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Submitted via email

Ms. Karen Douglas
Commissioner
California Energy Commission
1516 Ninth Street
Sacramento, California 95814

NEMA Supplemental Response to CCR Title 20 45 Day Language Regarding Exit and Life Safety Signage

The National Electrical Manufacturers Association (NEMA) appreciates the opportunity to provide the attached information to supplement and expand on our letter of October 31, 2011 regarding the subject 45 day language.

As you may know, NEMA is the association of electrical equipment manufacturers, founded in 1926 and headquartered in Arlington, Virginia. Its member companies manufacture a diverse set of products including power transmission and distribution equipment, lighting systems, factory automation and control systems, and medical diagnostic imaging systems. Worldwide annual sales of NEMA-scope products exceed \$120 billion. These comments are submitted on behalf of NEMA Emergency Lighting section companies.

Thank you for your consideration of this information and proposal. If you have any questions on these comments, please contact Alex Boesenberg of NEMA at 703-841-3268 or alex.boesenberg@nema.org.

Sincerely,

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Comments and Recommendations from the NEMA Emergency Lighting Product Section

It is the continued request of the member companies in the Emergency Lighting Section of the National Electrical Manufacturers Association (NEMA) to exclude emergency lighting equipment from the proposed CEC Battery Charger rulemaking. The reduction in charge energy allowance contained in the 45-day language would result in the inability of the products to meet the battery charge / discharge test as required by the UL 924 Standard for Emergency Lighting and Power Equipment. NEMA member companies, again, submit to you that emergency lighting equipment should not be among the products affected by the CEC proposal. The industry provides the following information and explanation as to why all battery chargers used in and with emergency lighting equipment should be exempted.

In the last CEC hearing it was stated by Suzanne Foster-Porter with Ecova, formally known as Ecos Consulting:

“This standard does not impact the type of lighting, the amount of lighting, the quality of light that’s used with the emergency egress and only measures the energy use that a battery has used to create the backup system for that light.”, and “The CASE report—in preparation for the CASE report, we reported test data from one specific lighting system and investigated the circuitry of others to confirm that the battery charging circuitry found within an emergency egress light is the same type of topology, technology and approach that is used with other battery charger systems found in other parts of the standard; and concluded that the technology from other battery charger systems that have similar topology can transfer to this technology.”

Although that statement by itself, without any knowledge of requirements placed on emergency lighting products, may be true, when considered in the full context of the performance and safety requirements for emergency lighting products, the statement does not hold. Emergency lighting products are tested and listed in accordance with the Underwriters Laboratory safety standard 924. This standard is comprehensive in its requirements for charging the battery and requires a minimum of 90 minutes of light output before dropping below 87.5% of the nominal battery voltage. We are not aware of any other battery charger product with such a requirement. If a product is unable to meet specifications and cannot be manufactured we argue this would be a significant reduction of light output. UL 924 compliant products are designed to meet (or exceed) this requirement. Testing is well defined as are the energy performance requirements to operate emergency lighting products. We recommend that the CEC fully review and become informed on the UL 924 requirements for these life safety products. NEMA members offer their assistance for a full technical discussion of this technology and product performance.

The proposed regulation also does not provide any definition of emergency lighting products. Emergency lighting is comprised of many different types of products with specific purposes. Emergency lighting goes beyond exit signs and includes products which illuminate an emergency path of egress. These products range from individual unit equipment complete with lights and batteries, emergency fluorescent battery packs, central DC storage equipment, small and large AC inverters and more.

Comments by Proposal Section

Section 1602. Definitions.

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(1) Emergency Lighting and Self-Contained Lighting Controls.

The fact that emergency lighting and self-contained lighting controls are placed together makes us question whether the definition of emergency lighting is understood. Emergency lighting

products are designed to define and illuminate the building means of egress during times of utility power failure.

