TITLE 24 ISSUES & RECOMMENDATIONS FOR THE 2016 BUILDING ENERGY STANDARDS

It is my contention, based on working with California's energy code in a professional capacity since 1978, 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 flexible. Designing the code to be easier to understand, and more flexible, 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.

With the release of the draft Standards this month, obviously there will not be time to deal with many of the suggestions listed below for this code cycle; proposed actions listed below on the standards development process are intended for future code design cycles (note: many of the suggestions listed below have been submitted during previous code development cycles, and several have been expressed earlier this year to commission staff, as issues with the '13 Standards became understood). Hopefully ideas that cannot be dealt with within the available time for the 2016 code cycle can be considered for the next code version.

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STANDARDS DEVELOPMENT PROCESS

- SCHEDULE:

  Problem: The call for Standards ideas, and workshops to discuss research findings and code update proposals, have been occurring before and during the time of the roll-out of the most recent Standards. Those that work with the Standards are often too busy dealing with learning the new code, and explaining new code features to their clients, to participate effectively in the public review process for the next code design. Just as important, it takes many months of working with a new code before practitioners develop a good understanding of what works and what needs improvement.

  Working on the next code while the most recent code is still new also dilutes precious staff resources that are always needed to deal with issues that arise during the roll-out of a new energy code.

Proposed Solution: Start the call for next generation energy code ideas, and hold workshops on studies and proposals, not before a minimum of 6 months after the current code takes effect. Doing so would require perhaps a two year delay in achieving a Zero Net Energy code for low-rise residential buildings. The trade-off being – when taking more time leads to a better designed code – a better framework for actually achieving the state's energy goals.

- ENERGY GOALS:

Problem: Ever since the power plant brownouts in the early 2000's, the CEC has been directed to emphasize energy savings during summer afternoon peak power plant energy usage. In order to reduce building cooling peak loads, the standards have aggressively pushed lower SHGC glazing. The result of this solution is lower heat gain summer and winter. And while the reduction in winter solar heat gain is generally not leading to more energy use in buildings with high internal loads (i.e. most commercial and institutional buildings), there is no doubt that lower winter solar gains do result in greater use of fossil fuel or electric heating in buildings with lower internal loads (especially single and multi-family residential dwellings).

And on the march towards Zero Net Energy buildings, if the code continues to push low winter solar heat solutions, then buildings that could otherwise make efficient use of winter solar heating will instead rely on greater amounts of active solar energy – increasing construction costs and embedded energy.

Proposed Solution: While it is understandable that the CEC would push for a "one size fits all" fenestration solution (reduces complexity for manufacturers, designers and builders), perhaps in the interest of reducing energy use further, the CEC should encourage residential passive solar design. The main components of this policy would be:

- Determine *prescriptive* shading requirements that, when high SHGC Low E based glazing is combined with adequate shading, would result in similar summer peak cooling load reductions as estimated for low SHGC glazing without shading.
- Where *prescriptive* shading requirements are met, *prescriptive* vertical fenestration SHGCs and U-factors would be based on products with high SHGC Low E glass with non-metal frames.
- For *performance* approach Standard energy budgets, the baseline fenestration would match the *prescriptive* requirements when no shading is provided. Where glazing areas incorporate shading that meets or exceeds the *prescriptive* shading requirements for use of high SHGC glazing, the Standard energy budget would be based on the prescriptive high SHGC allowance for shaded glazing.

The "passive solar" adjustments would apply to qualifying low-rise and high-rise dwelling units and hotel/motel guest rooms. [see also Taking Credit for Nonexistent Winter Passive Solar Heat Gains, in the residential/hotel code ideas section below]

- 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. The 13 Standard include for the first time a mandatory minimum insulation requirement for nonresidential buildings. While this is a measure I have been suggesting for several code cycles, I believe that these minimum insulation requirements may in fact result in building 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 13 Standards include a low-rise residential *prescriptive* radiant barrier requirement in coastal zones. While there may be some argument to be made for this requirement in new large homes, it's an unreasonable hardship for some residential additions.
    3. The 08 Standards included a new *prescriptive* Cool Roof requirement for heavy, steep roofing in cool coastal climate zones. This requirement obviously does not meet the reasonable pay-back requirement for adopted efficiency measures.

  - 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

- DESIGN THE ENERGY CODE TO REACH ENERGY EFFICIENCY GOALS IN A MANNER TO SEEMS REASONABLE TO THE BUILDING INDUSTRY

  Problem: As an energy consultant who has been involved with the Title 24 energy code since it was in draft form, it is my contention that the 2013 Standards are the first to elicit a strong negative reaction from the building design and construction industries, as well as from code enforcement agencies. While I find that in some instances the

increased complexity of the code has encouraged building designers to seek out more qualified energy consultants, the stringency of the code inspires some to seek out consultants willing to prepare compliance documentation that is inconsistent with code requirements.

The primary 2013 code issues causing concern and disagreement are, in my opinion:

- ACM software for nonresidential and residential buildings not ready on time. In fact, these programs are still not working properly, over a year after they were initially supposed to be ready.
- ACM software approved even though these programs did not (and do not) meet the ACM approval criteria.
- Onerous requirements for small nonresidential alterations and small residential additions.

