

**ANSI/ASHRAE/ICC/USGBC/IES Addendum aj to  
ANSI/ASHRAE/ICC/USGBC/IES Standard 189.1-2020**

# **Standard for the Design of High-Performance Green Buildings**

**Except Low-Rise  
Residential Buildings**

*The Complete Technical Content of the International Green Construction Code®*

Approved by the ASHRAE Standards Committee on April 24, 2023; by the International Code Council on April 21, 2023; by U.S. Green Building Council on May 17, 2023; by the Illuminating Engineering Society on May 29, 2023; and by the American National Standards Institute on May 31, 2023.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. Instructions for how to submit a change can be found on the ASHRAE® website ([www.ashrae.org/continuous-maintenance](http://www.ashrae.org/continuous-maintenance)).

The latest edition of an ASHRAE Standard may be purchased on the ASHRAE website ([www.ashrae.org](http://www.ashrae.org)) or from ASHRAE Customer Service, 180 Technology Parkway, Peachtree Corners, GA 30092. E-mail: [orders@ashrae.org](mailto:orders@ashrae.org). Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to [www.ashrae.org/permissions](http://www.ashrae.org/permissions).

© 2023 ASHRAE

ISSN 1041-2336



**ASHRAE Standing Standard Project Committee 189.1**

**Cognizant TC: 2.8 Building Environmental Impacts and Sustainability**

**SPLS Liaison: Jay Kohler · ASHRAE Staff Liaisons: Thomas Loxley**

**ICC Liaison: Mike Pfeiffer · IES Liaison: Mark Lien · USGBC Liaison: Wes Sullens**

|  |                  |                    |                    |
|--|------------------|--------------------|--------------------|
| Katherine Hammack*, <i>Chair</i>       | Thomas Culp*     | Thomas Lawrence    | Terry Sharp        |
| Charles Eley*, <i>Co-Vice Chair</i>    | David Delaquila  | Richard Lord       | Kent Sovocool*     |
| Josh Jacobs*, <i>Co-Vice Chair</i>     | Greg Eades*      | Mark Malkin        | Dennis Stanke      |
| Michael Jouaneh*, <i>Co-Vice Chair</i> | Jim Edelson*     | Jonathan McHugh*   | Wayne Stoppelmoor* |
| Lawrence Schoen*, <i>Co-Vice Chair</i> | Anthony Floyd*   | Susan McLaughlin*  | Christine Subasic* |
| Bryan Ahee                             | Ellen Franconi   | Erik Miller-Klein  | Kyle Thompson      |
| Costas Balaras                         | Robert Goo       | Brittany C. Moser* | John Topmiller     |
| Weby Bowles                            | Gregg Gress*     | Saber K. Nikkho    | Martha VanGeem*    |
| Jeff Bradley*                          | Thomas Hogarth*  | Tien Peng          | Scott West*        |
| Frank Burns                            | Donald Horn*     | Andrew Persily     | Theresa Weston*    |
| Julie Chandler                         | Jonathan Humble  | Rock Ridolfi       | Daniel Whittet     |
| Glen Clapper                           | Greg Johnson     | Steven Rosenstock* | Joe Winters*       |
| Ernest Conrad*                         | Jack Karlin      | Aniruddh Roy       | Jian Zhang*        |
| Dru Crawley                            | Gerald Kettler   | Brent Rutherford   |                    |
| John Cross*                            | Andrew Klein     | Michael Schmeida   |                    |
| Michael Cudahy*                        | Vladimir Kochkin | Matthew Setzekorn  |                    |

\* Denotes members of voting status when the document was approved for publication

---

**ASHRAE STANDARDS COMMITTEE 2022–2023**

|                                    |                      |                      |                                |
|------------------------------------|----------------------|----------------------|--------------------------------|
| Susanna S. Hanson, <i>Chair</i>    | Phillip A. Johnson   | Lawrence C. Markel   | Christopher J. Seeton          |
| Jonathan Humble, <i>Vice-Chair</i> | Srinivas Katipamula  | Patrick C. Marks     | Christian R. Taber             |
| William P. Bahnfleth               | Gerald J. Kettler    | Margaret M. Mathison | Paolo M. Tronville             |
| Thomas E. Cappellin                | Jay A. Kohler        | Kathleen Owen        | William F. Walter              |
| Douglas D. Fick                    | Cesar L. Lim         | Gwelen Paliaga       | Steven C. Sill, <i>BOD ExO</i> |
| Patricia Graef                     | Paul A. Lindahl, Jr. | Karl L. Peterman     | Sarah E. Maston, <i>CO</i>     |
| Jaap Hogeling                      | James D. Lutz        | Justin M. Prosser    |                                |
| Jennifer A. Isenbeck               | Julie Majurinv       | David Robin          |                                |

Connor Barbaree, *Senior Manager of Standards*

---

**SPECIAL NOTE**

This American National Standard (ANS) is a national voluntary consensus Standard developed under the auspices of ASHRAE. *Consensus* is defined by the American National Standards Institute (ANSI), of which ASHRAE is a member and which has approved this Standard as an ANS, as “substantial agreement reached by directly and materially affected interest categories. This signifies the concurrence of more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that an effort be made toward their resolution.” Compliance with this Standard is voluntary until and unless a legal jurisdiction makes compliance mandatory through legislation.

ASHRAE obtains consensus through participation of its national and international members, associated societies, and public review.

ASHRAE Standards are prepared by a Project Committee appointed specifically for the purpose of writing the Standard. The Project Committee Chair and Vice-Chair must be members of ASHRAE; while other committee members may or may not be ASHRAE members, all must be technically qualified in the subject area of the Standard. Every effort is made to balance the concerned interests on all Project Committees.

The Senior Manager of Standards of ASHRAE should be contacted for

- interpretation of the contents of this Standard,
- participation in the next review of the Standard,
- offering constructive criticism for improving the Standard, or
- permission to reprint portions of the Standard.

---

**DISCLAIMER**

ASHRAE uses its best efforts to promulgate Standards and Guidelines for the benefit of the public in light of available information and accepted industry practices. However, ASHRAE does not guarantee, certify, or assure the safety or performance of any products, components, or systems tested, installed, or operated in accordance with ASHRAE's Standards or Guidelines or that any tests conducted under its Standards or Guidelines will be nonhazardous or free from risk.

---

**ASHRAE INDUSTRIAL ADVERTISING POLICY ON STANDARDS**

ASHRAE Standards and Guidelines are established to assist industry and the public by offering a uniform method of testing for rating purposes, by suggesting safe practices in designing and installing equipment, by providing proper definitions of this equipment, and by providing other information that may serve to guide the industry. The creation of ASHRAE Standards and Guidelines is determined by the need for them, and conformance to them is completely voluntary.

In referring to this Standard or Guideline and in marking of equipment and in advertising, no claim shall be made, either stated or implied, that the product has been approved by ASHRAE.

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

## FOREWORD

Addendum aj adds Section 7.5.2.2 as a jurisdictional option along with Normative Appendix M. If adopted by an AHJ, this section would supplement Section 7.5.2.1 and allow the electricity greenhouse gas emissions of both the proposed design and the baseline building to be calculated using long-run marginal emission rates (LRMER). GHG emissions from direct use of fossil fuels and thermal energy in buildings would continue to be calculated using the procedures in Section 7.5.2.1.

The LRMER data in normative Appendix M are derived from the Cambium database developed and supported by the National Renewable Energy Laboratory. Specifically, the Cambium21\_LRMER\_GeaRegions.XLSX workbook was used as the source, with the assumptions documented in Informative Appendix J, Section J6. These assumptions are selected to provide consistency with the emission rates in Section 7.5.2.1.

**Note:** In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strike through~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

### Addendum aj to Standard 189.1-2020

Modify Table 4.2 as shown.

Table 4.2 Requirements Determined by the Jurisdiction (Normative in the IgCC)

| Section        | Section Title, Description, and Directives | Jurisdictional Requirement   |
|----------------|--|--|
| [...]          | [...]                                      | [...]  |
| <u>7.5.2.2</u> | <u>Long-Run Marginal Emission Rates</u>    | <input type="checkbox"/> <u>12×24 values (month-hour)</u><br><input type="checkbox"/> <u>24 h values (annual-hour)</u> |
| [...]          | [...]                                      | [...]  |

Add new Section 7.5.2.2 as shown. (Note: Markup is omitted from new equations for ease of reading.)

**7.5.2.2 [JO] Long-Run Marginal Emission Rates.** Section 7.5.2.2 replaces Section 7.5.2.1 for electricity emissions calculations. Electricity *carbon dioxide equivalent* ( $CO_2e$ ) emissions for the *baseline building design* and *proposed design* shall be calculated using the long-run marginal emission rates from Normative Appendix M for each time period. The calculation shall be made using month-hour or annual-hour values and shall be *approved*. For fossil fuels and thermal energy, the  $CO_2e$  emissions shall be calculated by multiplying by the  $CO_2e$  emission factors from Table 7.5.3 times the annual consumption.

$$GHG_x = \sum_t [q_{e,t} \times e_{e,t}] + \sum_i [Q_i \times e_i]$$

where

$GHG_x$  = annual long-run marginal  $CO_2e$  emissions for  $GHG_{UBB}$ ,  $GHG_{RBB}$ , and  $GHG_P$  units  $CO_2e$  for a specified GWP time horizon

$q_{e,t}$  = annual electricity consumption for time period  $t$ , MWh

$e_{e,t}$  = long-run marginal  $CO_2e$  emissions rate for electricity in time period  $t$  from Normative Appendix M, Tables M-1 through M-20 units kg/MWh

$t$  = index for time period of electricity consumption

$Q_i$  = annual energy consumption for fossil fuels or thermal energy, MWh

$e_i$  =  $CO_2e$  emissions rate taken from Table 7.5.3 for fossil fuel or thermal energy type  $i$

$i$  = index for fossil fuel or thermal energy type

**Informative Note:** The  $CO_2e$  time-horizon is independent of the index for the time period of electricity consumption ( $t$ ).

The avoided emissions from off-site renewable energy procurement shall be calculated as shown in the following equation and meet the requirements of Section 7.4.1.3.

$$AE = \sum_g [Q_g \times REPF \times AE_g]$$

where

$Q_g$  = annual renewable electricity procured for renewable energy generator type  $g$ , MWh

$g$  = index for generator type

$AE_g$  = annual avoided  $CO_2e$  emissions rate for renewable energy generator type  $g$  from Normative Appendix M, Table M21, units kg/MWh

REPF = applicable renewable energy procurement factor from Table 7.4.1.2

**7.5.2.2.1 LRMER Building Performance Factors.** Building performance factors for carbon from Table 7.5.2.2.1 shall be used.

