BUILDING TECHNOLOGIES PROGRAM

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

Energy Conservation Standards
Proposed Rulemaking for
Battery Chargers and External Power Supplies

May 2nd , 2012

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Department of Energy

Energy Efficiency and Renewable Energy

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Welcome and Introduction

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

9:00 – 9:05 am	Welcome, Introductions, Ground Rules
9:05 – 9:15 am	Opening Remarks, Background, Regulatory History
9:15 – 9:45 am	Opening Comments from Participants
9:45 – 10:30 am	Market Assessment Including Product Definitions and Scope
10:30 – 10:45 am	**Break**
10:45 – 11:45 am	Technology Assessment, Screening and Engineering Analyses
11:45 – 12:15 pm	Energy Use and Markups Analysis
12:15 – 1:15 pm	**Lunch**

Welcome and Introduction

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1:15 – 2:15 pm	Life Cycle Cost, Shipments, National Impact, Regulatory Impact, and Manufacturer Impact Analyses
2:15 – 2:30 pm	Utility Impact, Employment Impact, and Environmental Impact Analyses
2:30 – 2:45 pm	**Break**
2:45 – 4:15 pm	Summary of Results and Proposed Standards
4:15 – 4:30 pm	Labeling
4:30 – 4:55 pm	Closing Comments from Participants
4:55 – 5:00 pm	**Closing Remarks**

Listening Via the Webcast

- The Department is broadcasting this meeting live over the Internet.
- DOE is providing the webcast to accommodate stakeholders that are unable to attend the public meeting.
- The web broadcast allows stakeholders to listen in and view the slides of the presentations.
- All stakeholders are encouraged to submit written comments after the public meeting.

Purpose of the Public Meeting and Comments From Participants

- **Purposes**
  - To invite comment on proposed energy conservation standard levels;
  - To present methodologies and characterize results of the 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 next steps in the rulemaking.

Public Meeting Agenda

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1. Overview
2. Market Assessment
3. Tech Assessment, Screening, and Engineering
4. Energy Use; Markups Analysis
5. Life-Cycle Cost and Payback Period Analysis
6. Shipments, NIA, RIA, and MIA Analysis
7. Environmental Impacts
8. Results and Proposed Standards

Background and Overview
Statutory Authority

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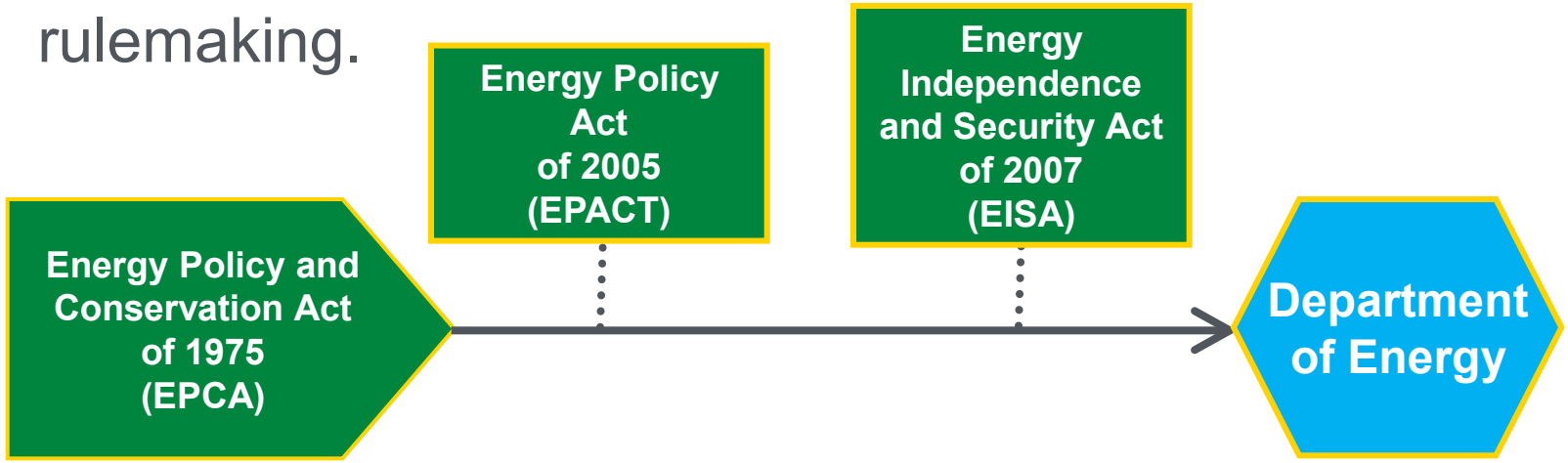
- The Energy Policy Act of 2005 (EPACT) amended the Energy Policy and Conservation Act (EPCA), adding battery chargers (BCs) and external power supplies (EPSs) to the appliance standards program.

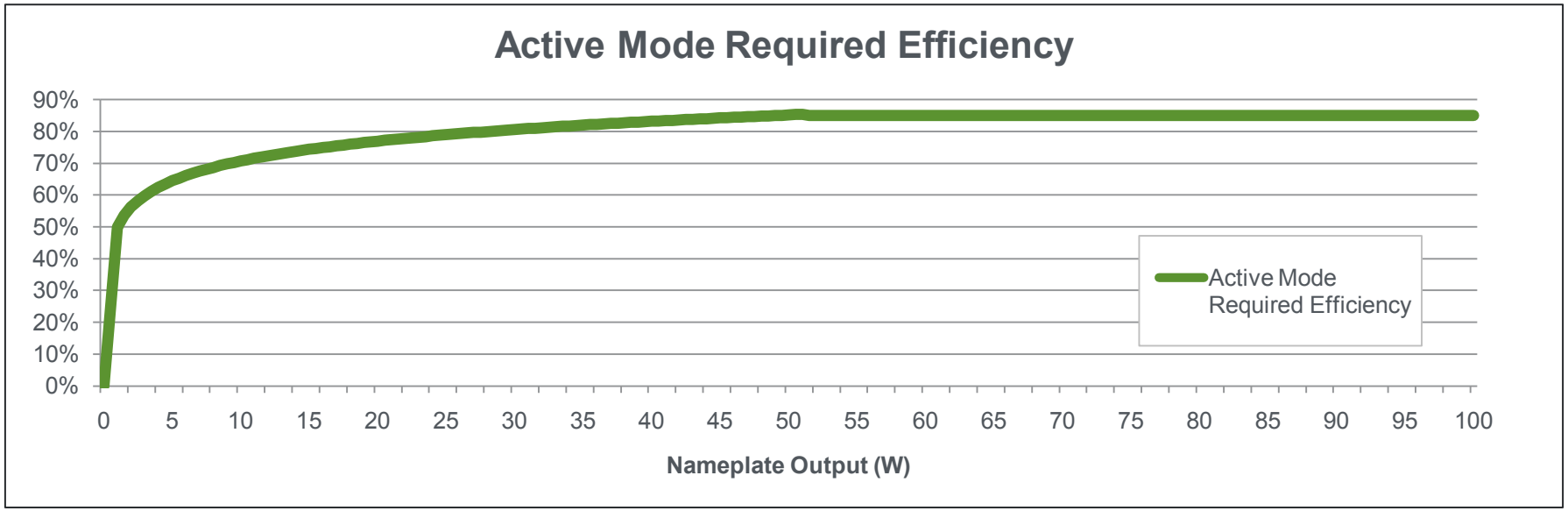
- The Energy Independence and Security Act of 2007 (EISA) further amended EPCA resulting in the current rulemaking.



Background and Overview
Standards for Class A EPSs

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

- **EISA-mandated Class A EPS Standards, Compliance Date: July 1, 2008**



Nameplate Output	Active Mode Required Efficiency (decimal equivalent of a percentage)
< 1 Watt	0.5*(nameplate_output)
1 – 51 Watts	0.5+ 0.09*ln(nameplate_output)
> 51 Watts	0.85
Nameplate Output	No-Load Mode Maximum Consumption
≤ 250 Watts	0.5 Watts

Background and Overview
Test Procedures

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- Test procedures are codified in Title 10 of the Code of Federal Regulations (CFR), Part 430, Subpart B
  - Battery chargers in Appendix Y
  - External power supplies in Appendix Z

- Test Procedure Final Rule:
  - Standby and Off Mode procedures published on March 27, 2009. 74 FR 13318.
  - BC Active Mode procedures published on June 1, 2011. 76 FR 31750.

Background and Overview
Rulemaking Schedule

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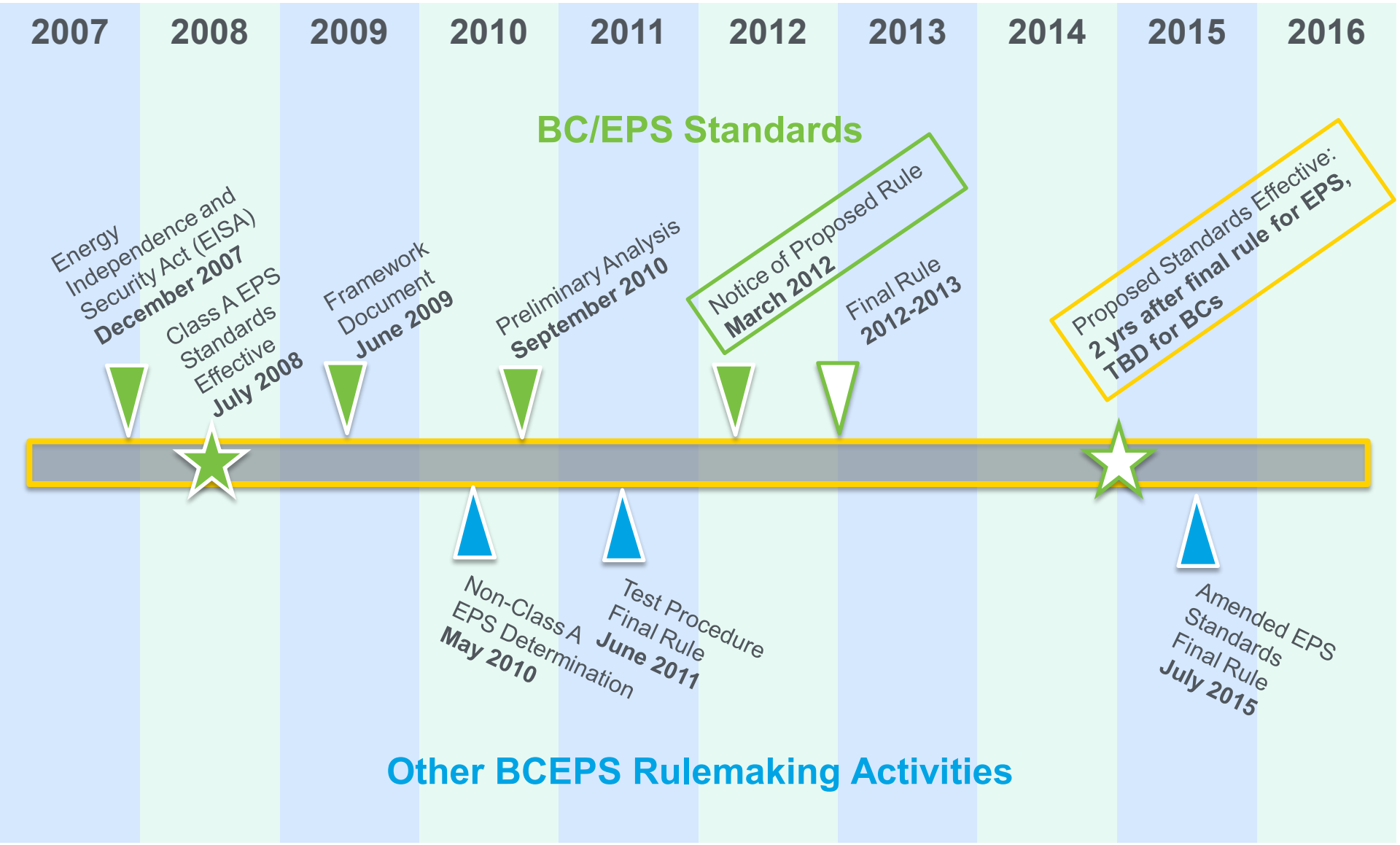

Background and Overview

Criteria for Selecting Standard Levels

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- EPCA directs DOE to consider seven factors when setting energy conservation standards

EPCA Factor	DOE 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	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

Standards NOPR Stage

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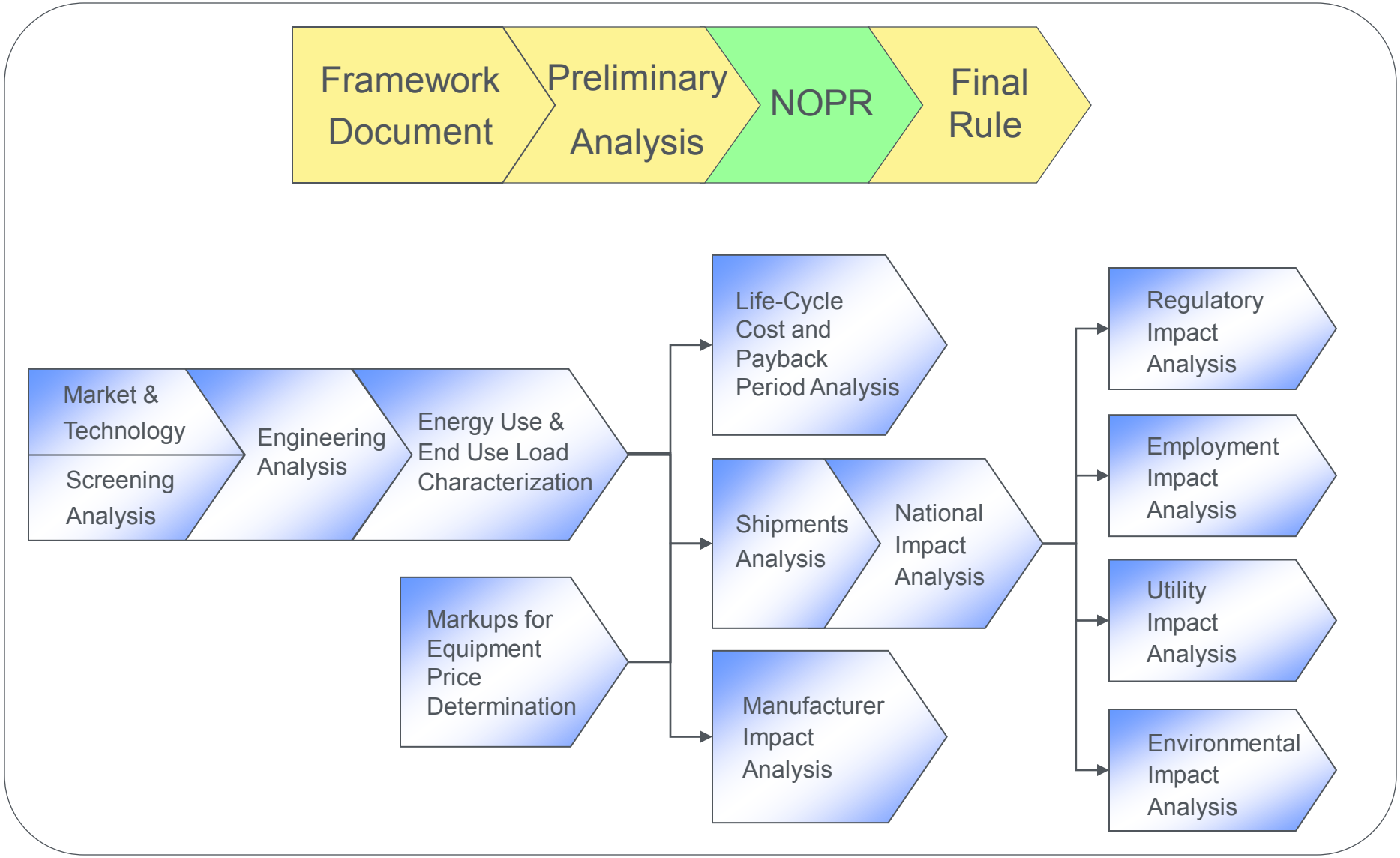

Proposed Energy Conservation Standards

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- DOE is proposing:
  - Amended standards for Class A EPSs
  - New standards for certain non-Class A EPSs
  - New standards for battery chargers

Summary of Proposed Rule Impacts

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	EPSs	Battery Chargers
National Energy Savings (quadrillion BTU)	0.99	1.36
Net Consumer Benefits* (2010$ billions)	0.79 – 1.87	6.04 – 10.96
Net Social Benefits* (2010$ billions)	1.80 – 2.89	7.41 – 12.37

***Ranges represent net present values at 3% and 7% discount rates**

Issue for Discussion

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Issue Box: DOE welcomes comments, data, and information concerning its NOPR for battery chargers and external power supplies. Issues that correspond to those raised in DOE's published material will be numbered in accordance with that material. Whether invited by an issue box or not, comments are welcome on any part of DOE's analysis.

Issue box numbering corresponds to the list of issues published at the end of the NOPR, available at:

http://www1.eere.energy.gov/buildings/appliance_standards/residential/battery_external_nopr.html

DOE Requests Feedback

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- In all correspondence, include all of the following:
  - NOPR for Energy Conservation Standards for Battery Chargers and External Power Supplies
  - Docket Number: EERE-2008-BT-STD-0005 and
  - Regulatory Identification Number (RIN):1904–AB57

- **Contact Information:**
  Federal eRulemaking Portal: http://www.regulations.gov

  Email: BC&EPS_ECS@ee.doe.gov

Postal Mail:

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Comment period closes: **Friday, May 25th, 2012, midnight EDT**

Opening Comments from Participants

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- Opening Statements

Public Meeting Agenda

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

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Market Assessment
Product Classes

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Where merited, DOE sets standards based on:

(1) the type of energy used; or

(2) Capacity or some other performance-related feature.

Consumer utility is one factor considered with respect to performance-related features.

Separate standards must be set for each class.

Market Assessment
External Power Supply Definition

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Statutory Definition:

- A circuit that is used to convert household electric current into DC current or lower-voltage AC current to operate a consumer product (42 U.S.C. 6291(36)(A))

Key Features:

- Is outside (external to) the product it operates
- Attaches to, and obtains power from, mains
- Outputs DC current or lower-voltage AC current
- Powers a consumer product

Market Assessment
Overlap

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PRELIMINARY ANALYSIS:

- Wall adapter considered an EPS only if it lacked charge control.
- Charge control proved elusive.

PROPOSED APPROACH:

- DOE considers all wall adapters to be EPSs.
- DOE proposes to give special treatment to those EPSs that cannot operate an end-use consumer product directly.

Market Assessment
Overlap

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

Protocol for distinguishing direct from indirect operation EPSs:

1. Charge the battery.
2. Disconnect the EPS from the product.
3. Turn on the product and note how long it takes to start. This is the “normal startup time”.
4. Continue operating the product until it stops functioning.
5. Connect the EPS to the product.
6. Turn on the product and note how long it takes to start. This is the “dead battery startup time”.

Then compare the two startup times:

Dead Batt. ST ≤ Normal ST + 5 seconds ► direct operation

Dead Batt. ST > Normal ST + 5 seconds ► indirect operation

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Figure 1. EPS that can directly power the application – Product Classes B, C, D, E, X, and H

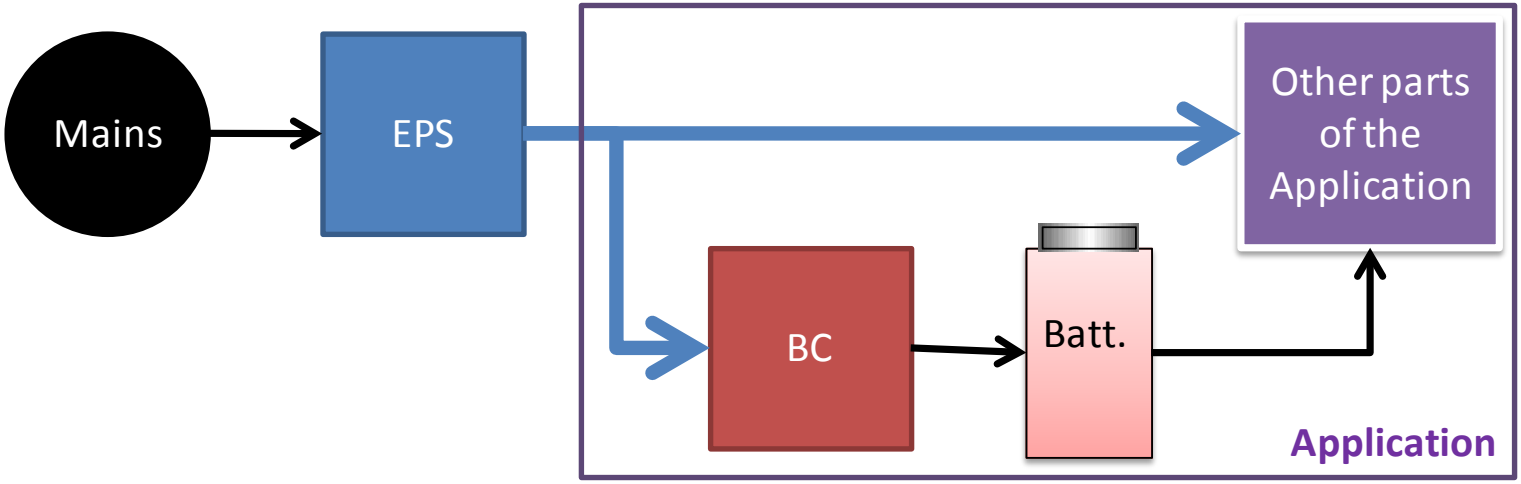
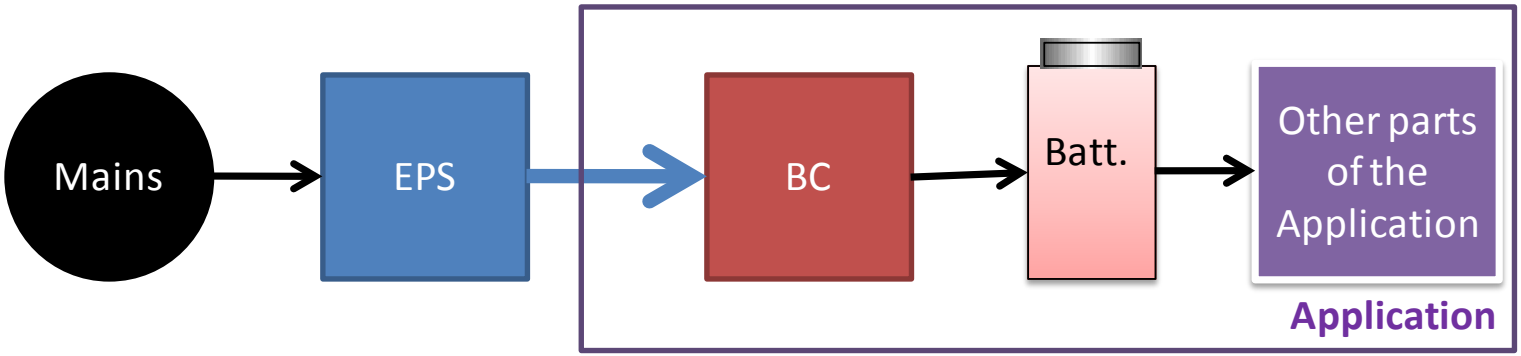


Figure 2. EPS whose power all flows to the battery charger – Product Class N



Market Assessment

EPS Product Classes

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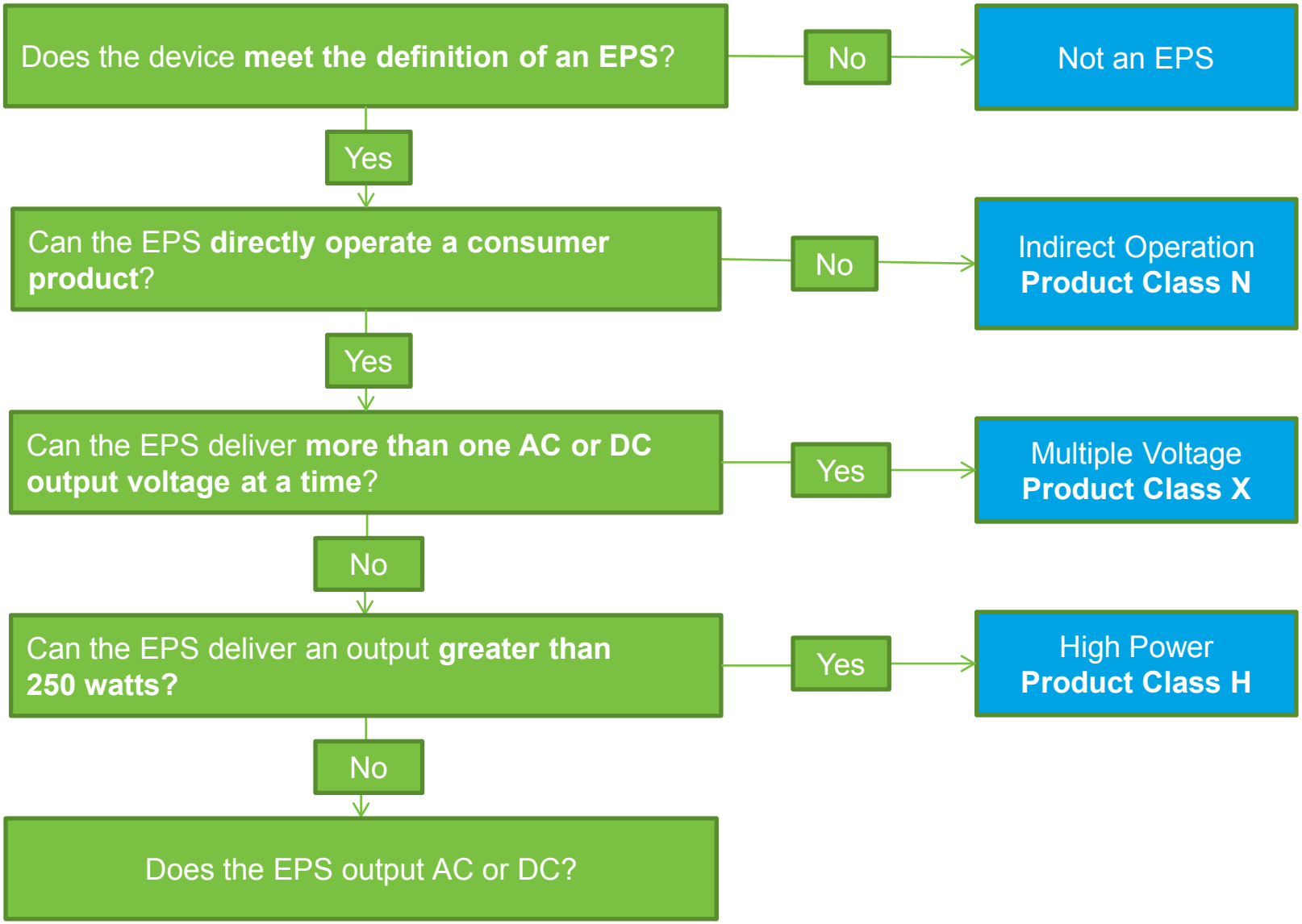
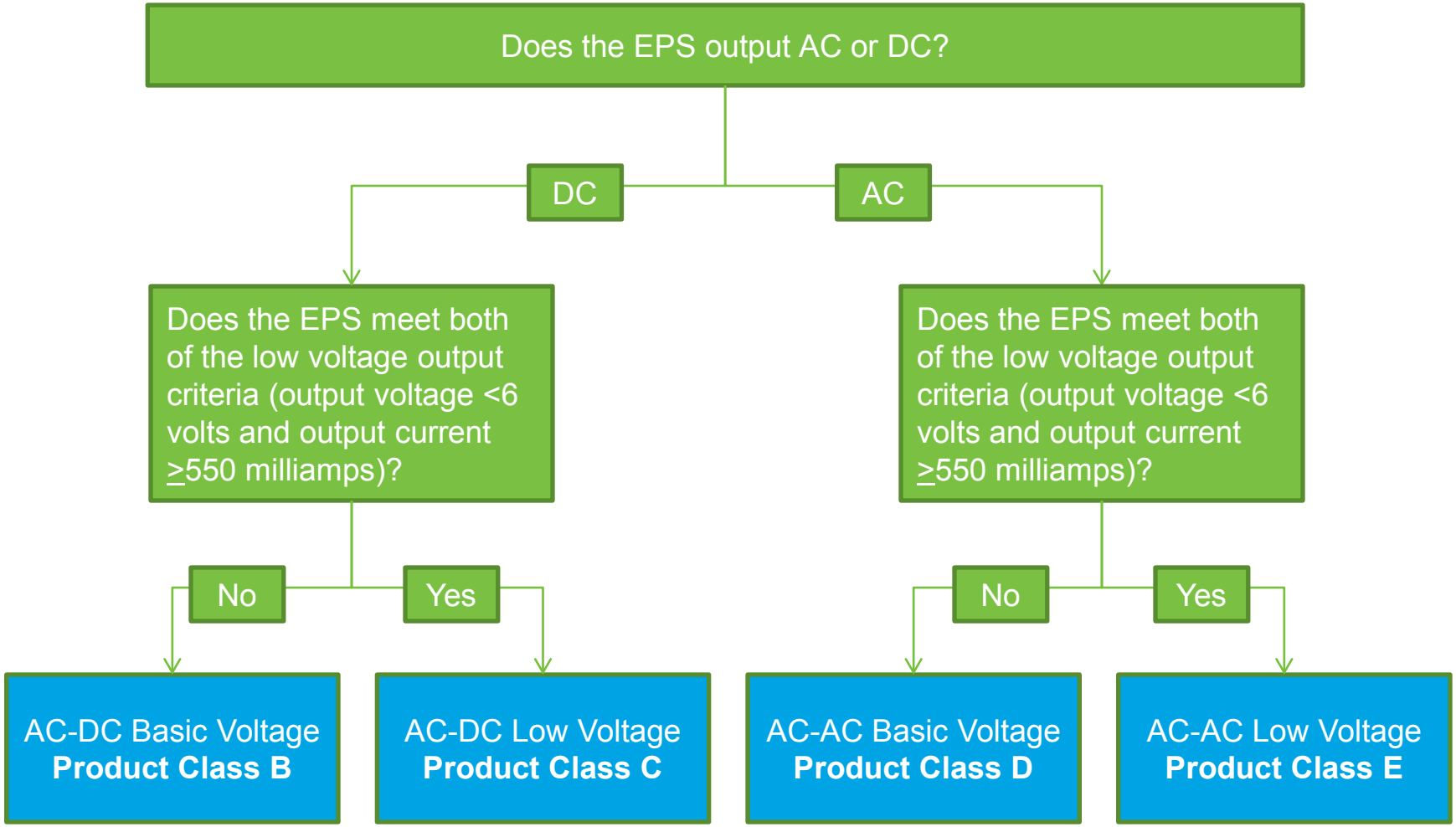
- AC-DC Basic Voltage Product Class B
- AC-DC Low Voltage Product Class C
- AC-AC Basic Voltage Product Class D
- AC-AC Low Voltage Product Class E
- Multiple Voltage Product Class X
- High Power Product Class H
- Indirect Operation Product Class N

Market Assessment
EPS Product Classes



Market Assessment
EPS Product Classes



Market Assessment
EPS Product Classes

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Total U.S. EPS Market in 2009

345 million units/yr.

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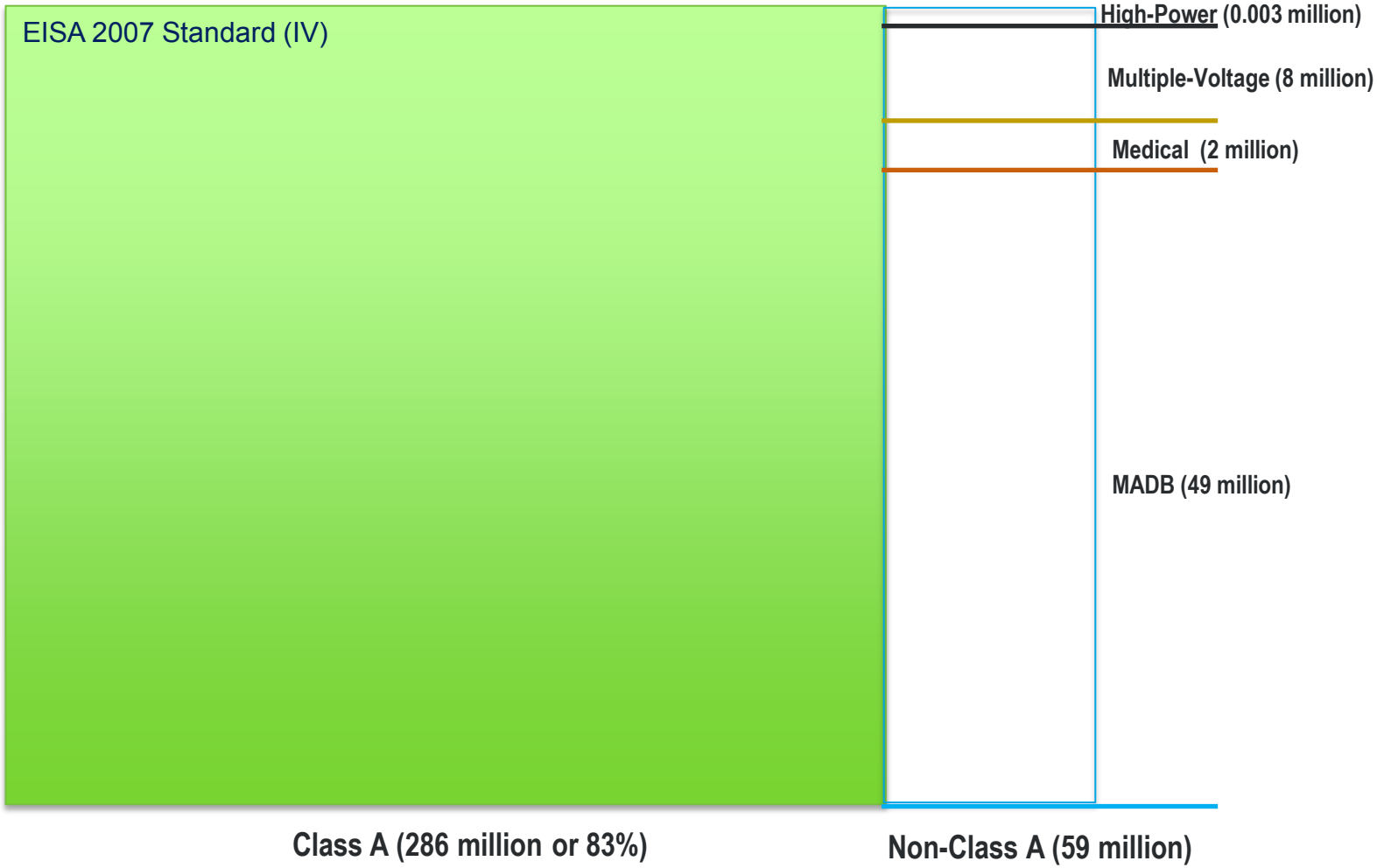
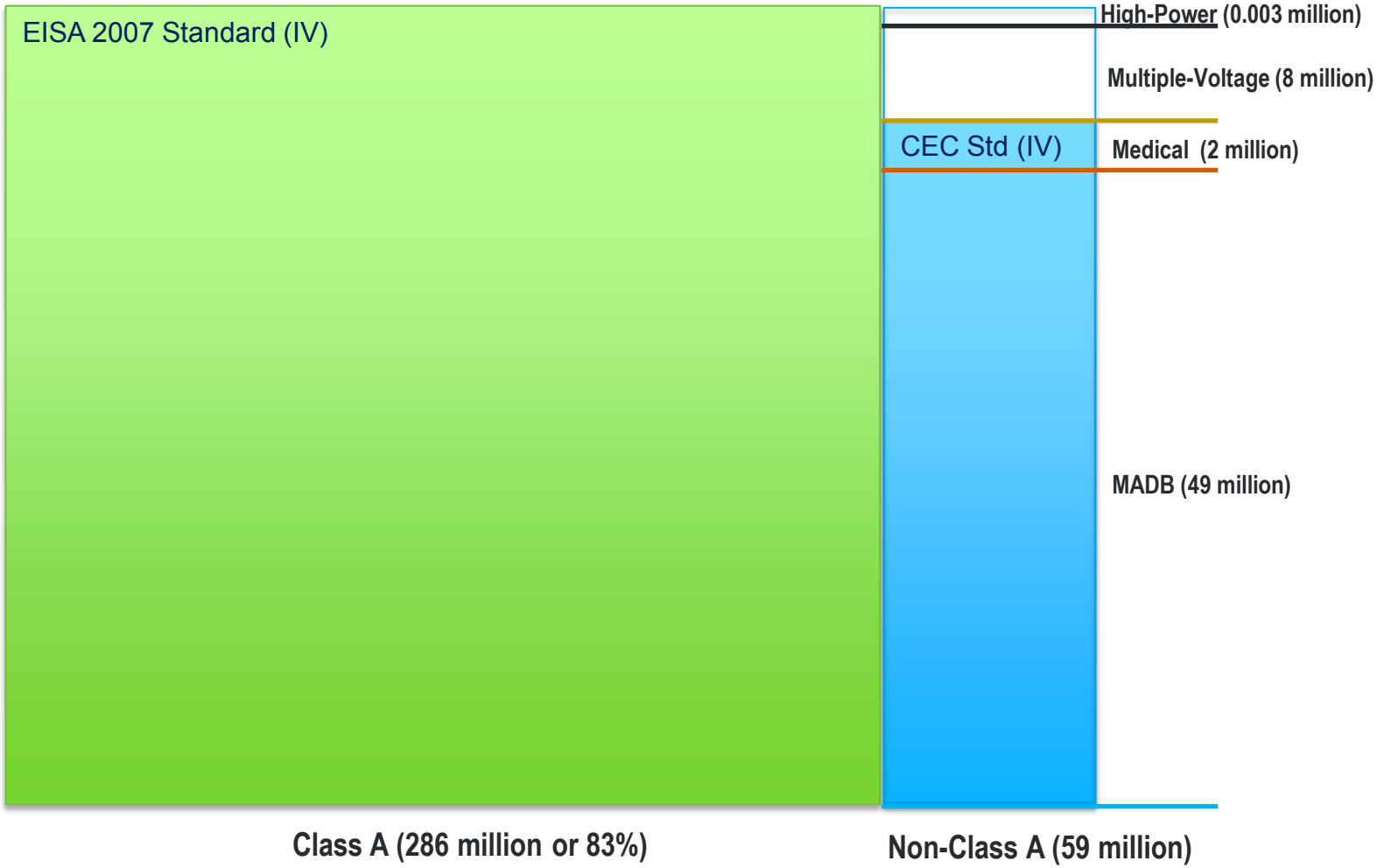
EISA 2007 set standards for Class A EPSs.