Proposed Solution:

- While working towards zero net energy buildings is important, keep in mind that when certain code measures are considered by large numbers to be too onerous and unreasonable, the design, construction and enforcement communities are more likely to work outside of the rules.
- The more confusing the energy code, the less likely that it will be followed as intended.
- If the necessary elements required to implement the Standards, including ACM programs, manuals, and training, are not ready in a timely manner, delay the Standards until such time as the Standards can be rolled out in a satisfactory manner.

- <u>ENERGY CONSULTANT CERTIFICATION OR LICENSING</u>

Problem: 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
- Continuing education
- 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. Licensed energy professionals should be required to prepare Title 24 compliance reports for all nonresidential buildings (possibly excepting small buildings) and all multi-family residential buildings (possibly excepting two and three unit buildings).

Any person who wants to do professional building energy analysis work should welcome the chance to prove their professional qualifications. The argument that certain engineers don't need to separately qualify for this work because their engineering credentials prove their knowledge of the energy code does not conform to reality. Many engineers simply purchase an energy compliance program, and produce reports without training in the energy code. Because building departments often do not scrutinize energy reports carefully (perhaps especially those produced by established engineering firms), engineers who produce erroneous reports often do not receive crucial feedback that their reports are in fact not in conformance with the energy code.

While some people prepare erroneous energy compliance reports due to lack of knowledge, others purposely bend the rules, knowing that the likelihood of their non-conforming reports being rejected by a building department are fairly slim. When licensing is a professional requirement, professionals are much less likely to jeopardize their career by ignoring code provisions.

- 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;
  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) Once there is a class of licensed 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.

- COMPLIANCE FORM INFORMATION:
  - **Problem 1:** Forms do not always clearly indicate construction requirements. This is an issue with each new code. On the other hand, the requirement in the '13 code for all nonresidential compliance forms to be included on plan sheets is both tedious, a waste of paper, and makes it more difficult for field inspectors to pick out the important information to be verified.

    Proposed Solution:
    1) 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 and possibly new technologies need to be dealt with, this manual would be open to modifications.
    2) Code update staff and contractors would be tasked with noting any new requirements that need to be reflected in the compliance forms, and therefore added to the 'Form Design Manual'.
    3) The Form Design Manual ought to emphasize that form content needs to be aimed at three audiences: Plan Reviewers, Contractors, and Field Inspectors.
    4) Revert back to some compliance forms for checking the energy efficiency calculations, and some compliance forms designed for field inspections. Only the latter would be required to be placed on plan sheets.

  - **Problem 2:** Envelope compliance forms have never adequately dealt with the fenestration area limits built into the code. Examples: a) Nonresidential maximum "site-built" fenestration that may be modeled with NA-6 values; b) Residential maximum areas for various fenestration that has area limits for certain relaxed efficiency requirements.

    Proposed Solution: Where there are area limits on certain types of fenestration, require ACM programs to limit the areas of those products that are modeled with those relaxed energy values – and to clearly document the areas and requirements for these fenestration products.

  - **Problem 3:** The 13 code envelope forms, for "site-built" fenestration modeled with NA-6 values, list the NA-6 values. However, the field inspector cannot know what glass values are required.

    Proposed Solution: Where NA-6 values are modeled, the forms should list the glass values instead of the "fenestration" values, note the type of frame, and note that the envelope compliance for these products use the NA-6 approach based on the listed glass and frame type to calculate "fenestration" values.

- MANDATORY MEASURE COMPLIANCE FORMS:
  Problem: The '13 compliance manuals did not include mandatory measures (MM) forms/noteblocks. Evidently, the CEC felt 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 level of complexity the code is at, 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 nonresidential, high-rise residential, hotel/motel, and low-rise residential mandatory measures forms or noteblocks in the compliance manuals, with explanations. 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

- <u>BUILD FLEXIBILITY INTO CODE TO ALLOW THE CEC TO MAKE CERTAIN ADJUSTMENTS DURING THE CODE CYCLE</u>

  - ALLOW ADJUSTMENT OF CERTAIN REQUIREMENTS. Add language that allows the CEC to open a docket to consider narrow code changes that could take place during a code cycle. The language would restrict this process to only where code errors have been identified that cannot be remedied simply with a compliance manual "clarification".

  - ALLOW DISAPPROVAL OF PERFORMANCE MODELING OF CERTAIN EQUIPMENT. Add language to the Standards that allows the CEC to bar *performance* compliance credit for equipment and/or devices, or combinations of equipment and/or devices, that have not explicitly been authorized to receive *performance* credit; and where the CEC finds that receiving credit for the equipment, device(s), or combination thereof, is not in keeping with the intent of the Standards.

    Example: CEC staff decided after adoption of the 2005 Standards, but before they took effect, that they did not have the authority to ban modeling tankless gas water heaters combined with recirculation systems, although this is a combination of equipment that has not been evaluated for energy efficiency.

