CALIFORNIA TITLE 24 COMPLIANCE WITH VIEW SMART GLASS

view

CALIFORNIA TITLE 24 COMPLIANCE WITH VIEW SMART GLASS

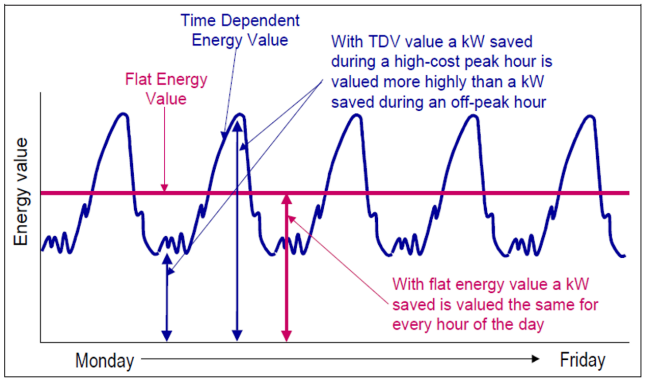
WHAT IS TITLE 24?

The California Code of Regulations (CCR) contains the rules and regulations of various state regulatory agencies for California, divided into 28 titles. Title 24 contains the California Building Standards Code. Within Title 24, there are 12 parts that cover different aspects of building construction. Part 6 is the California Energy Code, also titled The Energy Efficiency Standards for Residential and Nonresidential Buildings. These standards address the energy efficiency requirements of new construction, additions, and alternations to residential and nonresidential buildings. The California Energy Commission updates the standards every three years. The goal of the California Title 24 energy standards is to encourage designers to select energy saving measures that perform better during periods of high energy demand, reducing the load on utilities.

On January 1, 2020, the 2019 California Building Energy Efficiency Standards (Title 24, Part 6) went into effect and is the current version[1] required for compliance in the state of California.

WHAT IS TIME DEPENDENT VALUATION (TDV)?

Title 24 utilizes Time Dependent Valuation (TDV)[2] energy as the basis for compliance under the Alternative Compliance Method, which is required when using the building performance path. The rationale behind Time Dependent Valuation (TDV) is that energy efficiency measure savings should be valued differently at different times to better reflect the actual costs to users, the utility system, and society. For example, the savings of an energy measure that is very efficient during hot summer weekday afternoons would be valued more highly than a measure that achieves efficiency during the off-peak.



PC: PG&E Time Dependent Valuation (TDV) – Economics Methodology

The TDV methodology accounts for the source energy consumed in producing and delivering each unit of site energy, including, but not limited to, power generation, transmission, and distribution losses. TDV multipliers also account for outdoor air temperature variation across 16 different climate zones in California since energy demand has a strong correlation to temperature variations. TDV multipliers are embedded in the California Building Energy Code Compliance software and published in 8760 hourly tables by climate zone[3]. The unit for TDV energy is kBtu/kWh.

WHAT IS VIEW SMART GLASS TECHNOLOGY AND IS IT RECOGNIZED BY TITLE 24?

View Smart Glass incorporates electrochromic technology to automatically change its performance (Solar & Visible Transmission) to modulate the amount of heat and light entering a space. This is achieved with the application of a low voltage electric current to a ceramic coating deposited on surface 2 of an insulating glass unit. The tinting process is both active (tinting is fully controllable through software) and reversible (glass is not permanently tinted and can revert to a fully clear state when desired).

Title 24 defines chromogenic glazing[4] as a class of glazing whose primary function is to switch reversibly from a high transmission state to a low transmission state with associated changes in VT and SHGC.

View Smart Glass meets the definition of chromogenic glazing as defined in Title 24.

HOW DOES VIEW SMART GLASS HELP PROJECTS COMPLY WITH TITLE 24?

The California Energy Commission utilizes TDV as the compliance metric to encourage building design features to reduce or shift energy demand during traditional peak periods of high energy cost, such as summer afternoons when the utility is forced to use less efficient supplementary power plants to meet excess demand. By reducing SHGC to as low as 0.09, View Smart Glass can significantly reduce building peak loads during the hottest and sunniest days, helping a project achieve a lower annual TDV energy use compared to the Title-24 mandated glazing. This improves the margin of compliance for the project.

Projects can comply with Title 24 using either of two methods: Prescriptive or Performance. The performance method is preferred for most projects with high glazing area due to its reliance on whole building energy performance and the flexibility allowed in tradeoffs between efficiency measures.

PRESCRIPTIVE PATH COMPLIANCE

Under the prescriptive path, each component of the building envelope must meet a specific energy-efficiency requirement (Sections 140.3 - 140.9). The prescriptive approach is the simplest but also the least flexible.

