractors of America data (2005) from the *Financial Analysis for the HVACR Contracting Industry*
  - RS Means Company Inc. data (2008) from *Mechanical Cost Data - 31th Annual Edition*
  - Sales Tax Clearinghouse Inc. data (2009) from *State Sales Tax Rates Along with Combined Average City and County Rates*
- NOPR analysis changes:

Inputs	Preliminary Analysis	Changes for the Proposed Rule
Consumer Price	Reported in 2007$	Reported in 2008$
Sales Taxes	2006 data	2009 data

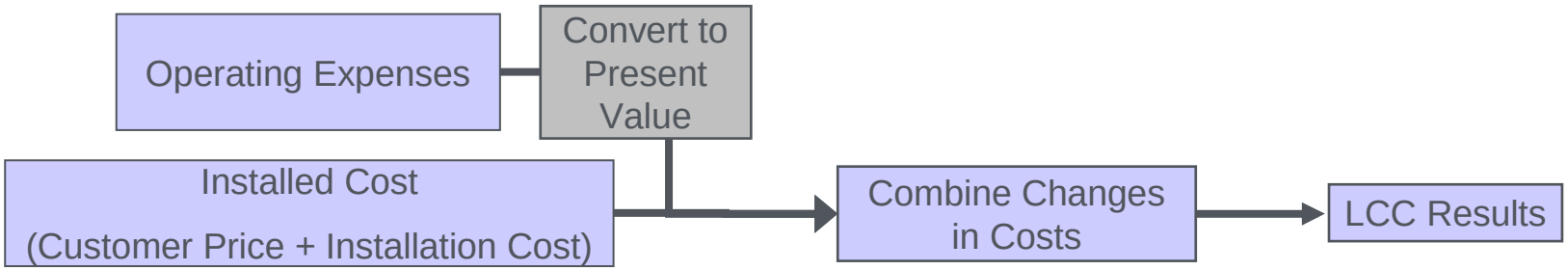
Energy Use Characterization

- Method
  - *Water Heaters:* Used RECS 2005 and applied hot water draw model to calculate daily hot water use. Determined energy use using the water heater analysis model (WHAM).
  - *DHE and Pool Heaters*: Used RECS and test procedure to determine energy use.
- NOPR analysis changes:

Product Class	Preliminary Analysis	Changes for the Proposed Rule
All Products	Based on sample from RECS 2001. Product characteristics from 2007-2008 data.	Sample updated using RECS 2005. Product characteristics updated to latest available data (March 2009 AHRI Directory; June 2008 FTC Pool Heater Directory).
Gas Storage Water Heaters	Used single point RE value per efficiency level	Distribution of RE values based on number of models in 2009 AHRI Directory.
Electric Storage Water Heaters	Accounted for HPWH cooling effect by estimating impacts on heating/cooling loads. Single point value for heating capacity for HPWH	Accounted for the cost of venting for a fraction of HPWH installations. Distribution of values for heating capacity for HPWH
Instantaneous Gas-Fired Water Heaters	Performance adjustment factor was constant at 8.8%.	Performance adjustment factor varies from 0% to 8.8% depending on hot water use.
DHE	Gas fireplaces included in the GWF DHE and GR DHE.	Gas fireplaces included in the Hearth DHE products class only.
Pool Heaters	Used household sample from RECS 2001.	Increased sample using RECS 1993, 1997, 2001, and 2005.

Life-Cycle Cost and Payback Period Analyses

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



Installation Costs

- Method:
  - Based on data from 2008 RS Means, consultant reports, 2001 WH rulemaking for OSWHs, and 1993 DHE rulemaking
- NOPR analysis changes:

Product Class	Preliminary Analysis	Changes for the Proposed Rule
All Products	1) National labor costs 2) Installation materials and labor costs in 2007$ 3) No extra attic installation cost for water heaters	1) Regional labor costs 2) Installation materials and labor costs in 2008$ 3) Accounted for added attic installation cost (GSWH, ESWH)
Gas-Fired Storage Water Heaters	1) No space constraints costs for water heater designs with increased insulation. 2) Did not account for a fraction of natural draft water heaters requiring stainless steel vent connectors. 3) Average venting costs for all households.	1) Added space constraints installation cost to a fraction of 1.5” and 2” insulation design 2) Added cost of stainless steel vent connector to a fraction of households. 3) Venting costs calculated for each individual household.
Electric Storage Water Heater	1) Space constraints only to conditioned space and above 2.5” insulation and above 2) No HPWH venting cost	1) Adjustment to the fraction of households impacted by space constraints. 2) Cost of venting for some households with HPWHs that experience cooling effect.
DHE	No Hearth Products	Assumed hearth DHE installation cost similar to gas room DHE

Heat Pump Water Heater Installation Costs

Installation Cost Description	Assignment to Installations	Installations impacted	Average Cost
Additional Labor	All installations	100%	$69
Closet Door Redesign (Space Constraints)	50% of indoor and heated basement replacement installations	16%	$344
Tempering Valve Addition (Space Constraints)	20% of all replacement installations	16%	$142
Condensate Pump	25% of all replacement installations	20%	$154
Venting Adder	40% of replacement installations with cooling load effects	10%	$460
Larger Drain Pan	All installations	100%	$2

Sources: Labor cost hours and material cost from 2008 RSMeans, condensate pump from retailer web sites, drain pan from 2001 TSD

Cooling Effect Approach: All HPWH households experiencing cooling load effects in the heating season are either assigned the venting adder or the extra cost for space heating is accounted in the energy use calculations.

ISSUE 13. DOE seeks comment its analysis of installation costs for water heaters. DOE is particularly interested in comments on its analysis of installation costs for heat pump water heaters.

Energy Prices

- Method: Average monthly and annual energy prices are calculated using EIA historical data and energy price trends come from AEO 2009
  - *Water Heaters:* Used average monthly energy prices
  - *DHE and Pool Heaters*: Used average annual energy prices
- NOPR analysis changes:

Inputs	Preliminary Analysis	Changes for the Proposed Rule
Energy Prices	*Electricity:* Based on EIA's 2006 Form 861 data. *Natural Gas:* Based on EIA's 2006 Natural Gas Navigator. *Oil:* Based on EIA's 2006 Petroleum Navigator. *LPG:* EIA's 2005 State Energy Consumption, Price, and Expenditure Estimates	Electricity: Based on EIA's 2007 Form 861 and Form 826 data. Natural Gas: Based on EIA's 2007 Natural Gas Navigator. *Oil:* Based on EIA's 2007 Petroleum Navigator. *LPG*: EIA's 2006 State Energy Consumption, Price, and Expenditure Estimates
Energy Price Trends	Forecasted using EIA's AEO2008. *Variability*: None	Forecasted using EIA's AEO2009. *Variability*: Regional energy price forecasts for the nine census divisions.

Maintenance Costs

- Method
  - Cost of regular scheduled product maintenance
  - Based on data from RS Means and other sources (including consultant reports for GSWH, ESWH, GIWH, and PH; 2001 WH rulemaking for OSWHs, 1993 rulemaking for DHE)
- NOPR analysis changes:

Inputs	Preliminary Analysis	Changes for the Proposed Rule
All Products	1) National labor costs 2) Maintenance materials and labor costs in 2007$ 2) No storage tank water heater annual flushing maintenance cost	1) Regional labor costs 2) Maintenance materials and labor costs in 2008$ 2) Applied annual flushing maintenance cost to a fraction of households (2.5%)
Gas-Fired Storage Water Heaters	None.	Added FVIR maintenance cost.
Instantaneous Gas-Fired Water Heater	Includes annual de-liming cost to all households	Annual de-liming cost applied to a fraction of households (75%)

Repair Costs

- Method: Determines price for replacing or repairing components which have failed
  - applicable to a fraction of households
  - accounts for components likely to be repaired during the lifetime of the product
- NOPR analysis changes:

Product Class	Preliminary Analysis	Changes for the Proposed Rule
All Products	1) National labor costs 2) Maintenance materials and labor costs in 2007$ 3) Fraction repaired based on lifetime component only.	1) Regional labor costs 2) Maintenance materials and labor costs in 2008$ 3) Fraction of products requiring repair based on consultant data .
Electric Storage Water Heaters	None.	Added Heating Element

Heat Pump Water Heater Repair and Maintenance Costs

Maintenance Cost Component	Applicability	Average Annual Cost	Maximum Cost	% of Consumers with Maintenance Cost
Tank Flushing	All	$3	$105	2.5%* every year
Evaporator Cleaning	HPWH Only	$2	$122	10%** every 5 years

Sources: Costs – 2008 RSMeans, Fraction of installations (flushing) and labor hours - Consultant Report; Fraction of installations (evaporator) - 2001 CAC TSD (survey) and RECS2005

Repair Cost Component	Applicability	Average Annual Cost	Maximum Cost	% of Consumers with Maintenance Cost
Electric Resistance Element	All	$24	$123	20%*
Compressor	HPWH Only	$28	$290	10%**
Evaporator Fan	HPWH Only	$13	$126	10%**

Sources: Labor cost (regional) from 2008 RSMeans, Material cost – consultant report, retailer web sites, Labor hours – consultant report, CA study, Fraction of installations (electric res element) and labor hours - Consultant Report, Fraction of installations (compressor & fan) - based on component lifetime

ISSUE 14. DOE seeks comment on its analysis of repair and maintenance costs for heat pump water heaters.

Product Lifetime

- Method:
  - DOE characterized the product lifetime using a Weibull probability distribution.
- NOPR analysis changes:

Product Class	Preliminary Analysis	Changes for the Proposed Rule
Water Heaters	Based on various sources including Appliance Magazine.	Based on RECS equipment age data, AHS equipment stock data, and AHRI shipments data.
DHE	Lifetime values from the 1993 TSD.	Added Hearth DHE product class with the same lifetime.
PH	Based on various sources including industry associations, and retailers.	EERE, industry associations, consultant report, and retailers to derive a lifetime distribution

- Results:

Product Class	Preliminary Analysis Average	NOPR Average
Gas-Fired Storage Water Heaters	12	13
Electric Storage Water Heaters	14	13
Oil-Fired Storage Water Heaters	9	13
Instantaneous Gas-Fired Water Heaters	20	20
Direct Heating Equipment	15	15
Pool Heaters	6	8

Discount Rates

- Method: The finance cost of raising funds to purchase major home appliances is interpreted as either:
  - the financial cost of any debt incurred to purchase equipment, or
  - the opportunity cost of any equity used to purchase equipment.
- NOPR analysis changes:

Inputs	Preliminary Analysis	Changes for the Proposed Rule
Asset/Debt Share Allocations	Federal Reserve Board's *Survey of Consumer Finances* for the years 1989, 1992, 1995, 1998, 2001, 2004	Added Federal Reserve Board's *Survey of Consumer Finances 2007*
Debt interest rates	Federal Reserve Board's *Survey of Consumer Finances* for the years 1989, 1992, 1995, 1998, 2001, 2004	Added Federal Reserve Board's *Survey of Consumer Finances 2007*
Asset interest rates	Data from 1980-2007	Updated data from 1980-2008.

- Results:

Housing Type	Finance Cost Based On:	Preliminary Analysis Mean (%)	NOPR Mean (%)
New Construction	Mortgage	3.2	3.0
Replacements	Home equity loans, Credit card, Other loans, Checking & savings accounts, Certificates of deposit, Bonds, Stocks	5.5	4.8

Product Assignment in the Base Case

- Method:
  - Avoids overstating the benefits from increasing equipment efficiency by showing the percentage of consumers already purchasing efficient equipment.
  - Use market share by efficiency data, model databases, and assume higher market shares for energy star products
- NOPR analysis changes:

Product Class	Preliminary Analysis	Changes for the Proposed Rule
All Products	March 2008 AHRI water heaters and DHE directory, June 2007 FTC pool heater directory, 2003-2007 AHRI shipments data	March 2009 AHRI water heaters and DHE directory, June 2008 FTC pool heater directory, 2003-2008 AHRI shipments data
Gas-Fired Storage Water Heaters	Market share assumed to be 3.75% for 0.67 EF and 2.5% for 0.80 EF at 40 gallons	Market share updated to 5.25% for 0.67 EF and 1% for 0.80 EF.
Electric Storage Water Heaters	Market share assumed to be 5% for 2.2 EF	Market share updated to 4% for 2.0 EF and 1% for 2.2 EF.
Oil-Fired Storage Water Heaters	March 2008 AHRI directory	March 2009 AHRI directory and manufacturer market share inputs
DHE	Hearth product market share mixed in with FWF DHE and GR DHE	Added separate Hearth products class