**Table 7.5.2.2.1 Building Performance Factors for Emissions (BPF<sub>E</sub>) and Renewable Fraction (RF<sub>E</sub>) for Use with LRMER**

| Climate Zone       | Building Type |                     |             |        |            |        |        |           |            |
|--------------------|---------------|---------------------|-------------|--------|------------|--------|--------|-----------|------------|
|                    | Multifamily   | Healthcare/Hospital | Hotel/Motel | Office | Restaurant | Retail | School | Warehouse | All Others |
| 0A/1A              | 0.88          | 0.79                | 0.83        | 0.57   | 0.70       | 0.53   | 0.66   | 0.25      | 0.67       |
| 0B/1B              | 0.88          | 0.79                | 0.83        | 0.57   | 0.70       | 0.53   | 0.66   | 0.25      | 0.67       |
| 2A                 | 0.86          | 0.77                | 0.80        | 0.57   | 0.70       | 0.48   | 0.65   | 0.24      | 0.65       |
| 2B                 | 0.82          | 0.76                | 0.84        | 0.58   | 0.73       | 0.49   | 0.67   | 0.25      | 0.66       |
| 3A                 | 0.88          | 0.74                | 0.79        | 0.57   | 0.74       | 0.53   | 0.68   | 0.32      | 0.67       |
| 3B                 | 0.79          | 0.78                | 0.85        | 0.60   | 0.76       | 0.54   | 0.67   | 0.26      | 0.68       |
| 3C                 | 0.71          | 0.84                | 0.94        | 0.55   | 0.79       | 0.53   | 0.80   | 0.21      | 0.69       |
| 4A                 | 0.77          | 0.74                | 0.78        | 0.51   | 0.75       | 0.57   | 0.57   | 0.42      | 0.64       |
| 4B                 | 0.73          | 0.77                | 0.83        | 0.57   | 0.78       | 0.58   | 0.64   | 0.35      | 0.67       |
| 4C                 | 0.61          | 0.80                | 0.86        | 0.54   | 0.81       | 0.75   | 0.77   | 0.45      | 0.70       |
| 5A                 | 0.72          | 0.77                | 0.78        | 0.53   | 0.77       | 0.56   | 0.60   | 0.52      | 0.66       |
| 5B                 | 0.66          | 0.76                | 0.81        | 0.57   | 0.81       | 0.66   | 0.65   | 0.48      | 0.68       |
| 5C                 | 0.60          | 0.81                | 0.84        | 0.55   | 0.82       | 0.76   | 0.68   | 0.41      | 0.69       |
| 6A                 | 0.68          | 0.78                | 0.77        | 0.52   | 0.79       | 0.68   | 0.59   | 0.57      | 0.67       |
| 6B                 | 0.60          | 0.79                | 0.79        | 0.52   | 0.81       | 0.72   | 0.58   | 0.53      | 0.67       |
| 7                  | 0.63          | 0.79                | 0.77        | 0.49   | 0.81       | 0.62   | 0.57   | 0.50      | 0.64       |
| 8                  | 0.72          | 0.78                | 0.78        | 0.55   | 0.79       | 0.57   | 0.60   | 0.46      | 0.66       |
| Renewable Fraction | 0.50          | 0.35                | 0.50        | 0.50   | 0.10       | 0.50   | 0.50   | 0.50      | 0.50       |

*Insert new Normative Appendix M as shown, and reletter subsequent appendices accordingly.*

**(This is a normative appendix and is part of this standard.)**

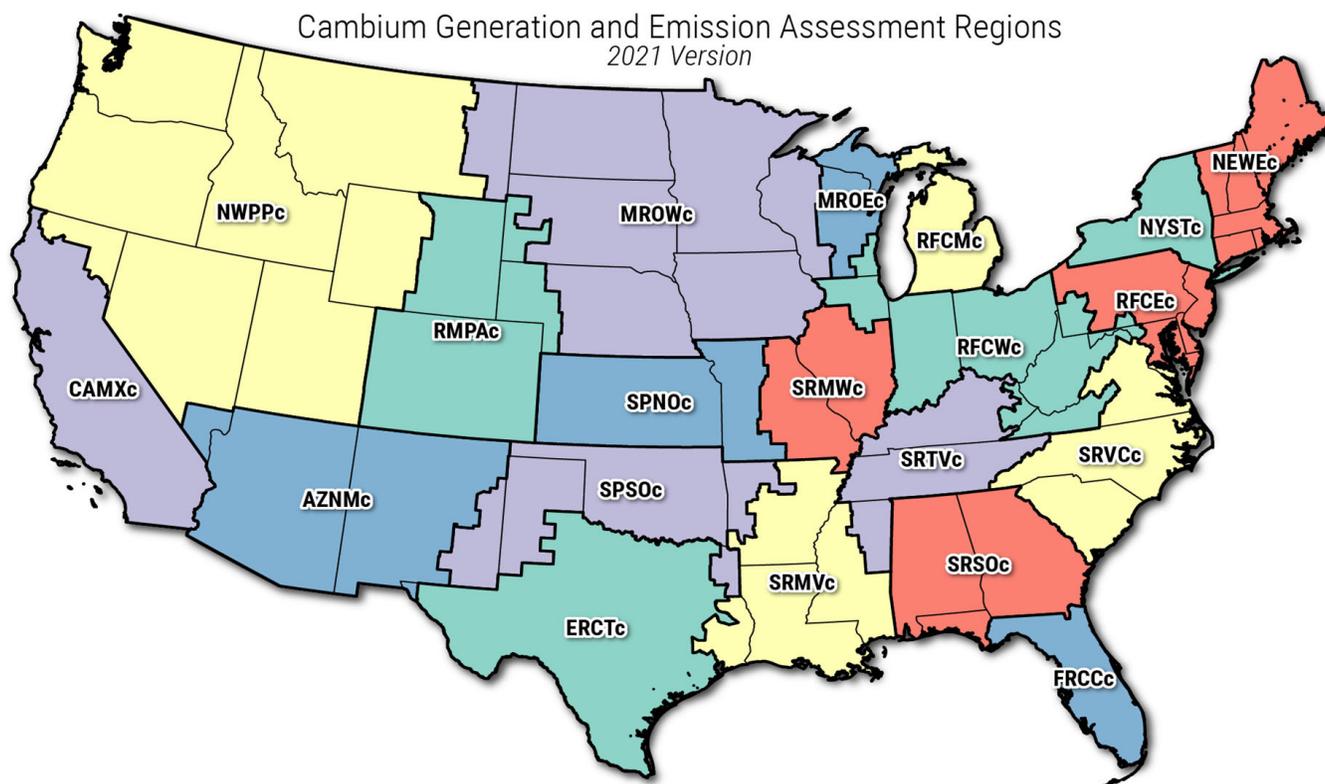
## **NORMATIVE APPENDIX M**

### **LONG-RUN MARGINAL EMISSION RATES**

Normative Appendix M contains the long-run marginal emission rates for use with Section 7.5.2.2. LRM-ERs, based on a 20-year  $CO_2e$  time horizon, are provided for the Cambium Generation and Emission Assessment Regions shown in Figure M-1. Where comparing or combining  $CO_2e$  values, a consistent GWP time-horizon shall be used for all estimates of  $CO_2e$ .

#### **Informative Notes:**

1. The Cambium regions are similar, but not quite identical to the EPA eGRID subregions. New York state, for example, is one region for Cambium.
2. Long-run emissions rates based on a 100-year  $CO_2e$  time-horizon can be generated using the NREL Cambium Database “Cambium21\_LRMER\_GEAregions.xlsx,” which can be downloaded at <https://data.nrel.gov/submissions/183>. The 100-year time-horizon data should be used whenever the results of this analysis are combined with or compared to 100-year  $CO_2e$  results in a whole building life-cycle assessment.



**Figure M-1 Cambium generation and emission assessment regions.**

**Table M-1 AZNMc—Hourly and Avoided Emissions (kg/MWh)**

| <b>Hour</b> | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>Apr</b> | <b>May</b> | <b>Jun</b> | <b>Jul</b> | <b>Aug</b> | <b>Sep</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> | <b>Annual</b> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 0–1         | 284        | 297        | 232        | 229        | 245        | 231        | 331        | 381        | 381        | 294        | 297        | 296        | 295           |
| 1–2         | 289        | 299        | 237        | 228        | 253        | 238        | 349        | 407        | 402        | 297        | 313        | 295        | 305           |
| 2–3         | 292        | 301        | 242        | 233        | 251        | 244        | 358        | 424        | 422        | 302        | 316        | 297        | 311           |
| 3–4         | 294        | 298        | 239        | 234        | 248        | 262        | 370        | 434        | 428        | 302        | 310        | 296        | 315           |
| 4–5         | 291        | 295        | 235        | 232        | 249        | 263        | 366        | 432        | 422        | 301        | 305        | 292        | 312           |
| 5–6         | 287        | 296        | 227        | 226        | 234        | 247        | 342        | 416        | 408        | 297        | 291        | 288        | 300           |
| 6–7         | 281        | 289        | 214        | 203        | 194        | 199        | 269        | 339        | 350        | 278        | 280        | 279        | 266           |
| 7–8         | 266        | 272        | 202        | 183        | 180        | 191        | 248        | 289        | 283        | 236        | 253        | 263        | 240           |
| 8–9         | 238        | 236        | 179        | 177        | 181        | 184        | 239        | 278        | 275        | 225        | 235        | 240        | 225           |
| 9–10        | 236        | 232        | 171        | 178        | 177        | 184        | 230        | 264        | 270        | 221        | 237        | 237        | 221           |
| 10–11       | 235        | 233        | 168        | 176        | 181        | 182        | 232        | 261        | 260        | 228        | 238        | 236        | 220           |
| 11–12       | 236        | 232        | 172        | 180        | 183        | 186        | 228        | 259        | 253        | 226        | 237        | 240        | 220           |
| 12–13       | 234        | 233        | 169        | 184        | 187        | 181        | 224        | 248        | 259        | 224        | 242        | 238        | 219           |
| 13–14       | 235        | 231        | 170        | 186        | 187        | 183        | 223        | 254        | 255        | 225        | 238        | 246        | 220           |
| 14–15       | 229        | 233        | 172        | 186        | 185        | 186        | 220        | 249        | 253        | 220        | 239        | 239        | 218           |
| 15–16       | 246        | 236        | 175        | 189        | 190        | 185        | 225        | 259        | 255        | 228        | 259        | 254        | 225           |
| 16–17       | 272        | 259        | 195        | 202        | 198        | 190        | 244        | 273        | 279        | 261        | 282        | 284        | 243           |
| 17–18       | 277        | 284        | 227        | 220        | 217        | 217        | 267        | 297        | 320        | 274        | 280        | 289        | 264           |
| 18–19       | 278        | 282        | 218        | 230        | 232        | 227        | 281        | 325        | 338        | 278        | 280        | 284        | 273           |
| 19–20       | 278        | 283        | 217        | 232        | 238        | 244        | 295        | 333        | 332        | 272        | 279        | 285        | 276           |
| 20–21       | 277        | 282        | 217        | 228        | 233        | 239        | 293        | 332        | 333        | 268        | 275        | 285        | 274           |
| 21–22       | 277        | 283        | 218        | 228        | 230        | 231        | 296        | 336        | 335        | 270        | 276        | 286        | 274           |
| 22–23       | 278        | 283        | 222        | 227        | 237        | 235        | 305        | 352        | 346        | 273        | 286        | 290        | 281           |
| 23–24       | 281        | 286        | 227        | 224        | 235        | 229        | 318        | 363        | 364        | 282        | 291        | 292        | 286           |

**Table M-2 CAMXc—Hourly and Avoided Emissions (kg/MWh)**

| <b>Hour</b> | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>Apr</b> | <b>May</b> | <b>Jun</b> | <b>Jul</b> | <b>Aug</b> | <b>Sep</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> | <b>Annual</b> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 0–1         | 279        | 214        | 113        | 83         | 80         | 84         | 144        | 229        | 210        | 193        | 278        | 270        | 181           |
| 1–2         | 297        | 223        | 120        | 91         | 80         | 94         | 147        | 239        | 233        | 201        | 283        | 287        | 191           |
| 2–3         | 301        | 226        | 124        | 89         | 88         | 98         | 158        | 242        | 243        | 209        | 293        | 287        | 196           |
| 3–4         | 293        | 219        | 123        | 89         | 85         | 93         | 159        | 249        | 245        | 209        | 284        | 285        | 195           |
| 4–5         | 280        | 209        | 114        | 88         | 86         | 100        | 156        | 250        | 242        | 205        | 270        | 289        | 191           |
| 5–6         | 264        | 196        | 108        | 81         | 64         | 61         | 95         | 175        | 217        | 194        | 263        | 273        | 165           |
| 6–7         | 247        | 185        | 89         | 63         | 56         | 52         | 83         | 104        | 126        | 93         | 218        | 252        | 130           |
| 7–8         | 184        | 109        | 60         | 57         | 53         | 52         | 75         | 107        | 124        | 87         | 140        | 159        | 101           |
| 8–9         | 112        | 103        | 57         | 54         | 53         | 54         | 74         | 102        | 119        | 93         | 125        | 126        | 90            |
| 9–10        | 110        | 99         | 55         | 54         | 54         | 53         | 73         | 106        | 114        | 95         | 129        | 124        | 89            |
| 10–11       | 111        | 99         | 55         | 53         | 53         | 52         | 70         | 109        | 120        | 83         | 128        | 126        | 88            |
| 11–12       | 109        | 100        | 53         | 53         | 54         | 52         | 68         | 114        | 123        | 80         | 134        | 128        | 89            |
| 12–13       | 111        | 99         | 53         | 55         | 52         | 54         | 72         | 116        | 118        | 79         | 135        | 133        | 90            |