The National Fire Protection Association (NFPA) 101 Life Safety Code Section 7.9 dictates methods and requirements for emergency lighting of the means of egress. Further, NFPA 101 Requirements Section 7.8 defines illumination of the means of egress during normal utility power. This is typically the lighting seen in buildings at night after business hours. The requirements for each are similar but unique. Lighting controls have been considered by the CEC in an effort to turn off egress path illumination (under normal utility power conditions) when the building is unoccupied in an effort to save energy. This makes sense. However, this is not the case for emergency lighting. The most obvious reason for this is that if emergency lighting products lose power they immediately turn on their lamps and would drain the batteries leaving the units inoperable in the event of a true power failure. Additionally, even if the lamps were overridden the unit batteries would begin to self-discharge leaving the units in a less than capable condition.

Emergency lighting products need to be ready to provide immediate output for a minimum of 90 minutes as required by Underwriters Laboratories standard 924 and various building codes. This is for obvious safety reasons. The 90-minute requirement of UL 924 is a minimum and there are installations which need / require longer time (up to 8 hours) of required lighting based on the type of facility the equipment is installed. Some emergency lighting equipment is indeed listed for these extended runtimes to the UL 924 standard.

Emergency lighting also goes beyond the evacuation of people. It is often noted by emergency responders (fire department personnel, etc.) that they use emergency lighting to assist them in safely traveling through and exiting a building during firefighting operations. This is an additional motivation behind the design and manufacture of UL 924 listed / recognized products. All emergency lighting (signs and unit equipment) deliver an immediate maximum energy (in the form of illuminance for lighting or luminance for signs) for a relatively short but critical period of time. These are the prime design considerations, as specified by UL 924, for emergency lighting and should not be viewed as an opportunity for reducing energy consumption.

Emergency lighting is not an optional piece of equipment. Emergency lighting is mandated by building codes across the nation. The proposed 45-day language would have the effect of reducing the effectiveness of emergency lighting to a point that some products would fail to meet State and Federal building and life safety codes.

Upon examining *Section 1602 Definitions...(l) Emergency Lighting and Self-Contained Controls*, we find no definition of emergency lighting. All the definitions under that section refer to lighting controls and none exist for emergency lighting in the current version of Title 20.

For this reason, it is our recommendation to separate Emergency Lighting from Self-Contained Lighting Controls in Section 1602 (l). Please see the end of these comments for our recommended wording to describe emergency lighting products.

Section 1604 Test Methods for Specific Appliances

(1) Emergency Lighting. The test method for illuminated exit signs is 10 CFR Section 431.204(b) (2008)

Note that exit signs have been eliminated from the proposed regulation as California (CEC) already has power requirements for exit signs.

Section 1605.2 State Regulations for Federally-Regulated Appliances.

(1) Emergency Lighting and Self-Contained Lighting Controls

1) See Section 1605(1) for energy efficiency standards for illuminated exit signs.

This refers to the Federal Standard (assumed to be EPA 2005) which does not relate to this proposal.

Section 1605.3. State Regulations for Non-Federally-Regulated Appliances.

(1) Emergency Lighting and Self Contained Lighting Controls.

(1) Illuminated Exit Signs. See Section 1605.1(1) for energy efficiency standards for illuminated exit signs.

Again, this is referring to federal regulations of exit signs only.

“Battery charger system (BCS)” means a battery charger coupled with its batteries or battery chargers coupled with their batteries, which together are referred to as battery charger systems. This term covers all rechargeable batteries or devices incorporating a rechargeable battery and the chargers used with them. Battery charger systems include, but are not limited to:

