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# Whitepaper: Valuing Dimming in Energy Efficiency Programs

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## Background

The DesignLights Consortium (DLC) introduced LED dimming requirements in its Solid-State Lighting (SSL) Version 5.0 and Version 5.1 Technical Requirements, released on February 14, 2020. The V5 dimming requirements enhance the controllability of lighting products across all DLC eligible categories, in order to not only increase potential energy savings, but also improve the perceived quality of light, comfort, and wellbeing for end users of occupied spaces. V5.0 requires dimming for all DLC Premium products. V5.1 extends the dimming requirement to nearly all DLC Standard products, including lamps.[1] Indoor products must be continuously dimmable, and outdoor products can be stepped or continuously dimmable.

The DLC dimming policies ensure that products listed on the Qualified Products List (QPL) have the capability to be dimmed, and are marketed as such by manufacturers, should the customer wish to take advantage of dimming. This white paper is intended to provide DLC Members – the utilities and energy efficiency programs who offer incentives for DLC qualified products – information about how the dimming requirements will affect their programs, the ways in which energy savings can be calculated and claimed, and what trade ally partners need to know.

## What does it mean to be dimmable?

While most people are familiar with what it means to be dimmable, there are no industry standards or tests that validate the dimmability of a product.[2] The Illuminating Engineering Society (IES) defines dimming as "*the ability to change the luminous flux of one or more lamps or luminaires*" (Illuminating Engineering Society, 2020). For the purpose of product qualification in SSL V5.0/V5.1, DLC relies upon the following definitions for dimmable products:

1. **Dimmable**: a product that (a) includes a dimmable driver and/or is capable of being dimmed by an external control signal, and (b) is identified as dimmable on the product specification sheet.
2. **Continuous Dimming**: Per NEMA LSD-64: *a lighting control strategy that varies the light output of a lighting system over a continuous range from full light output to a minimum light output without flickering in imperceptible steps.* To meet Technical Requirements V5.1, continuous dimming must be capable of reducing the light output to at least 20% of full light output.
3. **Stepped Dimming**: Per NEMA LSD-64: *a lighting control strategy that varies the light output of a lighting system in one or more predetermined steps of greater than one percent of full output. The changes between levels are generally perceptible.* Under Technical Requirements V5.1, stepped dimming must be capable of reducing the light output to at least 70% of full light output.

Importantly, the DLC does not set requirements for how dimmable products are installed and/or used in the field. There is no requirement that DLC products be used in a dimming application, nor are there any requirements relating to specific dimming control protocols (0-10V, DALI, etc.). A product listed on the

[1] The following products are exempt from the V5.1 DLC Standard tier dimming requirements: Case Lighting, Landscape/Accent Flood and Spot Luminaires, Specialty: Sports Flood, Specialty: Tunnel Lighting, and any Specialty Primary Use Designation intended for a hazardous location.
[2] There are industry standards for how a dimmable product operates within a certain dimming interface, such as ANSI C137.1 for 0-10V dimming.

QPL as dimmable may require the installation of additional components and/or building infrastructure to enable dimming.

## Why is the DLC dimming requirement notable?

Prior research indicates that building occupants have a strong preference to control the light levels within their space. A study of 118 participants by National Research Council Canada showed that three quarters of office workers surveyed desired more control over their lighting, with half wanting dimming control and a majority stating that better lighting would improve their mood and efficiency (Newsham, Veitch, Arsenault, & Duval, 2004). Another investigation showed that nearly 60 percent of office workers studied placed a "high" or "very high" value on being able to dim their lighting (Morrow, Rutledge, Maniccia, & Rea, 1998). A field simulation study revealed that people who had dimming control reported higher ratings of lighting quality and overall satisfaction with their work environment, and higher self-rated productivity (Boyce, Hunter, Myer, Newsham, & Veitch, 2003).

