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Additional submitted attachment is included below.

TITLE 24 ISSUES & RECOMMENDATIONS FOR THE 2019 BUILDING ENERGY STANDARDS

It is my contention, based on my working with California's energy code in a professional capacity since 1978[1], that California would save more energy, and achieve energy savings at a faster rate, if much more emphasis was placed on code compliance, as well as working to make the code simpler and more reflective of real-world design and construction concerns. Designing the code to be easier to understand, while also providing more options for legitimate design and construction concerns, would result in more support, greater understanding, and higher levels of compliance. Requiring compliance document authors to demonstrate knowledge of the code, and addressing the plan review and field check shortfalls that currently exist, would lead to much greater compliance as well.

Contents

STANDARDS DEVELOPMENT PROCESS

- ENERGY GOALS:

  Issue: Ever since the power plant brownouts in the early 2000's, the Standards have been designed to emphasize energy savings during summer afternoon peak power plant energy usage. One key building product change pushed by the code: Very low SHGC glazing. This is an important efficiency measure for buildings with high internal heat loads (most commercial and industrial buildings). However, for single and multi-family residential dwellings, and for smaller nonresidential buildings in colder climate zones, the reduced winter solar gains caused by the low SHGC glazing results in greater use of fossil fuel or electricity for space heating in these buildings.

  Proposed Solution: While the code could be designed to allow high SHGC Low E glazing when proper shading is provided, perhaps manufactures, designers, and consumers would find that a code that provided for both low and high SHGC glazing too complex. Nevertheless, I hope that the CEC will explore this option with stakeholders.

  The more elegant solution would be glazing that automatically limits solar gain when outdoor temperatures are warm, and automatically increases solar gain when outdoor temperatures are cool. The CEC could support research and development of such glazing.

[1] Previous professional experience: member CEC Professional Advisory Group; member CABEC Standards Comm.; CABEC Nonresidential Standards Chair; member CABEC Board of Directors.

- INSTITUTIONAL MEMORY:

  Problem: With staff turnover at the CEC, and changing code development consulting firms, it appears that previous lessons learned, and rationales for various code design decisions, often get lost during the development of subsequent Standards.

  Proposed Solution: Keep an electronic code development history, with clear notations on the development of each code requirement, and on changes made to the code. The portions of this 'development history document' that are relevant to staff and consultants working on updating the code ought to be required reading. And updating this history ought to be an essential part of each new code development cycle.

- STANDARDS DEVELOPMENT – OUTSIDE CONSULTANT REQUIREMENTS:

  - EFFICIENCY MEASURES: TECHNICAL AND MARKET ISSUES. Do more to ensure that outside consultants for Standards development analyze proposed new efficiency measures for life-cycle cost effectiveness, as well as expected availability.

    Examples:

    1. A mandatory minimum insulation requirement for nonresidential buildings began with the '13 Standards. While this was a measure I had been suggesting for several code cycles, I believe that the minimum insulation requirements may be too great, resulting in greater energy use in milder climate areas – where less insulation would help buildings shed unwanted internal heat without causing much energy increase during peak heating or cooling conditions. While the additional energy use that excessive insulation may cause is likely fairly minor, the energy cost of creating and transporting this extra insulation ought to also be accounted.
    2. The Prescriptive radiant barrier requirement for low-rise residential buildings used to be only for warm climate zones, but was added to most coastal zones in the '13 Standards. While there may be some argument to be made for this requirement in new large homes, it's an unreasonable hardship for residential additions.
    3. There are several warm climate zones, where Cool Roof is a residential Prescriptive requirement for steep roofing, but not for low-slope roofing. I suspect that Cool Roof roofing at low-slope roofs in warm climates would meet the pay-back requirements for code efficiency measures.

  - CODE DEVELOPMENT DOCUMENTATION. Requirements should be strengthened for outside Standards development consultants to clearly document the steps taken to arrive at the results they report for all efficiency measures studied. I have attempted to discover, from CEC staff and from outside vendors, how certain new requirements came into being (for example: higher U-factor requirements for some high-rise residential walls than for non-residential walls in the same climate zone), to no avail.

INITIATIVES TO IMPROVE ENERGY CODE COMPLIANCE

- ENERGY CONSULTANT CERTIFICATION OR LICENSING

  Problem: The lack of any required professional qualifications of those that prepare Title 24 compliance documentation, in concert with increasing complexity in the building energy standards, has lead to the following consequences (not a comprehensive list):

  - Firms and individuals acquire ACM compliance programs and produce compliance reports without understanding the energy code.
  - Some firms and individuals are willing to produce erroneous Title 24 compliance, knowing that there is no professional sanction for doing so.
  - Firms and individuals who make the effort to prepare Title 24 compliance documents correctly must compete against many who do not go to the trouble of learning the code, and/or do not bother to prepare compliance documents correctly.

  Proposed Solution: The C.E.C. should make a public declaration that instituting a professional licensing or certification requirement for energy consultants is an essential element for improving the rate of energy code compliance. The main elements of a licensing program would be:

    - Training
    - Examinations
    - Education in preparation for each new code cycle[2]
    - Ensuring that licensed (or certified) members perform in a professional and ethical manner

  Such a program could be run in-house, or the C.E.C. could sanction an outside entity to run this program on the C.E.C.'s behalf (such as CABEC).

- ENFORCEMENT:

  Problem: See problem described under Certification/Licensing above.

  Proposed Solution: Here are several ideas to improve enforcement of the Title 24 code:

  1) Simplify how envelope requirements are presented in the code (e.g. using insulation R-values instead of assembly U-factors)
  2) Design compliance forms to clearly indicate to field inspectors what the building's envelope, mechanical and lighting requirements are.
  3) The C.E.C. should spot check building department current plan reviews and current field inspections on a routine basis. If permit applicants fear a delay in receiving a construction permit and/or an occupancy permit, they will be much more likely to carefully choose a design team and construction team that results in a Title-24 compliant project;

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[2] I am not recommending an annual continuing education requirement, as many professional credentialing programs have; rather, what is appropriate where the code changes every several years is a rigorous education component based on when new energy code versions are to take effect.

4) Set up a program for the CEC, CEC contractors and/or utilities to do energy plan checking and field inspection for a certain percentage of submittals to building departments and to DSA. If permit applicants and builders know that the risk of their projects being found out of compliance has increased, they will take more care to meet the energy code;
5) When there is a class of licensed (or certified) energy analysts, building departments and DSA could optionally allow these energy analysts to review and stamp construction documents before permit submittal; building departments might be willing to discount energy plan check fees for such submittals;
6) Encourage building departments to use knowledgeable third-party energy plan reviewers (with firm restrictions on business relationships between the reviewers and the design firms);
7) Mandate or encourage building departments to confidentially accept "whistle-blower" information about specific projects.

- <u>COMPLIANCE FORM INFORMATION</u>:

  Problem: Forms do not always clearly indicate construction requirements.

  Proposed Solution: Create a compliance 'Form Design Manual' that lists pertinent data that compliance forms should include. Staff and consultants working on new forms would use the Form Design Manual to help ensure that basic necessary information is included in new forms. As new form format ideas, new technologies and new code requirements need to be dealt with, this manual would be open to modifications.

- <u>NONRESIDENTIAL/HIGH-RISE RESIDENTIAL/HOTEL MANDATORY MEASURE COMPLIANCE FORMS</u>:

  Problem: The Nonresidential Compliance Manual (NCM) used to include nonresidential mandatory measures (MM) forms/noteblocks. Starting with the '13 code, these forms are no longer provided. And there have never been MM forms for high-rise dwelling units and hotel/motel guest rooms. Perhaps the CEC feels that the design community ought to be able to generate their own lists of required mandatory measures. There are two problems with this approach:

  1) At the energy code's level of complexity, it is a very difficult chore for those in the design community to assemble a comprehensive, and unambiguous, list of mandatory measures.
  2) Without official MM lists, enforcement officials don't have an easy method to determine all mandatory measures that may be applicable to a given project.

  Proposed Solution:

  Include mandatory measures forms, or noteblocks in the NCM for nonresidential, high-rise residential, and hotel/motel buildings. Also provide MM forms for high-rise dwelling units and for guest rooms. By providing field inspectors with an official version of mandatory measures, they can feel more confident that the applicable measures are listed on the plans.

GENERAL ENERGY CODE IDEAS & ISSUES

- BASE ALL ASSEMBLY INSULATION REQUIREMENTS ON R-VALUES

Issue: For several code cycles, nonresidential/high-rise residential/hotel/motel occupancy assembly insulation requirements have been expressed in assembly U-factors. Starting with the '16 code, low-rise residential wall insulation requirements are also expressed in terms of assembly U-factors rather than an insulation R-values. Understanding the insulation requirements, and what assemblies meet these requirements, is difficult for the design and enforcement communities – and even for some energy compliance authors.

Proposed Solution: Express both Mandatory Minimum and Prescriptive requirements in insulation R-values, rather than in assembly U-factors. This will significantly simplify the understanding of Title 24 opaque assembly insulation requirements. The interior and exterior layers of frame assemblies (other than insulation board layers) would not affect energy compliance (e.g. such layers would be "fixed" in ACM compliance for the Standard and Proposed budget calculations).