- (1) electronic devices with a battery that are normally charged from AC line voltage or DC input voltage through an internal or external power supply and a dedicated battery charger;*
- (2) the battery and battery charger components of devices that are designed to run on battery power during part or all of their operations;*
- (3) dedicated battery systems primarily designed for electrical or emergency backup; and*
- (4) devices whose primary function is to charge batteries, along with the batteries they are designed to charge. These units include chargers for power tool batteries and chargers for automotive, AA, AAA, C, D, or 9 V rechargeable batteries, as well as chargers for batteries used in larger industrial motive equipment and à la carte chargers.*
- (5) The charging circuitry of battery charger systems may or may not be located within the housing of the end- use device itself. In many cases, the battery may be charged with a dedicated external charger and power supply combination that is separate from the device that runs on power from the battery.*

In the above quote from the 45-day language, item 3 refers to emergency backup but no definition for emergency backup exists in the standard. It needs to be clarified as to which particular situation it refers. Searching through the entire proposal, emergency lighting is not

addressed. We believe it should be kept that way with exclusion for emergency lighting (life safety) products.

*(13) Emergency Lighting and Self-Contained Lighting Controls.
All occupant sensing devices which utilize microwave radiation for detection of occupants shall be marked with an approved Federal Communications Commission identifier. In addition, such devices must have permanently affixed installation instructions recommending that the device be installed at least 12 inches from any area normally used by room occupants.*

Again, grouping emergency lighting with self-contained lighting controls even though the two have nothing in common strikes us as odd. The word emergency is strewn throughout the document but no real definition or clarity is given to this mission critical product.

Energy Savings Estimates

A topic that has not been adequately addressed to date is the issue of what the actual benefit of reducing energy consumption in the emergency lighting area actually means to overall energy savings. An analysis of the potential energy savings as compared to overall energy usage is revealing.

Analysis of California energy usage from California’s Energy Consumption Data Management (ECDMS) – State of California (refer to Appendix A) and the US Energy Information Administration shows the following:

US Estimate of California Total Energy Usage

$$\begin{aligned}
 & US \text{ Estimate of California Total Energy Usage } \left(\frac{\text{Billion BTU}}{\text{Yr}} \right) \\
 & = \frac{8003 \text{ Trillion BTU}}{\text{Yr}} * \frac{1000 \text{ Billion}}{\text{Trillion}} = 8,003,000 \frac{\text{Billion BTU}}{\text{Yr}}
 \end{aligned}$$

$$\begin{aligned}
 & US \text{ Estimate of California Total Energy Usage } \left(\frac{\text{GWh}}{\text{Yr}} \right) \\
 & = \frac{8,003,000 \text{ Billion BTU}}{\text{Yr}} * \frac{1 \text{ GWh}}{3.41 \text{ Billion BTU}} = 2,354,838 \frac{\text{GWh}}{\text{Yr}}
 \end{aligned}$$

Or written out expressed in KWh/Yr: 2,354,838,000,000 KWh/year.

However evaluating California’s electrical energy use gives the following:

California Electrical Only Energy Use $\left(\frac{\text{GWh}}{\text{Yr}} \right)$ (From Appendix A)

274,985 Million KWh = **274,985 GWh/Yr**

Or written out in terms of KWh/Year: 274,985,000,000 KWh/year.

US Federal Estimates of California Electrical Energy Use (From Appendix B)

$$= \frac{885.7 \text{ Trillion BTU}}{\text{Yr}} * \frac{1000 \text{ Billion}}{1 \text{ Trillion}} \frac{1 \text{ GWh}}{3.41 \text{ Billion BTU}} = 259,736 \frac{\text{GWh}}{\text{Yr}}$$

Note: The US Energy Information Administration's database (see Appendix B) is basically in agreement with California's estimated electrical energy usage.

So how does this relate to the proposed regulation's anticipated energy savings?

