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*Comment Received From: Facade Tectonics Institute*  
*Submitted On: 11/2/2020*  
*Docket Number: 19-BSTD-03*

## **Comment on fenestration performance requirements**

Please see attached document

*Additional submitted attachment is included below.*

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Chris Stutzki

Peter Weismantle

Roger Fricke

30<sup>th</sup> October 2020

Re: **19-BSTSD-03 2022 Energy Code Nonresidential High-Performance Envelope**

Dear Sir/Madam,

On behalf of the Façade Tectonics Institute (FTI), I am pleased to provide the following feedback (below) on the proposed changes to Title 24 (T24) related to the non-residential envelope provisions. FTI is a 501c3 non-profit, member based organization which represents a large cross-section of the ownership, architecture, engineering, construction, fabrication and building product manufacturing community in the US, Canada, and in California, committed to promoting the widespread design and application of high performance facades for the benefit of people and planet. The Institute was incubated initially by the University of Southern California's Architecture Department over ten years ago and has since become known globally for its technical biennial world congress and in-depth technical expertise related to the building skin. The participation on our advocacy committee reflects the breadth of our membership. We aim to bridge the silos between participant groups in order to create solutions for high-performance building façades. FTI also brings national and global perspectives on all these code development challenges from its diverse and experienced membership. Please visit our website [www.facadetectonics.org](http://www.facadetectonics.org) for more information.

California has the potential for advancing progress towards a net-zero carbon built environment, an important national objective, and which motivates our interest in seeing that the next generation of T24 envelope requirements supports this critical national and global imperative. We would like to underscore our commitment to driving to higher performance buildings and to working with the California Energy Commission to reach the State's net zero energy and carbon reduction goals. We have provided feedback to the US Department of Energy this year on the barriers to achieving higher performing facades and recommendations for improving building codes and standards. I have attached copies of the fenestration and opaque envelope feedback for your reference.

The members of the FTI advocacy committee and contributors to developing this feedback are as follows:

Keith Boswell, SOM Architects (San Francisco, CA)  
Chris DeHaven, McCarthy Building Companies (California)  
Roger Fricke, Clark Construction (California)  
Joe Conover, Clark Construction (California)  
Richard Green, Green Façades  
Jeff Heymann, Benson Industries  
Stephane Hoffman, Morrison Hershfield  
Stacey Hooper, NBBJ Architecture (Los Angeles, CA)  
Louis Koehl, Handel Architects  
Irene Martin, Arup (Los Angeles, CA)  
Mic Patterson, Façade Tectonics Institute (Los Angeles, CA)  
Helen Sanders, Technoform North America  
Steve Selkowitz, LBNL (Berkeley, CA)  
Matt Staublin, Architect (Los Angeles, CA)  
Hamid Vossoughi, WSP  
Peter Weismantle, Adrian Smith + Gordon Gill Architecture LLC  
Andrea Zani, Eckersley O'Callaghan (San Francisco, CA)

We look forward to continuing the dialogue and to working with you to achieve the State's sustainability goals. We hope that CEC will view FTI as a broad industry-based, yet non-

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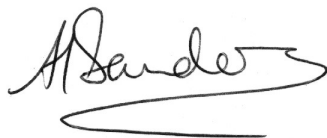
Chris Stutzki

Peter Weismantle

Roger Fricke

profit, public interest focused partner to help you meet the state's upcoming energy and environmental goals.

Sincerely,



Helen Sanders  
President, Façade Tectonics Institute

**Attachments:** FTI responses to DOE's RFI for non-residential fenestration and opaque envelopes, 2020.

### **FTI's Feedback on Title 24 Non-Residential Envelope Proposals:**

In the past, California has been a national leader in setting aggressive, but achievable, performance targets, and partnering with the building industry to meet them. We are surprised and disappointed at the lack of movement in fenestration stringency being proposed in the 2022 version of Title 24. We do not understand how California is to meet their stated net zero energy goals in 2030 without additional tightening of fenestration performance. The transition from today's code compliant solutions to those needed in 2030 must be implemented over a relatively short time frame so it is imperative that the 2022 cycle take that next step.

