ZERO CODE™

for

CALIFORNIA

A California building energy standard for new nonresidential, high-rise residential and hotel/motel buildings.
ZERO Code for California
Based on the California Title 24, Part 6, Building Energy Efficiency Standards, 2019

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DISCLAIMER

Architecture 2030 does not guarantee, certify, or assure the safety or performance of any buildings, products, components, or systems installed in accordance with the ZERO Code for California or referenced standards.

In referring to the ZERO Code for California and in the design of any building or use of any product, no claim shall be made, either stated or implied, that the building or product has been approved by Architecture 2030.

The ZERO Code for California standard is presented solely as a guide, which may be modified and consequently adopted as such by appropriate legal jurisdictions. In utilizing the standard or Energy Calculator, practitioners must research and ensure compliance with ordinances and codes applicable in their jurisdictions.
INTRODUCTION

The ZERO Code for California (ZERO Code\textsubscript{ca}) is a building energy standard developed by Architecture 2030 that applies to new commercial, institutional, high-rise residential, and hotel/motel buildings, the prevalent building types being constructed in cities today. The ZERO Code\textsubscript{ca}, which can be adopted immediately, integrates cost-effective energy efficiency standards with on-site and/or off-site renewable energy resulting in Zero-Net-Carbon (ZNC) buildings. The ZERO Code\textsubscript{ca} can either be incentivized or required by implementing jurisdictions. Adoption of the ZERO Code\textsubscript{ca} is an important component of addressing climate change and reducing CO\textsubscript{2} emissions in these building types.

The ZERO Code\textsubscript{ca} includes prescriptive and performance paths to compliance based on the California Building Energy Efficiency Standards (BEES) and is supported by the compliance tool and simulation software CBECC-Com. The ZERO Code\textsubscript{ca} is also supported by a web-enabled Energy Calculator that eases the implementation process and reduces errors when using the prescriptive path.

The ZERO Code\textsubscript{ca} offers code adaptable language and a flexible approach for incorporating renewable energy, both through on-site generation and/or off-site procurement. By establishing a flexible approach, the ZERO Code\textsubscript{ca} is applicable to all new new commercial, institutional, high-rise residential, and hotel/motel buildings, including those buildings with limited on-site renewable energy generating capacity (e.g. buildings in dense urban environments).

Technical support documents are available that explain the concepts of the ZERO Code\textsubscript{ca} and describe potential options for off-site procurement of renewable energy. The feasibility/desirability of each option will vary with each authority having jurisdiction that adopts the ZERO Code\textsubscript{ca}. 
THE ZERO CODE FOR CALIFORNIA

1. PURPOSE

New nonresidential, high-rise residential and hotel/motel buildings shall be energy efficient and install on-site renewable energy systems and/or procure off-site renewable energy of adequate capacity to achieve zero net energy (ZNE).

2. SCOPE

This standard applies to new commercial, institutional, high-rise residential, and hotel/motel buildings that are addressed by the California Building Energy Efficiency Standards (BEES). See Section 100.0–Scope of the BEES.

3. DEFINITIONS AND TERMS

The definitions from the California BEES shall apply to this standard and are supplemented by the definitions below.

**authority having jurisdiction (AHJ):** the agency or agent responsible for enforcing this standard.

**building source energy (BSE):** the source energy consumption of the building calculated on an hourly basis, kBtu/y.

**eligible hydro:** hydroelectric plants less than 30 MW that qualify for the California renewable portfolio standards.

**procurement factor (PF):** a factor related to the method used to procure off-site renewable energy, unitless.

**source energy credit (SEC):** the annual source energy credit from renewable energy, either generated on-site or procured off-site, kBtu/y.

**source energy factor (SEF):** the source energy that results from the generation or procurement of renewable energy, kBtu/KWh.

**source energy intensity (SEI):** the source energy intensity for a particular building type and climate zone, kBtu/ft²-y.

**time dependent source (TDS) energy:** an 8,760 time-series of the hourly source energy factors for electricity and natural gas, which vary by climate zone, kBtu/kWh for electricity and kBtu/therm for gas.
4. ADMINISTRATION AND ENFORCEMENT

4.1 Compliance

New buildings shall comply with Section 5 (minimum energy efficiency) and Section 6 (renewable energy).

4.2 Compliance Software

The California Building Energy Code Compliance (CBECC-Com) software may be used to demonstrate compliance with the ZERO Code for California through the performance approach. The Architecture 2030 ZERO Code website has tools to assist compliance when the prescriptive approach is used.