- <u>BASE ALL ASSEMBLY INSULATION REQUIREMENTS ON R-VALUES</u>

  Issue: For nonresidential/high-rise residential/hotel/motel occupancies, and for metal frame assemblies of low-rise residential occupancies, assembly insulation requirements are expresses in maximum assembly U-factors. Understanding the 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 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.

Description: R-values would be provided for assemblies where R-value of insulation is an acceptable expression of the requirement. Where it is not, compliance using a certified ACM program would be required. ACM programs would use the *prescriptive* envelope requirements to determine the Standard assembly U-factor.

Sample: Below is a sample partial NR table. 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-13	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 R-value, where only the depth of the insulation varies. This is too subtle of an assembly variable to expect code enforcement officials to deal with. For each insulation R-value, do not provide varying U-factors based on insulation depth. Instead, provide only the worst-case U-factor for any given material's R-value.
- 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 and 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).
- ADD: fiberglass doors.
- 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.
- REMOVE ASSEMBLIES: R-30 and R-38 high-density batts from metal frame construction (unless batt manufacturers are found that make high-density batts in widths designed for metal frame construction).

- <u>INSUFFICIENT NUMBER OF CLIMATE ZONES:</u>

  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.

- <u>FENESTRATION DEFINITIONS:</u>

  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.

- EXEMPTIONS TO COOL ROOF ROOFING REQUIREMENT

Issue: Some roof or deck areas are totally or substantially shaded, and some roof or deck areas have coverings where a cool roof product is not available. Cool roof products are unlikely to be cost-effective for areas that are substantially shaded. However, under the current code all roofs and decks above conditioned space are subject to the *prescriptive* cool roof requirement.

Proposed Solutions:

- EXEMPT SHADED ROOF & DECK AREAS. Consider exempting shaded roofs and decks from the cool roof requirement. Criteria would need to be established regarding the shade structure (opaque, maximum height above deck). Where the "roof" is substantially shaded (for example a parking garage office below a parking deck) the roof would be exempt from cool roof requirements. Where a roof is partially shaded, such as with a large fixed opaque canopy, the exempt area could be a fixed percentage of the shade structure roof area that overlaps the deck in plan view.
- EXEMPT DECKS WITH ARTIFICIAL GRASS PLAYING FIELDS ON THEM. At schools, sometimes roofs including a playing field. While the weight of a sod system would probably exempt it from the cool roof requirements, artificial grass systems probably do not meet the weight-based exception. However, the added insulation that these systems add to a roof probably has a similar effect on reducing heat gain as does a Cool Roof.
- EXEMPT WALKING DECKS? Research as to whether there are, or will soon be (by the estimated effective date of the next energy code) cool roof type decking products that comply with the *prescriptive* cool roof requirements. If these kind of products are, or are expected to be, available, or if the CEC feels that maintaining the cool roof requirement for decks, combined with better education, will spur the deck product industry to meet this need, then no exception for decks is necessary. However, if it appears that cool roof decking will not be available by the time the next Standards take effect, consider exempting decks from the cool roof prescriptive requirement.

- 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 into outdoor space.

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. Consider that in some cases, the edge of the concrete floor structure will coincide with the boundary of the heated space, resulting in ambient heat loss at the exposed concrete edge. In other cases, the concrete deck continues beyond the heated space perimeter, resulting in heat loss to both ambient conditions and to the adjoining unheated concrete floor structure.

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.

- <u>STAIR AND ELEVATOR FLOOR AREAS:</u>

  Issue: Current floor area guidelines overcount stair area, and are not clear as to elevator area.

  Proposed Solutions: Revise floor area rules, and make consistent for residential and nonresidential buildings:

  - STAIRS: Counting the stair area for every building level over-counts the floor space that stairs account for. And when stairs occur in a larger multi-story open space, the area to count at each level becomes more uncertain. Stair area (area of treads and mid-floor landings) ought to be counted at every floor except at the top floor that the stairway serves. For example, in a two-story house, the stair area would be counted once. In a seven story office building, for stairs ending at the seventh floor, stair area would be counted six times. If the stairway provides roof access as well, the stair area would be counted seven times.
  - ELEVATORS: The floor area may optionally be counted once (regardless of the number of floors) or not at all. For nonresidential buildings, elevator lights are often (perhaps usually) overlooked in the lighting compliance calculations. Clarify whether the elevator lights must be modeled. If elevator light fixture modeling is optional, note that the floor area should not be counted unless the lights are modeled.

- <u>SKYLIGHT CURBS:</u>

  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.

- <u>RADIANT FLOOR HEATING:</u>

Issues: a) Section 110.8(g) Insulation Requirements for Heated Slab Floors, does not explicitly cover raised concrete floors; b) Slab insulation for alterations not clear; c) requirement for heated slabs abutting foundation walls may need improvement, and d) the Standards don't note that insulation used to meet this requirement is not eligible for *performance* compliance credit.