**Table M-2 CAMXc—Hourly and Avoided Emissions (kg/MWh) (Continued)**

| Hour  | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| 13–14 | 107 | 102 | 54  | 56  | 51  | 53  | 71  | 114 | 107 | 79  | 138 | 138 | 89     |
| 14–15 | 115 | 107 | 56  | 56  | 51  | 54  | 72  | 108 | 105 | 79  | 138 | 155 | 91     |
| 15–16 | 150 | 105 | 58  | 56  | 53  | 53  | 76  | 106 | 102 | 95  | 183 | 201 | 101    |
| 16–17 | 245 | 167 | 79  | 67  | 63  | 55  | 83  | 110 | 132 | 140 | 246 | 257 | 133    |
| 17–18 | 236 | 188 | 82  | 71  | 68  | 55  | 87  | 130 | 167 | 150 | 241 | 248 | 143    |
| 18–19 | 233 | 185 | 77  | 72  | 75  | 77  | 102 | 141 | 158 | 142 | 239 | 241 | 145    |
| 19–20 | 234 | 181 | 78  | 71  | 73  | 70  | 93  | 126 | 156 | 138 | 237 | 243 | 141    |
| 20–21 | 237 | 184 | 77  | 73  | 73  | 65  | 94  | 125 | 155 | 135 | 240 | 243 | 140    |
| 21–22 | 242 | 186 | 87  | 79  | 85  | 66  | 120 | 156 | 173 | 150 | 246 | 246 | 151    |
| 22–23 | 253 | 185 | 99  | 84  | 73  | 63  | 130 | 184 | 176 | 159 | 247 | 248 | 157    |
| 23–24 | 269 | 198 | 107 | 83  | 82  | 73  | 155 | 218 | 190 | 184 | 262 | 259 | 173    |

**Table M-3 ERCTc—Hourly and Avoided Emissions (kg/MWh)**

| Hour  | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| 0–1   | 358 | 380 | 265 | 212 | 256 | 331 | 357 | 422 | 393 | 287 | 347 | 361 | 335    |
| 1–2   | 360 | 389 | 268 | 207 | 258 | 336 | 356 | 424 | 397 | 286 | 355 | 365 | 337    |
| 2–3   | 359 | 396 | 274 | 200 | 258 | 345 | 359 | 436 | 402 | 286 | 363 | 362 | 341    |
| 3–4   | 364 | 383 | 278 | 211 | 255 | 360 | 370 | 448 | 416 | 302 | 369 | 364 | 347    |
| 4–5   | 364 | 391 | 281 | 230 | 271 | 385 | 385 | 452 | 427 | 315 | 367 | 376 | 357    |
| 5–6   | 374 | 395 | 286 | 225 | 263 | 359 | 390 | 452 | 435 | 321 | 377 | 376 | 357    |
| 6–7   | 377 | 396 | 282 | 187 | 208 | 310 | 368 | 395 | 381 | 286 | 359 | 377 | 330    |
| 7–8   | 339 | 361 | 214 | 166 | 192 | 277 | 320 | 364 | 329 | 221 | 298 | 331 | 287    |
| 8–9   | 275 | 323 | 200 | 160 | 184 | 267 | 309 | 339 | 316 | 213 | 247 | 269 | 262    |
| 9–10  | 246 | 307 | 187 | 152 | 184 | 278 | 306 | 335 | 315 | 212 | 249 | 259 | 257    |
| 10–11 | 255 | 283 | 184 | 153 | 179 | 271 | 307 | 333 | 317 | 207 | 262 | 252 | 256    |
| 11–12 | 247 | 277 | 179 | 155 | 187 | 278 | 305 | 328 | 327 | 215 | 271 | 252 | 257    |
| 12–13 | 246 | 267 | 184 | 158 | 189 | 274 | 309 | 328 | 329 | 221 | 265 | 241 | 257    |
| 13–14 | 235 | 253 | 184 | 168 | 192 | 270 | 306 | 325 | 324 | 220 | 265 | 243 | 255    |
| 14–15 | 240 | 250 | 189 | 170 | 196 | 268 | 307 | 321 | 329 | 220 | 260 | 240 | 255    |
| 15–16 | 246 | 255 | 184 | 168 | 191 | 266 | 297 | 312 | 322 | 217 | 272 | 251 | 253    |
| 16–17 | 298 | 295 | 197 | 169 | 189 | 258 | 285 | 308 | 329 | 250 | 332 | 323 | 270    |
| 17–18 | 363 | 358 | 254 | 204 | 209 | 276 | 299 | 333 | 401 | 351 | 391 | 365 | 315    |
| 18–19 | 363 | 376 | 303 | 278 | 279 | 343 | 357 | 401 | 431 | 338 | 374 | 350 | 351    |
| 19–20 | 368 | 367 | 297 | 264 | 289 | 359 | 375 | 399 | 395 | 334 | 356 | 343 | 348    |
| 20–21 | 364 | 363 | 286 | 252 | 278 | 355 | 367 | 397 | 388 | 313 | 354 | 341 | 341    |
| 21–22 | 362 | 369 | 274 | 240 | 267 | 359 | 364 | 397 | 388 | 297 | 330 | 342 | 336    |
| 22–23 | 350 | 367 | 268 | 225 | 259 | 359 | 364 | 420 | 388 | 299 | 336 | 347 | 336    |
| 23–24 | 350 | 370 | 275 | 215 | 256 | 351 | 367 | 436 | 379 | 293 | 338 | 356 | 337    |

**Table M-4 FRCCc—Hourly and Avoided Emissions (kg/MWh)**

| Hour  | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| 0–1   | 580 | 597 | 467 | 364 | 376 | 533 | 537 | 633 | 581 | 536 | 520 | 662 | 534    |
| 1–2   | 580 | 596 | 491 | 389 | 415 | 587 | 584 | 652 | 608 | 564 | 519 | 673 | 558    |
| 2–3   | 583 | 589 | 491 | 426 | 453 | 623 | 613 | 668 | 632 | 577 | 510 | 657 | 573    |
| 3–4   | 579 | 589 | 498 | 420 | 468 | 627 | 630 | 670 | 641 | 589 | 509 | 650 | 578    |
| 4–5   | 570 | 580 | 473 | 396 | 433 | 621 | 635 | 671 | 630 | 567 | 513 | 651 | 567    |
| 5–6   | 546 | 568 | 470 | 378 | 407 | 562 | 623 | 641 | 589 | 527 | 489 | 653 | 542    |
| 6–7   | 519 | 533 | 429 | 290 | 286 | 416 | 383 | 443 | 429 | 451 | 446 | 620 | 436    |
| 7–8   | 444 | 429 | 296 | 231 | 215 | 331 | 277 | 314 | 295 | 310 | 335 | 466 | 328    |
| 8–9   | 334 | 355 | 251 | 204 | 205 | 302 | 262 | 284 | 252 | 264 | 277 | 343 | 277    |
| 9–10  | 291 | 306 | 237 | 202 | 193 | 288 | 254 | 277 | 272 | 254 | 265 | 302 | 261    |
| 10–11 | 270 | 295 | 233 | 204 | 209 | 285 | 264 | 276 | 263 | 257 | 251 | 307 | 259    |
| 11–12 | 283 | 291 | 229 | 203 | 217 | 287 | 280 | 274 | 266 | 261 | 259 | 314 | 264    |
| 12–13 | 288 | 281 | 231 | 201 | 218 | 286 | 284 | 291 | 259 | 270 | 257 | 322 | 266    |
| 13–14 | 285 | 287 | 234 | 198 | 215 | 286 | 299 | 293 | 280 | 270 | 259 | 318 | 269    |
| 14–15 | 292 | 307 | 245 | 206 | 222 | 300 | 311 | 311 | 283 | 295 | 260 | 322 | 280    |
| 15–16 | 315 | 323 | 247 | 214 | 228 | 337 | 318 | 325 | 319 | 312 | 273 | 348 | 297    |
| 16–17 | 379 | 361 | 264 | 220 | 243 | 370 | 325 | 380 | 363 | 385 | 360 | 513 | 343    |
| 17–18 | 484 | 468 | 355 | 264 | 282 | 427 | 400 | 474 | 451 | 450 | 409 | 569 | 416    |
| 18–19 | 489 | 490 | 407 | 335 | 367 | 517 | 503 | 548 | 500 | 459 | 425 | 569 | 470    |
| 19–20 | 491 | 491 | 411 | 342 | 392 | 537 | 534 | 560 | 494 | 453 | 416 | 567 | 477    |
| 20–21 | 486 | 485 | 401 | 330 | 367 | 523 | 518 | 551 | 488 | 452 | 415 | 566 | 467    |
| 21–22 | 490 | 486 | 398 | 318 | 349 | 505 | 499 | 534 | 482 | 468 | 420 | 573 | 462    |
| 22–23 | 505 | 497 | 402 | 311 | 336 | 474 | 482 | 551 | 485 | 498 | 435 | 584 | 465    |
| 23–24 | 545 | 545 | 453 | 329 | 347 | 498 | 503 | 619 | 530 | 514 | 484 | 634 | 502    |

**Table M-5 MROEc—Hourly and Avoided Emissions (kg/MWh)**

| Hour  | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| 0–1   | 495 | 505 | 456 | 362 | 434 | 479 | 585 | 569 | 497 | 439 | 482 | 520 | 490    |
| 1–2   | 493 | 508 | 450 | 364 | 436 | 478 | 588 | 571 | 496 | 440 | 486 | 508 | 489    |
| 2–3   | 499 | 500 | 456 | 367 | 436 | 479 | 587 | 569 | 494 | 447 | 495 | 508 | 490    |
| 3–4   | 500 | 499 | 452 | 363 | 436 | 477 | 595 | 574 | 522 | 452 | 495 | 519 | 494    |
| 4–5   | 495 | 481 | 438 | 348 | 370 | 361 | 528 | 579 | 508 | 435 | 478 | 518 | 464    |
| 5–6   | 492 | 481 | 417 | 273 | 268 | 269 | 390 | 410 | 411 | 417 | 465 | 518 | 400    |
| 6–7   | 484 | 441 | 320 | 204 | 224 | 236 | 336 | 320 | 287 | 302 | 415 | 516 | 341    |
| 7–8   | 395 | 317 | 256 | 173 | 210 | 222 | 303 | 292 | 253 | 254 | 289 | 424 | 284    |
| 8–9   | 322 | 282 | 234 | 161 | 203 | 216 | 282 | 266 | 242 | 238 | 266 | 369 | 258    |
| 9–10  | 311 | 272 | 227 | 154 | 194 | 220 | 281 | 260 | 233 | 237 | 277 | 359 | 253    |
| 10–11 | 308 | 276 | 227 | 153 | 189 | 218 | 271 | 254 | 232 | 233 | 273 | 357 | 250    |
| 11–12 | 306 | 268 | 224 | 151 | 185 | 213 | 267 | 247 | 231 | 236 | 268 | 348 | 246    |
| 12–13 | 300 | 267 | 224 | 148 | 186 | 208 | 261 | 244 | 228 | 238 | 263 | 352 | 244    |

**Table M-5 MROEc—Hourly and Avoided Emissions (kg/MWh) (Continued)**

| <u>Hour</u> | <u>Jan</u> | <u>Feb</u> | <u>Mar</u> | <u>Apr</u> | <u>May</u> | <u>Jun</u> | <u>Jul</u> | <u>Aug</u> | <u>Sep</u> | <u>Oct</u> | <u>Nov</u> | <u>Dec</u> | <u>Annual</u> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 13–14       | 301        | 274        | 225        | 149        | 189        | 210        | 260        | 243        | 232        | 233        | 274        | 351        | 245           |
| 14–15       | 310        | 281        | 231        | 154        | 193        | 211        | 261        | 248        | 234        | 236        | 298        | 375        | 252           |
| 15–16       | 381        | 317        | 248        | 160        | 203        | 216        | 273        | 255        | 249        | 298        | 390        | 488        | 288           |
| 16–17       | 472        | 424        | 313        | 209        | 238        | 239        | 295        | 299        | 333        | 400        | 467        | 525        | 349           |
| 17–18       | 478        | 475        | 415        | 312        | 317        | 304        | 360        | 389        | 444        | 428        | 471        | 525        | 409           |
| 18–19       | 474        | 479        | 437        | 373        | 420        | 408        | 456        | 484        | 466        | 430        | 467        | 523        | 453           |
| 19–20       | 479        | 471        | 426        | 368        | 424        | 442        | 490        | 486        | 455        | 424        | 461        | 518        | 456           |
| 20–21       | 481        | 478        | 429        | 354        | 419        | 452        | 495        | 496        | 483        | 445        | 469        | 525        | 463           |
| 21–22       | 494        | 495        | 455        | 378        | 423        | 464        | 535        | 536        | 515        | 458        | 487        | 527        | 484           |
| 22–23       | 493        | 495        | 461        | 377        | 433        | 489        | 566        | 557        | 512        | 454        | 497        | 534        | 493           |
| 23–24       | 499        | 499        | 457        | 362        | 437        | 487        | 585        | 559        | 514        | 447        | 493        | 519        | 493           |