5. MINIMUM ENERGY EFFICIENCY

Buildings shall comply with the 2019 California BEES using either the performance requirements Section 140.1 or the prescriptive requirements of Section 140.2

6. RENEWABLE ENERGY

6.1 Zero Net Energy

The source energy credits from on-site renewable energy systems or procured off-site renewable energy shall be greater than or equal to the building source energy on an annual basis. Building source energy and source energy credits from renewable energy systems shall be evaluated for each hour of the year and summed.

\[
\text{Building Source Energy} \leq \text{Source Energy Credit}_{\text{On-Site RE}} + \text{Source Energy Credit}_{\text{Off-Site RE}}
\]

(From Equations 2 or 3)  
(From Equations 4 or 5)  
(From Equation 6)

6.2 Building Source Energy

When the proposed building complies with the California BEES using the prescriptive requirements of Section 140.2, the building source energy shall be calculated by multiplying the conditioned floor area times the source energy intensity from Table 6.1.
Building Source Energy = Conditioned Floor Area \times Source Energy Intensity
(kBtu/y) (ft²) (kBtu/ft²/y) (from Table 6.1)

When the proposed building complies with the California BEES using the performance requirements of Section 140.1, the building source energy shall be determined by multiplying the hourly building energy for each fuel times the time dependent source (TDS) energy rate for that hour and fuel.

Equation 3

\[
\text{Building Source Energy} = \sum_{h=1}^{8760} \text{BE}_h \cdot \text{TDS}_{e,h} + \sum_{h=1}^{8760} \text{BG}_h \cdot \text{TDS}_{g,h}
\]

where

BE\text{h} = Building electricity use for the h\text{th} hour of the year

TDS\text{e,h} = Time-dependent source energy rate for electricity use in the h\text{th} hour of the year

BG\text{h} = Building gas use for the h\text{th} hour of the year

TDS\text{g,h} = Time-dependent source energy rate for gas use for the h\text{th} hour of the year
Table 6.1 Source Energy Intensities (SEI) by Building Type and Climate (kBtu/ft²-y)

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Office</th>
<th>Retail</th>
<th>School</th>
<th>Restaurant</th>
<th>Hotel</th>
<th>Warehouse</th>
<th>Residential</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>38</td>
<td>35</td>
<td>39</td>
<td>186</td>
<td>31</td>
<td>26</td>
<td>29</td>
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<tr>
<td>2</td>
<td>41</td>
<td>37</td>
<td>36</td>
<td>177</td>
<td>29</td>
<td>20</td>
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<td>3</td>
<td>38</td>
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<tr>
<td>4</td>
<td>40</td>
<td>35</td>
<td>34</td>
<td>175</td>
<td>27</td>
<td>18</td>
<td>29</td>
</tr>
<tr>
<td>5</td>
<td>39</td>
<td>32</td>
<td>33</td>
<td>179</td>
<td>26</td>
<td>18</td>
<td>27</td>
</tr>
<tr>
<td>6</td>
<td>39</td>
<td>33</td>
<td>31</td>
<td>174</td>
<td>25</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td>7</td>
<td>38</td>
<td>32</td>
<td>30</td>
<td>168</td>
<td>24</td>
<td>13</td>
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<tr>
<td>9</td>
<td>41</td>
<td>37</td>
<td>33</td>
<td>171</td>
<td>27</td>
<td>15</td>
<td>29</td>
</tr>
<tr>
<td>10</td>
<td>42</td>
<td>38</td>
<td>34</td>
<td>175</td>
<td>28</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>11</td>
<td>44</td>
<td>42</td>
<td>39</td>
<td>183</td>
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<td>22</td>
<td>33</td>
</tr>
<tr>
<td>12</td>
<td>42</td>
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<td>38</td>
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<td>21</td>
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<td>39</td>
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<td>32</td>
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<td>45</td>
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<td>39</td>
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<td>32</td>
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<tr>
<td>15</td>
<td>46</td>
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<td>38</td>
<td>192</td>
<td>32</td>
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<td>34</td>
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<tr>
<td>16</td>
<td>46</td>
<td>45</td>
<td>45</td>
<td>187</td>
<td>36</td>
<td>31</td>
<td>35</td>
</tr>
</tbody>
</table>

6.3 Source Energy Credit from On-Site Renewable Energy

When the proposed building complies with the California BEES using the prescriptive requirements of Section 140.2, the source energy credit from on-site renewable energy shall be calculated by multiplying the estimated annual renewable energy production times the source energy factor from Table 6.2. The annual energy production from on-site renewable energy systems shall be determined using the PVWatts software or other software approved by the authority having jurisdiction.

\[
\text{Source Energy Credit}_{\text{OnSite RE}} = \frac{\text{Annual On-Site PV Production (kBtu)}}{\text{Source Energy Factor (kBtu/kWh)}}
\]

Equation 4

When the building complies with the California BEES using the performance requirements of Section 140.1, the source energy credit from on-site renewable energy systems shall be determined by multiplying the renewable energy production for each hour times the time dependent source (TDS) energy rate for that hour.
Equation 5

\[
Source \ Energy \ Credit_{OnSite\ RE} = \sum_{h=1}^{8760} OnSiteRE_h \cdot TDS_{e,h}
\]

where

\(OnSiteRE_h = \) On-site renewable energy production for the \(h^{th}\) hour of the year