Description: R-values would be provided for assemblies where insulation R-value is an acceptable expression of the requirement. For assemblies where insulation R-value cannot express the requirement (such as for spandrel systems), compliance using a certified ACM program would be required. ACM programs would use the *prescriptive* envelope requirements to determine the Standard assembly U-factor.

Below is a partial sample of what a nonresidential Prescriptive insulation table might look like. The residential insulation table would be similar. (R-values shown are for example only)

NONRESIDENTIAL ASSEMBLY INSULATION REQUIREMENTS

	Climate Zone		
Assembly Type	CZ 3	CZ 12	CZ 16
Roof: Continuous[1] insulation or wood framing	R-19	R-30	R-38
Walls: metal framing	R-13 plus R-5 continuous	R-21 plus R-5 continuous	R-21 plus R-8 continuous
Walls: wood framing or no framing[2]	R-15	R-19	R-21
Exposed Floor: wood framing or no framing[2]	R-19	R-19	R-21

Note: For all projects with roof and exposed floor assemblies where insulation is interrupted by metal framing members, and for projects with proposed assembly types listed above that are not designed to meet the insulation requirements stated in this table, and for projects incorporating any other exposed assembly types, a certified ACM program must be used to show building envelope compliance.

[1] Continuous insulation is insulation above the roof deck that is not interrupted by any framing members. For the determination of the average R-value of tapered roof insulation systems, see *******.

[2] Example of "no framing" is includes insulated metal panels with no metal framing bridging the inner and outer panel faces.

- J.A.4 ASSEMBLY / ACM U-FACTORS

  Issues: The following issues should be dealt with for ACM compliance, as well as in the J.A.4 if the CEC does not elect to enact my proposal (above) to revert building assembly requirements to R-values:

  - INSULATION DEPTH: The current J.A.4 assemblies include multiple U-factors for the same insulation R-value, based only on the depth of the insulation varies. At the time energy compliance calculations are performed, designers/builders often have not decided whether to use lower R/inch product in deeper framing, or higher R/inch product in thinner framing. And we know that inspectors will only look for whether insulation meets the design R-value, not whether that insulation is a high or low R/inch product.

    Therefore, the JA4 table insulation values should only provide the worst-case U-factor for any given insulation R-value – so that insulation depth is not a compliance variable.

  - METAL AND WOOD COMBINATION FRAMING: I have encountered several buildings with metal main roof framing members and wood submembers (perlins). The insulation is interrupted by both metal and wood framing. Typically, I believe, the wood framing interrupts the insulation much more frequently than does the metal framing. Consider a framing factor that assumes the assembly has both metal and wood framing.

  - METAL ROOF FRAME SPACING: It is not unusual for insulation to be placed between metal framing that is 48" to 96" o.c. Add J.A.4 roof assemblies for this type of construction.

  - METAL FRAMING & FIREPROOFING: J.A.4 should add metal frame roof assemblies where the metal framing is fireproofed.

  - SPANDREL PANELS: The JA4 assumes that the base (uninsulated) spandrel panel includes an air gap between the panel and a gypsum board (or similar) layer. The Standards ought to always assume the conservative choice – which in this case would be only the glass or metal spandrel panel, uninsulated. In decades of reviewing architectural plans, I have never seen a spandrel panel such as assumed for the base spandrel condition.

  - "WET" ROOF INSULATION SYSTEMS: Develop assembly U factors adjusted for use of wet insulation systems (see more under Nonresidential Building ideas, below).

  - NOTE ALLOWED DOOR SUBSTITUTES: Opaque door construction is often not known at the time the energy compliance is prepared. Note that insulated FG doors and insulated metal doors are allowed substitutes for wood doors.

  - METAL PIN MODELING: Develop insulation factors for insulation that is secured with metal pin attachments (stick-pins). Metal pins are used not only to hold batt and board insulation to walls and the underside of decks, but also to hold rigid roof insulation laid over roof decks. If the thermal affects of metal pins are found to be negligible and not necessary to account for, this should be stated in the Standards assembly modeling protocols.

- INSUFFICIENT NUMBER OF CLIMATE ZONES:

  Issue: Currently, there are no transitional climate zones between cool coastal and inland valley hot zones, and between inland valley hot zones and mountain zones, resulting in some current climate zones covering too great a range of climate conditions. Examples include areas adjacent to the border between climate zones 3 and 12, areas near the border between C.Z.'s 1 and 2, and especially areas adjacent to the border between the interior valley C.Z.'s and mountain C.Z. 16.

  Proposed Solution: Add additional climate zones in locations where current climate zone does not adequately express the local climatic conditions.

- FENESTRATION DEFINITIONS:

  Issue: Definition names are not expressive of the distinction that is intended. For example, both "manufactured" and "site-assembled" fenestration is manufactured. And "site-built" fenestration is often assembled off-site – usually at a glazing shop, occasionally at a factory.

  Proposed Solution:.Work with NFRC to adopt clearer terminology.

  - Change "Manufactured" to "**Factory Assembled**". "Factory Assembled" better captures the intent of the distinction between this type of fenestration and so-called "site-built" fenestration.
  - Change "Site-Built" to "**CW+SF**", or some other nomenclature that better fits Curtainwall and Storefront type fenestration systems. Because these systems are often assembled off-site, and sometimes in a factory, the current term is not accurate. If the intent is for Curtainwall and Storefront type fenestration to have differing requirements from typical factory assembled fenestration, then a clear solution is to clearly label these two fenestration types as what they are (i.e. "CW+SF"), and note that their requirements apply regardless of where they area assembled.

- INSULATION LOCATION AT RAISED CONCRETE FLOORS:

  Issue: When insulation is placed under the concrete floor, energy code compliance modeling does not account for the heat loss from perimeter of the concrete floor – whether the concrete deck ends at the footprint of the conditioned space, or continues beyond the building footprint to support adjacent outdoor spaces.

  Proposed Solution: Study heat loss at the perimeter of raised concrete floors. Factor this heat loss into Prescriptive envelope requirements. Develop protocols for more accurately modeling raised slab heat loss in Performance compliance envelope calculations.

  From a thermal efficiency standpoint, placing insulation between finish flooring and the raised concrete floor is more effective than under-floor insulation, and the Standards should account for this efficiency difference.

- SKYLIGHT CURBS:

  Issue: Skylight curbs often (perhaps usually) are overlooked in building modeling.

Proposed Solution: The easiest way to deal with skylight curbs is to institute a mandatory minimum curb insulation requirement, and not require curbs to be modeled. Barring this, the Title 24 Manuals could better emphasize that all curbs must be modeled. Either way, envelope compliance forms could include a reminder about insulating or modeling skylight curbs.

- RADIANT FLOOR HEATING:

  Issues: Section 110.8(g) Insulation Requirements for Heated Slab Floors, are said by CEC staff to not apply to raised concrete floors.

  Proposed Solution: Add to section 110.8 minimum mandatory insulation requirements for heated raised slab floors, and clarify that 110.8(g) applies to "slab-on-grade" floors.

- HEAT PUMP SIZING:

  Issue: Low-rise residential standards do not regulate minimum heat pump size. Nonresidential standards require heat pumps to meet at least 75% of calculated peak heating load (otherwise, the supplemental electric resistance heat must be modeled as electric resistance heating, per §140.4(g) Exception 2). Undersizing heat pumps results in more reliance on the electric resistance heat strips

  Proposed Solutions: Study benefit of requiring heat pumps for all building types to meet a minimum of 100% of the calculated peak heating load of the space. This requirement may result in more fan power in some instances, so energy trade-offs should be assessed. Regardless, a minimum size requirement should be set for low-rise residential buildings.

- AGED BOARD INSULATION VALUES:

  Issue: Not all manufacturers of plastic-based board insulation report the same type of R-value test results.

  Proposed Solutions: Require that modeled R-values values for plastic-based board insulation be based on aged values. Either ban use of insulation products not reporting aged values, or develop a factor to convert initial R-values to aged R-values.

- NUMBER OF BUILDINGS:

  Issue: The Standards are silent on whether multiple buildings on a single site can be modeled together, as if they constitute a single "building"; or whether each building must be modeled separately. This leaves energy analysts and enforcement officials uncertain as to what is allowed.

  Proposed Solution: The Standards should clarify the modeling of projects that contain multiple unique buildings. Perhaps the Standards should require each building to comply separately, except when multiple buildings are served by a single DHW system, or when multiple buildings are served by a single central HVAC system, or both. Clarify whether separate conditioned structures that are structurally tied by residing upon a common parking structure podium are considered one building or multiple buildings.

- VENTILATION & HEAT RECOVERY:

  Issue: High ventilation rates waste energy.