Despite a clear occupant preference for dimming, the capability remains limited in commercial settings. According to the U.S. Department of Energy (DOE), only 1% of lamps and luminaires in the commercial sector are installed with a dimmer and 82% of lamps and luminaires have no controls beyond a simple switch (Navigant, 2017). This low dimming utilization rate is rooted in the limitations of fluorescent technology – which is by far the most installed lighting technology in the commercial sector. Dimming fluorescent lighting is technologically possible, but the equipment required to do so is considerably more expensive than non-dimming hardware. Furthermore, a dimmed fluorescent system can often exhibit undesirable effects such as flickering, color shift, and a shortened useful life if not carefully specified, installed, and commissioned (O'Rourke, Bierman, & Rowe, 2008). As a result of these issues, non-dimming fluorescent lighting was typically installed in commercial buildings, which means most existing buildings lack the infrastructure (controls and wiring) to support dimming.

The performance and cost of dimming LEDs is an improvement from fluorescent lighting, yet the utilization of dimming remains limited by industry standard practices (based on the shortcomings of legacy technology) and the lack of existing dimming infrastructure. The DLC dimming requirements aim to break this trend by ensuring that nearly all qualified products are dimmable, with future plans to focus on educating specifiers, installers, and end-users on the benefits (both energy-saving and non-energy-saving) of dimming. Products qualified under V5.1 will also include information on the QPL about the dimming communication protocol, such as wireless controls, which can eliminate the need for existing dimming infrastructure.

## Existing dimming requirements and standards

Multiple codes, standards, and organizations already have requirements related to the use and performance of dimming. The DLC dimming requirements in SSL V5.0 and V5.1 complement and build upon these existing references.

California's nonresidential Title 24 Building Energy Efficiency Standards are a primary example. There are several ways in which dimming is incorporated into the Title 24-2019 standard, including:

- Continuous dimming 100% down to 10% is required for indoor LED luminaires.[3]
- Occupancy sensing controls capable of partial-on or partial-off settings for certain spaces.[4]
- Automatic daylighting controls capable of reducing light output by at least 65%.[5]
- Outdoor automatic scheduling controls capable of reducing the lighting power by at least 50% and no more than 90%, and capable of scheduling a minimum of two nighttime periods with independent (different) lighting levels.[6]
- Outdoor motion sensing controls capable of reducing the lighting power by at least 50% and no more than 90%.[7]
- Lighting controls in buildings larger than 10,000 square feet shall be capable of automatically reducing lighting power in response to a Demand Response Signal.[8]

While these Title 24 building code requirements are only applicable in California, it is likely that additional local and state governments may adopt similar building code requirements in the future.

The International Energy Conservation Code (IECC), which has been adopted in some form by 48 states,[9] also includes numerous requirements that depend on dimming capabilities. Examples include:

- Indoor lighting capable of being reduced by at least 50% of maximum lighting power.[10]
- Occupancy sensing controls capable of partial-on or partial-off settings for certain spaces.[11]
- Daylight responsive lighting controls, with a continuous dimming requirement (15-100%) for offices and classrooms.[12]
- Capability to reduce exterior lighting by 30% from midnight to 6am.[13]
- An alternative compliance pathway of luminaire-level lighting controls (LLLC) that are capable of dimming.[14]

Additionally, IECC 2021 will include a requirement for parking garage lighting to dim when no activity is detected and in response to daylight in areas next to wall openings.[15]

LEED Building Design + Construction (BD+C) v4.1 offers up to two points for Interior Lighting that includes dimmable or multilevel lighting for 90% of occupant spaces.[16]

The ENERGY STAR Luminaires version 2.2 specification includes performance requirements for luminaires if/when they are marketed as dimmable. When applicable, the luminaire and its components