\(TDS_{e,h} = \) Time-dependent source energy rate for electricity use in the \(h^{th}\) hour of the year

Table 6.2 Source Energy Factor (SEF) for On-Site Photovoltaic Production (Btu/kWh)

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Source Energy Factor</th>
<th>Climate Zone</th>
<th>Source Energy Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2,501</td>
<td>9</td>
<td>2,551</td>
</tr>
<tr>
<td>2</td>
<td>2,526</td>
<td>10</td>
<td>2,525</td>
</tr>
<tr>
<td>3</td>
<td>2,527</td>
<td>11</td>
<td>2,530</td>
</tr>
<tr>
<td>4</td>
<td>2,537</td>
<td>12</td>
<td>2,486</td>
</tr>
<tr>
<td>5</td>
<td>2,512</td>
<td>13</td>
<td>2,472</td>
</tr>
<tr>
<td>6</td>
<td>2,491</td>
<td>14</td>
<td>2,526</td>
</tr>
<tr>
<td>7</td>
<td>2,509</td>
<td>15</td>
<td>2,542</td>
</tr>
<tr>
<td>8</td>
<td>2,537</td>
<td>16</td>
<td>2,588</td>
</tr>
</tbody>
</table>

6.4 Source Energy Credit from Off-Site Renewable Energy

The source energy credit for off-site renewable energy shall be determined with the following equation.

Equation 6

\[
Source \ Energy \ Credit_{OffSite\ RE} = \sum_{p=1}^{n} PF_p \cdot \left[ \sum_{r=1}^{q} OffSiteRE_{r,p} \cdot SEF_r \right]
\]

where

\(OffSiteRE_{r,p} = \) Off-site renewable energy procurement for the \(r^{th}\) generation source and for the \(p^{th}\) procurement method (MWh)

\(PF_p = \) Renewable energy procurement factor for the \(p^{th}\) method from Table 6.3 (unitless)
SEF, = Source energy factor for the rᵗʰ generation source from Table 6.4 (kBtu/MWh)

p = Index for the procurement method

r = Index for the renewable energy generation source

n = Number of procurement methods

q = Number of renewable energy generation sources for the pᵗʰ procurement method

Table 6.3 Renewable Energy Procurement Factors

<table>
<thead>
<tr>
<th>Class</th>
<th>Procurement Factor (PF)</th>
<th>Procurement Method</th>
<th>Additional Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.75</td>
<td>Community Renewables</td>
<td>REIFs Entity must be managed to prevent fraud or misuse of funds.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Virtual PPA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Self-Owned Off-Site Provisions shall prevent the generation asset from being sold separately from the building.</td>
</tr>
<tr>
<td>2</td>
<td>0.55</td>
<td>Green Retail Tariffs</td>
<td>The offering shall not include the purchase of unbundled RECs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Direct Access</td>
<td>The offering shall not include the purchase of unbundled RECs.</td>
</tr>
<tr>
<td>3</td>
<td>0.20</td>
<td>Unbundled RECs</td>
<td>The vintage of the RECs shall align with building energy use.</td>
</tr>
</tbody>
</table>

The following requirements apply to all off-site renewable energy procurement methods.

1. The building owner shall sign a legally binding contract to procure qualifying off-site renewable energy.
2. The procurement contract shall have duration of not less than 15 years and shall be structured to survive a partial or full transfer of ownership of the property.
3. RECs and other environmental attributes associated with the procured off-site renewable energy shall be assigned to the building project for the duration of the contract.
4. The renewable energy generating source shall be photovoltaic systems, solar thermal power plants, geothermal power plants, wind turbines, and eligible hydro.
5. The generation source shall be located where the energy can be delivered to the building site by the same utility or distribution entity; the same ISO or RTO; or within integrated ISO’s (electric coordination council).
6. The off-site renewable energy producer shall maintain transparent accounting that clearly assigns production to the ZNC building. Records on power sent to or purchased by the building shall be retained by the building owner and made available for inspection by the Authority Having Jurisdiction (AHJ) upon request.
Table 6.4 Source Energy Factor (SEF) for Off-Site Renewable Energy Procurement

<table>
<thead>
<tr>
<th>Off-Site Renewable Energy Generation Source</th>
<th>Source Energy Factor (Btu/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>4,840</td>
</tr>
<tr>
<td>Solar</td>
<td>2,769</td>
</tr>
<tr>
<td>Geothermal</td>
<td>4,636</td>
</tr>
<tr>
<td>Eligible Hydro</td>
<td>4,636</td>
</tr>
</tbody>
</table>
7. REFERENCES

California Building Energy Efficiency Standards, 2019