  Proposed Solutions:

  - MAXIMUM VENTILATION LIMIT: Consider instituting a Prescriptive maximum mechanical ventilation limit for certain primary function types, and not allowing tailored ventilation under Performance compliance for same. Or allow ventilation to exceed a set limit where a zone incorporates heat recovery (see below). I have plan-checked housing projects where the corridors were exhausting 100% of the conditioned air (100% fresh make-up air). Mechanical designers justify this by the construction savings of not supplying return air ducting.
  - HEAT RECOVERY: Require ventilation air heat recovery (e.g. air-to-air heat exchanger) in buildings or spaces with high OSA design (e.g. above 25% of HVAC system cfm), and certain amount of operating hours (e.g. min. of 20/week). Some residential buildings do have high OSA requirements; for instance, convalescent homes. Many industrial occupancies also have high OSA requirements.

- VESTIBULES in COLD CLIMATE ZONE:

  Issue: Large heat loss attributable to entering and exiting buildings in cold climates.

  Proposed Solution: Consider making unconditioned vestibules a residential and nonresidential prescriptive requirement for each building main entry and each tenant space outdoor main entry in Climate Zones 1 and 16. Under Performance compliance, lack of vestibules could be offset by such measures as greater building envelope thermal efficiency. Tighter envelope requirements could also be developed as a Prescriptive compliance alternative to vestibules.

- HISTORIC BUILDINGS: Clarify in the Standards that the envelope and mechanical exemption does not apply to additions.

- GLASS BLOCK: Are the Table 110.6-A U-factors based on solid block? If they are based on hollow block, and if there is more than a very minor difference in U-factor between solid block and hollow block, then U-factors for both solid block and hollow block ought to be listed.

- ENVELOPE REQUIREMENTS AT UNCONDITIONED SPACES: Clarify in the Standards that, other than for section 140.3(c) applicability to unconditioned nonresidential buildings, envelopes of unconditioned residential and nonresidential spaces are not subject to energy code requirements. [this is in part noted on Table 100.0-A in the ’16 Standards, although the exemption is not shown under Performance for residential or nonresidential buildings, and the description (“unconditioned process spaces”) is not accurate].

- MISCELLANEOUS BUILDING MODELING ISSUES TO CLARIFY:

  Issue: The following items are not clear in the Standards, nor in the Compliance

Manuals.

Proposed Solution: Clarify the following items in the Standards, the Compliance Manuals, or both (as appropriate):

- VENTILATION LOUVERS & PORTS: The Standards require that all envelope openings be closable. However, ventilation louvers and ports such as Z-ducts are available both with and without dampers. They are being used in many high-rise residential projects where opening windows for natural ventilation conflicts with noise control requirements. This brings up a few issues:
  - Should ventilation louvers and ports be modeled, or ignored, for envelope compliance?
  - Should ventilation ports without dampers be sold in California (i.e. are they used in non-conditioned spaces)?
  - Consider whether these systems should have some minimum insulation requirement, or perhaps exempt such systems from modeling requirements if they possess a threshold insulation level.
  - Are plan checkers noticing whether ventilation ports are being specified with or without dampers?
  - Are building inspectors noticing whether ventilation ports are being installed with or without dampers?
- ELEVATOR SHAFTS: Because elevator shafts are well ventilated, study whether walls separating elevators shafts from conditioned space should be deemed demising walls, requiring insulation if they are frame walls.

- <u>BUILDINGS & SPACES EXEMPT FROM TITLE 24:</u>
  - **Issue 1:** Reconsider the exception to treatment as "conditioned" space due to low space heating or cooling energy. In light of the code moving towards Net Zero Energy buildings, the 10 Btuh/s.f. heating and 5 Bthu/s.f. cooling exception contained in the definition for Conditioned Space, Directly, needs to be revisited. In fact, residences that meet "Passive House" protocols are supposed to use less heating than 10 Btuh/s.f. Obviously, such homes should not be exempt from the energy code.
  - **Issue 2:** Are the reasons that all Occupancy Group I buildings were made exempt from Title 24 still valid?

  Proposed Solution: Reconsider policies on exempting buildings and spaces from Title 24. Are current exemptions in keeping with California's building energy goals? Where are exemptions in conflict with energy goals? How might Title 24 exemption policies change to better promote building energy efficiency?

- <u>CLARIFY WHICH STANDARDS VERSION PROJECTS ARE SUBJECT TO</u>

  Problem: Some jurisdictions allow buildings to meet the energy Standards that were in effect at the time of the project's Site Permit. Given that the Site Permit may be issued many months, and sometimes more than a year, earlier than a functional

building permit (permission to construct a building), this can place many significantly large projects under an old code.

Proposed Solution: Clearly state in section 10-103 that the Standards that are in effect at the time a permit application is submitted for the construction of a building, are the Standards that the proposed project will be subject to. Note that "site permit" applications are not relevant to determining the energy code that buildings are subject to.

LOW-RISE RESIDENTIAL, HIGH-RISE RESIDENTIAL & HOTEL/MOTEL ENERGY CODE IDEAS:

- RESIDENTIAL STANDARDS: Low-Rise, High-Rise, Alternatives:

  Issue: The design of the low-rise residential standards is predicated on dwelling units with individual space conditioning systems; the design of the high-rise standards is based on buildings utilizing central heating systems. In reality, some residential low-rise buildings are served by central systems, and some residential high-rise buildings are served by individual dwelling unit systems.

  Using the number of floors to differentiate building requirements, including glazing and insulation standards, as well as in modeling requirements for HVAC systems, cannot be supported by real-world building energy use. The current requirements result in awkward and wasteful modeling exercises for high-rise buildings, such as having to divide the residential areas into various zones served by different heat pump models[3].

  Proposed Solution: Replace the current "low-rise" and "high-rise" standards with the following:

  1. INDIVIDUAL DWELLING UNIT SPACE CONDITIONING (IDUSC Residential Standards)
  2. CENTRAL SPACE CONDITIONING [serving multiple dwelling units] (CSC Residential Standards)

  IDUSC Residential Standards would be similar to the current low-rise residential standards. CSC Residential Standards would be similar to the current high-rise residential standards. If a building uses both types of systems, each area would meet its own standard. Exception: when a building area served by one space conditioning system type does not exceed 20% of the building, the entire building can meet the standards for the major system type.

- PENALIZING NON-CONFORMING IMPROVEMENTS (low-rise residential):

  Issue: As of the 2005 Standards, energy improvements to existing low-rise residential buildings that do not meet Prescriptive requirements are penalized under Performance compliance (in earlier codes, any energy improvement that was better than the existing

[3] While Low-Rise standards treat all heat pumps with the same efficiency identically, the high-rise standards require systems with different capacities, fan motors, etc., to be modeled as unique systems serving unique zones.

condition earned an energy "credit"). Not only does this discourage some improvements where meeting Prescriptive requirements is not practical, it encourages "bending" the rules and can result in erroneous load calculations.

Proposed Solution: Treat improvements that don't meet Prescriptive requirements as energy neutral, rather than penalizing such improvements. This could lead to greater energy savings because owners will not be discouraged to make upgrades.

- LOW-RISE RESIDENTIAL FENESTRATION AREA:

Issue: Under the current Prescriptive fenestration allowance approach, based solely on floor area, very small buildings are penalized (i.e. receive a very small glazing area allowance), and very large buildings receive an unduly large glazing allowance. As Title 24 regulates energy on an energy per floor area square foot basis, larger homes already receive a much larger total energy allowance, as compared to smaller homes. Allowing very large glazing areas only adds to the energy intensity of these larger homes.

Proposed Solution: During several previous code development cycles, I suggested a residential fenestration area allowance based on a formula that includes both CFA and perimeter. While this fenestration allowance method tailored allowed glazing areas to more reasonable proportions, relative to building size, the formula approach is likely too complex for code consideration.

Therefore, I offer a simplified version, where the Prescriptive fenestration allowance simply varies depending on CFA.

CFA	fenestration allowance %
≤ 1499	24
1500 - 1999	22
2000 - 2999	20
3000 - 3999	18
4000 - 4999	16
≥ 5000	14

An exception to the above table would be made for townhomes, which are a much different type of design than multi-family buildings consisting exclusively, or mainly, of "flat" style dwelling units. Townhomes (defined as having no dwelling unit either above or below) would have a fenestration allowance of 20%, regardless of building size.

- LOW-RISE RESIDENTIAL MULTI-FAMILY PRESCRIPTIVE GLASS AREA:

Should a restructuring of the fenestration allowance for all low-rise residential buildings, as suggested above, not be found acceptable, consider reducing the fenestration allowance for larger multi-family residential buildings. I have found that larger multi-family buildings often have glass areas of around 10 to 13 percent of the C.F.A.

- RESTORE CREDIT FOR REDUCED GLAZING AREAS (low-rise residential):

  Issue: Eliminating the credit for glazing areas less than the Prescriptive allowance made the 2005 (and subsequent) Standards appear to be less rational, creating less respect for the Standards. By eliminating the small glazing area credit under Performance compliance, buildings with larger glazing areas (that don't exceed the Prescriptive area allowance) receive a higher Standard energy budget – thus encouraging designers to increase glazing areas up to the Prescriptive limit.

  The rationale for eliminating the credit for smaller glazing areas was that multi-family projects typically have smaller glazing areas than the Prescriptive limit (which was designed with single-family buildings in mind). This can be addressed by changing the Prescriptive allowance for multi-family projects (see suggestion above).