Request for Additional Comments

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

National Impact Analysis

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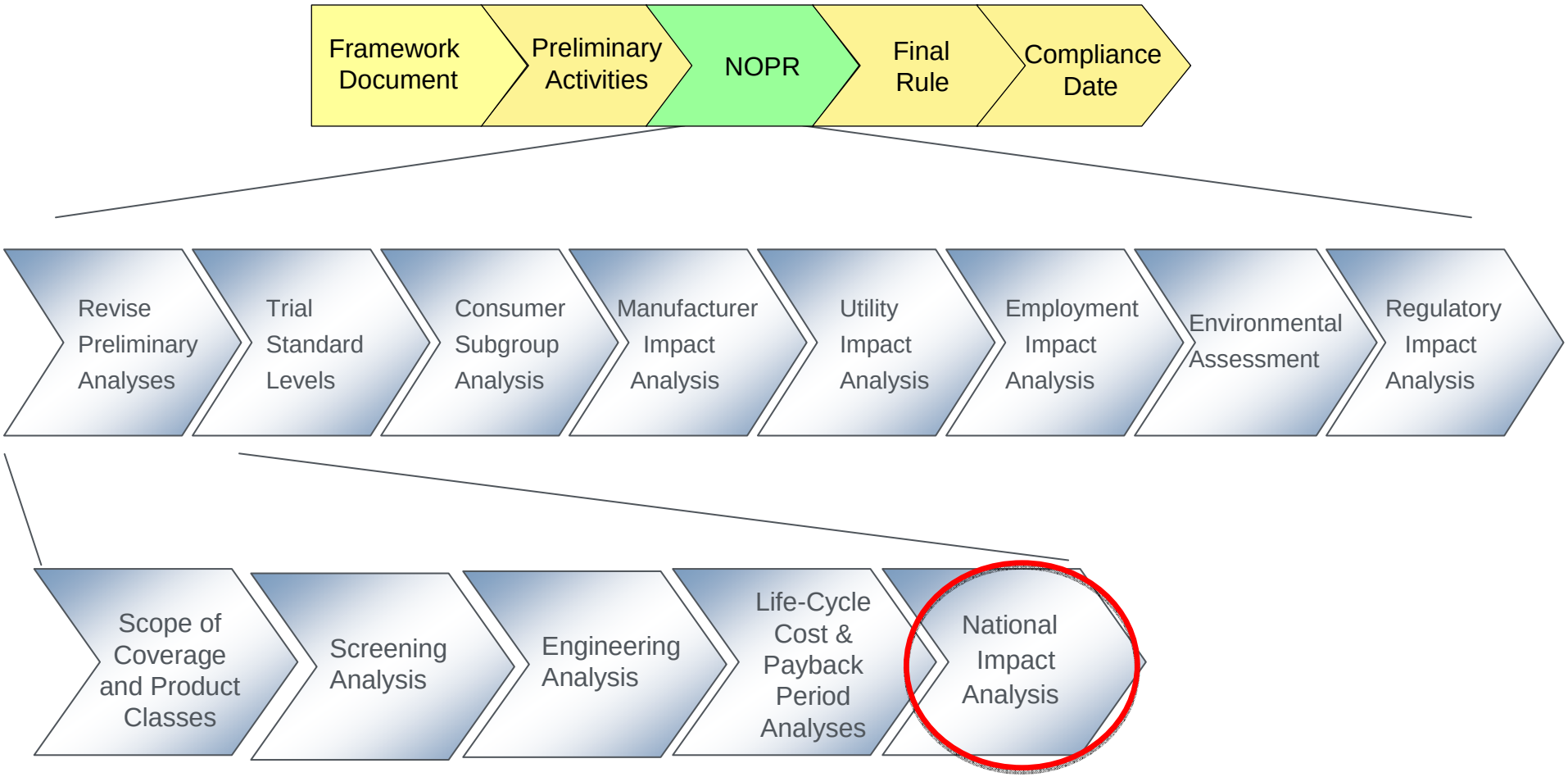
NOPR Analyses Flow Diagram



The NOPR analyses consist of revisions to the Preliminary Activities.

Purpose

- Shipments Analysis
  - To estimate heating product shipments over time.
- National Impact Analysis
  - To estimate the National Energy Savings (NES) from heating product energy conservation standards at different efficiency levels.
  - To estimate the national economic impact on the nation (or the Net Present Value (NPV)) from heating product energy conservation standards at different efficiency levels.

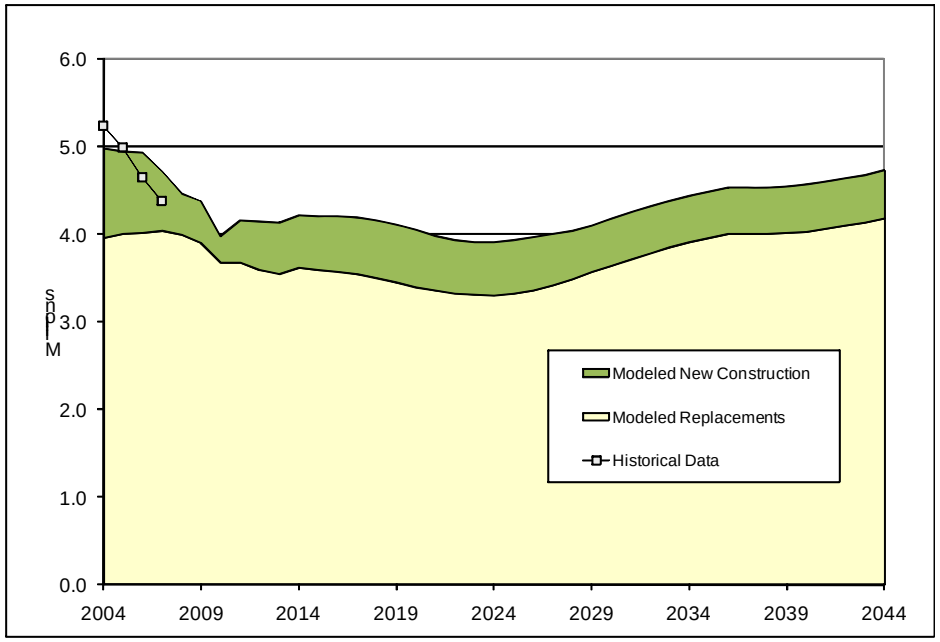
Changes to NOPR Shipments Analysis

Input	Preliminary Analysis	Changes to Proposed Rule
Water Heaters - Historical Shipments	1988-2007 AHRI shipments data.	Updated to include 2008 AHRI and 1997-2007 Oil Heating Journal shipments data
Water Heaters - New Construction	Used AEO2008 new housing forecasts.	New housing forecast updated with AEO2009 projections.
Water Heaters – Replacements	Considered total product stock by vintage and established the failure of the stock using retirement functions from the LCC analysis.	Retirement function updated with new lifetime results.
DHE - Historical Shipments	1988-2007 data provided by AHRI.	Updated to include HPBA* data for hearth products, updated wall fan and gravity market share
DHE - Projections	Hearth shipments part of gas fan wall and gas room DHE.	Hearth DHE updated based on new housing forecasts from AEO2009.
Pool Heaters - Historical Shipments	Data from 1993 TSD.	Accounted for 2007-2008 data from manufacturers.
Pool Heaters - Replacements	Considered total product stock by vintage and established the failure of the stock using retirement functions from the LCC analysis.	Included estimated non-replacements of a fraction of pool heaters, updated retirement function with new lifetime results

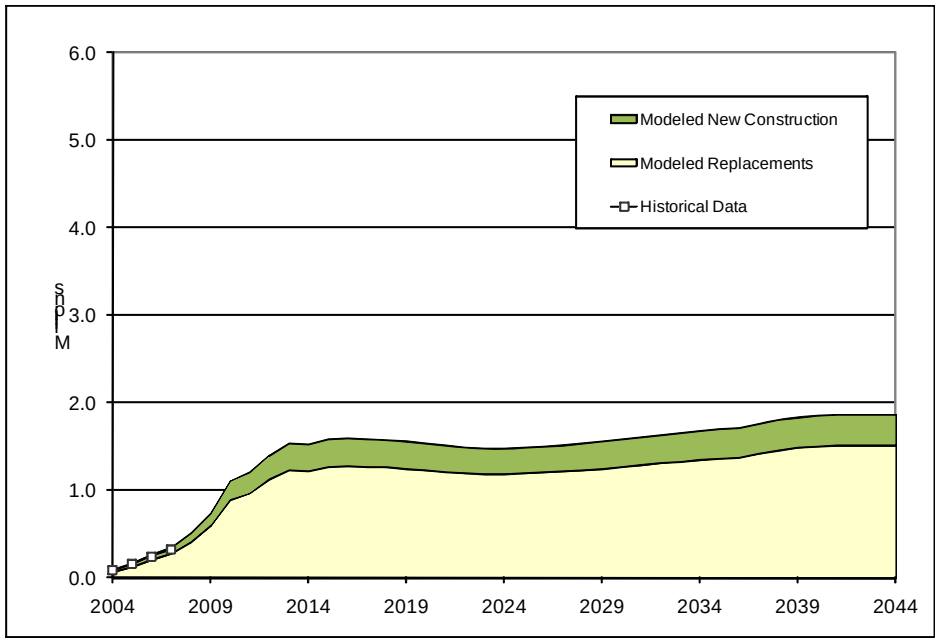
Shipments – Water Heater Approach and Results

- Shipments Forecast for Water Heaters (2015-2045):
  - Two market segments:
    - New construction: New housing construction forecasts multiplied by historical fuel market shares (average market shares from 2000-2008).
    - Replacements: Product retirement functions (product lifetimes) applied to product stock. Product stock is generated with historical shipments.
  - Accounted for market growth of Gas-Fired Instantaneous Water Heaters

Gas-Fired Storage Water Heaters



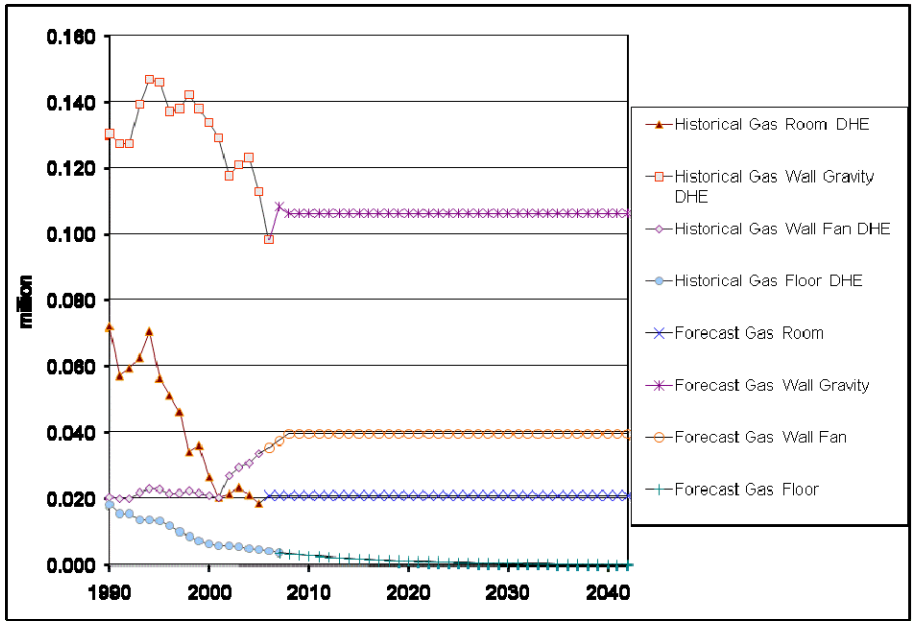
Gas-Fired Instantaneous Water Heaters



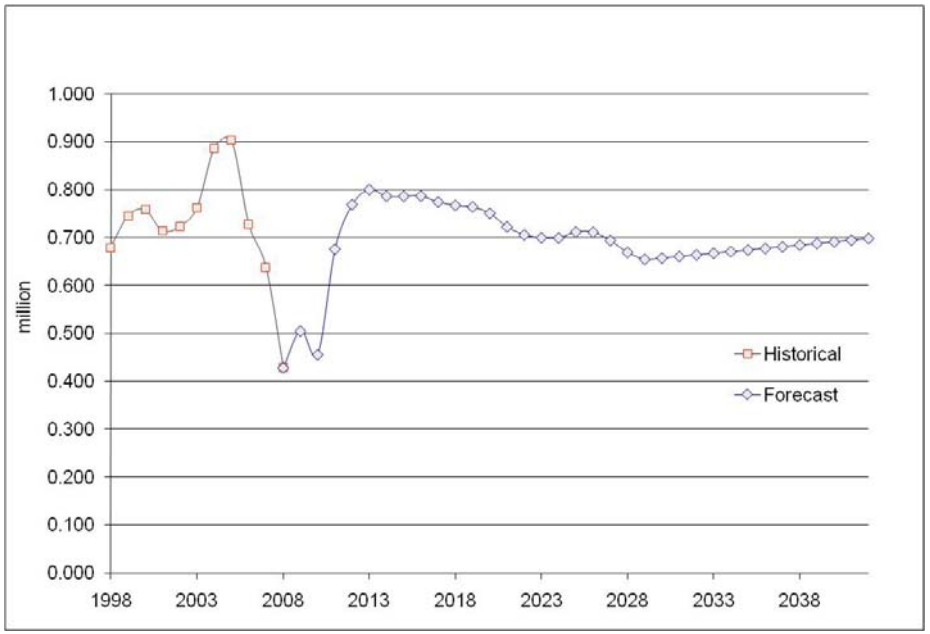
Shipments – DHE Approach and Results

- Shipments Forecast for Direct Heating Equipments (2013-2043):
  - No market segmentation: Forecast is based on historical trends.
    - Held constant (Gas Room DHE, Gas Wall Fan DHE, Gas Wall Gravity DHE)
    - Historical Trend (Gas Floor DHE)
    - Historical Shipments correlated with new constructions (proxy for economic growth) (Hearth DHE)

Gas Wall Fan, Gravity, Room and Floor DHE



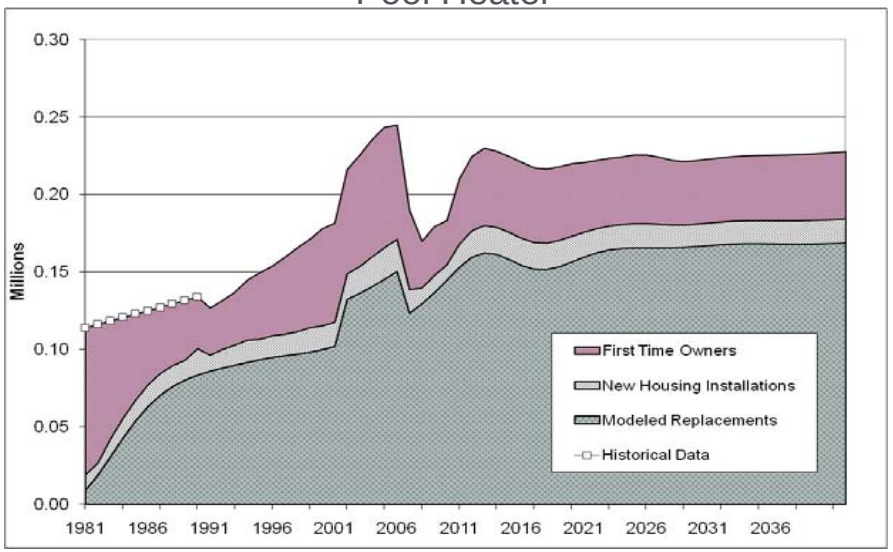
Hearth DHE



Shipments – Pool Heater Approach and Results

- Shipments Forecast for Pool Heaters (2013-2043):
  - 3 market segments:
    - New housing Installations: projection based on PK historical data
    - First time owners: projection based on PK historical data
    - Replacements : Equipment retirement functions (equipment lifetimes) applied to equipment stock. Equipment stock is generated with historical shipments. DOE also accounted for units that are not replaced.