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[3] California Title 24-2019, Part 6, Section 130.1 (b). Applicable to areas with connected lighting loads that exceed 0.5 watts per square, excluding restrooms, healthcare facilities, and areas with only one luminaire.
[4] California Title 24-2019, Part 6, Section 130.1 (c)
[5] California Title 24-2019, Part 6, Section 130.1 (d)
[6] California Title 24-2019, Part 6, Section 130.2(c)2
[7] California Title 24-2019, Part 6, Section 130.2(c)3
[8] California Title 24-2019, Part 6, Section 110.12(c)
[9] https://www.iccsafe.org/wp-content/uploads/Code_Adoption_Maps.pdf
[10] IECC 2009-2018, C405.2.2.2
[11] IECC 2012-2018, C405.2
[12] IECC 2015-2018, C405.2.3
[13] IECC 2018, C405.2.6
[14] IECC 2019, C405.2
[15] https://newbuildings.org/hubs/codes-policy/iecc-commercial-proposals/, code change number CE199
[16] https://www.usgbc.org/credits/new-construction-schools-new-construction-data-centers-new-construction-warehouse-and-dist-0

shall provide "continuous dimming from 100% to 20% of light output" and "at minimum light output, the luminaire shall not emit noise above 24 dBA when measured within one meter of the luminaire."[17]

Finally, the General Services Administration (GSA) sets standards applicable to the design and construction of new federal facilities, major repairs and alterations of existing federal buildings, and lease construction facilities that the federal government intends to own or has an option to purchase. GSA P100 includes requirements related to dimming such as:

- All luminaires must be provided with replaceable dimmable drivers.[18]
- LED lamps and retrofit kits must be dimmable using 0-10V and compatible with existing lighting control systems and future daylighting technologies.[19]
- Ambient lighting must be adjusted per daylight availability and/or personal dimming.[20]

## Energy savings potential from dimming

From an energy savings perspective, the importance of dimmable lighting is clear: the more an LED is dimmed, the less electricity it uses. The ability to dim light output is a prerequisite capability for many lighting control strategies. Manual dimming, high-end trim, and networked lighting controls, each discussed in more detail below, cannot be accomplished without dimming. Daylight harvesting also relies upon dimming, although the strategy can be implemented in a more basic fashion through switching. Since most utilities already offer incentives for daylight harvesting, it is not addressed below as a stand-alone strategy, but it is included as a component within networked lighting controls.

### MANUAL DIMMING

In the simplest use case of a manual dimmer, savings are realized when an occupant chooses a light level lower than the full rated output. Research has shown that when given the opportunity to dim lighting, occupants will often choose a light level lower than full output (Boyce, Hunter, Myer, Newsham, & Veitch, 2003). For example, a field study in the UK of 14 open-plan offices found that occupant controlled dimming resulted in an average light output of 55% of maximum (Moorea, D.J., & Slaterc, 2002).

Several studies, outlined in **Table 1,** have attempted to quantify the savings from manual dimming. The savings percentages shown account for the load reduction due to manual dimming and the frequency of use. There are currently no known energy efficiency program technical reference manuals (TRM) that provide a methodology for claiming savings from manual dimming.

[17] https://www.energystar.gov/sites/default/files/Luminaires%20V2.2%20Final%20Specification.pdf
[18] GSA 2018 P100, Section 6.3.2.2
[19] GSA 2018 P100, Section 6.3.2.2
[20] GSA 2018 P100, Section 6.3.2.5

**Table 1:** Energy Savings from Manual Dimming

| Study Title | Organization | Manual Dimming Savings | Reference |
|---|---|---|---|
| *Energy Savings Forecast of Solid-State Lighting in General Illumination Applications* | U.S. Department of Energy | 5-7%[21] | (Navigant, 2019) |
| *Energy Saving Lighting Control Systems for Open-Plan Offices* | National Research Council Canada | 11% | (Galasiu, Newsham, Suvagau, & Sander, 2007) |
| *Comparison of Control Options in Private Offices in an Advanced Lighting Controls Testbed* | Lawrence Berkeley National Laboratory | 9% | (Jennings, Rubinstein, DiBartolomeo, & Blanc, 2000) |
| DELTA Snapshot: *Private Office Lighting Controls* | Lighting Research Center | 6% | (Lighting Research Center, 1999) |

## HIGH-END TRIM

Beyond manual control, dimming can allow fine tuning of a lighting system through high-end trim, also known as "task tuning" and "institutional tuning." High-end trim allows an installer, commissioning agent, or facility manager to set the maximum light output such that the average illuminance at the work plane is appropriate for the type of use in the space and is at a comfortable level for the occupants. This feature can be useful to address issues with over-lighting and to balance energy savings with visual comfort. Over-lighting is particularly problematic with LED technology due to limitations in the standard lumen packages offered by manufactures and differences in the way that LED light output is rated and reported compared to traditional lighting.[22] Occupants also tend to perceive LED lighting as being brighter (Rea, 2012). As a result, it can be challenging for a contractor to select LED luminaires that deliver comparable illumination to a previous lighting system.

