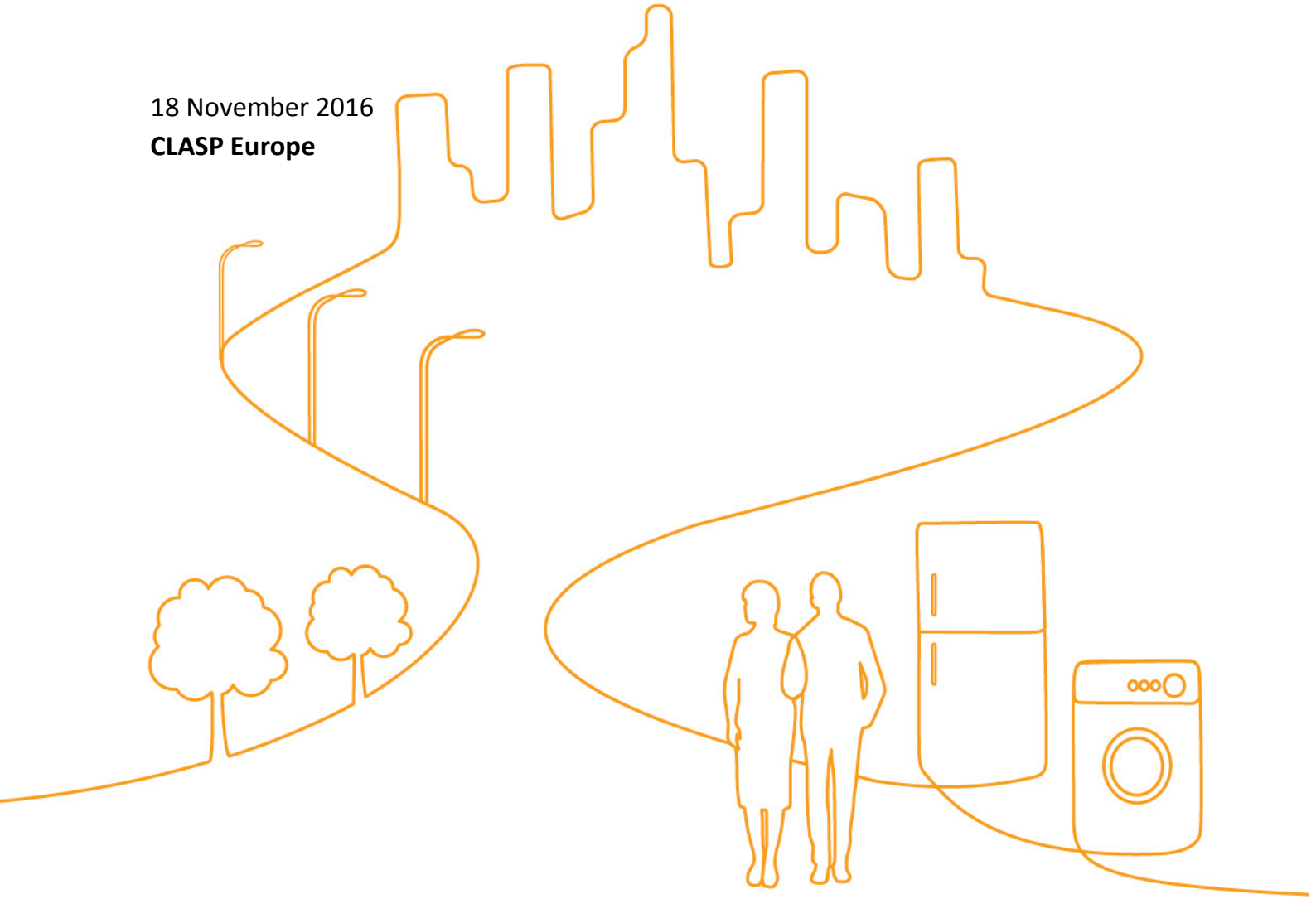
# Update to the Ecodesign Requirements for Televisions - Analysis of the European Market

*An assessment of potential levels of ambition of Ecodesign measures applied to the European television market in 2016, and recommendations for new ecodesign requirements.*