Proposed Solutions:

a) Revise the code language to indicate that the special insulation requirements for heated slab floors apply to both slab on grade and raised concrete floors.

b) Clarify in the Standards that retrofit slab insulation is required when adding radiant heat to a previously unheated slab.

c) Where heated slabs abut foundation walls, consider whether it is thermally practical to allow the vertical insulation to be placed on the outside face of the foundation wall instead of the inside fact. I suspect that placing the insulation on the outside face of the foundation wall will allow much heat to short-circuit away from the heated slab area.

d) Note in the Standards that insulation used to meet the heated slab floor requirement is not modeled for *performance* compliance credit. Although this would be addressed in the ACM guidelines, it is helpful to also note it in the Standards language for a more clear understanding.

- <u>HEAT PUMP SIZING:</u>

  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. 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.

- <u>AGED BOARD INSULATION VALUES:</u>

  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.

- <u>NUMBER OF BUILDINGS:</u>

  Issue: Standards are silent on whether multiple buildings on a single site can be modeled together as one, or 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 are considered one building or multiple buildings.

Leaving the decision about modeling multiple structures to building officials is not very practical because it is often difficult, or impossible, to receive an official (i.e. written) ruling in a timely manner.

- 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 when 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 and each tenant space 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.

- SOLAR READY: Clarify in the Standards when this requirement is applicable for alterations, and when it is applicable for additions.

- 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 140.13(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 '13 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, clarify that walls separating elevators shafts from conditioned space are demising walls, requiring insulation if they are frame walls.

- BUILDINGS & SPACES EXEMPT FROM TITLE 24:
  - **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?
- **Issue 3:** There are several aspects of Exception 2 to Sect. 100.0(e)2.D.ii.b that ought to be revisited. Examples: A) If a house with wood heat receives an exception to Title 24, what is the likelihood of mechanical heat being retrofitted later – especially if the house is not built thermally-efficient? B) Perhaps residential and nonresidential buildings that use renewable energy for space conditioning (including to power mechanical systems) and water heating ought to be exempt from Title 24. They are not clearly exempt now. However, as compared to the current Exception for residential structures, buildings designed to rely on renewable energy for their space and water heating would typically have a much larger investment made is such systems, and therefore could be considered less likely to retrofit depletable energy using systems in the future as compared to homes using such technology as wood heaters.

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?

- CLARIFY WHICH STANDARDS PROJECTS ARE SUBJECT TO

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 months or perhaps a year earlier than a building permit, 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, based on State regulation, at the time of a building permit submittal are the Standards that the proposed project will be subject to.

- WRITE FORMULAS UNAMBIGUOUSLY:

Problem: Mathematical formulas in the Joint Appendices that require both addition and multiplication within a single formula omit symbols to indicate the operation order. Not everyone is aware of the order of operations when different mathematical operations occur within the same formula.

Proposed Solution: Always include parenthesis and other characters as required to make the order of math operations within all formulas clear.

COMMON ACM ISSUES:

(pertain to residential and nonresidential programs)

- PUBLIC DOMAIN ACM PROGRAMS

Issue: CEC staff does not have resources to support public domain ACM programs. Using tax dollars to produce programs that compete against private vendor providers of ACM programs is dubious, especially given the relatively small market for these programs.

Proposed Solution: Work to change the law that now requires the CEC to publish public domain ACM programs.

- ACM PROGRAM FILE CONVERSIONS:

  Issue: ACM programs are not always clear on what steps a user must take to ensure that a file converted from a previous standards version to a new standards version of a program has been converted properly.

  Proposed Solution: The ACM manuals should state that ACM programs must clearly articulate, in an on-screen message that automatically appears when the user attempts to convert a file, exactly what steps users must take to convert a file created under a version of the ACM program for one standard to be usable for compliance with the program version designed for the current (or soon to be current) standards. As part of its approval evaluation, the CEC should ensure that this requirement is met.

- TAKE MEASURES TO ELIMINATE FALSE EFFICIENCY CREDITS:

  Issue: I have seen compliance reports that take credit for various items that are not technically correct. One example: Modeling storage tanks with zero standby loss.

  Proposed Solution: Require ACM programs to balk at calculating compliance when required factors are missing, and when required factors fall outside of a set allowed range to be defined in the respective ACM manuals.

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

- MISSING LOW-RISE MANDATORY MINIMUM INSULATION:

  Issue: Section 150.0(a) does indicate whether or not the roof and floor insulation applies to any construction, or only frame construction. The wall insulation requirement is stated to apply only to frame construction. Therefore:

  a) Standards unclear as to concrete roof insulation requirement.
  b) Standards have no mass wall insulation requirement.
  c) Standards unclear as to concrete floor insulation requirement.

  Proposed Solution: Require a minimum of R-8 continuous insulation, or R-21 between framing, for concrete roofs and floors. Require a minimum of R-4 continuous, or R-13 between framing, for mass walls.

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

  Issue: The design of the Low-Rise standards is based 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[1].

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 standards would be similar to the current low-rise residential standards. CSC 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: where building area served by one 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 previous code, they 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 instead of penalizing them. This could lead to greater energy savings because owners will not be discouraged to make upgrades.

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

  Issue: In climate zones where vertical fenestration has no SHGC requirement, the fenestration usually is low SHGC type. 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 0.05 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.