Pool Heater



Fuel Switching

- DOE considered Fuel Switching to gas-fired storage water heaters in the case of a standard that effectively requires an electric heat pump water heater.

Gas-Fired Water Heater Efficiency Level	Average Total Installed Cost Differential for Homes that Switch	Change in Electric WH Shipments due to Switching	
		New Construction	Replacements
Baseline	$145	0.5%	4.6%
1	$85	0.3%	2.3%
2	$77	0.2%	1.7%
3	$116	0.1%	6.2%
4	$104	0.1%	5.5%
5	$89	0.1%	4.5%
6	$2	0.0%	0.0%

Fuel-Switching (Issue #15)

ISSUE15. DOE seeks comments on its approach for analyzing fuel switching that may result from the proposed standards on water heaters and the other heating products.

In particular, DOE requests comments on:
(1)DOE's general approach, which does not involve price elasticities;
(2)DOE's analysis of switching to gas-fired storage water heaters in the case of a standard that effectively requires an electric heat pump water heater
(3)Its conclusion that the proposed standards would not induce switching from a gas storage water heater to an electric storage water heater; and
(4)Its conclusion that the proposed standards would not induce switching for gas-fired instantaneous water heaters, DHE, and pool heaters.

Changes in NIA NOPR Analysis

Inputs	Preliminary Analysis	Changes for the Proposed Rule
Base-Case and Standards-Case Forecasted Efficiencies	Efficiency market shares estimated for compliance year. Forecasted efficiencies remain constant except for gas and electric water heaters, which increase slightly over forecast period.	Updated efficiency market shares estimates for compliance year and updated gas and electric water heaters forecasted efficiency trends.
Energy Prices Trends	AEO2008 national forecasts (to 2030) and extrapolation to 2043 (and 2045).	Updated using AEO2009 regional forecasts.
Present Year	Future expenses are discounted to 2007.	Future expenses are discounted to 2010, when the final rule is expected to be published.

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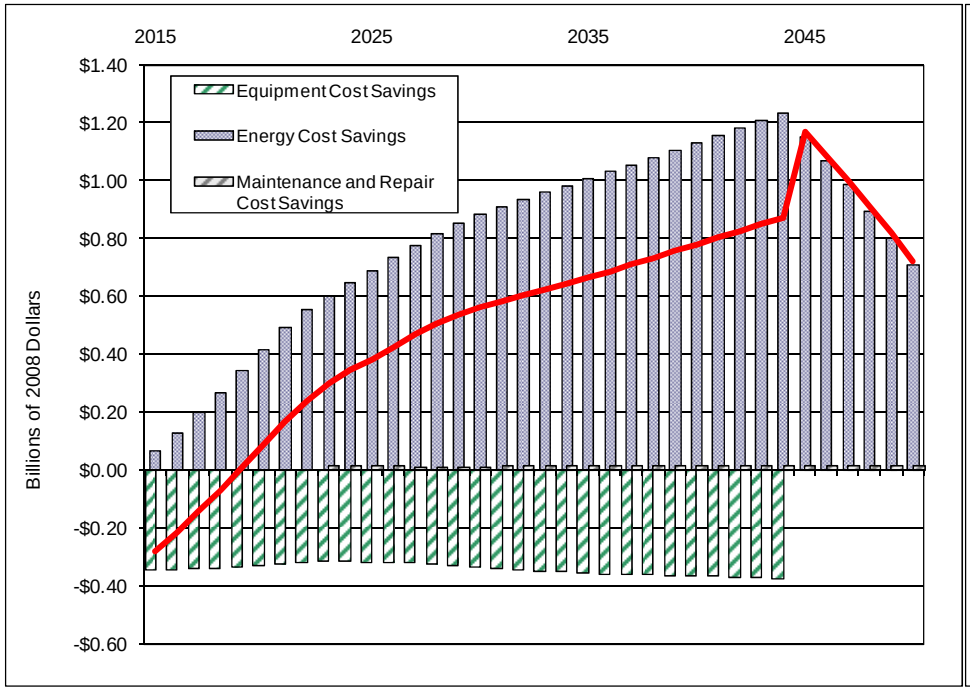
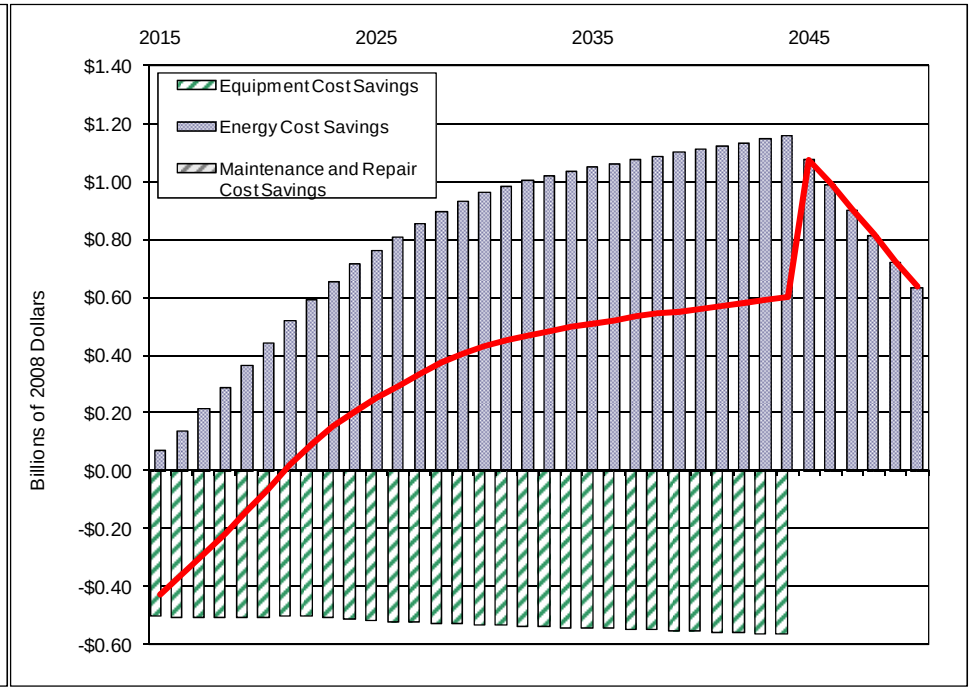
Results at the Proposed Standard Level



Gas-Fired Storage Water Heaters (EL 2)



Electric Storage Water Heaters (EL 5)

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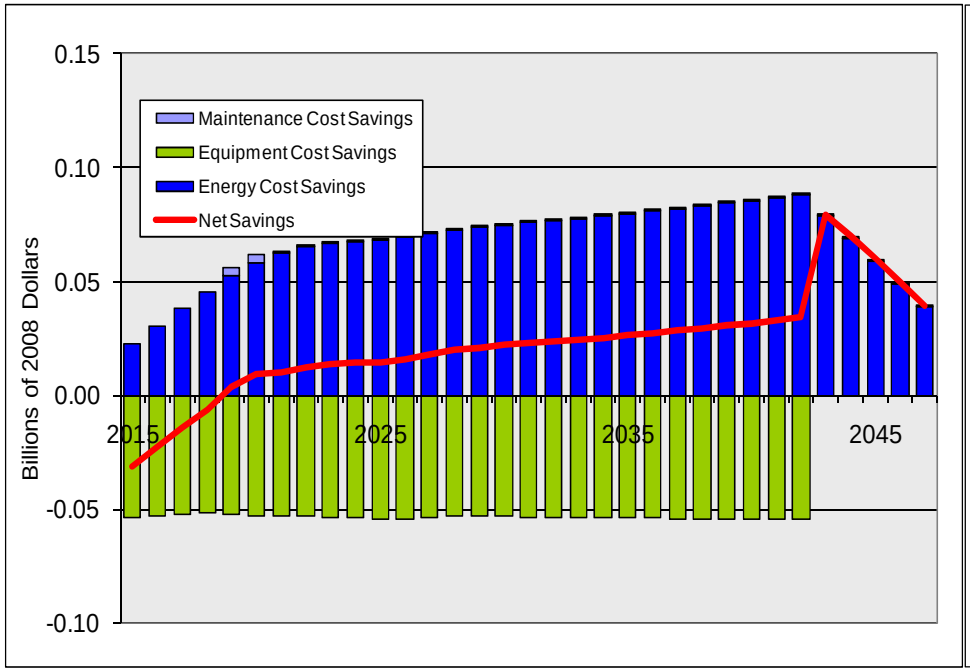
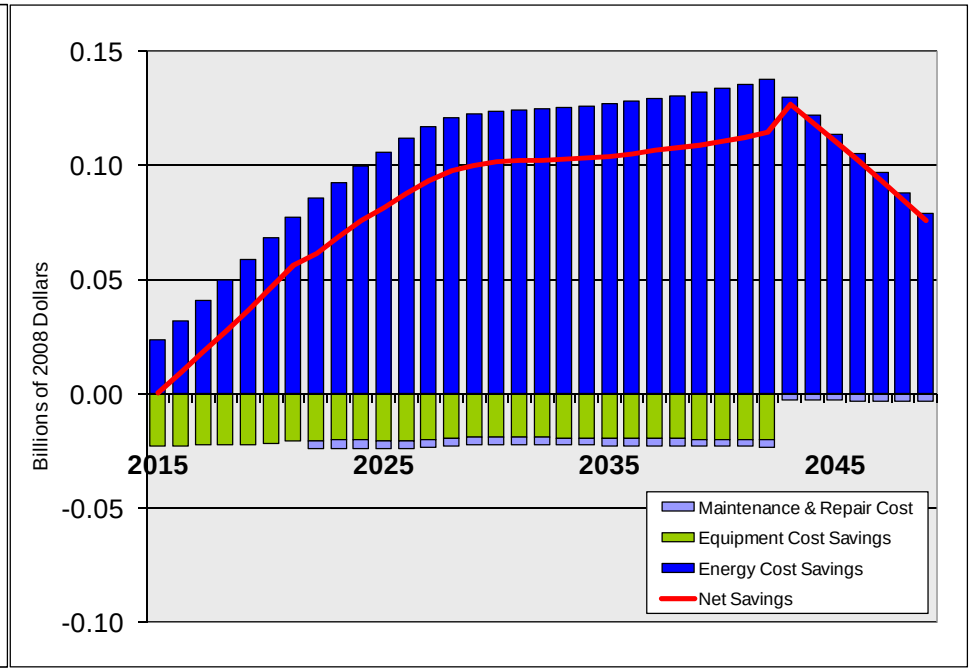
Results at the Proposed Standard Level



Pool Heaters (EL 5)



Gas Hearth Direct Heating Equipment (EL 1)