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**About CLASP**

An independent, non-profit organisation, CLASP improves the environmental and energy performance of the appliances and related systems we use every day, lessening their impacts on people and the world around us. CLASP develops and shares practical and transformative policy and market solutions in collaboration with global experts and local stakeholders. We are the leading international resource and voice for energy efficiency standards and labels (S&L) for appliances, lighting, and equipment. Since 1999, CLASP has worked in over 50 countries on 6 continents pursuing every aspect of appliance energy efficiency, from helping structure new policies to evaluating existing programs. Please visit www.clasp.ngo

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## Acronyms and Abbreviations

| | |
|---|---|
| ABC | Automatic Brightness Control |
| CF | Consultation Forum |
| DG ENER | Directorate General – Energy (European Commission) |
| dm | decimetres (10 centimetres) |
| EEI | Energy Efficiency Index |
| HD | High Definition |
| HDR | High Dynamic Range |
| IEC | International Electrotechnical Commission |
| LCD | liquid crystal display |
| LED | Light Emitting Diode |
| OLED | Organic Light Emitting Diode |
| TV | television |
| UHD | Ultra High Definition |

# 1. The Commission's 2014 television proposal needs updating

In late 2014, the European Commission held a Consultation Forum and proposed energy-efficiency requirements for electronic displays. The Commission received comments on this proposal from a number of stakeholders, however since that time, no update has been published. CLASP is hoping that following the recent final approval of the Paris agreement and positive messages from the European Commission concerning ecodesign, the Commission will soon move forward with the review of the 2009 ecodesign regulation for televisions.

To support the policy-making process and assess what potential for ambition might exist with televisions, CLASP developed a database of 2016 televisions based on the product fiche published on the web, and found that the Commission's 2014 draft requirements for televisions are lacking in ambition when applied to a 2016 model database. This report presents the new database and recommends updating the energy-efficiency requirements based on these new data.

The equations below provide the minimum energy efficiency performance levels that were proposed by the Commission in the 2014 draft regulation for televisions. These Tiers were intended to take effect one, three and five years after adoption of the measure:

Tier 1: $Power_{max} = 3 \times \left[100 \times \tanh\left(0.02 + 0.006 \times (Area - 11)\right) + 4\right] + 6$

Tier 2: $Power_{max} = 2 \times \left[99 \times \tanh\left(0.02 + 0.0065 \times (Area - 11)\right) + 4\right] + 6$

Tier 3: $Power_{max} = 1 \times \left[98 \times \tanh\left(0.02 + 0.007 \times (Area - 11)\right) + 4\right] + 6$

Table 1 presents the model pass-rates (i.e., the percentage that meets the requirements) derived by applying the draft 2014 efficiency equations above to the 2016 model database (database is presented in Annex A). CLASP found 100% of the 2016 HD models were compliant with Tier 1, and 86% were compliant with Tier 2. For UHD models 91% were compliant with Tier 1 and more than half of the models on the 2016 market are already compliant with Tier 2. These compliance rates sound very high, however please note that since the Commission has not yet adopted a level, any equations would not apply until 2018 at the earliest. Thus some of the older and less efficient models in the 2016 database will have been replaced with more efficient models, meaning the actual pass-rates in the years the tiers become effective will be even higher.

### Table 1. Commission's 2014 proposal applied to a 2016 model database

| | Tier/Label Class: | n = | Tier 1 | Tier 2 | Tier 3 |
|---|---|---|---|---|---|
| | # of HD Models Passing | 304 | 304 | 261 | 7 |
| | # of UHD Models Passing | 274 | 249 | 142 | 0 |
| | # of Models Passing | 578 | 553 | 403 | 7 |
| | % Models Passing | | 96% | 70% | 1% |
| HD | **% of Models Passing** | 304 | **100%** | **86%** | **2%** |
| HD | 10 to < 25 $dm^2$ | 26 | 100% | 81% | 0% |
| HD | ≤ 25 to < 50 $dm^2$ | 142 | 100% | 75% | 1% |
| HD | ≤ 50 to < 75 $dm^2$ | 66 | 100% | 100% | 3% |
| HD | ≤ 75 to < 100 $dm^2$ | 64 | 100% | 98% | 5% |
| HD | ≤ 100 to < 150 $dm^2$ | 5 | 100% | 100% | 20% |
| HD | ≥ 150 $dm^2$ | 1 | 100% | 0% | 0% |
| UHD | **# of Models Passing** | 274 | **91%** | **52%** | **0%** |
| UHD | 10 to < 25 $dm^2$ | 0 | 0% | 0% | 0% |
| UHD | ≤ 25 to < 50 $dm^2$ | 35 | 97% | 34% | 0% |
| UHD | ≤ 50 to < 75 $dm^2$ | 55 | 98% | 44% | 0% |
| UHD | ≤ 75 to < 100 $dm^2$ | 96 | 86% | 56% | 0% |
| UHD | ≤ 100 to < 150 $dm^2$ | 71 | 94% | 68% | 0% |
| UHD | ≥ 150 $dm^2$ | 17 | 65% | 24% | 0% |