  Proposed Solution: The credit for small glazing areas should be reinstated, as less glazing is a legitimate energy saving feature.

- TAKING CREDIT FOR NON-EXISTENT WINTER PASSIVE SOLAR GAINS:

  Issue: In climate zones where vertical fenestration has no SHGC requirement, the constructed fenestration is usually the low SHGC type, because that is what is readily available. However, savvy Performance compliance authors will model the proposed glazing as clear glass, knowing that the winter "credit" for free solar heat will outweigh the slight summer cooling penalty in heating dominant climate zones.

  Proposed Solution: Require, and note on compliance forms, that in climate zones with no Prescriptive SHGC requirement, the actual SHGC may not be lower than 0.10 lower than the SHGC modeled for compliance.

- SOUTH GLASS SHADING:

  Issue: Shading is not currently required to be modeled. Compliance credit is sometimes given for greater solar gains than will actually occur.

  Proposed Solution: Require fixed external shading of south-facing windows to be modeled in all heating-dominant climate zones.

- REQUIRE MINIMUM INSULATION FOR RAISED CONCRETE FLOORS IN LOW-RISE & HIGH-RISE RESIDENTIAL OCCUPANCIES

  Issue: The low-rise and high-rise residential standards have no minimum raised concrete floor insulation requirements. Allowing uninsulated floors at dwelling units result in certain tenants having much higher energy costs, and much less thermal comfort, than their neighbors.

  Proposed Solution: Rescind the elimination of the mandatory R-8 minimum concrete floor insulation requirement for Low-Rise Residential that existed in the '98 Standards, and apply it to High-Rise Residential buildings as well.

  However, consider making this mandatory minimum floor insulation requirement only apply to dwelling unit and guest room floors, giving designers/builders some flexibility for insulation at common area exposed floors.

- CREATE PRESCRIPTIVE PATHS FOR ADDITIONAL SPACE CONDITIONING DISTRIBUTION DESIGNS

  Issue: The ’16 code only has Prescriptive compliance options for two distribution system options: a) heating ducts in the attic, and b) 100% of the distribution system in conditioned space. This lack of options may not present a big problem for new construction, given the popularity of the Performance compliance approach. However, larger residential additions are also subject to these same requirements. And when additions are added to modern buildings, often there are no improvement opportunities at the existing building that can be used to achieve compliance under the Performance approach.

  Proposed Solution: Create Prescriptive requirement packages for the following additional space conditioning scenarios: a) Ducts below exterior floor, and b) 100% of distribution system in conditioned space, except for the FAU located in garage. This additional Prescriptive flexibility will be especially important for residential addition compliance.

- HIGH-RISE RESIDENTIAL/HOTEL DEMISING WALL REQUIREMENTS:

  Issue: The Nonresidential Standards do not call for insulation at mass type demising walls. Dwelling units and guest rooms may abut unconditioned space with a mass type demising wall separation.

  Proposal: For high-rise residential dwelling units, and hotel/motel guest rooms, require a minimum of R-5 insulation at mass type demising walls.

- HEAT TAPE: This is sold in California for use in new construction (especially hotel/motel), although not explicitly allowed by Title 24. Develop methods to account for use of heat tape in DHW systems.

- COMBINED HYDRONIC & RECIRCULATION CONTROLS:

  Issue: Since the ’08 Standards, section 110.3(c)2 requires DHW recirculation loops to have an automatic means to turn off the system (i.e. a timer). This mandatory requirement is not compatible with central combined hydronic systems (where a single hot water loop provides space heat and domestic hot water).

  Proposed Solution: Exempt combined hydronic recirculation loops from the automatic shutoff requirement.

- BAY WINDOWS and PRESCRIPTIVE COMPLIANCE:

  Issue: Bay windows make up a small portion of a homes envelope. But under Prescriptive compliance, they are subject to the Package roofing, radiant barrier, and insulation requirements.

  Proposed Solution: To help simplify Prescriptive compliance, for bay window roofs, walls and floors allow the mandatory minimum insulation requirements to suffice; Eliminate the roofing and RB requirement for bay window roofs.

- “COOL ROOF” ROOFING in HOT SUMMER AREAS:

Issue: Since the 2008 code, Cool Roof type roofing has been a Prescriptive mandate for low-sloped roofing in only climate zones 13 and 15. There are several other hot climate zones where Cool Roof roofing would likely be cost-effective.

Proposed Solution: Study adding a Prescriptive Cool Roof mandate for low-slope roofs in climate zones 2, 4, 9. 10, 12 and 14.

- ADDITION "COOL ROOF" ROOFING REQUIREMENT:

  Issue: The energy code exempts additions of up to 300 sq. ft. CFA from meeting the *prescriptive* Cool Roof roofing requirement. However, most addition projects do not also include replacing the existing roofing, and matching the existing roofing is usually an important goal (and sometimes a community requirement). Performance compliance is not practical as a way to trade-off the lack of Cool Roof roofing, except where new mechanical equipment is installed.

  Proposed Solution: Allow additions to forego the *prescriptive* Cool Roof requirement in exchange for additional roof or wall insulation.

- RESIDENTIAL DEMISING WALLS:

  Issue: While residential demising walls are defined, the energy code does not indicate the insulation requirements for these walls. Requirements are noted in the '16 RCM, but they ought to be listed in the standards language as well. According to the '16 RCM, demising walls must meet the mandatory insulation requirements of 150.0(c) – R-13 at 2x4 framing, R-19 at 2x6 framing.

  Proposed Solutions:

  a) At Table 150.1-A, change "Walls" to "Exterior Walls".
  b) At section 150.1(a), note insulation requirements for Demising Walls.
  c) Consider requiring R-15 for 2x4 walls and R-21 for 2x6 walls.

- RESIDENTIAL LARGE AC UNITS:

  Issue: The low-rise residential standards have no EER requirements, nor economizer requirements, for larger AC units that are rated with EER.

  Proposed Solution: A) Replace SEER with EER efficiency requirement ratings for larger AC units, and alter the residential ACM to reflect this; B) Require economizers for residential AC units of 5 tons and greater capacity.

- RADIANT FLOORS and THERMAL MASS CREDIT: Mechanically heated slabs do not absorb as much excess heat from solar radiation, due to their higher temperature. Any credit awarded to thermal mass for reducing space heating due to the thermal "flywheel" affect should account for slab temperature, just floor coverings have been accounted for.

- ROOF ALTERATION INSULATION REQUIREMENTS:

Issue: For roof alterations, the Standards only require meeting mandatory minimum insulation levels. With the '16 code changing the minimum from R-30 to R-22, Prescriptive requirements for alterations are too lax.

Proposal: Change the Prescriptive roof alteration insulation requirement to R-30. Furthermore, when the alteration includes replacing a roof deck above attic space, radiant barrier ought to be *prescriptively* required in climate zones where it is required for new buildings.

- ADDITION ROOF INSULATION REQUIREMENTS:

Issue 1: For additions with floor areas not exceeding 700 sq. ft. floor area, the '16 code reduced the Prescriptive roof insulation requirement from matching the insulation requirement for new residences (R-30 or R-38, depending on climate zone, in the '13 code), to only R-22 (matching the mandatory minimum insulation requirement). This is a large reduction in insulation.

Proposal 1: Change the Prescriptive roof insulation requirement for additions that are up to 700 sq. ft. CFA to match the Prescriptive roof insulation requirements of the 2013 energy code (i.e. R-38 or R-30 depending on C.Z.).

Issue 2: For additions with floor areas over 700 sq. ft. floor area, the '16 code Prescriptive roof insulation requirements match those for new residences. However, the two choices – ducts in attic, or 100% of air distribution in conditioned space – are often not practical choices for additions. And when there are no energy improvements to make to the existing house, Performance compliance is often not practical.

Proposal 2: Modify the addition Prescriptive requirements as noted for the following conditions:

a) Where existing ducts are in the attic, but where the addition will not have ducts in the attic, and where the addition roof/ceiling system is not open to the existing attic, allow the roof insulation to meet Option C.
b) Where existing ducts are under the floor, and where the addition ducts will be under the floor, allow the roof insulation to meet Option C.
c) Clarify that where the existing ducts are not in conditioned space, but the addition will have its own HVAC system, either without ducts, with ducts under the floor, or with 100% of the new air distribution system in conditioned space, that the roof insulation may meet Option C.

- ADDITION IAQ VENTILATION & VENTILATION COOLING REQUIREMENTS:

Issues:

a) 150.1(a) Exception 1 does not clarify whether the exception was meant to apply to additions that are less than 1,000 sq. ft. CFA, if the addition is a new dwelling unit.
b) It is not clear whether 150.1(a) Exception 1 was supposed to exempt additions to multi-family buildings, where the total addition area exceeds 1,000 sq. ft. CFA, but where no single dwelling unit addition floor area exceeds 1,000 sq. ft. CFA.

Proposal: Clarify 150.1(a) Exception 1 so that it will be clear whether additions that are less than 1,000 sq. ft. CFA that are new dwelling units are subject to ASHRAE 62.2. And clarify 150.1(a) Exception 1 as to whether the 1,000 sq. ft. or less exception is per building, or per dwelling unit.