Trial Standard Levels

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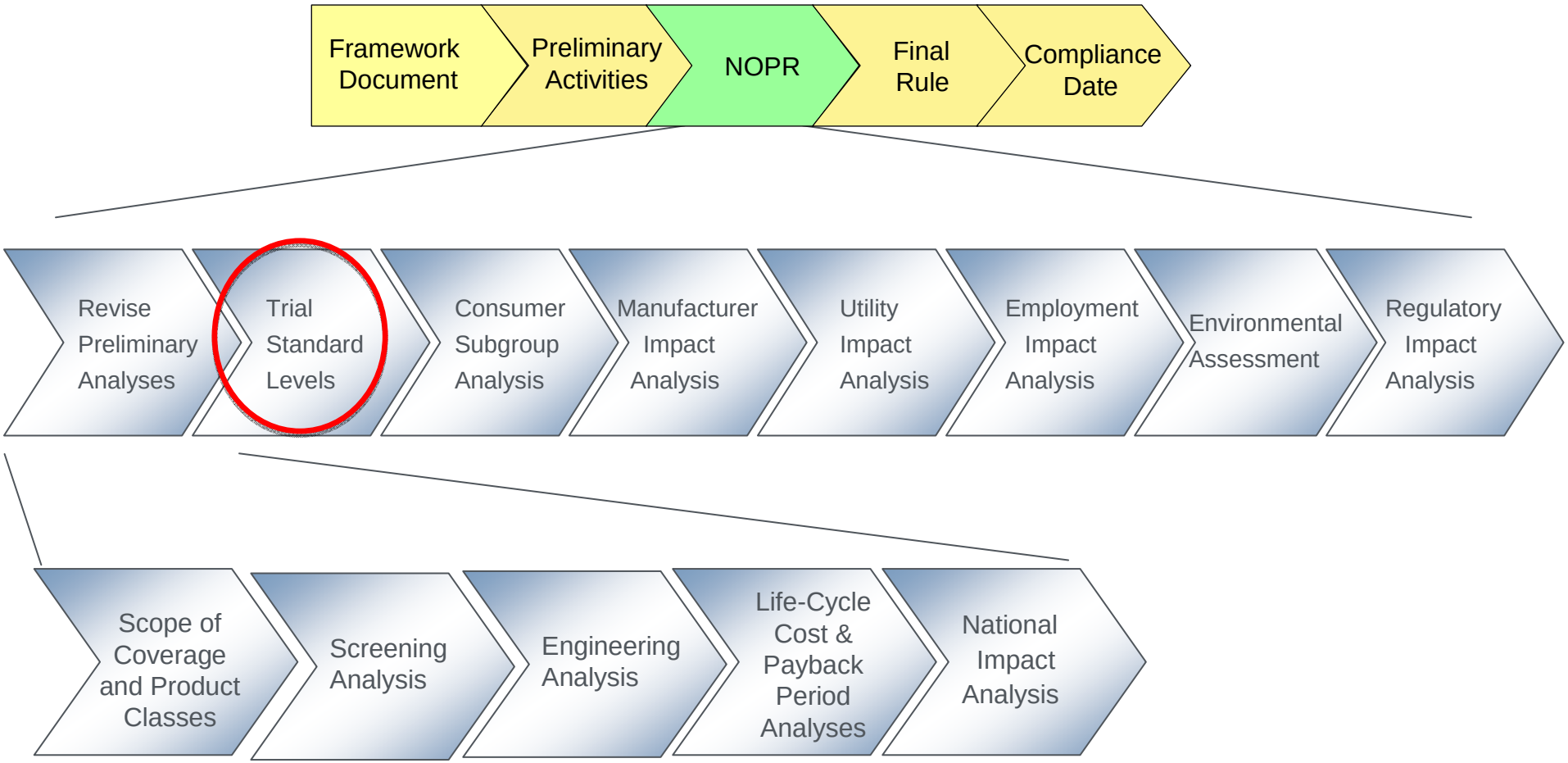
NOPR Analyses Flow Diagram

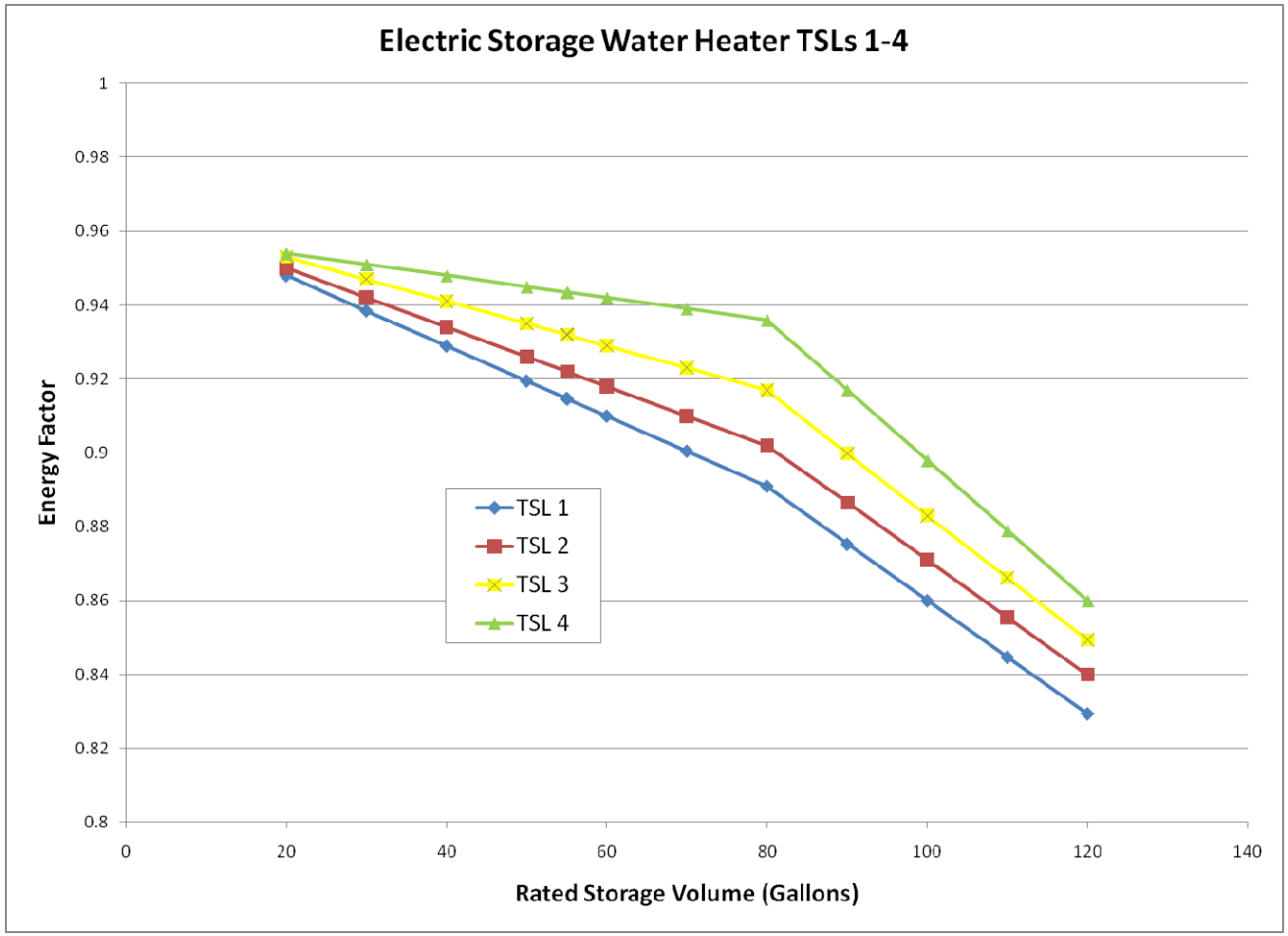


The NOPR analyses consist of revisions to the Preliminary Activities.

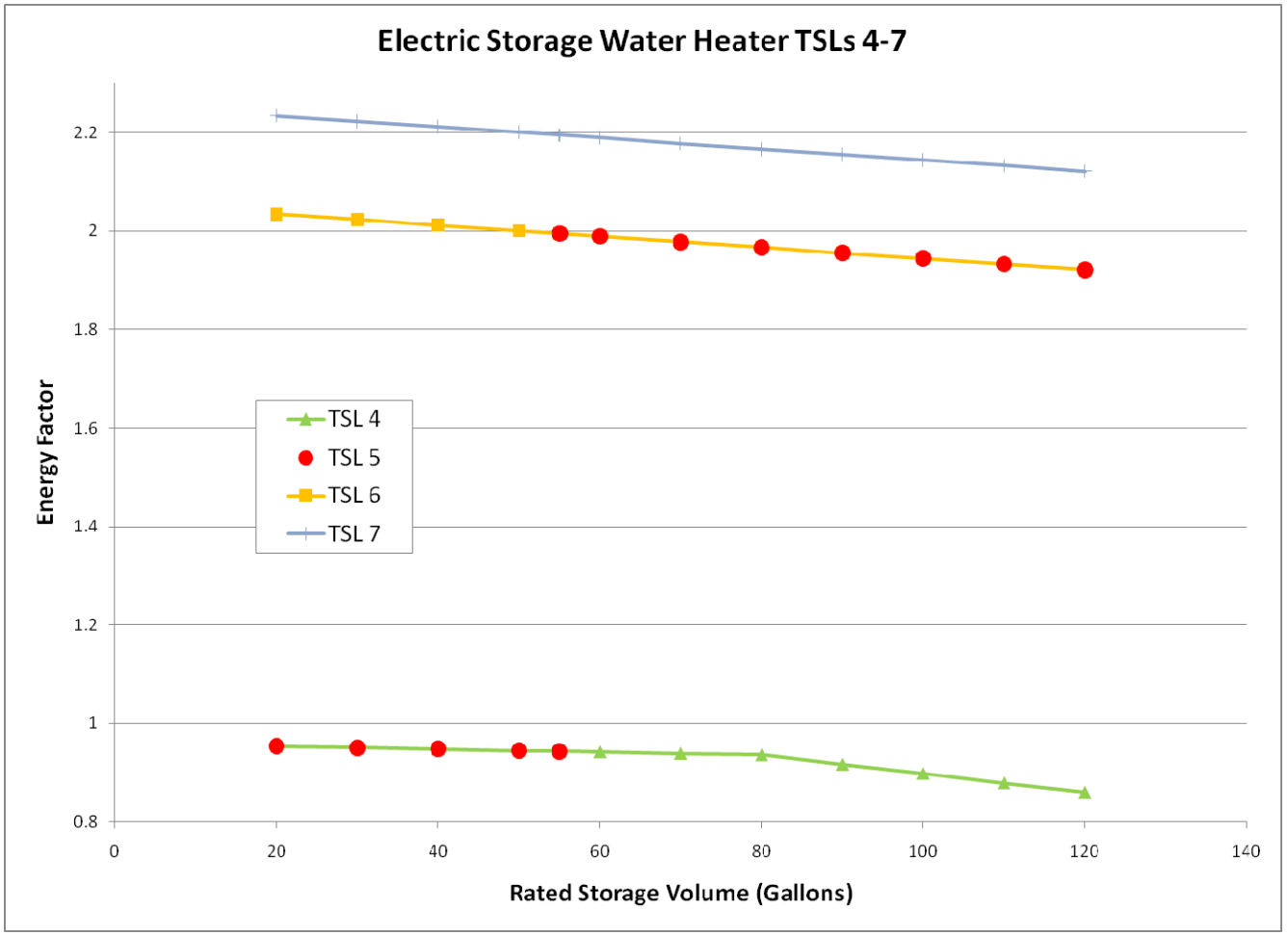
Selection of Trial Standard Levels

- 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 product classes, and may vary between product classes; and
    - NOPR analyses assess impacts for trial standard levels (not product classes).
- Method
  - Trial standard levels are assembled from the product classes identified in the NOPR.
    - Each trial standard level consists of the standard levels from each product class that meets a certain set of criteria.

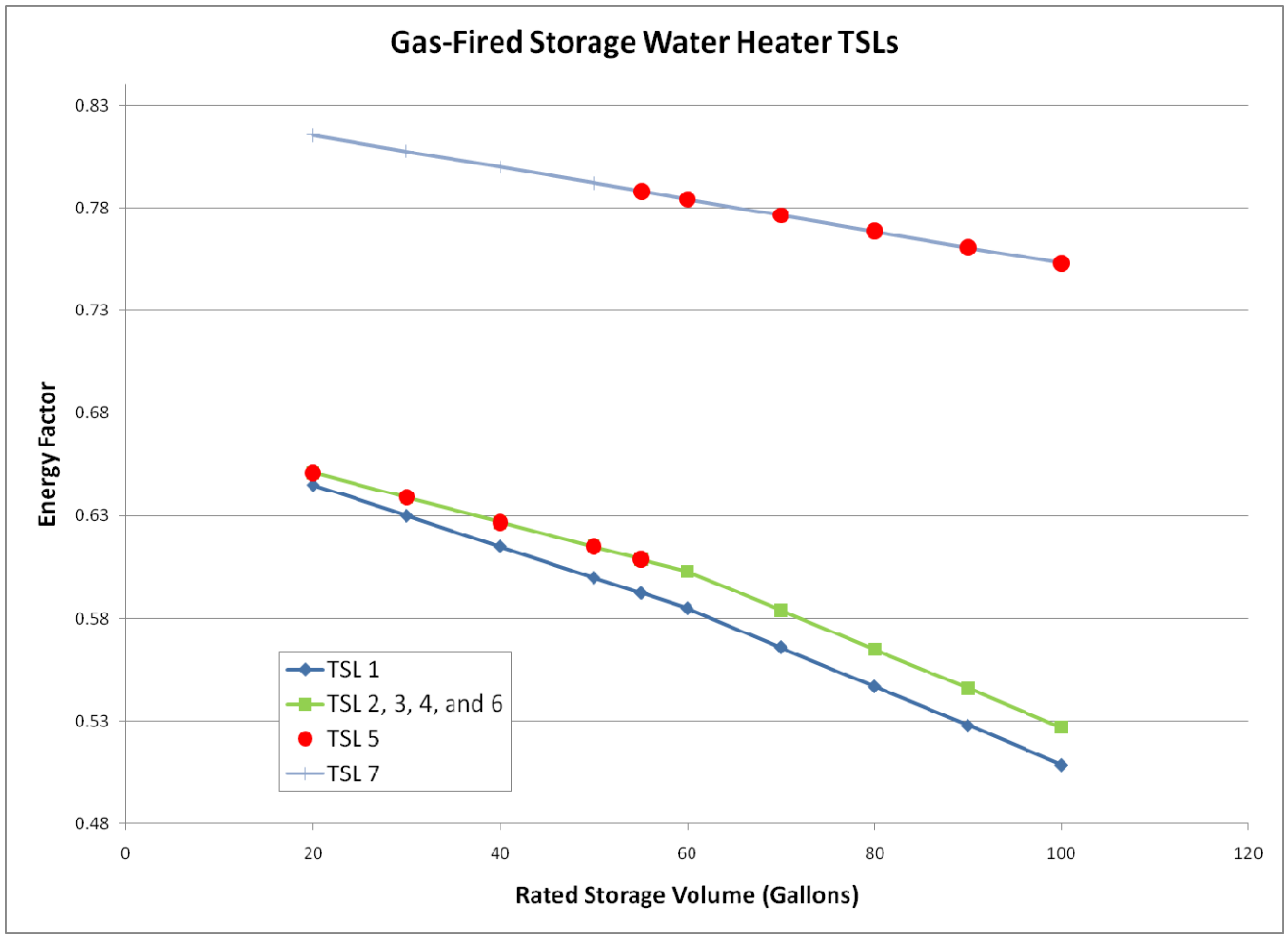
Trial Standard Levels 1 through 4 for the NOPR Electric Storage Water Heaters