Once high-end trim levels are established, occupants cannot easily override the setting. Multiple studies have evaluated the savings from high-end trim, summarized in **Table 2**. Enabling and implementing high-end trim has a tremendous impact on energy savings: 21-36% according to the studies reviewed. These savings can only be realized with dimmable lighting systems, a fact that was a primary driver in establishing the DLC dimming requirement in SSL V5.0 and V5.1.

[21] Depending on space type relevant for dimming applications. Dimming savings potential for commercial office (5%), commercial education (5%), commercial retail (6%), and commercial health care (7%). See Table F.4.
[22] https://americanelectriclighting.acuitybrands.com/-/media/abl/americanelectriclighting/files/education/white-paper-photometric-measurement.pdf

**Table 2:** Energy Savings from High-end Trim

| Study Title | Organization | High-end Trim Savings | Reference |
|---|---|---|---|
| *Energy Savings from Networked Lighting Control (NLC) Systems with and without LLLC* | DLC and Northwest Energy Efficiency Alliance (NEEA) | 27% | (Energy Solutions, 2020) |
| *Evaluation of Advanced Lighting Control Systems in a Working Office Environment* | U.S. Department of Energy | 21%[23] | (Pacific Northwest National Laboratory, 2018) |
| *Adjusting Lighting Levels in Commercial Buildings* | Seventhwave | 22% | (Seventhwave, 2015) |
| *A Meta-Analysis of Energy Savings from Lighting Controls in Commercial Buildings* | Lawrence Berkeley National Laboratory | 36% | (Williams, Atkinson, Garbesi, & Rubinstein, 2011) |
| *Comparison of Control Options in Private Offices in an Advanced Lighting Controls Testbed* | Lawrence Berkeley National Laboratory | 23% | (Jennings, Rubinstein, DiBartolomeo, & Blanc, 2000) |

High-end trim could be implemented as an independent control strategy, with savings comparable to the values shown above in Table 2, using merely a wall dimmer and control wires (the same equipment as manual dimming), since many wall dimmers include a setting for high-end trim. There are currently no known TRMs that provide a methodology for claiming savings from high-end trim as an independent control strategy. Alternatively, high-end trim may be included as an additive capability used with other control strategies. For example, the 2021 Illinois Statewide Technical Reference Manual version 9.0 documents a 10% additive energy savings factor when high-end trim is included with other control strategies.[24]

### NETWORKED LIGHTING CONTROLS (NLC) AND LUMINAIRE-LEVEL LIGHTING CONTROLS (LLLC)

Finally, with multi-strategy automated controls, such as networked lighting controls (NLC) and luminaire-level lighting controls (LLLC), dimming is a prerequisite capability for high-end trim/task tuning, continuous daylight dimming, and multi-level control. These control systems have the potential to maximize energy savings, reaching levels significantly higher than possible with LED alone, as shown in **Table 3**. The DOE estimates that by 2035, the annual savings from commercial lighting controls could reach 81 terawatt-hours (TWh) – roughly equivalent to the annual electricity consumed by the state of South Carolina[25]) – if connected/networked lighting controls reach high levels of adoption.[26] These savings risk being stranded if LED products are qualified, promoted, and installed as non-dimmable and incapable of functioning with networked lighting controls.