Market Assessment
EPS Product Classes

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

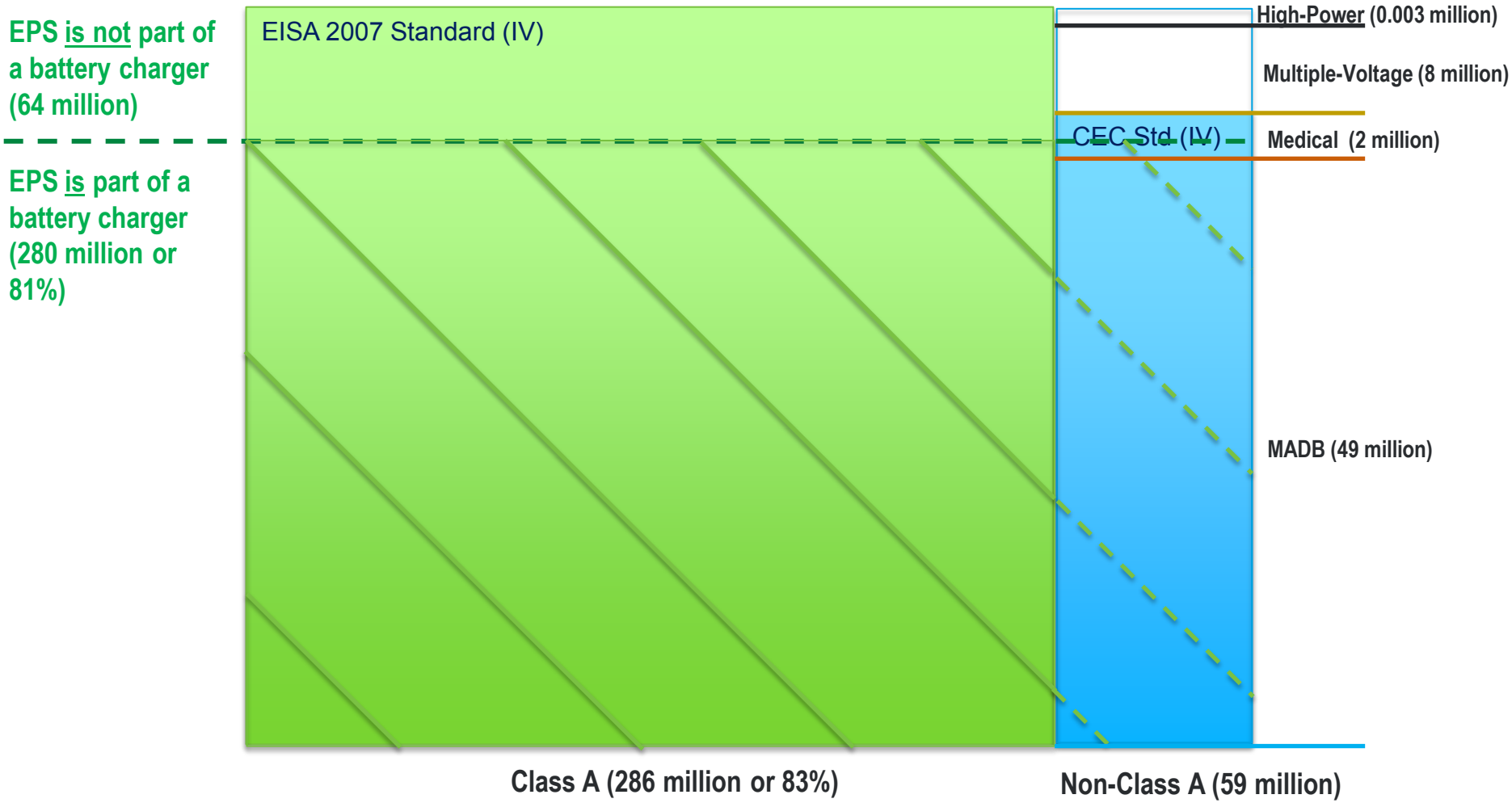
California has a standard for "state-regulated" EPSs.



Market Assessment
EPS Product Classes

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

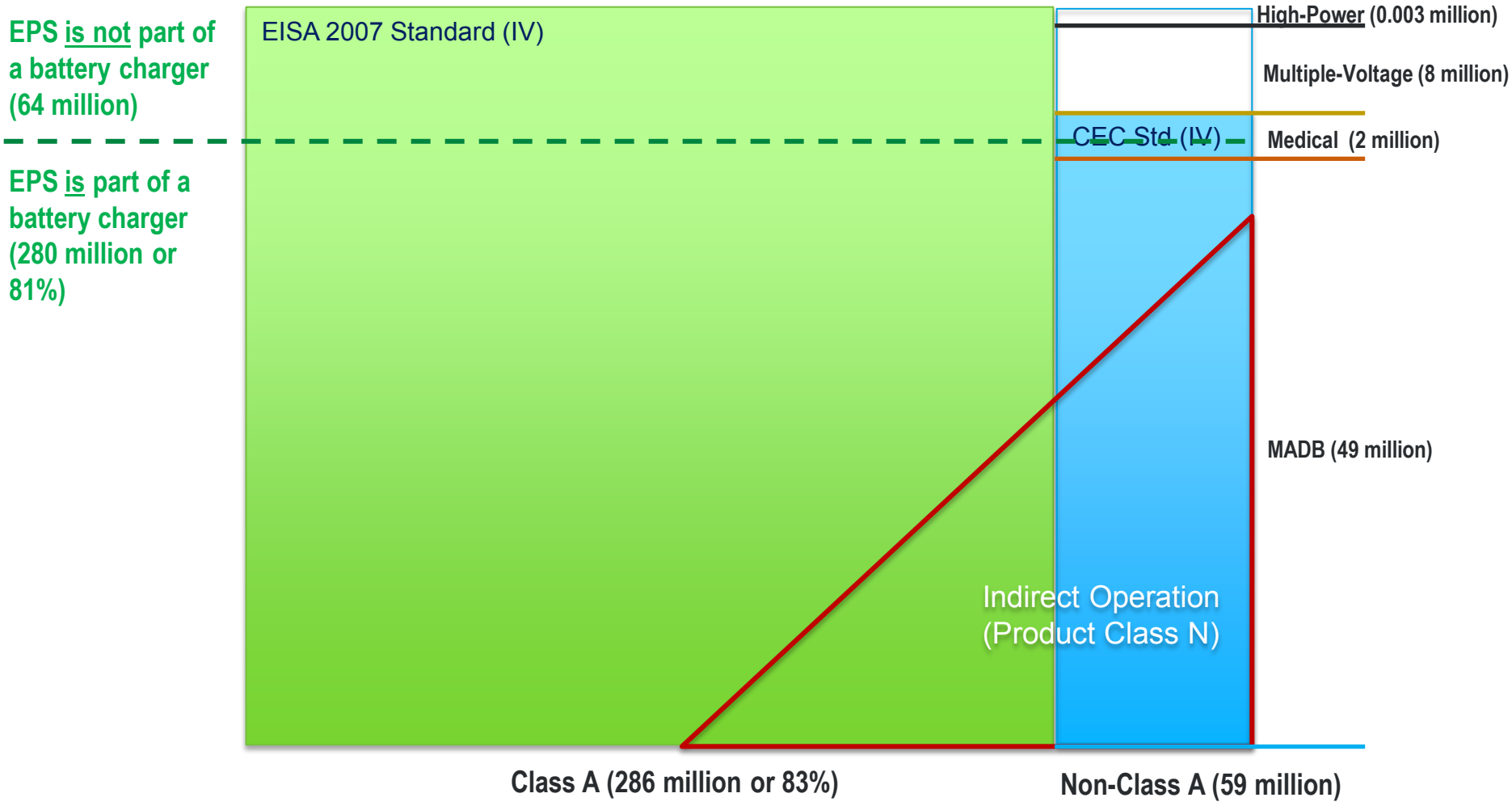
Most EPSs are components of battery chargers.



Market Assessment
EPS Product Classes

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

Many EPSs cannot operate an end-use consumer product directly.



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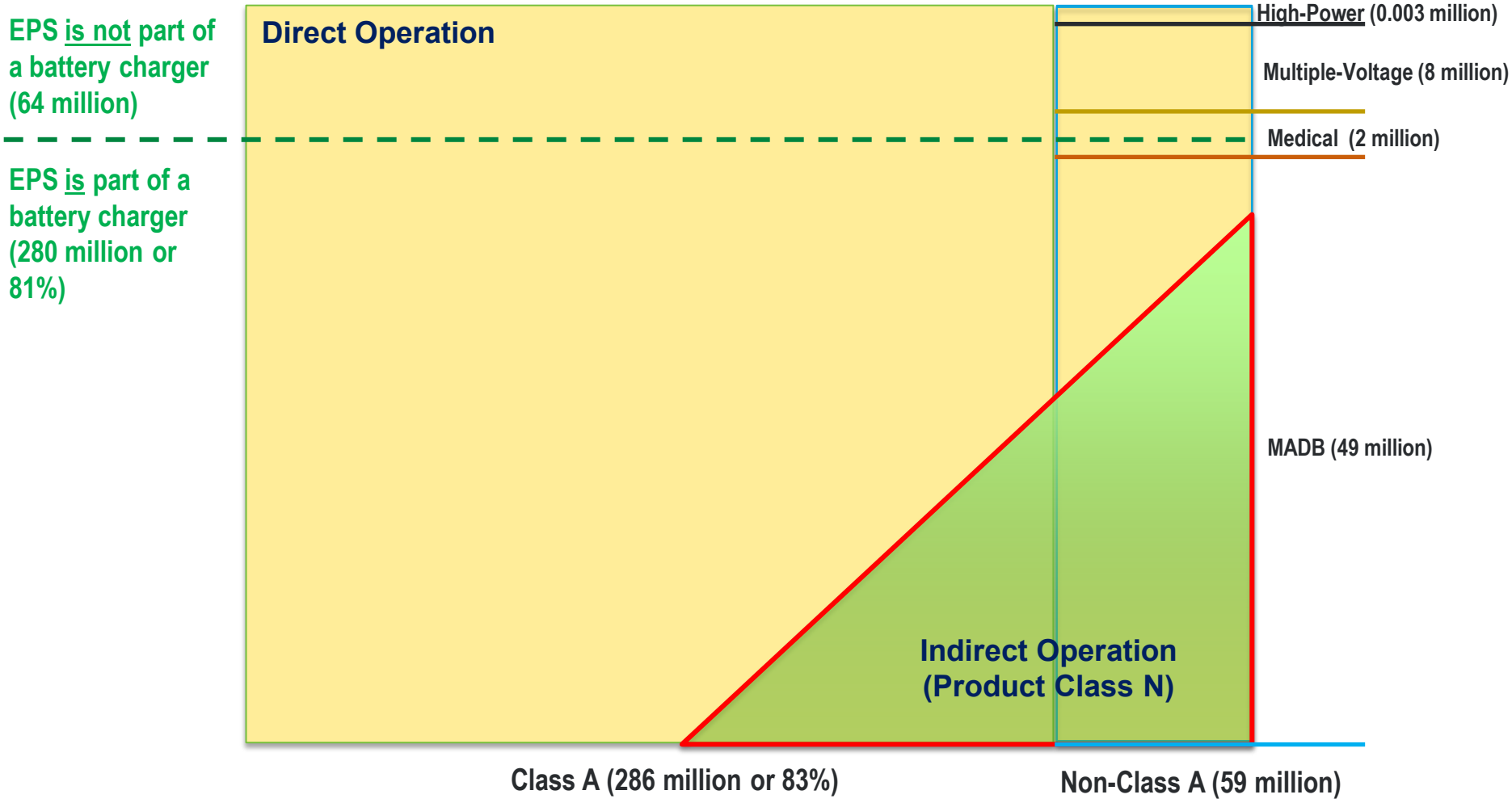
DOE proposes to handle indirect operation EPSs separately from direct operation EPSs.



Statutory Definition:

- A device that charges batteries for consumer products, including battery chargers embedded in other consumer products (42 U.S.C. 6291(32))

Key Features:

- May obtain power from mains or another source
- May have an EPS as a component

Market Assessment

Battery Charger Product Classes

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Product Class		Input / Output Type	Battery Energy	Special Characteristic or Battery Voltage
ID	Description			
1	Low Energy, Inductive	AC In, DC Out	< 100 Wh	Inductive Connection
2	Low Energy, Low Voltage			< 4 V
3	Low Energy, Medium Voltage			4–10 V
4	Low Energy, High Voltage			> 10 V
5	Medium Energy, Low Voltage		100–3000 Wh	< 20 V
6	Medium Energy, High Voltage			≥ 20 V
7	High Energy		> 3000 Wh	-
8	Low Energy, Low Voltage DC Input	DC In, DC Out	-	< 9 V Input
9	Low Energy, High Voltage DC Input			≥ 9 V Input
10a	AC Output	AC In, AC Out	-	Without AVR
10b				With AVR

Statutory Definition:

- Any article (other than an automobile, as defined in section 32901(a)(3) of title 49) of a type which in operation consumes, or is designed to consume, energy… and which, to any significant extent, is distributed in commerce for personal use or consumption by individuals without regard to whether such article of such type is in fact distributed in commerce for personal use or consumption by an individual… (42 U.S.C. 6291(1))

For further guidance, see:
http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/cce_faq.pdf

Market Assessment
Issues for Comment

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

Item 6. DOE seeks comment on its proposed approach to classifying EPSs that indirectly operate consumer products.

Item 9. DOE requests information on the existence of any battery chargers or EPSs that do not appear to fit cleanly into a single product class.

Item 33. DOE seeks comment on solid-state lighting EPSs (drivers), specifically on whether there are any unique features that might warrant treating them as a separate product class, market size, proportion of SSL luminaires that use EPSs, the efficiency of those EPSs, and usage patterns.

Item 34. DOE requests information on the existence of any battery chargers that can only be operated on 12V input, whether a device that can be powered only from a 12V power outlet can be assumed to be designed solely for use in RVs and other mobile equipment, and whether there are battery chargers with DC inputs other than 5V and 12V.

Market Assessment
Overview

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Purpose

- Analyze the consumer end-uses of BCs and EPSs to characterize the markets for BCs and EPSs

Outputs

- Shipments, lifetimes, and efficiency distributions for BCs and EPSs
- Identifies market trends that may affect unitary or aggregate BC or EPS energy consumption

The Importance of Applications

- BCs and EPSs are typically packaged with end use consumer products.
  - Understanding the BC and EPS markets requires analyzing the markets for BC and EPS applications.
- Characteristics of the application directly affect BC and EPS analyses:
  - Shipments
  - Lifetime
  - Power requirements
- DOE identified approximately 80 applications that use BCs and/or EPSs.
  - See Appendix 3-A for a list of applications that have been identified.

Market Assessment
EPS Shipments in 2009

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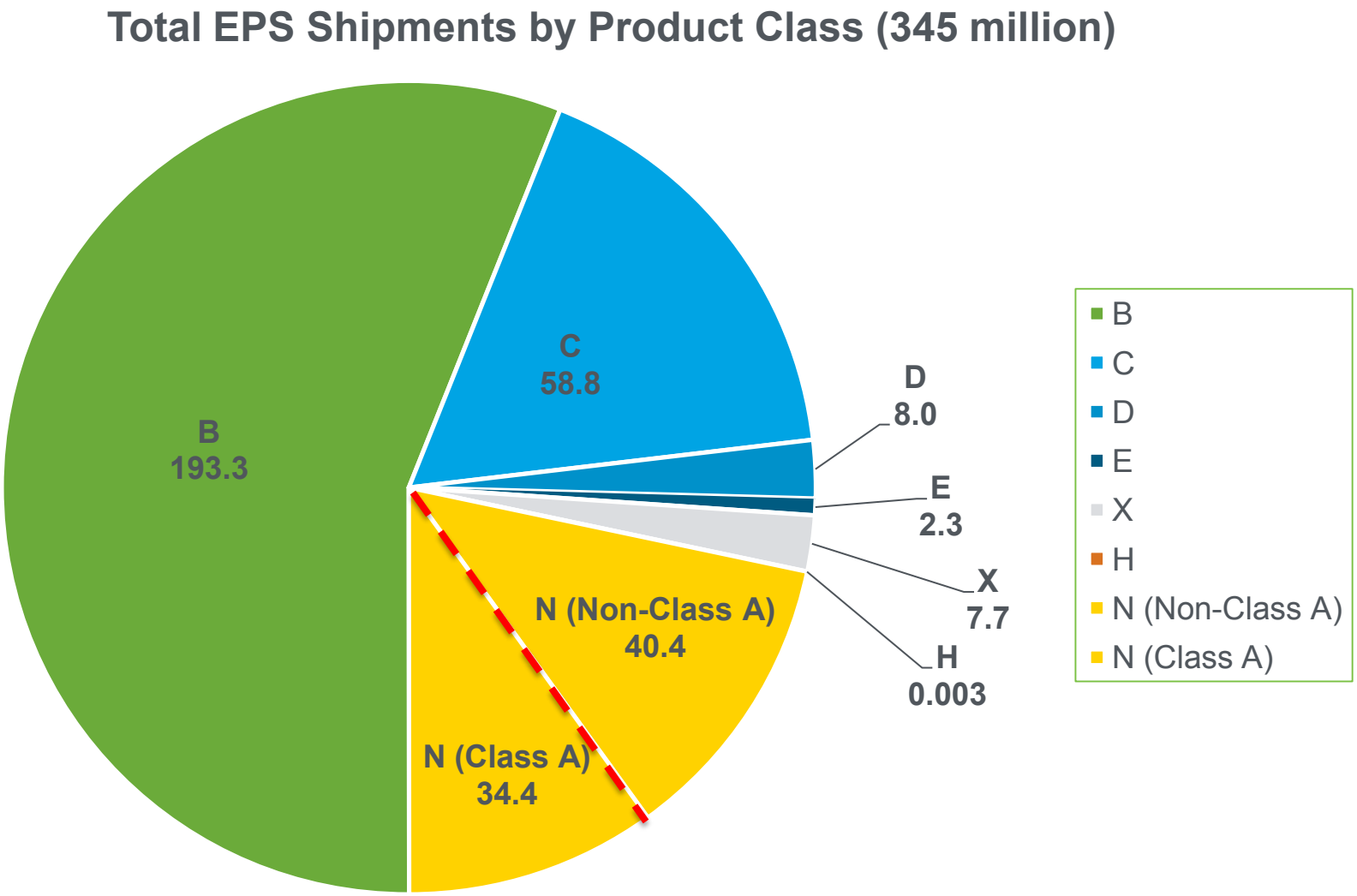

Market Assessment
EPS Shipments in 2009

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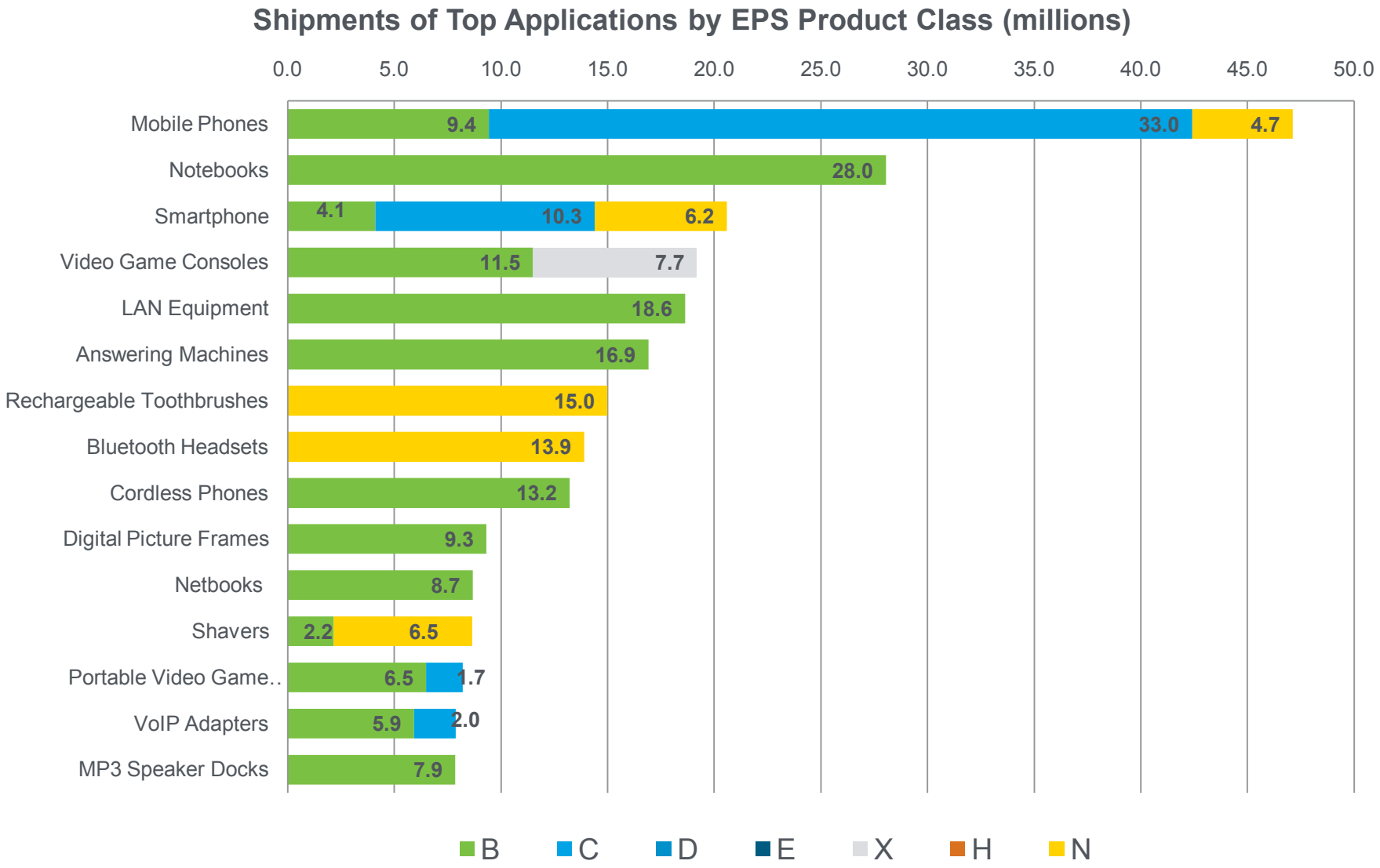

Market Assessment
BC Shipments in 2009

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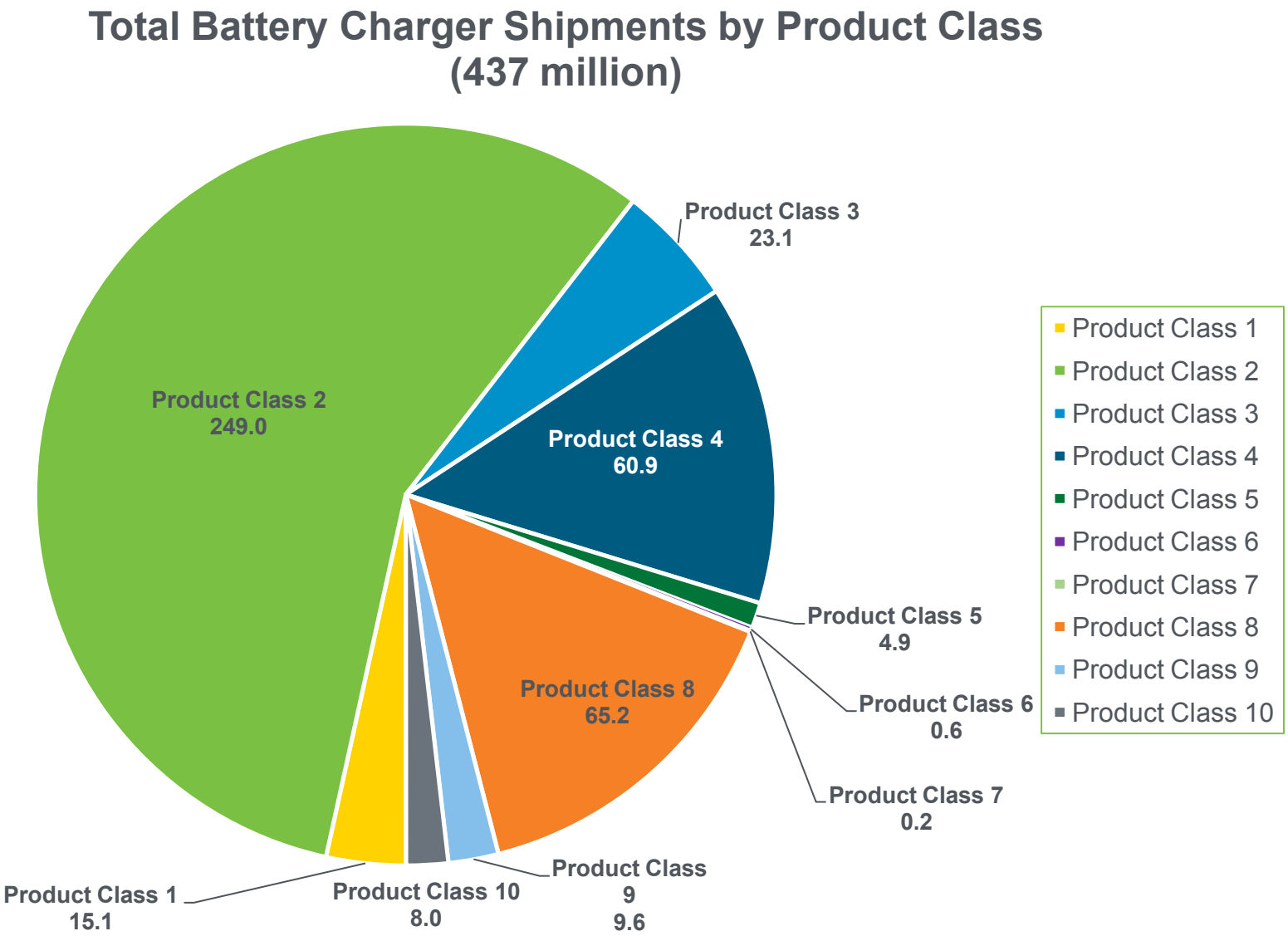

Market Assessment
BC Shipments in 2009

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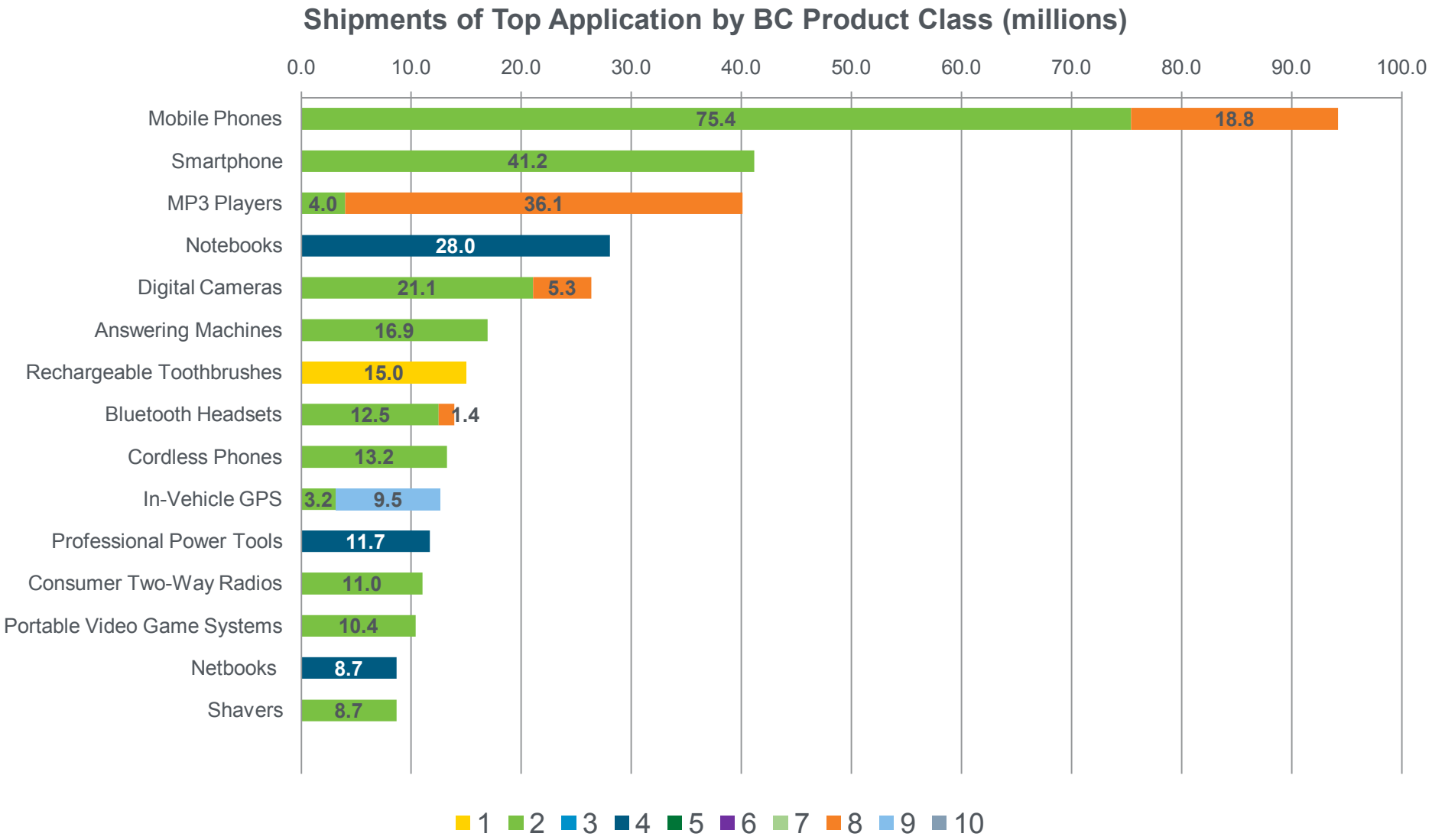

Market Assessment
Product Lifetimes

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Application	Lifetime (in years)	Application	Lifetime (in years)
Mobile Phones	2.0/4.0*	VoIP Adapters	5.0
Notebooks	3.3	Inkjet Imaging Equipment	5.0
Cordless Phones / Answering Machines	5.2	MP3 Speaker Docks	4.0
LAN Equipment	4.0	Digital Picture Frames	5.0
MP3 Players	4.0	Digital Cameras	6.0
In-Vehicle GPS	5.0	Netbooks	3.5
Portable Video Game Systems	3.0	Baby Monitors	4.0
Video Game Consoles	5.0	Home Security Systems	7.3
Power Tools	5.5	Camcorders	4.9
Portable DVD Players	4.0	Computer Speakers	5.0

*Lifetime for typical mobile phone is 2 years, however DOE assumed that EPS will last for four years (the lifetime of two phones) as a result of industry standardization around the Micro-USB charger technology.

Application- and product class-level shipment and lifetime estimates and sources are available in bceps_nopr_market.xlsx.

Market Assessment
Issues for Comment

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

Item 4. Market Data

DOE seeks comments on its estimates of BC and EPS shipments and lifetimes for each application and product class.

DOE is especially interested in receiving comment on its assumptions that EPSs for mobile phones and smartphones are likely to standardize around a common connection standard and, as a result, remain in use beyond the lifetimes of their associated applications.

Item 5. Use in the Commercial Sector

DOE seeks comment on which BC and EPS applications are used in the commercial sector, what fraction of shipments are to the commercial sector, and how product lifetimes and usage may differ between residential and commercial settings.

Item 27. DOE seeks comment on its estimates of the proportions of certain applications that ship with EPSs designed to directly operate the application versus indirectly operate the application.

BREAK

- **Break 10:30-10:45 AM**

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Technology Assessment

Purpose

- Examine factors that affect the efficiency of BCs and EPSs

Outputs

- Technology options for improving efficiency

Technology Assessment
Modes of Operation and Efficiency Metrics

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- EPS Modes of Operation
  - No-Load Mode, *Instantaneous Power consumption [W]*
  - Active Mode, *Average efficiency [%]*

- BC Modes of Operation
  - Active or Charge Mode, *24-hour energy consumption [Wh]*
  - Maintenance Mode, *Instantaneous Power consumption [W]*
  - Standby Mode, *Instantaneous Power consumption [W]*
  - Off Mode, *Instantaneous Power consumption [W]*

- DOE analyzed BCs based on their unit energy consumption (UEC), which is a weighted combination of each mode of operation with units of kWh/yr.

Technology Assessment

Technology Options to Improve Efficiency

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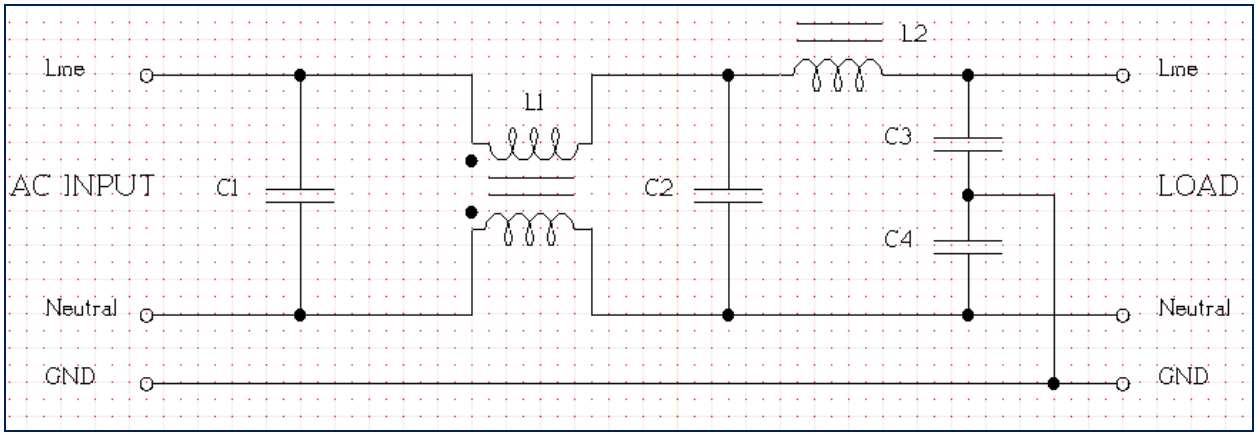
- Technology options applicable to both EPSs and BCs:
  - Improved Transformer Core Material
  - Low-Power Integrated Circuits
  - Schottky Diodes and Synchronous Rectification
  - Low-Loss Transistors

- Technology options unique to BCs:
  - Elimination/Limitation of Maintenance Current
  - Elimination of No-Battery Current
  - Battery Chemistry

Fully detailed in Chapter 3 of the TSD.

- DOE examined the impacts of Electromagnetic Interference (EMI) in the non-Class A Determination Analysis (75 FR 27170).

- DOE believes there is no impact on consumer utility in moving from linear to SMPS technology largely because of other requirements set by the FCC and the inclusion of EMI filters.



Input EMI Filter

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Item 10. EMI in External Power Supplies for Communication Products

DOE seeks comment on possible issues of electromagnetic interference and/or radio frequency interference associated with switch-mode power supplies (SMPS) used with amateur radios, including design options for reducing or eliminating interference.

Screening Analysis

Purpose

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

Outputs

- A list of design options that can be used to achieve higher efficiency

Approach

- DOE evaluated each technology option based on the following criteria:

Technological feasibility

Practicability to manufacture, install and service

Impacts on product utility or availability to consumers

Impacts on health or safety

See Appendix A to Subpart C of 10 CFR Part 430 (4)(a)(4) and (5)(b).

Screening Analysis
Technology Options Screened Out

- EPSs
  - No EPS technology options were screened out of this analysis

- BCs

BC Technology Option	Failed Screening Criterion
Lowering charging current or increasing voltage	Adverse impacts on product utility to consumers
Capacitive reactance	Adverse impacts on safety
Non-inductive chargers for toothbrushes and other wet applications	Adverse impacts on safety

Engineering Analysis

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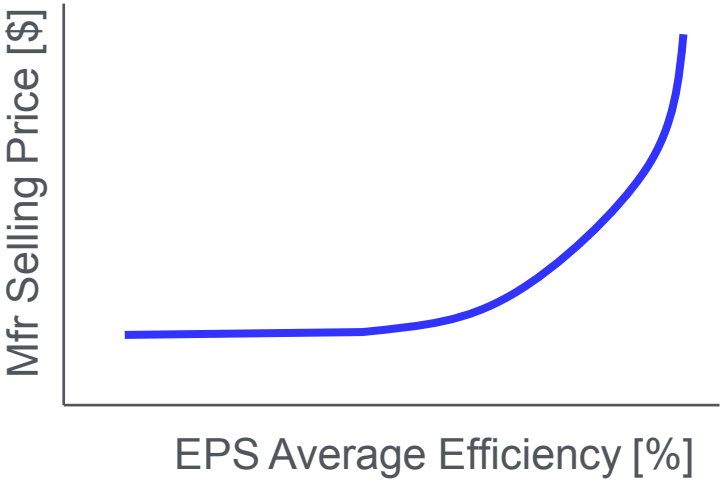
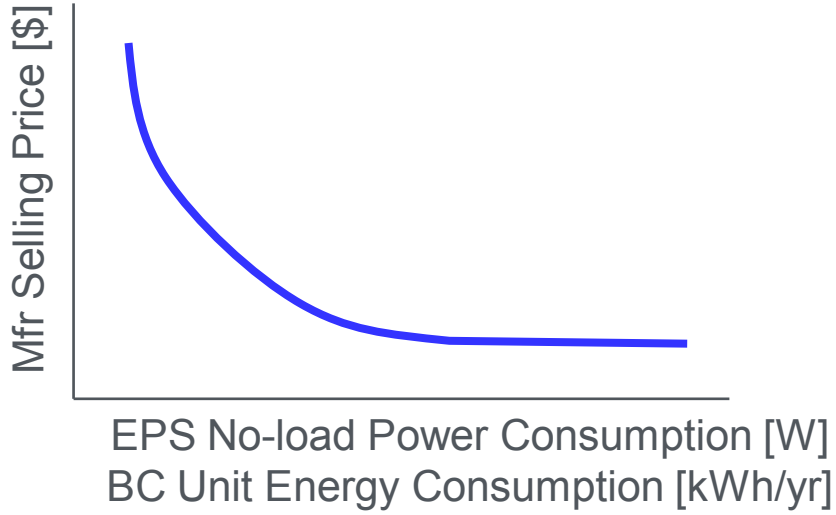
Purpose

– Establish the relationship between cost and the energy-efficiency of EPSs and BCs.

Outputs

– Cost-efficiency curves (three variations)





More Efficient

More Efficient

Engineering Analysis

DOE will present the Engineering Analysis for

- External Power Supplies (PCs B, C, D, and E)
- External Power Supplies (PCs X and H)
- Battery Chargers

Indirect Operation EPSs were not isolated within the Engineering Analysis

External Power Supplies (B, C, D, and E)

Engineering Methodology

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

Choose Representative Product Classes

Select Representative Units

Develop Candidate Standard Levels

Testing Representative Units

Conduct Manufacturer Interviews

Scale Cost and Efficiency Data

Generate Final Cost-Efficiency Curves

- **Choose** representative product classes based primarily on market volumes and existing standards.
- **Select** specific "representative units" using market survey data.
- **Develop** efficiency levels based on benchmark levels of performance including a maximum technologically feasible efficiency level.
- **Conducted** testing of representative units to corroborate the Candidate Standard Levels.
- **Discuss** initial cost and efficiency data with manufacturers and gather additional information on their costs for improving efficiency .
- **Scale** cost and efficiency data to normalize data and account for varying features (e.g. cord length).
- **Apply** markups and aggregate results to generate final cost-efficiency curves for all representative units and product classes.

External Power Supplies (B, C, D, and E)
Representative Product Classes

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

- There is one representative product class for direct operation EPSs.
- DOE developed one set of candidate standard levels (CSLs) for product class B based on four representative units.
- DOE scaled the CSLs from product class B to the other product classes.

Product Class	Type	Description
B	**Representative**	**Basic voltage, AC-DC Conversion**
C	Scaled	Low-voltage, AC-DC Conversion
D	Scaled	Basic voltage, AC-AC conversion
E	Scaled	Low-voltage, AC-AC conversion

External Power Supplies (B, C, D, and E)
Representative Units

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

- DOE selected four representative units based on:
  - Selecting units within product class B
  - Identifying popular products according to a market survey
  - Ensuring that there would be many test units
  - Selecting enough units to curve fit the CSLs

Representative Unit	Nameplate Output Power [watts]	Nameplate Output Voltage [volts]	Example Application
1	2.5	5	Mobile Phone
2	18	12	Modem
3	60	15	Laptop Computer
4	120	19	Laptop Computer

External Power Supplies (B, C, D, and E)
Candidate Standard Levels

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

- DOE characterized EPSs at five Candidate Standard Levels (CSLs) of efficiency.
- EPS CSLs were developed using "matched pairs" of efficiency metrics.
- The CSLs consist of efficiency and no-load equations that never decrease in stringency in either metric.

CSL	Reference	Basis
0	EISA 2007	EISA 2007 equations for efficiency and no-load power
1	Energy Star 2.0	Energy Star 2.0 equations for efficiency and no-load power
2	Intermediate	Curve fit to manufacturer data points
3	Best in Market	Curve fit to test unit data points
4	Max Tech	Curve fit to manufacturer data points

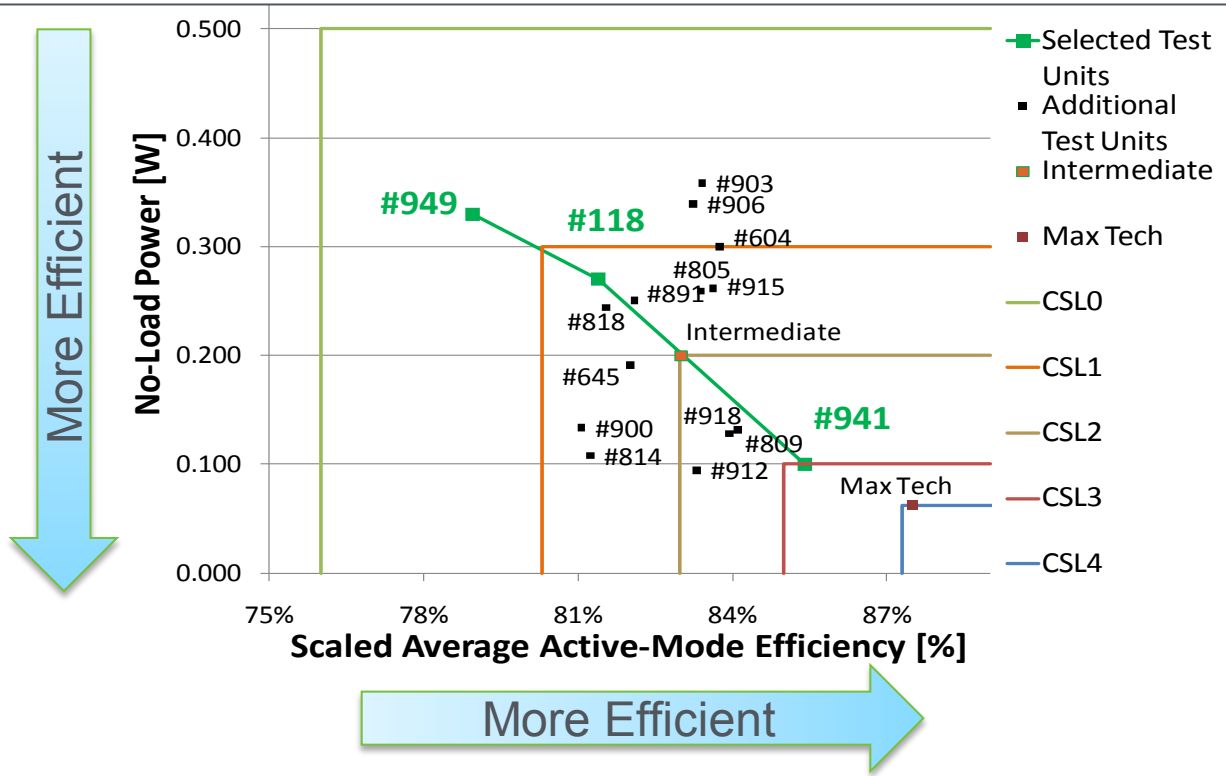
External Power Supplies (B, C, D, and E)

Testing Representative Units

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

- DOE measured the efficiency of EPSs that closely matched the nominal ratings of the representative units.
- DOE used those test results to develop CSLs above the known industry standards.