Emergency Lighting Energy Potential Savings as Compared to California Electrical Energy Use

CASE Study Anticipated Energy Saving (Emergency Backup Lighting) = $37.95 \frac{\text{GWh}}{\text{Yr}}$ (as compared to 259,736 GWh/yr).

$$\text{Percentage Decrease in Energy Usage: } \left(1 - \frac{(259,736 - 37.95)}{259,736} \right) = .000146 \text{ or } .0146\% / \text{Yr}$$

Even if one includes 'Emergency Systems' (no definition is given for 'Emergency Systems') the anticipated savings would be $137.81 \frac{\text{GWh}}{\text{Yr}}$ (as compared to 259,736 GWh/yr).

$$\text{Percentage Decrease in Energy Usage: } \left(1 - \frac{(259,736 - 137.81)}{259,736} \right) = .000531 \text{ or } .0531\% / \text{Yr}$$

Although 37.95 GWh/Year sounds like an incredible amount of energy, when compared to the State of California's annual electrical energy usage of 259,736 GWh/Year it becomes insignificant (.0146%). Energy savings is very important but safety is not an acceptable bartering item to gain it.

Additionally, if one looks at the total energy savings of all categories (335 GWh/Yr) as proposed by the battery charger efficiency proposed rulemaking the numbers look like this:

$$\text{Electrical Energy Reduction per Year: } \left(1 - \frac{(259,736 - 335)}{259,736} \right) = .00129 \text{ or } .129\%$$

Legislative Criteria

Section 25402, subdivision (c), of the Public Resources Code authorizes the Energy Commission to adopt regulations for minimum levels of operating efficiency of appliances whose use, as determined by the Commission, requires a significant amount of energy on a statewide basis.

New and revised regulations must be feasible and attainable and must not result in any added total costs to the consumer over the designed life of the appliances concerned. The added total cost is derived by comparing the cost and performance

of a typical model that the consumer would purchase with the proposed standard in effect to the cost and performance of a typical model that the consumer would purchase without the proposed standard in effect.

The projected savings do not appear to meet the requirements of the Legislative Criteria of Section 25402, subdivision (c), of the Public Resources Code.

Even if this were to be construed as significant savings it is noteworthy that the analysis includes all categories of products and would seem to assume that all existing products in the field would be instantly removed and supplanted by the new, more energy efficient products. Based on the rate of new product sales and attrition of old products it would be many years before these savings would be realized.

NEMA's Proposed Wording:

Section 1601. Scope.

(l) Self-contained lighting Controls.

(w) Battery charger systems, except those:

(3) used to charge a battery or batteries in emergency lighting products as defined in Section 1602(m) ~~in an illuminated exit sign, as defined in Section 1602(l).~~

Section 1602. Definitions.

(m) "Emergency Lighting" is defined as products manufactured, tested and listed or recognized in accordance with Underwriters Laboratories Standard 924 *Emergency Lighting and Power Equipment.*

Thank you for the opportunity to provide these comments. Please seriously consider the life safety ramifications of including emergency lighting in this and any future proposals.

Appendix A – California Electrical Energy Usage Source: Energy Consumption Data Management (ECDMS) – State of California All Usage Expressed in Millions of kWh

Utility Type	Utility Name	Year	Ag & Water Pump	Commercial Building	Commercial Other	Industry	Mining & Construction	Residential	Streetlight	Total Usage
Investor owned utility	Bear Valley Electric Service	2010	0.03	10.27	0.00	0.00	0.00	76.06	0.19	86.56
Investor owned utility	Mountain Utilities	2010	0.00	0.00	0.00	0.00	0.00	5.55	0.00	5.55
Investor owned utility	Pacific Gas and Electric Company	2010	5,002.48	30,857.58	4,091.01	10,745.89	2,339.88	31,021.13	465.91	84,523.88
Investor owned utility	Pacificorp	2010	94.94	229.27	25.03	49.78	2.26	416.14	3.88	821.29
Investor owned utility	San Diego Gas and Electric Company	2010	305.75	8,343.41	1,844.20	1,330.68	166.76	7,315.87	178.40	19,485.07
Investor owned utility	Sierra Pacific Power Company	2010	11.31	218.89	29.64	1.44	20.76	282.84	0.41	565.29
Investor owned utility	Southern California Edison Company	2010	2,925.96	32,082.06	4,238.32	12,162.14	1,757.44	28,531.75	499.89	82,197.57
Joint utility agency	Calaveras Public Power Agency	2010	10.36	15.93	6.25	0.00	0.00	0.00	0.00	32.54
Joint utility agency	Tuolumne County Public Power Agency	2010	0.00	20.01	6.83	0.00	0.00	0.00	0.00	26.84
Publicly owned utility	Azusa Light & Water	2010	7.78	78.81	10.20	67.81	1.77	73.94	0.12	240.43
Publicly owned utility	City of Alameda	2010	0.02	233.69	38.29	13.90	7.54	141.60	0.00	435.03
Publicly owned utility	City of Anaheim	2010	0.83	1,819.61	231.84	580.61	68.48	886.62	0.00	3,587.98
Publicly owned utility	City of	2010	3.52	0.00	0.00	0.00	0.00	50.01	2.60	56.13