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[23] Initially installed LED fixtures had an annual energy use intensity of 1.91 $kWh/ft^2$. Tuned LED fixtures had an annual energy use intensity of 1.50 $kWh/ft^2$, representing 21.4% savings from the LED baseline.
[24] https://ilsag.s3.amazonaws.com/IL-TRM_Effective_010121_v9.0_Vol_2_C_and_I_09252020_Final.pdf
[25] According to the EIA, South Carolina used 80.2 TWh of electricity in 2019. https://www.eia.gov/electricity/state/
[26] https://www.energy.gov/sites/prod/files/2020/02/f72/2019_ssl-energy-savings-forecast.pdf, table 4.10

**Table 3:** Energy Savings from Networked Lighting Controls (NLC)

| Study Title | Organization | NLC Savings | Reference |
|---|---|---|---|
| *Energy Savings from Networked Lighting Control (NLC) Systems with and without LLLC* | DLC and Northwest Energy Efficiency Alliance (NEEA) | 49% | (Energy Solutions, 2020) |
| *Energy Savings Forecast of Solid-State Lighting in General Illumination Applications* | U.S. Department of Energy | 53-72%[27] | (Navigant, 2019) |
| *Evaluation of Advanced Lighting Control Systems in a Working Office Environment* | U.S. Department of Energy | 43%[28] | (Pacific Northwest National Laboratory, 2018) |
| *Energy Saving Lighting Control Systems for Open-Plan Offices* | National Research Council Canada | 42-47%[29] | (Galasiu, Newsham, Suvagau, & Sander, 2007) |

Multiple existing TRMs include a measure for networked lighting controls, and most reference the 47% savings figure from the 2017 version of the DLC's study on savings from networked lighting controls (Energy Solutions, 2017).[30]

## Claiming savings from dimming

The new DLC V5 Technical Requirements may have implications on the way in which energy efficiency programs calculate and claim lighting program energy savings. With increased efficacy requirements in SSL V5.0, programs have an opportunity to capture more lighting savings due to lower LED wattages. Under SSL V5.1, dimming has the potential to provide additive savings, and programs would be well served to address this prospect at the same time as when technical reference manuals are revised for efficacy. As mentioned above, the DLC dimming requirements apply only to the product capability and not the actual installation. Therefore, programs that intend to claim savings related to dimming must ensure that the necessary control devices and wiring (if applicable) are also installed.

The typical approach to calculating lighting control energy savings is shown below, in a convention similar to that found in technical reference manuals.

[27] Depending on space type. See Table F.4.
[28] Initially installed LED fixtures had an annual energy use intensity of 1.91 kWh/ft$^2$. Tuned LED fixtures with networked occupancy and daylight sensors had an annual energy use intensity of 1.09 kWh/ft$^2$, representing 42.9% savings from the LED baseline.
[29] The lighting systems evaluated in this study were not networked. The results represent the simultaneous implementation of occupancy sensors, daylight dimming, and individual dimming.
[30] Including TRMs for Illinois, Massachusetts, Michigan, Texas, and Wisconsin

$\Delta kWh = KW_{Controlled} * Hours * (CSF_{EE} - CSF_{Base}) * WHF_e$

*Where:*

$KW_{Controlled}$ = Total lighting load connected to the control in kilowatts. Savings is per control. The total connected load per control should be collected from the customer or a deemed value shall be used. $KW_{Controlled}$ shall not include any portion of the lighting load for which the control is not connected or applicable.

Hours = Total operating hours of the controlled lighting circuit before the lighting controls are installed. If customer-specific information is not collected, a deemed annual operating hour estimate by building type is typically defined within TRMs.

CSF = Control savings factor, representing the percentage reduction from the non-controlled lighting system. Where controls are already present prior to the new installation, the baseline control savings ($CSF_{Base}$) must be discounted from the new control savings ($CSF_{EE}$). A measured control savings factor should be used where energy monitoring data are available. In the absence of measured values, recommended deemed CSF values are presented in Table 4.