LOW-RISE RESIDENTIAL ACM ISSUES

- LOW-RISE MULTI-FAMILY (MF) STANDARD FENESTRATION DISTRIBUTION: Unlike high-rise MF buildings, where the Standard energy budget model distributes fenestration area in proportion to the actual design, low-rise energy models always distribute fenestration in the Standard energy model equally at the four cardinal orientations. This can create a very large compliance issue with MF projects, where the actual orientation, due to site restrictions, may be predominantly in only two orientations. Therefore, for MF projects, the Standard energy model should distribute the allowed fenestration areas proportionately to the proposed design.

- SURFACES ADJOINING UNCONDITIONED SPACES: Modeling unconditioned garages that are contiguous with conditioned space is a current ACM requirement. However, this modeling doesn't contribute to the goal of creating energy-efficient buildings. Rather than model the various exterior surfaces of adjoining unconditioned spaces, provide the ACM program with adequate data for it to determine reasonable air temperature assumptions for unconditioned spaces. Perhaps setting the unconditioned space temperature as the outdoor temperature + house design temperature, divided by 2, would be accurate enough for this purpose. Then all demising surfaces facing unconditioned space would be modeled as facing "unconditioned space", thus alleviating the need to model the unconditioned space(s).

- FRAME ASSEMBLY FINISHES: The CEC decided a few code cycles ago to set interior and exterior layers of frame walls at default values, so that compliance authors would not be able to take credit for layers that may not really exist, but are unlikely to be verified. The reasoning was valid. But the '13 code restored modeling these layers. Frame wall interior and exterior layers ought to be defaulted, as in past codes, so that the only compliance/design decisions are type and size of framing members, and type, thickness and R-value of the cavity insulation.

- LARGE AIR CONDITIONER REQUIREMENTS:

  Issue: As noted in the section above, the Residential Standards are missing requirements for AC systems with cooling capacities greater than 65,000 Btuh. While systems this size would be unusual for dwelling units, they are not uncommon for common areas of multi-family residential buildings.

  Proposal: For package DX cooling systems > 65,000 Btuh capacity, the Standard system should be rated in EER and include an economizer.

- ZONAL CREDIT FOR HEAT PUMPS: The '13 and '16 residential modeling engines will not provide a zonal control credit for heat pumps, as it does for gas-fired FAUs,

Unless there is a practical reason for this ban, allow residences served by heat pumps to receive a zonal control credit.

- SINGLE DHW SYSTEM SERVING MULTIPLE BUILDINGS: When one system serves multiple buildings, and the ratio serving one building yields an effective size that is less than 75 gallons, the current ACM software uses the EF instead of the RE to calculate efficiency, although the EF is not relevant to the modeled system. Provide a mechanism to inform the ACM program when modeling a portion of a large DHW system, so that the correct efficiency rating will be used.

  Or if the above solution is not practical, require that multiple buildings served by a single DHW system be modeled as a single building. If the ACM software is modified so that one can enter the appropriate efficiency when modeling a portion of a large water heater, the option of modeling all buildings served by that water heater, as if they represent a single building, should still be provided.

- COMBINED HYDRONIC & RECIRCULATION: Low-rise residential performance compliance programs should include the capability to model DHW recirculation from combined hydronic boilers, just as they currently do for combined hydronic water heaters.

NONRESIDENTIAL ENERGY CODE IDEAS & ISSUES

(high-rise residential occupancies included in Residential code comments, above)

- PROCESS SPACE EXCEPTION:

  Issue: "Process Space" is exempt from envelope and mechanical energy code compliance (based on the definitions of "process space" and "conditioned space"). This exemption is contrary to the state's energy goals.

  Proposed Solution: Because of the regulatory complexity that would be involved in setting energy requirements for mechanical systems serving process spaces, continue to exempt mechanical systems serving process spaces from energy code compliance. Process space envelope would be subject to the same requirements as other conditioned spaces, just as indoor lighting currently is.

- MANDATORY MINIMUM INSULATION REQUIREMENTS (§120.7):

  - **Issue 1:** Although establishing mandatory minimum insulation requirements is consistent with the goal of encouraging more energy-efficient buildings, the Standards would be looked on more favorably if they incorporated some flexibility.

    Proposed Solution: Allow exceptions to the insulation requirements for small areas. For example: 50 sq. ft. of spandrel and 50 sq.ft. of concrete and masonry walls at new buildings, 25 sq. ft. of spandrel and 25 sq.ft. of concrete and masonry walls at alterations and additions, 6" concrete curbs at frame wall/stucco buildings – which is fairly common.

    Should this small relaxation of minimum insulation be considered to potentially cause too much additional energy use, increase the Prescriptive roof or wall

insulation requirements to counter the energy impacts that the small exceptions listed above might cause.

- **Issue 2:** Some spandrel designs will meet mandatory minimum insulation requirements without adding insulation. And the JA4 spandrel U-factors assume an air gap and gypsum board layer, even though this does not necessarily (and typically does not) occur in actual construction.

  Proposed Solutions:

  a) Require R-5 minimum insulation (insulation between metal framing OK) at spandrel conditions.

  b) For JA4 assemblies, always make conservative assumptions about the makeup of assemblies. In the case of spandrel assemblies, assume that basic spandrel assemblies only consist of the basic panel and framing. Do not assume that an air gap and second solid layer occur.

- **Issue 3:** §120.7 mentions "light mass walls" as "6 inch or greater Hollow Core Concrete Masonry Unit", and mentions "heavy mass walls" as "8 inch or greater Hollow Core Concrete Masonry Unit". There is no mention of the actual definition of "light mass" and "heavy mass", as there at Note 2 for Table 140.3-C (which ought to occur for Table 140.3-B as well). This code language appears to leave out regulation for solid masonry units and monolithic concrete walls.

  Proposed Solution: If the intention is that the terms "light mass" and "heavy mass" be applied identically to how they are applied to the Prescriptive wall requirements of 140.3(a)2, then these terms ought to be defined identically to the 140.3(a)2 definition at Table 140.3-C. Example types of materials may be mentioned, as long as the wording is clear that these requirements are not limited to only certain types of light mass or heavy mass walls.

- **Issue 4:** The frame wall minimum insulation requirements are too high for mild weather locations.

  Proposed Solution: For climate zones with relatively mild winter and summer temperatures, revise the minimum frame wall insulation requirements so that insulative sheathing is not required to meet the requirement.

- **Issue 5:** The minimum values are expressed in assembly maximum U-factors, which are difficult for designers and enforcement agencies to understand and enforce.

  Proposed Solution: Change from assembly maximum U-factors to insulation minimum R-values. See related suggestion on making all assembly insulation requirements expressed as insulation R-values, under General Energy Code Ideas & Issues, above.

- <u>DEMISING ROOFS & FLOORS:</u>

  Issue: While demising walls are modeled as facing unconditioned adjacent spaces, ceilings and floors that face unconditioned spaces are treated as if they are exterior assemblies. This is not thermally accurate modeling, and imposes Cool Roof requirements (Prescriptively) on demising ceilings.

Proposed Solution: Define "demising ceiling" and "demising floor", and revise ACM rules accordingly. Demising ceilings would be exempt from Cool Roof requirements. Consider mandating the following insulation values:

- Wood frame demising ceiling: R-19
- Metal frame demising ceiling: R-30
- Concrete demising ceiling: R-16 (4" curtainwall semi-rigid fiberboard insulation)
- Wood frame demising floor: R-13
- Metal frame demising floor: R-30
- Concrete demising floor, nonresidential: no requirement.
- Concrete demising floor, high-rise residential & hotel/motel: R-12 (a common value for spray-on insulation)

Note: should the idea of "demising ceiling" be rejected, then make ceilings between conditioned and unconditioned enclosed spaces exempt from any Cool Roof requirements.

- <u>FENESTRATION REQUIREMENTS – SMALL NON-CONFORMING GLASS AREAS:</u>

  Issue: The nonresidential Prescriptive requirements do not accommodate minor areas of low-efficiency glazing that are often a required design component. This is especially true for "vision panels" in exit doors – such as is common in classrooms, but also found in many other types of spaces.

  Proposed Solution: One approach would be to exempt door vision panels – at a maximum of 3.5 sq. ft. per door. Another option would be to include an exemption for a limited glazing area. This latter approach might allow a maximum of 25 sq. ft. for entire new buildings, and 10 sq. ft. for tenant improvements and building alterations, to be exempt from fenestration energy requirements.

- <u>ENVELOPE COMPLIANCE – SMALL NON-CONFORMING MASS WALL AREAS:</u>

  Issue: Nonresidential building stucco exterior walls are often placed on 6" high concrete curbs, for maintenance and durability. This is very common in school construction, but is also found in many other types of spaces. However, not only does Prescriptive compliance not accommodate this, the mandatory minimum insulation requirements do not accommodate this.

  Proposed Solution: Modify the mandatory minimum insulation requirements, and Prescriptive compliance, to accommodate concrete curbs that occur below frame walls.