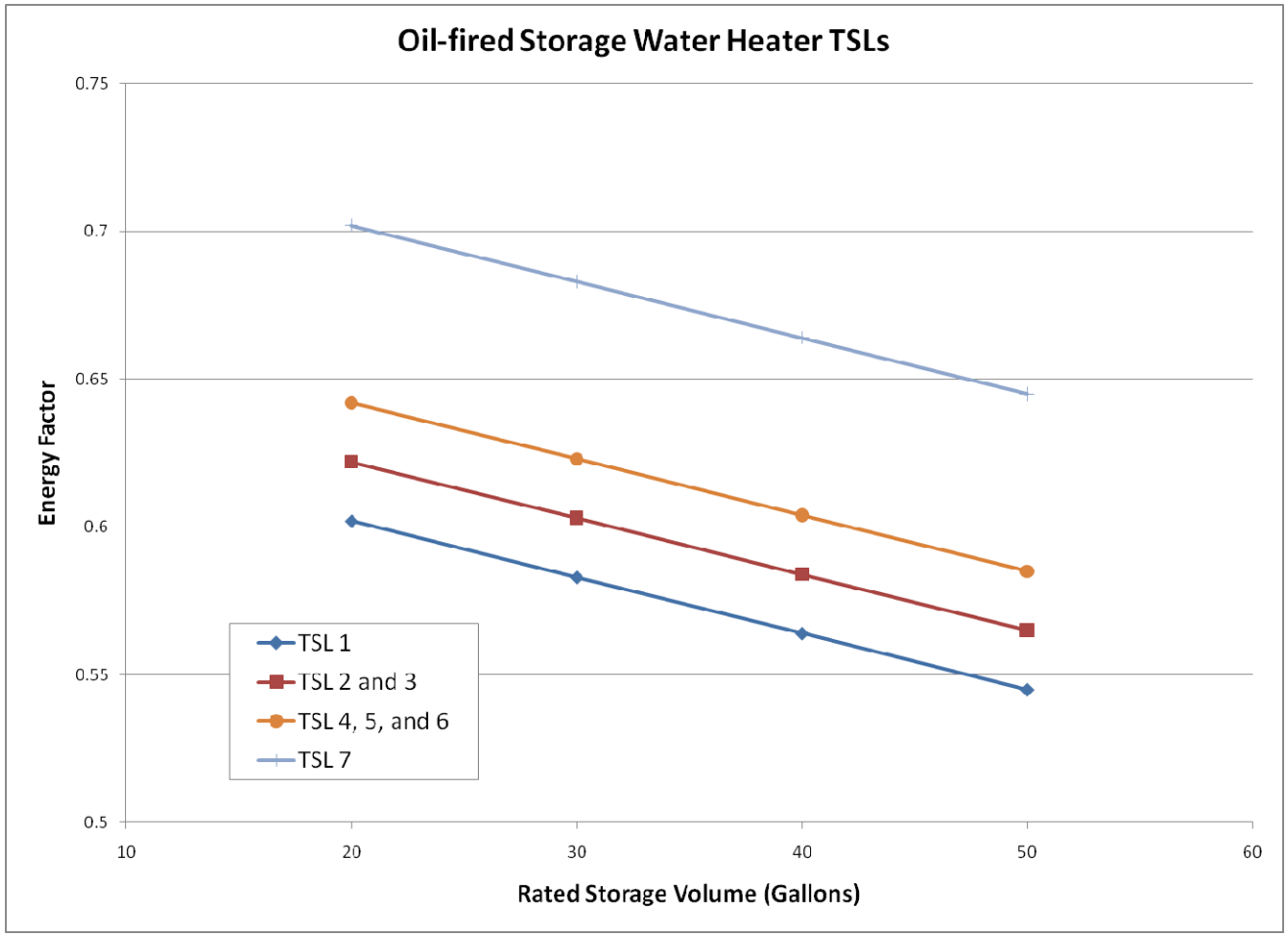
Trial Standard Levels 4 through 7 for the NOPR Electric Storage Water Heaters



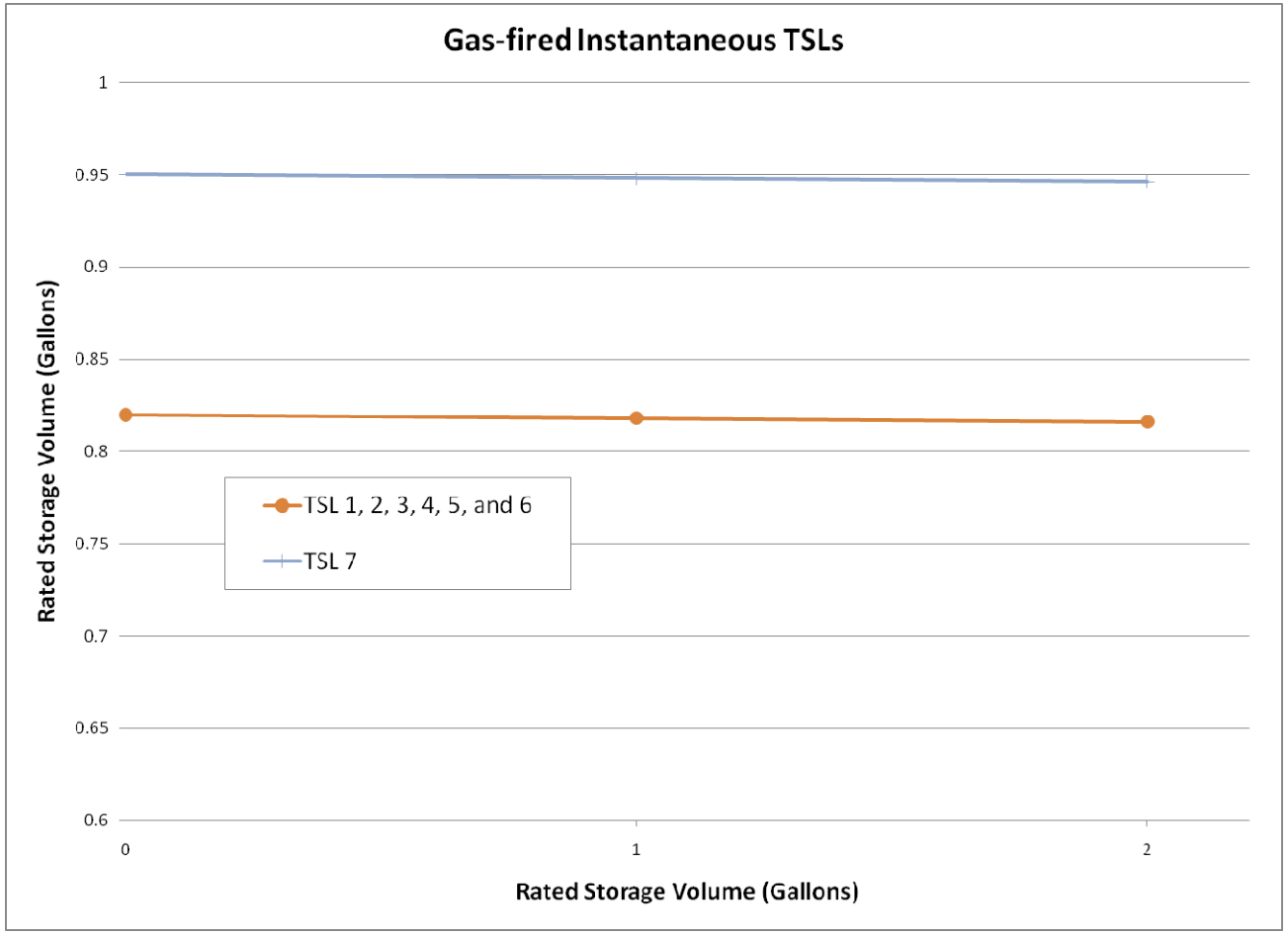
Trial Standard Levels for the NOPR Gas-fired Storage Water Heaters



Trial Standard Levels for the NOPR Oil-fired Storage Water Heaters



Trial Standard Levels for the NOPR Gas-fired Instantaneous Water Heaters



Trial Standard Levels for the NOPR Direct Heating Equipment

Trial Standard Level	Wall Fan AFUE*	Wall Gravity AFUE	Floor AFUE	Room AFUE	Hearth AFUE
TSL 6	80	72	58	83	93
TSL 5	75	72	58	83	72
TSL 4	80	71	58	68	72
TSL 3	77	71	58	68	67
TSL 2	76	68	58	67	67
TSL 1	75	66	58	66	67

* AFUE = Annual Fuel Utilization Efficiency for representative capacity range analyzed.
** EI = Electronic Ignition

Trial Standard Levels for the NOPR
Pool Heaters

Trial Standard Level	Thermal Efficiency
TSL 6	95
TSL 5	86
TSL 4	84
TSL 3	83
TSL 2	82
TSL 1	81

Consumer Subgroup Analysis

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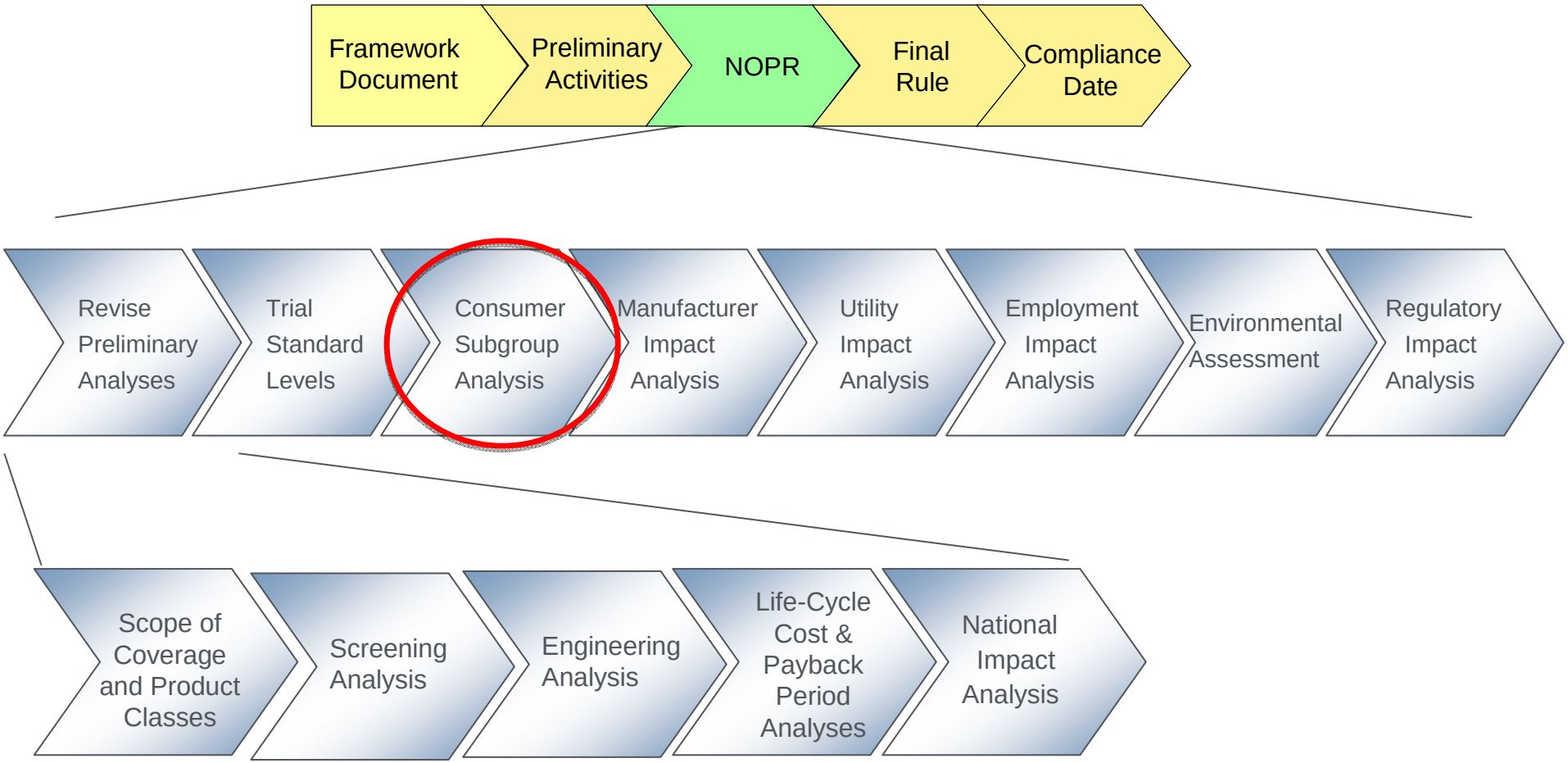
NOPR Analyses Flow Diagram



The NOPR analyses consist of revisions to the Preliminary Activities.