[1] 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.

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

- LOW-RISE RESIDENTIAL FENESTRATION AREA:

  Issue: Under the current 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. Allowing very large glazing areas only adds to the energy intensity of these larger homes.

  Proposed Solution: Develop a fenestration area allowance methodology that scales the allowance to actual need. As compared to the current 20% CFA standard, a new area allowance should result in slightly greater allowed area for very small buildings, and moderately less area for very large homes and for multi-family buildings.

  A fenestration allowance formula that accounts for both floor area and perimeter will produce the kind of result described above. An explanation, as well as examples, may be found in APPENDIX A of this paper. Appendix A outlines a proposal for a single formula to determine allowed fenestration area for all low-rise residential building types, including multi-family and additions. This formula results in similar glazing allowances for average size homes as the current floor area basis formula, reduces the allowed fenestration area of very large homes, and brings the glazing allowance of multi-unit buildings in line with actual design practice, without having to justify various formulas for different sizes or types of residential buildings.

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

  Should a restructuring of the fenestration allowance for all 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. This change would eliminate the rationale for eliminating the credit for reduced glazing area – it was an alternative to establishing a separate glazing to floor area ratio baseline for multi-family buildings.

- RESIDENTIAL ADDITION FENESTRATION AREA (low-rise residential):

  Issue: Eliminating glazing due to the location of an addition is not an efficiency measure, but rather the natural consequence of the addition design. Therefore, the notion that additions should receive an additional glazing area allowance based on the area of glazing removed due to the addition location cannot be supported in an energy code whose aim is to gradually reduce building energy consumption. This "credit" for removed glazing area also produces widely differing addition glazing allowances, depending on existing glazing areas (if any) to be removed.

  Proposed Solution: Establish a prescriptive allowed glazing area for additions that does not vary based on existing conditions. The residential glazing allowance formula shown in Appendix A would produce realistic allowances for additions. However, if that standard is not adopted, I would suggest a standard of somewhere around 30% to

25% of the addition CFA. Why not use the 20% CFA standard of Package D? Because the 20% standard is based on an entire house area, and many additions are entirely or mainly living areas, which typically have much higher glazing to floor area ratios than do other areas of a house.

- 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 suggestions above).

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

- 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 some exterior assemblies to have very low insulation levels can 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 occurred in the '98 Standards, and apply it to High-Rise Residential buildings as well.

- 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 insulation and radiant barrier 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 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 – at least by the time the '16 code takes affect, when energy costs will be higher, and the premium for Cool Roof products will likely be lower than now.

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

- DOMESTIC WATER HEATING ISSUES:
  - TANKLESS WATER HEATERS AND RECIRCULATION: Until or unless recirculation energy factors are developed specifically for tankless (or direct) water heaters combined with recirculation systems, do not allow this combination of equipment to be modeled for performance compliance.
  - STORAGE TANKS: I don't believe that storage tanks are addressed, or adequately dealt with, in the ACM. See also Standby Loss above in General Issues section.
  - TANKLESS WATER HEATERS AND STORAGE TANKS: Until or unless ACM modeling algorithms are developed to model this combination of equipment, do not allow this combination of equipment to be modeled for performance compliance.
  - BUILT-IN WATER HEATERS: Some Jacuzzis and dishwashers and other devices have built-in water heaters. Should the Standards remain silent on these, say some or all are exempt, or clearly require all to be included in the energy evaluation?
  - RECIRCULATION MANDATORY CONTROLS: Beginning with the '05 Standards, it is mandatory for multi-family DHW systems to be equipped with automatic time control. I have heard that these are often not used on large multi-family projects, where residents might use hot water at any time, and where the distance between dwelling unit and DWH could result in very long wait times. Unless studies show that time controls are routinely used in larger residential facilities, consider changing the requirement to utilize either time or temperature control, whichever the plumbing designer feels will be most effective for the particular application.

- RETROFIT DHW RECIRCULATION SYSTEMS: Low-rise residential performance compliance programs should have the capability to model portions of recirculation DHW systems without pipe insulation, for cases where recirculation is added to existing construction.

- SPACE HEATING WATER HEATERS and REQUIREMENTS for ADDITIONAL INSULATION: Currently, if water heater is used for Combined Hydronic space heating system, then it must have blanket if EF < .58. However, if the same water heater is instead used for space heating only, a blanket is not required. Should the blanket requirement be consistent regardless of how the hot water is used?

- 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 as it does for floor coverings.

- ROOF ALTERATION INSULATION REQUIREMENTS:

  Issue: The '13 Standards only require meeting mandatory minimum insulation levels.

  Proposal: For all but very small alterations (perhaps up to 100 sq. ft.), the *prescriptive* insulation requirement for alterations ought to match the *prescriptive* insulation requirement for new construction. Furthermore, when the alteration includes replacing a roof deck above attic space, radiant barrier ought to be *prescriptively* required.

- ADDITION WALL INSULATION: Clarify in the Standards that the *prescriptive* reduced wall R-value for smaller additions is for wood framing.