  Should this small relaxation of minimum insulation be considered to have too much impact on energy use, increase the Prescriptive roof or wall insulation requirements to counter the energy impacts that the uninsulated wall curb might cause.

- <u>FRAMELESS GLAZING SYSTEMS:</u>

Issue: While aesthetically pleasing (to some), frameless glazing systems result in a relatively large gap around the glass doors. This results in large energy loss at the door area – especially in windy conditions.

Proposed Solution: Eliminate the exception to 110.6(b), thereby requiring all exterior doors to be weatherstripped.

- "WET" ROOF INSULATION SYSTEMS:

  Issue: The 2005 Standards were the first to address this issue [118(h); Jt. Appx. IV, table IV.5, note 4]. However, only climate zones 1 and 16 are now affected, and only by use of a side-calculation. As rainwater circulating between the insulation board and the roof deck below will carry away building heat as the water is drained from the roof, this energy loss should be accounted for in all climate zones.

  Proposed Solution: R-value adjustment for wet insulation systems should be a) Applicable to all climate zones; b) Pre-calculated in a Jt. Appx. IV table for this purpose.

- NONRESIDENTIAL CONDITIONED FLOOR AREA.

  Issue: Currently, conditioned floor area is measured to the outer face of exterior partitions. This poses two problems:

  a) Floor area for the Area Category Method is measured to the inside face of exterior partitions. This presents a clear conflict with the conditioned floor area.
  b) There is no good reason for buildings with thicker walls to have a greater energy allowance than buildings with thinner walls (energy is regulated on a per floor area square foot basis).

  Proposed Solution: Nonresidential floor area for overall building area should be measured to the inside surface of the exterior walls, as it was under the 2nd Generation Standards, and as it currently is for indoor lighting under the Area Category method. Not only would there be benefits in having the lighting and overall building area rules match, it also is a more rational floor area measuring point for energy calculations. Also, this change would end confusion as to whether various exterior elements (pilasters, etc.) should be included in the floor area.

- NONRESIDENTIAL COOL ROOF SOLAR EXCEPTION:

  Issue: Under Prescriptive compliance, areas covered by solar panels are exempt from the Cool Roof roofing requirement. However, as a practical matter, because the areas between solar panel rows are not exempt, Cool Roof roofing will have to be installed under Prescriptive compliance.

- **Proposal:** Create a Cool Roof exception where a substantial portion of the roof area is covered by solar panels. Perhaps if a minimum of 80% of a roof surface, on a given roof plane, is covered by solar panels, the roofing of that roof plane should be exempt from the Prescriptive Cool Roof requirement.

- NONRESIDENTIAL SMALL ADDITIONS – ROOFING REQUIREMENTS:

Issue: Under *prescriptive* compliance, additions are subject to the same roofing requirements as for new buildings. And this is reasonable for larger additions. However, for small additions, where it is more likely that the existing building's roofing will not be replaced, requiring Cool Roof roofing at the addition is often a hardship. (note: Small residential additions are exempt from roofing requirements for this same reason)

- **Proposed Solution:** Allow additions up to 1,000 sq. ft. CFA to be exempt from roofing requirements. For additions up to 10,000 sq. ft. CFA, provide a *prescriptive* trade-off for no Cool Roof roofing in exchange for a prescribed extra amount of roof insulation.

- <u>NONRESIDENTIAL SMALL ADDITIONS – FENESTRATION REQUIREMENTS:</u>

  Issue: Under Prescriptive compliance, addition fenestration is subject to the same requirements as for new buildings. And this is reasonable in most cases. However, when the addition has a relatively small glazing area, requiring NFRC certification is more onerous than warranted.

  Proposed Solution: Allow additions that have site-built fenestration not exceeding 400 square feet to meet the values of Table 141.0-A (the Prescriptive alteration fenestration requirements).

- <u>NONRESIDENTIAL FENESTRATION ALTERATIONS:</u>
  - **Issue 1:** The Prescriptive requirement for replacement fenestration is somewhat less stringent than for new fenestration areas. But imposing new building fenestration requirements on very small glazing areas that are not replacement glazing essentially forces the entire replacement plus additional glazing areas to meet new construction fenestration requirements – i.e. NFRC certification. Which for small projects is more onerous than warranted.

    Proposed Solution: Allow the replacement fenestration values of Table 141.0-A to also be used for up to 200 sq. ft. of new (non-replacement) vertical glazing area.
  - **Issue 2:** Currently, the Prescriptive requirements for altering skylights are the same as for new skylights. For both altered skylights and for new skylights, requiring NFRC certification for small areas of new skylights is more onerous than warranted.

    Proposed Solution: For up to 50 sq. ft. of combined new and altered skylight area, modify the Prescriptive requirements to stipulate that any skylights with Low E glass, with a frame that is either thermally-broken or non-metal, comply.
  - **Issue 3:** Exceptions 1, 2 and 3 to Section 141.0(b)2 A, which nullify the Prescriptive SHGC and VT requirements for small areas of replacement or new vertical glazing and for skylights, are a holdover from old energy code versions where tinted glass was a Prescriptive requirement, and it was felt that tint glass should not be imposed on small new glazing areas where the existing glass may not be tinted. However, given that fenestration subject to these exemptions still has to meet the Prescriptive U-factor requirements, and that Low E glass is required to meet the U-factor requirement, and that "clear" Low E glass can meet the

Prescriptive SHGC and VT requirement, these exceptions no longer provide any useful benefit.

Proposed Solution: Delete all three of the exceptions to Section 141.0(b)2 A.

- ALTERATION ASSEMBLY REQUIREMENTS:

Issue: 141.0(b)1. indicates mandatory minimum insulation requirements for altered exterior assemblies. As there are no Prescriptive compliance values in 141.0(b)2., the mandatory minimum values are also the Prescriptive compliance values. The Standards do not indicate insulation requirements – whether mandatory minimum or Prescriptive – for new assemblies that occur at new conditioned volumes that are not building additions (i.e. no new CFA).

For example: An existing conditioned space, with existing "roof" insulation at the ceiling. The ceiling will be demolished, and the conditioned volume will now reach up to the building's actual roof. Under this scenario, the walls that span from the previous ceiling to the roof, and the roof, are "new" assemblies, not "altered" assemblies, as they enclose a newly conditioned space volume.

I have also seen projects where the roof of an existing conditioned space is removed, and a new taller roof is built above the space, with new exterior walls extending from the previous roof level to the new taller roof. Again, this project includes new assemblies at an existing conditioned floor area, but at new conditioned volume.

Proposed Solution: While the incidence of new assemblies at new conditioned volumes that are not associated with building additions is not common enough to warrant establishing both mandatory and Prescriptive values, such new assemblies are certainly an opportunity to mandate more thermal insulation than is required for "altered" assemblies. In section 141.0(b)1., add insulation requirements for new assemblies that will be constructed to contain new conditioned volumes at existing conditioned floor areas. These would be mandatory, and also serve as Prescriptive requirements.

Suggested insulation requirements for new assemblies at new conditioned volumes that are not part of building additions:

- ROOFS: Match the insulation requirements of Table 140.3-B.
- WALLS, METAL FRAMING: R-15 at nominal 4" walls; R-21 at nominal 6" walls.
- WALLS, WOOD FRAMING: R-13 at 2x4 walls; R-19 at 2x6 walls.

Note: Insulative sheathing should not be considered for new exterior walls requirements, as such walls would typically be extensions of existing walls.

- DUCT SEALING PRESCRIPTIVE REQUIREMENT:

Issue: Section 144(k) requires small buildings with exposed ducts connected to single-zone systems to be HERS tested for leakage. However, fan coil units are not one of the system types listed, even though they are technologically very similar to the other system types.

Proposed Solution: Add "fan coil units" to list of system types that qualify ducted systems to meet Prescriptive sealing requirement.

- AUTOMATIC DAYLIGHTING CONTROLS:

  Issue: Since the advent of the '13 Standards, automatic daylight controls in Secondary Sidelit Daylit Zones is (with a few exceptions) mandatory under Prescriptive compliance, but optional under Performance compliance. In order to be exempt from daylighting controls in Secondary Sidelit Daylit Zones, a 3d Performance model must be created, which simulates the amount of daylight at various indoor areas, and estimates the amount of extra energy required when daylight controls are not installed in the Secondary zones.

  As much as I am in favor of the Performance approach, and providing designers flexibility in meeting the state's building energy efficiency goals, I believe that the required 3d modeling for exempting daylight controls is too complex from a modeling and an enforcement perspective.

  Proposed Solution: In the interest of simplifying the energy code, and nonresidential ACM requirements, make automatic daylight controls mandatory in Secondary Sidelit Daylit Zones (with a few exceptions, as currently in the code). Likewise, abandon having a 3d version of nonresidential ACM programs.