The Commission's 2014 proposal has one level of stringency at each Tier, and that requirement is applied to both screen resolutions – HD and UHD. CLASP is concerned that this approach may not present the most optimal solution for ecodesign, given that it appears to have a more significant impact UHD displays compared to HD displays, and it seems to have a limited impact on HD displays. Note however that HD displays are in decline as UHD becomes more popular in the market.

We should also take into account the fact that the Tiers presented in the 2014 proposal would be scheduled to take effect usually two years hence. This means that the draft 2014 Tiers – not yet adopted – would apply at the earliest in 2018 for Tier 1. Due to the fact that televisions are experiencing rapid improvements in energy-efficiency driven by a number of different factors, including advances in light emitting diodes, computer processors, quantum dots and the emergence of LED direct emissive displays, the impact of an ecodesign policy measure is best made taking into account a rate of improvement over time.

Thus, in order to better understand the impact of the 3 proposed Tiers on the year of their respective entry into force, CLASP prepared a projection of television performance applying a constant average improvement in the energy efficiency of electronic displays of 7% per year (see Chapter 3 of this report for the derivation and discussion of this projection).

Table 2 presents a technology projection analysis and regulatory measure compliance rates, applying an estimated 7% improvement in energy performance improvement to the 2016 database. It is assumed that the draft Ecodesign regulation takes effect in Europe in 2018, 2020 and 2022. Applying the annual energy-efficiency improvements, the compliance rates of the current model dataset become quite large. For HD TVs, 100% of the models are projected to comply with Tier 1 and Tier 2, meaning that the Commission's 2014 proposal would not remove any HD models from the market until 2022. For UHD models, only 3% of models would be impacted in 2018 and just 12% in 2020. In 2022, with a 7% technology improvement per year between 2016 and 2022, only 26% of UHD televisions compliant with Commission's Tier 3 equation.

**Table 2. Commission's 2014 proposal applied to the 2016 Model Database projected forward to 2018, 2020 and 2022 assuming an annual energy performance improvement of 7%**

| Technology Projection | Percent of HD models passing | Percent of UHD models passing |
|---|---|---|
| Proposed Tier 1 in 2018 | 100% | 97% |
| Proposed Tier 2 in 2020 | 100% | 88% |
| Proposed Tier 3 in 2022 | 66% | 26% |

From this analysis, we conclude that the two first Tiers of the proposal as presented to the Consultation Forum in 2014 would have a very limited impact on the market, and that the third Tier, although sending a strong long-term signal, appears to disproportionately impact UHD displays even when taking into account efficiency improvements. It was due to this concern that CLASP developed a new database of 2016 European television models and conducted this new analysis on a potential update to the Commission's regulatory level.

## 2. New CLASP 2016 Model Database

CLASP compiled a database of European television models by visiting the websites of popular manufacturers across Europe, including: LG, Loewe, Panasonic, Philips, Samsung, Sharp, Sony, Thomson and Toshiba. The television product fiche files for models currently available on these manufacturer's websites were downloaded and imported into Microsoft Excel. A copy of this database can be found in Annex A to this report, and is also available in spreadsheet format on the CLASP website.

The table below presents a summary of the TV models in the 2016 database and broken down by resolution – high definition (HD) and ultra high definition (UHD). The average specific power[1] was found to be 1.06 for HD displays and 1.20 for UHD displays. This shows that for current televisions on the European market in 2016, UHD requires an average of approximately 13% more power per unit screen area when compared to HD displays.

**Table 3. 2016 European TV model database prepared from product fiche files**

| Screen Resolution | Average specific power (W/dm$^2$) | Model Count |
|---|---|---|
| High Definition (HD) | 1.06 W/dm$^2$ | n = 304 |
| Ultra High Definition (UHD) | 1.20 W/dm$^2$ | n = 274 |
| All Models | 1.13 W/dm$^2$ | n = 578 |

The graph below presents the average power of HD and UHD televisions by screen size.