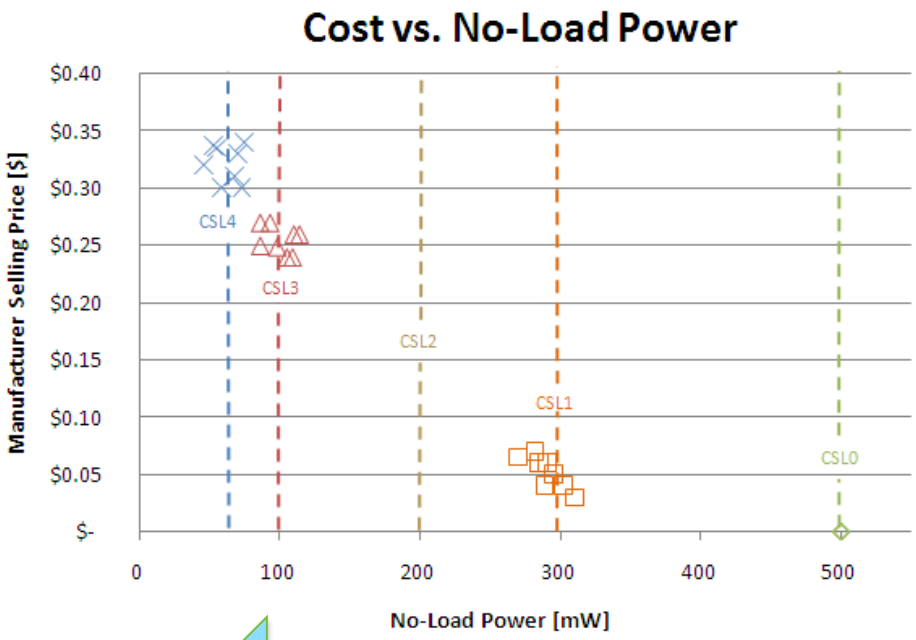
No-Load Power vs. Scaled Efficiency for 18-Watt Units

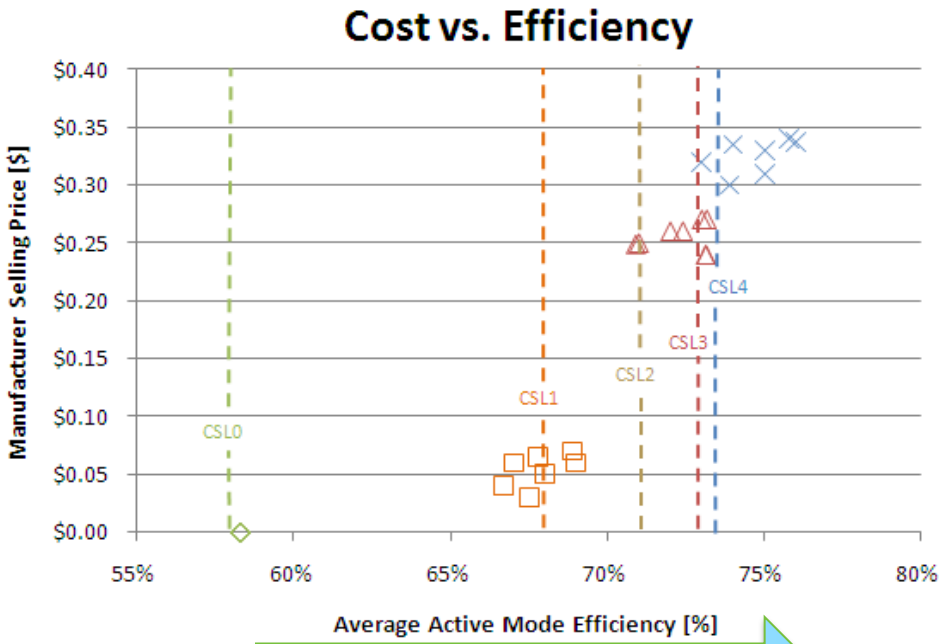


External Power Supplies (B, C, D, and E)
Manufacturer Interviews

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

- Manufacturers provided costs for matched pairs of efficiency and no-load power, under an NDA.
- Manufacturer data often did not align exactly with CSLs.





More Efficient

More Efficient

Graphs are illustrative only. They contain no actual manufacturer data.

External Power Supplies (B, C, D, and E)
Cost and Efficiency Scaling

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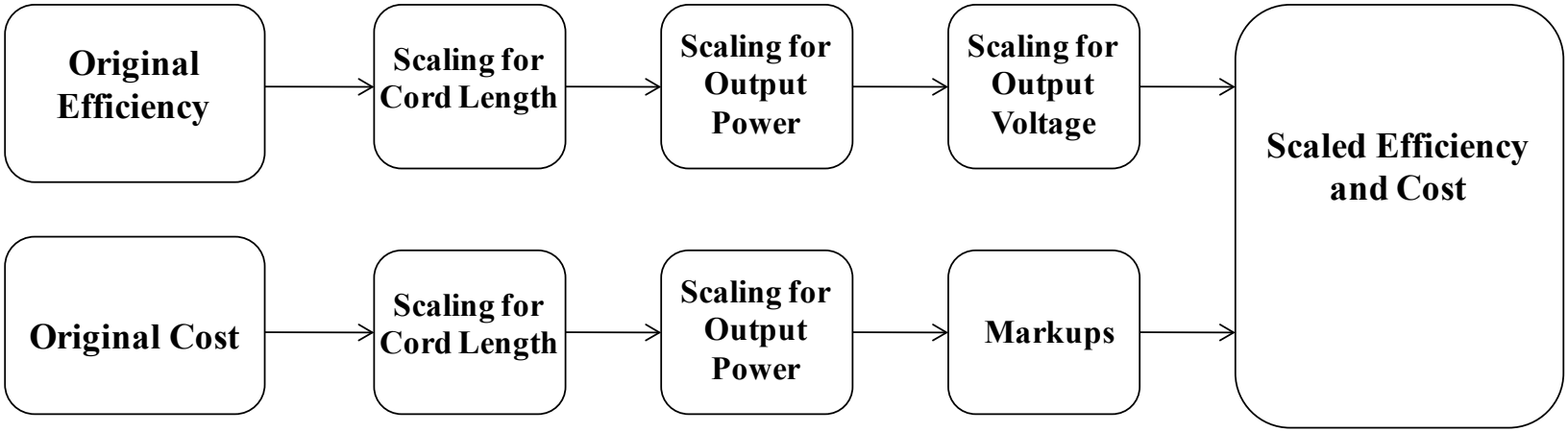
- DOE scaled manufacturer cost data to align with representative unit specifications:
  - Output cord length
  - Output power
  - Output voltage
  - Markups to manufacturer selling price (MSP)

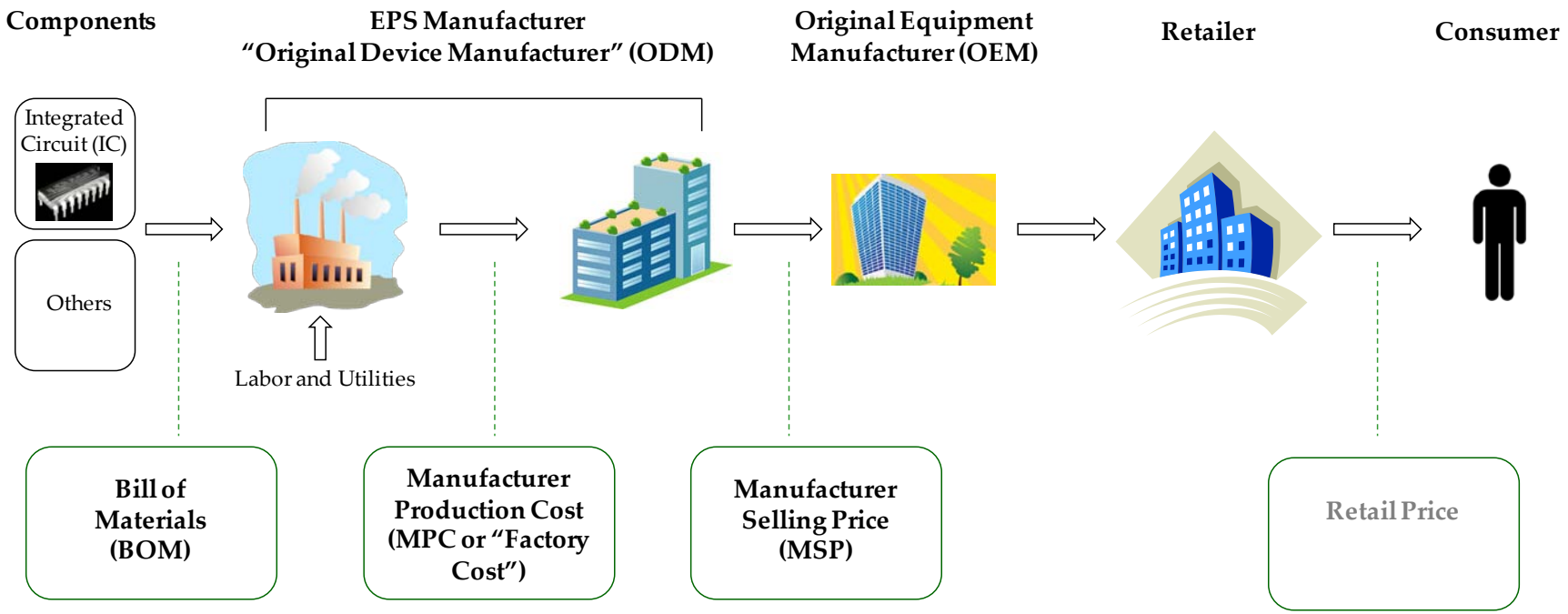


Additional details in TSD chapter 5.

External Power Supplies (B, C, D, and E)
Cost Markups

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

- DOE estimated EPS markups as:
  - MPC to MSP is 35.5% or 1.355 (range of 1.2 to 1.85)
  - BOM to MSP is 62.5% or 1.625



External Power Supplies (B, C, D, and E)
Aggregation Methodology

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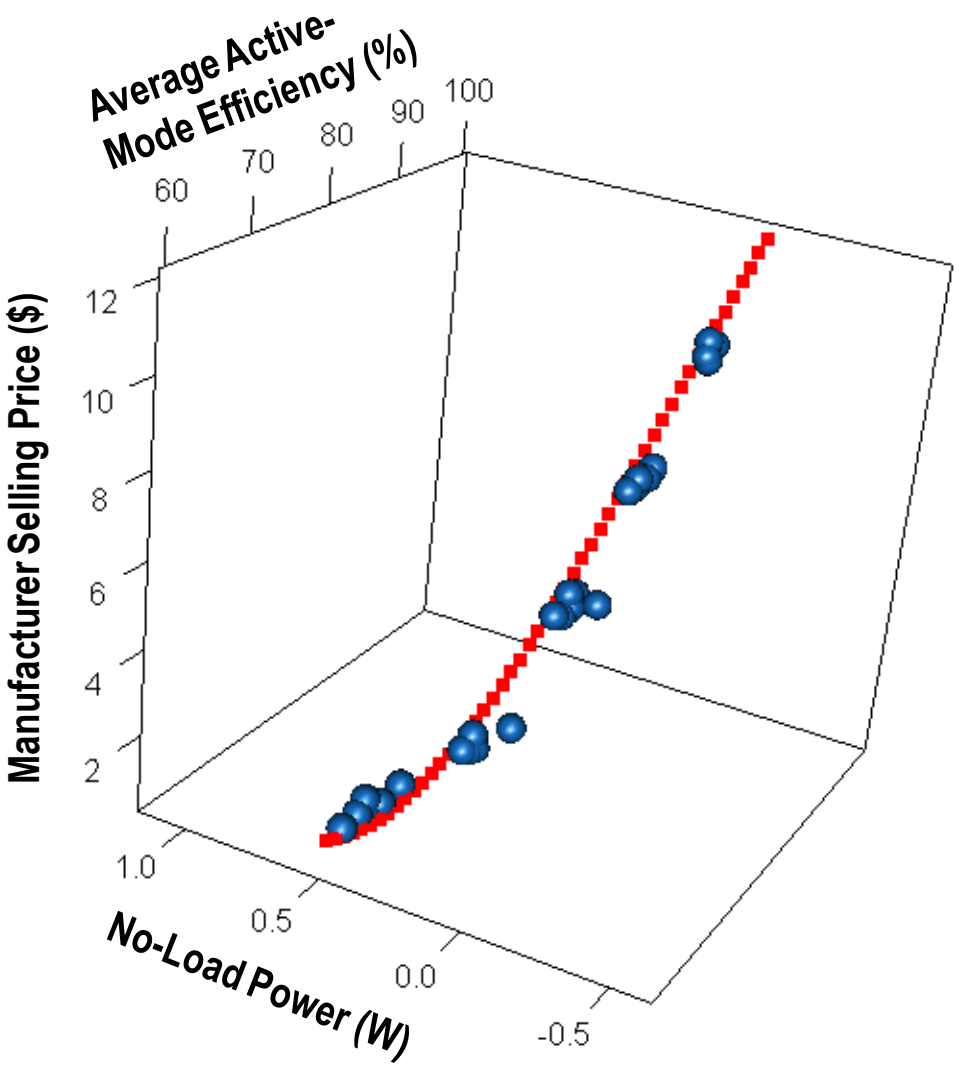
- DOE developed a best fit line in 3D using the cumulative cost, efficiency, and no-load data obtained from manufacturers.
- The resulting equation was used to generate the costs exactly at the proposed CSLs.



*The graph is for illustrative purposes only. It does not contain any actual manufacturer data.

External Power Supplies (B, C, D, and E)

Product Class Scaling

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- DOE scaled product class B CSLs to generate CSLs for product classes C, D, and E.
- Low-voltage EPSs have less stringent average efficiency requirements.
- AC-AC EPSs have less stringent no-load requirements.

	Basic Voltage Output	Low-Voltage Output	
AC-DC Conversion	B	C	**More** stringent **no-load** requirements
AC-AC Conversion	D	E	**Less** stringent **no-load** requirements
	More stringent **efficiency** requirements	**Less** stringent **efficiency** requirements	

Additional details in TSD chapter 5.

Engineering Analysis

DOE will present the Engineering Analysis for

- External Power Supplies (PCs B, C, D, and E)
- External Power Supplies (PCs X and H)
- Battery Chargers

External Power Supplies (X and H)

Engineering Analysis Methodology

- DOE applied the same analytical structure to non-Class A (NCA) EPSs as the direct operation EPSs.
- DOE used results from the determination analysis as inputs (75 FR 27170).
- Only multiple-voltage and high power EPSs were analyzed, while medical and MADB EPSs were rolled into the direct operation analysis.

External Power Supplies (X and H)

Representative Units

- DOE analyzed one representative unit for multiple-voltage EPSs and one representative unit for high power EPSs.
- DOE found that high power EPSs can increase efficiency while reducing costs in some cases.

Product Class	Representative Unit			Example Application
	Nameplate Output Power [W]	Nameplate Output Voltage [V]	Second Nameplate Output Voltage [V]	
X	203	5	12	Video Game Console
H	345	13.8	N/A	Amateur Radio

External Power Supplies (X and H)

High Power EPS CSLs

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

- DOE created its CSLs for high power EPSs by using a combination of test data, manufacturer data, and scaling from direct operation product class B.
- DOE scaled its 120W CSLs to the 345W representative unit to generate new best-in-market and max-tech CSLs with associated MSPs.

Item 12. CSLs for High Power External Power Supplies

DOE seeks comment on its methodology for generating CSL3 and CSL4 for high-power EPSs.

Engineering Analysis

DOE will present the Engineering Analysis for

- External Power Supplies (PCs B, C, D, and E)
- External Power Supplies (PCs X and H)
- Battery Chargers

Battery Chargers
Engineering Methodology

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

Choose Representative Product Classes

Select Representative Units

Develop Candidate Standard Levels

Test and Teardown Representative Units

Conduct Manufacturer Interviews

Scale Cost and Efficiency Data

Generate Final Cost-Efficiency Curves

- **Choose** representative product classes based primarily on market data and volumes.
- **Select** specific "representative units" using market survey data.
- **Develop** efficiency levels based on benchmark levels of performance including a maximum technologically feasible efficiency level.
- **Evaluate** the typical material costs associated with the representative units and characterize associated efficiencies.
- **Discuss** initial cost and efficiency data with manufacturers and gather additional information on their costs for improving efficiency .
- **Scale** cost and efficiency data based on range of battery energies for each product class
- **Apply** markups and aggregate results to generate final cost-efficiency curves for all representative units and product classes.

Battery Chargers
Product Classes

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

Product Class		Input / Output Type	Battery Energy	Special Characteristic or Battery Voltage
ID	Description			
1	Low Energy, Inductive	AC In, DC Out	< 100 Wh	Inductive Connection
2	Low Energy, Low Voltage			< 4 V
3	Low Energy, Medium Voltage			4–10 V
4	Low Energy, High Voltage			> 10 V
5	Medium Energy, Low Voltage		100–3000 Wh	< 20 V
6	Medium Energy, High Voltage			≥ 20 V
7	High Energy		> 3000 Wh	-
8	Low Energy, Low Voltage DC Input	DC In, DC Out	-	< 9 V Input
9	Low Energy, High Voltage DC Input			≥ 9 V Input
10a	AC Output	AC In, AC Out	-	Without AVR
10b				With AVR

Battery Chargers
Representative Units

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

Rep. Unit #	Product Class	Voltage *V*	Battery Energy *Wh*	Applications Examined
1	Low Energy, Inductive	3.6	1.5	Toothbrushes
2	Low Energy, Low Voltage	3.6	3	Mobile Phones, Cordless Phones, Power Tools, Digital Cameras
3	Low Energy, Med. Voltage	7.2	10	Power Tools
4	Low Energy, High Voltage	10.8	20	Power Tools and Notebook Computers
5	Med. Energy, Low Voltage	12	800	Marine Chargers
6	Med. Energy, High Voltage	36	384	Lawn mowers, Wheelchairs
7	High Energy	48	3750	Golf Cars
8	Low Energy, 5V DC Input	3.6	2	MP3 Players
9	Low Energy, 12V DC Input	3.6	5	GPS
10	Low Energy, AC Output	12	70	UPS

Battery Chargers
Candidate Standard Levels

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

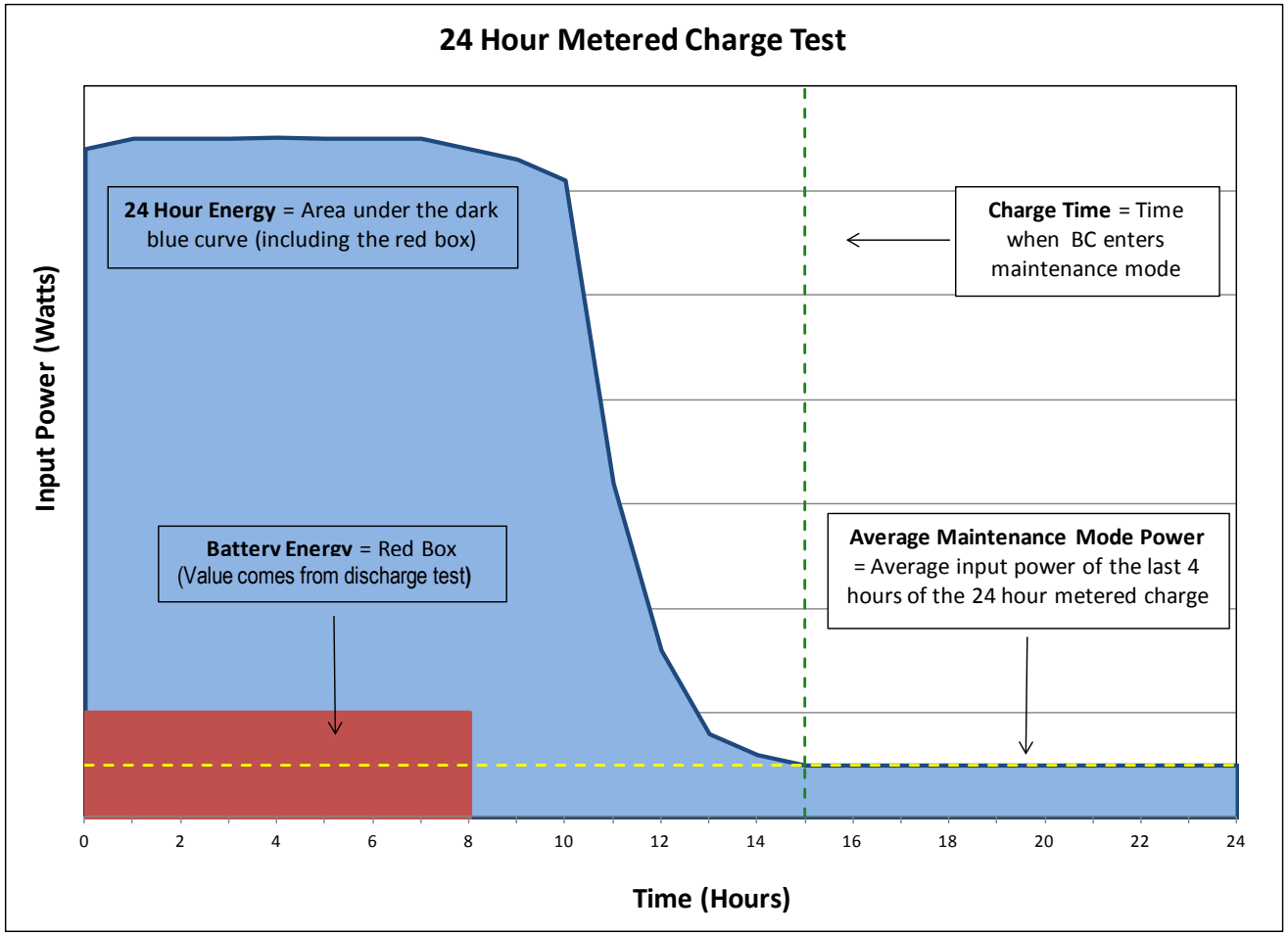
- CSLs were based on:
  - Efficiencies available in the market
  - The maximum technologically feasible level indicated by manufacturers and technical experts

CSL	Reference	Basis
0	Baseline	Least efficient units in the market
1	Mid Market	Efficiency in the middle of the market (where possible)
2	Best in Market	Most efficient test unit data points
3	Max Tech	Manufacturer max tech data points and technical experts

- DOE combined outputs from the test procedure into a metric called unit energy consumption (UEC) in kWh/yr.

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

- DOE used metrics from the test procedure to calculate unit energy consumption.



- DOE calculated unit energy consumption with the equation:

$$UEC = 365\left(n(E_{24} - P_m(24 - t_c) - E_{batt}) + \left(P_m\left(t_{a\&m} - (t_c n)\right)\right) + (P_{sb} t_{sb}) + \left(P_{off} t_{off}\right)\right)$$

Where:

- E_{24} = 24 hour energy
- E_{batt} = Measured battery energy
- P_m = Maintenance mode power
- P_{sb} = Standby mode power
- P_{off} = Off mode power
- t_c = Time to completely charge a fully discharged battery
- *n = Number of charges per day*
- *$t_{a\&m}$ = Time per day spent in active and maintenance mode*
- *t_{sb} = Time per day spent in standby mode*
- *t_{off} = Time per day spent in off mode*[1]

Parameters in **blue** are outputs from the test procedure and those in **red** are assumed

[1] Those values shown in *italics* are parameters assumed in the usage profile and change for each product class. Further discussion of them and their derivation is found in IV.E. The other values should be determined according to section 5 of Appendix Y to Subpart B of Part 430.

- DOE calculated unit energy consumption with the equation:

For charge and maint 24 hrs:

$$UEC = 365\left(n\left(E_{24} - 5P_m - E_{batt}\right)\boxed{\frac{24}{t_{cd}}} + \left(P_m\left(t_{a\&m} - (t_{cd} - 5)n\right)\right) + \left(P_{sb}t_{sb}\right) + \left(P_{off}t_{off}\right)\right)$$

For charge and maint over 24 hrs:

$$UEC = 365\left(n\left(E_{24} - 5P_m - E_{batt}\right)\boxed{\frac{24}{(t_{cd} - 5)}} + \left(P_{sb}t_{sb}\right) + \left(P_{off}t_{off}\right)\right)$$

Where:

- E_{24} = 24 hour energy
- E_{batt} = Measured battery energy
- P_m = Maintenance mode power
- P_{sb} = Standby mode power
- P_{off} = Off mode power
- tcd = Time to completely charge a fully discharged battery
- *n = Number of charges per day*
- *$t_{a\&m}$ = Time per day spent in active and maintenance mode*
- *t_{sb} = Time per day spent in standby mode*
- *t_{off} = Time per day spent in off mode*[1]

Parameters in **blue** are outputs from the test procedure and those in **red** are assumed

[1] Those values shown in *italics* are parameters assumed in the usage profile and change for each product class. Further discussion of them and their derivation is found in IV.E. The other values should be determined according to section 5 of Appendix Y to Subpart B of Part 430.

Battery Chargers
Candidate Standard Levels

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

- Each representative unit CSL was characterized by a specific UEC:

	Unit Energy Consumption by Representative Unit *kWh/yr*				
PC	1	2	3	4	5
	Low Energy, Inductive	Low Energy, Low Voltage	Low Energy, Medium Voltage	Low Energy, High Voltage	Med. Energy, Low Voltage
CSL #	1.5 Wh, 3.6 V	3 Wh, 3.6 V	10 Wh, 7.2 V	20 Wh, 10.8 V	800 Wh, 12 V
0	8.73	8.66	11.90	37.73	84.60
1	6.10	6.47	4.68	9.91	56.09
2	3.04	2.86	0.79	4.57	29.26
3	1.29	1.03	0.75	3.01	15.35
4	-	0.81	-	-	-

* For some product classes, manufacturer interviews did not yield any cost-efficiency data at the max-tech CSL.

Battery Chargers
Candidate Standard Levels

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

- Each representative unit CSL was characterized by a specific UEC:

	Unit Energy Consumption by Representative Unit *kWh/yr*				
PC	6	7	8	9	10
	Medium Energy, High Voltage	High Energy	Low Energy, Low Voltage, DC input	Low Energy, Low Voltage, DC input	Low Energy, AC Output
CSL #	384 Wh, 36 V	3750 Wh, 48 V	2 Wh, 3.6 V	5 Wh, 3.6 V	70 Wh, 12 V
0	120.60	255.05	0.90	0.79	19.27
1	81.71	191.74	0.66	0.26	6.13
2	38.33	131.44	0.24	0.13	4.0
3	16.79	-	0.19	-	1.5

* For some product classes, manufacturer interviews did not yield any cost-efficiency data at the max-tech CSL.

Battery Chargers
Testing and Teardowns

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

- DOE purchased several battery chargers at various rated battery energies and voltages.
- Each unit was tested according to the DOE test procedure for battery chargers.
- After calculating UEC for each unit tested, DOE selected those units closest to the representative battery energy and voltage for teardowns.
- iSuppli subsequently created a BOM by tearing down and inventorying all components of the battery charger that affect battery charging.

Battery Chargers
Manufacturer Interviews

- After entering into an NDA, manufacturers provided costs for designs with specific performance parameters.
- For product classes 1 and 10, manufacturer data on costs and product performance was aggregated and used to develop a cost versus efficiency relationship. For all other product classes test and teardown data was used.
- Input from manufacturers was also used to help develop max-tech CSLs.

Battery Chargers
Cost Model

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

- DOE applied average markups to the BOM costs in order to obtain an MSP.

Product Class	Product Class Description	Average BC Manufacturer Markup
1	Low Energy, Inductive	1.18
2	Low Energy, Low Voltage	1.18
3	Low Energy, Med. Voltage	1.18
4	Low Energy, High Voltage	1.46
5	Med Energy, Low Voltage	2.11
6	Med. Energy, High Voltage	2.11
7	High Energy	2.11
8	Low Energy, Low Voltage DC Input	1.18
9	Low Energy, High Voltage DC Input	1.18
10	Low Energy, AC Output	1.6

Battery Chargers
UEC Scaling Methodology

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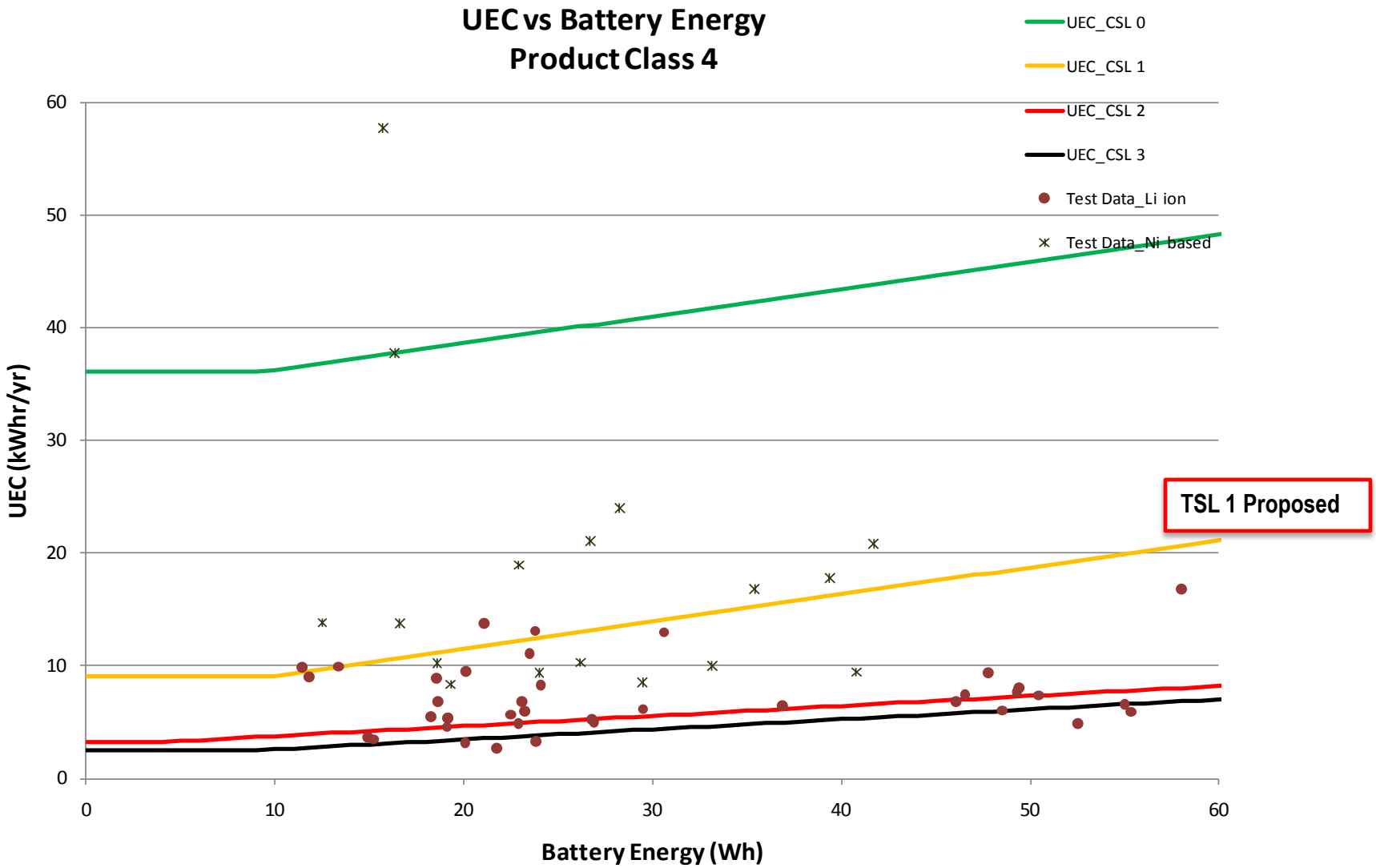
- UEC is scaled by observing the behavior of three performance parameters relative to battery energy
  - 24 Hour Energy (E_{24})
  - Maintenance Mode Power (P_m)
  - Standby Mode Power (P_{sb})
- The parameters are combined to obtain UEC as a function of battery energy using the usage profile assumptions for each product class
- Boundary Condition:

$$UEC_{min} = 365\left((P_m\ t_{a\&m}) + (P_{sb}\ t_{sb})\right)$$

- For all CSLs of PCs 1& 8, UEC is constant for all battery energies

Battery Chargers
UEC versus Battery Energy



Battery Chargers
Scaling of Product Class 10

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- The Max Tech level (CSL 3) has been selected as the proposed standard level
- DOE was unable to find and test products that performed as well as manufacturers stated was possible (specifically for CSL 2&3)
- DOE assumes that the manufacturer data received was not exactly equivalent to DOE test procedure inputs, but instead was based on the power supplied directly to the battery
- In order to account for this discrepancy DOE tested more UPSs and obtained the battery input power to develop an “adder” for both basic UPSs and UPSs with AVR functionality

Battery Chargers
Scaling of Product Class 10

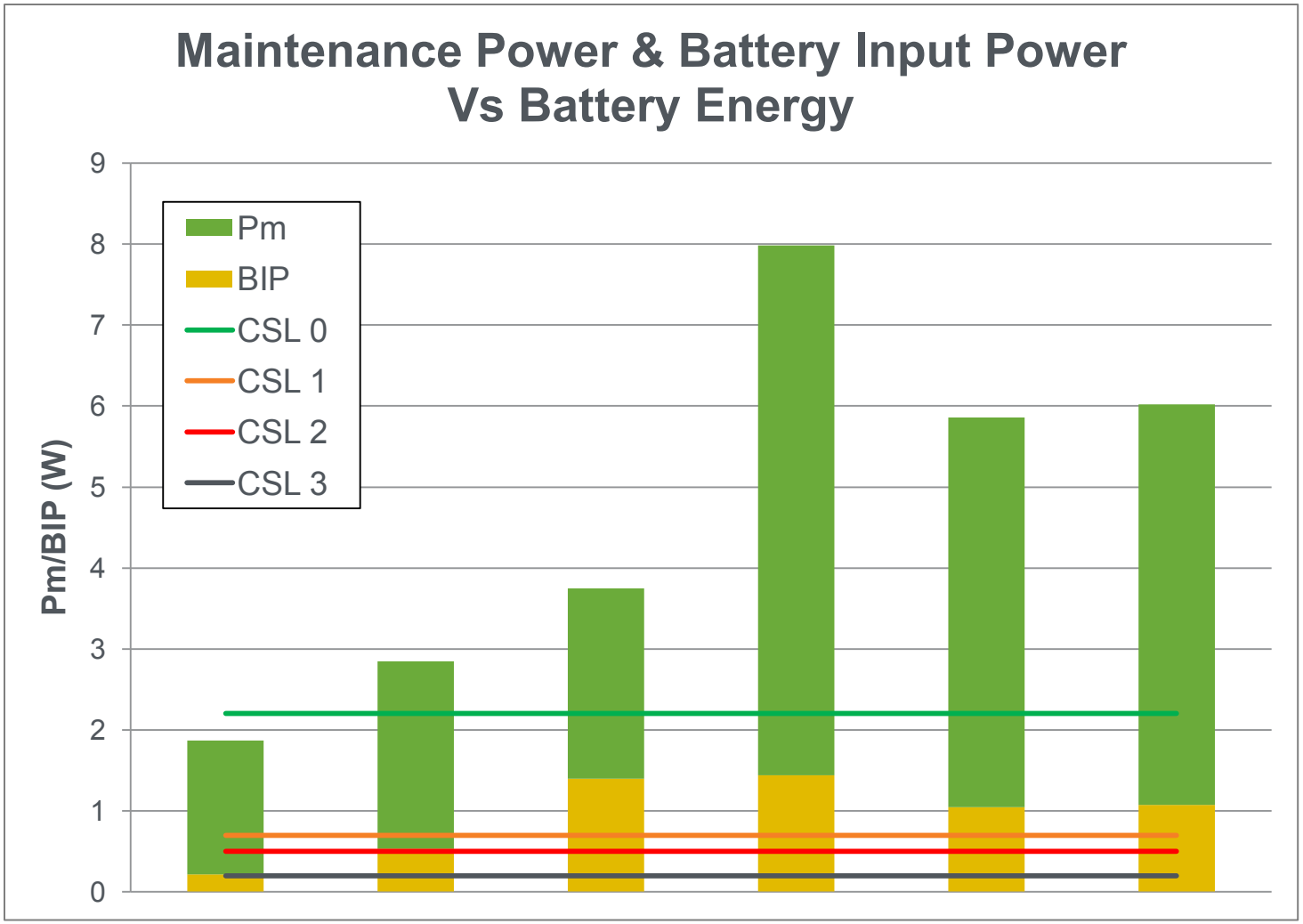
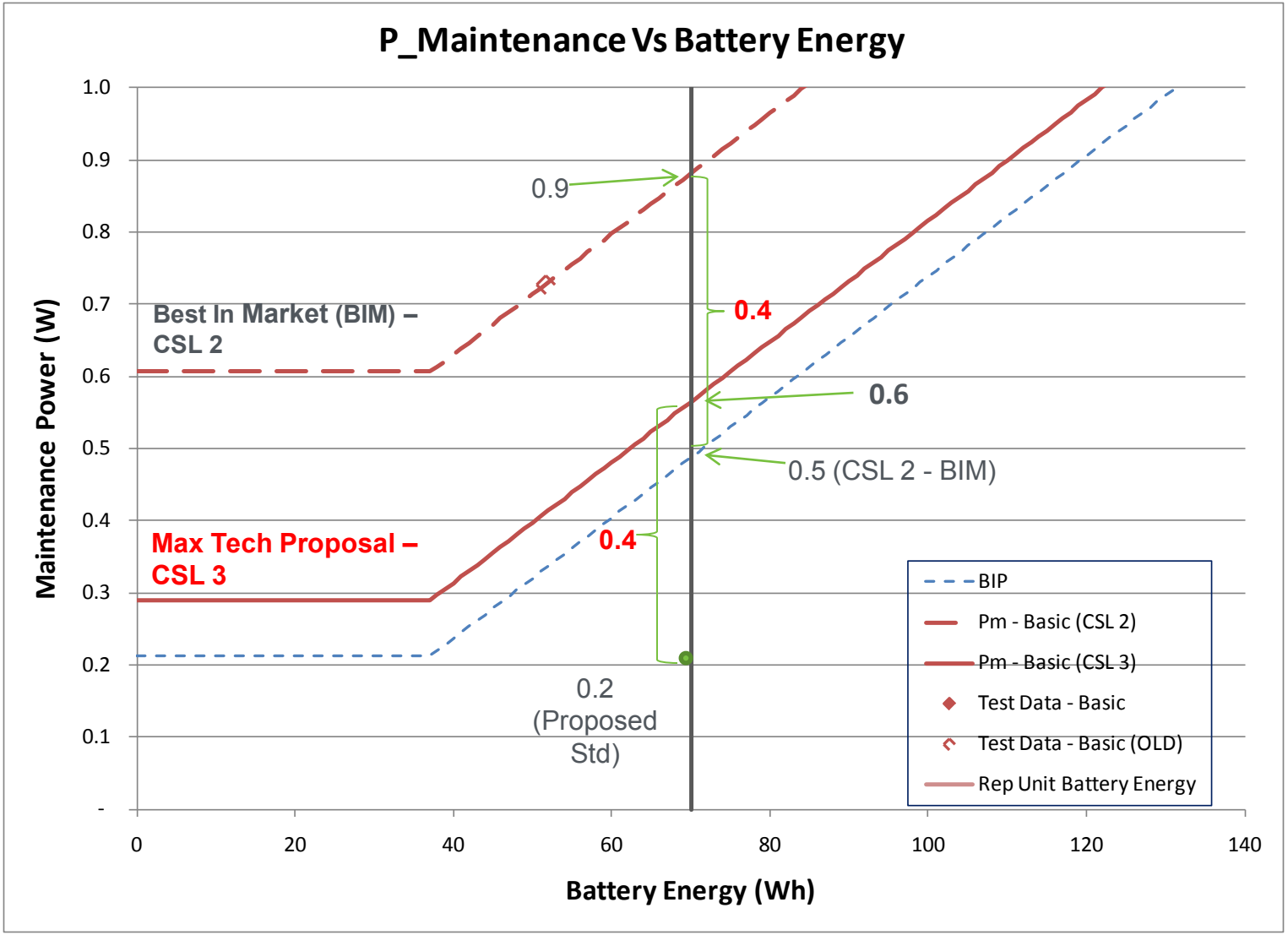
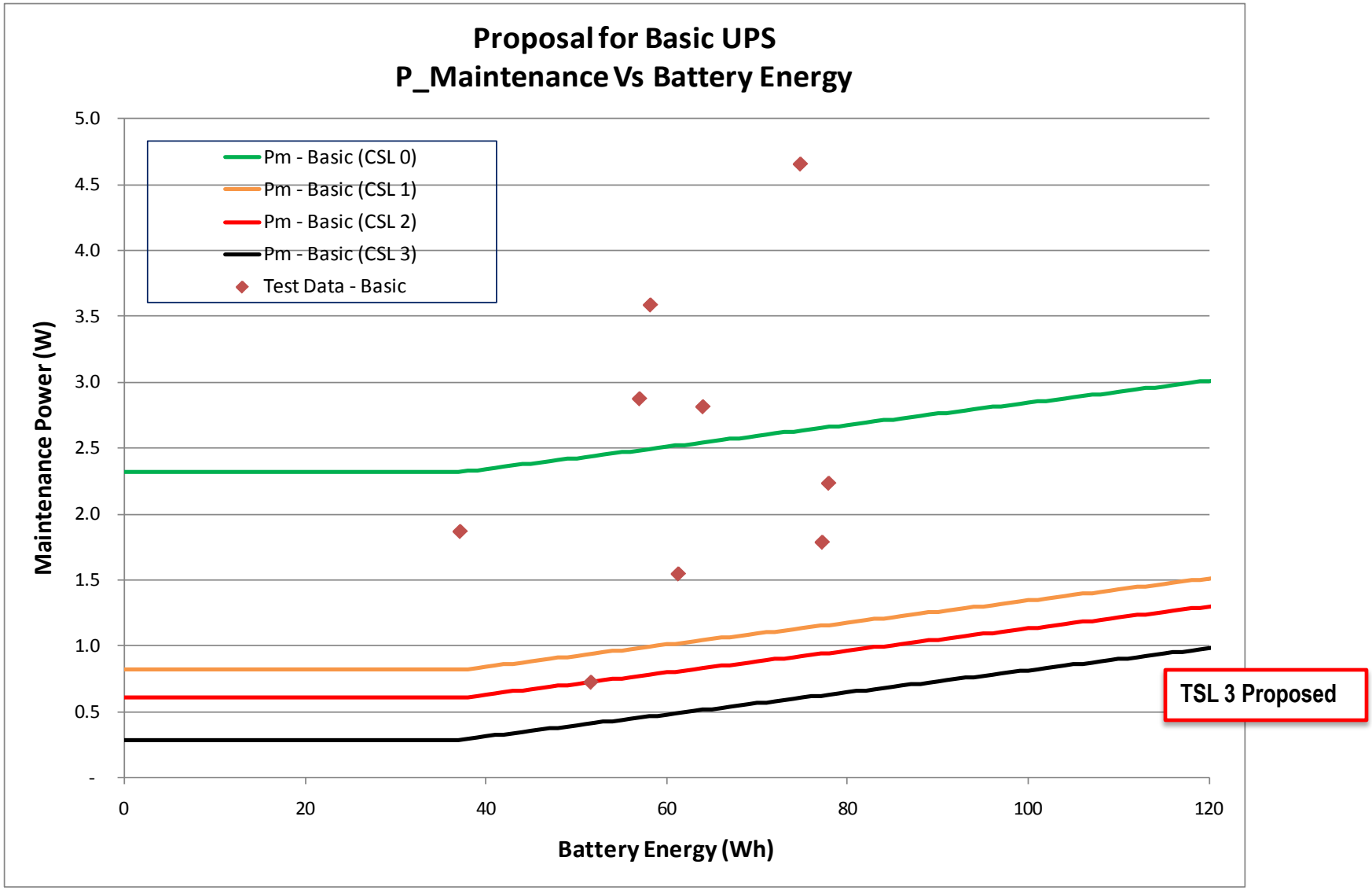


Illustration - Basic Pm Adder for UPS



Battery Chargers
Proposal for Basic UPS



Issue for Comment: DOE seeks comment on its methodology for generating Product Class 10 CSLs based on battery input power and input from manufacturers.