To receive credit for chromogenic glazing, T-24 allows the use of the lower-rated SHGC and the higher-rated VT. For the standard View Smart Glass dual pane IGU, the values are 0.09 (SHGC) and 0.52 (VT).

Table 140.3-B- Prescriptive Envelope Criteria Commercial & Residential Buildings

	T-24 Requirements			View Smart Glass			
	Fixed Window	Curtainwall or Storefront	Skylight, Curb Mounted	Tint 1	Tint 2	Tint 3	Tint 4
Max U-factor (Btu/hr. Ft2. °F)	0.36*	0.41*	0.58*	0.29**			
Max SHGC (Solar Heat Gain Co-efficient)	0.25	0.26	0.25	0.40	0.25	0.12	0.09
Min VT (Visible Transmission)	0.42	0.46	0.49	0.52	0.31	0.06	0.01

All View Glass values are for a Standard Dual Pane IGU with 90% Argon modeled using LBL Window 7.7.
*Represents assembly U-Factor (Glass & Window Frame)
**Represents Center of Glass U-value only

VIEW SMART GLASS COMPLIES WITH THE TITLE 24 PRESCRIPTIVE PATH.

PERFORMANCE PATH COMPLIANCE

Under the performance path, the TDV energy calculated for the proposed design must be less than the standard design building. This exercise can only be done using an energy analysis program approved by the California Energy Commission (CEC). The CEC has approved specific energy analysis computer programs[5] in accordance with the California Code of Regulations - CBECC-Com 2019.1.1 and EnergyPro 8.1.

The standard design is auto-generated from the proposed building specifications by the compliance software and meets all prescriptive requirements of T-24 with a maximum allowed Window Wall Ratio (WWR) of 40%. The proposed design can have a higher WWR as long as the whole building TDV energy is lower than the standard design at 40% WWR. The TDV energy required for compliance only includes HVAC end uses, interior lighting, and domestic hot water. It excludes process loads, receptacle loads, and exterior lighting.

The approved compliance software packages do not yet have the option of modeling multistate dynamic glazing with time-varying properties. Only one value for SHGC and VLT can be entered for the entire annual simulation.

To receive credit for chromogenic glazing under the performance path, the following is required[6]:

- Use the "best rating" as model inputs in the compliance software (use the lower-rated SHGC and the higher-rated VT)
- Ensure that the automatic controls to receive best rating values are verified per the protocols listed in Appendix NA7 [See Appendix Part A]

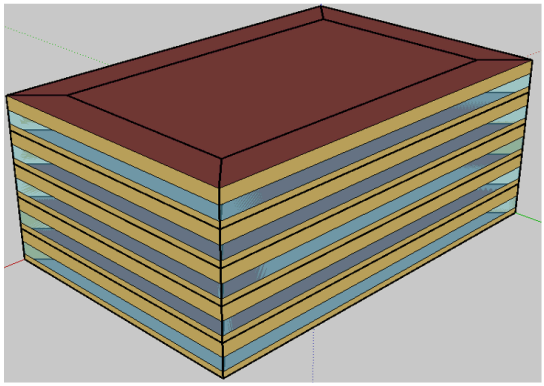
- OR -

- Provide an NFRC Dynamic Glazing Compliance Label [See Appendix Part B]

View Smart Glass compliance with the T-24 performance path is based on whole building simulation with CEC-approved compliance software.

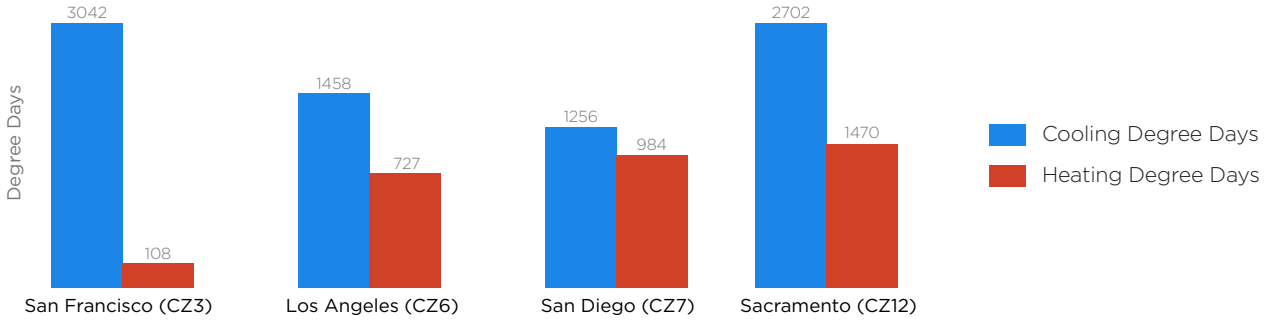
PERFORMANCE PATH COMPLIANCE EXAMPLE WITH VIEW SMART GLASS

This mid-rise Dept. Of Energy (DOE) office building prototype[7] with a WWR of 40% and 90K SF floor area was selected as an example project for compliance analysis[8] across four cities with diverse heating and cooling degree days - San Francisco, Los Angeles, San Diego, and Sacramento.