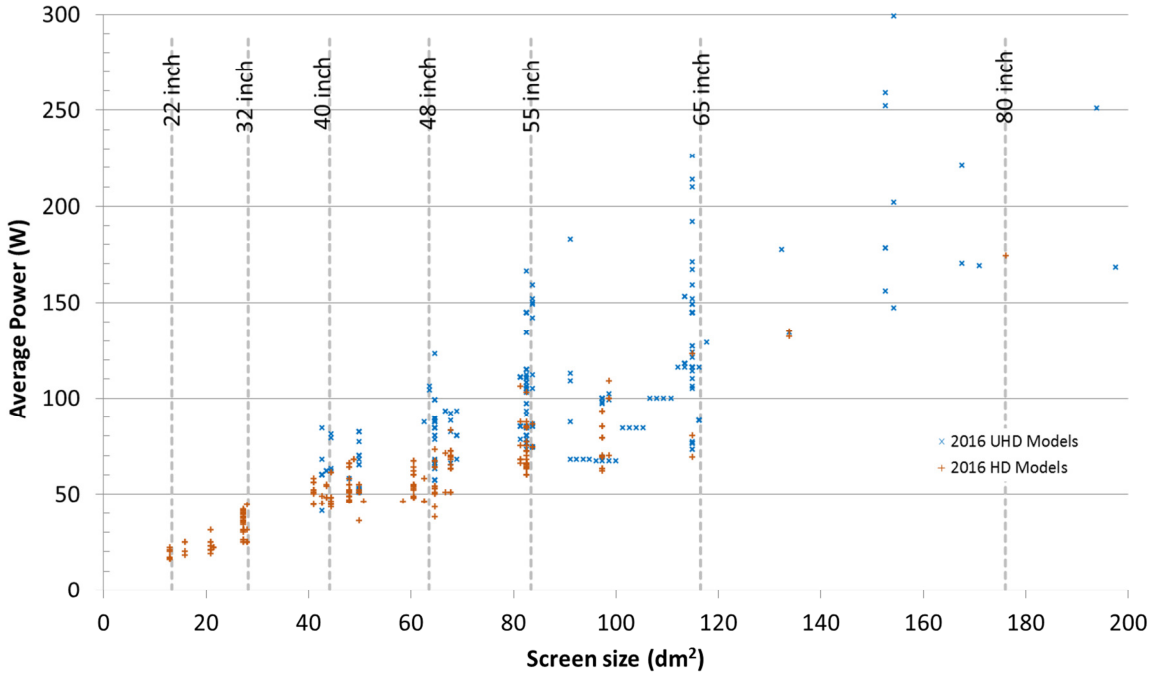
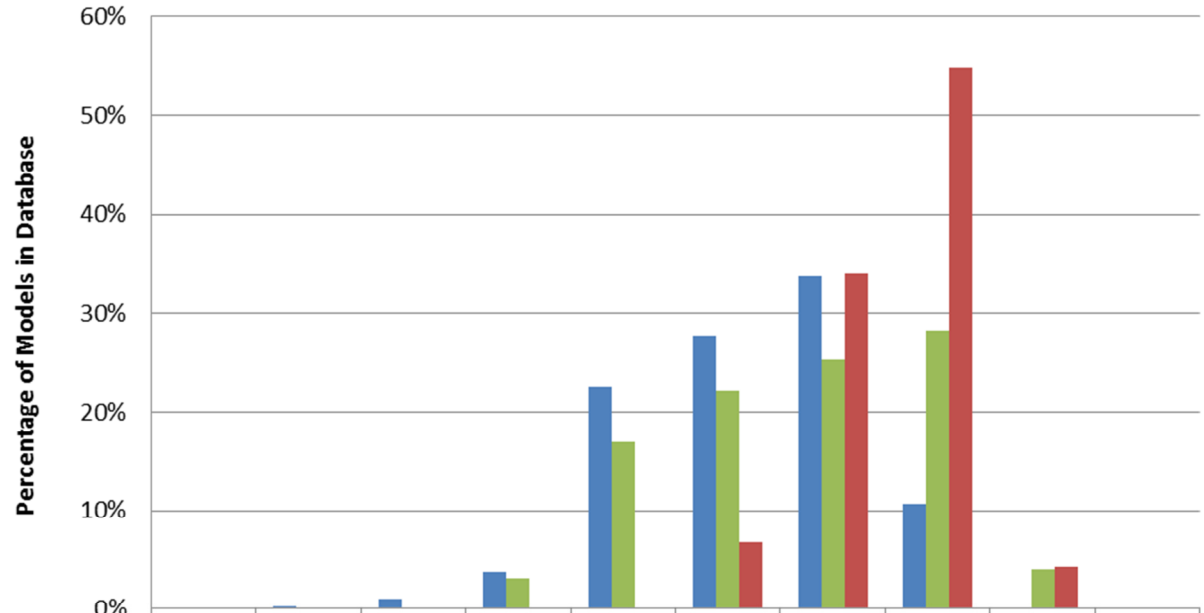