owned utility	Banning	0								
Publicly owned utility	City of Biggs	2010	0.00	0.91	0.00	11.96	0.00	4.34	0.00	17.21
Publicly owned utility	City of Burbank	2010	8.43	582.06	185.68	64.16	4.18	270.28	0.00	1,114.79
Publicly owned utility	City of Colton	2010	9.60	83.01	13.67	70.47	0.25	153.20	0.03	330.23
Publicly owned utility	City of Corona	2010	2.12	38.84	13.04	3.59	12.62	5.02	0.00	75.24
Publicly owned utility	City of Gridley	2010	0.00	15.36	0.60	3.47	0.01	14.88	0.00	34.32
Publicly owned utility	City of Healdsburg	2010	0.20	35.17	4.40	6.46	1.27	29.95	0.16	77.61
Publicly owned utility	City of Hercules	2010	0.01	4.50	3.81	4.72	0.07	4.06	0.00	17.16
Publicly owned utility	City of Lodi	2010	5.39	108.33	8.27	78.79	15.83	141.05	0.03	357.70
Publicly owned utility	City of Lompoc	2010	4.97	50.60	9.08	6.59	2.19	57.25	0.00	130.68
Publicly owned utility	City of Needles	2010	1.18	28.28	3.80	0.04	0.41	4.46	0.00	38.17
Publicly owned utility	City of Palo Alto	2010	5.08	615.33	17.74	141.53	17.46	161.58	3.60	962.31
Publicly owned utility	City of Pasadena	2010	16.87	752.32	38.43	27.34	4.27	328.00	16.15	1,183.37
Publicly owned utility	City of Rancho Cucamonga	2010	0.65	62.88	0.32	0.05	0.37	0.00	0.74	65.01
Publicly owned utility	City of Redding	2010	16.22	361.50	30.97	11.00	3.84	376.30	0.00	799.84
Publicly owned utility	City of Riverside	2010	19.14	1,022.04	56.26	202.73	12.02	663.34	22.49	1,998.03
Publicly owned utility	City of Roseville	2010	0.80	554.31	57.33	200.31	18.96	420.63	1.88	1,254.23
Publicly owned utility	City of San Francisco	2010	46.61	354.06	541.30	14.20	3.20	22.29	29.05	1,010.71