- ALTERED COMPONENT INSPECTION REQUIREMENT: Clarify at §150.2(b)2.B. that the third party inspection requirement only pertains to those alterations for which credit is sought for the upgrade from the current component condition.

RESIDENTIAL ACM ISSUES

Note: Some of the following issues which were relevant to the '05 or '08 code may or may not have been addressed in the '13 code.

- 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: Rather than model the various surfaces of adjoining unconditioned spaces (such as garages), 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. Demising surfaces facing unconditioned space would then be modeled as they currently are.

- 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.

- DHW UNFIRED STORAGE TANK MODELING: Review the modeling of storage tanks in water heating systems utilizing boilers. The ACM may not adequately deal with energy losses associated with the storage tank.

- <u>LARGE AIR CONDITIONER REQUIREMENTS:</u>

  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 residential modeling engine 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 system, so that the correct efficiency rating will be used.

- 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 comments, above)

- PROCESS SPACE EXCEPTION:

  Issue: Process spaces are exempt from energy code compliance (based on the definitions of "process space" and the definition of "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, exempt mechanical systems serving process spaces from energy code compliance. Process space envelope and lighting would be subject to the same requirements as other conditioned spaces.

- 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 also 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, 50 sq.ft. of concrete and masonry walls, 6" concrete curbs at school buildings.

  - **Issue 2:** Some spandrel designs will meet the mandatory minimum 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 (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 uses the term "Glass spandrel panel". Spandrel panels may be glass, metal, or other material.

    Proposed Solution: Use a more inclusive term in place of "glass".

  - **Issue 4:** While §120.7 mentions "light mass walls" and "heavy mass walls", these are defined within this section as pertaining to "hollow core masonry units". Which appears to leave out regulation for solid masonry units and monolithic concrete walls.

    Proposed Solution: Describe covered assemblies in a way that clearly makes the requirements inclusive of all intended assemblies.

- **Issue 5:** 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 6:** 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.

- SCHOOLS & PRESCRIPTIVE ENVELOPE COMPLIANCE:

  Problem: School buildings typically have two components that the *prescriptive* envelope requirements don't easily accommodate: Frame walls sitting on concrete curbs, and vision panels in exterior doors.

  Proposed Solution: Structure the *prescriptive* envelope requirements to accommodate concrete curbs and single-pane door vision panels. If doing so without other adjustments would be considered too large of an energy increase, then let schools accommodate these typical elements in exchange for some increased efficiency measure. Perhaps somewhat lower U-factor windows, for example.

- FENESTRATION REQUIREMENTS – SMALL NON-CONFORMING GLASS AREAS:

  Problem: The fenestration requirements only accommodate areas of low-efficiency glazing through "area-weighted" U-factor and SHGC calculations. This is an onerous requirement when there is a desire for very small glazing areas to not meet the *prescriptive* values.

  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.

- VT REQUIREMENT:

  Problem: The new *prescriptive* VT requirement in the '13 Standards is not implemented under *performance* compliance. Changing the fenestration VT does not affect the *performance* score. However, lowering the VT will reduce the effective amount of daylight.

  Proposed Solution: With the increased complexity of calculating daylighting control credit under the *performance* approach in the '13 code, most projects are likely simply following *prescriptive* daylight control requirements, even when the building otherwise is complying under the *performance* approach. If that is expected to remain being the

case, then the practical solution to setting a VT requirement is to change the requirement from *prescriptive* to mandatory.

However, should VT change from a *prescriptive* to a mandatory requirement, the Standards ought to exempt some percentage of fenestration – perhaps 5 to 10% - from this requirement.

- SKYLIGHT EFFICIENCY:

  Issue: The '13 Standards eliminated the *prescriptive* SHGC requirement for plastic glazed skylights. This was done to encourage the use of skylights that transmit adequate daylight. And with the *prescriptive* 5% roof area limitation for skylights, it was felt that not having a SHGC requirement would be an acceptable trade-off. However, with no area limitation under the *performance* approach, one can legally design buildings with very large areas of high SHGC plastic skylights. And because plastic skylights are not only the inexpensive "bubble" type, but also high-efficiency fiberglass panel type, a large credit can be obtained because of this code design flaw.

  Proposed Solution: The *prescriptive* no SHGC requirement for plastic skylights should only apply to plastic skylight areas up to 5% of the roof area. Under the *performance* approach, any plastic skylight area exceeding 5% of the roof area would be subject to the same SHGC requirement as for glass skylights.

- FRAMELESS GLAZING SYSTEMS:

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

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

- VARIABLE VT GLASS:

  Issue: Some new types of glazing have variable visible light transmittance. The Standards are silent on how this should be dealt with for automatic daylight PAFs.

  Proposed Solution: Clarify that sidelit and skylit EA must be based on the lowest available VT of the glass. Exception: when there are controls installed that allow VT reduction only when daylight is not available (i.e. VT only reduced during non-daylight hours), the daylight VT may be used to calculate EA.

- "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.

- OCCUPANT SENSOR LIGHTING CREDIT:

  Issue: Since the ’08 code, there has been no credit for a standard occupant sensor (OS) lighting control, as the commission decided to push use of MLOS controls. And while MLOS controls never achieved popularity (I see that they have been omitted in the ’16 draft code), standard OS controls clearly result in energy savings. Therefore, they ought to receive PAF credit to encourage their use.