**Figure 1. Scatter plot of average power vs. screen size, 2016 European Televisions**

[1] Specific power is a measure of average watts of power consumed while playing the IEC 62087 test video divided by the screen area. In the above table, the data show that combining HD and UHD, approximately 1.13 watts of power are needed per square decimetre (100 square centimetres) of screen area.

Comparing to previous television model databases, we note that there has been an improvement in energy performance when comparing the energy label classes with our 2016 database. Figure 2 presents the European model databases from 2012 and 2014 with 2016.




| | G | F | E | D | C | B | A | A+ | A++ | A+++ |
|---|---|---|---|---|---|---|---|---|---|---|
| 2012 Data | 0% | 0% | 1% | 4% | 22% | 28% | 34% | 11% | 0% | 0% |
| 2014 Data | 0% | 0% | 0% | 3% | 17% | 22% | 25% | 28% | 4% | 0% |
| 2016 Data | 0% | 0% | 0% | 0% | 0% | 7% | 34% | 55% | 4% | 0% |

**Figure 2. Progression of label classes in 2012, 2014 and 2016 television model databases**

The new CLASP 2016 database does not include computer monitors. We have noticed from our analysis of previous datasets that their specific power consumption tends to be on average higher than for televisions. We understand that one reason for this is that older / less efficient display technologies are maintained for the production of computer screens at lower cost. There is however no technical reason for computer monitors not to achieve the same efficiency levels as televisions.

Another noticeable difference between our new 2016 dataset and the 2014 data base is the relative share of HD screens versus UHD. In the 2014 database, UHD represented only 5% of the models on the market, however in 2016, UHD has almost the same number of models as HD. This significant increase in the availability of UHD displays in the market raises their relative importance and enables a calculation of the increased power consumption of UHD vs. HD. On average, we found that the specific power consumption ($W/dm^2$) of UHD screens is on average 13% higher than for HD screens. Thus, the significant increase in the UHD share would also have an impact on the respective pass-rates when the effect of an efficiency requirement is applied to both datasets.

# 3. Rate of Technology Improvement

As discussed above, television technology has continued to improve in efficiency, along with advancements in LEDs, computer processors and new design configurations. Within the last decade, there has been a transition from cathode ray tubes to flat-panel LCD displays, first back-lit with cold-cathode fluorescent tube and then later LED technology. There has also been plasma displays, and recently organic light emitting diode (OLED) displays. And the technology continues to evolve, with LED direct emissive displays (i.e., removing the LCD panel filter) expected to be demonstrated at the Consumer Electronics Show in Las Vegas in January 2017 and to become main stream in about 4 years.

With these improvements in technology, the average efficiency of televisions increases, meaning they are able to provide a better viewing experience using less power. The following are some of the display technology trends that are having an impact, improving energy-efficiency:

- Light emitting diodes (LEDs) - the light source driving most television screens today continues to benefit from improvements in efficacy (i.e., lumens of light per watt of power consumed), as well as better colour stability and accuracy;
- Back-lit display technology incorporating dynamic full array architecture – for certain models, rather than have the LEDs running all the time or with limited picture-related dimming (e.g. edge – lit displays) television manufacturers have developed technology to control the backlit zones (several hundred ) in the area of the full display) in order to enhance the viewing experience – while also saving energy;
- Computer processors – the performance – both in terms of speed/calculations and power consumption for processors used to run the televisions, particularly in the complex processing requirements of display drive has continued to advance, with ultra-high speed dedicated instruction set 8-core processors now being used in certain models; and
- Direct emissive displays - OLED televisions are on the market already, and in January 2018 it's expected that the first direct emissive displays incorporating quantum dot nanocrystal enhanced LED pixels will be launched with a 30 to 50% predicted improvement in display energy efficiency for a given brightness. In some 2016 high-end LCD displays, nanocrystal filters are already providing reduced light transmission loss from back lights and significant improvements in their colour performance.