CBECC-com 2019 was used to generate the annual TDV for the building with View Smart Glass as the proposed design vs. the T-24 mandated glazing (SHGC 0.25) as the standard design. To isolate the impact of glazing, no other parameter was changed between the proposed and standard design cases.

Annual Heating vs Cooling Demand



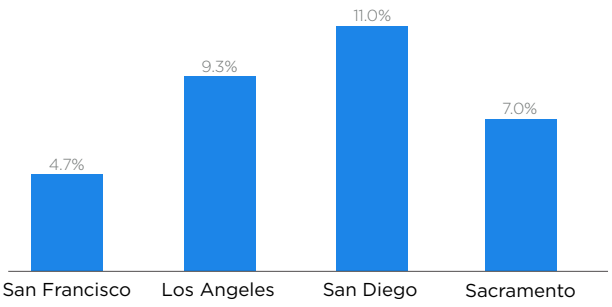
RESULTS USING FIXED SHGC/VT METHOD

Dynamic glazing was modeled using a fixed input: lowest SHGC and highest VT as allowed by the standard[6]. The HVAC system in the energy model was auto-sized in CBECC-Com 2019.

The proposed design with View Smart Glass complies with the Title 24 performance path with a high margin.

The high margin of TDV compliance with View Smart Glass shows potential for increasing the WWR between 25-50% depending on climate and project details.

Annual TDV savings with View vs T-24 baseline



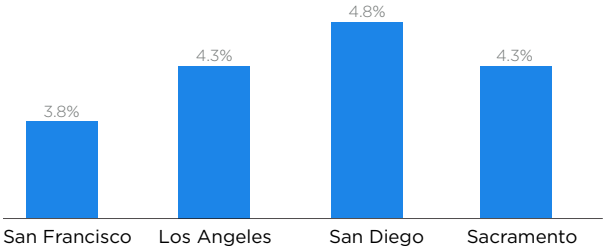
An increase in WWR for a specific building project with View will depend on whole building compliance considering all other efficiency measures for lighting, HVAC, and opaque envelope properties.

VALIDATION USING DYNAMIC SHGC & VT

Recognizing the present limitations of T-24 compliance software in modeling View Smart Glass, the example DOE prototype was also simulated using EnergyPlus software. EnergyPlus has the ability to model View Smart Glass[9] in all four tint states using the actual product control algorithm.

This modeling approach is not required for compliance with T-24. It is intended only to validate that View Smart Glass will also comply with T-24 when modeled as a multi-tint product if, in the future, the compliance software is enabled with such a feature.

Annual TDV savings with View vs T-24 baseline



For additional questions or to learn more about View, please contact View at simulation@view.com

REFERENCES:

1. California Energy Commission – 2019 Building Energy Efficiency Standards - https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2019-building-energy-efficiency
2. HMG & E3, 2002. Time Dependent Valuation of Energy for Developing Building Efficiency Standards
3. TDV 2019 multipliers for California climate zones - https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=16-BSTD-06
4. 2019 Building Energy Efficiency Standards – Chromogenic Glazing definition – Pg. 66 https://ww2.energy.ca.gov/2018publications/CEC-400-2018-020/CEC-400-2018-020-CMF.pdf
5. 2019 Building Energy Efficiency Standards Approved Computer Compliance Programs - https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2019-building-energy-efficiency-2
6. 2019 Nonresidential Compliance Manual - Pg. 3-54 https://ww2.energy.ca.gov/2018publications/CEC-400-2018-018/Compliance_Manual-Complete_without_forms.pdf
7. PNNL, DOE. Commercial Prototype Building Models, U.S. Department of Energy. 2018
8. Dutta, R & Ramachandran, S. Evaluating the Time Dependent Valuation (TDV) benefit of electrochromic glazing for Title 24 Compliance. 2019 ASHRAE Building Performance Analysis Conference, Denver
9. Dutta, R. Modeling an electrochromic window using a multi-criteria control strategy. Building Performance Analysis Conference and Simbuild co-organized by ASHRAE and IBPSA-USA, Chicago, IL, 2018

APPENDIX

PART A: TITLE 24 INSTALLATION AND VERIFICATION PROTOCOL FOR DYNAMIC GLAZING

Retrieved from: https://ww2.energy.ca.gov/title24/2019standards/rulemaking/documents/2018-05-09_hearing/2019_Reference_Appendices.php