  Proposed Solution: Restore the PAF credit for standard OS systems (limited to spaces where OS controls are not required).

- 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 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 SMALL ADDITIONS – FENESTRATION REQUIREMENTS:

  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 includes only a small area of glazing, meeting the new construction NFRC requirements is more onerous than warranted.

  Proposed Solution: Allow additions that have site-built fenestration not exceeding 100 square feet to meet the values of Table 141.0-A.

- NONRESIDENTIAL ENVELOPE ALTERATIONS:

  Issue: 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. Which for small projects is more onerous than warranted. And the Table 141.0-A “relaxed” energy values are not practical for many skylights.

  Note: the current exception to 141.0(b)2Ai is not a practical exception, because in order to meet the Table 141.0-A U factors, a high-performance glass must be used anyway.

  Proposed Solution:

a) Allow the replacement fenestration values of Table 141.0-A to also be used for up to 150 sq. ft. of new (non-replacement) vertical glazing area.
b) Allow new glass skylights of up to 50 sq. ft. to be added without meeting the new building Table 140.3-B and C glass skylight energy requirements, as long as the glass is Low E and the frame is thermally-broken or non-metal.

- OPERABLE WINDOWS:

  Issue: Natural ventilation can save energy if HVAC systems respond appropriately. But Title 24 does not provide credit for opening windows in nonresidential buildings.

  Proposal: Study efficiency savings likely to occur through use of operable windows in nonresidential buildings. Provide an ACM credit for operable windows when they are equipped with an interlock to prevent HVAC operation in the zone in which the opened window resides.

- 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 system to meet *prescriptive* sealing requirement.

- DEMISING ROOFS & FLOORS:

  Issue: It seems awkward, and it is inconsistent, to model ceilings and floors facing unconditioned spaces as if they are exterior assemblies, instead of modeling them as demising partitions, as demising walls are.

  Proposed Solution: Change definition of "demising wall" to "demising partition", and revise ACM rules accordingly. Consider mandating the following values:

  - Frame demising ceiling: R-19
  - Concrete demising ceiling: R-16 (4" curtainwall semi-rigid fiberglass insulation)
  - Frame demising floor: R-13
  - Concrete demising floor: no requirement.

- 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.

- NONRESIDENTIAL LIGHTING ALTERATIONS:

  Issue: The '13 code greatly reduced the "triggers" for requiring spaces to meet new construction lighting power and control requirements. These very stringent

requirements may not adequately account for the imbedded energy within existing light fixtures. And requiring very large lighting changes when only wishing to make relatively small lighting changes puts the energy code in a bad "light".

Proposed Solutions:

- Change the number of new luminaires within any enclosed space that trigger that space having to meet 140.6 new construction lighting power from 10% to 25%.
- Make changes of enclosed space area a trigger for 140.6 compliance only if the changed space will receive new light fixtures. In other words, simply moving a wall and moving existing luminaires should not trigger new construction lighting power.
- Don't require automatic daylight controls unless project will have a minimum number of new luminaires. Perhaps a minimum of three within a primary sidelit zone, three within a secondary sidelit zone, three within a skylit zone. This is another case where requiring daylight controls when only one or two new luminaires fall within a daylight zone is overly burdensome.

- <u>AREA CATEGORY LIGHTING CLARIFICATIONS:</u>

  - 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 typically will install a few light fixtures to provide just enough illumination 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 0.6 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 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, the 50% head height value used to determine zone width is complicated for 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 in the '08 code, 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: Language 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 we performed Title 24 analysis on 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>PROCESS LOADS:</u>

  Issue: In my experience, mechanical designers can declare any process load 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 on 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.

- <u>NONRESIDENTIAL WATER HEATING:</u>

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.

While it would be important to capture the energy cost of recirculation systems on proposed electric water heaters, I make no recommendation at this time as to whether to mandate modeling recirculation systems tied to gas water heaters.

- EXEMPT LIGHTING, INDOORS & OUTDOORS: Clarify that when exempt lighting and process equipment lighting is exempt (such as kitchen hoods, walk-in freezers, and swimming pools), that the floor or surface area representing the footprint of the equipment or facility whose lighting is exempt shall also be excluded from the lighting compliance calculations.

- 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.
  Proposal: Study efficiency savings likely to occur through use of operable windows in nonresidential buildings. Provide an ACM credit for operable windows when they are equipped with an interlock to prevent HVAC operation in the zone in which the opened window resides.

NONRESIDENTIAL ACM ISSUES

Note: Some of the following issues which were relevant to the ’05 code may or may not have been addressed in the ’08 code.

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

  Issue: In the ’13 Standards, the reference AC system for any size multi-story nonresidential building became a PVAV system. And yet for single-story buildings, PVAV becomes the reference system only for buildings over 10,000 sq. ft. CFA. This energy budget is out of line with both *prescriptive* 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 PVAV system.