**Table M-6 MROWc—Hourly and Avoided Emissions (kg/MWh)**

| <u>Hour</u> | <u>Jan</u> | <u>Feb</u> | <u>Mar</u> | <u>Apr</u> | <u>May</u> | <u>Jun</u> | <u>Jul</u> | <u>Aug</u> | <u>Sep</u> | <u>Oct</u> | <u>Nov</u> | <u>Dec</u> | <u>Annual</u> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 0–1         | 252        | 255        | 204        | 133        | 163        | 203        | 304        | 322        | 249        | 196        | 263        | 323        | 244           |
| 1–2         | 245        | 260        | 203        | 134        | 163        | 214        | 309        | 318        | 259        | 193        | 255        | 320        | 244           |
| 2–3         | 252        | 259        | 204        | 131        | 167        | 207        | 328        | 309        | 255        | 203        | 274        | 308        | 246           |
| 3–4         | 251        | 256        | 204        | 139        | 171        | 211        | 314        | 323        | 264        | 196        | 262        | 302        | 245           |
| 4–5         | 249        | 252        | 206        | 150        | 171        | 200        | 328        | 324        | 261        | 203        | 252        | 305        | 245           |
| 5–6         | 242        | 254        | 205        | 143        | 133        | 148        | 217        | 257        | 238        | 193        | 243        | 310        | 217           |
| 6–7         | 241        | 238        | 180        | 110        | 101        | 125        | 162        | 179        | 165        | 168        | 236        | 299        | 185           |
| 7–8         | 231        | 184        | 135        | 90         | 100        | 125        | 153        | 155        | 142        | 129        | 183        | 272        | 161           |
| 8–9         | 182        | 151        | 130        | 85         | 99         | 119        | 141        | 142        | 135        | 124        | 155        | 227        | 142           |
| 9–10        | 157        | 144        | 124        | 81         | 96         | 117        | 138        | 137        | 128        | 120        | 157        | 208        | 135           |
| 10–11       | 158        | 153        | 121        | 83         | 96         | 115        | 134        | 123        | 120        | 115        | 151        | 226        | 134           |
| 11–12       | 153        | 148        | 119        | 81         | 95         | 112        | 128        | 125        | 128        | 115        | 151        | 217        | 131           |
| 12–13       | 151        | 147        | 115        | 80         | 93         | 112        | 129        | 125        | 124        | 117        | 151        | 213        | 130           |
| 13–14       | 153        | 144        | 115        | 80         | 92         | 110        | 133        | 123        | 127        | 118        | 149        | 216        | 130           |
| 14–15       | 145        | 147        | 119        | 84         | 94         | 109        | 129        | 128        | 127        | 116        | 160        | 220        | 131           |
| 15–16       | 167        | 150        | 119        | 89         | 97         | 112        | 134        | 128        | 134        | 127        | 170        | 252        | 140           |
| 16–17       | 232        | 178        | 134        | 96         | 105        | 117        | 134        | 139        | 160        | 170        | 244        | 299        | 166           |
| 17–18       | 242        | 240        | 190        | 122        | 121        | 127        | 158        | 176        | 222        | 211        | 243        | 291        | 195           |
| 18–19       | 238        | 240        | 220        | 186        | 187        | 175        | 215        | 239        | 245        | 206        | 232        | 290        | 223           |
| 19–20       | 242        | 238        | 206        | 180        | 196        | 223        | 247        | 249        | 230        | 198        | 236        | 286        | 230           |
| 20–21       | 243        | 241        | 212        | 165        | 186        | 225        | 243        | 255        | 253        | 204        | 236        | 285        | 231           |
| 21–22       | 242        | 247        | 215        | 176        | 183        | 233        | 258        | 251        | 263        | 207        | 242        | 285        | 236           |
| 22–23       | 244        | 258        | 218        | 155        | 174        | 237        | 271        | 297        | 262        | 210        | 253        | 295        | 243           |
| 23–24       | 255        | 241        | 216        | 138        | 172        | 226        | 300        | 307        | 263        | 200        | 262        | 317        | 246           |

**Table M-7 NEWEc—Hourly and Avoided Emissions (kg/MWh)**

| <b>Hour</b> | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>Apr</b> | <b>May</b> | <b>Jun</b> | <b>Jul</b> | <b>Aug</b> | <b>Sep</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> | <b>Annual</b> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 0–1         | 411        | 386        | 338        | 249        | 328        | 375        | 445        | 453        | 388        | 376        | 400        | 412        | 384           |
| 1–2         | 411        | 386        | 340        | 242        | 329        | 377        | 443        | 435        | 383        | 373        | 397        | 410        | 381           |
| 2–3         | 410        | 388        | 333        | 246        | 331        | 375        | 444        | 436        | 379        | 371        | 394        | 410        | 380           |
| 3–4         | 410        | 391        | 333        | 241        | 334        | 374        | 446        | 439        | 379        | 375        | 393        | 409        | 380           |
| 4–5         | 418        | 395        | 336        | 244        | 316        | 321        | 406        | 442        | 378        | 370        | 397        | 414        | 373           |
| 5–6         | 417        | 396        | 337        | 215        | 271        | 258        | 337        | 362        | 349        | 366        | 392        | 418        | 346           |
| 6–7         | 417        | 380        | 296        | 180        | 262        | 240        | 297        | 307        | 284        | 311        | 379        | 419        | 317           |
| 7–8         | 377        | 322        | 252        | 162        | 250        | 227        | 291        | 289        | 259        | 278        | 313        | 377        | 285           |
| 8–9         | 317        | 285        | 239        | 153        | 236        | 225        | 279        | 275        | 241        | 274        | 275        | 332        | 263           |
| 9–10        | 316        | 271        | 233        | 149        | 223        | 225        | 271        | 272        | 240        | 277        | 269        | 328        | 258           |
| 10–11       | 314        | 273        | 230        | 148        | 222        | 219        | 263        | 278        | 249        | 278        | 264        | 327        | 257           |
| 11–12       | 320        | 276        | 221        | 152        | 223        | 223        | 260        | 282        | 240        | 277        | 266        | 330        | 257           |
| 12–13       | 317        | 273        | 222        | 152        | 216        | 218        | 271        | 278        | 241        | 277        | 268        | 330        | 257           |
| 13–14       | 310        | 270        | 218        | 154        | 216        | 223        | 275        | 292        | 238        | 274        | 266        | 326        | 257           |
| 14–15       | 317        | 269        | 219        | 162        | 218        | 234        | 293        | 288        | 239        | 280        | 290        | 340        | 265           |
| 15–16       | 381        | 295        | 227        | 174        | 220        | 236        | 295        | 295        | 252        | 308        | 374        | 423        | 291           |
| 16–17       | 415        | 375        | 269        | 186        | 244        | 255        | 315        | 331        | 309        | 366        | 399        | 429        | 326           |
| 17–18       | 410        | 387        | 334        | 235        | 289        | 293        | 371        | 394        | 364        | 380        | 394        | 434        | 361           |
| 18–19       | 412        | 389        | 342        | 248        | 320        | 336        | 408        | 423        | 360        | 383        | 393        | 430        | 374           |
| 19–20       | 414        | 390        | 342        | 247        | 320        | 343        | 413        | 424        | 354        | 381        | 396        | 430        | 375           |
| 20–21       | 414        | 392        | 340        | 241        | 320        | 343        | 411        | 420        | 356        | 372        | 401        | 425        | 373           |
| 21–22       | 414        | 394        | 337        | 244        | 332        | 353        | 420        | 414        | 371        | 378        | 410        | 423        | 377           |
| 22–23       | 422        | 398        | 351        | 251        | 343        | 375        | 431        | 442        | 387        | 382        | 409        | 428        | 388           |
| 23–24       | 418        | 403        | 346        | 255        | 342        | 380        | 444        | 476        | 395        | 377        | 415        | 431        | 394           |

**Table M-8 NWPPc—Hourly and Avoided Emissions (kg/MWh)**

| <b>Hour</b> | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>Apr</b> | <b>May</b> | <b>Jun</b> | <b>Jul</b> | <b>Aug</b> | <b>Sep</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> | <b>Annual</b> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 0–1         | 230        | 208        | 179        | 128        | 137        | 173        | 187        | 198        | 236        | 207        | 248        | 229        | 197           |
| 1–2         | 231        | 213        | 175        | 126        | 140        | 173        | 191        | 203        | 245        | 208        | 250        | 226        | 199           |
| 2–3         | 236        | 215        | 172        | 123        | 133        | 180        | 188        | 209        | 251        | 206        | 251        | 222        | 199           |
| 3–4         | 233        | 215        | 174        | 127        | 135        | 171        | 188        | 206        | 250        | 209        | 244        | 220        | 198           |
| 4–5         | 228        | 209        | 168        | 122        | 130        | 156        | 176        | 204        | 239        | 206        | 240        | 224        | 192           |
| 5–6         | 229        | 201        | 154        | 111        | 105        | 123        | 148        | 174        | 233        | 199        | 231        | 221        | 178           |
| 6–7         | 227        | 190        | 146        | 100        | 96         | 119        | 141        | 145        | 193        | 169        | 225        | 216        | 165           |
| 7–8         | 203        | 150        | 110        | 91         | 96         | 115        | 133        | 139        | 187        | 150        | 196        | 194        | 148           |
| 8–9         | 170        | 144        | 105        | 93         | 92         | 114        | 123        | 133        | 180        | 153        | 195        | 175        | 140           |
| 9–10        | 171        | 141        | 100        | 90         | 93         | 111        | 121        | 128        | 170        | 153        | 198        | 177        | 138           |
| 10–11       | 174        | 143        | 103        | 89         | 90         | 107        | 113        | 128        | 158        | 145        | 198        | 176        | 136           |
| 11–12       | 177        | 143        | 99         | 90         | 91         | 103        | 113        | 122        | 155        | 149        | 197        | 179        | 135           |
| 12–13       | 175        | 141        | 100        | 91         | 87         | 100        | 107        | 126        | 148        | 149        | 201        | 190        | 135           |

**Table M-8 NWPPc—Hourly and Avoided Emissions (kg/MWh) (Continued)**

| Hour  | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| 13–14 | 167 | 142 | 103 | 89  | 87  | 96  | 108 | 120 | 142 | 141 | 197 | 183 | 131    |
| 14–15 | 173 | 143 | 102 | 92  | 87  | 101 | 104 | 117 | 143 | 143 | 205 | 192 | 134    |
| 15–16 | 201 | 150 | 114 | 92  | 89  | 104 | 113 | 128 | 149 | 167 | 231 | 217 | 147    |
| 16–17 | 235 | 189 | 150 | 109 | 102 | 113 | 124 | 142 | 190 | 193 | 235 | 224 | 168    |
| 17–18 | 231 | 196 | 153 | 120 | 120 | 140 | 144 | 163 | 218 | 192 | 239 | 223 | 180    |
| 18–19 | 235 | 193 | 146 | 121 | 128 | 155 | 162 | 174 | 208 | 193 | 240 | 225 | 183    |
| 19–20 | 232 | 194 | 147 | 121 | 130 | 157 | 162 | 169 | 209 | 193 | 234 | 222 | 182    |
| 20–21 | 231 | 195 | 151 | 120 | 131 | 159 | 164 | 170 | 214 | 196 | 237 | 226 | 184    |
| 21–22 | 231 | 193 | 154 | 117 | 138 | 166 | 168 | 179 | 222 | 197 | 240 | 225 | 187    |
| 22–23 | 225 | 198 | 166 | 117 | 131 | 166 | 169 | 177 | 227 | 202 | 243 | 224 | 188    |
| 23–24 | 227 | 203 | 172 | 123 | 138 | 166 | 176 | 187 | 233 | 207 | 245 | 226 | 193    |