Public Meeting Agenda

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

1. Overview
2. Market Assessment
3. Tech Assessment, Screening, and Engineering
4. Energy Use; Markups Analysis
5. Life-Cycle Cost and Payback Period Analysis
6. Shipments, NIA, RIA, and MIA Analysis
7. Environmental Impacts
8. Results and Proposed Standards

Energy Use Analysis
Overview

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Purpose

- To estimate annual energy consumption of BCs and EPSs at each efficiency level for use in the LCC and NIA

Output

- Average unit energy consumption (UEC) in kWh/yr of BCs and EPSs in each product class at each candidate standard level of efficiency

Energy Use Analysis
Key Changes from Preliminary Analysis

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- Primary changes were to usage profile assumptions:
  - Developed usage profiles for residential and commercial users
  - Incorporated newly available data and stakeholder input
- Empirical data available for 40% of applications, which together represent about 80% of energy consumption.
- Complete list of assumptions available in energy use workbook on DOE's website:
  - http://www1.eere.energy.gov/buildings/appliance_standards/docs/bceps_nopr_energyuse.xlsx

Energy Use Analysis
Overall Approach

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- Consumed energy is the difference between the energy that flows into the BC or EPS and the energy that flows out to the application or battery.
- BC and EPS energy use is a function of:
  - Power requirements of battery or application
  - Consumer usage patterns
  - Efficiency of the BC or EPS
- Assumed usage profile does not change with BC or EPS efficiency, i.e., no “take back” or “rebound effect”.

EPS Energy Use Calculation

Application States and Loading Points

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

- For example, DOE identified six application states for notebook computers based on product testing:

Application State	Loading Point (Percent of Nameplate Output Power)
Charging the battery and operating	66%
Operating – High	60%
Charging the battery	38%
Operating	28%
Sleep	1.6%
Off	0.6%

EPS Energy Use Calculation

Example Usage Profiles – Residential Notebooks

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

- DOE identified two types of residential notebook users:
  - Usually plugged-in: 40% of users
  - Usually unplugged: 60% of users

Application State	Usually plugged-in (hrs/wk)	Usually unplugged (hrs/wk)	Weighted Average Profile (hrs/wk)
Percent of Users	*40%*	*60%*	***100%***
Charging the battery and operating	1.73	5.75	**4.14**
Operating – High	5.18	5.18	**5.18**
Charging the battery	1.13	5.75	**4.14**
Operating	43.08	13.01	**25.03**
Sleep	45.43	5.98	**21.76**
Off	67.87	89.99	**81.14**
No-Load	0	0	**0**
Unplugged	2.99	42.35	**26.60**

EPS Energy Use Calculation

Example Engineering Outputs

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- DOE selected efficiency and no-load output power values for each candidate standard level (CSL) in the engineering analysis.

Example: Efficiency metrics for a 60 Watt EPS in Product Class B

Efficiency Level	CSL 0	CSL 1	CSL 2	CSL 3	CSL 4
Active-Mode Efficiency	85%	87%	87%	88%	92%
No-Load Power (W)	0.50	0.50	0.20	0.07	0.05

EPS Energy Use Calculation

Summary of Inputs

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1. EPSs are categorized by nameplate output power.

2. Multiplying this output power by loading points yields the power requirements of the EPS in each application state.

3. The EPS's efficiency determines the level of power loss due to the EPS, which is essentially the power consumption of the EPS.

4. Usage profiles determine the time the application spends in each application state. Multiplying by time in use yields energy consumption.

EPS Energy Use Calculation

Total UEC from Application State Consumption

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Application State	UEC (kWh/year)				
	CSL 0	CSL 1	CSL 2	CSL 3	CSL 4
Charging the battery and operating	1.52	1.28	1.28	1.17	0.73
Operating – High	1.63	1.38	1.38	1.26	0.78
Charging the battery	0.87	0.74	0.74	0.67	0.42
Operating	3.88	3.29	3.29	3.00	1.86
Sleep	0.69	0.67	0.35	0.20	0.13
Off	2.33	2.29	1.05	0.51	0.34
No-Load	-	-	-	-	-
Unplugged	-	-	-	-	-
Total UEC	**10.93**	**9.65**	**8.09**	**6.81**	**4.25**

BC Energy Use Calculation

Steps

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1. For each application, DOE estimated:
   - Number of charges per day
   - Time per day spent in active, maintenance, no battery (standby), and off modes.

2. DOE combined the usage profiles with performance metrics from the engineering analysis to calculate BC energy use at each efficiency level.

BC Energy Use Calculation

Example Usage Profile

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

- Notebook BC usage profile was provided via stakeholder comment and is consistent with the usage profile used for EPSs:

	Weighted Average Usage Profile
Full Charges (#/day)	0.3
Active + Maintenance (hrs/day)	20.5
No Battery (hrs/day)	1.5
Off (hrs/day)	0
Unplugged (hrs/day)	2.0

Note: Full data set in Energy Use Analysis Spreadsheet , available on DOE website.

BC Energy Use Calculation

Example Engineering Outputs for PC 4

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In the engineering analysis DOE identified performance metrics for each candidate standard level (CSL).

Efficiency Level	CSL 0	CSL 1	CSL 2	CSL 3
24 Hour Energy [Wh]:	167.5	52.6	39.1	27.2
Charge Time [hr]:	0.6	0.9	1.5	0.6
Battery Energy [Wh]	16.3	13.4	19.1	14.9
Maintenance Power [W]:	5.9	1.4	0.5	0.4
Power, No Battery [W]:	2.2	1.4	0.3	0.4

Note: Efficiency values based on output metrics from the BC test procedure.

Values presented are for BC product class 4 (AC-DC, <100Wh, >10V)

BC Energy Use Calculation

Example: Notebook Computers

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Mode	UEC (kWh/year)			
	CSL 0	CSL 1	CSL 2	CSL 3
Charge	1.3	0.6	0.8	0.3
Maintenance	43.9	10.6	3.9	3.0
No Battery	1.2	0.8	0.2	0.2
Off	0.0	0.0	0.0	0.0
Total UEC	**46.4**	**12.0**	**4.8**	**3.5**

Item 22. Usage Profiles

DOE seeks substantiated estimates, with supporting data, of usage profiles for battery chargers, EPSs, and the applications they power.

Item 23. Loading Points

DOE seeks comment on its EPS loading point estimates, as well as test results that would allow it to improve the accuracy of those estimates.

Markups Analysis
Overview

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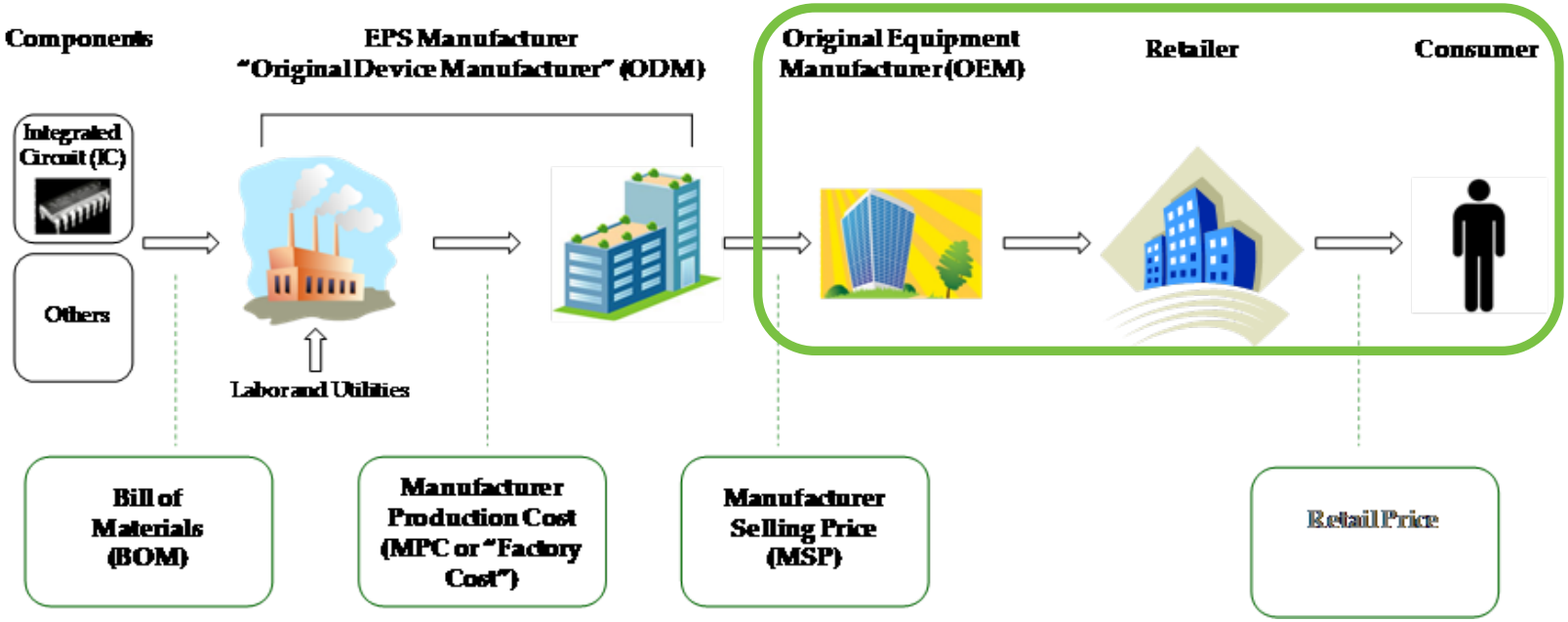
Purpose

- To derive the markups used to determine end-user (consumer) prices of BCs and EPSs

Outputs

- Composite markups for each BC and EPS product class
- Sales tax rates

Markups Analysis
Key Assumptions



- Analysis focuses on markups applied by the OEM and Retailer.
  - ODM markups calculated as part of the Engineering Analysis (chapter 5)

- Distribution can be complex – but the price is set by the most common path to market (illustrated above).

Markups Analysis
How Were Markups Calculated?

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

- Limited data available on markups.
- Obtained data on corporate gross margins from public financial filings of 83 end-use product manufacturers, retailers, and other distributors.
- Used average markups for these companies as a proxy for BC/EPS markups.
- For each application, combined markups of typical companies at each stage in the distribution chain to arrive at a composite markup.

Markups Analysis
A Hypothetical Example

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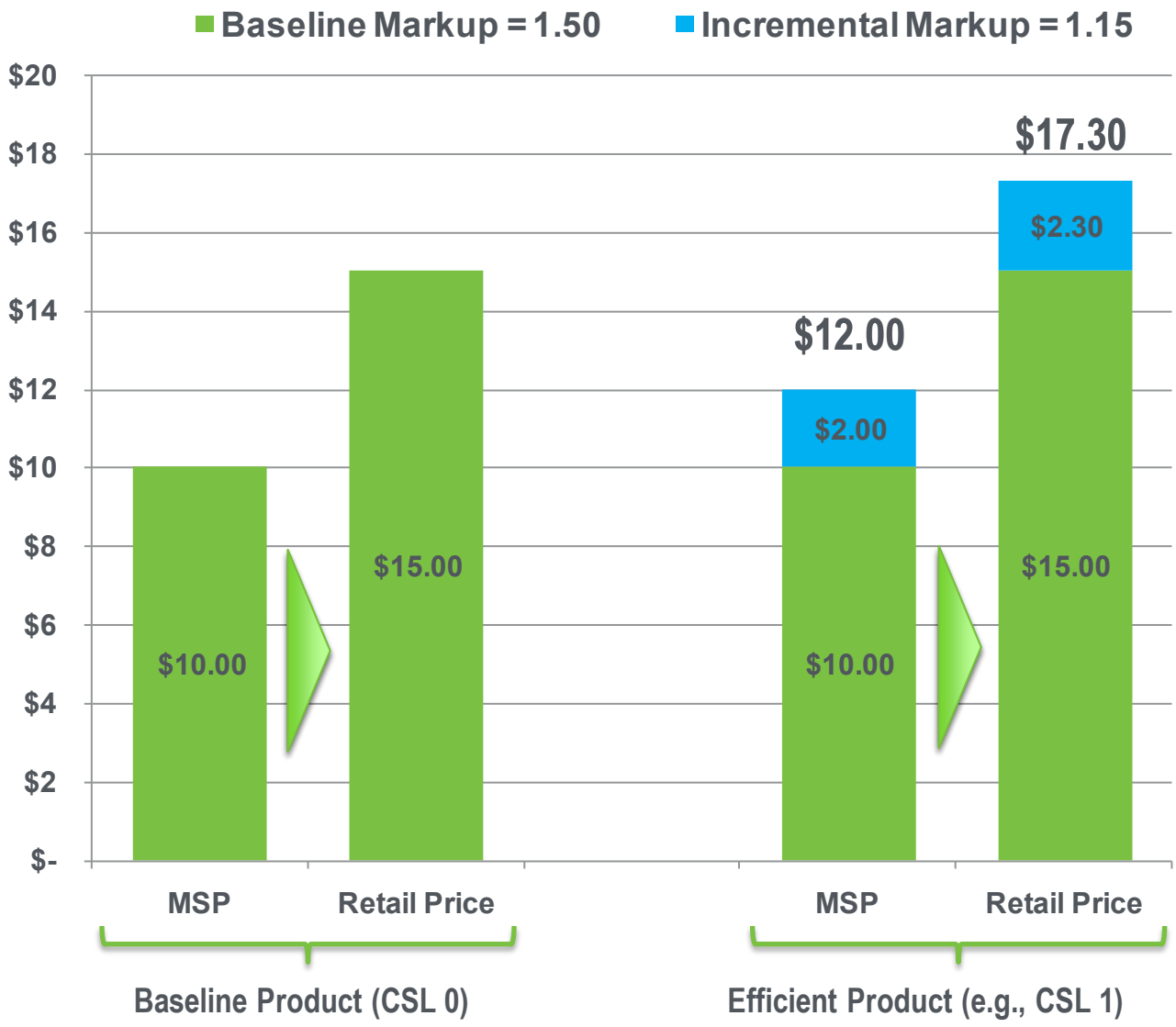

Baseline Markup:

-Relates the MSP to the retail price prior to a change in efficiency.

Incremental Markup:

-Relates the increase in MSP that results from an efficiency improvement to the retail price.

-Only covers costs that increase with an increase in efficiency.

-Labor and occupancy costs do not scale, so these are not marked up further.

Markups Analysis
Average Markups

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	Baseline Markup	Incremental Markup
OEM	1.48	1.18
Retailer	1.47	1.13
Sales Tax	1.07	1.07
Composite	**2.33**	**1.43**

Markups Analysis
Issues for Comment

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

Item 18. DOE seeks comment on its treatment of the market path, markups, and MSP estimates.

Item 29. DOE seeks comment on the accuracy of its distribution models for battery chargers and EPSs, as well as its estimates of battery charger and EPS markups. To the extent that these models and estimates can be improved, DOE seeks specific suggestions and supporting data.

BREAK - LUNCH

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

- **Break 12:15-1:15 PM**

Public Meeting Agenda

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

1. Overview
2. Market Assessment
3. Tech Assessment, Screening, and Engineering
4. Energy Use; Markups Analysis
5. Life-Cycle Cost and Payback Period Analysis
6. Shipments, NIA, RIA, and MIA Analysis
7. Environmental Impacts
8. Results and Proposed Standards

Life-Cycle Cost and Payback Period Analysis

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

- Purpose
  - Assess the net LCC and PBP impacts on a consumer due to energy conservation standards.

- Method
  - LCC equals consumer price plus the sum of annual operating costs discounted to a particular base year.
  - Results expressed as LCC difference (baseline minus standard level).
  - Simple Payback (years) is also calculated and reported.

Life-Cycle Cost and Payback Period Analysis

Changes from Preliminary Analysis

- A weighted average of residential and commercial sectors was used as the reference case, rather than the commercial sector being a sensitivity
- Base case market efficiency distributions specific to each application were derived and included in the analysis

Life-Cycle Cost and Payback Period Analysis

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

- External Power Supply Results

Representative Unit	Average LCC Savings (2010$)
2.5W AC-DC, Basic Voltage	0.04
18W AC-DC, Basic Voltage	0.69
60W AC-DC, Basic Voltage	-0.45
120W AC-DC, Basic Voltage	0.61
203W, Multiple Voltage	2.07
345W, High-Power	129.08

Life-Cycle Cost and Payback Period Analysis

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

- Battery Charger Results

Product Class	Product Class Description	Average LCC Savings (2010$)
1	Low Energy, Inductive	1.52
2	Low Energy, Low Voltage	0.16
3	Low Energy, Med. Voltage	0.35
4	Low Energy, High Voltage	0.43
5	Med Energy, Low Voltage	33.79
6	Med. Energy, High Voltage	40.78
7	High Energy	38.26
8	Low Energy, Low Voltage DC Input	3.04
9	Low Energy, High Voltage DC Input	---
10	Low Energy, AC Output	8.30

Public Meeting Agenda

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

1. Overview
2. Market Assessment
3. Tech Assessment, Screening, and Engineering
4. Energy Use; Markups Analysis
5. Life-Cycle Cost and Payback Period Analysis
6. Shipments, NIA, RIA, and MIA Analysis
7. Environmental Impacts
8. Results and Proposed Standards

Shipments Analysis
Overview

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

- Purpose
  - To forecast the number and efficiency of BCs and EPSs which would be shipped between 2013 and 2042, both with and without standards, for use in the national impact analysis

- Outputs
  - Shipments Forecast: the number of BCs and EPSs in each product class shipped each year between 2013 and 2042
  - Efficiency Forecast: the percent of shipments in each product class each year at each efficiency level

Shipments Analysis
Basic Structure

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- Account for changes from 2009 to 2013, when standards are assumed to take effect
  - Shipment volumes
  - Efficiency improvements due to exogenous factors
- Account for changes after standards take effect
  - Base case can change due to changes in shipments and product efficiency (independent of federal standards)
  - Standards case will shift efficiency distributions and may impact product shipments.

Shipments Analysis
Assumptions

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- Several adjustments to account for major market trends occurring between 2009 and 2013
- Growth rate of 0.75 percent annually after 2013 (mirrors population growth)
- No change over time in the mix of applications
- No difference between base case and standards cases
  - Functionality of BCs and EPSs limit options for substitution
  - Incremental price increases induced by standards generally very small relative to the total cost of the end-use product

Shipments Analysis
Short Term Efficiency Forecast Assumptions

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- Modest improvement in EPS efficiency due to standards in Europe
- Beginning Feb. 1, 2013, consumer battery chargers sold in California will need to meet CEC's BC efficiency standards
  - Less efficient products will remain on the market outside of CA
  - 13 percent of U.S. market will shift to meet CEC standards (corresponding to CA's share of GDP)

BC Product Class	CSL that Best Approximates the CEC Standard
1	CSL 0
2	CSL 2
3	CSL 2
4	CSL 2
5	CSL 3
6	CSL 3
7	CSL 1
8	CSL 0
10	CSL 3

Shipments Analysis

EPS Base Case Market Efficiency Distributions

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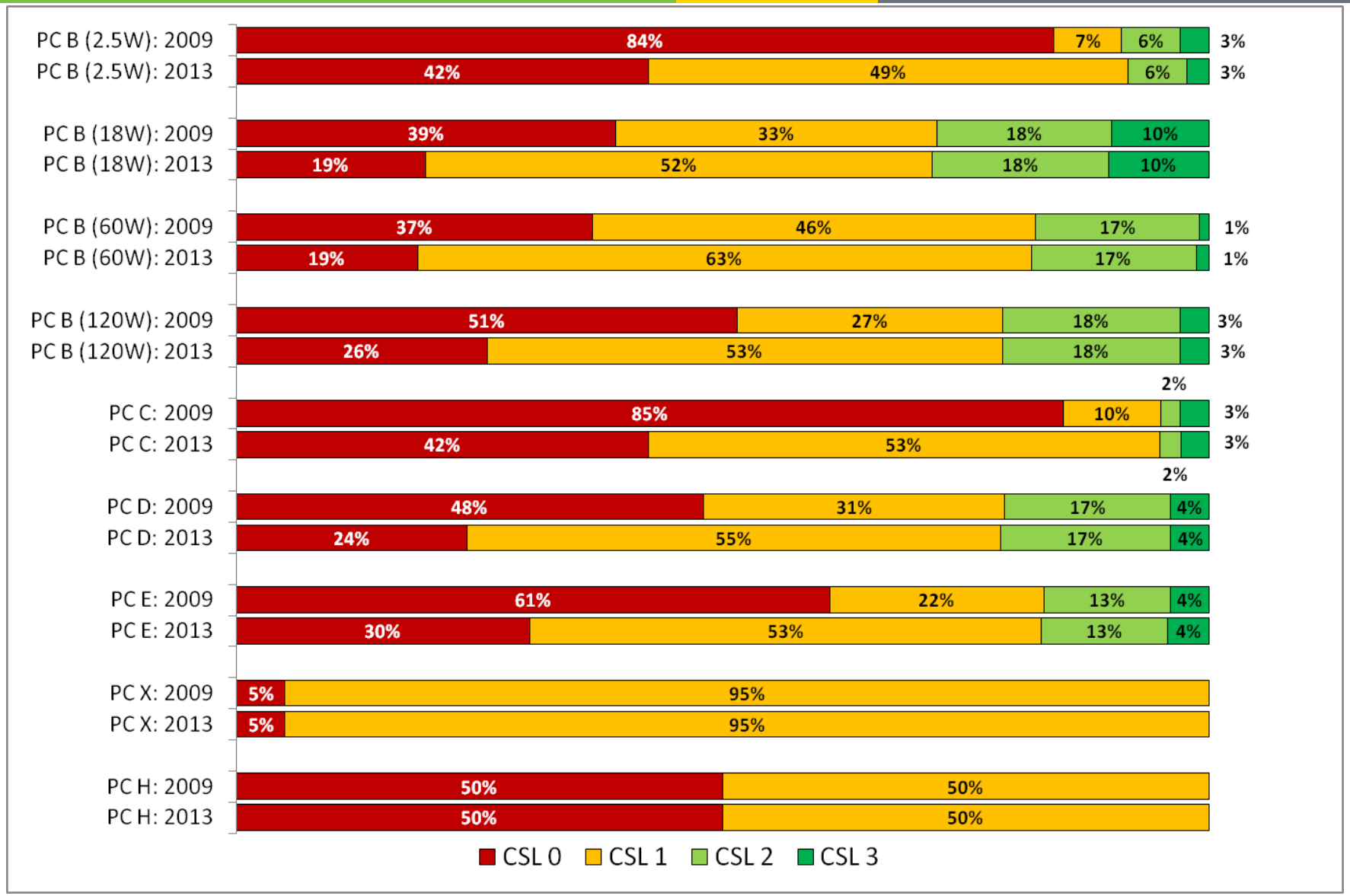
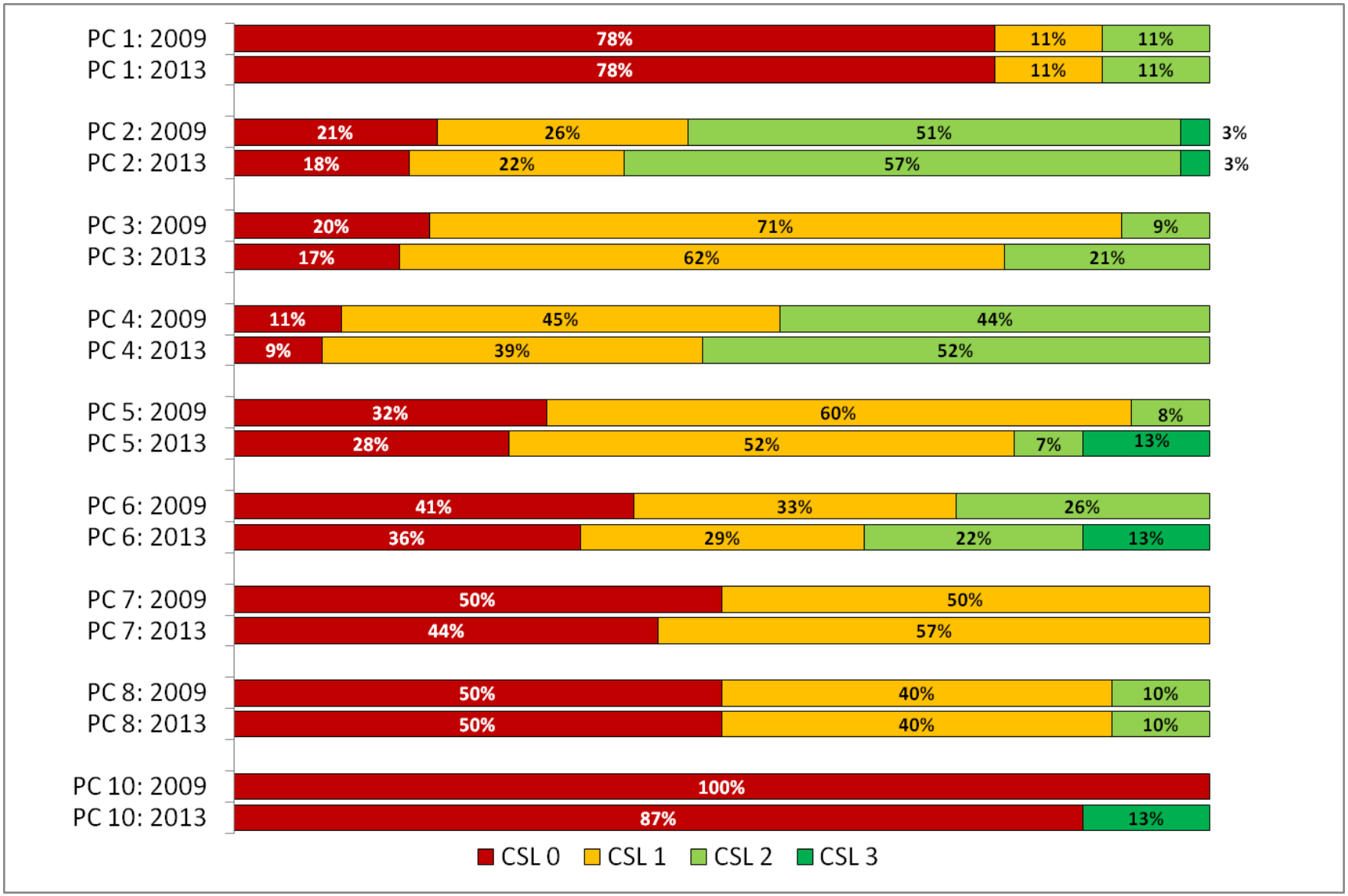


Shipments Analysis

BC Base Case Market Efficiency Distributions

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



Shipments Analysis
Roll-Up Market Response to Standards

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

- Products below standard will "roll-up" to comply with standards.
- Products at or above the standard will be not be affected.
- Efficiency assumed not to change between 2013 and 2042.

Year	Scenario	Percent of Market at Each Efficiency Level (BC Product Class 2)				
		CSL 0	CSL 1	CSL 2	CSL 3	CSL 4
2009	**Current Market**	**21%**	**26%**	**51%**	**3%**	**-**
2013	Base Case (No Standard)	18%	22%	57%	3%	-
	Standards Case CSL 1	-	40%	57%	3%	-
	Standards Case CSL 2	-	-	97%	3%	-
	Standards Case CSL 3	-	-	-	100%	-
	Standards Case CSL 4	-	-	-	-	100%

Shipments Analysis
Issues for Comment

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

Item 19. DOE seeks comment on its use of a roll-up market response to standards.

Item 20. DOE seeks comment on whether, and to what extent, battery charger efficiency would be likely to improve in the absence of standards.

Item 21. DOE seeks comment on its assumptions about the extent to which, if at all, EPS efficiency will improve for product classes B, C, D, E, X and H in the absence of mandatory standards, both prior to and after 2013.

Item 24. DOE seeks comment on its estimate that shipments of EPSs and battery chargers are inelastic and on other elasticity assumptions DOE has made.

Item 25. DOE seeks comment on its assumption that substitution impacts for EPSs and battery chargers are negligible.

National Impact Analysis
Overview

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

- Purpose
  - To estimate the national impacts of standards for BCs and EPSs shipped between 2013 and 2042
- Outputs
  - National Energy Savings (NES) – Primary energy savings
  - Net Consumer Benefits (NCB) – Energy cost savings less incremental product cost increases
  - Net Social Benefits (NSB) – Consumer benefits plus social benefits of avoided emissions

National Impact Analysis
Inputs

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

Input	Source
Unit Energy Consumption at each Efficiency Level	Energy Use Analysis
Unit Cost at each Efficiency Level	Engineering Analysis and Markups Analysis
Shipment Forecast	Shipments Analysis
Lifetime	Market Assessment
Efficiency Forecast	Shipments Analysis
Electricity Prices	EIA , *Annual Energy Outlook* through 2030 (Extrapolated for years after 2030)
Site-to-Source Conversion Factor	EIA , *Annual Energy Outlook 2010*
Value of Emissions Reductions	Environmental Assessment
Discount Rate	3% and 7% (OMB Regulatory Analysis Guideline A-4)

National Impact Analysis
General Approach

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

For each product class in each standards case:

1. Calculate the per-unit cost increase and the per-unit energy savings due to a standard

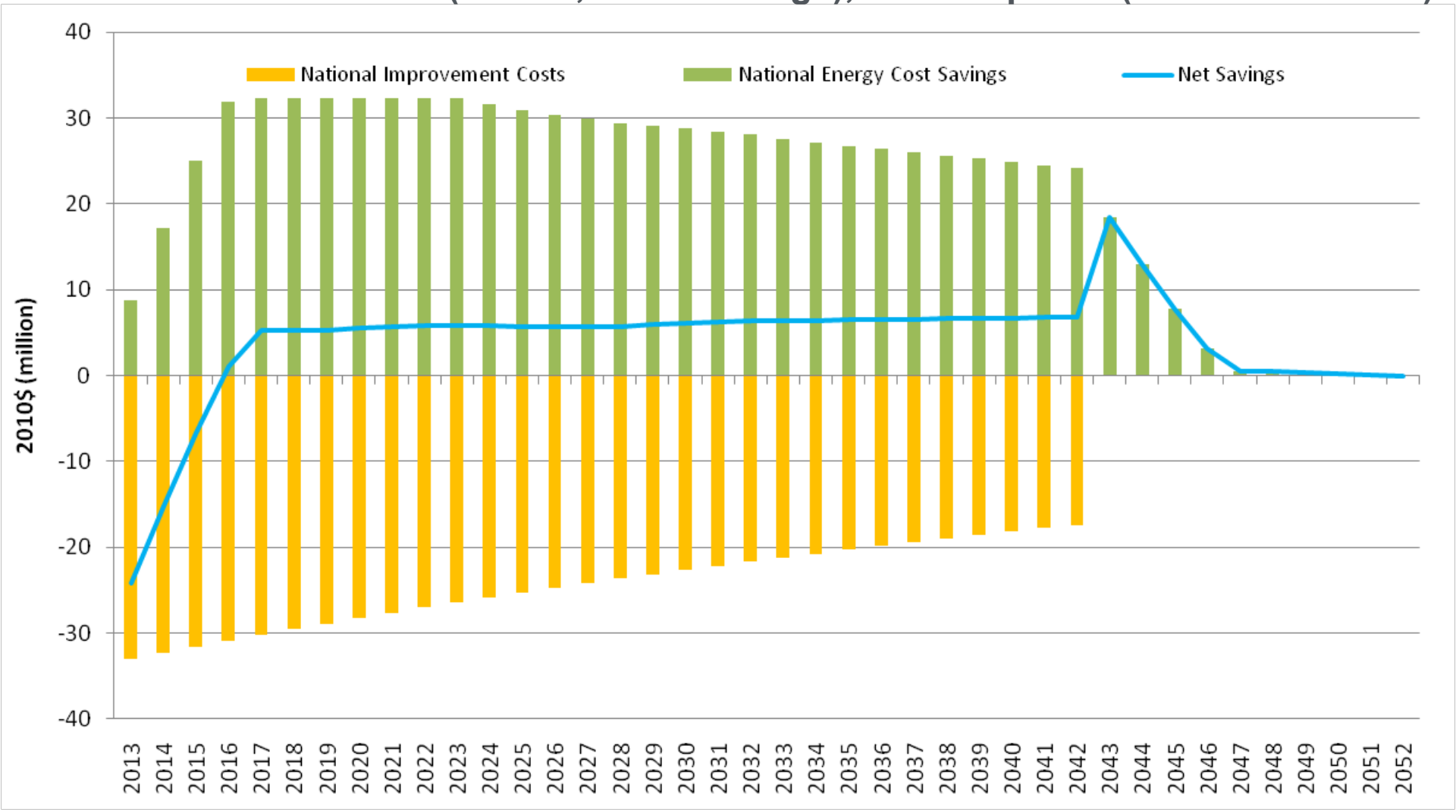
2. Calculate the number of units in use and energy savings each year from 2013 to 2052
   - 30 years of shipments between 2013 and 2042
   - Maximum lifetime of 10 years

3. Combine the above to determine NES and NCB

National Impact Analysis
Net Consumer Savings Example

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

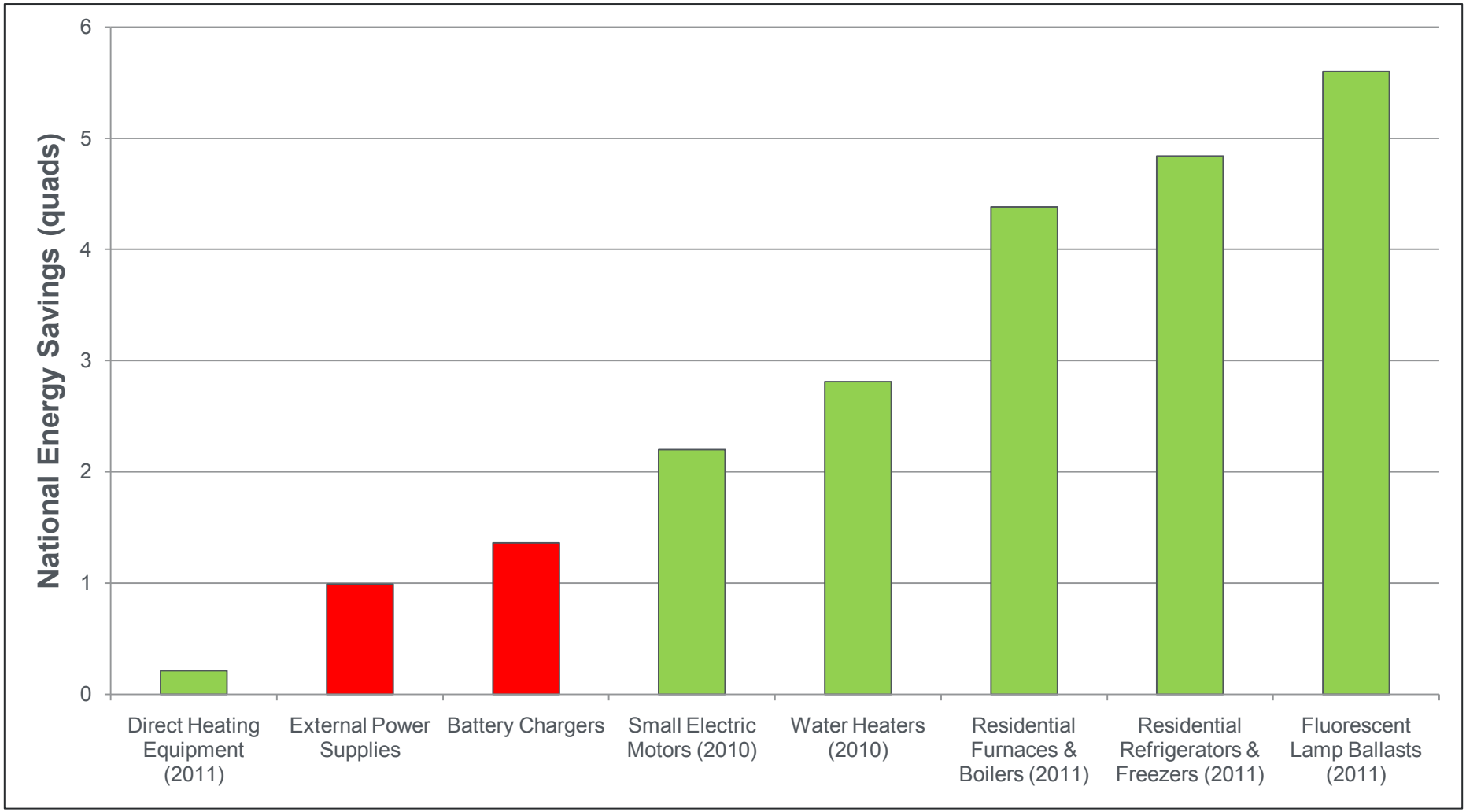
EPS Product Class B (AC-DC, Basic Voltage), 2.5W Rep Unit (3% discount rate)



National Impact Analysis

National Energy Savings in Context

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



National Impact Analysis
Four Sensitivity Analyses

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

- Price elasticity of demand
  - Explored an alternative scenario in which shipment volume decreases in response to price increases induced by standards
- CEC standards as de facto national BC standard
  - Efficiency distributions adjusted to reflect this scenario
- Alternative electricity price trend forecasts
  - Two alternative scenarios analyzed based on AEO indexes: low and high economic growth
- Product price trends
  - Assumes incremental product costs decrease over time

National Impact Analysis
Issues for Comment

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

Item 26. DOE seeks comment on the methodology employed for conducting the National Impact Analysis, including the calculations of National Inventory, National Energy Savings, and Net Present Value.