Consumer Subgroup Analysis

- Purpose
  - To evaluate the economic impacts of standards on consumer subgroups who may be disproportionately impacted compared with the general user population.
- Method
  - DOE identified seniors and low-income households that could be disproportionately affected, and examined the impact of proposed standards on these subgroups.
  - DOE used the LCC spreadsheet model to determine the impact on these subgroups.
- Output
  - LCC savings and simple payback period (in years) for the identified customer subgroups.
  - Determined that the subgroups were not disproportionately impacted by the standard.

Manufacturer Impact Analysis

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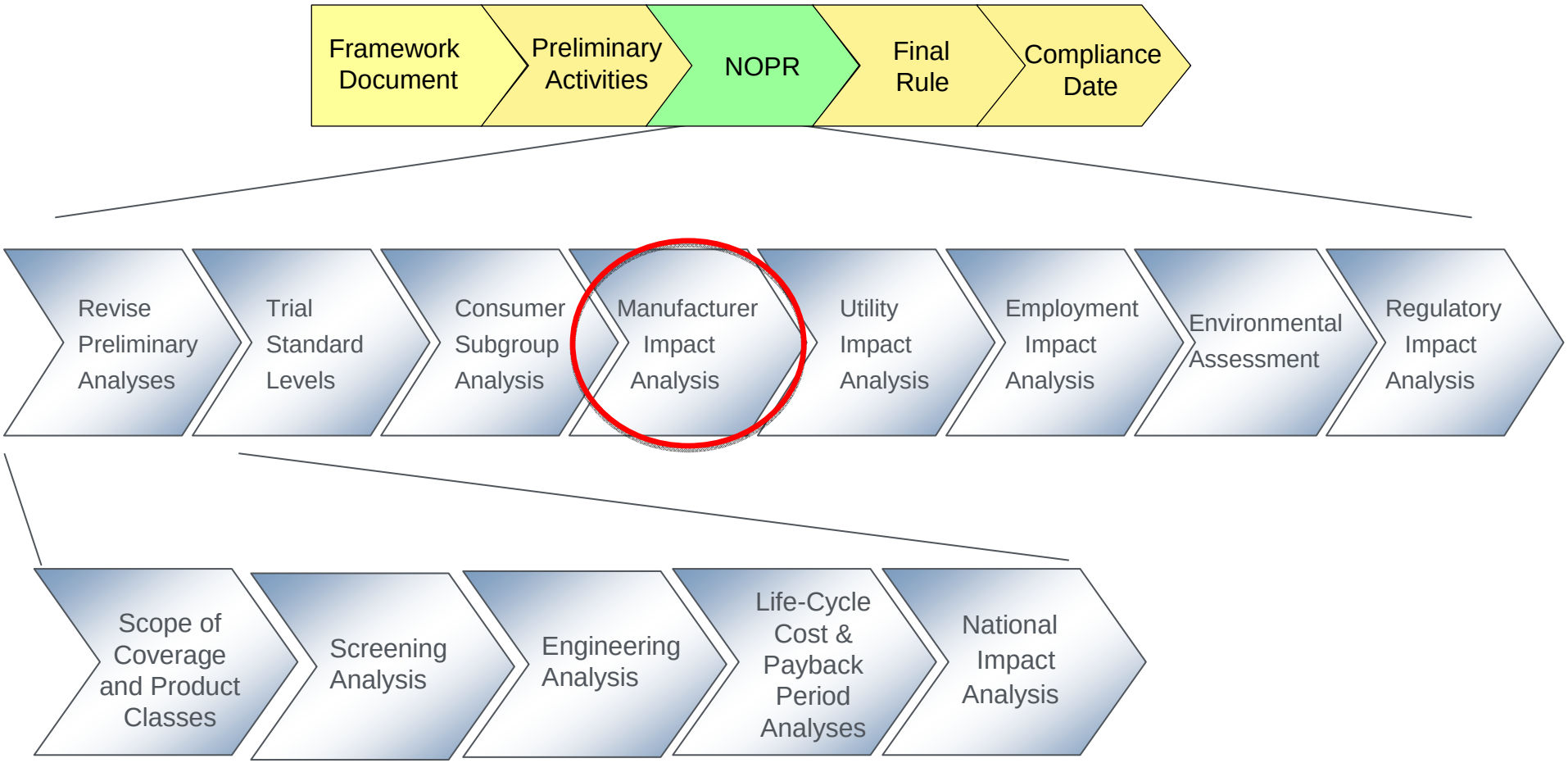
NOPR Analyses Flow Diagram



The NOPR analyses consist of revisions to the Preliminary Activities.

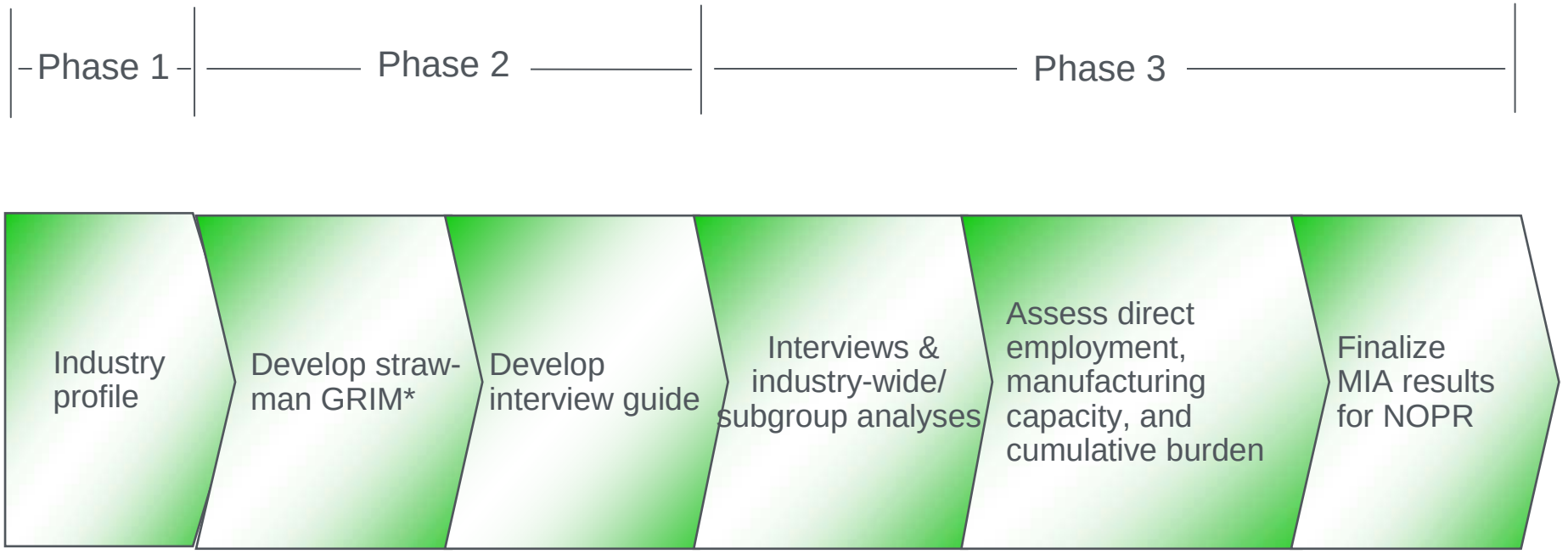
Purpose and Methodology

- Purpose
  - To assess the impacts of standards on manufacturers;
  - To identify and estimate impacts on manufacturer sub-groups that may be more severely impacted than the industry as a whole; and
  - To examine the direct employment impacts, manufacturing capacity, and the impact of cumulative regulatory burdens on the industry.

- Methodology
  - Analyze industry cash flow and net present value through use of the Government Regulatory Impact Model (GRIM); and
  - Interview manufacturers to refine inputs to the GRIM, develop sub-group analyses, and address qualitative issues.

Manufacturer Impact Analysis Process

- The MIA consists of three phases:



** Government Regulatory Impact Model (GRIM)*

Overview

- DOE used the standard NIA shipment scenario for all three heating products
  - For water heaters, this scenario accounts for fuel switching and uses the reference instantaneous market share scenario.

- Preservation of Return on Invested Capital - Upper Bound Scenario
  - Return on invested capital is the ratio of net operating profits (after taxes) to total invested capital.
  - In the standards case, markups are set so that as invested capital increases, net operating profits proportionately increase.

- Preservation of Operating Profit - Lower Bound Scenario
  - Operating profit is earnings before interest and taxes.
  - In the standards case, assumes once standards are implemented, manufacturers maintain same level of operating profits (in absolute terms) as before standards.

Summary of Results at the Proposed Standard Levels

- Water Heaters
  - At TSL 4, the technology used does not greatly differ from baseline models for gas-fired, electric, and oil-fired storage water heaters.
  - Electric storage manufacturers may have to greatly increase insulation thickness, but the proposed standard does not require substantial technology changes.
  - Some manufacturers in the oil-fired industry could face substantial costs to modify their existing residential lines.
- Direct Heating Equipment
  - Most traditional DHE manufacturers have existing product lines in 3 of the 4 product categories. However, manufacturers do face substantial conversion costs relative to shipments and could discontinue product lines to lower conversion costs.
  - DOE estimates the impacts on gas hearth DHE manufacturers are minimized because the proposed standard could likely be met with a purchased part and fairly small conversion costs.
- Pool Heaters
  - The proposed standard would require most manufacturers to modify existing product lines or expand the volume of lower volume products.

Water Heaters

- DOE identified five domestic small business manufacturers of covered residential water heaters
  - One manufacturer makes covered electric storage and gas-fired instantaneous water heaters that exceed the proposed standards.
  - Three manufacture oil-fired storage water heaters but mainly focus on products that are outside the scope of products covered by today's rulemaking.
  - One manufacturer has a full line of electric storage water heaters.
- DOE did not examine the impacts on small water heater manufacturers because it found that the standards for water heaters set forth in the proposed rule, if promulgated, would not have a significant economic impact on a substantial number of small business manufacturers

ISSUE 19. DOE seeks comment on the impacts of the proposed amended energy conservation standards on small manufacturers of residential water heaters.

Direct Heating Equipment

- For the direct heating equipment industry, DOE identified 12 domestic, small manufacturers:
  - 3 traditional DHE manufacturers.
  - 10 hearth DHE manufacturers.
- Small DHE businesses lack the scale to afford the large conversion investments, certification requirements, and the product development required for certain amended energy conservation standards;
- Adopting amended energy conservation standards at higher TSLs is likely to cause some small DHE businesses to exit the market; and
- Manufacturers will likely reduce the number of product families and capacities to keep required conversion costs within manageable limits.

Direct Heating Equipment MIA Issues (Issue # 21 – 22)

ISSUE 21. The impacts of the proposed amended energy conservation standards on small manufacturers of traditional DHE. DOE is interested in specific information regarding the potential for small manufacturers of traditional DHE to discontinue particular product lines as a result of the proposed standard, as well as the potential economic effects that discontinuing those particular product lines would have on small manufacturers of traditional DHE.

ISSUE 22. Alternatives to the proposed amended energy conservation standards for traditional DHE. Specifically, DOE is interested in information regarding alternatives that could provide significant cost-savings for small manufacturers while meeting DOE's energy conservation goals.

Direct Heating Equipment MIA Issues (Issue # 23 – 24)

ISSUE 23. DOE seeks comment on its characterization of typical small and large gas hearth DHE manufacturers.

ISSUE 24. DOE seeks comment on the impacts of the proposed amended energy conservation standards on small manufacturers of gas hearth DHE.

Pool Heaters

- DOE identified one domestic small business manufacturer of covered residential pool heaters
  - The small business manufacturer's products exceed the standards proposed by today's rulemaking.
- DOE did not examine the impacts on small water heater manufacturers because it found that the standards for pool heaters set forth in the proposed rule, if promulgated, would not have a significant economic impact on a substantial number of small business manufacturers

ISSUE 20. DOE seeks comment on the impacts of the proposed amended energy conservation standards on small manufacturers of gas-fired residential pool heaters.