**Table M-9 NYSTc—Hourly and Avoided Emissions (kg/MWh)**

| Hour  | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| 0–1   | 318 | 307 | 252 | 194 | 245 | 310 | 349 | 347 | 310 | 291 | 324 | 343 | 303    |
| 1–2   | 316 | 303 | 246 | 192 | 242 | 309 | 350 | 346 | 299 | 286 | 325 | 341 | 300    |
| 2–3   | 314 | 297 | 244 | 189 | 247 | 305 | 352 | 347 | 300 | 288 | 321 | 343 | 299    |
| 3–4   | 313 | 299 | 241 | 190 | 247 | 303 | 347 | 350 | 306 | 290 | 323 | 342 | 299    |
| 4–5   | 313 | 302 | 241 | 185 | 239 | 283 | 335 | 358 | 301 | 282 | 314 | 341 | 294    |
| 5–6   | 308 | 303 | 234 | 161 | 190 | 219 | 292 | 308 | 299 | 275 | 317 | 338 | 271    |
| 6–7   | 303 | 296 | 197 | 129 | 174 | 200 | 254 | 269 | 221 | 233 | 317 | 347 | 245    |
| 7–8   | 282 | 252 | 158 | 109 | 163 | 192 | 256 | 267 | 204 | 197 | 264 | 330 | 224    |
| 8–9   | 233 | 216 | 145 | 95  | 159 | 186 | 247 | 250 | 192 | 185 | 226 | 287 | 204    |
| 9–10  | 224 | 202 | 132 | 91  | 143 | 182 | 232 | 242 | 189 | 188 | 216 | 279 | 196    |
| 10–11 | 218 | 203 | 125 | 89  | 136 | 178 | 219 | 240 | 190 | 184 | 206 | 277 | 191    |
| 11–12 | 218 | 195 | 120 | 94  | 136 | 169 | 205 | 238 | 184 | 179 | 208 | 284 | 188    |
| 12–13 | 220 | 194 | 122 | 94  | 132 | 164 | 215 | 230 | 185 | 182 | 210 | 284 | 188    |
| 13–14 | 217 | 197 | 123 | 92  | 131 | 172 | 213 | 229 | 181 | 183 | 215 | 282 | 189    |
| 14–15 | 227 | 192 | 128 | 99  | 129 | 167 | 214 | 231 | 176 | 184 | 219 | 289 | 190    |
| 15–16 | 263 | 212 | 136 | 106 | 129 | 170 | 230 | 236 | 186 | 208 | 261 | 338 | 208    |
| 16–17 | 304 | 272 | 161 | 117 | 143 | 184 | 255 | 275 | 221 | 253 | 335 | 367 | 242    |
| 17–18 | 315 | 300 | 241 | 163 | 184 | 221 | 303 | 324 | 288 | 280 | 338 | 374 | 281    |
| 18–19 | 314 | 304 | 260 | 197 | 236 | 275 | 357 | 373 | 299 | 280 | 340 | 373 | 305    |
| 19–20 | 312 | 300 | 261 | 203 | 237 | 292 | 361 | 370 | 286 | 279 | 337 | 367 | 304    |
| 20–21 | 311 | 299 | 248 | 190 | 231 | 277 | 345 | 350 | 281 | 280 | 337 | 364 | 296    |
| 21–22 | 315 | 302 | 245 | 197 | 249 | 280 | 338 | 334 | 293 | 281 | 341 | 358 | 297    |
| 22–23 | 319 | 304 | 257 | 201 | 254 | 301 | 338 | 341 | 307 | 285 | 339 | 355 | 303    |
| 23–24 | 319 | 306 | 253 | 190 | 254 | 304 | 350 | 358 | 302 | 280 | 332 | 345 | 303    |

**Table M-10 RFCEc—Hourly and Avoided Emissions (kg/MWh)**

| <b>Hour</b> | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>Apr</b> | <b>May</b> | <b>Jun</b> | <b>Jul</b> | <b>Aug</b> | <b>Sep</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> | <b>Annual</b> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 0–1         | 670        | 599        | 469        | 402        | 493        | 568        | 774        | 737        | 609        | 496        | 596        | 612        | 595           |
| 1–2         | 666        | 604        | 466        | 402        | 497        | 561        | 759        | 732        | 603        | 492        | 594        | 612        | 592           |
| 2–3         | 664        | 607        | 471        | 402        | 498        | 555        | 762        | 730        | 599        | 489        | 591        | 614        | 590           |
| 3–4         | 668        | 611        | 474        | 407        | 505        | 558        | 769        | 743        | 599        | 499        | 591        | 614        | 594           |
| 4–5         | 671        | 628        | 468        | 383        | 500        | 568        | 784        | 749        | 609        | 506        | 592        | 626        | 597           |
| 5–6         | 697        | 630        | 436        | 339        | 405        | 444        | 637        | 700        | 607        | 485        | 593        | 647        | 558           |
| 6–7         | 710        | 632        | 380        | 273        | 310        | 346        | 524        | 529        | 451        | 418        | 577        | 666        | 491           |
| 7–8         | 644        | 537        | 303        | 199        | 258        | 299        | 439        | 429        | 354        | 338        | 462        | 618        | 412           |
| 8–9         | 508        | 400        | 252        | 168        | 231        | 276        | 381        | 380        | 319        | 279        | 335        | 487        | 340           |
| 9–10        | 442        | 356        | 220        | 166        | 211        | 265        | 342        | 340        | 296        | 263        | 308        | 425        | 307           |
| 10–11       | 422        | 343        | 211        | 160        | 198        | 248        | 345        | 317        | 294        | 263        | 303        | 421        | 298           |
| 11–12       | 411        | 332        | 211        | 160        | 197        | 252        | 330        | 306        | 281        | 260        | 302        | 410        | 291           |
| 12–13       | 406        | 319        | 213        | 159        | 190        | 241        | 329        | 303        | 279        | 257        | 301        | 405        | 287           |
| 13–14       | 412        | 318        | 209        | 151        | 186        | 249        | 333        | 296        | 264        | 258        | 299        | 398        | 284           |
| 14–15       | 420        | 321        | 206        | 153        | 193        | 246        | 339        | 306        | 261        | 253        | 301        | 418        | 288           |
| 15–16       | 444        | 341        | 209        | 169        | 198        | 246        | 349        | 309        | 262        | 270        | 347        | 468        | 304           |
| 16–17       | 596        | 407        | 232        | 173        | 211        | 261        | 371        | 320        | 302        | 353        | 535        | 647        | 372           |
| 17–18       | 694        | 577        | 343        | 231        | 277        | 309        | 429        | 434        | 457        | 457        | 601        | 679        | 461           |
| 18–19       | 703        | 621        | 419        | 341        | 409        | 431        | 576        | 580        | 548        | 476        | 600        | 680        | 538           |
| 19–20       | 702        | 620        | 426        | 361        | 457        | 528        | 664        | 635        | 538        | 467        | 590        | 676        | 564           |
| 20–21       | 700        | 613        | 411        | 339        | 432        | 509        | 621        | 592        | 527        | 471        | 584        | 664        | 547           |
| 21–22       | 691        | 630        | 432        | 356        | 452        | 533        | 640        | 629        | 592        | 488        | 595        | 664        | 568           |
| 22–23       | 691        | 624        | 465        | 396        | 493        | 578        | 706        | 731        | 634        | 511        | 592        | 655        | 600           |
| 23–24       | 674        | 607        | 470        | 412        | 515        | 593        | 755        | 703        | 617        | 505        | 593        | 632        | 599           |

**Table M-11 RFCMc—Hourly and Avoided Emissions (kg/MWh)**

| <b>Hour</b> | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>Apr</b> | <b>May</b> | <b>Jun</b> | <b>Jul</b> | <b>Aug</b> | <b>Sep</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> | <b>Annual</b> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 0–1         | 563        | 542        | 545        | 535        | 597        | 585        | 615        | 591        | 581        | 611        | 572        | 573        | 578           |
| 1–2         | 552        | 548        | 552        | 531        | 597        | 585        | 598        | 578        | 567        | 600        | 563        | 572        | 571           |
| 2–3         | 552        | 546        | 551        | 542        | 597        | 574        | 595        | 567        | 570        | 589        | 566        | 566        | 569           |
| 3–4         | 556        | 544        | 562        | 547        | 594        | 569        | 592        | 567        | 582        | 608        | 565        | 566        | 571           |
| 4–5         | 555        | 540        | 541        | 544        | 563        | 552        | 604        | 569        | 586        | 573        | 581        | 573        | 566           |
| 5–6         | 547        | 526        | 522        | 523        | 502        | 497        | 563        | 585        | 571        | 548        | 552        | 571        | 543           |
| 6–7         | 543        | 532        | 510        | 485        | 479        | 491        | 547        | 520        | 511        | 520        | 546        | 567        | 521           |
| 7–8         | 530        | 519        | 465        | 452        | 464        | 482        | 526        | 506        | 487        | 475        | 523        | 561        | 500           |
| 8–9         | 486        | 472        | 431        | 430        | 447        | 470        | 514        | 499        | 482        | 461        | 472        | 504        | 474           |
| 9–10        | 472        | 460        | 418        | 424        | 449        | 459        | 513        | 488        | 472        | 456        | 468        | 501        | 467           |
| 10–11       | 470        | 458        | 419        | 416        | 445        | 452        | 502        | 489        | 467        | 446        | 468        | 503        | 463           |
| 11–12       | 476        | 461        | 423        | 402        | 437        | 455        | 504        | 489        | 463        | 443        | 472        | 490        | 462           |
| 12–13       | 472        | 454        | 420        | 403        | 436        | 461        | 506        | 491        | 463        | 442        | 467        | 487        | 461           |

**Table M-11 RFCMc—Hourly and Avoided Emissions (kg/MWh) (Continued)**

| Hour  | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| 13–14 | 472 | 458 | 425 | 403 | 431 | 454 | 502 | 486 | 461 | 440 | 469 | 493 | 460    |
| 14–15 | 469 | 459 | 417 | 401 | 429 | 459 | 502 | 490 | 465 | 443 | 470 | 495 | 461    |
| 15–16 | 475 | 461 | 417 | 409 | 434 | 454 | 504 | 484 | 462 | 456 | 487 | 497 | 464    |
| 16–17 | 500 | 474 | 434 | 413 | 436 | 457 | 507 | 492 | 475 | 470 | 519 | 562 | 480    |
| 17–18 | 530 | 507 | 469 | 446 | 463 | 466 | 522 | 505 | 495 | 515 | 538 | 565 | 503    |
| 18–19 | 529 | 519 | 513 | 495 | 498 | 495 | 534 | 529 | 535 | 527 | 542 | 567 | 524    |
| 19–20 | 525 | 521 | 518 | 519 | 547 | 549 | 569 | 570 | 548 | 534 | 536 | 566 | 543    |
| 20–21 | 528 | 515 | 518 | 514 | 531 | 540 | 582 | 566 | 542 | 524 | 532 | 566 | 540    |
| 21–22 | 527 | 513 | 504 | 503 | 520 | 534 | 576 | 570 | 548 | 540 | 534 | 569 | 538    |
| 22–23 | 547 | 531 | 542 | 555 | 524 | 547 | 608 | 594 | 580 | 580 | 554 | 573 | 563    |
| 23–24 | 564 | 536 | 561 | 558 | 566 | 573 | 629 | 605 | 587 | 615 | 577 | 584 | 581    |