Regulatory Impact Analysis
Evaluation of Policy Alternatives

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

As directed by Executive Order 12866, DOE evaluated non-regulatory alternatives to proposed standards:

- Consumer Rebates
- Consumer Tax Credits
- Manufacturer Tax Credits
- Voluntary Energy Efficiency Targets
- Early Replacement
- Bulk Government Purchases

None were found to be as beneficial as standards.

See Chapter 17 of the TSD for methodology and results.

NOPR Manufacturer Impact Analysis
Overview

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

- Purpose
  - To assess the impacts of standards on manufacturers;
  - To identify and estimate impacts on manufacturer subgroups that may be more severely affected than the industry as a whole; and
  - To examine the direct employment, product competition, manufacturing capacity, and cumulative regulatory impacts on the industry.

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

NOPR Manufacturer Impact Analysis
Methodology

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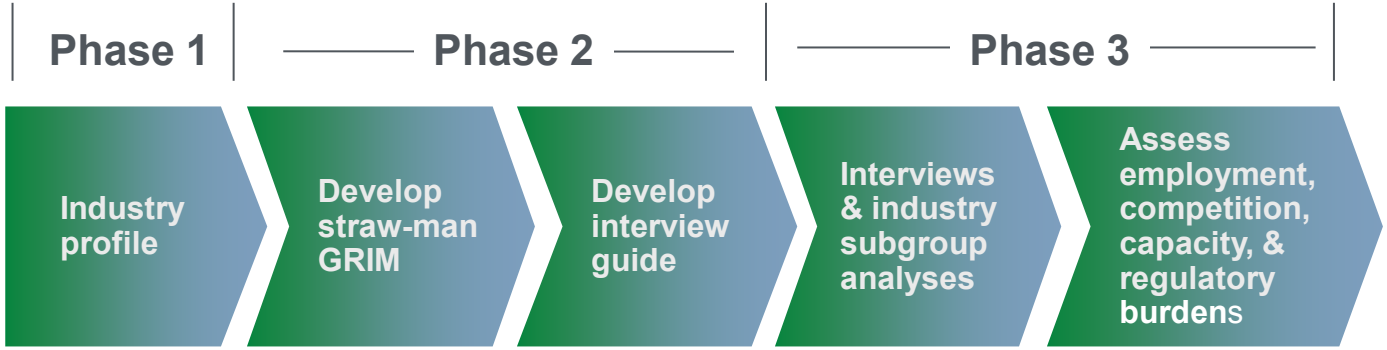
- Phase 1
  - DOE creates an industry profile to characterize the market and identify important issues that require further investigation.
- Phase 2
  - DOE prepares an industry cash flow model and an interview questionnaire to guide subsequent discussions with manufacturers.
- Phase 3
  - DOE interviews manufacturers and assesses the impacts of standards both quantitatively (using the GRIM) and qualitatively (impacts on employment, competition, manufacturing capacity, and regulatory burden).



NOPR Manufacturer Impact Analysis
Key Issues (1 of 2)

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

- Product Groupings
  - Some manufacturers expressed concern that requiring different applications within a product class to meet the same standard could be disadvantageous to some applications relative to others.
- Competition for Substitutes
  - Standards could push consumers to choose close substitutes of applications that are alternatively powered (e.g. gasoline, disposable batteries, power cord).
- Test Procedures Concerns
  - For some applications, manufacturers expressed concerns about the test procedure's ability to separate the battery charging function from the other functions (e.g. UPSs).

NOPR Manufacturer Impact Analysis
Key Issues (2 of 2)

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

- Separate Regulation of Battery Chargers and EPSs
  - Applications shipped with both a battery charger and an EPS could be subject to regulations for both components.
- Profitability Impacts
  - Cost increases could be partly absorbed by the OEMs and could reduce their overall profitability.
  - Similarly, conversion costs may not be recouped through higher selling prices.
- Potential Changes to Product Utility
  - Some manufacturers expressed concern that standards could pressure them to remove energy consuming features.

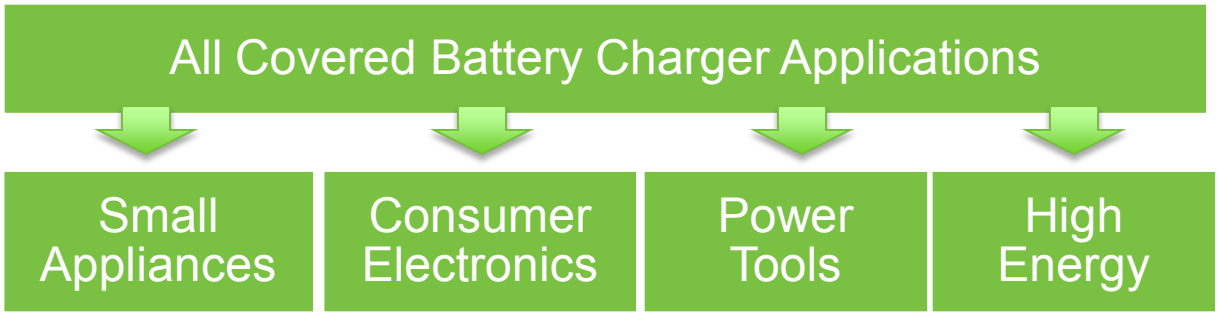
NOPR Manufacturer Impact Analysis

Battery Charger Industry Subgroups

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

- In general, DOE evaluated application manufacturers in the battery charger MIA.
  - DOE believes application manufacturers would be the party most directly financially impacted by any energy conservation standards.
  - Also, OEMs typically design the battery charger and would certify compliance with any DOE regulations.

- DOE assigned all battery charger applications to one of four industry subgroups and collected financial parameters specific to each in order to better characterize the differential impacts among the subgroups.



NOPR Manufacturer Impact Analysis

Markup Scenarios Analyzed

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- DOE modeled several profitability (markup) scenarios.
  - Two profitability scenarios were included in the EPS analysis:
    - flat markup and preservation of operating profit markup.
  - Three profitability scenarios were included in the battery charger analysis:
    - flat markup; pass through markup; and constant price markup.

	Lower Bound Profitability Scenario (Most Severe for Manufacturers)	**Upper Bound Profitability Scenario (Least Severe for Manufacturers)**
EPSs	Preservation of Operating Profit Markup Scenario	Flat Markup Scenario
Battery Chargers	Constant Price Markup Scenario	Flat Markup Scenario

NOPR Manufacturer Impact Analysis
Main Factors Driving INPV

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- In addition to the markup scenario selected, three main factors drive the standards case INPV at each TSL.
  - The application's current efficiency distribution;
  - The conversion costs;
  - And the relative incremental increase in the battery charger compared to the application MPC (for battery chargers).

- DOE's assumptions about conversion costs were driven by three main factors.
  - The share of products within each application that fall below the standard level (based on the application efficiency distribution);
  - The magnitude of the technology change from one CSL to a higher CSL (based on feedback from manufacturer interviews);
  - And the normal research and development and capital expenditure costs in the base case (based on financial inputs from the MIA).

NOPR Manufacturer Impact Analysis

External Power Supply INPV Results (1 of 2)

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

- EPS Product Classes B, C, D, & E (Lower – Upper Bound)

	Units	Base Case	Trial Standard Level		
			1	2	3
INPV	(2010$ millions)	231.9	169.4 – 193.0	150.5 – 196.7	108.4 – 249.8
Change in INPV	(2010$ millions)	-	(62.5) – (38.9)	(81.4) – (35.2)	(123.5) – 17.9
	(%)	-	(26.9%) – (16.8%)	(35.1%) – (15.2%)	(53.2%) – 7.7%
Product Conversion Costs	(2010$ millions)	-	29.1	34.5	36.3
Capital Conversion Costs	(2010$ millions)	-	32.2	38.1	40.1
Total Investment Required	(2010$ millions)	-	61.4	72.6	76.4

Proposed TSLs

NOPR Manufacturer Impact Analysis
External Power Supply INPV Results (2 of 2)

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

- EPS Product Class X (Lower – Upper Bound)

	Units	Base Case	Trial Standard Level		
			1	2	3
INPV	(2010$ millions)	44.1	43.4 – 43.7	31.4 – 32.2	26.3 – 39.6
Change in INPV	(2010$ millions)	-	(0.7) – (0.4)	(12.8) – (12.0)	(17.9) – (4.6)
	(%)	-	(1.7%) – (1.0%)	(28.9%) – (27.1%)	(40.5%) – (10.3%)
Product Conversion Costs	(2010$ millions)	-	0.3	6.9	6.9
Capital Conversion Costs	(2010$ millions)	-	0.4	7.6	7.6
Total Investment Required	(2010$ millions)	-	0.7	14.4	14.4

- EPS Product Class H (Lower – Upper Bound)

	Units	Base Case	Trial Standard Level		
			1	2	3
INPV	(2010$ millions)	0.11	0.06 – 0.07	0.06 – 0.07	0.06 – 0.08
Change in INPV	(2010$ millions)	-	(0.05) – (0.04)	(0.05) – (0.04)	(0.05) – (0.03)
	(%)	-	(45.5%) – (32.7%)	(44.0%) – (33.8%)	(47.3%) – (24.4%)
Product Conversion Costs	(2010$ millions)	-	0.02	0.02	0.02
Capital Conversion Costs	(2010$ millions)	-	0.02	0.02	0.02
Total Investment Required	(2010$ millions)	-	0.05	0.05	0.05

NOPR Manufacturer Impact Analysis

Battery Charger INPV Results (1 of 3)

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

- Battery Charger Product Class 1 (Lower – Upper Bound)

	Units	Base Case	Trial Standard Level		
			1	2	3
INPV	(2010$ millions)	491	450 – 492	390 – 493	51 – 520
Change in INPV	(2010$ millions)	-	(41) – 1	(101) – 1	(441) – 29
	(%)	-	(8.4%) - 0.1%	(20.6%) - 0.3%	(89.7%) - 5.9%
Product Conversion Costs	(2010$ millions)	-	0.8	1.9	4.3
Capital Conversion Costs	(2010$ millions)	-	0.0	1.8	2.0
Total Investment Required	(2010$ millions)	-	0.8	3.7	6.3

- Battery Charger Product Classes 2, 3, & 4 (Lower – Upper Bound)

	Units	Base Case	Trial Standard Level			
			1	2	3	4
INPV	(2010$ millions)	43,808 – 44,492	38,911 – 44,506	37,752 – 44, 625	32,944 – 45,020	29,246 – 45,467
Change in INPV	(2010$ millions)	-	(4, 897) – 15	(6,055) – 134	(10,863) – 528	(14,562) – 975
	(%)	-	(11.2%) – 0.0%	(13.8%) – 0.3%	(24.8%) – 1.2%	(33.2%) – 2.2%
Product Conversion Costs	(2010$ millions)	-	7.1	25.5	160.8	294.5
Capital Conversion Costs	(2010$ millions)	-	1.3	6.1	45.4	60.5
Total Investment Required	(2010$ millions)	-	8.4	31.6	206.2	355.0

NOPR Manufacturer Impact Analysis

Battery Charger INPV Results (2 of 3)

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

- Battery Charger Product Classes 5 & 6 (Lower – Upper Bound)

	Units	Base Case	Trial Standard Level		
			1	2	3
INPV	(2010$ millions)	1,549 – 1,584	1,226 – 1,589	1,324 – 1,543	235 – 2,275
Change in INPV	(2010$ millions)	-	(327) – 6	(225) – (40)	(1,314) – 692
	(%)	-	(21.0%) – 0.3%	(14.5%) – (2.5%)	(84.8%) – 43.7%
Product Conversion Costs	(2010$ millions)	-	1.8	9.8	16.3
Capital Conversion Costs	(2010$ millions)	-	0.0	2.1	4.6
Total Investment Required	(2010$ millions)	-	1.8	11.9	20.9

- Battery Charger Product Class 7 (Lower – Upper Bound)

	Units	Base Case	Trial Standard Level	
			1	2
INPV	(2010$ millions)	1,034 – 1,039	1,030 – 1,086	903 – 1,057
Change in INPV	(2010$ millions)	-	(4) – 47	(136) – 23
	(%)	-	(0.4%) – 4.5%	(13.1%) – 2.2%
Product Conversion Costs	(2010$ millions)	-	0.6	2.6
Capital Conversion Costs	(2010$ millions)	-	0.2	1.5
Total Investment Required	(2010$ millions)	-	0.7	4.1

NOPR Manufacturer Impact Analysis

Battery Charger INPV Results (3 of 3)

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

- Battery Charger Product Class 8 (Lower – Upper Bound)

	Units	Base Case	Trial Standard Level		
			1	2	3
INPV	(2010$ millions)	5,703	5,628 – 7,002	5,707 – 5,781	5,642 – 5,672
Change in INPV	(2010$ millions)	-	(75) – 1,300	4 – 78	(61) – (30)
	(%)	-	(1.3%) – 22.8%	0.1% - 1.4%	(1.1%) – (0.5%)
Product Conversion Costs	(2010$ millions)	-	13.2	35.8	79.5
Capital Conversion Costs	(2010$ millions)	-	0.0	6.1	6.8
Total Investment Required	(2010$ millions)	-	13.2	41.9	86.3

- Battery Charger Product Class 10 (Lower – Upper Bound)

	Units	Base Case	Trial Standard Level		
			1	2	3
INPV	(2010$ millions)	612 – 614	532 – 614	512 – 612	487 – 609
Change in INPV	(2010$ millions)	-	(81) – (0)	(100) – (2)	(126) – (5)
	(%)	-	(13.2%) – (0.1%)	(16.4%) – (0.4%)	(20.5%) – (0.9%)
Product Conversion Costs	(2010$ millions)	-	0.7	2.2	4.5
Capital Conversion Costs	(2010$ millions)	-	0.0	0.4	1.5
Total Investment Required	(2010$ millions)	-	0.7	2.6	6.0

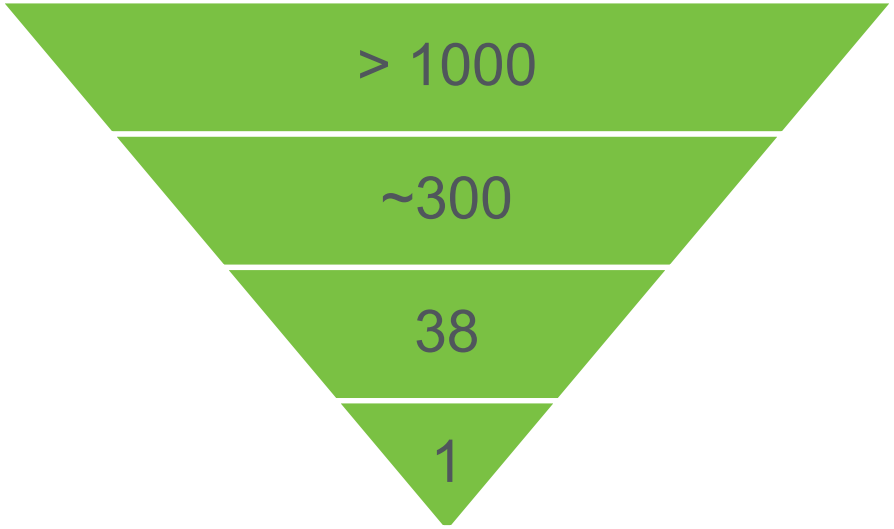
NOPR Manufacturer Impact Analysis

Small Business Impacts

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

- DOE searched several publicly available databases to identify any potential battery charger or EPS domestic small business manufacturers.
  - These included the Small Business Administration (SBA), DOE's Compliance Certification Management System (CCMS), various trade association lists, Hoovers, and Dun & Bradstreet.

- DOE's small business screening process:



Initial list of potential battery charger and EPS manufacturers

Manufacturers with fewer than 500 employees selling covered products

US owned and operated manufacturers

Actual small business ODMs based on calls and further analysis

NOPR Manufacturer Impact Analysis
Employment Impacts

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

- DOE found no significant impact on employment based on its domestic employment and small business searches.
  - DOE believes there are fewer than 100 US employees that could be affected by battery charger standards.
  - There are no EPS manufacturers with domestic manufacturing.
  - There is only one battery charger manufacturer with domestic manufacturing.

Issue for Comment: Direct Employment & Small Business Impacts

DOE requests comment on any known domestic EPS manufacturers and any additional domestic battery charger manufacturers, and whether they qualify as a small business.

Public Meeting Agenda

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

1. Overview
2. Market Assessment
3. Tech Assessment, Screening, and Engineering
4. Energy Use; Markups Analysis
5. Life-Cycle Cost and Payback Period Analysis
6. Shipments, NIA, RIA, and MIA Analysis
7. Impacts Summary
8. Results and Proposed Standards

Employment Impact Analysis

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

Purpose

- Assess the overall impact on national employment from the considered efficiency levels.
- Focus on indirect employment impacts.
  - Indirect employment impacts result from shifting consumer expenditures among goods and services and changing equipment and energy costs.
  - Direct employment impacts are estimated in the manufacturer impact analysis.

Method

- DOE used the Impact of Sector Energy Technologies (ImSET) model for the evaluation of indirect employment impacts. (Note: ImSET is an update of IMBUILD)

Employment Impact Analysis

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

- Example: Net Increase in Jobs from Indirect Employment Effects Under External Power Supply TSLs.

	TSL 1	TSL 2	TSL 3
	Thousands		
Product Class B			
2015	-04 to 0.5	-1.1 to 0.5	-5.1 to 0.4
2020	-0.1 to 0.7	-0.8 to 1.0	-4.4 to 1.2
Product Classes B, C, D, and E			
2015	-0.6 to 0.4	-1.4 to 0.6	-5.6 to 0.5
2020	-0.2 to 0.9	-0.9 to 1.2	-4.8 to 1.6
Product Class X			
2015	0.0 to 0.1	0.0 to 0.1	-0.7 to 0.0
2020	0.1	0.1	-0.6 to 0.1
Product Class H			
2015	0.0	0.0	0.0
2020	0.0	0.0	0.0

Utility Impact Analysis

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

Purpose

- Assess selected impacts on energy supply that would result from the imposition of standards.

Method

- The Department used the National Energy Modeling System (NEMS)-Building Technologies (BT), a variant of the NEMS used by EIA for their AEO report, as the basis of the Utility Impact Analysis.
- DOE modeled the energy savings impacts from the considered standard levels using NEMS-BT to generate forecasts that deviate from the AEO reference case.
- Outputs of the utility impact analysis include forecasts of electricity generation and avoided capacity resulting from the considered standard levels.

Utility Impact Analysis

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

- Example: Reduction in Electric Generating Capacity in 2042 Under Considered External Power Supply TSLs

	TSL 1	TSL 2	TSL 3
	Gigawatts		
Product Class B	0.255	0.404	0.734
Product Classes B, C, D, and E	0.326	0.510	0.893
Product Class X	0.035	0.040	0.082
Product Class H	0.001	0.001	0.001

Emissions Analysis

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

Purpose

- To report environmental impacts resulting from amended energy conservation standards, including changes in power plant emissions as well as site emissions from the use of gas and oil furnaces.

Method

- DOE assessed the environmental impacts using NEMS-BT.
  - The result is an estimate of national emission reductions of CO_2, NO_x, and mercury.
  - Estimates site SO_2 and NO_x emitted by fossil-fuel fired appliances using emissions factors.

Emissions Analysis

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

- Example: Cumulative Emissions Reduction for 2013 - 2042 Under External Power Supply TSLs

	TSL 1	TSL 2	TSL 3
Product Class B			
CO_2 (Mt)	21.7	34.3	62.5
NO_X (kt)	17.9	28.4	51.6
Hg(t)	0.115	0.182	0.331
Product Classes B, C, D, and E			
CO_2 (Mt)	27.5	43.0	75.4
NO_X (kt)	22.7	35.5	62.3
Hg(t)	0.145	0.227	0.398
Product Class X			
CO_2 (Mt)	2.95	3.38	6.92
NO_X (kt)	2.43	2.79	5.71
Hg(t)	0.015	0.018	0.036
Product Class H			
CO_2 (Mt)	0.054	0.058	0.065
NO_X (kt)	0.045	0.048	0.053
Hg(t)	0.000	0.000	0.000

Monetization of Emission Reductions

Purpose

- To estimate the potential monetary benefit of reduced power plant emissions resulting from the considered standard levels.

Method

- DOE used the most current Social Cost of Carbon (SCC) values developed through 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 \$4.9, \$22.3, \$36.5, and \$67.6 per metric ton in 2010 dollars.
- For emission reductions that occur in later years, these values grow in real terms over time.

Monetization of Emission Reductions

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

- Example: External Power Supply Product Classes B, C, D, and E: Estimates of Global Present Value of Cumulative CO_2 Emissions Reduction

TSL	$4.9/t	$22.3/t	$36.5/t	$67.6/t
	Million 2010$			
1	116	572	960	1,746
2	182	895	1,501	2,731
3	319	1,568	2,631	4,785

Estimates of Present Value of Cumulative NO_X Emissions Reduction

TSL	$450/t		$2,537/t		$4,623/t	
	Million 2010$					
Discount rate	3%	7%	3%	7%	3%	7%
1	6	4	37	20	67	37
2	10	6	57	32	104	54
3	18	10	100	56	183	102

BREAK

- **Break 2:30-2:45 PM**

Public Meeting Agenda

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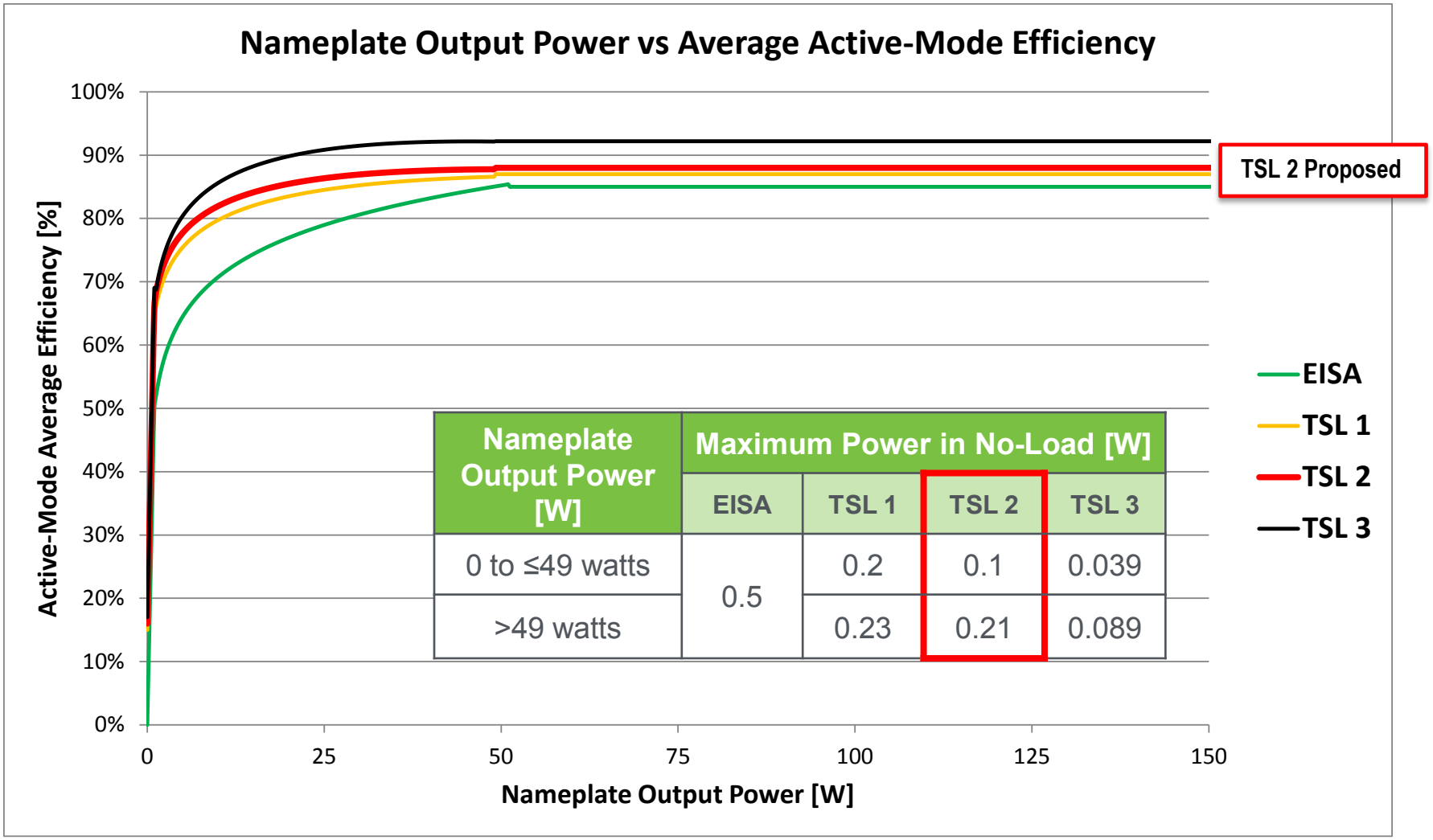
Results and Proposed Standards

EPS Product Class B

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

AC-DC, Basic Voltage External Power Supplies



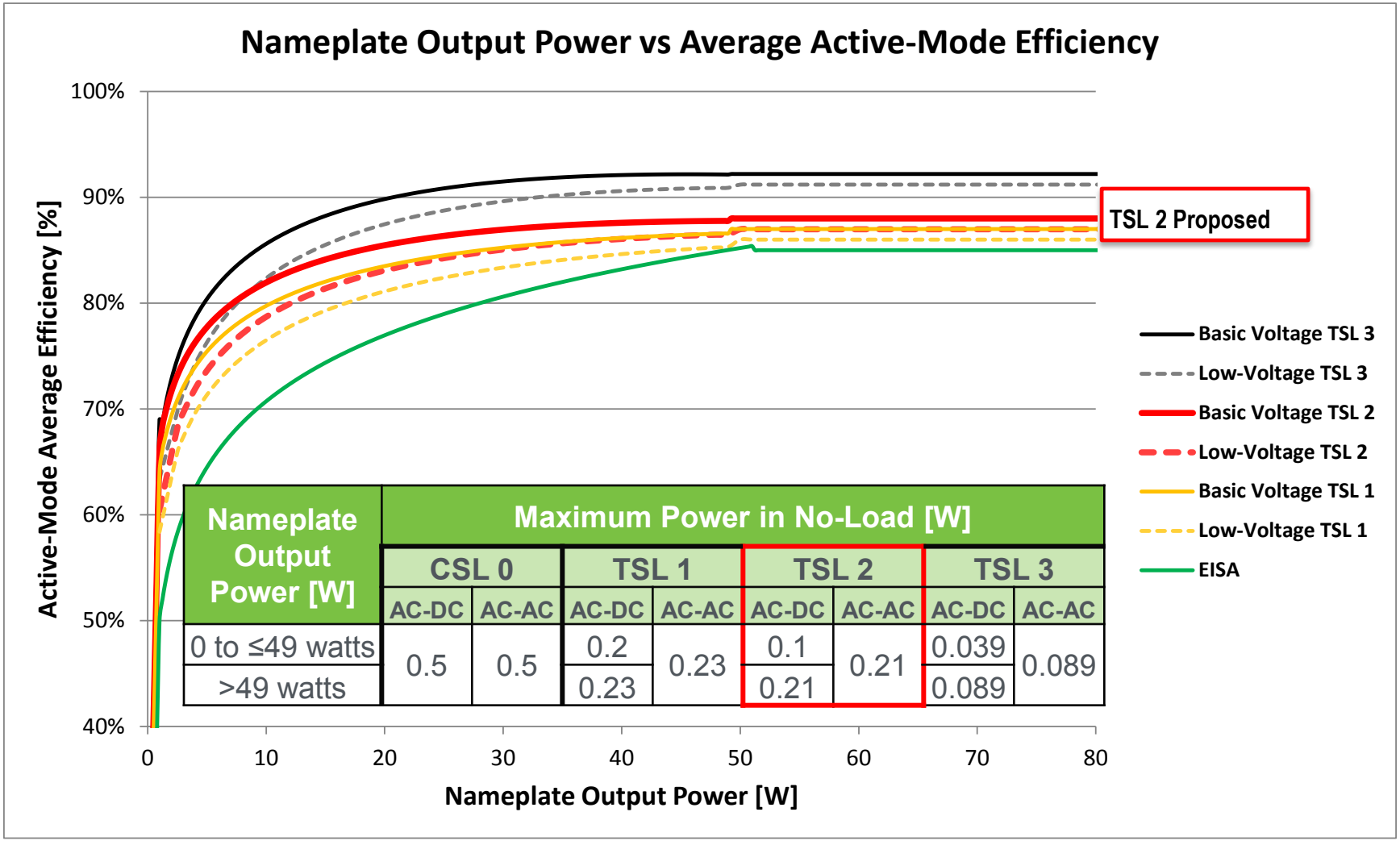
Nameplate Output Power [W]	Maximum Power in No-Load [W]			
	EISA	TSL 1	TSL 2	TSL 3
0 to ≤49 watts	0.5	0.2	0.1	0.039
>49 watts		0.23	0.21	0.089

Results and Proposed Standards

EPS Product Classes B, C, D, and E

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

External Power Supplies in Product Classes B, C, D, and E

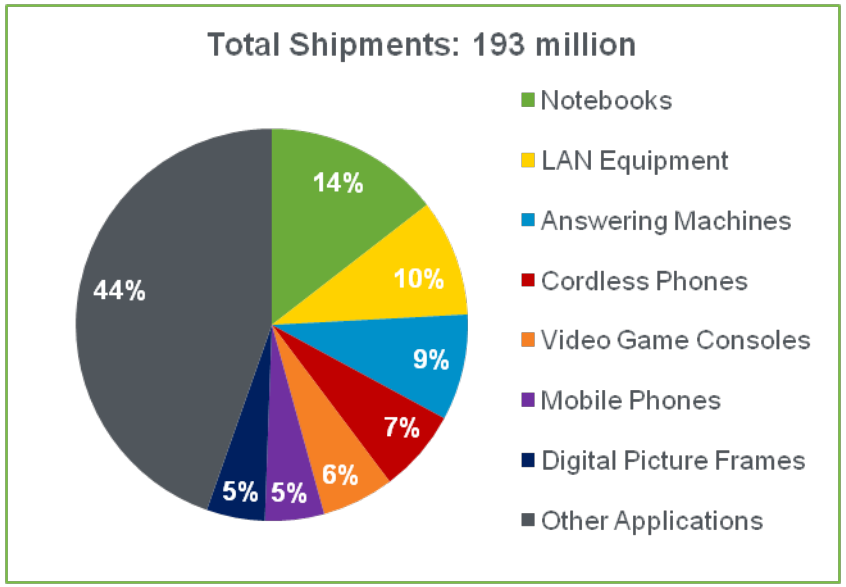


Nameplate Output Power [W]	Maximum Power in No-Load [W]							
	CSL 0		TSL 1		TSL 2		TSL 3	
	AC-DC	AC-AC	AC-DC	AC-AC	AC-DC	AC-AC	AC-DC	AC-AC
0 to ≤49 watts	0.5	0.5	0.2	0.23	0.1	0.21	0.039	0.089
>49 watts			0.23		0.21		0.089	

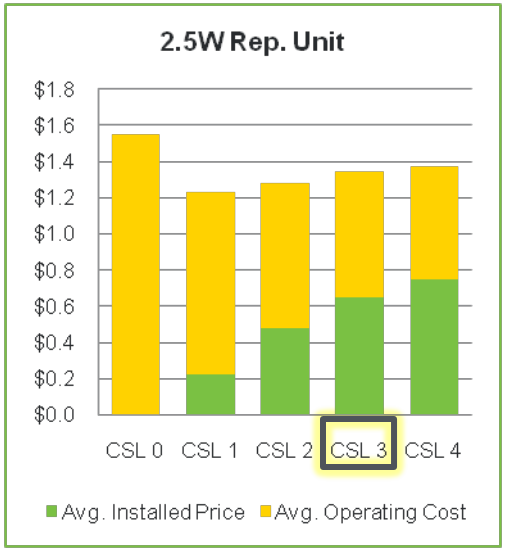
Results and Proposed Standards

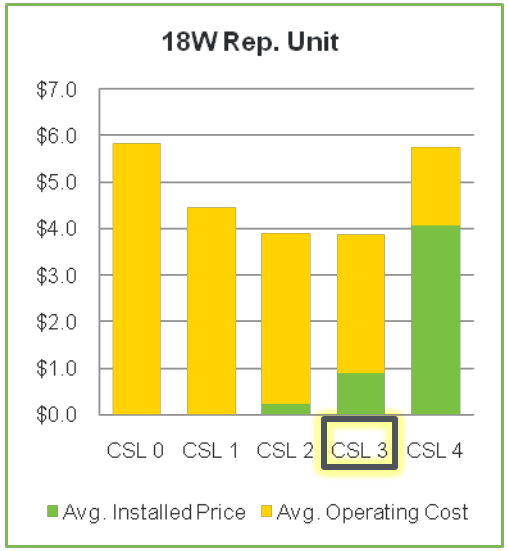
EPS Product Class B

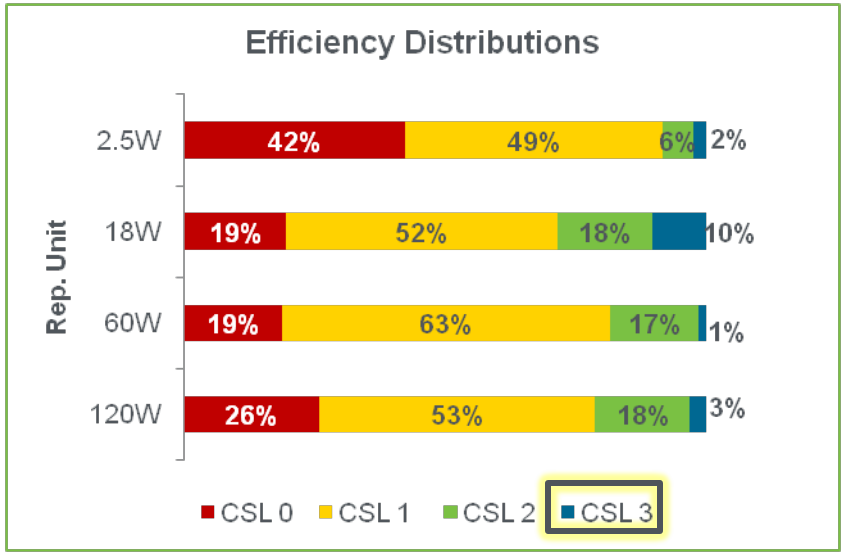
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

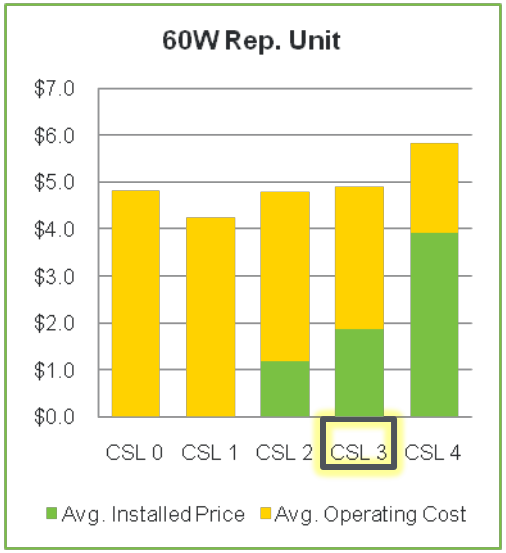


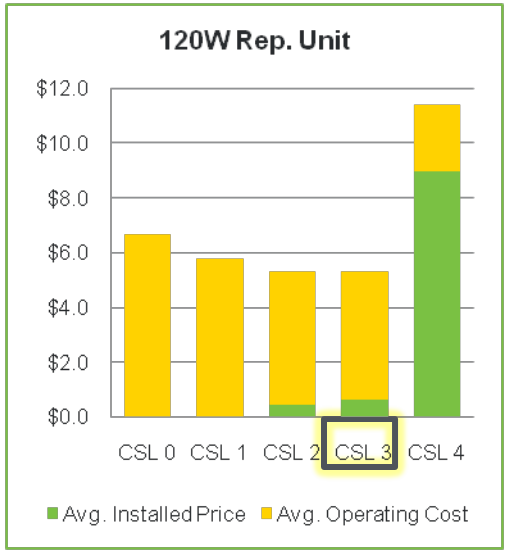
Average Life-Cycle Costs (2010$)







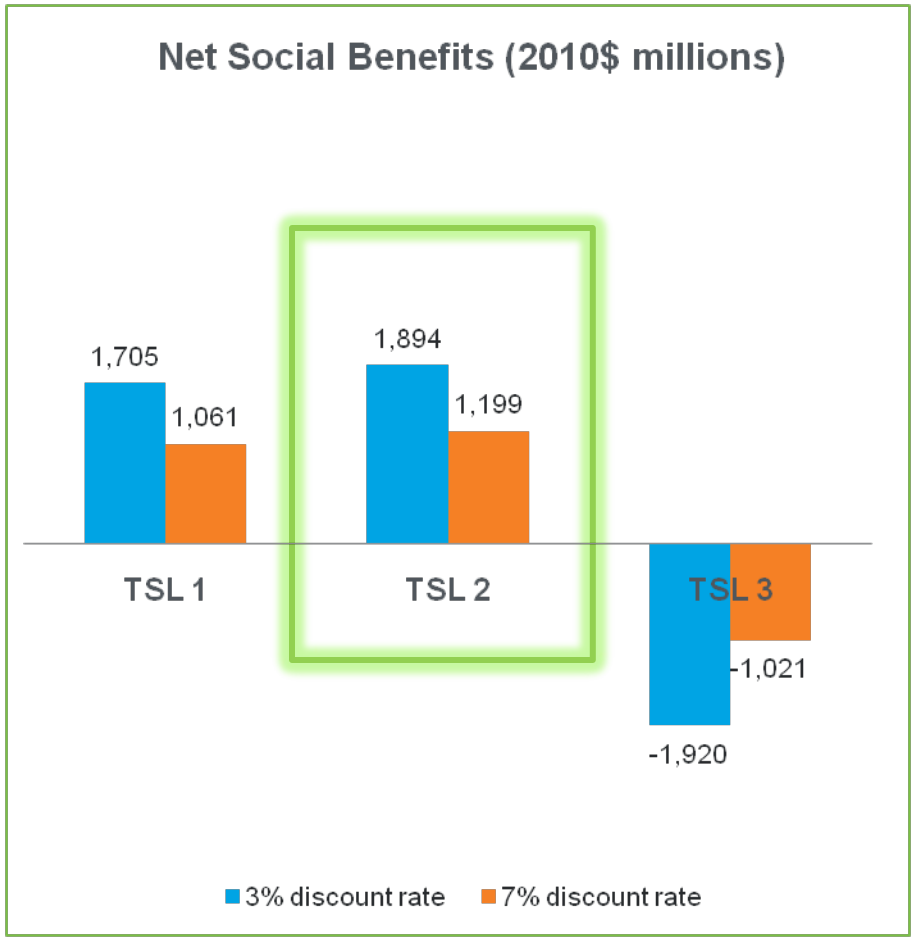




Results and Proposed Standards

EPS Product Class B

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



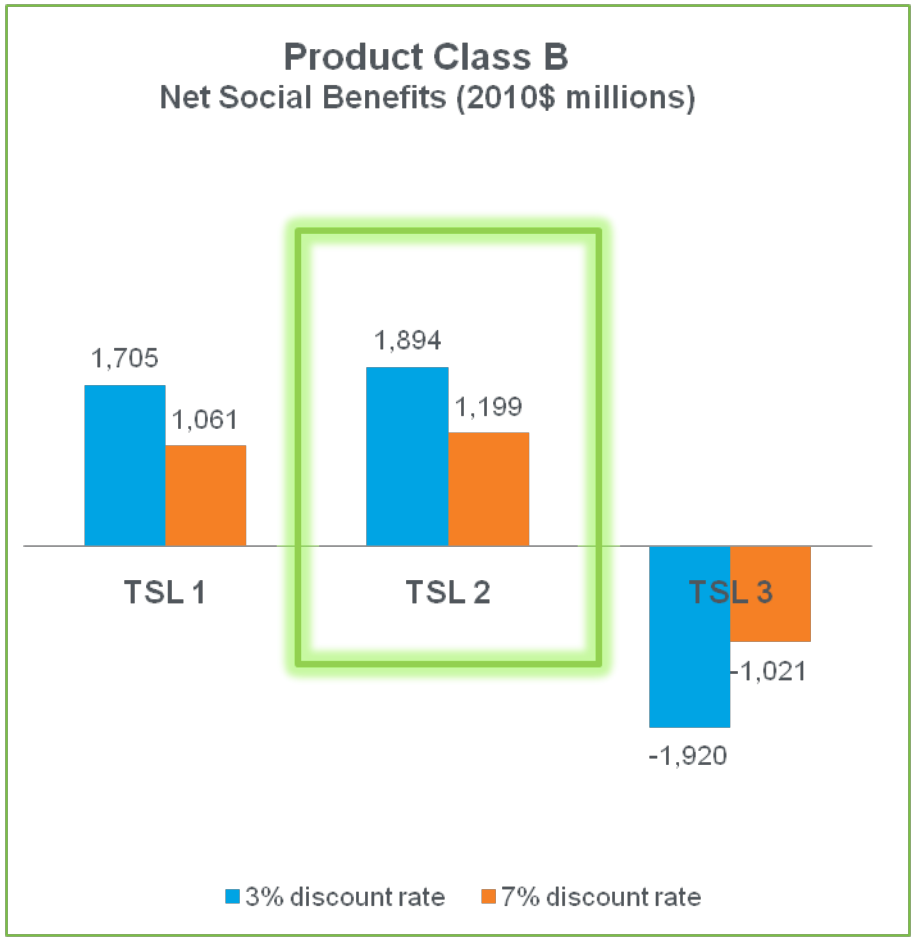
Projected National Impacts of Proposed Standard (TSL 2)	
National energy savings	0.7246 quads
Consumer NPV	$1,138 million (3% discount rate)
Change in industry NPV	–$81 million to –$35 million
CO_2 emissions savings	$710 million (3% discount rate)
Net Social Benefits	$1,894 million (3% discount rate)

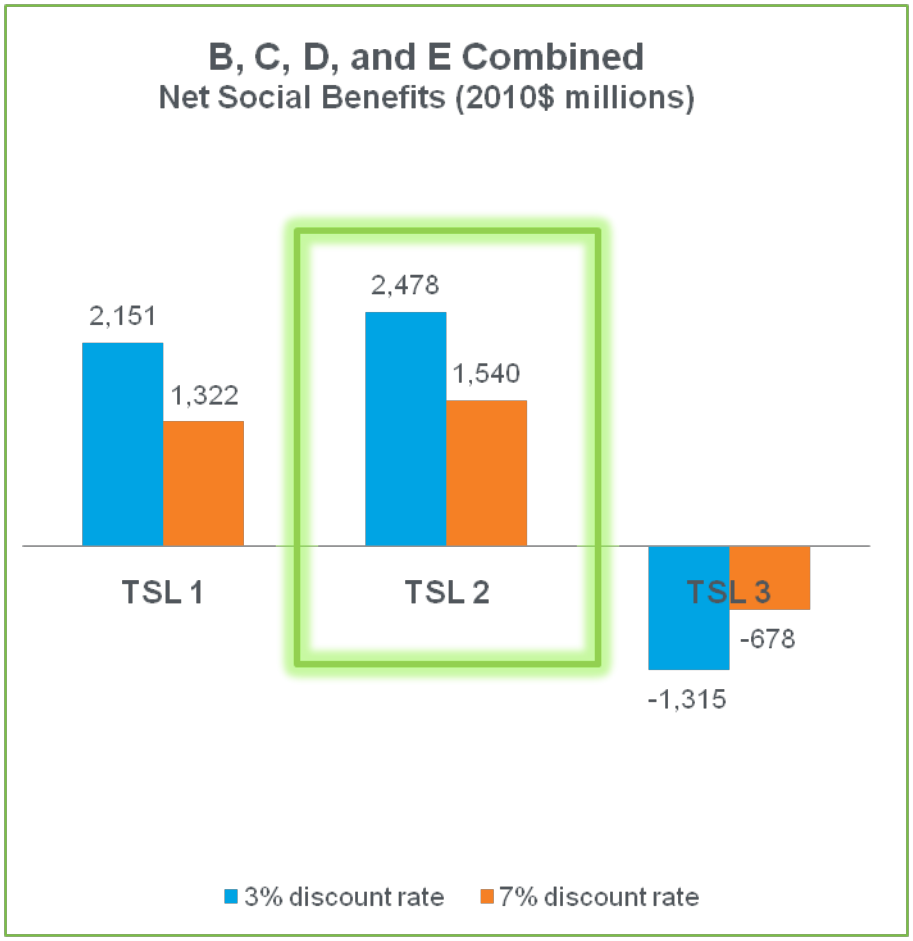
TSL 2 represents CSL 3 in product class B.