Publicly owned utility	City of Ukiah	2010	0.01	71.55	2.76	1.45	0.80	36.56	0.00	113.13
Publicly owned utility	City of Vernon	2010	0.00	192.44	18.44	712.54	0.46	0.18	0.00	924.06
Publicly owned utility	Department of Water Resources	2010	7,566.38	0.00	0.00	0.00	0.00	0.00	0.00	7,566.38
Publicly owned utility	Glendale Water & Power	2010	3.45	606.72	20.27	51.04	25.85	372.72	17.16	1,097.21
Publicly owned utility	Imperial Irrigation District	2010	248.93	1,142.85	184.59	190.13	61.93	1,389.83	9.30	3,227.57
Publicly owned utility	Lassen Municipal Utility District	2010	5.75	54.14	0.00	0.00	0.00	73.85	0.43	134.17
Publicly owned utility	Los Angeles Department of Water and Power	2010	37.16	10,447.35	1,688.70	2,295.96	196.80	8,017.65	245.48	22,929.10
Publicly owned utility	Merced Irrigation District	2010	10.10	175.20	7.12	201.39	6.20	47.67	1.52	449.20
Publicly owned utility	Metropolitan Water Department	2010	2,195.80	0.00	0.00	0.00	0.00	0.00	0.00	2,195.80
Publicly owned utility	Modesto Irrigation District	2010	137.63	795.78	57.95	672.47	24.88	849.08	11.98	2,549.76
Publicly owned utility	Moreno Valley Utilities	2010	0.05	57.53	0.24	2.41	0.58	34.04	1.09	95.95
Publicly owned utility	Port of Oakland	2010	0.00	9.29	33.38	4.86	0.00	0.00	0.00	47.53
Publicly owned utility	Port of Stockton	2010	0.09	7.26	3.70	2.03	0.01	0.00	0.00	13.10
Publicly owned utility	Sacramento Municipal Utility District	2010	182.72	4,108.55	491.79	818.32	118.11	4,487.41	86.23	10,293.12
Publicly owned utility	Shasta Dam Area Public	2010	0.00	11.96	0.00	123.67	0.00	39.64	0.00	175.27

	Utility District									
Publicly owned utility	Silicon Valley Power	2010	0.04	1,515.00	52.97	1,104.70	12.56	243.77	0.00	2,929.05
Publicly owned utility	Truckee-Donner Public Utility District	2010	8.94	67.40	0.51	0.00	0.00	79.78	0.06	156.69
Publicly owned utility	Turlock Irrigation District	2010	260.04	495.76	97.60	452.03	9.20	675.59	0.00	1,990.22
Publicly owned utility	Victorville Municipal	2010	0.02	5.34	3.74	49.65	0.02	0.00	0.10	58.87
Rural electric cooperative	Anza Electric Cooperative, Inc.	2010	1.62	0.00	0.00	0.00	0.00	33.05	0.00	34.67
Rural electric cooperative	Plumas-Sierra Rural Electric Cooperative	2010	14.08	62.85	17.80	1.12	0.33	59.86	0.02	156.06
Rural electric cooperative	Surprise Valley Electrical Corporation	2010	46.53	7.19	1.43	0.05	0.42	36.68	0.05	92.36
Rural electric cooperative	Valley Electric Association, Inc.	2010	16.23	0.00	0.00	0.00	0.00	0.12	0.00	16.35
Self Generator	Self Generation in the BUGL Planning Area	2010	0.00	5.72	0.00	0.00	0.06	1.24	0.00	7.02
Self Generator	Self Generation in the IID Planning Area	2010	0.00	4.07	0.05	0.15	0.00	1.66	0.00	5.92
Self Generator	Self Generation in the LADWP Planning Area	2010	0.00	333.26	2.82	771.71	24.26	11.77	0.00	1,143.83
Self Generator	Self Generation	2010	0.00	0.00	0.00	1.03	0.00	0.00	0.00	1.03

or	n in the OTHER Planning Area									
Self Generator	Self Generation in the PASD Planning Area	2010	0.00	2.38	0.00	0.00	0.00	0.63	0.00	3.01
Self Generator	Self Generation in the PGE Planning Area	2010	25.56	709.13	75.68	3,450.85	960.60	261.05	0.00	5,482.88
Self Generator	Self Generation in the SCE Planning Area	2010	22.64	594.68	270.19	2,768.46	1,517.50	99.18	0.00	5,272.66
Self Generator	Self Generation in the SDGE Planning Area	2010	5.43	454.21	80.16	156.37	0.13	53.89	0.00	750.19
Self Generator	Self Generation in the SMUD Planning Area	2010	0.08	29.40	0.46	9.25	0.00	11.76	0.00	50.95
Western Area Power Agency	Central Valley Project	2010	1,641.45	804.98	862.41	0.00	182.33	0.00	0.00	3,491.17