**Table M-12 RFCWc—Hourly and Avoided Emissions (kg/MWh)**

| Hour  | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| 0–1   | 674 | 649 | 564 | 480 | 575 | 635 | 769 | 745 | 656 | 573 | 630 | 643 | 638    |
| 1–2   | 673 | 656 | 564 | 480 | 571 | 627 | 758 | 732 | 651 | 562 | 631 | 643 | 634    |
| 2–3   | 670 | 660 | 566 | 478 | 568 | 620 | 754 | 733 | 644 | 561 | 629 | 644 | 631    |
| 3–4   | 675 | 658 | 573 | 488 | 575 | 620 | 761 | 740 | 650 | 573 | 637 | 649 | 637    |
| 4–5   | 684 | 659 | 565 | 482 | 582 | 635 | 773 | 755 | 678 | 594 | 651 | 665 | 646    |
| 5–6   | 683 | 644 | 544 | 456 | 491 | 475 | 679 | 749 | 676 | 560 | 642 | 687 | 610    |
| 6–7   | 677 | 636 | 505 | 346 | 345 | 342 | 511 | 529 | 532 | 513 | 615 | 691 | 525    |
| 7–8   | 653 | 572 | 376 | 249 | 286 | 295 | 433 | 416 | 382 | 366 | 516 | 668 | 440    |
| 8–9   | 517 | 404 | 303 | 208 | 261 | 278 | 390 | 375 | 332 | 306 | 357 | 532 | 359    |
| 9–10  | 439 | 368 | 270 | 200 | 246 | 271 | 362 | 350 | 311 | 285 | 328 | 473 | 328    |
| 10–11 | 418 | 351 | 261 | 193 | 238 | 268 | 362 | 337 | 307 | 278 | 327 | 465 | 320    |
| 11–12 | 409 | 348 | 260 | 189 | 235 | 269 | 350 | 325 | 300 | 276 | 328 | 445 | 314    |
| 12–13 | 406 | 337 | 257 | 188 | 231 | 265 | 348 | 318 | 306 | 277 | 324 | 432 | 310    |
| 13–14 | 407 | 338 | 258 | 184 | 227 | 265 | 338 | 312 | 301 | 279 | 321 | 437 | 307    |
| 14–15 | 415 | 345 | 254 | 185 | 229 | 268 | 341 | 311 | 302 | 274 | 327 | 442 | 309    |
| 15–16 | 427 | 360 | 257 | 194 | 237 | 274 | 344 | 321 | 306 | 290 | 378 | 489 | 324    |
| 16–17 | 543 | 424 | 279 | 201 | 254 | 288 | 361 | 330 | 339 | 371 | 539 | 646 | 382    |
| 17–18 | 645 | 575 | 397 | 280 | 312 | 322 | 406 | 408 | 460 | 508 | 612 | 680 | 467    |
| 18–19 | 655 | 618 | 503 | 423 | 438 | 420 | 518 | 550 | 580 | 532 | 617 | 679 | 545    |
| 19–20 | 654 | 619 | 522 | 470 | 532 | 549 | 627 | 636 | 589 | 531 | 611 | 681 | 589    |
| 20–21 | 654 | 618 | 510 | 457 | 524 | 560 | 629 | 627 | 582 | 523 | 606 | 673 | 584    |
| 21–22 | 663 | 628 | 519 | 447 | 520 | 574 | 639 | 644 | 630 | 560 | 616 | 672 | 597    |
| 22–23 | 676 | 639 | 556 | 483 | 551 | 613 | 708 | 727 | 678 | 594 | 634 | 664 | 632    |
| 23–24 | 673 | 651 | 570 | 493 | 572 | 643 | 749 | 736 | 669 | 586 | 636 | 665 | 642    |

**Table M-13 RMPAc—Hourly and Avoided Emissions (kg/MWh)**

| <b>Hour</b> | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>Apr</b> | <b>May</b> | <b>Jun</b> | <b>Jul</b> | <b>Aug</b> | <b>Sep</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> | <b>Annual</b> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 0–1         | 223        | 237        | 171        | 158        | 175        | 188        | 209        | 237        | 243        | 227        | 265        | 258        | 217           |
| 1–2         | 227        | 232        | 173        | 162        | 174        | 206        | 223        | 240        | 256        | 238        | 269        | 253        | 222           |
| 2–3         | 225        | 231        | 168        | 154        | 179        | 198        | 234        | 247        | 244        | 229        | 276        | 259        | 222           |
| 3–4         | 229        | 233        | 174        | 155        | 180        | 199        | 234        | 258        | 253        | 222        | 269        | 261        | 224           |
| 4–5         | 227        | 225        | 183        | 155        | 175        | 176        | 222        | 244        | 250        | 234        | 259        | 245        | 217           |
| 5–6         | 215        | 206        | 175        | 145        | 159        | 157        | 171        | 214        | 231        | 223        | 254        | 240        | 200           |
| 6–7         | 224        | 205        | 152        | 140        | 137        | 144        | 145        | 189        | 214        | 203        | 243        | 240        | 187           |
| 7–8         | 213        | 182        | 154        | 129        | 146        | 148        | 139        | 170        | 184        | 185        | 226        | 223        | 176           |
| 8–9         | 181        | 162        | 150        | 135        | 150        | 144        | 142        | 160        | 183        | 184        | 207        | 200        | 167           |
| 9–10        | 172        | 164        | 143        | 138        | 141        | 139        | 132        | 155        | 174        | 188        | 213        | 189        | 162           |
| 10–11       | 166        | 174        | 134        | 133        | 146        | 138        | 131        | 154        | 170        | 181        | 220        | 195        | 161           |
| 11–12       | 174        | 190        | 140        | 136        | 139        | 138        | 127        | 152        | 166        | 182        | 208        | 190        | 161           |
| 12–13       | 178        | 180        | 137        | 140        | 136        | 139        | 124        | 160        | 165        | 190        | 210        | 188        | 161           |
| 13–14       | 182        | 171        | 136        | 141        | 141        | 141        | 125        | 160        | 157        | 193        | 208        | 201        | 162           |
| 14–15       | 174        | 172        | 135        | 135        | 133        | 133        | 125        | 152        | 155        | 179        | 216        | 217        | 159           |
| 15–16       | 198        | 192        | 141        | 147        | 137        | 138        | 127        | 157        | 170        | 193        | 244        | 232        | 172           |
| 16–17       | 214        | 212        | 173        | 154        | 152        | 139        | 148        | 184        | 195        | 211        | 233        | 245        | 187           |
| 17–18       | 215        | 204        | 193        | 169        | 172        | 150        | 174        | 209        | 215        | 204        | 235        | 238        | 198           |
| 18–19       | 209        | 206        | 192        | 175        | 175        | 172        | 181        | 214        | 216        | 204        | 235        | 242        | 202           |
| 19–20       | 219        | 204        | 181        | 169        | 173        | 187        | 197        | 218        | 203        | 212        | 230        | 256        | 205           |
| 20–21       | 223        | 210        | 180        | 167        | 169        | 184        | 182        | 206        | 210        | 218        | 233        | 244        | 202           |
| 21–22       | 223        | 210        | 174        | 161        | 173        | 200        | 193        | 217        | 225        | 229        | 242        | 249        | 208           |
| 22–23       | 233        | 216        | 172        | 161        | 183        | 199        | 194        | 230        | 228        | 211        | 255        | 251        | 212           |
| 23–24       | 224        | 225        | 166        | 158        | 174        | 182        | 201        | 225        | 232        | 215        | 263        | 263        | 211           |

**Table M-14 SPNOc—Hourly and Avoided Emissions (kg/MWh)**

| <b>Hour</b> | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>Apr</b> | <b>May</b> | <b>Jun</b> | <b>Jul</b> | <b>Aug</b> | <b>Sep</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> | <b>Annual</b> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 0–1         | 362        | 378        | 298        | 221        | 311        | 307        | 460        | 490        | 459        | 285        | 364        | 349        | 363           |
| 1–2         | 370        | 388        | 286        | 219        | 299        | 295        | 465        | 482        | 462        | 282        | 365        | 354        | 362           |
| 2–3         | 377        | 390        | 296        | 218        | 307        | 306        | 479        | 489        | 455        | 278        | 365        | 362        | 366           |
| 3–4         | 375        | 377        | 302        | 227        | 319        | 317        | 480        | 488        | 452        | 284        | 354        | 366        | 367           |
| 4–5         | 362        | 374        | 305        | 233        | 308        | 294        | 456        | 451        | 451        | 308        | 346        | 360        | 358           |
| 5–6         | 357        | 373        | 286        | 206        | 240        | 216        | 347        | 365        | 391        | 294        | 353        | 358        | 318           |
| 6–7         | 357        | 352        | 247        | 154        | 198        | 175        | 296        | 278        | 313        | 241        | 344        | 346        | 277           |
| 7–8         | 324        | 285        | 179        | 135        | 175        | 190        | 247        | 239        | 267        | 197        | 268        | 311        | 236           |
| 8–9         | 261        | 242        | 165        | 128        | 170        | 173        | 224        | 225        | 261        | 184        | 232        | 257        | 211           |
| 9–10        | 251        | 223        | 157        | 125        | 165        | 166        | 208        | 217        | 253        | 181        | 225        | 250        | 203           |
| 10–11       | 240        | 233        | 155        | 128        | 166        | 168        | 202        | 192        | 245        | 181        | 222        | 238        | 197           |
| 11–12       | 240        | 221        | 146        | 128        | 168        | 164        | 201        | 190        | 239        | 173        | 218        | 236        | 193           |
| 12–13       | 242        | 221        | 143        | 133        | 169        | 158        | 203        | 184        | 229        | 176        | 216        | 237        | 192           |

**Table M-14 SPNOc—Hourly and Avoided Emissions (kg/MWh) (Continued)**

| Hour  | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| 13–14 | 229 | 229 | 144 | 127 | 166 | 154 | 204 | 191 | 219 | 171 | 214 | 233 | 190    |
| 14–15 | 223 | 227 | 149 | 128 | 166 | 157 | 207 | 201 | 221 | 174 | 219 | 255 | 194    |
| 15–16 | 260 | 243 | 152 | 135 | 169 | 167 | 193 | 199 | 231 | 182 | 255 | 263 | 203    |
| 16–17 | 317 | 267 | 176 | 158 | 185 | 174 | 215 | 213 | 265 | 243 | 329 | 321 | 236    |
| 17–18 | 349 | 344 | 248 | 200 | 224 | 198 | 262 | 276 | 349 | 297 | 352 | 331 | 283    |
| 18–19 | 356 | 348 | 284 | 265 | 298 | 260 | 337 | 347 | 363 | 299 | 354 | 327 | 321    |
| 19–20 | 349 | 358 | 280 | 259 | 303 | 295 | 360 | 343 | 370 | 285 | 356 | 326 | 326    |
| 20–21 | 360 | 350 | 286 | 245 | 293 | 307 | 341 | 348 | 372 | 281 | 348 | 336 | 324    |
| 21–22 | 355 | 353 | 300 | 249 | 299 | 313 | 365 | 369 | 400 | 293 | 352 | 336 | 335    |
| 22–23 | 359 | 362 | 300 | 246 | 315 | 338 | 402 | 429 | 438 | 289 | 357 | 349 | 353    |
| 23–24 | 369 | 366 | 296 | 234 | 324 | 320 | 436 | 465 | 444 | 284 | 369 | 344 | 360    |

**Table M-15 SPSOc—Hourly and Avoided Emissions (kg/MWh)**

| Hour  | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| 0–1   | 301 | 343 | 229 | 202 | 249 | 293 | 394 | 453 | 399 | 271 | 308 | 315 | 319    |
| 1–2   | 297 | 354 | 230 | 199 | 250 | 296 | 398 | 450 | 418 | 278 | 306 | 319 | 322    |
| 2–3   | 307 | 353 | 229 | 196 | 258 | 304 | 406 | 462 | 427 | 275 | 312 | 322 | 326    |
| 3–4   | 311 | 344 | 234 | 210 | 254 | 321 | 420 | 469 | 446 | 283 | 320 | 318 | 332    |
| 4–5   | 305 | 336 | 230 | 215 | 259 | 330 | 434 | 476 | 443 | 284 | 319 | 314 | 333    |
| 5–6   | 306 | 341 | 226 | 212 | 250 | 291 | 409 | 445 | 440 | 282 | 310 | 316 | 323    |
| 6–7   | 305 | 330 | 223 | 181 | 197 | 245 | 368 | 372 | 371 | 250 | 300 | 309 | 292    |
| 7–8   | 281 | 307 | 176 | 148 | 172 | 222 | 305 | 320 | 293 | 203 | 243 | 274 | 249    |
| 8–9   | 229 | 258 | 159 | 139 | 167 | 206 | 284 | 288 | 281 | 177 | 203 | 235 | 224    |
| 9–10  | 204 | 246 | 148 | 136 | 163 | 210 | 273 | 276 | 273 | 178 | 196 | 220 | 216    |
| 10–11 | 207 | 228 | 147 | 135 | 158 | 206 | 263 | 261 | 260 | 171 | 205 | 216 | 210    |
| 11–12 | 206 | 227 | 140 | 136 | 161 | 218 | 265 | 251 | 258 | 173 | 207 | 210 | 210    |
| 12–13 | 198 | 220 | 146 | 138 | 164 | 209 | 268 | 253 | 256 | 172 | 204 | 202 | 208    |
| 13–14 | 195 | 220 | 146 | 141 | 164 | 203 | 269 | 252 | 250 | 173 | 196 | 208 | 207    |
| 14–15 | 203 | 217 | 145 | 142 | 165 | 207 | 269 | 253 | 252 | 176 | 199 | 214 | 209    |
| 15–16 | 212 | 228 | 147 | 143 | 168 | 210 | 261 | 249 | 261 | 171 | 213 | 226 | 212    |
| 16–17 | 250 | 265 | 158 | 150 | 169 | 215 | 263 | 268 | 289 | 214 | 279 | 282 | 236    |
| 17–18 | 305 | 323 | 212 | 185 | 203 | 237 | 307 | 324 | 375 | 295 | 317 | 312 | 284    |
| 18–19 | 299 | 338 | 253 | 248 | 278 | 315 | 369 | 385 | 403 | 285 | 303 | 299 | 319    |
| 19–20 | 296 | 325 | 241 | 236 | 282 | 321 | 378 | 378 | 390 | 272 | 297 | 291 | 314    |
| 20–21 | 294 | 322 | 231 | 219 | 275 | 316 | 359 | 375 | 375 | 256 | 290 | 290 | 305    |
| 21–22 | 293 | 320 | 219 | 210 | 256 | 318 | 369 | 377 | 388 | 255 | 284 | 293 | 304    |
| 22–23 | 291 | 327 | 227 | 202 | 250 | 315 | 390 | 414 | 402 | 265 | 298 | 298 | 313    |
| 23–24 | 294 | 335 | 232 | 202 | 255 | 312 | 404 | 441 | 409 | 267 | 307 | 311 | 320    |