- NONRESIDENTIAL LIGHTING ALTERATIONS:

  Issue 1: The '13 code greatly reduced the alteration thresholds that trigger spaces with altered lighting to meet new construction lighting power and control requirements; this policy continued in the '16 code. For example, any space where a perimeter wall is re-located and one luminaire is altered has to meet lighting power requirements for new construction, and meet many of the new construction automatic control requirements. While I fully support energy efficiency, I urge the CEC to consider the ramifications of adopting overly-stringent requirements:

  - Such requirements may not adequately account for the imbedded energy within existing light fixtures.
  - Requiring extensive lighting changes when the designer/owner wishes only to make relatively small lighting changes puts the energy code in a bad "light".
  - Overly onerous alteration regulations encourage building owners (or tenants) to make alterations without a building permit, thus increasing the chances that an energy-inefficient remodel will occur.

  Proposed Solutions:

  a) Make a general exception to the lighting alteration requirements, that exempts lighting alterations from meeting the power and control requirements of 140.6, when the number of new and altered luminaires within any enclosed space does not exceed 20% of the quantity of luminaires currently serving the same footprint area, and when the new luminaires meet the following criteria:

     - Built-in LED engine, and
     - Not a luminaire where light sources can be added to it (e.g. "light track")

b) Don't require automatic daylight controls unless a project will have a minimum number of new luminaires in a DL zone. Perhaps a minimum of three within a primary sidelit zone, three within a secondary sidelit zone, three within a skylit zone. Requiring daylight controls when only one or two new luminaires fall within a daylight zone is overly burdensome.

Issue 2: Exception 2 to Section 141.0(b)2 I allows two luminaires to be replaced with no restrictions. The replacement luminaires could be very high power as compared to the existing luminaires. For example, fluorescent can lights can be replaced with track lights.

Proposed Solution: Stipulate in Exception 2 that the replacement luminaires must meet following criteria: a) Built-in LED engine, and b) Not a luminaire where light sources can be added to it (e.g. "light track").

- AREA CATEGORY LIGHTING CLARIFICATIONS:
  - TASK AREA ADJUSTMENTS: The Area Category table includes additional lighting wattage based on "task areas". The NCM notes that "task areas" must clearly be shown on the plans. However, "task area" is never clearly defined, and in the case of additional ornamental, accent and decorative lighting, a task area definition is unlikely to be developed that would be regularly enforced.

    Proposal: a) For ornamental, accent and decorative lighting, either eliminate the extra allowance (and increase the area LPD allowance slightly for certain spaces), or develop a fixed wattage allowance per enclosed space, not to exceed a fixed allowance per luminaire; b) For other types of additional lighting wattage allowances, clearly define the extent of, and maximum area of, "task areas".
  - UNDEVELOPED TENANT AREAS: When tenant space is undeveloped, the building owner will typically install a few light fixtures to provide just enough illumination for prospective lessees to see. The illumination may be much less power than the 0.6 watts/sq.ft. budget of "all other". More importantly, it is unclear which Area Category is appropriate for spaces receiving temporary tenant space lighting.

    Proposal: A new Area Category function called "Temporary Tenant Space Lighting", with an LPD of 0.4 watts/sq.ft. (also see NR ACM Issues section, below)
  - LIBRARY LIGHTING AREAS: Currently, function choices are Reading and Stacks. Does "Reading" mean the main circulation, check-out, reference and reading areas? If so, rename the function "Reading, Circulation, Reference & Check-out" – or at least clarify what "Reading" applies to with a footnote.
  - FINANCIAL INSTITUTIONS: Currently, there is a Financial Transactions primary function. As this function receives the same LPD as office space, and given that it is always vague how to apply this to public areas of a bank that are primarily circulation, but also contain some areas for completing bank paperwork, consider the following changes:
    - Eliminate Financial Transactions primary function.

- Clarify that teller areas may be assigned the Office primary function, as well as other areas of the bank where activities area primarily office type tasks.
- Create a Financial Institution Public Area primary function. The LPD for this area would recognize that the area is primarily circulation, but also contains some work stations for customers to complete bank paperwork.

- "SPEED LINE" (Cafeteria food display/selection area): Clarify whether this area should be modeled as "Dining", "Kitchen", or a new category. If either dining or kitchen is the correct category, change the Function Area name to denote this (i.e. "Dining/Speed Line"), or include a note on the Area Category table, and in the § 100.1 definitions, explaining this.

- SIDELIT DAYLIGHTING ZONE WIDTH:

  Issue: The '13 code changed the daylight (DL) zone width from the previous 2' beyond the window jamb to 50% of the window head height beyond the window jamb. While a taller glazing area would be expected to create a wider daylit area at some distance away from the window, the light spill to the sides of the window, nearby the window, would likely be similar regardless of how tall the window is. In addition, basing the DL zone width beyond the window jambs at 50% of the window head height complicates enforcement.

  Proposed Change: Change the margin beyond the window jamb from the current head height percentage, to a fixed value of 3 ft. This is wider than the '08 code value, is likely to be a fairly good standard for side light spread beyond window jambs, and it is easy to understand and check.

- MEDICAL LIGHTING EXCEPTION:

  Issue: 140.6(a)3. The language is not clear. One could construe that exam lights are exempt if they are switched separately from general lighting anywhere within the same facility.

  Proposed Clarification: "… provided that these lighting systems are additions to and separately switched from a general lighting system serving the same enclosed space".

- OUTDOOR LIGHTING ISSUES:

  - ALTERATIONS & ADDITIONS: Problem: the general area lighting power allowance for new projects includes a wattage allowance based on the project perimeter. Alterations and additions are not allowed to use this perimeter allowance, because it's often an odd fit for alterations and additions. Consider adopting a revised general area lighting power allowance for both new projects, alterations and additions that does not include a perimeter factor. The general power allowance ought to be similar per square foot of subject area regardless of whether the area is for an entirely new project, an addition to an existing project, or an alteration of an existing project.
  - CANOPY LIGHTING, COVERED OUTDOOR LIGHTING: There are a few questions about canopy lighting and covered outdoor lighting that need clarification:

1. Should all hardscape areas that are under an opaque cover receive a greater LPD than hardscape areas open to the sky?
2. If the answer to 1 above is "yes", should all covered hardscape areas receive the same LPD?
3. If the answer to 2 above is "yes", then the current Specific Application category "Non-Sales Canopies" should be changed to "Covered Hardscape", or similar.
4. If the answer to 2 above is "no", then one or more additional Specific Application categories should be created.
5. A particular covered hardscape situation that the current standards do not appear to specifically address are multi-suite buildings with many exit doors to the outdoors. Examples include motels and retail buildings. In multi-story buildings, there can be multiple levels of covered walkways adjacent to the building. While the definition of "canopy" in the Standards could be construed to cover these covered hardscape areas, the coverings of these continuous walkways are typically thought of as roof eaves, arcades, or walkways (serving the level above). The standards should make clear what the LPD is for these covered walkways.
6. Canopies above vehicle maintenance areas are not addressed. Change "Sales Canopies" to "Sales and Vehicle Maintenance Canopies".

- FACADE LIGHTING: The lit area that the allowance is based on is unclear. For example, on a multi-story building, are sconce lights lighting one floor in height or multiple floors in height? Are there better methods to define the lit area? If not, perhaps replace the facade lighting power allotment with a facade lighting efficacy requirement.
- UTILITY AREAS: Study whether utility-type areas should be provided a greater lighting power allowance than the general hardscape allowance. For example, a "server farm" building project of ours contained large outdoor mechanical equipment areas. For security and visibility around the equipment, these areas may need a somewhat higher lighting power allowance.
- DOOR LIGHTING ALLOWANCE: Code says luminaire must be within 20' of a door. But the code ought to also say that only doors within 20' of an entrance luminaire may be counted. Otherwise, when determining the door-based wattage allowance, there is no restriction on counting doors that have no luminaires associated with them.

- <u>EXEMPT LIGHTING, INDOORS & OUTDOORS:</u> Clarify that when general lighting and process equipment lighting is exempt (such as at kitchen hoods and walk-in freezers), that the floor or surface area representing the footprint of the equipment or space served by the exempt lighting shall also be excluded from the lighting compliance calculations.

- <u>PROCESS LOADS:</u>

  Issue: In my experience, mechanical designers can declare any amount of equipment process load (BTUs, watts), and it is not questioned. Mechanical designers are often not provided with specific equipment loads, and therefore have to guess what loads to expect when sizing the AC equipment. Obviously, this loose policy leads to much AC

over-sizing and energy waste.

Proposed Solution: Require that in order for process equipment loads to be modeled for AC sizing and Performance compliance calculations, that those loads be tabulated and shown on the plans. While this won't ensure that more effort will always go into determining actual AC needs, hopefully it will encourage enough earlier planning and estimating of process loads to make a meaningful reduction in energy usage.

- NONRESIDENTIAL WATER HEATING:

  Issue: Current Standards contain no restrictions on electric storage service water heaters. These are energy wasteful – especially so when connected to a recirculation system.

  Proposed Solution: Prescriptive compliance should ban electric storage service water heaters. Any in-line (tankless) electric water heating system, without a recirculation system, or with an on-demand circulation system, would be acceptable for Prescriptive compliance, as would any gas-fired system (tankless or storage). Under Performance compliance, the service water heating budget for electric water heaters would be based on an in-line electric system without recirculation. The budget for gas water heaters would be based on a minimum efficiency gas storage water heater.