Utility Impact Analysis

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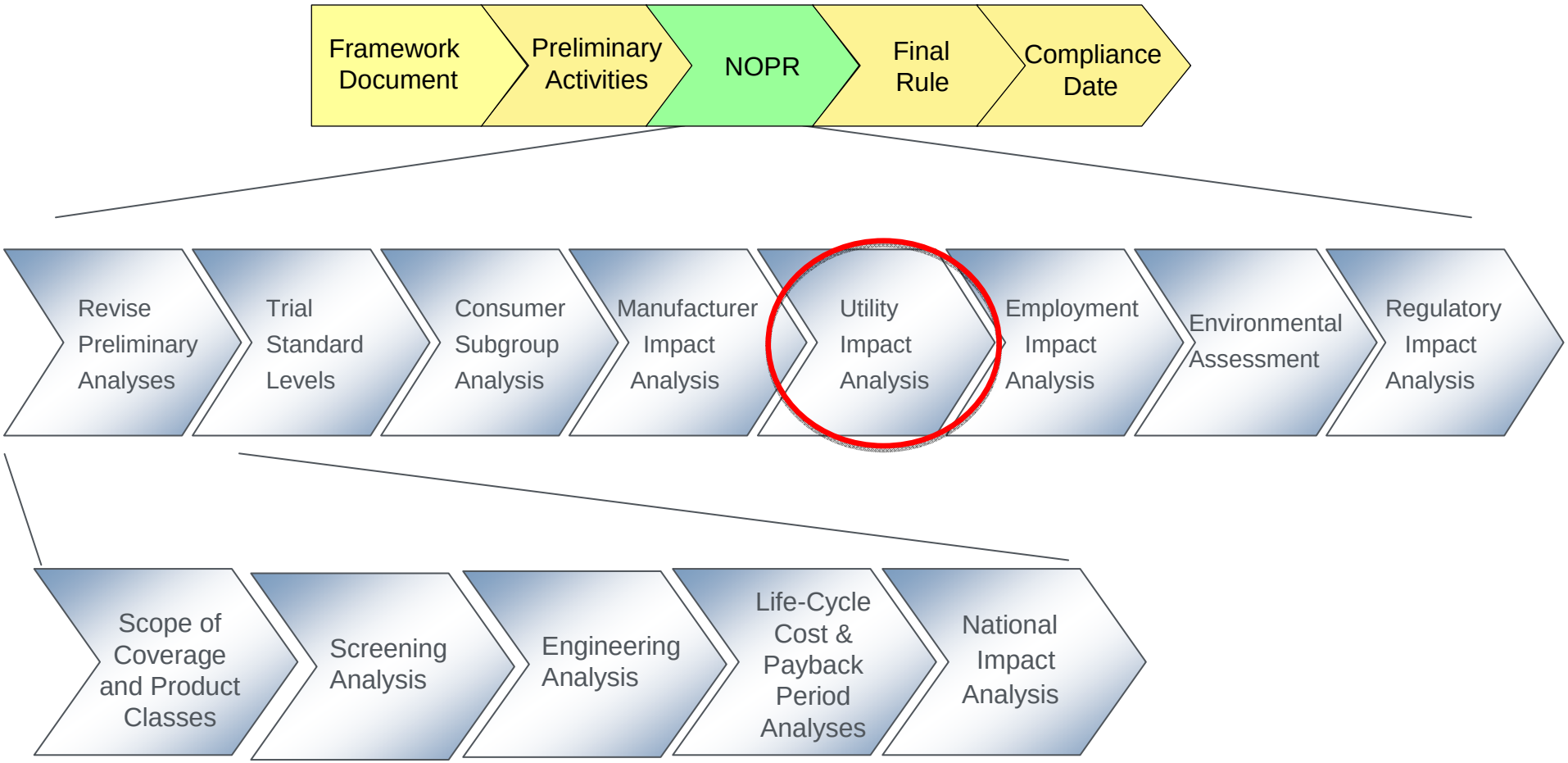
NOPR Analyses Flow Diagram



The NOPR analyses consist of revisions to the Preliminary Activities.

Utility Impact Analysis

- Purpose
  - To investigate the effects on utilities from reduced energy sales and peak load demand due to potential standards.
- Method
  - Use National Energy Savings Results; and
  - Use the EIA's National Energy Modeling System (NEMS-BT) tailored for DOE's Building Technologies Program.
- Output
  - Change in electricity and gas sales and price by region;
  - Change in the mix of electricity generation; and
  - Change in installed capacity and generation.
    - *Water Heaters*: TSLs 1 through 7 resulted in installed generation capacity reductions ranging from 0.129 to 5.28 GW in the year 2030.
    - *DHE*: TSLs 1 through 6 resulted in very small installed generation capacity increases ranging from 21 to 109 MW in the year 2030.
    - *Pool Heaters*: TSLs 1 through 6 resulted in very small installed generation capacity increases ranging from 2 to 32 MW in the year 2030.

Employment Impact Analysis

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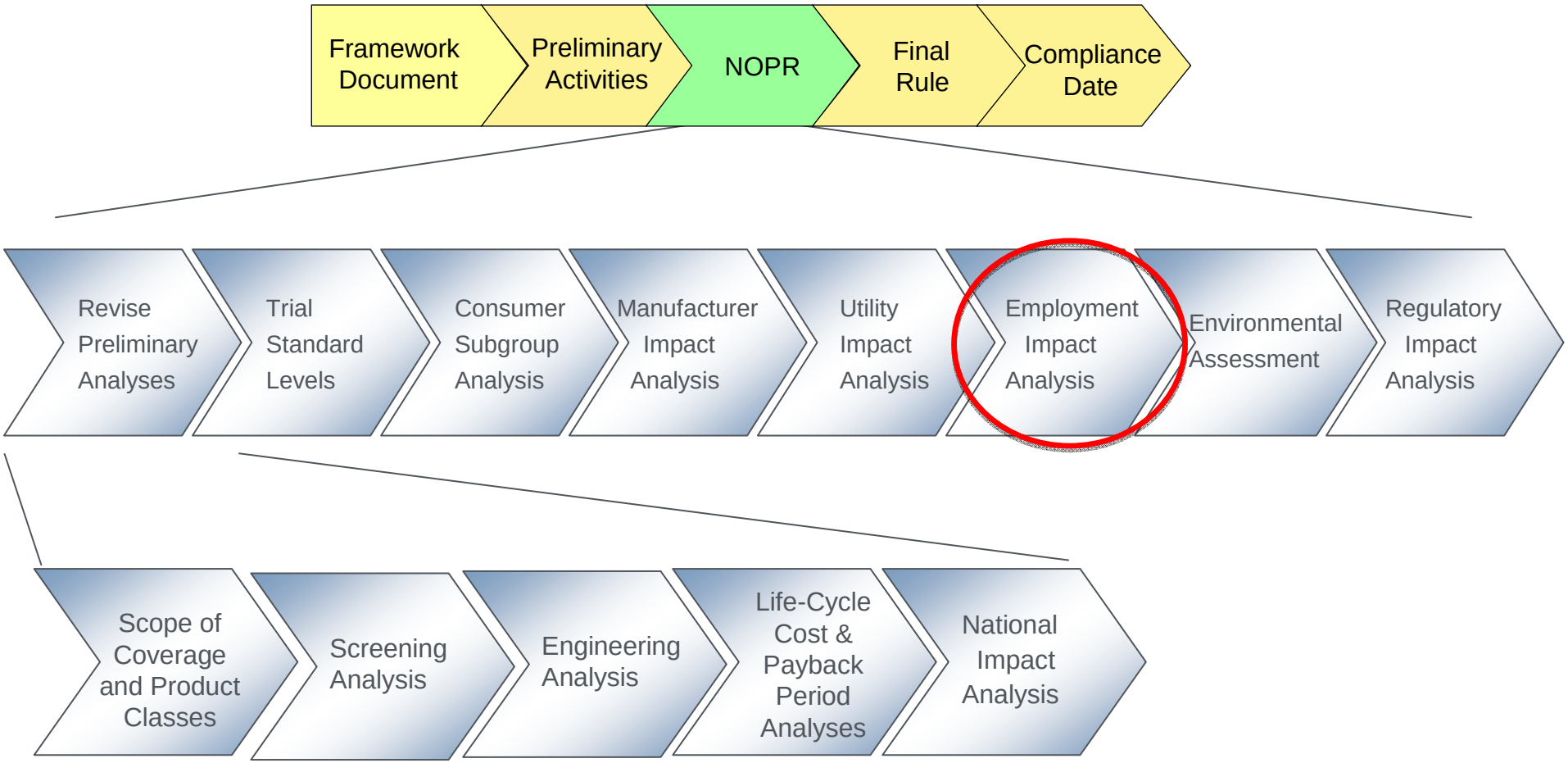
NOPR Analyses Flow Diagram



The NOPR analyses consist of revisions to the Preliminary Activities.

Employment Impact Analysis

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- Purpose
  - To report net jobs created or eliminated nationally as a consequence of new or amended energy conservation standards. Employment impacts include direct and indirect impacts.
- Method
  - Uses the Impact of Sector Energy Technologies (ImSET) model to assess the indirect employment impacts;
  - Estimate changes in employment, industry output, and wage income in the overall United States economy resulting from changes in expenditures in the various sectors of the economy;
  - Estimate changes in costs and benefits using the NIA analysis; and
  - Direct employment impacts are addressed in the MIA.

Employment Impact Analysis

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

- Output
  - Change in employment in national economy, other than in the manufacturing sector being regulated, as a consequence of the amended energy conservation standards.
- Results by Product Class
  - Water Heaters
    - All TSLs result in a net increase in jobs, ranging between 3,000 and 50,000 jobs.
  - Direct Heating Equipment
    - All TSLs result in a very small net increase in jobs.
  - Pool Heaters
    - TSLs 1-5 result in a very small net increase in jobs and TSL 6 results in a very small net decrease in jobs.

Environmental Assessment

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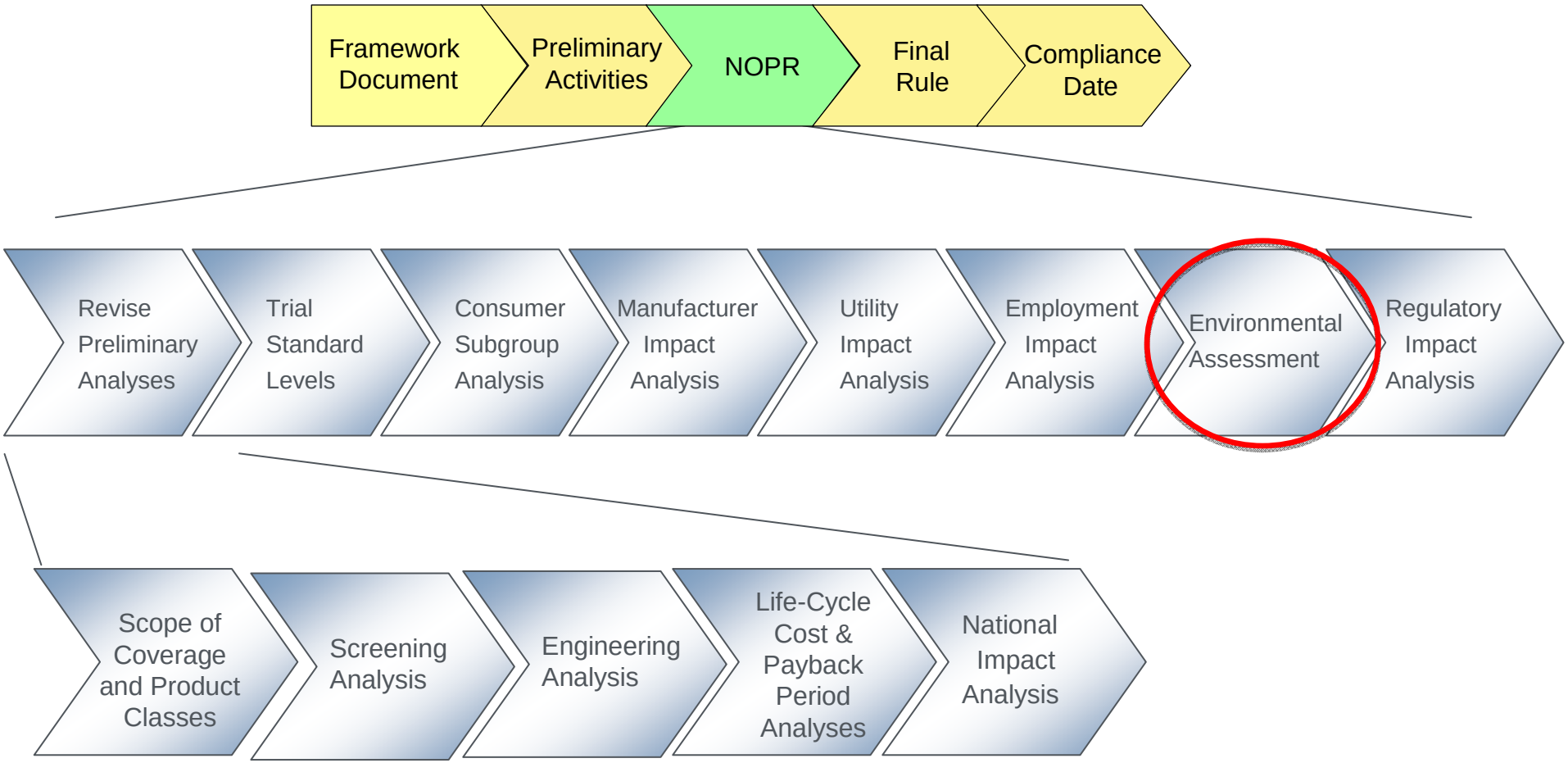
NOPR Analyses Flow Diagram