**Table M-16 SRM<sub>Vc</sub>—Hourly and Avoided Emissions (kg/MWh)**

| <b>Hour</b> | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>Apr</b> | <b>May</b> | <b>Jun</b> | <b>Jul</b> | <b>Aug</b> | <b>Sep</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> | <b>Annual</b> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 0–1         | 493        | 493        | 429        | 391        | 483        | 523        | 609        | 601        | 546        | 457        | 490        | 481        | 506           |
| 1–2         | 490        | 501        | 433        | 389        | 475        | 513        | 616        | 599        | 541        | 457        | 493        | 482        | 505           |
| 2–3         | 487        | 501        | 433        | 381        | 478        | 508        | 619        | 598        | 541        | 456        | 494        | 481        | 503           |
| 3–4         | 487        | 488        | 425        | 385        | 483        | 521        | 631        | 596        | 547        | 457        | 499        | 476        | 505           |
| 4–5         | 462        | 469        | 399        | 365        | 477        | 508        | 624        | 588        | 534        | 432        | 466        | 469        | 488           |
| 5–6         | 450        | 446        | 366        | 329        | 364        | 371        | 532        | 533        | 506        | 408        | 440        | 467        | 438           |
| 6–7         | 443        | 432        | 324        | 255        | 281        | 314        | 432        | 406        | 378        | 325        | 407        | 457        | 374           |
| 7–8         | 373        | 368        | 258        | 219        | 254        | 288        | 371        | 345        | 321        | 260        | 304        | 364        | 313           |
| 8–9         | 317        | 329        | 237        | 205        | 243        | 273        | 345        | 317        | 297        | 240        | 265        | 318        | 285           |
| 9–10        | 282        | 308        | 222        | 202        | 235        | 263        | 328        | 302        | 287        | 235        | 259        | 308        | 272           |
| 10–11       | 274        | 291        | 221        | 200        | 220        | 254        | 318        | 281        | 271        | 233        | 258        | 292        | 261           |
| 11–12       | 276        | 287        | 217        | 201        | 219        | 259        | 296        | 273        | 261        | 233        | 262        | 288        | 257           |
| 12–13       | 271        | 283        | 214        | 203        | 221        | 255        | 297        | 273        | 258        | 232        | 263        | 281        | 256           |
| 13–14       | 272        | 287        | 214        | 200        | 214        | 250        | 294        | 278        | 257        | 230        | 255        | 282        | 254           |
| 14–15       | 274        | 290        | 217        | 201        | 223        | 255        | 302        | 281        | 256        | 226        | 260        | 294        | 257           |
| 15–16       | 288        | 303        | 212        | 198        | 231        | 266        | 300        | 284        | 270        | 228        | 279        | 318        | 265           |
| 16–17       | 357        | 337        | 236        | 212        | 242        | 290        | 311        | 306        | 312        | 292        | 381        | 394        | 303           |
| 17–18       | 416        | 408        | 316        | 279        | 296        | 324        | 373        | 388        | 427        | 368        | 421        | 421        | 368           |
| 18–19       | 423        | 426        | 362        | 349        | 382        | 417        | 460        | 468        | 464        | 372        | 422        | 427        | 417           |
| 19–20       | 428        | 427        | 356        | 351        | 410        | 442        | 486        | 477        | 460        | 366        | 420        | 424        | 424           |
| 20–21       | 436        | 435        | 337        | 332        | 432        | 447        | 493        | 476        | 465        | 377        | 427        | 432        | 428           |
| 21–22       | 459        | 454        | 351        | 326        | 411        | 481        | 539        | 512        | 500        | 420        | 450        | 460        | 452           |
| 22–23       | 472        | 487        | 393        | 355        | 448        | 542        | 588        | 566        | 537        | 441        | 475        | 485        | 489           |
| 23–24       | 485        | 490        | 426        | 404        | 491        | 555        | 617        | 604        | 549        | 461        | 496        | 480        | 511           |

**Table M-17 SRM<sub>Wc</sub>—Hourly and Avoided Emissions (kg/MWh)**

| <b>Hour</b> | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>Apr</b> | <b>May</b> | <b>Jun</b> | <b>Jul</b> | <b>Aug</b> | <b>Sep</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> | <b>Annual</b> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 0–1         | 529        | 529        | 425        | 358        | 457        | 502        | 617        | 626        | 582        | 421        | 527        | 504        | 513           |
| 1–2         | 531        | 531        | 417        | 352        | 446        | 489        | 628        | 632        | 566        | 419        | 525        | 505        | 510           |
| 2–3         | 540        | 531        | 427        | 358        | 449        | 491        | 639        | 635        | 561        | 420        | 529        | 510        | 514           |
| 3–4         | 542        | 520        | 427        | 367        | 460        | 507        | 643        | 638        | 572        | 434        | 529        | 510        | 518           |
| 4–5         | 525        | 499        | 425        | 355        | 418        | 412        | 587        | 606        | 572        | 437        | 511        | 510        | 492           |
| 5–6         | 517        | 490        | 393        | 275        | 302        | 287        | 429        | 442        | 461        | 412        | 496        | 516        | 422           |
| 6–7         | 501        | 451        | 297        | 192        | 241        | 239        | 365        | 345        | 343        | 285        | 443        | 502        | 355           |
| 7–8         | 404        | 331        | 225        | 162        | 214        | 237        | 316        | 303        | 290        | 233        | 312        | 409        | 290           |
| 8–9         | 343        | 292        | 204        | 153        | 202        | 230        | 296        | 282        | 273        | 218        | 291        | 361        | 265           |
| 9–10        | 328        | 277        | 197        | 147        | 199        | 221        | 288        | 274        | 268        | 212        | 281        | 353        | 257           |
| 10–11       | 318        | 283        | 194        | 145        | 196        | 223        | 280        | 255        | 259        | 211        | 279        | 326        | 250           |
| 11–12       | 317        | 271        | 189        | 149        | 192        | 217        | 275        | 249        | 258        | 209        | 272        | 324        | 245           |
| 12–13       | 320        | 271        | 187        | 148        | 188        | 214        | 270        | 241        | 249        | 211        | 274        | 328        | 243           |

**Table M-17 SRMWc—Hourly and Avoided Emissions (kg/MWh)**

| Hour  | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| 13–14 | 313 | 275 | 187 | 144 | 192 | 214 | 271 | 244 | 248 | 203 | 275 | 333 | 243    |
| 14–15 | 314 | 278 | 189 | 149 | 193 | 218 | 274 | 257 | 248 | 217 | 304 | 357 | 251    |
| 15–16 | 384 | 322 | 200 | 157 | 199 | 231 | 277 | 263 | 272 | 256 | 388 | 425 | 279    |
| 16–17 | 469 | 400 | 270 | 208 | 235 | 250 | 309 | 305 | 350 | 365 | 487 | 483 | 340    |
| 17–18 | 488 | 470 | 366 | 308 | 328 | 311 | 391 | 406 | 461 | 411 | 501 | 486 | 409    |
| 18–19 | 490 | 473 | 389 | 370 | 420 | 408 | 480 | 493 | 474 | 417 | 500 | 485 | 452    |
| 19–20 | 494 | 476 | 384 | 363 | 415 | 435 | 495 | 492 | 471 | 406 | 495 | 481 | 454    |
| 20–21 | 505 | 481 | 392 | 348 | 403 | 444 | 493 | 499 | 502 | 431 | 497 | 492 | 461    |
| 21–22 | 515 | 488 | 424 | 372 | 425 | 472 | 541 | 547 | 543 | 453 | 513 | 493 | 486    |
| 22–23 | 516 | 511 | 434 | 375 | 460 | 514 | 573 | 586 | 562 | 443 | 518 | 508 | 505    |
| 23–24 | 534 | 509 | 428 | 369 | 466 | 514 | 603 | 621 | 563 | 432 | 528 | 493 | 511    |

**Table M-18 SRSOc—Hourly and Avoided Emissions (kg/MWh)**

| Hour  | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| 0–1   | 616 | 576 | 483 | 438 | 507 | 564 | 767 | 770 | 622 | 573 | 587 | 645 | 604    |
| 1–2   | 616 | 580 | 525 | 499 | 567 | 605 | 796 | 752 | 635 | 598 | 594 | 656 | 626    |
| 2–3   | 625 | 581 | 555 | 526 | 611 | 642 | 784 | 743 | 642 | 597 | 596 | 657 | 636    |
| 3–4   | 620 | 577 | 553 | 501 | 615 | 647 | 771 | 735 | 644 | 607 | 588 | 654 | 632    |
| 4–5   | 608 | 560 | 501 | 457 | 590 | 637 | 776 | 735 | 642 | 564 | 571 | 655 | 614    |
| 5–6   | 581 | 550 | 459 | 410 | 530 | 569 | 754 | 754 | 600 | 490 | 549 | 646 | 581    |
| 6–7   | 573 | 540 | 434 | 335 | 380 | 358 | 494 | 563 | 478 | 454 | 533 | 610 | 485    |
| 7–8   | 553 | 496 | 352 | 230 | 268 | 256 | 336 | 401 | 342 | 325 | 456 | 569 | 389    |
| 8–9   | 425 | 385 | 272 | 187 | 234 | 216 | 276 | 315 | 260 | 237 | 329 | 441 | 303    |
| 9–10  | 342 | 332 | 229 | 173 | 208 | 211 | 237 | 276 | 230 | 209 | 288 | 355 | 259    |
| 10–11 | 310 | 313 | 220 | 173 | 201 | 209 | 213 | 249 | 216 | 209 | 271 | 334 | 243    |
| 11–12 | 315 | 298 | 217 | 169 | 210 | 197 | 211 | 222 | 204 | 205 | 266 | 333 | 236    |
| 12–13 | 330 | 289 | 215 | 174 | 211 | 194 | 216 | 206 | 188 | 201 | 268 | 331 | 232    |
| 13–14 | 323 | 295 | 213 | 174 | 215 | 195 | 221 | 207 | 195 | 201 | 263 | 328 | 232    |
| 14–15 | 332 | 299 | 209 | 174 | 230 | 211 | 228 | 219 | 202 | 215 | 264 | 339 | 239    |
| 15–16 | 344 | 313 | 226 | 175 | 251 | 240 | 248 | 225 | 216 | 213 | 282 | 362 | 254    |
| 16–17 | 386 | 330 | 240 | 193 | 271 | 269 | 279 | 251 | 252 | 260 | 351 | 456 | 289    |
| 17–18 | 512 | 444 | 328 | 226 | 326 | 307 | 342 | 349 | 359 | 367 | 514 | 575 | 378    |
| 18–19 | 556 | 516 | 409 | 311 | 394 | 386 | 438 | 457 | 441 | 413 | 529 | 588 | 450    |
| 19–20 | 555 | 526 | 434 | 348 | 451 | 455 | 501 | 518 | 460 | 412 | 523 | 590 | 482    |
| 20–21 | 558 | 529 | 426 | 339 | 439 | 456 | 510 | 502 | 450 | 411 | 523 | 594 | 479    |
| 21–22 | 560 | 535 | 417 | 321 | 415 | 444 | 496 | 486 | 480 | 422 | 521 | 598 | 475    |
| 22–23 | 585 | 549 | 423 | 334 | 423 | 493 | 509 | 583 | 537 | 445 | 542 | 625 | 506    |
| 23–24 | 619 | 578 | 462 | 381 | 455 | 547 | 624 | 713 | 614 | 500 | 572 | 658 | 566    |