  Because non-demand type pumped recirculation systems can have a large impact on water heating energy use, designs using non-demand recirculation should be required to comply under the Performance approach. The standard energy budget for such systems should be based on either no recirculation, or on push-button (demand) pumped recirculation.

- LOCAL CODE RESTRICTIONS ON AC EQUIPMENT PLACEMENT:

  Issue: Some local jurisdictions require rooftop AC equipment to be located in such a way that long duct runs are required, necessitating more fan power.

  Proposal: Work with local jurisdictions on solutions that will lower AC fan power requirements.

NONRESIDENTIAL ACM ISSUES

- STANDARD AC SYSTEM TYPE (for determining Standard energy budget):

  Issue: Starting with the '13 Standards, the reference AC system for any size multi-story nonresidential building became a PVAV system. And for single-story buildings, PVAV became the standard system for buildings over 10,000 sq. ft. CFA. This creates an energy budget that is out of line with both Prescriptive HVAC requirements and with available, cost-effective technology. And it should be noted that, with in-fill developments, some new multi-story nonresidential buildings, and many additions, may be much smaller than can practically use a PVAV system.

  Proposal: Determine the smallest single-story, and smallest multi-story, building size where PVAV systems are shown to be both available (in terms of matching capacities

with loads) and cost-effective. Match the ACM reference system type to these findings.

- ACM RULES FOR STANDARD AC SYSTEM SIZING:

  Issue: I recently modeled a new building with a VAV system, and unknown to me, erroneously modeled heating airflows much lower than would meet the loads. The calculated annual design fan power was much lower than standard. The CEC's Nonresidential ACM team informed me that the CBECC-Com program would have warned me of unmet load hours, but the ACM program I was using did not have this feature.

  As a matter of fact, prior to the 2013 code, when CBECC-Com was adopted as the Performance program, the nonresidential ACM rules sized the "baseline", or standard, HVAC system capacities, airflow, and fan powers to match those of the proposed HVAC systems, or sized the standard HVAC system based on the zonal load calculations, whichever resulted in lower values for the standard system(s). In this way, undersized HVAC systems did not produce a compliance "credit", but oversized HVAC systems produced a compliance "penalty". Under the current ACM rules, someone can make an honest mistake, or easily cheat, gain a large compliance "credit", and it would be unlikely to be noticed.

  Proposal: Restore the standard HVAC sizing rules of the 2008 Standards, which matched the design AC sizing, unless the design AC system(s) is/are deemed oversized.

- ACM PROGRAM DAYLIGHTING CONTROL CREDIT MODELING:

  Issue: With the advent of the '13 code, modeling daylighting (DL) for credit, or the absence of Secondary Sidelit zone DL controls for the "penalty", has become too cumbersome for reliable modeling (requiring 3rd party software to prepare '3d' geometric building models); such complex computerized building models cannot be expected to be scrutinized by enforcement agency reviewers.

  Proposal: Change all requirements for automatic daylight controls from Prescriptive to Mandatory.

- EXISTING CENTRAL PLANT MODELING:

  Issue: The Standards are silent as to whether, when new buildings are served by existing central plants, the central plant efficiency, capacity, and pump information can or should be modeled. Including central plant energy features is problematic because it is not easy to determine, let alone field check, these features.

  Proposal: The Standards should stipulate that when buildings are served by existing central plant energy, all energy associated with the central plant system is exempt. Furthermore, central plant systems may not be modeled under Performance compliance. Only HVAC equipment that is part of the project, such as fan coil units, should be subject to either Prescriptive or Performance compliance.

- FOUR ORIENTATION PERFORMANCE COMPLIANCE:

Issue: Some nonresidential projects include several identical buildings, except for orientation. This is especially true for hotel/motel projects, but could apply to commercial projects as well.

Proposal: To simplify compliance of multiple identical buildings, allow four orientation compliance for nonresidential buildings, as is presently allowed for low-rise residential buildings.

- ACM PROGRAM CHANGE NOTIFICATIONS:

  Issue: ACM program users, and compliance verification officers, often are not aware when a mandatory program upgrade is/was available.

  Proposal: All ACM program vendors should be required to send notices to each licensed user within a short, defined time period, whenever a mandatory upgrade to the ACM program has been made. Furthermore, the cover page of the Title 24 compliance report should indicate the specific version number of the program (i.e. "5.030")

  An automatic software update feature could suffice for the notification requirement only if the ACM publisher can know which users have enabled the auto update feature.

- ACM PROGRAM COMPLIANCE FORMS AND EDITING:

  Issue: Many (perhaps all) ACM programs can publish forms in PDF format. These forms can be easily edited, making the production of false results relatively easy.

  Proposal: Research whether it is possible for ACM programs to incorporate the following requirements (or similar requirements that would address the issue of editing compliance results):

  - Publish PDF format forms that contain certain fields that can be edited (such as explanatory notes), but that do not allow editing of vital compliance information. Either the program could allow explanatory notes to be added before publishing the report, or explanatory notes could be added to the PDF file if the PDF pages can be created in such a manner that edits can only be made in certain fields where explanatory notes are allowed to be added.
  - Prevent the creation of any electronic format report that can be converted into a PDF format report with no editing controls

  If technical restrictions on editing ACM generated forms are not possible, then consider requiring all ACM programs to "publish" compliance report results electronically directly to a CEC database (in addition to conventionally printing reports for compliance submittal). Allow enforcement agency officers to access project compliance data in this database, to ensure that submitted compliance report results have not been edited.

- ELIMINATE CREDIT FOR LOW LIGHTING POWER IN RETAIL SALES AREAS:

  Issue: Retail sales spaces change often, and all lighting changes are allowed to meet the *prescriptive* allowance (regardless of the original space's LPD). For complete building energy compliance under the Performance approach (i.e. envelope and

lighting, or envelope, lighting and mechanical), allowing credit for low lighting power is a very temporary energy savings trade-off in many retail situations.

Proposed Solution: For areas assigned the retail/wholesale sales area category, where the Proposed lighting power is lower than the Allowed lighting power, the Allowed lighting power shall be adjusted to match the Proposed lighting power.

Note: Over a few code cycles, staff has informed me that this retail lighting limitation has been implemented. I have never found this to be true. On Nov. 17, 2014 I once again tested this on a certified nonresidential ACM program, and the program yielded an efficiency credit when I changed retail sales area lighting from the *prescriptive* LPD, to 50% of the *prescriptive* LPD.

- ELIMINATE CREDIT FOR TEMPORARY TENANT SPACE LIGHTING:

  Issue: As noted above, developers often install a small amount of lighting in unleased tenant spaces, with the intention that the future space occupant will install additional lighting.

  Proposed Solution: Rather than give undue credit for low lighting power of temporary lighting, for areas assigned the suggested new Area Category called "Temporary Tenant Space Lighting" (see section above), where the Proposed lighting power is lower than the Allowed lighting power, the Allowed lighting power shall be adjusted to match the Proposed lighting power.

- ACM PROGRAM INPUT AND OUTPUT REQUIREMENTS: Compliance programs should be clear to both the energy analyst and to the enforcement agency as to how complex HVAC systems are modeled, especially with regard to modeling designed HVAC systems versus modeling "default" systems. The following ACM rules will help much in this regard:
  - Program input fields must identify each field that can be defaulted by not inserting any value.
  - Program output must identify all inputs that are default inputs.
  - Performance compliance forms must describe what equipment is allowed when output says "default" equipment modeled. For example, if the secondary pumps are defaulted (assuming they can be defaulted), note whether there is a limit on the number of pumps and horsepower of the pumps.
  - Program output must identify all input fields that have no value input, and are not default capable, by printing the word "none". For example, if no primary CHW loop pump system is modeled, and this is not a default-capable input, the output would say "none" under primary CHW loop.

- COLD & WARM SHELL RETAIL SPACES:

  Issue: When modeling a "retail" building or space under the Performance approach, when indoor lighting is not included in the model, there is no good choice for occupancy type. (Note: I did lobby to remove "retail" from the Complete Building approach list, because it wasn't a good fit for lighting compliance when the proportion of sales area to non-sales area varies significantly)

Proposal: Establish a "Retail Building/Deferred Lighting" occupancy type, available only for Performance approach modeling when indoor lighting is not included in the calculations.

- DESIGN VAV FAN POWER FOR "WARM SHELL" PROJECTS: Because the conditioned air distribution system is installed under a future permit for this type of project, the mechanical engineer can only guess what the brake horsepower will be. While the nominal fan horsepower can be used, this seems to be an unfair penalty to impose on a building simply because the air distribution system is unknown. Consider establishing a default static pressure that must be used to calculate the brake horsepower for warm shell buildings.

- DEMISING CEILINGS AND DEMISING FLOORS: Create standard demising ceilings and demising floors, per the suggestion in the Nonresidential Energy Code Ideas & Issues section, above. If the CEC elects to not create demising ceilings, add a method to denote where "roofs" face fully enclosed spaces above. Such "roof" areas would not be subject to Cool Roof in the Standard budget.