20,930.96 101,351.06 15,481.08 39,641.30 7,604.89 88,376.82 1,598.96 274,985.06 Million KWh/Yr
 274,985,063,875.00 KWh/Yr

Appendix B – Energy Usage by State – Source: US Energy Information Administration

Rank	Coal		Natural Gas ^a		Petroleum ^b		Retail Electricity Sales		Total Consumption per Capita	
	State	Trillion Btu	State	Trillion Btu	State	Trillion Btu	State	Trillion Btu	State	Million Btu
1	Texas	1,497.9	Texas	3,462.2	Texas	5,512.4	Texas	1,178.1	Wyoming	955.8
2	Indiana	1,365.4	California	2,391.4	California	3,590.0	California	885.7	Alaska	907.5
3	Ohio	1,267.3	Louisiana	1,300.3	Florida	1,682.6	Florida	766.8	Louisiana	749.8
4	Pennsylvania	1,223.9	New York	1,166.1	New York	1,465.0	Ohio	499.2	North Dakota	660.8
5	Illinois	1,015.0	Florida	1,081.8	Louisiana	1,385.4	Pennsylvania	490.5	Iowa	471.5
6	Kentucky	937.1	Illinois	958.3	Pennsylvania	1,317.7	New York	477.8	Texas	456.1
7	Missouri	765.6	Pennsylvania	833.8	Illinois	1,282.2	Illinois	466.4	South Dakota	443.8
8	West Virginia	742.9	Ohio	768.9	Ohio	1,204.7	Georgia	446.2	Kentucky	435.2
9	Michigan	735.9	Michigan	746.8	New Jersey	1,110.9	North Carolina	435.6	Nebraska	422.9
10	Georgia	723.4	Oklahoma	678.3	Georgia	1,061.8	Virginia	370.1	Montana	422.4
11	North Carolina	678.7	New Jersey	638.9	North Carolina	870.8	Indiana	338.9	Indiana	408.7
12	Alabama	631.0	Colorado	530.1	Virginia	863.8	Michigan	334.8	Alabama	405.1
13	Florida	581.5	Indiana	514.2	Michigan	860.9	Tennessee	322.9	Oklahoma	404.4
14	Tennessee	477.7	Georgia	475.4	Indiana	792.2	Washington	307.6	West Virginia	392.9
15	Wyoming	473.9	Alabama	473.9	Tennessee	778.4	Kentucky	303.0	Mississippi	386.0
16	Iowa	444.6	Massachusetts	408.6	Washington	777.1	Alabama	282.7	Kansas	384.9
17	Wisconsin	425.9	Minnesota	405.6	Kentucky	680.1	Missouri	271.9	Arkansas	365.3
18	North Dakota	423.3	Wisconsin	392.5	Missouri	676.6	Louisiana	268.4	South Carolina	347.1
19	Arizona	413.3	Arizona	376.7	Minnesota	625.6	South Carolina	260.7	Minnesota	343.8
20	Oklahoma	373.3	Mississippi	371.3	Massachusetts	595.2	New Jersey	258.6	Tennessee	339.5
21	South Carolina	372.0	Alaska	344.0	Alabama	593.0	Arizona	250.6	New Mexico	333.8
22	Utah	365.0	Virginia	330.6	South Carolina	560.6	Wisconsin	226.2	Idaho	329.5
23	Kansas	356.1	Washington	319.4	Wisconsin	552.2	Minnesota	218.4	Maine	327.1
24	Colorado	350.2	Iowa	317.4	Maryland	545.1	Maryland	213.6	Ohio	315.1
25	Virginia	334.6	Kansas	289.4	Arizona	540.3	Oklahoma	186.1	Wisconsin	308.7
26	Minnesota	328.7	Nevada	283.7	Oklahoma	500.7	Massachusetts	185.5	Washington	304.7