We understand that there is an upfront cost effectiveness criterion at play, but we assert that the achievement of net-zero does not come for free, and that, as it has in the past, innovation and volume specification and application will bring current cost adders down to more reasonable levels. In fact, the current cost effectiveness criteria can negatively impact the achievement of economies of scale in higher performance products needed to reach net zero.

We believe that getting the envelope right is more than just about immediate cost-effectiveness, it must be about achieving long-term cost effectiveness in higher performing products that get us to net-zero. After the 2022 version of Title 24, there are only 2 more code cycles before we reach 2030. If minimal changes to fenestration performance are made in this cycle, this is not sufficient to get the envelope performance where it needs to be in 2030 without enacting drastic changes in the last two cycles which will challenge the cost effectiveness benchmark even more. There seems to be a disconnect between the requirement for cost-effectiveness based on energy cost payback and the need to achieve net zero building performance in 10 years. Should California be looking at other contributions to payback like building resiliency to climate events (e.g. human costs related to passive survivability), and the costs of not getting to net-zero? What is the cost of doing nothing (or not enough)?

A report by the Allen Consulting group from June 2003 demonstrated the clear long-term positive economic impact of improved energy efficiency in Australia. It showed accrual of long-term gains in GDP, as well as reduction in greenhouse gas emissions and energy use, with relatively short-term pain.

We recommend changing the requirements or targets for what constitutes cost-effective to a broader concept that understands that there is a necessary upfront cost to getting to net-zero in the time frame needed, and that cost effectiveness should be looked at beyond that of first cost, including the future cost to the State of doing nothing. Our membership includes general contractors and envelope sub-contractors who know the cost of

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construction very well, and we would welcome the opportunity to support CEC in the collection and verification of robust as-built cost-effectiveness data.

We also noticed that the CASE team's presentation on the cost effectiveness calculations said that in building prototypes which were expected to contain curtainwall and storefront products, it was assumed that 80% of the building fenestration was fixed window and 20% curtainwall and storefront. Our AEC advocacy committee members think that this could be a flawed assumption, especially for the medium and large office building types, and also for retail. Typically, we would expect 80+% of fenestration to be curtainwall and storefront on medium and large office buildings. We would be interested to know how this changes the analysis. Also, when there is such a big difference between fixed window requirements and those for curtainwall and storefront, you may inadvertently encourage the market to use the lower performing storefront and curtainwall glazing types in buildings, which will not cause the market to move in the right direction for net zero.

Our member practitioners estimate that fenestration U-factors need to get to ~0.20 btu/°f.hr.ft<sup>2</sup> to achieve net zero [1] and fenestration systems with this performance are already available from many manufacturers. Therefore, we must make achieving that target cost effective by 2030. With curtainwall and storefront U-factors being held at 0.41 btu/°f.hr.ft<sup>2</sup> (for most climate zones) and no limit to how they can be traded off with HVAC and other internal systems, getting to the net zero target in 2030 will require rapid increases in stringency for fenestration in the 2025 and 2028 code versions. In the meantime, we aren't training the market to use higher performing envelopes and achieve better economies of scale with fenestration of even interim performance. While a U-factor of 0.20 btu/°f.hr.ft<sup>2</sup> typically means using triple pane glazing, first we need to push the envelope to get more out of fenestration using high performance frames and double pane glazing, by requiring U-factors of, say, 0.34 btu/°f.hr.ft<sup>2</sup> (this is being done for fixed windows in T24, but not for other fixed fenestration like curtainwall and storefront).

The fact of the matter is that a 0.41 btu/°f.hr.ft<sup>2</sup> for curtainwall and storefront represents a trivial-to-meet performance standard and will cause California to fall behind the rest of the west coast, and other parts of the U.S. in terms of energy stringency. And as our members who do work in California know, the performance of the as-installed fenestration performance is generally even worse because of the ability to trade off with internal systems, not to mention we already over-estimate envelope performance in our simulations by not accounting adequately for thermal bridging. Curtainwall typically has much lower frame to glass ratio than a typical window because of the larger units, so a more stringent performance is more easily achievable when using project sizes. The non-residential envelope CASE report [2] section 4.2.2.1 notes that curtainwall products with U-factors below 0.30 are available and U-factors below 0.36 are available with common technology.