$WHF_e$ = Waste heat factor for energy to account for cooling energy savings from efficient lighting. If a building is un-cooled, the $WHF_e$ value is 1.0. WHF will vary by climate zone and should be established independently for each energy efficiency program.[31]

In addition to the calculation of energy savings, a program must establish assumptions for measure costs, measure lifetime, and the applicability to retrofit and new construction programs. Recommendations and reference values for these various assumptions are presented below in **Table 4**. Given the degree to which costs can vary, it is recommended that program administrators review existing project applications, survey distribution partners, and/or collect data from customers to establish incremental cost assumptions. For many products, such as indoor luminaires, the incremental cost between a non-dimmable and a dimmable product has become insignificant or irrelevant as manufacturers standardize on dimmable drivers as a default product option. For other products, such as replacement lamps, an incremental cost remains between non-dimmable and dimmable products, but the difference is expected to decrease as more products become dimmable.

[31] https://www.aceee.org/files/proceedings/1994/data/papers/SS94_Panel3_Paper25.pdf

**Table 4:** Dimming-related measure assumptions for calculating lighting control energy savings

| Dimming-related Measure | Recommended Control Savings Factor (CSF) | Operating Hours | Measure Cost | Measure Life | Applicability to New Construction |
|---|---|---|---|---|---|
| **Manual Dimming** | 5-7%, depending on space type[32] | Reported or deemed | Controls + labor[33] | 10 years[34] | Yes, unless code requires dimming (e.g. CA Title 24) |
| **High-end Trim** | 27%[35] | Reported or deemed | Controls + labor + $0.06 per ft$^2$ [36] | Same as fixture life | Yes, beyond the code LPD allowances |
| **NLC / LLLC** | 49%[37] | Reported or modified deemed[38] | Varies[39]<br>LLLC: $61/fixture[40] | NLC: 15-16 years[41]<br>LLLC: same as fixture life | Yes, for high-end trim (as above) and spaces where code does not require occupancy and/or daylight sensors |

32 Per DOE *Energy Savings Forecast of Solid-State Lighting in General Illumination Applications*, available at https://www.energy.gov/sites/prod/files/2019/12/f69/2019_ssl-energy-savings-forecast.pdf.

33 The studies reviewed for manual dimming did not identify a cost for manual dimming. A majority of DLC-qualified LED products are already dimmable, making the incremental fixture cost for dimming negligible. Therefore, the cost for manual dimming should reflect the material (wall dimmer and control wiring) and labor to install dimming controls.

34 Based on research conducted by Guidehouse, interviewing 46 contractors on the effective useful life (EUL) of existing lighting controls (dimming and other), reported in a January 27, 2020 memo to ComEd available at https://ilsag.s3.amazonaws.com/ComEd-Retrofit-Add-On-EUL-Results-Memo-2020-01-27.pdf.

35 Per DLC/NEEA *Energy Savings from Networked Lighting Control (NLC) Systems with and without LLLC*, available at https://www.designlights.org/lighting-controls/reports-tools-resources/energy-savings-from-networked-lighting-controls-with-without-LLLC/report/.

36 The material (wall dimmer and control wiring) and installation labor costs of high-end trim are similar to manual dimming. The commissioning labor is estimated at $0.06 per square foot per *Adjusting Lighting Levels in Commercial Buildings*, available at http://www.seventhwave.org/sites/default/files/task-tuning-fact-sheet-2015.pdf.

37 Per DLC/NEEA *Energy Savings from Networked Lighting Control (NLC) Systems with and without LLLC*, available at https://www.designlights.org/lighting-controls/reports-tools-resources/energy-savings-from-networked-lighting-controls-with-without-LLLC/report/.

38 NLC and LLLC are typically associated with projects and buildings that have longer than average operating hours. The DLC/NEEA study *Energy Savings from Networked Lighting Control (NLC) Systems with and without LLLC* calculated the inferred annual operating hours, presented in Figure 20, for the 194 buildings evaluated in the study.

39 The cost for NLC can vary widely, depending on equipment type, installation complexity, and project characteristics, making it difficult to use a deemed value. The Wisconsin Focus on Energy 2020 Technical Reference Manual uses a deemed measure cost of $1.68 per square foot for NLC, but that values is based on older manufacturer data from 2016.