  Proposal: Determine the smallest single-story, and smallest multi-story, building size where PVAV systems are shown to be both available and cost-effective. Match the ACM reference system type to these findings.

- 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, and certainly 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 it 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, are subject to either *prescriptive* or *performance* compliance.

- 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.

- ACM PROGRAM MODELING AND INCORRECT ENERGY CREDIT:

  Issue: In the past, I have found nonresidential ACM programs that provide energy credit for mandatory daylight lighting controls and mandatory occupant sensor lighting controls.

  Proposal: a) Require ACM program vendors to certify that their programs do not provide energy credit for mandatory measures; b) The CEC should test ACM programs to confirm that they meet this requirement.

- 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.

- PORTABLE SCHOOL BUILDINGS – PERFORMANCE REQUIREMENTS:

  Issue: The '13 NCM calls for *performance* compliance runs at 12 orientations. This is an excessive requirement to show that a design is energy-efficient for a particular climate zone.

Proposed Solution: Reduce the number of orientations to eight. Require that ACM programs have the capability to automatically produce an 8-orientation modeling run.

- 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 not 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.

- SMALL AIR CONDITIONERS/NO SEER VALUES:

  Issue: The '13 (and earlier) NR ACM reference manual, in section 5.7.5, calls for package DX cooling systems ≤ 65,000 Btuh capacity, to be modeled using SEER. However, some package cooling systems in this size class are only rated in EER – such as "Computer AC, air-cooled, < 65k", based on Appliance Standards requirements. Modeling an EER when the program is expecting an SEER results in an unfair penalty.

  Proposal: Establish EERs for package DX cooling systems ≤ 65,000 Btuh capacity for cases where SEER is not available.

- 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.

- FANS & PUMPS:
  - ALLOW FOR MULTIPLE SIZES. ACM compliance software is currently limited to one pump size and one fan size per system. When a system employs multiple size fans and/or multiple size pumps, the input must use an average size, which does not accurately account for the differing efficiencies between small and large fans and pumps. If the modeling engine supports this, require that each system can be modeled with two different size pumps and fans.
  - DHW & CONDENSER WATER PUMP MODELING: For '05 Standards performance compliance, tall buildings tend to suffer a large energy penalty when pump HP and GPM are modeled. Look into whether the ACM provides a realistic pump energy budget for efficient pumps in tall buildings.
  - HYDRONIC HEAT PUMPS: Since the '05 Standards, buildings designed with hydronic heat pumps have a high degree of difficulty achieving *performance* compliance, as the ACM assumes a pump energy use that much exceeds the calculated energy savings of the heat pump unit itself (note: I have not verified whether this issue continues with the '13 NR ACM). Explore whether the ACM fixed assumptions and algorithms for this system type are appropriate.

APPENDIX A

PROPOSAL FOR REGULATING LOW-RISE RESIDENTIAL FENESTRATION AREAS

The following proposal was developed as with the goal of reducing the prescriptive fenestration area allowance for larger buildings (single-family as well as multi-family), while at the same time providing a modest increase in allowed fenestration area for very small dwellings. It also becomes a more appropriate method of regulating glazing area in high-rise residential buildings than the current basis – 40% of gross wall area – that is identical to the nonresidential building baseline fenestration area restriction.

Conditioned floor area (CFA) would be used to determine a "Basic Wall Area" (BWA), which is the wall area the building would have if it was a square building with 8 ft. high walls. This BWA wall area is the square root of the Conditioned Floor Area times 4 (the perimeter if CFA represented a square building) times 8 (representing typical wall height). The BWA then is $\sqrt{C.F.A.}$ x 4 x 8, or $\sqrt{C.F.A.}$ x 32. 10% or 11% of this calculated wall area is a glazing allowance that is added to a second glazing allowance based a percentage of the C.F.A. (as in the current Standards). Below are two possible formulas for the prescriptive fenestration area:

$$(0.13 \times \text{C.F.A.}) + (\sqrt{C.F.A.} \times 32 \times 0.11).$$

or

$$(0.14 \text{ x C.F.A.}) + (\sqrt{C.F.A.} \text{ x } 32 \text{ x } 0.10).$$

The following chart compares the prescriptive low-rise residential fenestration areas under the current standards with two possible alternative fenestration allowances (all areas in square feet).

Building Area:	200	500	1,000	2,000	3,000	5,000	10,000	100,000
20% C.F.A.	40	100	200	400	600	1,000	2,000	20,000
13% C.F.A. + $\sqrt{C.F.A.}$ x 3.5	75	143	241	416	581	897	1,650	14,107
14% C.F.A. + $\sqrt{C.F.A.}$ x 3.2	73	141	241	423	595	926	1,720	15,012

The result is that small additions receive a small additional allowed glazing area, the glazing area for average size homes is approximately the same as under the current standards, the glazing area for very large homes is reduced about 10 to 15% compared to the current allowance, and the glazing area for a 100,000 square foot multi-family building is about 15% of the floor area, which is fairly typical for this building type. If the glazing allowance for small additions is deemed too generous, the ability to receive credit for glazing area removed could be eliminated under the prescriptive approach.