Results and Proposed Standards

Product Classes B, C, D, and E

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





CSLs in product classes C, D, and E were scaled from product class B.

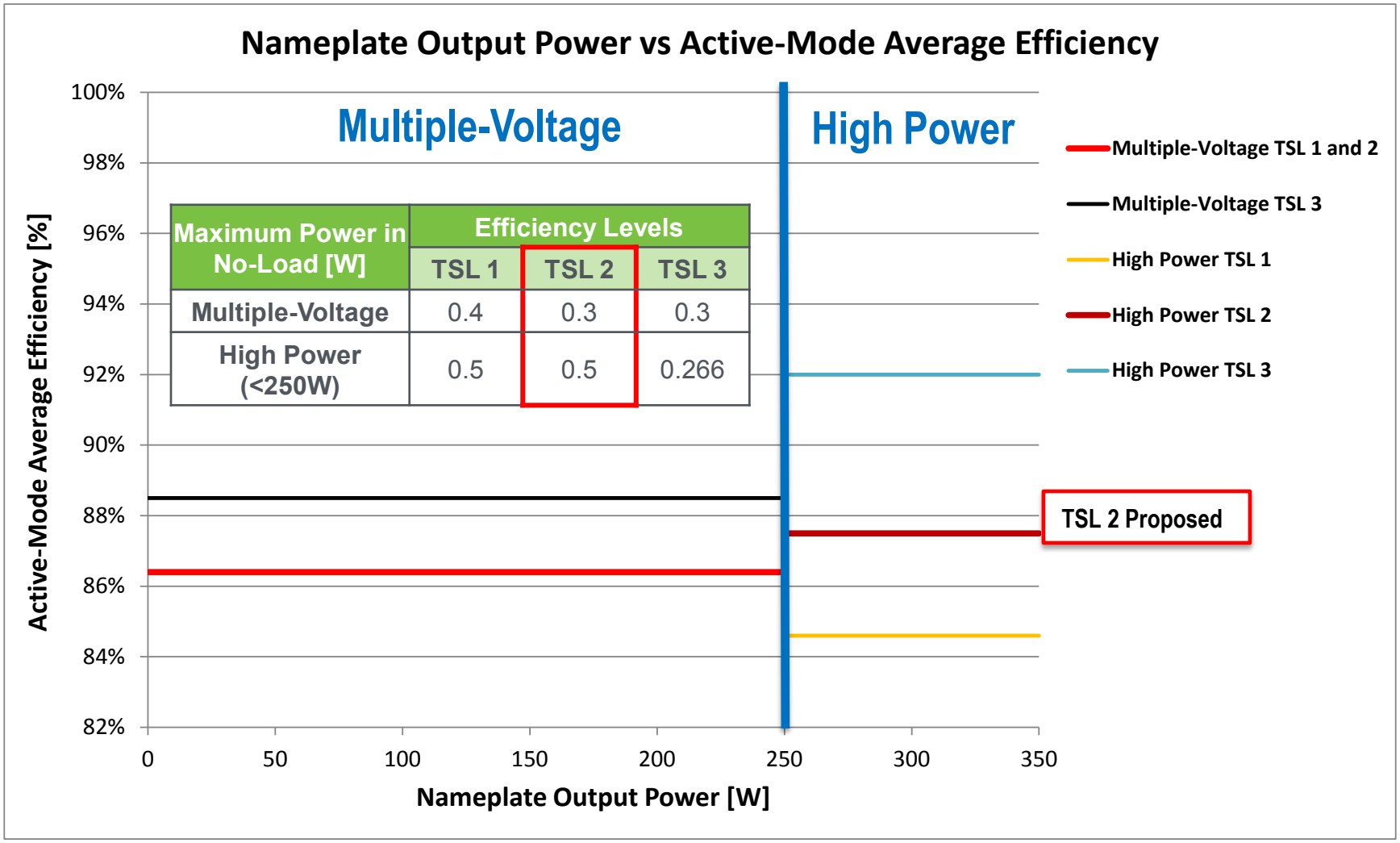
Net social benefits are still maximized at TSL 2 when product classes B, C, D, and E are considered as a whole.

Results and Proposed Standards

EPS Product Classes X and H

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

Multiple-Voltage and High Power External Power Supplies



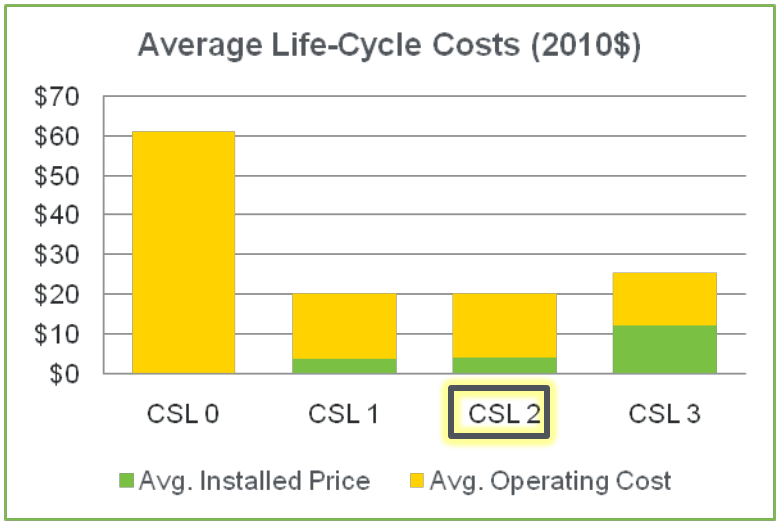
Maximum Power in No-Load [W]	Efficiency Levels		
	TSL 1	TSL 2	TSL 3
Multiple-Voltage	0.4	0.3	0.3
High Power (<250W)	0.5	0.5	0.266

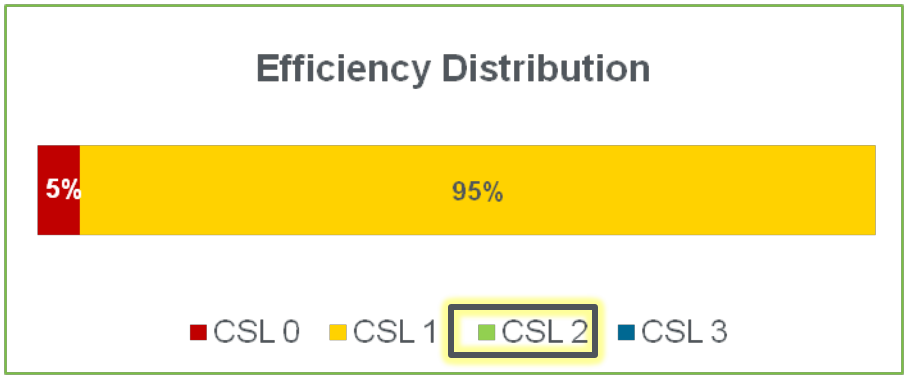
Results and Proposed Standards

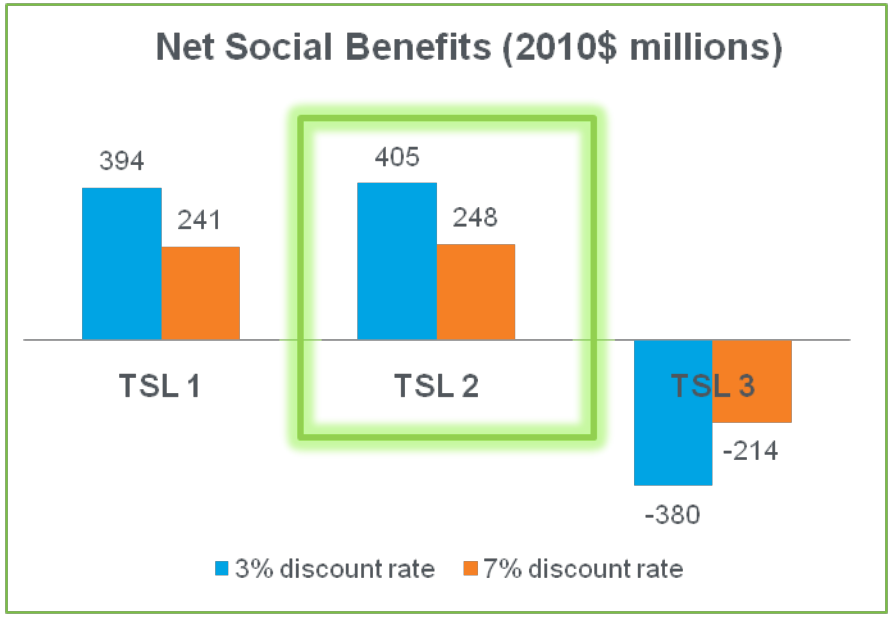
EPS Product Class X

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

Product Class X: Multiple Voltage
Annual Shipments: 7.7 million video game consoles







TSL 2 represents CSL 2 in product class X.

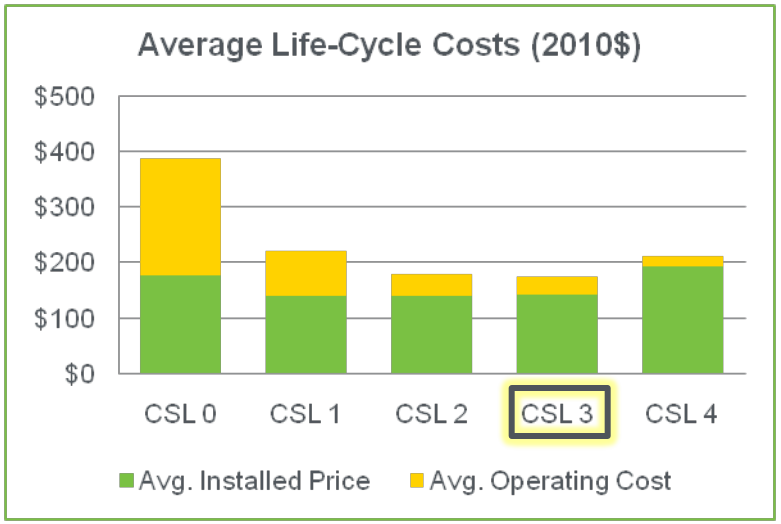
Projected National Impacts of Proposed Standard (TSL 2)	
National energy savings	0.0718 quads
Consumer NPV	$330 million (3% discount rate)
Change in industry NPV	–$12.8 million to –$12.0 million
CO_2 emissions savings	$70 millions (3% discount rate)
Net Social Benefits	$405 million (3% discount rate)

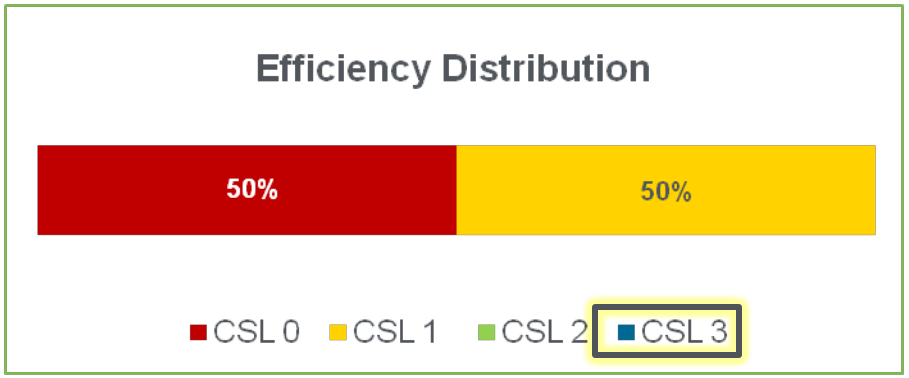
Results and Proposed Standards

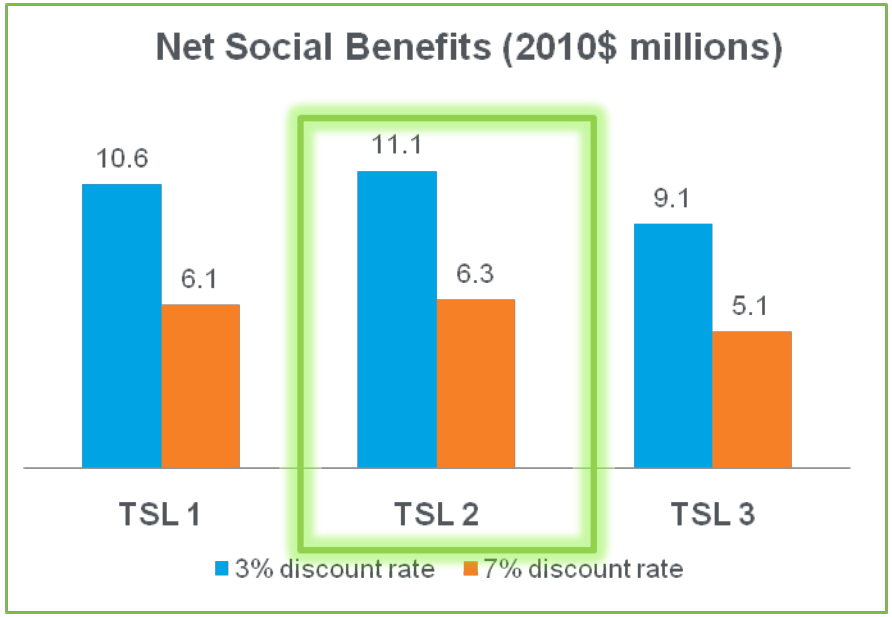
EPS Product Class H

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

Product Class H: High Power (>250W)
Annual Shipments: 3,000 amateur radios





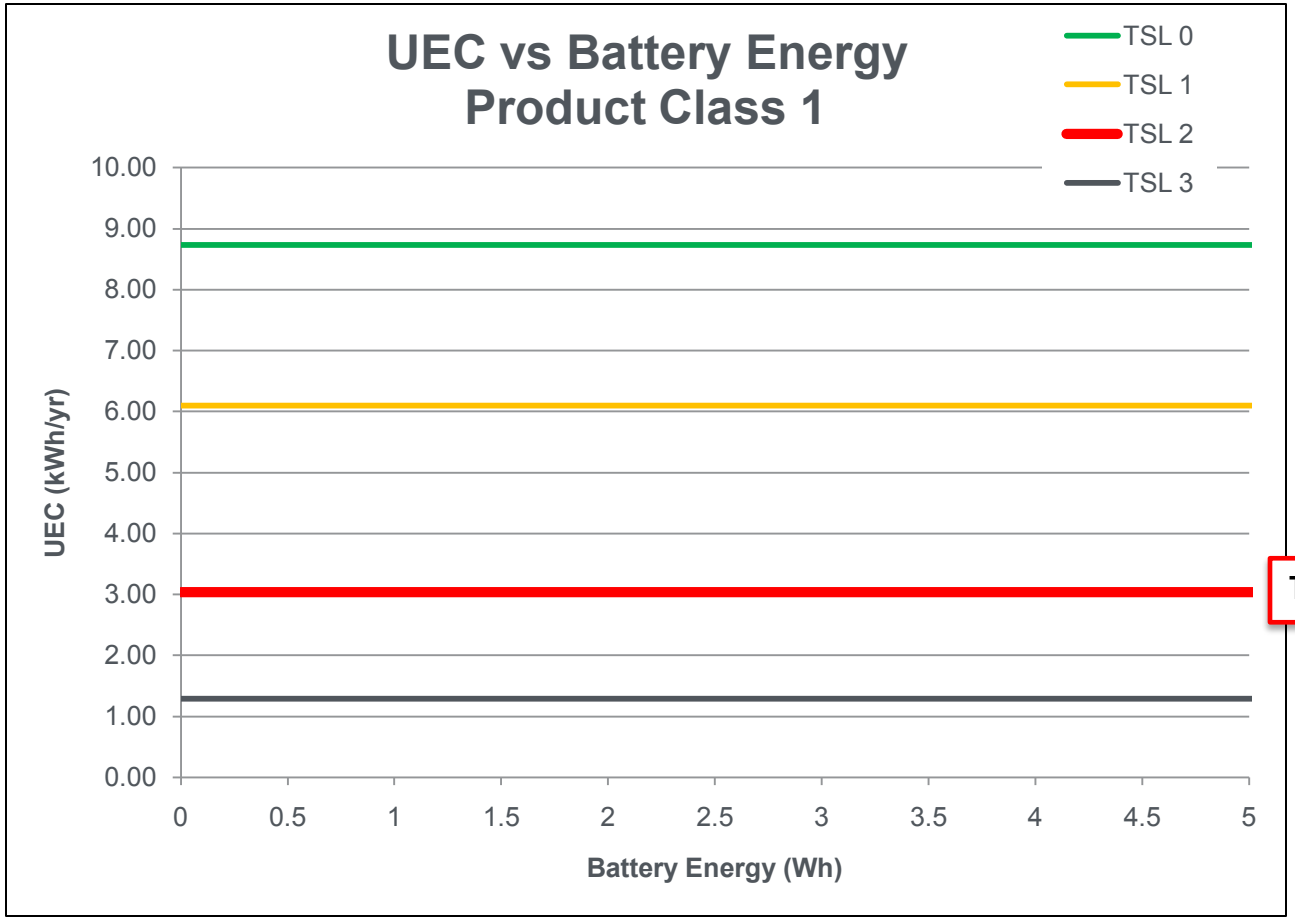


TSL 2 represents CSL 3 in product class H.

Projected National Impacts of Proposed Standard (TSL 2)	
National energy savings	0.0014 quads
Consumer NPV	$9.7 million (3% discount rate)
Change in industry NPV	–$0.05 million to –$0.04 million
CO_2 emissions savings	$1.3 million (3% discount rate)
Net Social Benefits	$11.1 million (3% discount rate)

Results and Proposed Standards

Battery Charger Product Class 1



TSL 2 Proposed

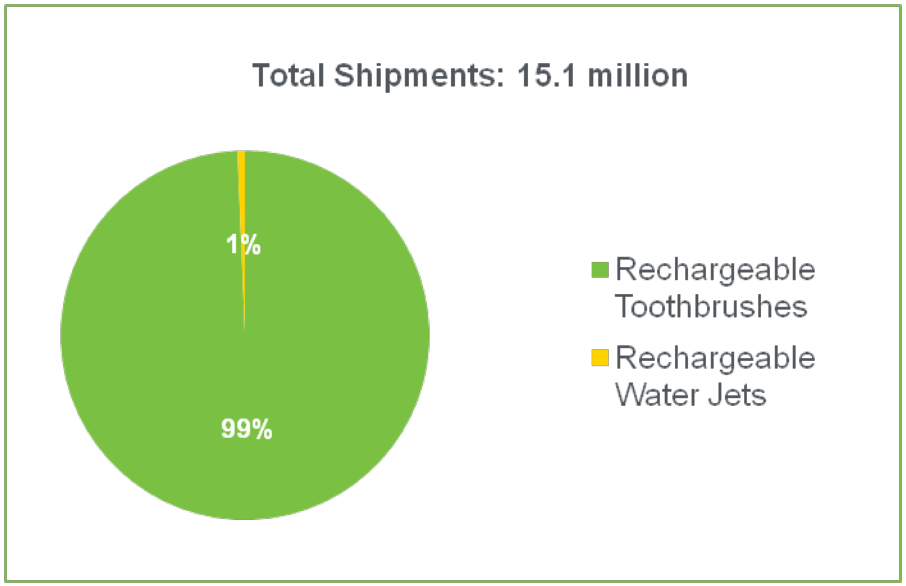
PC 1	Low-Energy, Inductive	3.04 kWh/yr

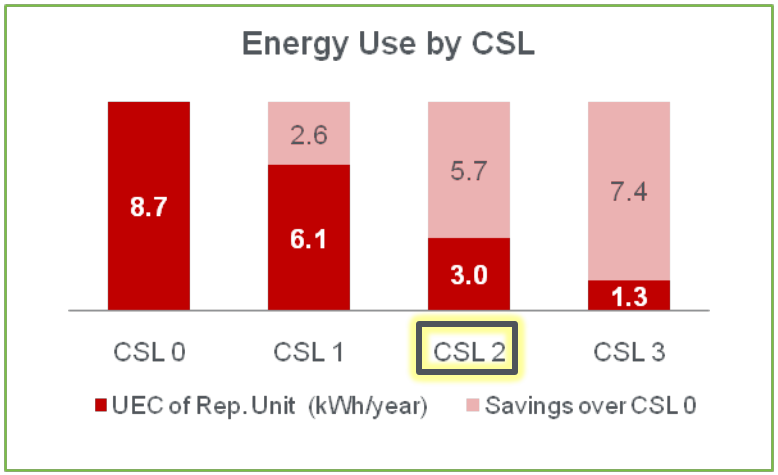
Results and Proposed Standards

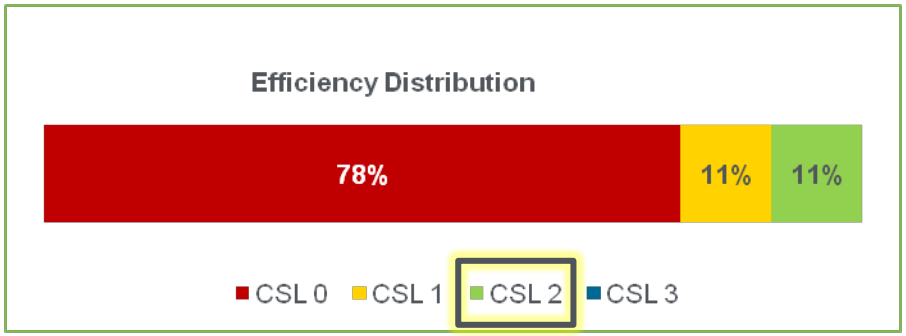
Battery Charger Product Class 1

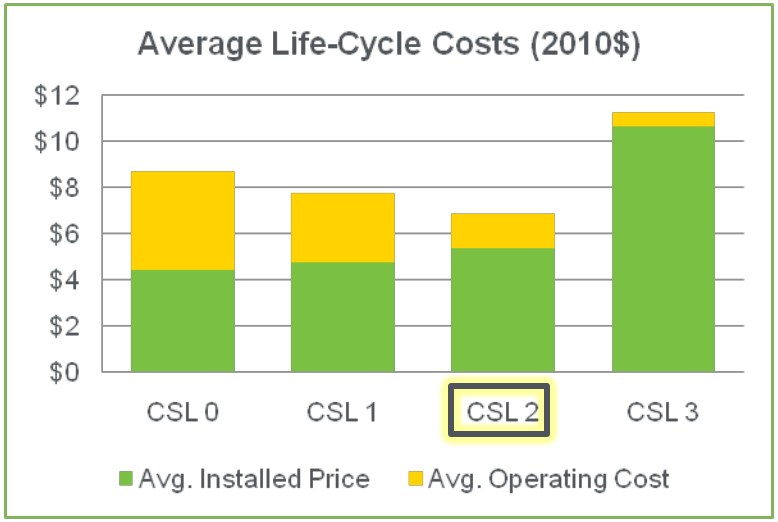
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

AC input/ DC output, battery energy <100 Wh, inductive connection





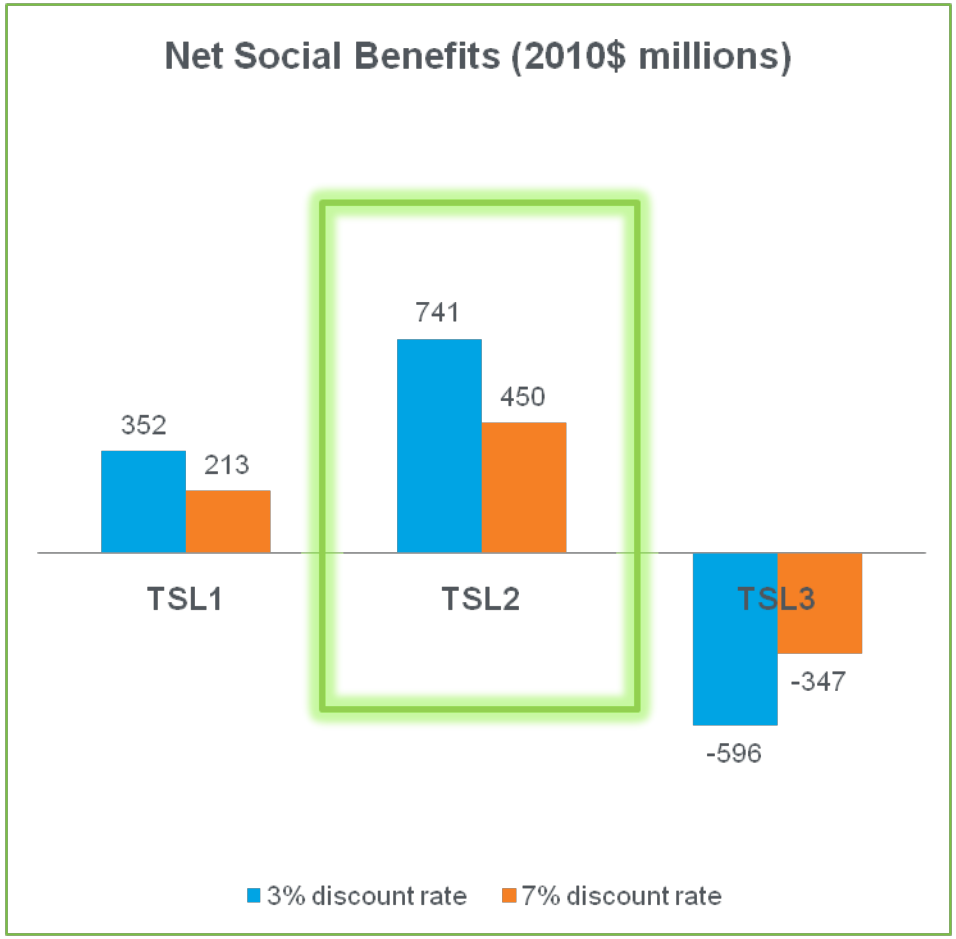




Results and Proposed Standards

Battery Charger Product Class 1

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



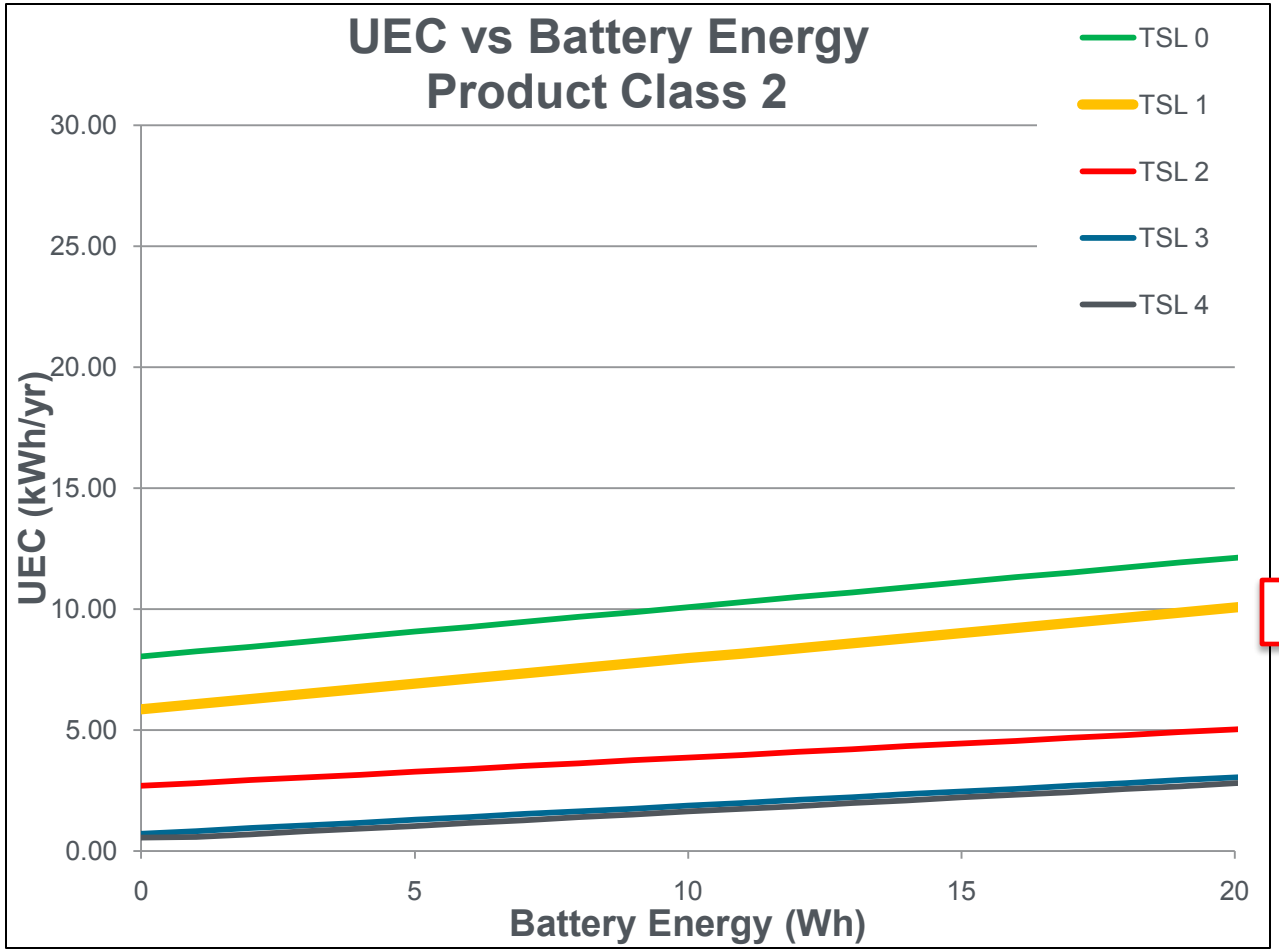
Projected National Impacts of Proposed Standard (TSL 2)	
National energy savings	0.596 quads
Consumer NPV	$4,648 million (3% discount rate)
Change in industry NPV	–$225 million to –$40 million
CO_2 emissions savings	$127 million (3% discount rate)
Net Social Benefits	$5,264 million (3% discount rate)

TSL 2 represents CSL 2 in product class 1.