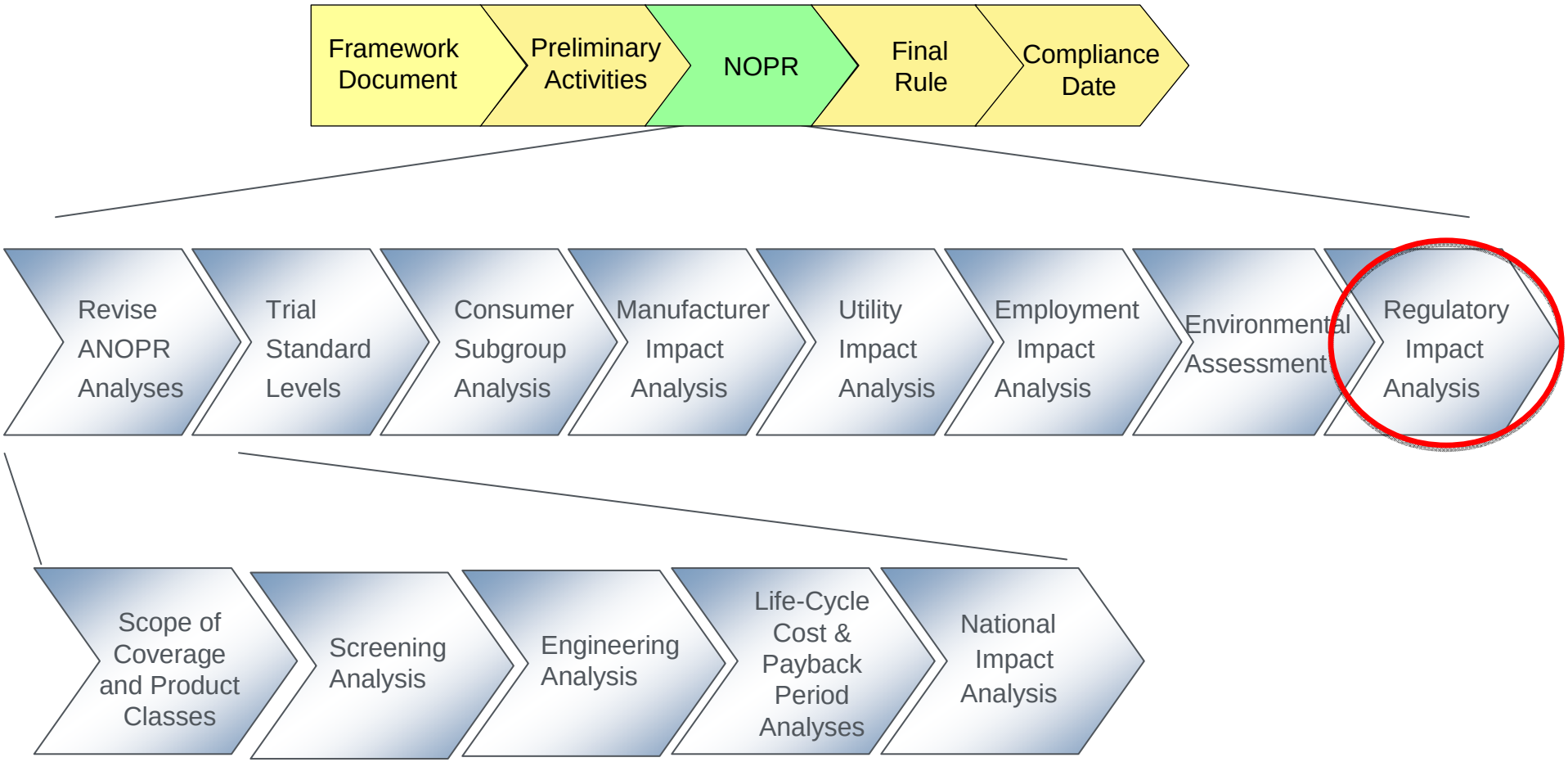
The NOPR analyses consist of revisions to the Preliminary Activities.

Environmental Assessment

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

- Purpose
  - To report environmental impacts as a consequence of the amended energy conservation standards, including changes in power plant emissions.
- Method
  - Use National Energy Savings Results; and
  - Use the EIA's National Energy Modeling System (NEMS-BT) tailored for DOE's Building Technologies Program.
- Output
  - Calculated the reduction in power plant emissions of carbon dioxide (CO_2), oxides of nitrogen (NO_X) and mercury (Hg), using the NEMS-BT computer model.
  - Calculated the reduction in on-site emissions (CO_2 and NO_X) where gas appliances are used (i.e., gas-fired water heaters and direct heating equipment)
  - Sulfur dioxide (SO_2) emissions were not included due to the emissions cap set by the Clean Air Act Amendments of 1990. Impact on SO_2 emissions changes was estimated as too small to affect value of emissions allowances under the cap.
  - Monetized value of reductions in CO_2, NO_X, and Hg.
  - Assessed impact to SO_2 allowance prices.

NOPR Analyses Flow Diagram



The NOPR analyses consist of revisions to the Preliminary Activities.

Regulatory Impact Analysis

- Purpose
  - To investigate the national impacts due to non-regulatory alternatives compared with mandatory energy conservation standards.
  - The non-regulatory alternatives that DOE analyzed include:
    - No New Regulatory Action;
    - Consumer Rebates;
    - Commercial Customer Tax Credits;
    - Voluntary Energy-Efficiency Targets—ENERGY STAR;
    - Manufacturer Tax Credits;
    - Early Replacement;
    - Bulk Government Purchases; and
    - State Building Codes for Water Heaters.
- Method
  - Modify NIA spreadsheet model to consider the above scenarios and assess their effect on adoption of equipment at the proposed standard levels.
- Output
  - National Energy Savings and Net Present Value of the non-regulatory alternatives.

Summary of Proposed Standards and Additional Considerations for the Final Rule

Proposed Amended Energy Conservation Standards for Residential Water Heaters (TSL 4)

Product Class	Proposed Standard Level	
Gas-fired Storage	For tanks with a Rated Storage Volume at or below 60 gallons: EF = 0.675 – (0.0012 x Rated Storage Volume in gallons)	For tanks with a Rated Storage Volume above 60 gallons: EF = 0.717 – (0.0019 x Rated Storage Volume in gallons)
Electric Storage	For tanks with a Rated Storage Volume at or below 80 gallons: EF = 0.96 – (0.0003 x Rated Storage Volume in gallons)	For tanks with a Rated Storage Volume above 80 gallons: EF = 1.088 – (0.0019 x Rated Storage Volume in gallons)
Oil-fired Storage	EF = 0.68 – (0.0019 x Rated Storage Volume in gallons)	
Gas-fired Instantaneous	EF = 0.82 – (0.0019 x Rated Storage Volume in gallons)	

Additional Considerations for Final Rule

ISSUE 16. DOE's consideration of TSL 6 in the final rule for residential water heaters and the associated issues DOE has identified surrounding heat pump water heaters.

In particular, DOE is interested in comments regarding the following issues surrounding heat pump water heater technology:

1. Availability of heat pump water heaters;
2. Installation and repair costs;
3. Installer and servicer retraining required to serve the market;
4. Installation issues regarding heat pump water heaters and whether they are a direct replacement for traditional electric storage water heater technology;
5. Manufacturability of heat pump water heaters; and
6. Impacts on consumer utility from heat pump water heaters.

Additional Considerations for Final Rule

ISSUE 17. DOE's consideration of TSL 5 in the final rule for residential water heaters and the associated issues DOE has identified surrounding standards that effectively require different technologies for different subsets of products.

- In particular, DOE is interested in comments regarding the possibility of manufacturers circumventing the standard by manufacturing products at storage volumes slightly below the product division or discontinuing the manufacture of large-volume products all together due to high conversion costs for only a small portion of the market. DOE is interested in comments regarding the storage volume where the product division should occur, and whether DOE should consider other divisions for the final rule (e.g., 66 gallons, 75 gallons, or some other gallon size).
- In particular, DOE is interested in receiving comments about the following issues surrounding the consideration of TSL 5: (1) consumer acceptance; (2) installer and servicer training; (3) product substitution (i.e., substituting multiple units at lower volume in place of one at a higher volume); (4) engineering resource constraints; (5) product discontinuation (for large-volume products); and (6) manufacturing issues.

Proposed Amended Energy Conservation Standards for Residential Direct Heating Equipment (TSL 3) and Pool Heaters (TSL 4)

Direct Heating Equipment Product Class	Proposed Standard Level
Gas Wall Fan with Input Capacities up to 42,000 Btu/h	AFUE = 76%
Gas Wall Fan with Input Capacities over 42,000 Btu/h	AFUE = 77%
Gas Wall Gravity with Input Capacities up to 27,000 Btu/h	AFUE = 70%
Gas Wall Gravity with Input Capacities over 27,000 Btu/h up to 46, 000 Btu/h	AFUE = 71%
Gas Wall Gravity with Input Capacities over 46,000 Btu/h	AFUE = 72%
Gas Floor with Input Capacities up to 37,000 Btu/h	AFUE = 57%
Gas Floor with Input Capacities over 37,000 Btu/h	AFUE = 58%
Gas Room with Input Capacities up to 20,000 Btu/h	AFUE = 62%
Gas Room with Input Capacities over 20,000 Btu/h up to 27,000 Btu/h	AFUE = 67%
Gas Room with Input Capacities over 27,000 Btu/h up to 46,000 Btu/h	AFUE = 68%
Gas Room with Input Capacities over 46,000 Btu/h	AFUE = 69%
Gas Hearth with Input Capacities up to 20,000 Btu/h	AFUE = 61%
Gas Hearth with Input Capacities over 20,000 Btu/h and up to 27,000 Btu/h	AFUE = 66%
Gas Hearth with Input Capacities over 27,000 Btu/h and up to 46,000 Btu/h	AFUE = 67%
Gas Hearth with Input Capacities over 46,000 Btu/h	AFUE = 68%

Pool Heater Product Class	Proposed Standard Level
Gas-fired	Thermal Efficiency = 84%

Additional TSL Considerations for NOPR

ISSUE 18. The appropriateness of TSL 4 for residential pool heaters in light of the negative life cycle costs for a majority of consumers. In addition, DOE's consideration of other TSLs, including TSL 3, as an alternative for the final standard level.

DOE invites comments on any remaining issues pertaining to this NOPR.

Issues for Public Comment

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

Issues on which DOE seeks comment - NOPR issues #1-6

1. The max-tech efficiency levels identified for the analyses, including whether the efficiency levels identified by DOE can be achieved using the technologies screened-in during the screening analysis (see section IV.B), and whether higher efficiencies are achievable using technologies that were screened-in during the screening analysis.
2. The potential burdens to manufacturers of hearth-type DHE as a result of the testing, certification, reporting, and enforcement provisions
3. EPCA's efficiency descriptor requirements in any potential test procedure revisions for electric pool heaters
4. DOE's proposed definition for vented hearth heaters.
5. DOE's product classes for water heaters. In particular, DOE is seeking comment about the need for a separate product class for low-boy water heaters.
6. DOE's approach for analyzing ultra-low NO_X gas-fired storage water heaters and the need for a separate product class.

Issues for Public Comment

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

Issues on which DOE seeks comment - NOPR issues #7-10

7. DOE's approach to developing the energy efficiency equations, the appropriate slope of energy efficiency equations at each efficiency level analyzed, and the appropriate storage volumes for changing the slope of the line. DOE is also interested in any alternative to the energy efficiency equations that DOE should consider for the final rule.
8. The need for a separate product class for heat pump water heaters. Specifically, DOE is interested in receiving comments on whether a heat pump water heater can be used as a direct replacement for an electric resistance water heater, and in which instances a heat pump water heater cannot be used as a direct replacement for an electric resistance water heater.
9. DOE's proposed product classes for the four existing types of DHE.
10. DOE's proposed product class divisions for gas hearth DHE.

Issues for Public Comment

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

Issues on which DOE seeks comment - NOPR issues #11-14

11. The manufacturability of heat pump water heaters and the capability of manufacturers to ramp up production of heat pump water heaters. Specifically, DOE is seeking comment on how long it would take and the magnitude of the costs for manufacturers to convert all product lines to heat pump water heaters if it were required by an amended energy conservation standard. In addition, DOE is seeking comment about the length of time required to retrain installers and servicers of water heaters for the installation and servicing of heat pump water heaters.
12. DOE's estimated manufacturer production costs for storage water heaters at storage volumes outside of the representative volume.
13. DOE's analysis of installation costs for water heaters; DOE is particularly interested in comments on its analysis of installation costs for heat pump water heaters.
14. DOE's analysis of repair and maintenance costs for heat pump water heaters.

Issues for Public Comment

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

Issues on which DOE seeks comment - NOPR issues #15-17

15. DOE's approach for analyzing fuel switching that may result from the proposed standards on water heaters and the other heating products. In particular, DOE requests comments on its general approach, which does not involve price elasticities; its analysis of switching to gas-fired storage water heaters in the case of a standard that effectively requires an electric heat pump water heater; its conclusion that the proposed standards would not induce switching from a gas storage water heater to an electric storage water heater; and its conclusion that the proposed standards would not induce switching for gas-fired instantaneous water heaters, DHE, and pool heaters.
16. DOE's consideration of TSL 6 in the final rule for residential water heaters and the associated issues DOE has identified surrounding heat pump water heaters.
17. DOE's consideration of TSL 5 in the final rule for residential water heaters and the associated issues DOE has identified surrounding standards that effectively require different technologies for different subsets of products.

Issues for Public Comment

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

Issues on which DOE seeks comment - NOPR issues #18-24

18. The impacts of the proposed amended energy conservation standards on small manufacturers of residential water heaters.
19. The impacts of the proposed amended energy conservation standards on small manufacturers of gas-fired residential pool heaters.
21. The impacts of the proposed amended energy conservation standards on small manufacturers of traditional DHE. DOE is interested in specific information regarding the potential for small manufacturers of traditional DHE to discontinue particular product lines as a result of the proposed standard, as well as the potential economic effect discontinuing those particular product lines would have on small manufacturers of traditional DHE.
22. Alternatives to the proposed amended energy conservation standards for traditional DHE. Specifically, DOE is interested in information regarding alternatives that could provide significant cost-savings for small manufacturers while meeting DOE's energy conservation goals.
23. DOE's characterization of typical small and large gas hearth DHE manufacturers.
24. The impacts of the proposed amended energy conservation standards on small manufacturers of gas hearth DHE.

Closing

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

How to Submit Comments…

- Public Meeting – Oral comments will be captured in the transcript and become part of the public record.
- Written comments – NOPR comment period open until February 9, 2010.
  Reference docket #: EE–2006–BT–STD–0129 and/or RIN #: 1904–AA90.

Email: ResWaterDirectPoolHtrs@ee.doe.gov

Mail: Ms. Brenda Edwards
U.S. Department of Energy
Building Technologies Program, Mailstop EE–2J
1000 Independence Avenue, SW.
Washington, DC 20585–0121.
Telephone: (202) 586–2945.

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