**Table M-19 SRTVc—Hourly and Avoided Emissions (kg/MWh)**

| <b>Hour</b> | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>Apr</b> | <b>May</b> | <b>Jun</b> | <b>Jul</b> | <b>Aug</b> | <b>Sep</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> | <b>Annual</b> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 0–1         | 628        | 643        | 615        | 615        | 651        | 680        | 679        | 686        | 674        | 642        | 650        | 642        | 651           |
| 1–2         | 632        | 644        | 614        | 614        | 645        | 670        | 693        | 701        | 656        | 633        | 649        | 639        | 650           |
| 2–3         | 626        | 634        | 614        | 603        | 641        | 659        | 693        | 696        | 671        | 640        | 650        | 641        | 648           |
| 3–4         | 617        | 623        | 605        | 580        | 671        | 680        | 698        | 699        | 690        | 653        | 635        | 640        | 649           |
| 4–5         | 590        | 586        | 542        | 533        | 661        | 640        | 680        | 693        | 655        | 578        | 585        | 632        | 615           |
| 5–6         | 559        | 550        | 501        | 482        | 500        | 449        | 585        | 590        | 598        | 525        | 547        | 609        | 543           |
| 6–7         | 546        | 536        | 452        | 356        | 370        | 358        | 457        | 466        | 457        | 463        | 518        | 596        | 469           |
| 7–8         | 492        | 455        | 355        | 300        | 332        | 335        | 408        | 395        | 387        | 360        | 399        | 498        | 397           |
| 8–9         | 417        | 406        | 309        | 283        | 320        | 323        | 399        | 370        | 349        | 330        | 354        | 430        | 360           |
| 9–10        | 390        | 383        | 294        | 281        | 315        | 321        | 380        | 364        | 337        | 319        | 347        | 423        | 348           |
| 10–11       | 392        | 370        | 284        | 278        | 313        | 318        | 377        | 363        | 333        | 315        | 354        | 407        | 344           |
| 11–12       | 385        | 365        | 280        | 278        | 317        | 320        | 372        | 365        | 329        | 315        | 354        | 404        | 342           |
| 12–13       | 379        | 366        | 279        | 280        | 322        | 320        | 368        | 357        | 328        | 316        | 349        | 399        | 340           |
| 13–14       | 383        | 360        | 276        | 284        | 322        | 320        | 370        | 358        | 334        | 313        | 348        | 401        | 340           |
| 14–15       | 388        | 373        | 280        | 284        | 327        | 336        | 375        | 364        | 331        | 320        | 354        | 416        | 347           |
| 15–16       | 400        | 388        | 295        | 290        | 338        | 343        | 385        | 375        | 347        | 344        | 393        | 458        | 364           |
| 16–17       | 457        | 444        | 350        | 325        | 371        | 360        | 412        | 403        | 394        | 416        | 489        | 524        | 411           |
| 17–18       | 528        | 498        | 408        | 382        | 419        | 396        | 460        | 460        | 464        | 466        | 534        | 561        | 464           |
| 18–19       | 532        | 521        | 456        | 428        | 479        | 454        | 520        | 526        | 510        | 478        | 535        | 564        | 501           |
| 19–20       | 537        | 524        | 450        | 435        | 488        | 484        | 556        | 534        | 503        | 477        | 533        | 571        | 510           |
| 20–21       | 545        | 532        | 456        | 433        | 494        | 487        | 541        | 527        | 526        | 510        | 545        | 581        | 516           |
| 21–22       | 579        | 577        | 490        | 465        | 521        | 536        | 570        | 575        | 604        | 596        | 578        | 606        | 559           |
| 22–23       | 609        | 616        | 566        | 538        | 621        | 643        | 616        | 651        | 666        | 635        | 625        | 633        | 619           |
| 23–24       | 623        | 638        | 592        | 599        | 670        | 672        | 658        | 687        | 677        | 653        | 648        | 627        | 646           |

**Table M-20 SRVc—Hourly and Avoided Emissions (kg/MWh)**

| <b>Hour</b> | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>Apr</b> | <b>May</b> | <b>Jun</b> | <b>Jul</b> | <b>Aug</b> | <b>Sep</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> | <b>Annual</b> |
|-------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| 0–1         | 544        | 568        | 424        | 328        | 447        | 543        | 686        | 688        | 590        | 476        | 508        | 544        | 537           |
| 1–2         | 536        | 575        | 440        | 336        | 449        | 522        | 679        | 696        | 580        | 470        | 510        | 556        | 537           |
| 2–3         | 536        | 571        | 456        | 340        | 459        | 498        | 680        | 699        | 570        | 471        | 505        | 565        | 536           |
| 3–4         | 538        | 567        | 461        | 360        | 471        | 491        | 677        | 708        | 575        | 487        | 511        | 570        | 541           |
| 4–5         | 543        | 553        | 467        | 349        | 474        | 525        | 696        | 713        | 593        | 516        | 508        | 575        | 547           |
| 5–6         | 521        | 526        | 431        | 320        | 414        | 394        | 613        | 698        | 569        | 478        | 483        | 575        | 507           |
| 6–7         | 509        | 513        | 388        | 253        | 280        | 271        | 477        | 526        | 434        | 411        | 448        | 547        | 429           |
| 7–8         | 474        | 452        | 298        | 185        | 213        | 210        | 366        | 404        | 313        | 309        | 366        | 518        | 350           |
| 8–9         | 382        | 327        | 235        | 158        | 191        | 189        | 310        | 336        | 264        | 245        | 269        | 407        | 281           |
| 9–10        | 330        | 309        | 210        | 145        | 173        | 174        | 279        | 302        | 239        | 222        | 246        | 361        | 253           |
| 10–11       | 324        | 285        | 200        | 142        | 168        | 169        | 259        | 275        | 225        | 206        | 239        | 355        | 240           |
| 11–12       | 315        | 282        | 198        | 138        | 161        | 158        | 246        | 237        | 206        | 206        | 241        | 351        | 229           |
| 12–13       | 328        | 271        | 196        | 139        | 160        | 164        | 232        | 220        | 199        | 204        | 242        | 344        | 224           |

**Table M-20 SRVCC—Hourly and Avoided Emissions (kg/MWh) (Continued)**

| Hour  | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| 13–14 | 323 | 276 | 194 | 140 | 158 | 162 | 223 | 219 | 197 | 210 | 236 | 340 | 221    |
| 14–15 | 337 | 280 | 183 | 148 | 163 | 167 | 232 | 223 | 197 | 213 | 245 | 351 | 225    |
| 15–16 | 335 | 300 | 189 | 154 | 171 | 176 | 244 | 224 | 195 | 230 | 273 | 391 | 236    |
| 16–17 | 414 | 338 | 225 | 167 | 184 | 193 | 262 | 236 | 228 | 307 | 394 | 495 | 281    |
| 17–18 | 477 | 473 | 344 | 236 | 248 | 236 | 322 | 335 | 351 | 395 | 446 | 522 | 361    |
| 18–19 | 481 | 490 | 379 | 294 | 332 | 326 | 424 | 436 | 410 | 414 | 445 | 522 | 414    |
| 19–20 | 483 | 495 | 389 | 308 | 366 | 377 | 471 | 469 | 403 | 404 | 438 | 512 | 429    |
| 20–21 | 483 | 491 | 378 | 296 | 338 | 349 | 452 | 439 | 395 | 406 | 440 | 514 | 417    |
| 21–22 | 492 | 505 | 398 | 296 | 362 | 373 | 447 | 478 | 461 | 452 | 451 | 521 | 439    |
| 22–23 | 522 | 534 | 450 | 335 | 462 | 458 | 564 | 578 | 554 | 496 | 491 | 528 | 502    |
| 23–24 | 531 | 560 | 450 | 331 | 469 | 527 | 637 | 650 | 580 | 489 | 494 | 554 | 529    |

**Table M-21 Avoided Emissions from Off-Site Purchase of Renewable Energy (kg/MWh)**

| GEA Region | Solar | Wind | Hydro | Other Renewables |
|------------|-------|------|-------|------------------|
| AZNMc      | 220   | 259  | 266   | 260              |
| CAMXc      | 85    | 131  | 134   | 136              |
| ERCTc      | 256   | 311  | 304   | 304              |
| FRCCc      | 280   | 432  | 437   | 411              |
| MROEc      | 248   | 399  | 389   | 377              |
| MROWc      | 129   | 201  | 188   | 191              |
| NEWEc      | 257   | 333  | 328   | 327              |
| NWPPc      | 128   | 170  | 167   | 167              |
| NYSTc      | 189   | 257  | 255   | 252              |
| RFCEc      | 298   | 476  | 448   | 455              |
| RFCMc      | 465   | 520  | 511   | 515              |
| RFCWc      | 315   | 512  | 489   | 487              |
| RMPAc      | 159   | 195  | 187   | 191              |
| SPNOc      | 199   | 295  | 272   | 280              |
| SPSOc      | 215   | 279  | 269   | 270              |
| SRMVc      | 268   | 388  | 373   | 377              |
| SRMWc      | 250   | 404  | 362   | 383              |
| SRSOc      | 254   | 452  | 436   | 423              |
| SRTVc      | 352   | 505  | 483   | 483              |
| SRVCC      | 241   | 405  | 391   | 383              |

*Add new section J6 to Informative Appendix J as shown.*

## **J6. LONG-RUN MARGINAL EMISSION RATES**

The long-run marginal emission rates published in Normative Appendix M were taken from the Cambium database as published in the Cambium21\_LRMER\_GEARegions.XLSX workbook, and using the settings shown in Table J16.

Avoided emissions in Table M-21 are based on the hourly signatures of electricity production for solar, wind and hydro, taken from the Cambium database. The avoided emissions for “other renewables” assume that the generators produce a constant amount of electricity for all hours of the year.

**Table J-16 Cambium Assumptions Used for Long-Run Marginal Emission Rates**

| <b>Setting</b>            | <b>Value</b>      | <b>Choices/Description</b>   |
|---------------------------|-------------------|--|
| Emission                  | CO <sub>2</sub> e | CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, CO <sub>2</sub> e      |
| Emission stage            | Combined          | Combustion, precombustion, combined  |
| Start year                | 2023              | First year of emissions  |
| Evaluation period (years) | 20                | Period over which emissions are tabulated                                    |
| Discount rate (real)      | 0.03              | Future emissions are discounted this much each year                          |
| Scenario                  | Low RE costs      | Midcase, low RE costs, high RE costs, 95% decarb by 2050, 95% decarb by 2035 |
| Global warming potentials | 20-year (AR5)     | 20-year (AR5), 100-year (AR5), custom  |
| Location                  | End-use           | End-use, busbar  |

**POLICY STATEMENT DEFINING ASHRAE'S CONCERN  
FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES**

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

### **Standard 189.1 and the International Green Construction Code**

Standard 189.1 serves as the complete technical content of the International Green Construction Code<sup>®</sup> (IgCC). The IgCC creates a regulatory framework for new and existing buildings, establishing minimum green requirements for buildings and complementing voluntary rating systems. For more information, visit [www.iccsafe.org](http://www.iccsafe.org).

### **About ASHRAE**

Founded in 1894, ASHRAE is a global professional society committed to serve humanity by advancing the arts and sciences of heating, ventilation, air conditioning, refrigeration, and their allied fields.

As an industry leader in research, standards writing, publishing, certification, and continuing education, ASHRAE and its members are dedicated to promoting a healthy and sustainable built environment for all, through strategic partnerships with organizations in the HVAC&R community and across related industries.

To stay current with this and other ASHRAE Standards and Guidelines, visit [www.ashrae.org/standards](http://www.ashrae.org/standards), and connect on LinkedIn, Facebook, Twitter, and YouTube.

### **Visit the ASHRAE Bookstore**

ASHRAE offers its Standards and Guidelines in print, as immediately downloadable PDFs, and via ASHRAE Digital Collections, which provides online access with automatic updates as well as historical versions of publications. Selected Standards and Guidelines are also offered in redline versions that indicate the changes made between the active Standard or Guideline and its previous edition. For more information, visit the Standards and Guidelines section of the ASHRAE Bookstore at [www.ashrae.org/bookstore](http://www.ashrae.org/bookstore).

### **IMPORTANT NOTICES ABOUT THIS STANDARD**

**To ensure that you have all of the approved addenda, errata, and interpretations for this Standard, visit [www.ashrae.org/standards](http://www.ashrae.org/standards) to download them free of charge.**

**Addenda, errata, and interpretations for ASHRAE Standards and Guidelines are no longer distributed with copies of the Standards and Guidelines. ASHRAE provides these addenda, errata, and interpretations only in electronic form to promote more sustainable use of resources.**