These procedures detail the installation and verification protocols necessary to meet acceptance requirements of dynamic glazing. Each dynamic glazing product shall be provided with a temporary NFRC Label on the glazing or an NFRC Label Certificate to identify the thermal performance (e.g. U-factor, Solar Heat Gain Coefficient (SHGC), and Visible Transmittance (VT)) of each product being installed. The NFRC label certificate shall be located at the job site for verification by the enforcement agency. In addition, the responsible person shall fill out the Certificate of Installation and the Certificate of Acceptance, Fenestration Acceptance Certificate. The responsible person shall verify 1) the dynamic glazing to be installed matches the energy Certificate of Compliance documentation and building plans. A copy of the Installation and Acceptance certificate shall be given to the building owner and the enforcement agency for their records.

NA7.4.3.2 THE RESPONSIBLE PERSON OR INSTALLER SHALL MEET THE FOLLOWING PROTOCOLS BEFORE INSTALLATION:

(a) Verify the dynamic glazing matches with building plans and Energy Compliance forms.

(b) From the building plans or energy compliance forms, identify the azimuth orientation in degrees or in cardinal orientation for each of the dynamic glazing to be installed to ensure the correct dynamic glazing specifications or model are installed in the appropriate orientation.

(c) Verify dynamic glazing controls if applicable matches the building plans schedule.

(d) Verify NFRC's Certified Product Directory (CPD) number if applicable. See http://cpd.nfrc.org/cpd2/.

(e) If no NFRC Label or FC-1 is Form is included, then verify with the Responsible Person of the building construction or enforcement agency to ensure the dynamic glazing is actually meets or exceeds the energy specifications before installation.

(f) Installation of dynamic glazing shall meet the manufactures installation instructions.

(g) After the installation the installer completes and signs the Declaration Statement on the Installation Certificate of Installation. A signed copy of the Certificate(s) of Installation shall remain at the job site for verification by the building inspector.

NA7.4.3.3 FIELD TECHNICIAN OR RESPONSIBLE PERSON SHALL MEET THE FOLLOWING PROTOCOLS AFTER INSTALLATION:

(a) Verify the Certificate of Installation and the Declaration Statement is signed before inspection of the installation; and

(b) When controls are installed with the dynamic glazing, it should be verified that it meets the exact operation specifications of the dynamic glazing installation, functional and testing instructions.

(c) After dynamic glazing inspection is complete ensure the Certificate of Acceptance form is completed and including the signature of the Declaration Statements; and

(d) Provide certificates and additional copies to the builder, enforcement agency and building owner at occupancy.

NA7.4.3.3 FIELD TECHNICIAN OR RESPONSIBLE PERSON SHALL MEET THE FOLLOWING PROTOCOLS AFTER INSTALLATION:

The following documentation shall be made available to the responsible party of construction or building owner at occupancy.

(a) A completed and signed Certificate of Installation and Certificate of Acceptance, form(s)

(b) If supplied by the manufacturer, a copy of the manufacturer's warranty and user manual

PART B: HOW TO OBTAIN NFRC LABEL OR CERTIFICATION FOR VIEW SMART GLASS WINDOWS?

NFRC certifications are obtained for the entire window assembly and not for just the insulated glass unit (IGU). View only provides the IGU, and therefore cannot provide an NFRC label for it. The glazier or window fabricator (whoever is responsible for providing the entire window assembly) typically provides the NFRC testing and report. View can provide the NFRC approved center of glass performance values to the responsible party for proper modeling. The product specifications are listed in the latest International Glazing Database (IGDB) database.

PART C: MODELING INPUTS FOR PERFORMANCE PATH COMPLIANCE EXAMPLE

FIXED SHGC/VT METHOD	
Building Area (SF)	90,000
Window to Wall Ratio (%)	40
Floor plate (ft)	170 x 100
Lighting Controls	Dimmable Lighting Controls
HVAC System	Packaged VAV system with HW Boiler
Lighting Power Density (W/SF)	0.6
Equipment Power Density (W/SF)	1.5
Glazing Input Method	Simplified glass input
Dynamic Glazing Modeling Methodology	Single input for SHGC and VT
Modeling Software	CBECC-Com 2019

DYNAMIC SHGC/VT METHOD	
Glazing Input Method	Spectral glazing data from LBL Windows
Dynamic Glazing Modeling Methodology	Multi-state modeling using View control algorithm (Intelligence)
Modeling Software	EnergyPlus v9.3

View is a technology company and the market leader in smart windows. View Smart Windows use artificial intelligence to automatically adjust in response to the sun and increase access to natural light, to improve people's health and experience in buildings, while simultaneously reducing energy consumption to mitigate the effects of climate change. Every View installation also includes a smart building platform that consists of power, network, and communication infrastructure. For more information, please visit: www.view.com.