40 The 2021 Illinois Statewide Technical Reference Manual version 9.0 uses a deemed measure cost of $61 for LLLC.

41 The 2021 Illinois Statewide Technical Reference Manual version 9.0 uses a deemed measure life of 15 years for NLC. The Wisconsin Focus on Energy 2020 Technical Reference Manual uses a deemed measure life of 16 years for NLC.

## Program Strategies

Administrators of commercial lighting energy efficiency programs can take steps to support the transition to more dimmable and controllable LED lighting products. In advance of the SSL V5.1 QPL revisions, programs could choose to promote and distinguish dimmable and controllable LED products through education, market readiness efforts, and higher incentives.

- An important first step is communicating the energy and non-energy benefits of dimmable/controllable lighting to trade allies and customers. The DLC outlined many of these benefits in a blog post titled *The Value of Dimming*, published in March 2020.[42]
- Many energy efficiency programs sponsor lighting control training for installers, but a need exists for training that focuses on sales strategies (for distributors) and proper programming and operation (for facility managers).
- To the extent that additional energy savings can be claimed, as previously discussed, higher incentives for dimmable and controllable LED products may be warranted, when bundled with dimming control products.
- Incentives to support high-end trim as a stand-alone measure, with post-installation commissioning/verification, should be considered in parallel with existing lighting control incentives. In addition to energy savings, high-end trim helps ensure that utility customer satisfaction is met by providing the ability to precisely set the recommended target and/or preferred light level.
- Incentives for energy monitoring, and reporting of the data, can be useful in verifying the energy savings from dimming, high-end trim, and NLC/LLLC.
- In the event that dimmable and controllable LED products are installed without controls, programs should develop methods to identify and revisit these customers at a future date to potentially unlock control savings if/when the costs, capabilities, and benefits meet the customer's needs and criteria. Doing so minimizes the impact of lighting control savings being stranded.

## QPL Implications

The DLC V5 dimming requirements will affect the listing status of products on the SSL QPL, and therefore the incentive eligibility within energy efficiency programs. With V5.0, non-dimmable products that were qualified in the V4.4 DLC Premium tier will be reclassified into the V5.0 DLC Standard tier. Programs that offer higher or exclusive incentives for DLC Premium qualified products need to be aware of this change and are advised to notify trade ally partners in advance. Under V5.1, non-dimmable products (other than those that are exempt[1]) will be delisted from the QPL.[43]

As non-dimmable products are delisted from the QPL, the percentage of dimmable of products on the QPL will gradually increase. Prior to the release of V5.0 and V5.1, approximately 70% of all products on the QPL were dimmable. Among products that have already been qualified under V5.1, 99% are

[42] https://blog.designlights.org/2020/03/31/the-value-of-dimming/
[43] The V5.1 transition details and timelines can be found at https://www.designlights.org/solid-state-lighting/qualification-requirements/v5-transition/.

dimmable. Similar trends are expected to occur in the market as the new requirements take effect and dimmable products become more prevalent.

As stated, the DLC dimming requirements do not extend to project specifications nor product installation. While the capability to dim will be available on a greater number of products, the decision to install and use dimming controls to realize the benefit from dimming remains up to the customer, unless mandated by building and/or energy code.

Dimming capability not only unlocks greater energy savings and flexibility to meet carbon reduction goals as LEDs replace legacy technology, but also gives occupants better control over their environment, reducing discomfort glare and allowing for customizable light levels. Dimmable lighting is a first, and crucial, step toward better quality, smarter lighting.

## Additional Resources

The additional resources related to the dimming requirements in SSL V5.0 and V5.1, outlined in **Table 5**, are available to DLC Members.

Table 5: DLC Member Resources Related to Dimming Requirements

| Title and Link | Description |
|---|---|
| **Value of Dimming Blog Post** | A DLC blog post that discusses why dimming can deliver benefits far beyond energy savings. |
| **TLED Dimming FAQ** | This document of frequently asked questions provides information regarding the V5.1 dimming requirement for T8 linear replacement lamps (TLEDs). |
| **Member Talking Points** | V5.0 and V5.1 background regarding the development of the policies, focus areas of each policy, timing, resources available, and more. |

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