Results and Proposed Standards

Battery Charger Product Class 2

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



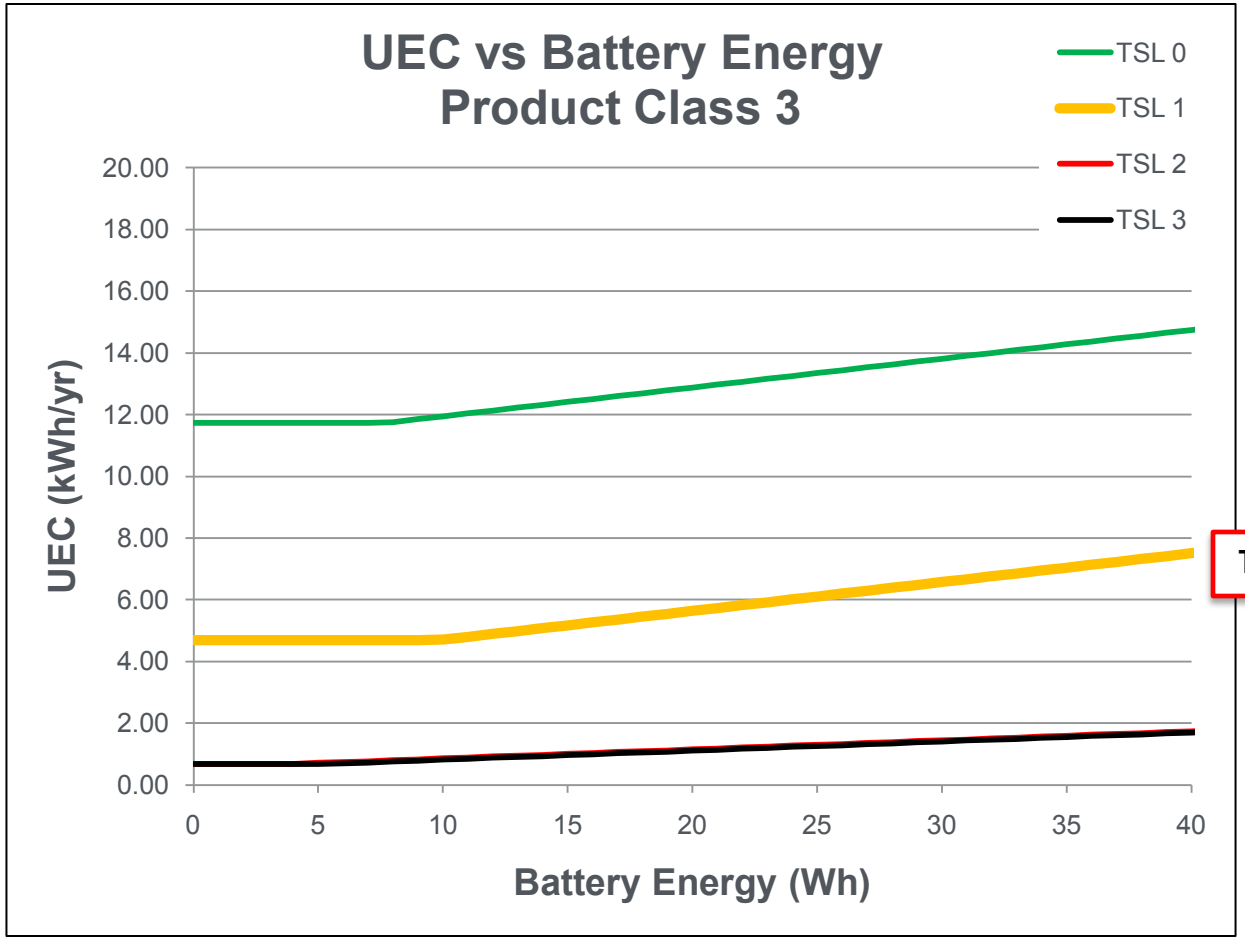
TSL 1 Proposed

PC 2	Low-Energy, Low-Voltage	= 0.2095(Ebatt*) + 5.87

Results and Proposed Standards

Battery Charger Product Class 3

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



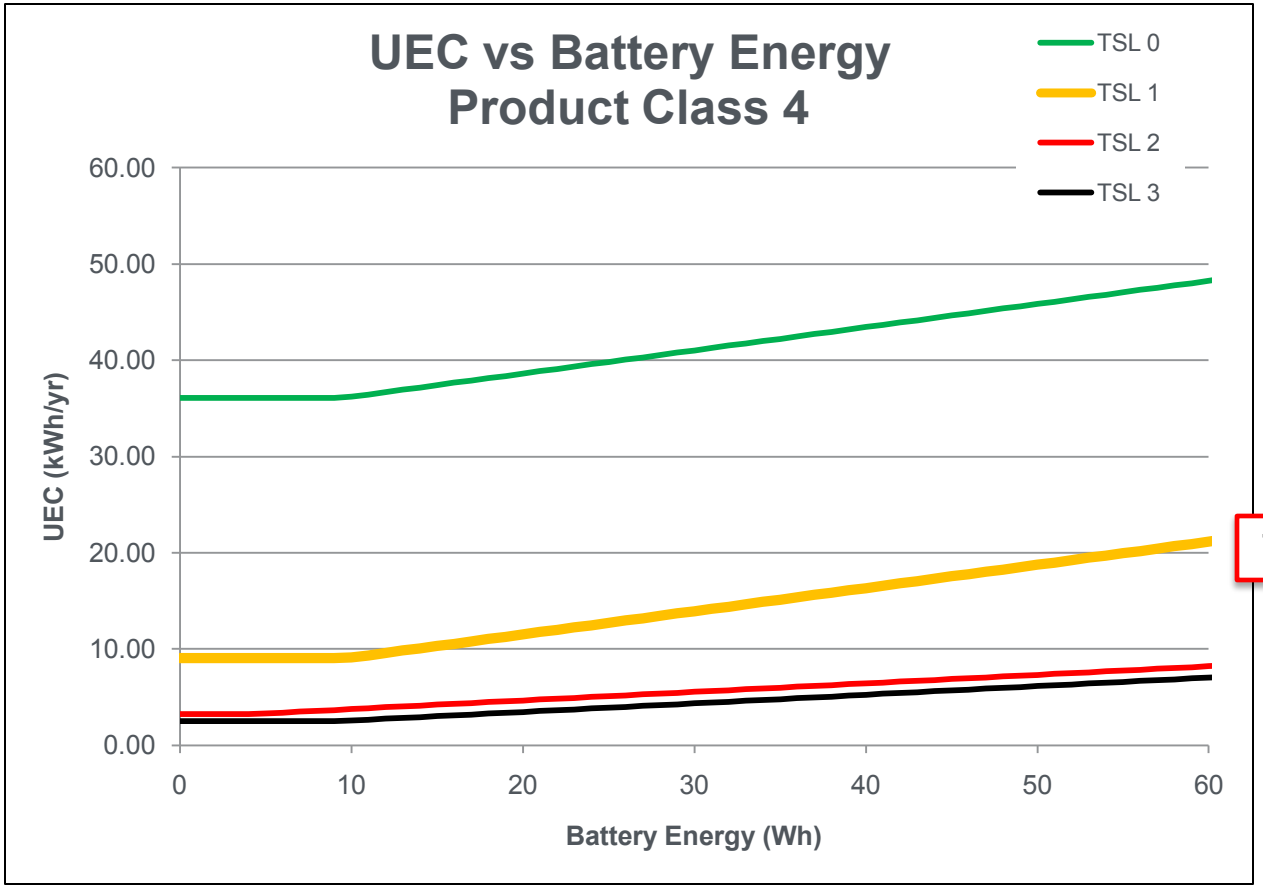
TSL 1 Proposed

PC 3	Low-Energy, Medium-Voltage	For Ebatt < 9.74 Wh, = 4.68 For Ebatt ≥ 9.74 Wh, = 0.0933(Ebatt) + 3.77

Results and Proposed Standards

Battery Charger Product Class 4

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



TSL 1 Proposed

PC 4	**Low-Energy, High-Voltage**	**For Ebatt < 9.71 Wh, = 9.03 For Ebatt ≥ 9.71 Wh, = 0.2411(Ebatt) + 6.69**

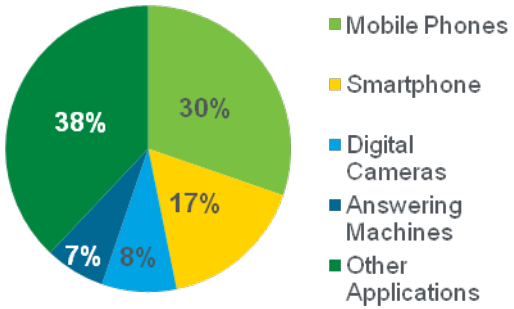
Results and Proposed Standards

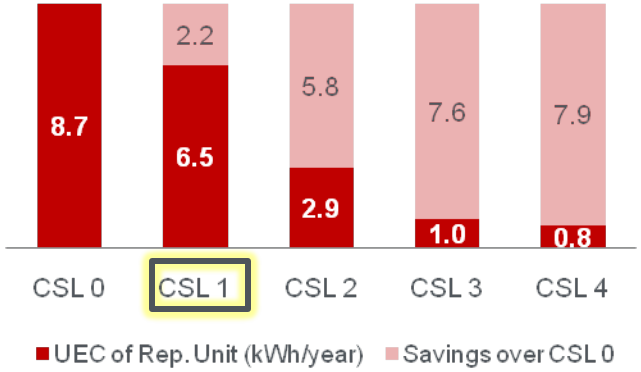
Battery Charger Product Classes 2, 3, and 4

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

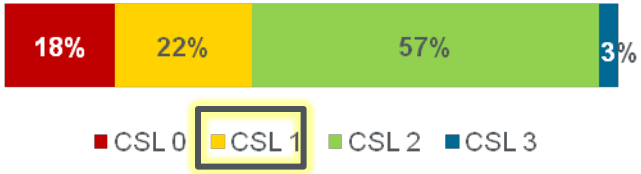
AC input/ DC output, battery energy < 100 Wh, non-inductive connection

Product Class 2 (<4V)
249 million

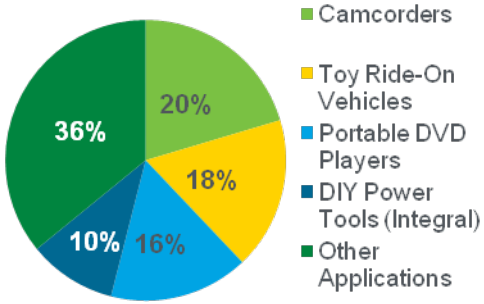


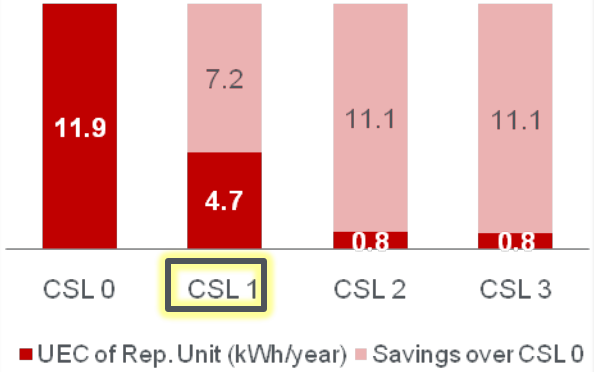


Efficiency Distribution

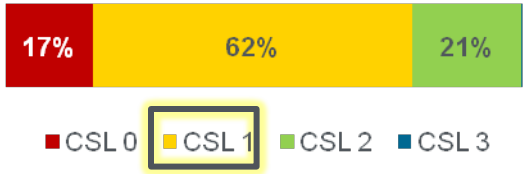


Product Class 3 (4-10V)
23 million

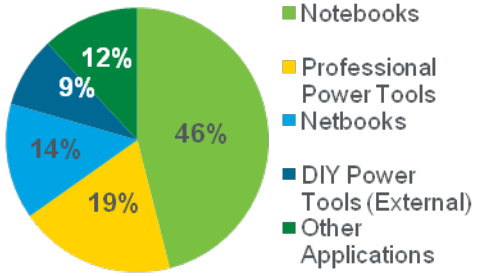


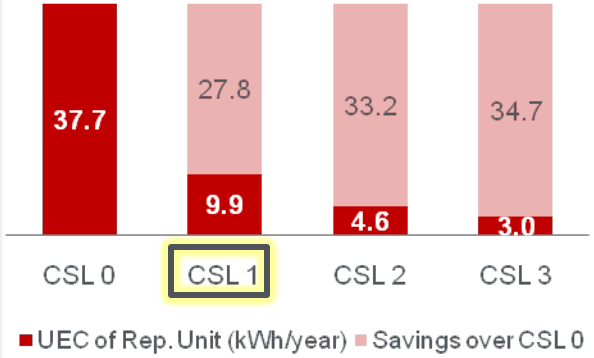


Efficiency Distribution



Product Class 4 (>10V)
61 million



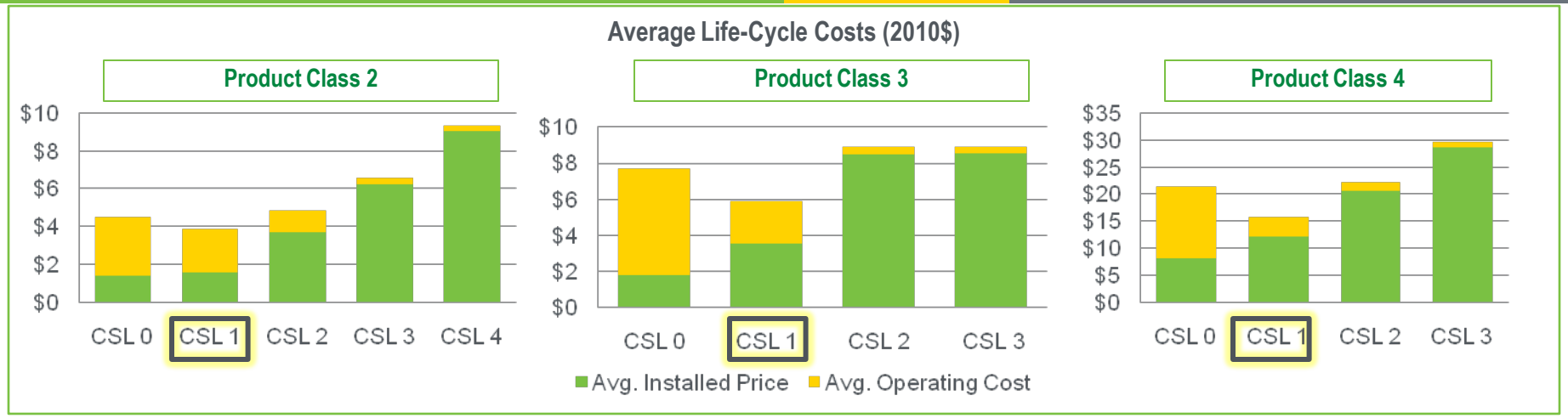


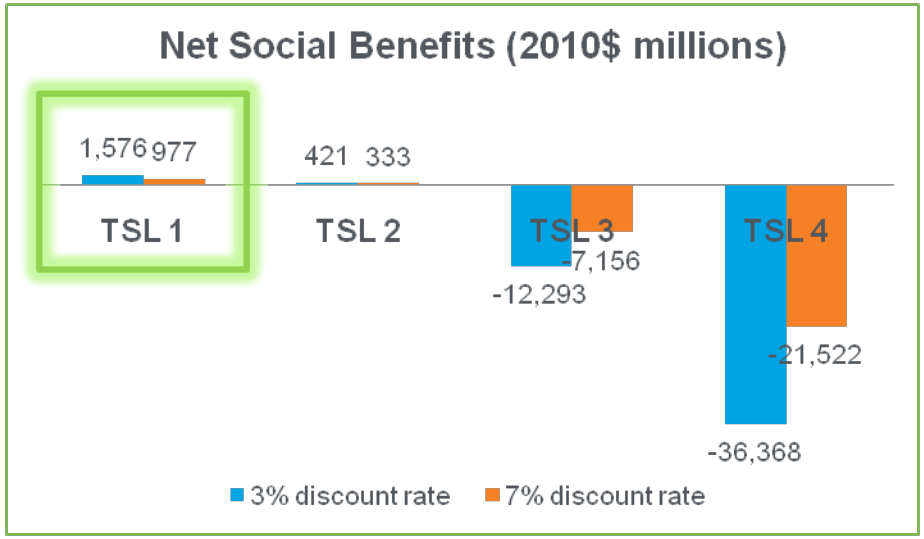
Efficiency Distribution

Results and Proposed Standards

Battery Charger Product Classes 2, 3, and 4

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





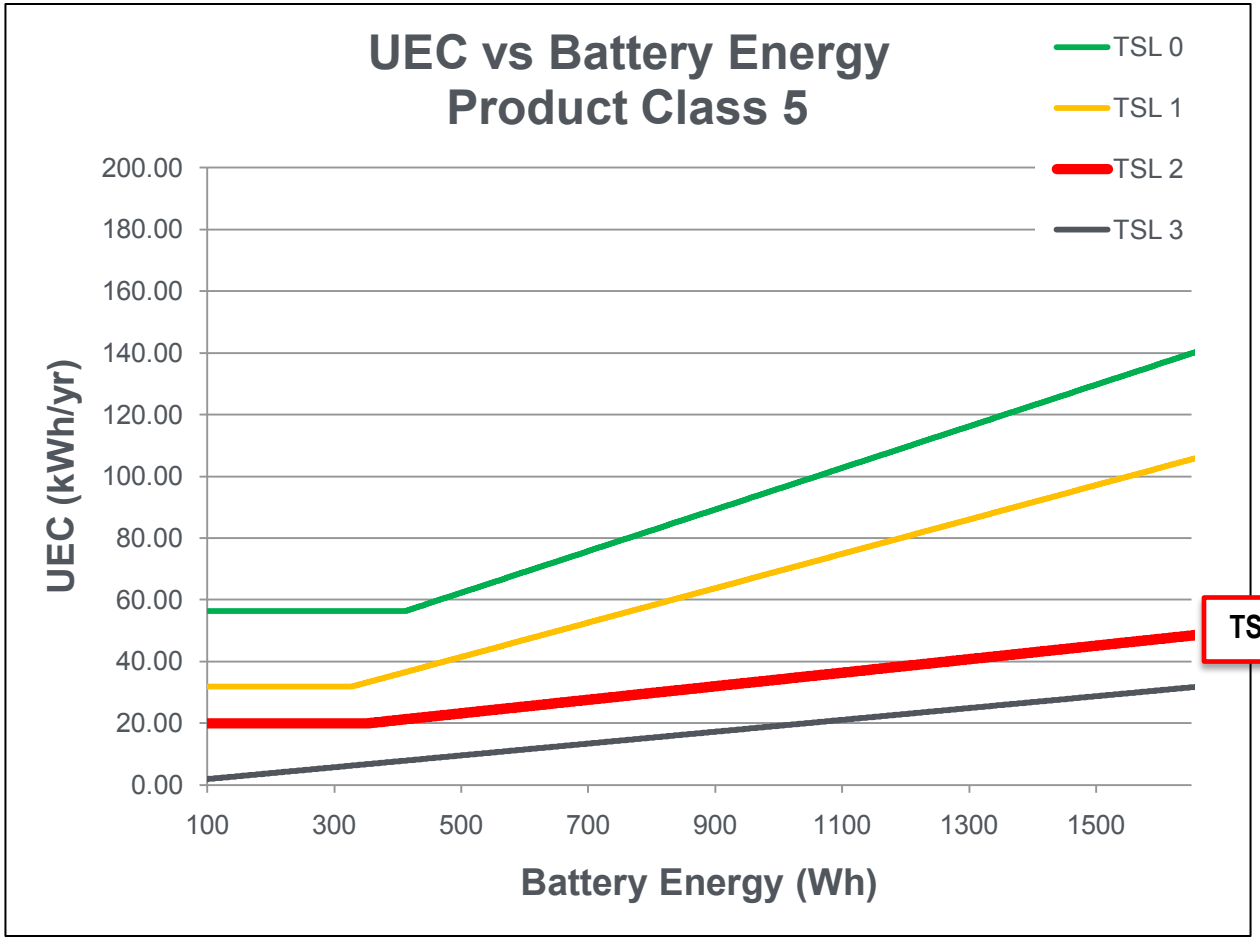
Projected National Impacts of Proposed Standards (TSL 1)	
National energy savings	0.309 quads
Consumer NPV	$1,255 million (3% discount rate)
Change in industry NPV	–$5 million to $15 million
CO_2 emissions savings	$302 million (3% discount rate)
Net Social Benefits	$1,576 million (3% discount rate)

TSL 1 represents CSL 1 in product classes 2, 3, and 4.

Results and Proposed Standards

Battery Charger Product Class 5

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



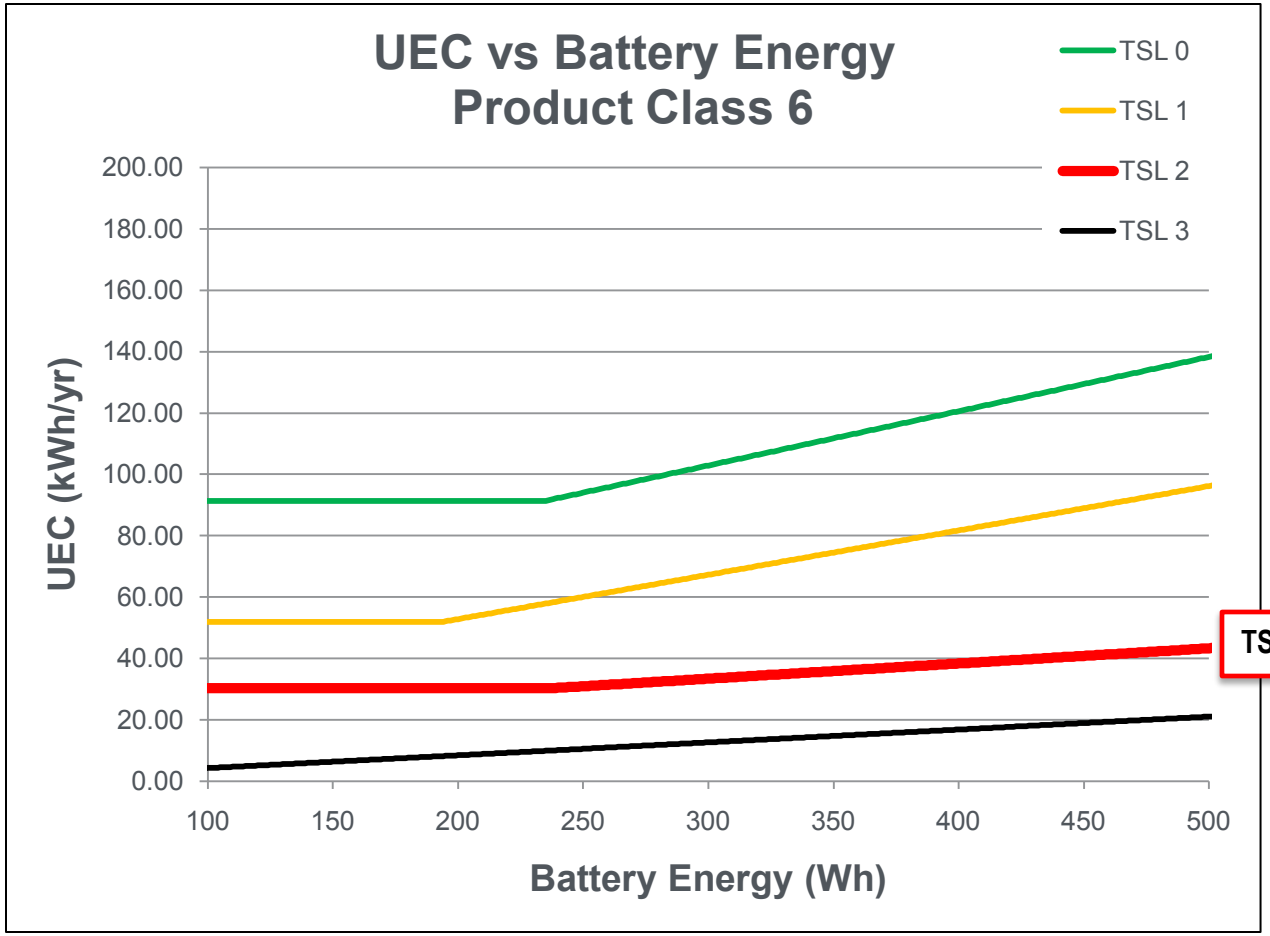
TSL 2 Proposed

PC5	Medium-Energy, Low-Voltage	For Ebatt < 355.18 Wh, = 20.06 For Ebatt ≥ 355.18 Wh, = 0.0219(Ebatt) + 12.28

Results and Proposed Standards

Battery Charger Product Class 6

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



TSL 2 Proposed

PC 6	Medium-Energy, High-Voltage	For Ebatt < 239.48 Wh = 0.37 For Ebatt ≥ 239.48 Wh = 0.0495(Ebatt) + 18.51

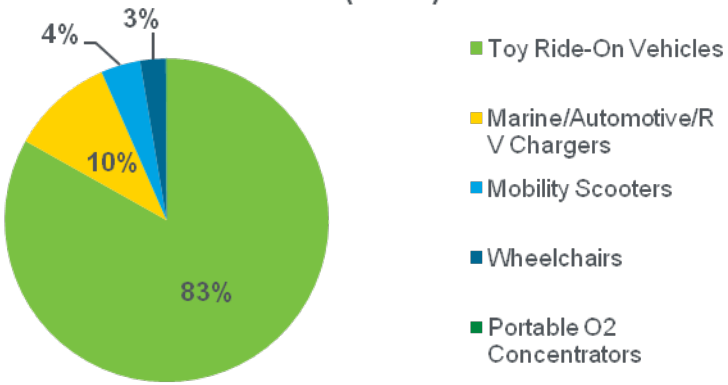
Results and Proposed Standards

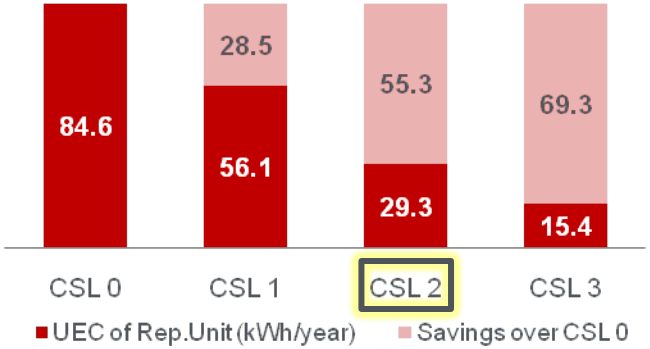
Battery Charger Product Classes 5 and 6

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

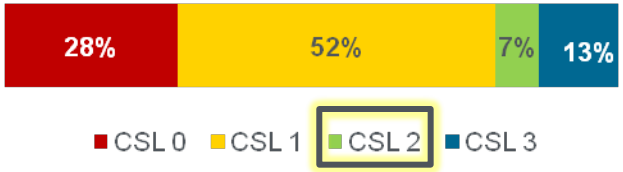
AC input/ DC output, battery energy 100 – 3000 Wh

Product Class 5 (<20V) 4.9 million

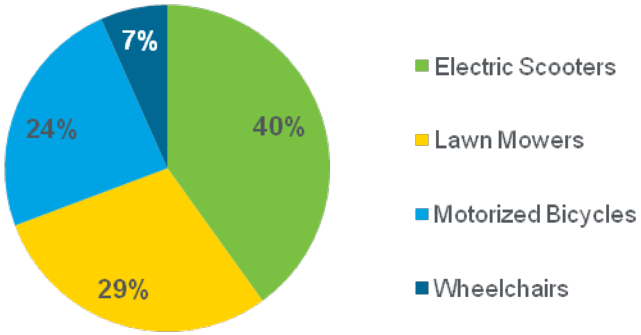


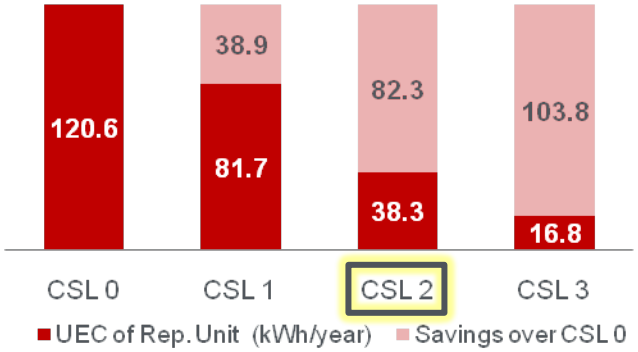


Efficiency Distribution

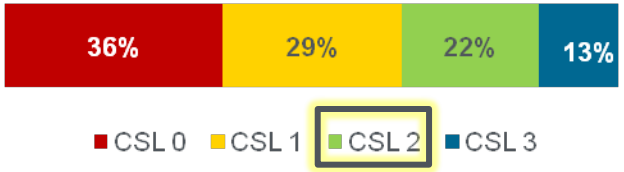


Product Class 6 (>=20V), 0.6 million





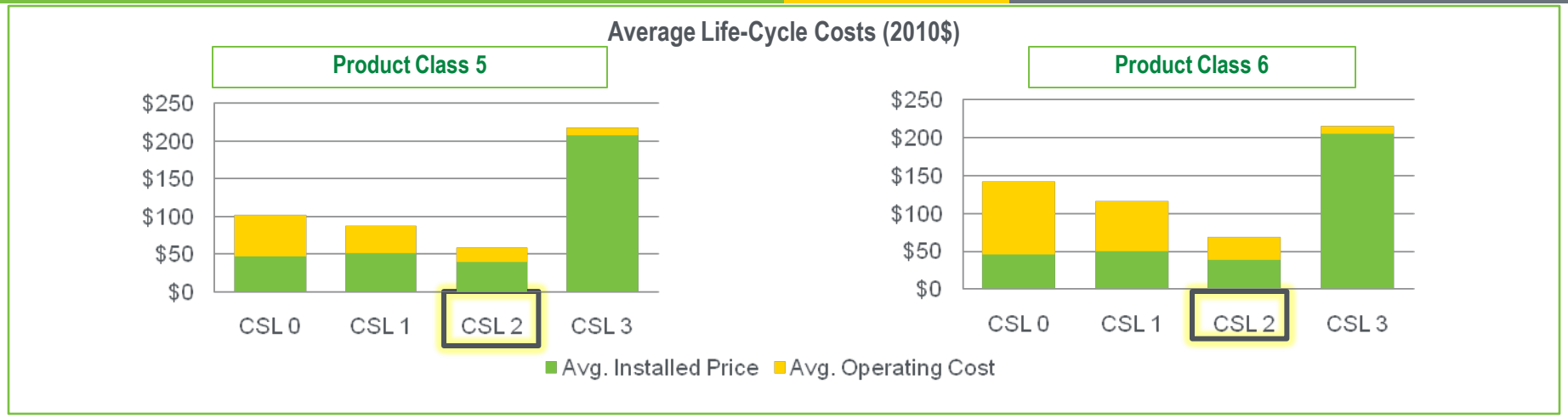
Efficiency Distribution

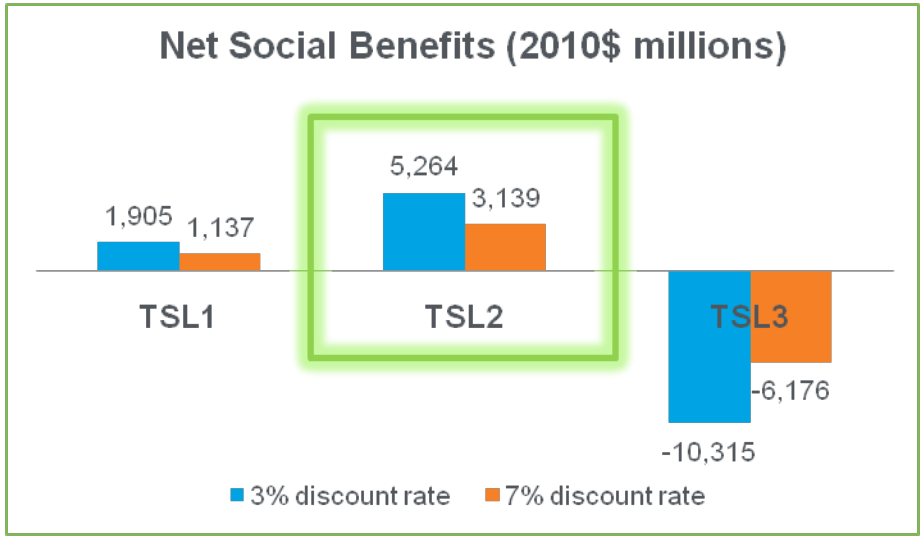


Results and Proposed Standards

Battery Charger Product Classes 5 and 6

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





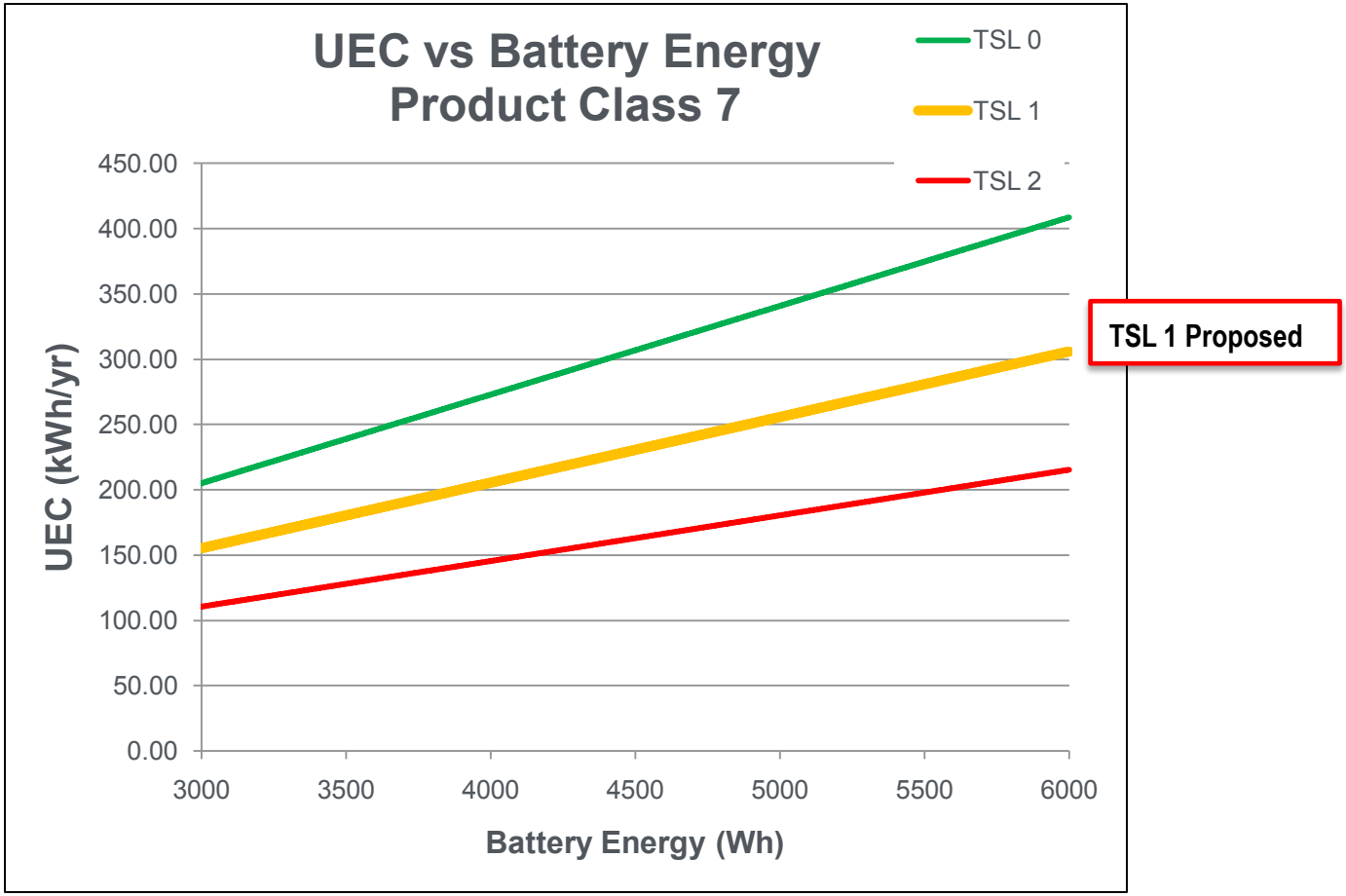
Projected National Impacts of Proposed Standards (TSL 2)	
National energy savings	0.596 quads
Consumer NPV	$4,648 million (3% discount rate)
Change in industry NPV	–$225 million to –$40 million
CO_2 emissions savings	$580 million (3% discount rate)
Net Social Benefits	$5,264 million (3% discount rate)

TSL 2 represents CSL 2 in product classes 5 and 6.

Results and Proposed Standards

Battery Charger Product Class 7

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



PC 7	**High-Energy**	**= 0.502(Ebatt) + 4.53**

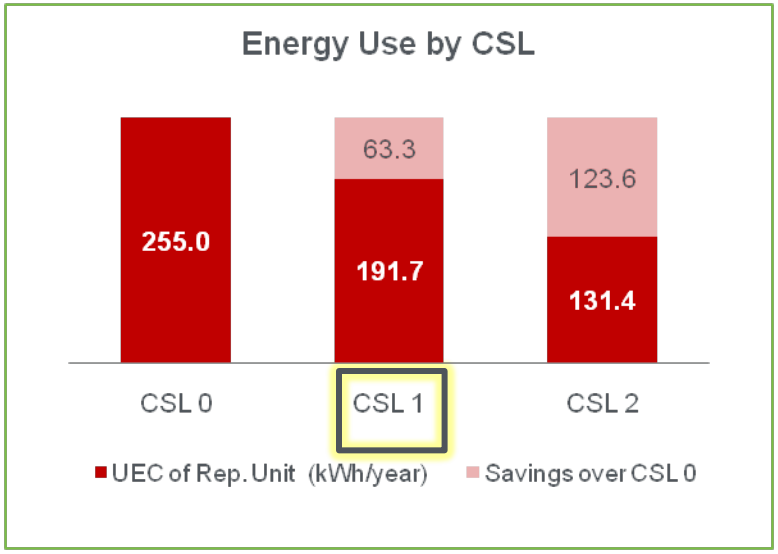
Results and Proposed Standards

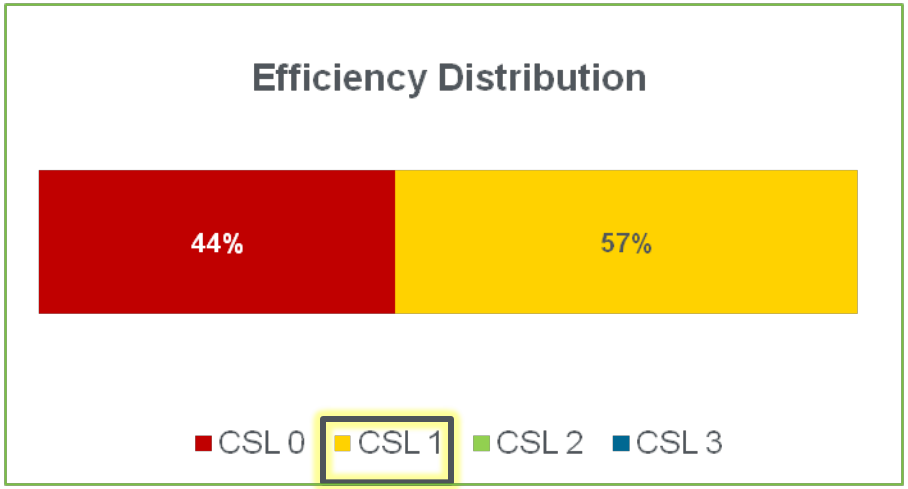
Battery Charger Product Class 7

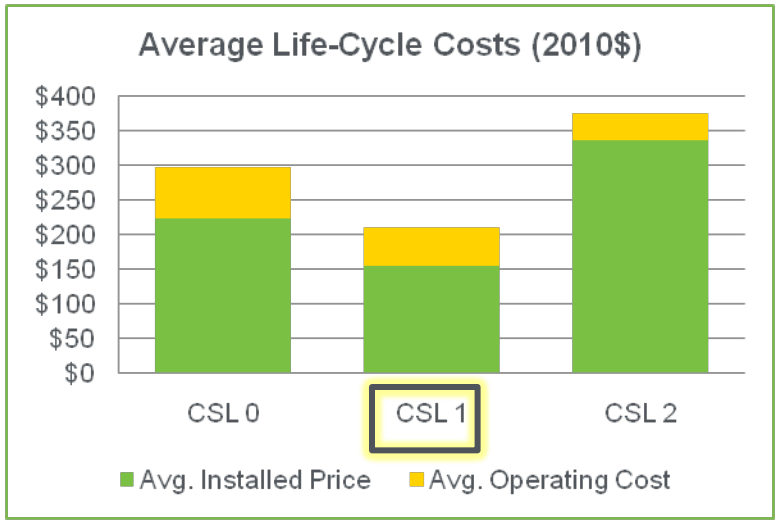
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

AC input/ DC output ,
battery energy >3,000 Wh

Annual Shipments: 210,000 golf carts



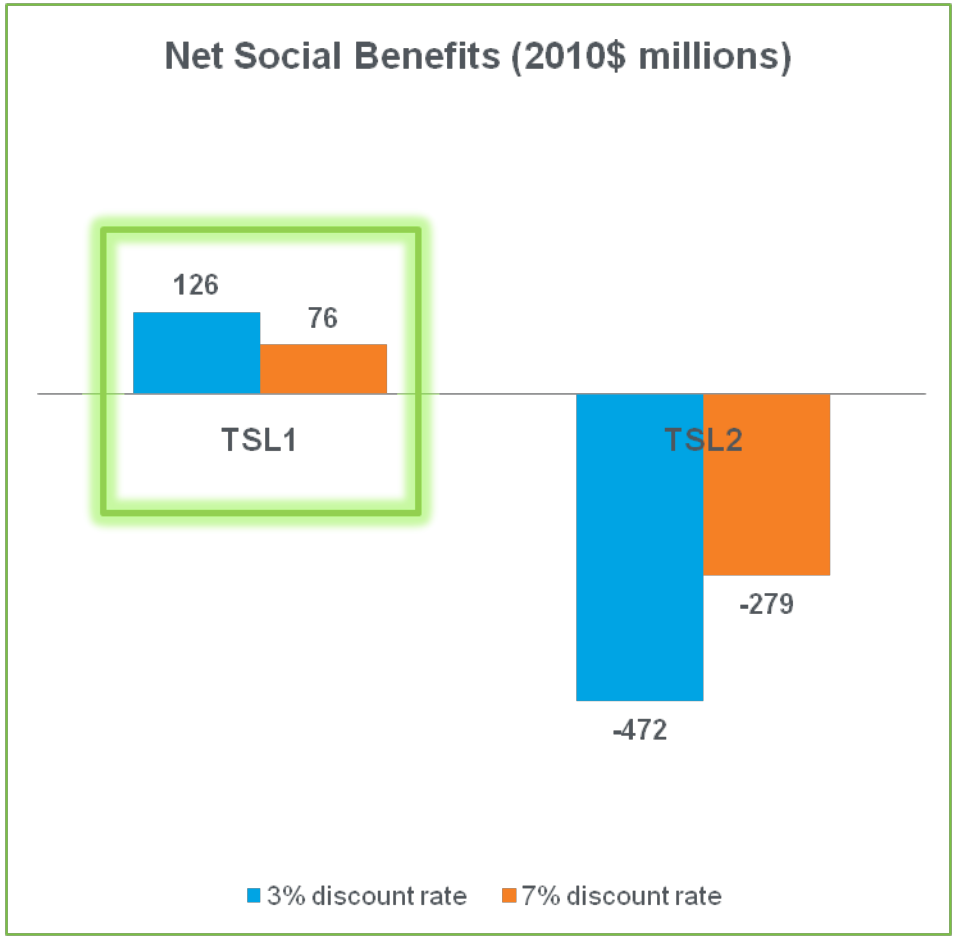




Results and Proposed Standards

Battery Charger Product Class 7

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



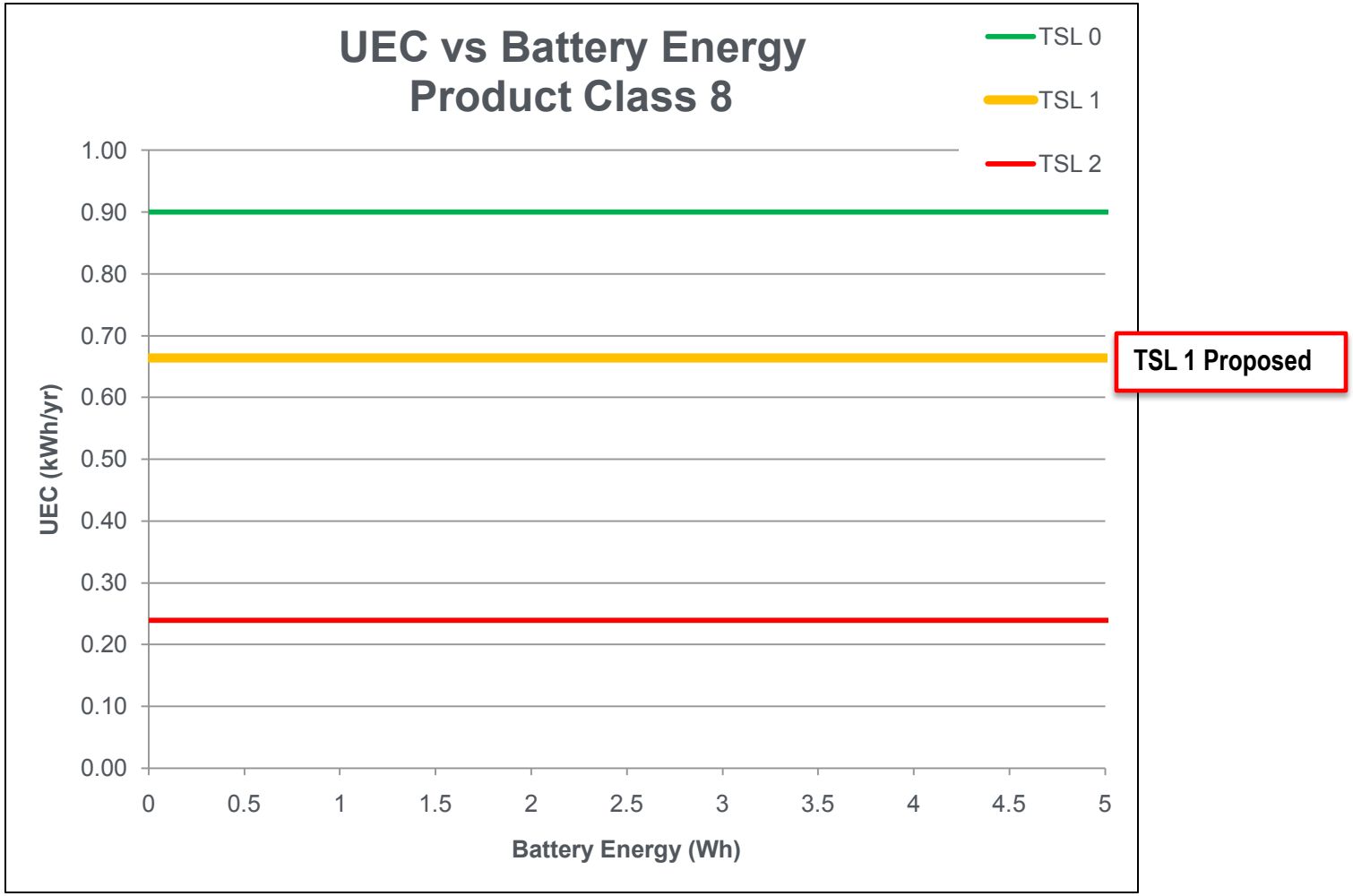
Projected National Impacts of Proposed Standard (TSL 1)	
National energy savings	0.0067 quads
Consumer NPV	$119 million (3% discount rate)
Change in industry NPV	–$4 million to $47 million
CO_2 emissions savings	$6.4 million (3% discount rate)
Net Social Benefits	$126 million (3% discount rate)

TSL 1 represents CSL 1 in product class 7.