While improved technology may have an initial incremental higher cost, it has been noted by the EPA in their report "Estimating the Economic Benefits of Energy Efficiency and Renewable Energy" [3] that cost savings from energy efficiency have significant return to the economy over medium and long term that results in cumulative economic growth.

In addition, as California decarbonizes its electric grid, and turns to electricity for hot water and heat, peak demand may start to move to the early morning in winter in some climate zones, and a bad thermally performing envelope will exacerbate the problem of meeting peak demand in the early morning when PV power is not yet available. The assumptions we make related to HVAC systems now may not be true in 10 years as the climate changes. A high-performance envelope is the key to maintaining and containing the interior environment with acceptable energy costs and reduced impact on the grid.

It should be instructive to California code regulators to review what other states are doing to address these challenges. Currently, Washington State has a U-factor requirement of 0.38 btu/°f.hr.ft<sup>2</sup> and Seattle is moving to 0.34 btu/°f.hr.ft<sup>2</sup> for AW rated curtainwall,

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storefront and windows for their next version with no allowed trade off with other systems. A curtainwall/storefront U-value of 0.38 btu/°f.hr.ft<sup>2</sup> is really not hard to meet either, and typically requires a simply thermally broken frame, a dual pane IGU with a regular low-e coating and just one other additional element chosen from argon gas fill, wider thermal break, fourth surface low-e, or warm-edge spacer, all of which are existing cost-effective technology. This performance is already required in IECC 2018 for climate zones 4 and 5, and systems are widely available that can meet it.

In British Columbia, they are signaling to the market where building performance will go between now and 2032 by creating a series of step codes that will be enacted at various points during the decade. This tells manufacturers the targets that will be needed in advance of enactment. Local jurisdictions are adopting the steps at different rates, and providing financial incentives for projects exceeding mandatory requirements, thus stimulating the market to achieve the economies of scale for higher performing products. Moreover, BC has implemented targets specifically for envelope performance (Thermal Envelope Demand Intensity or TEDI) in parallel with the typical Energy Use Intensity (EUI) because they understand that they cannot achieve net zero without a focus on envelope performance and they cannot allow excessive trade-offs to be made in this area. This is an excellent case study of how to move the market and improve the building envelope at the same time.

The members of Façade Tectonics Institute feel the urgent need to push back hard now on the lack of stringency around the envelope, especially fenestration U-factors, and the continued ability to trade off poorer envelope with higher performance internal building systems, e.g. HVAC and lighting. FTI's architect-engineering-construction industry practitioners believe there should be a defined minimum level of performance below which the envelope should not be allowed to fall, and this should begin with a fenestration backstop. We understand that increasing stringency for internal systems will naturally restrict the ability to trade off, but is this enough? Other jurisdictions around the country and continent do not believe so. Massachusetts, Washington State, New York City have already enacted more restrictive envelope backstops, and ASHRAE 90.1 is just poised to do the same for their next version. We believe that the fenestration backstop proposed for T24, rather than a full envelope backstop is a superior way of achieving the goal of better enclosures, because it eliminates some of the unintended consequences, and promotes the appropriate use of glazing, including operable windows.

Another reason to rethink these tradeoffs is the fact that the useful life of building systems varied widely. Lighting is often upgraded or replaced every 10-15 years, HVAC ~ 25-30 years but building envelope is often unchanged for 50-75 years. Thus, it is critical to make the investment in high performance facades now since we expect them to be in operation for the second half of the 21<sup>st</sup> century. Also, the enclosure, which does not have the benefit of the same ease of upgradeability as the other internal systems, should not be allowed to be a counterweight which reduces the benefits of these other upgraded systems. Also, giving more weight to mechanical/active systems at the expense of the envelope does not provide buildings the ability to adapt to power interruptions that are occurring more frequently in California as a result of managing the impacts of climate change.