27	New Mexico	306.2	Missouri	266.5	Colorado	480.2	Colorado	174.1	District of Columbia	304.0
28	Maryland	266.9	Oregon	254.7	Iowa	423.4	Oregon	162.3	Missouri	303.9
29	Arkansas	264.1	North Carolina	250.6	Mississippi	414.6	Mississippi	157.1	Virginia	303.4
30	Louisiana	252.5	Arkansas	248.1	Kansas	392.7	Iowa	148.9	Georgia	300.5
31	Nebraska	249.6	New Mexico	247.1	Oregon	373.0	Arkansas	147.3	Illinois	295.9
32	Montana	172.8	Utah	223.6	Connecticut	353.4	Kansas	130.5	Pennsylvania	290.0
33	New York	156.0	Tennessee	222.6	Arkansas	349.1	Nevada	117.0	Colorado	289.6
34	Mississippi	141.7	Kentucky	214.0	Utah	271.2	West Virginia	103.3	Delaware	288.1
35	Massachusetts	92.1	Maryland	204.6	Alaska	257.6	Connecticut	101.4	Oregon	279.0
36	Washington	84.0	South Carolina	197.0	New Mexico	251.5	Nebraska	97.1	New Jersey	275.3
37	Nevada	83.8	Connecticut	187.8	Nevada	250.0	Utah	94.1	North Carolina	272.0
38	New Jersey	59.6	Nebraska	164.9	Hawaii	234.3	Idaho	77.6	Utah	271.3
39	California	52.4	Wyoming	145.7	West Virginia	218.3	New Mexico	73.9	Michigan	270.9
40	South Dakota	37.5	West Virginia	113.9	Nebraska	214.9	Wyoming	56.5	Nevada	268.2
41	Delaware	33.9	Rhode Island	94.9	Maine	206.1	Montana	48.9	Vermont	254.5
42	Oregon	33.2	Idaho	86.8	Montana	174.5	North Dakota	43.2	Maryland	251.3
43	New Hampshire	32.8	Montana	76.4	Wyoming	166.4	District of Columbia	41.6	Florida	232.0
44	Connecticut	26.3	Maine	73.0	New Hampshire	163.2	Maine	38.5	New Hampshire	229.2
45	Hawaii	19.0	South Dakota	66.3	Idaho	153.8	Delaware	38.4	Connecticut	224.3
46	Alaska	14.5	New Hampshire	62.0	North Dakota	128.5	South Dakota	37.6	Arizona	220.8

47	Idaho	8.4	North Dakota	57.6	South Dakota	120.0	New Hampshire	36.5	California	217.0
48	Maine	1.7	Delaware	51.7	Rhode Island	99.6	Hawaii	34.6	Massachusetts	216.3
49	District of Columbia	0.3	District of Columbia	33.5	Delaware	94.5	Rhode Island	26.0	Hawaii	209.5
50	Rhode Island	0.0	Vermont	8.7	Vermont	84.8	Alaska	21.4	Rhode Island	207.4
51	Vermont	0.0	Hawaii	2.7	District of Columbia	19.7	Vermont	18.8	New York	195.6
	United States	19,693.2	United States	23,414.4	United States	36,321.0	United States	12,272.5	United States	308.0

*Natural gas as it is consumed; includes supplemental gaseous fuels that are commingled with natural gas.

†Petroleum products that are consumed; includes fuel ethanol blended into motor gasoline.

Web Page: All data are available at <http://www.eia.gov/state/seds/seds-data-complete.cfm>.

Sources: Data sources, estimation procedures, and assumptions are described in the Technical Notes.