Results and Proposed Standards

Battery Charger Product Class 8

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



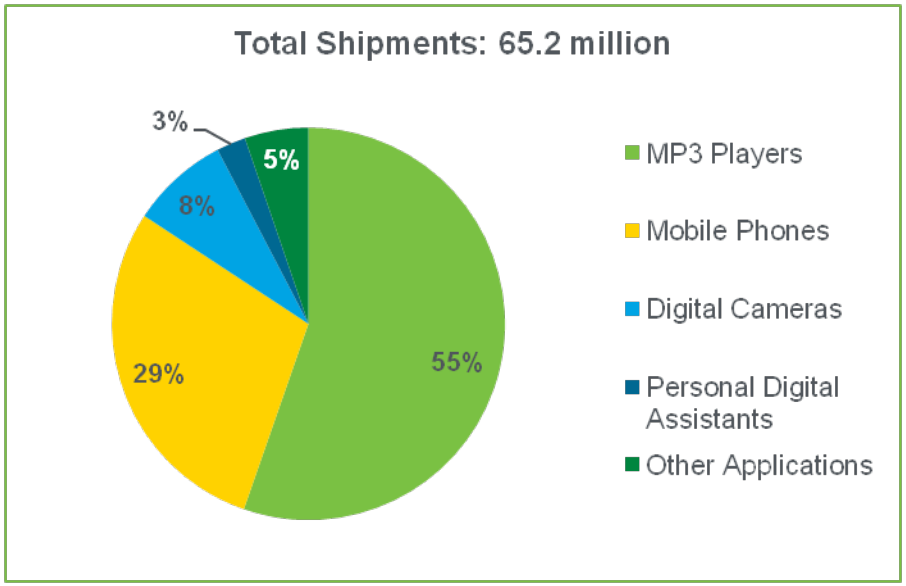
8	Low-Voltage DC Input	0.66 kWh/yr

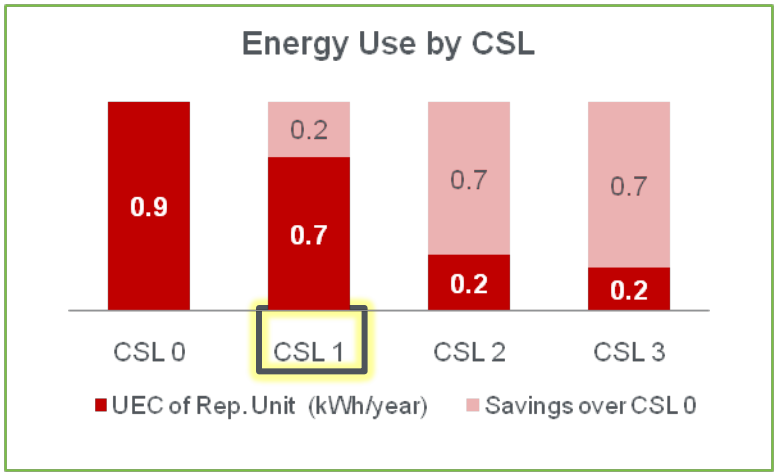
Results and Proposed Standards

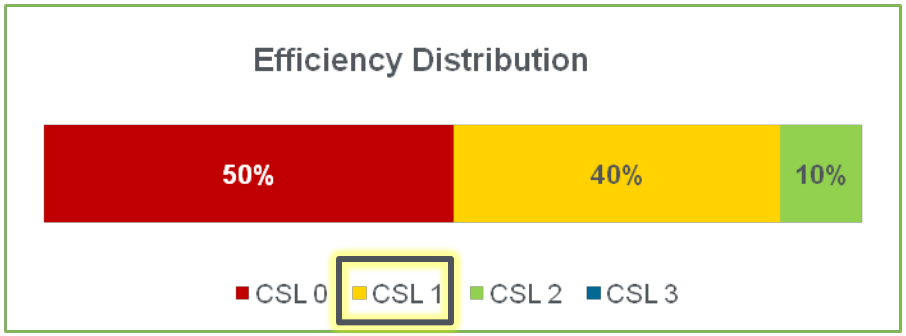
Battery Charger Product Class 8

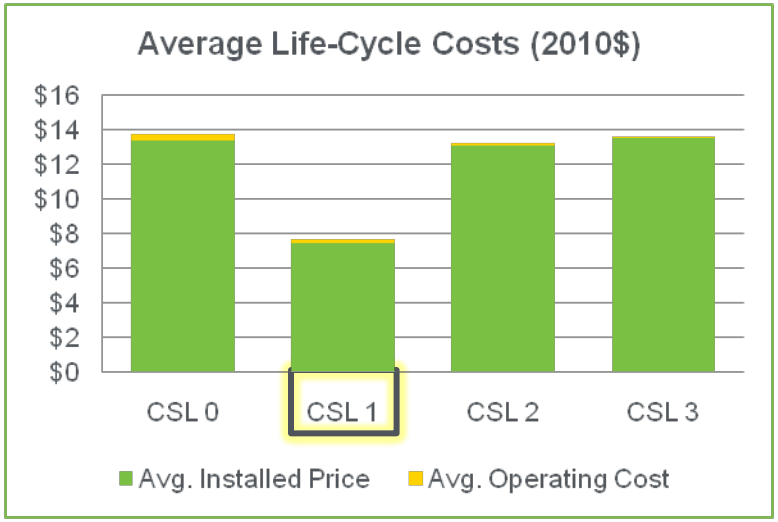
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

DC input/ DC output, battery voltage <9V





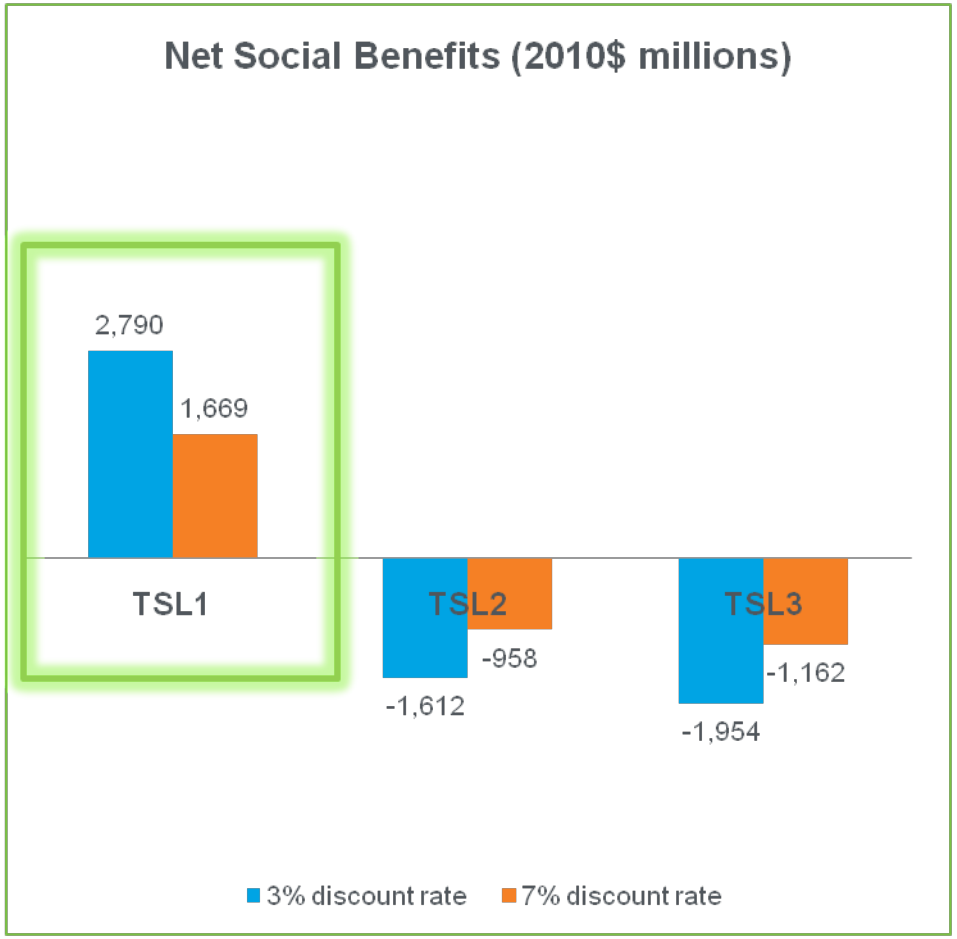




Results and Proposed Standards

Battery Charger Product Class 8

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



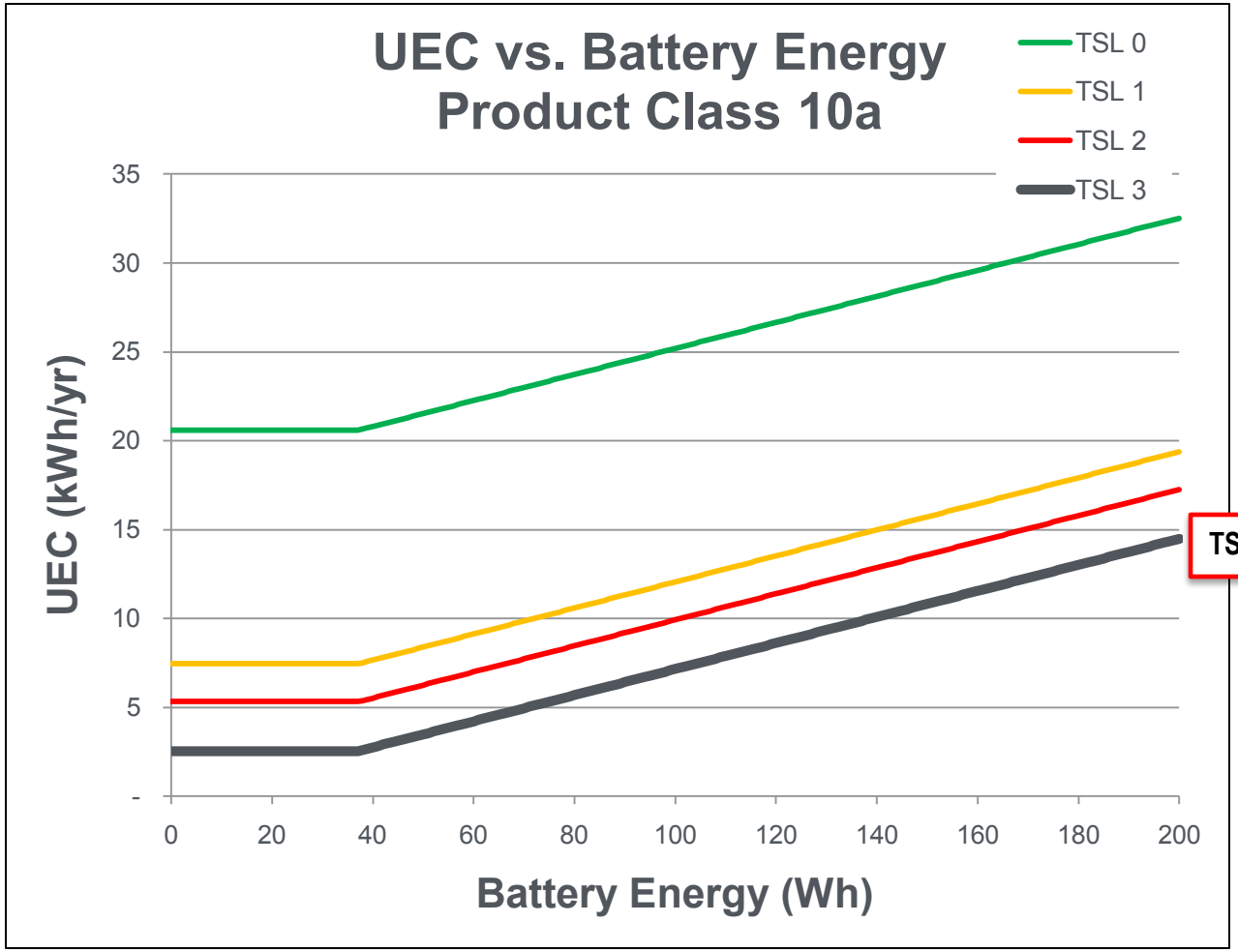
TSL 1 represents CSL 1 in product class 7.

Projected National Impacts of Proposed Standard (TSL 1)	
National energy savings	0.0096 quads
Consumer NPV	$2,780 million (3% discount rate)
Change in industry NPV	–$75 million to $1,300 million
CO_2 emissions savings	$9.4 million (3% discount rate)
Net Social Benefits	$2,790 million (3% discount rate)

Results and Proposed Standards

Battery Charger Product Class 10a

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



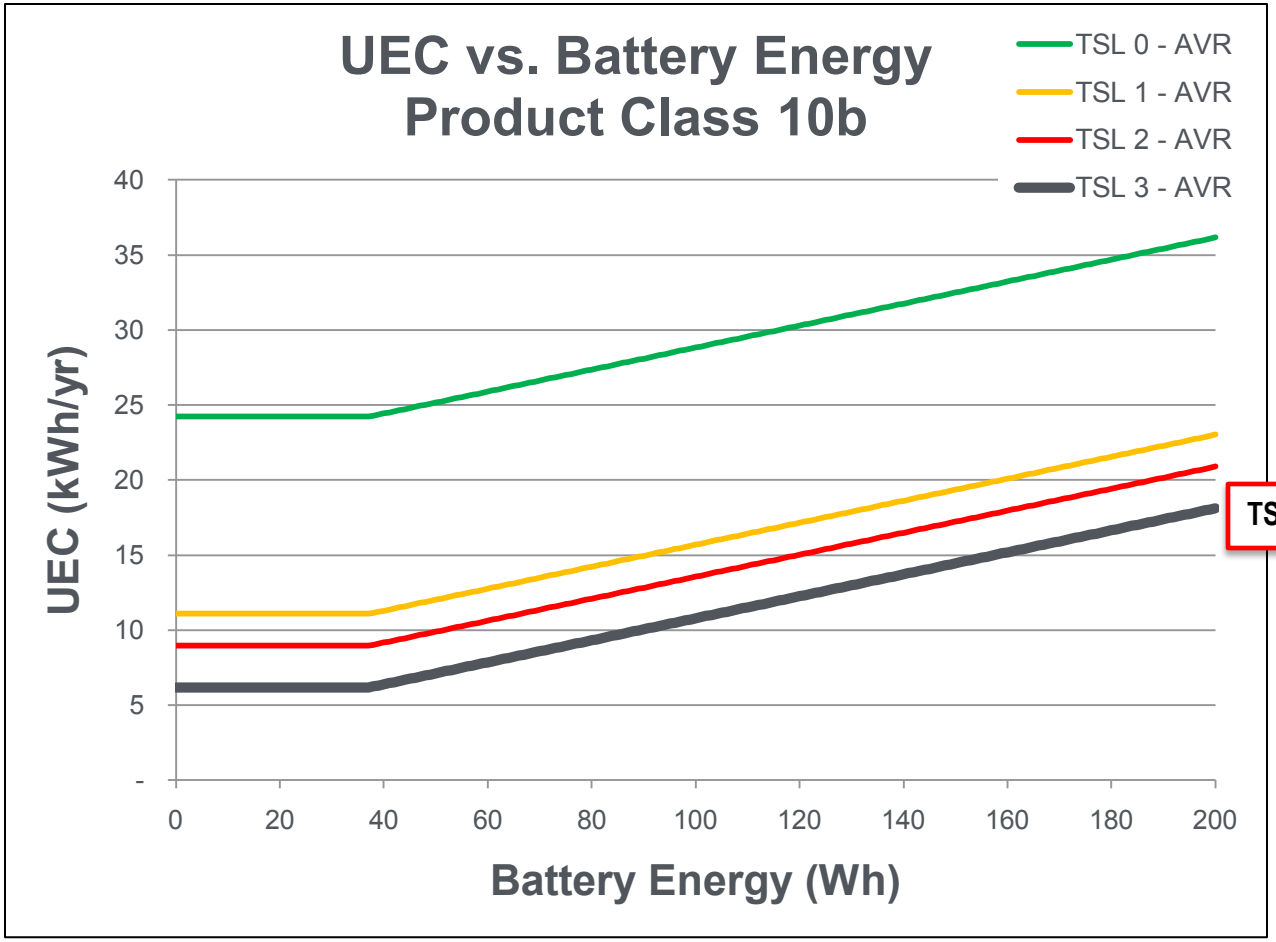
TSL 3 Proposed

10a	AC Output (w/out AVR)	For Ebatt < 37.2 Wh = 2.54 For Ebatt ≥ 37.2 Wh = 0.0733(Ebatt) – 0.18

Results and Proposed Standards

Battery Charger Product Class 10b

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



TSL 3 Proposed

10b	AC Output (w/ AVR)	For Ebatt < 37.2 Wh = 6.18 For Ebatt ≥ 37.2 Wh = 0.0733(Ebatt) + 3.45

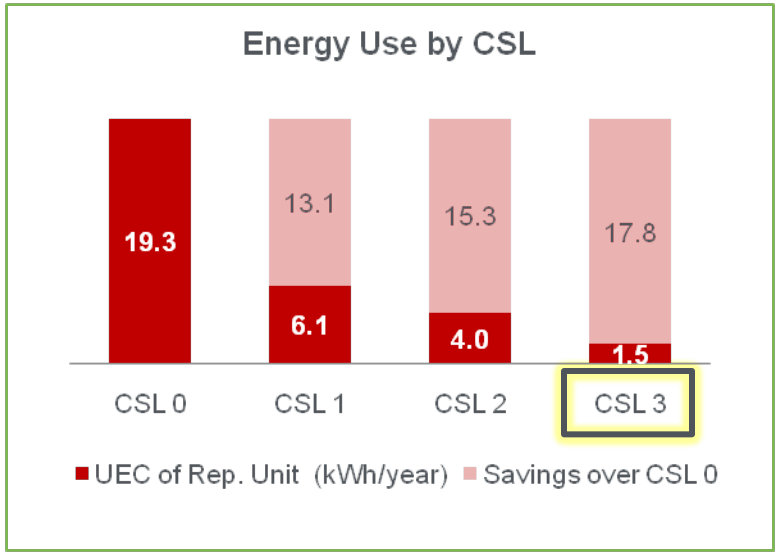
Results and Proposed Standards

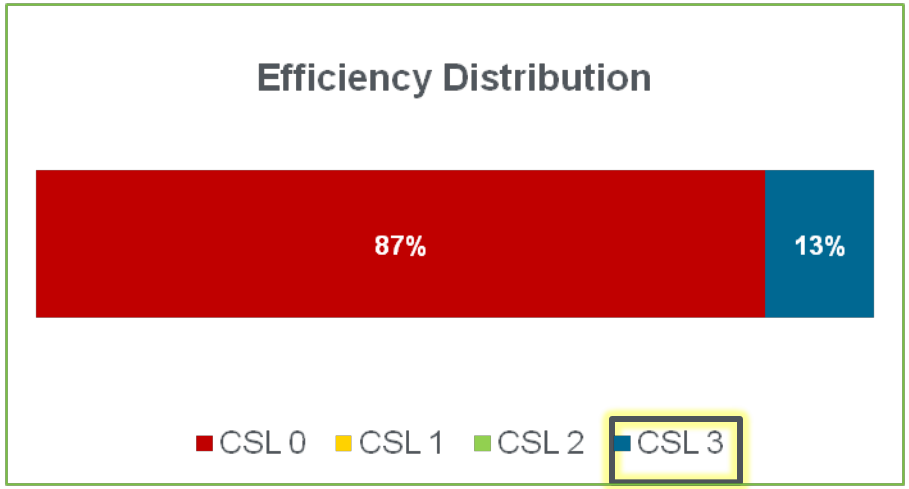
Battery Charger Product Class 10

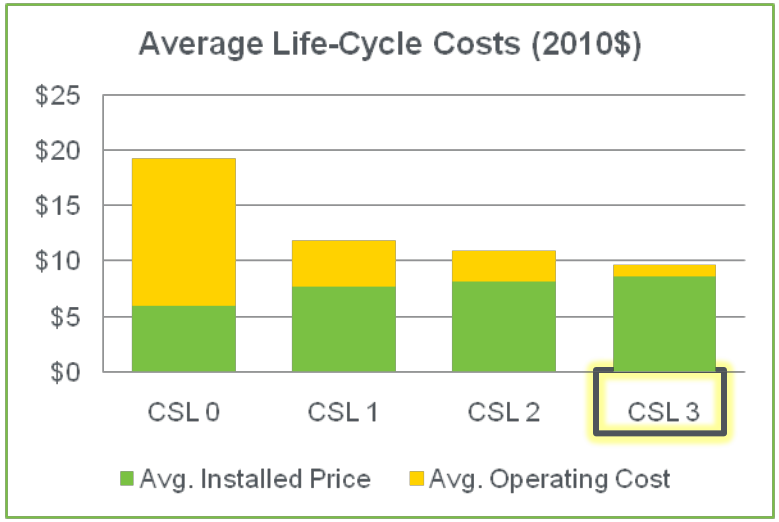
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

AC input/ AC output

Annual Shipments: 8 million uninterruptible power supplies (UPS)



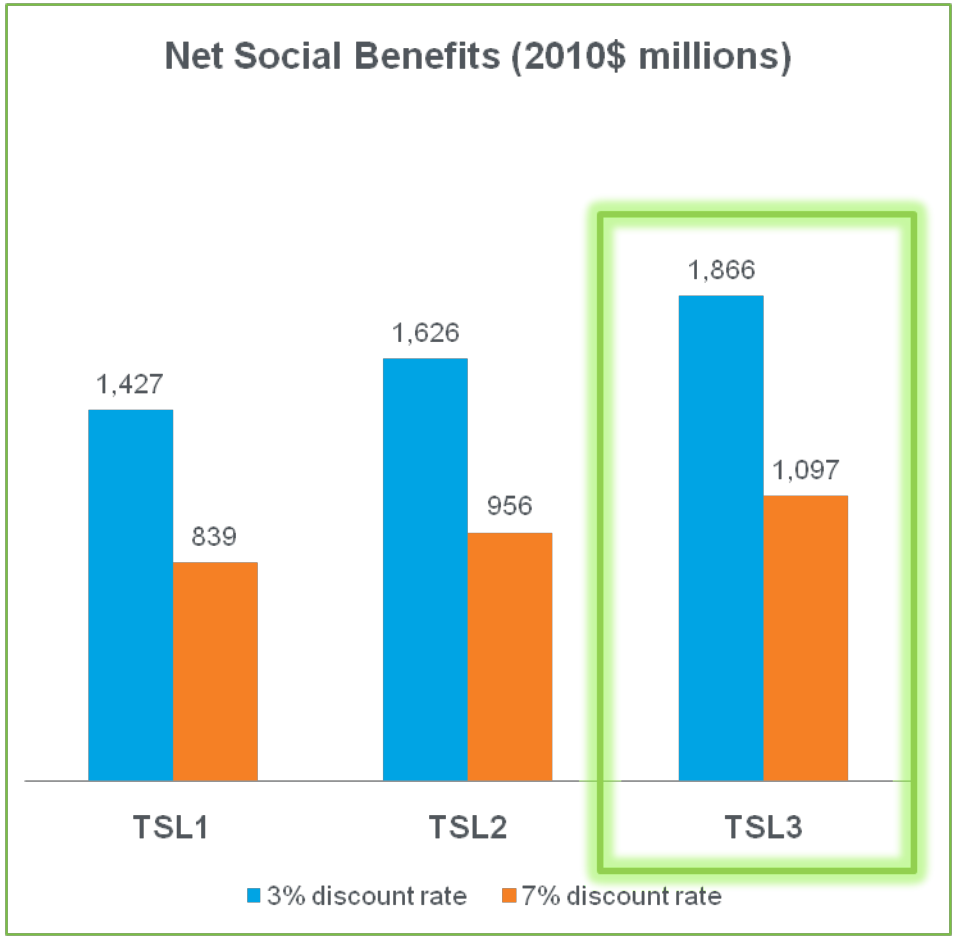




Results and Proposed Standards

Battery Charger Product Class 10

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



Projected National Impacts of Proposed Standards (TSL 3)	
National energy savings	0.3124 quads
Consumer NPV	$1,550 million (3% discount rate)
Change in industry NPV	–$126 million to –$5 million
CO_2 emissions savings	$298 million (3% discount rate)
Net Social Benefits	$1,866 million (3% discount rate)

TSL 3 represents CSL 3 in product class 10.

Proposed Standards
Issues for Comment

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

Item 1. DOE requests interested party feedback, including any substantive data, regarding today's proposed standard levels and the potential for lessening of utility or performance related features.

Item 8. DOE seeks comment, information, and/or data on whether the proposed standards would impact any features in the regulated products or in their associated complimentary applications. If so, DOE seeks comment as to whether these impacts would impact the utility of either the product or the application, and on whether, how, and to what degree consumer welfare might be impacted by the proposed standards.

Item 36. DOE is interested in receiving comments from industry, states, and other interested parties on the best ways to ensure a smooth transition from the battery charger standards established in California to the national standards addressed in this proposed rule.

Additional Item. DOE seeks input on the length of the compliance period for battery chargers.

Comparing DOE's Proposed Standards to CEC Levels

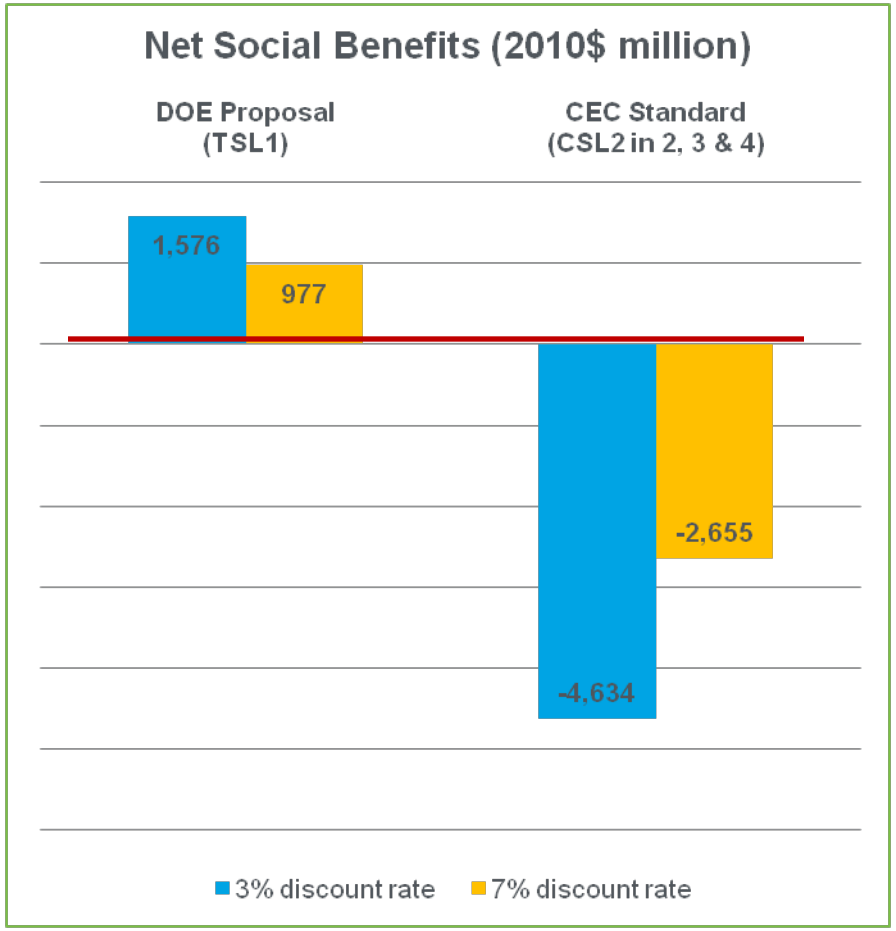
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

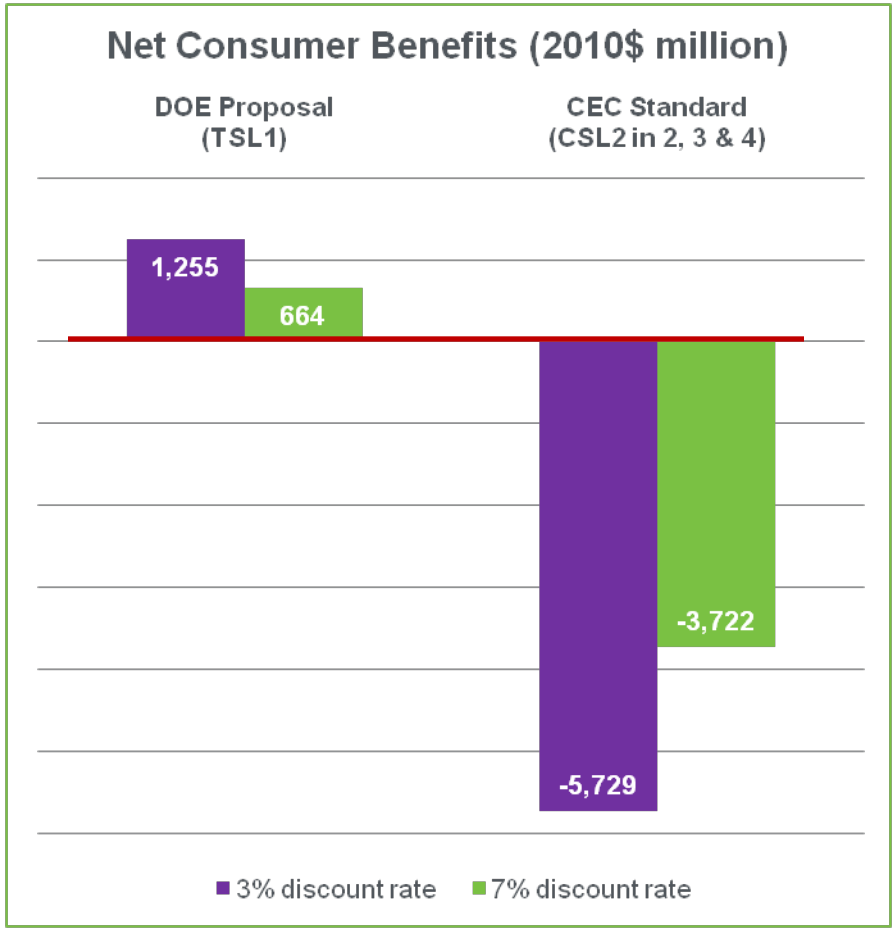
Battery Charger Product Class	Typical Application	Proposed DOE Standard Level (CSL)	CSL that Best Approximates the CEC Standard
1 (low-energy, inductive)	Toothbrushes	2	0
2 (low-energy, low-voltage)	Mobile and Cordless Phones	1	2
3 (low-energy, medium-voltage)	Camcorders, Portable DVD Players	1	2
4 (low-energy, high-voltage)	Notebooks, Large Power Tools	1	2
5 (high-energy, low-voltage)	Marine Chargers	2	3
6 (high-energy, high-voltage)	Scooters, Lawnmowers	2	3
7 (high-energy)	Golf Cars	1	1
8 (DC input < 9 V)	MP3 Players, Mobile Phones	1	0
10 (AC output)	Uninterruptible Power Supplies	3	3

Comparing DOE's Proposed Standards to CEC Levels

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

Battery charger product classes 2, 3, and 4

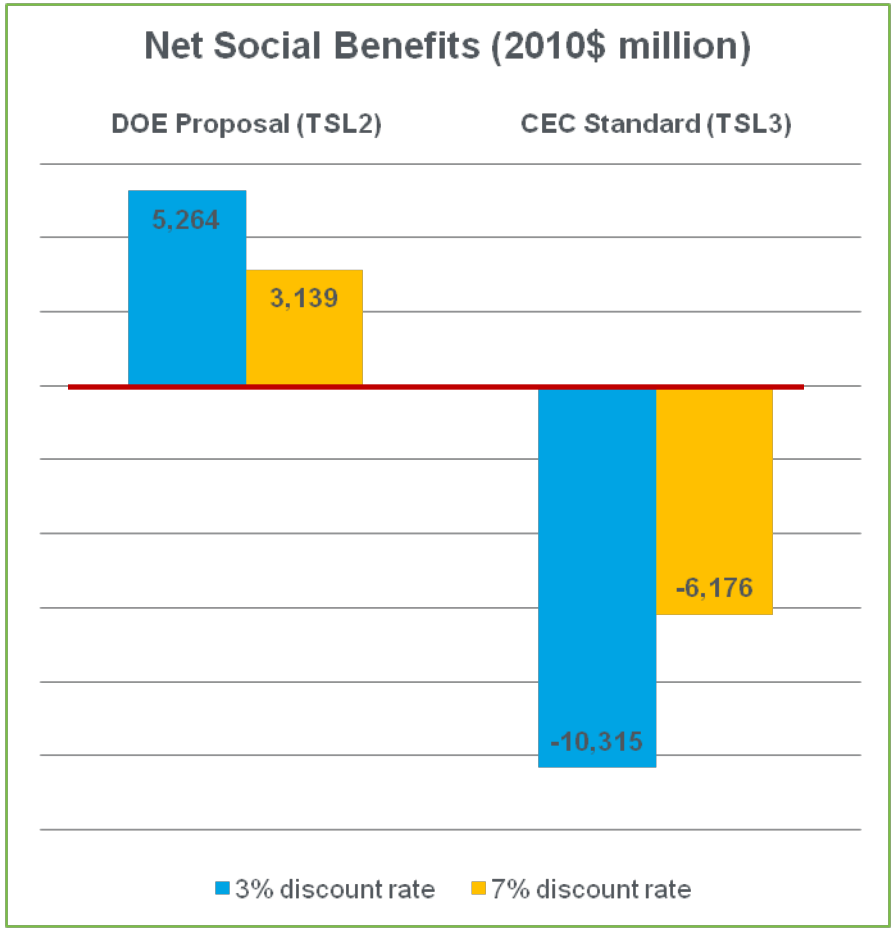


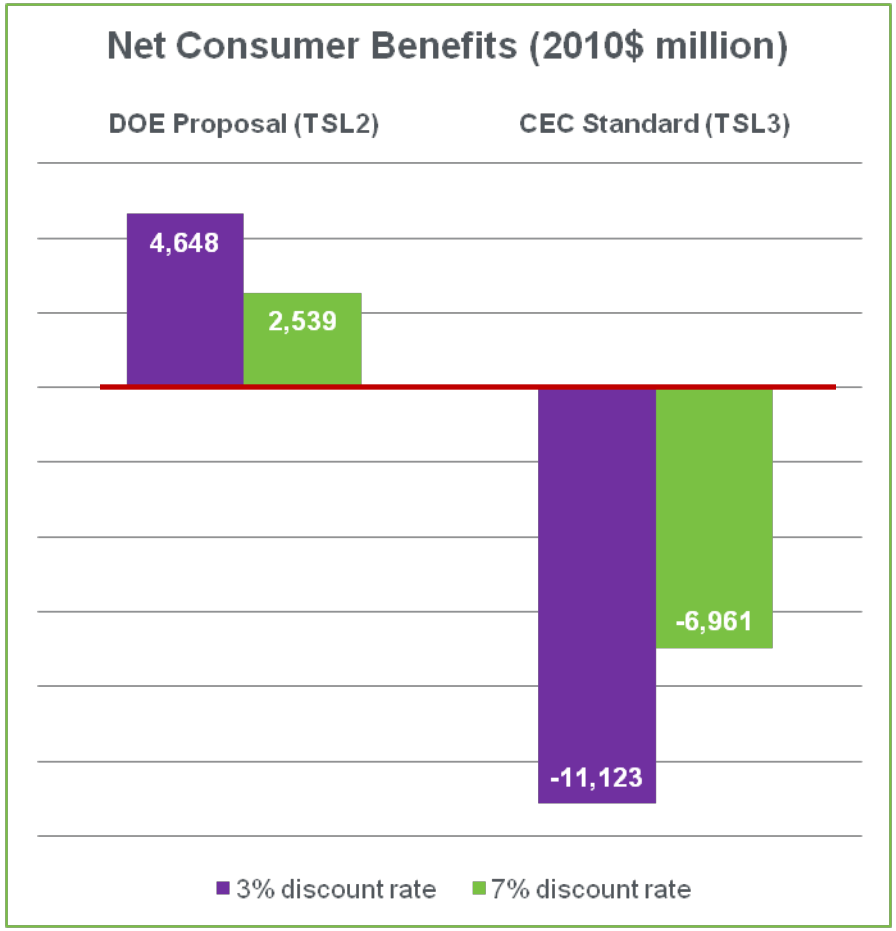


Comparing DOE's Proposed Standards to CEC Levels

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

Battery charger product classes 5 and 6





Labeling

DOE's Proposal for External Power Supplies

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

Type of EPS		Labeling Requirements	
Direct Operation	All	VI (or higher)	
Indirect Operation*	"Class A"	IV N (or higher)	"ACME Model No. XXXXXX" (if sold separately)
	"Non-Class A"	EPS-N	

* An indirect operation EPS that meets the more stringent standard required of an otherwise comparable direct operation EPS may follow the marking requirements for direct operation EPSs.

Labeling
DOE's Proposal for Battery Chargers

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

BC-III Denotes compliance with DOE standards

Other markings reserved for battery chargers that:

BC-I Meet no established standard

BC-II Meet a standard less stringent than the DOE standard

BC-IV Meet a standard more stringent than the DOE standard

NRDC's proposal specifies location of marking:

Battery Charger Form Factor	Location of Marking
One housing	Any visible location on that housing
Three separate housings	Component that contains charge control
Power supply and charge control together, battery separate	Component that contains power supply and charge control
Charge control and battery together, power supply separate	Component that contains charge control and battery

Labeling
Issues for Comment

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

Item 35. DOE welcomes comment on any and all issues related to efficiency markings for battery chargers and EPSs.

Closing Remarks

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

In all correspondence, please refer to the Battery Chargers and External Power Supplies Energy Conservation Standard

Docket Number EERE-2008-BT-STD-0005 and
Regulatory Identification Number (RIN) 1904-AB57

Federal eRulemaking Portal: http://www.regulations.gov

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Comment period closes May 25th, 2012