The ability to relax curtainwall and storefront performance over what is already a lax prescriptive value is causing California to kick the can down the road, making it even harder to achieve the 2030 net zero targets on time, and less likely that manufacturers will invest in R&D to meet the cost effectiveness targets for new products.

We strongly recommend:

- (1) **Moving the storefront and curtainwall requirements in all climate zones to 0.38 btu/°f.hr.ft<sup>2</sup>** as a minimum. We would argue that the requirements need to move to 0.34 btu/°f.hr.ft<sup>2</sup>, like windows, to move the market more gradually to the net zero target rather than leaving all the reductions to the last 2 cycles.

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- (2) Since ~90% of buildings achieve compliance by the performance path, **implementing the 10% fenestration backstop language** that we recommended previously, to limit the degradation of performance that can be achieved through the performance path. For the potential small number of buildings that may have a technical feasibility problem in meeting this requirement, that may fall outside the exceptions we have proposed, provide a review process in which they can justify why this requirement can't be met in a reasonable way. Most of the concerns raised about this 10% backstop have been around the potential of non-specific unknowns that would occur in rare cases. We do not believe that the "potential" of "unknown" issues arising in a small number of buildings should be the reason for preventing the needed movement of the broader market towards net zero. Industry suppliers need to see demand from that mainstream market to make the changes and investments in thermally improved products as standard practice, which in turn lowers future cost. While adoption of the backstop in CALGreen is an option, it does not seem to address the immediacy of the need in the entire market and the 3 code cycles from now to 2030. Envelope backstops which are stricter than the current fenestration backstop have already been successfully adopted in 2020 elsewhere in the US, plus the envelope specific requirement in BC. The commission should review the experiences of these jurisdictions to understand their effectiveness and how to provide additional exceptions if needed.
- (3) **Creating a code roadmap** showing multiple steps (not just CALGreen) for fenestration and envelope performance (and other building areas), as in BC, where the utilities and jurisdictions could provide additional incentives for stretching past baseline code, and industry can plan for performance needs.
- (4) **Set targets for envelope specific metrics** like TEDI in BC, or Envelope Thermal Transfer Value (ETTV), as in Singapore, in addition to EUI in order to promote the needed improvement in envelope performance including a focus on thermal bridging.

We recommend these items because, as practicing professionals, in our experience these are practical and achievable.

We encourage the commission to re-take the leadership position California once had as the national leader for building energy code development. The Façade Tectonics Institute and our membership would value the opportunity to support the California Energy Commission in this pursuit and in developing aggressive, yet realistic Title 24 requirements for the building envelope to support achieving the state's net zero goal by 2030.

### Reference information

[1] Please refer to the guide to low energy demand in large buildings by BC Housing <https://www.bchousing.org/research-centre/library/residential-design-construction/guide-low-energy-demand-large-buildings>, specifically refer to the climate zone 4 design measures, figure 4.9, Page 4.14.

In this example, to get to net zero performance (passive house level design) which is level 4 of the BC step code, they identify three different design alternatives. A relatively efficient double glazed system (U-value of 0.35) (the orange line in figure 4.9 of the report, see below ) would require a highly insulated wall with effective mitigation of thermal bridging which is not something that California is anywhere near achieving, plus a level 1 of air leakage control that the state has yet to implement. As a result, this puts California on the track for the third design option which requires a high-performance triple glazed window - in this case  $U=0.15$  btu/°f.hr.ft<sup>2</sup>, even better than the R5 window mentioned above.

[2] <https://title24stakeholders.com/wp-content/uploads/2020/10/2020-T24-NR-HP-Envelope-Final-CASE-Report.pdf>

[3] Quantifying the Multiple Benefits of Energy Efficiency and Renewable Energy: A Guide for State and Local Governments (2018) <https://www.epa.gov/statelocalenergy/quantifying-multiple-benefits-energy-efficiency-and-renewable-energy-guide-state>