Thus, the technology improvements observed in recent years are projected to continue over the next five years, with direct emissive displays offering a very significant improvement in energy efficiency savings.

Given the above technology trends in the marketplace, CLASP reviewed the average specific power of a series of databases to keep track of the annual rate of performance improvement. Table 4 presents these databases that were analysed, and the annual average specific power improvement.

### Table 4. Observed Improvements in average specific power (W/dm$^2$) in electronic display data

| Database | Value |
|---|---|
| DigitalEurope 2012 Model database – average specific power | 1.833 W/dm$^2$ |
| DigitalEurope 2014 Model database – average specific power | 1.629 W/dm$^2$ |
| Percent improvement over 2 years | 11% |
| Annualised percent improvement | 5.6% |
| CLASP February 2015 Model database – average specific power UHD | 1.320 W/dm$^2$ |
| CLASP September 2016 Model database – average specific power UHD | 1.146 W/dm$^2$ |
| Percent improvement over 1.5 years | 13.2% |
| Annualised (note: 18 month period) percent improvement | 8.8% |
| **Average annualised percent improvement of Digital Europe and CLASP model databases** | **7.2%** |

Given this, when conducting our analysis on the impact of the proposed EEI values on our new (2016 models) database, we will use an annual percentage improvement rate of 7% per annum.

# 4. Updating the 2014 proposal

In this report, CLASP presents a suggested update to the Commission's 2014 draft efficiency proposal based on the new 2016 television model database discussed in Chapter 2 (and presented in Annex A). In order to prepare these new requirements, CLASP evaluated the percentage pass-rates of the 2014 minimum energy performance equations applied to the 2014 database and then projected forward the 2014 database with 7% annual improvement (see Chapter 3 for discussion on rate of technology progression). The actual and projected pass-rates for the proposed Tiers from the 2014 proposal applied to the models of the 2014 database are presented in Table 5.

**Table 5. Actual and projected pass-rates for the models from the 2014 Database (1010 models), with proposed Tiers from the 2014 proposal**

| Tier | 2014 database models passing | Percent of models that meet the performance Tiers applying a 7% annual efficiency improvement | | |
|---|---|---|---|---|
| | | 2016 | 2018 | 2020 |
| Tier 1 | 72% | 83% | | |
| Tier 2 | 46% | | 73% | |
| Tier 3 | 5% | | | 46% |

When updating the equations and thresholds in this new analysis, CLASP sought to be consistent with the level of ambition of the Commission's 2014 proposal. We however took into account some of the comments that were made following the presentation of the 2014 proposal by the Consultation Forum members. As a result we are suggesting more evenly spaced Tiers, with a higher percentage of models that meet the requirements for Tier 3.

Furthermore, as discussed in Chapter 1 of this report, it would seem that having one equation for both HD and UHD models would either omit potential energy savings from HD models or apply disproportionately higher regulatory pressure on UHD models. Therefore, CLASP's proposal in this Chapter offers different threshold requirements for HD and UHD, in recognition of the utility offered by the higher resolution screens. The percentages pass-rates for Tier 1 and 2 of current models are slightly lower that pass-rates proposed in 2014 due to the fact that a larger share of HD TVs would now be excluded, whereas the pressure on UHD displays would be slightly less strict than that which was proposed in 2014. This aspect should be considered in the knowledge that HD displays are in decline as UHD becomes more popular in the European market.

The proposed update of the Commission's 2014 proposal presented in this report is based on the same equation structure that the Commission introduced in its 2014 draft regulation, making adjustments to move the curve. 2014 draft regulation, making adjustments to move the curve. However, rather than propose three separate equations for each Tier, CLASP suggests to have one equation to calculate the EEI and then have different EEI requirements – one set of requirements for HD and one set of requirements for UHD. This EEI value can then also be used on the energy label, where we suggest the Commission not make an allowance for UHD vs. HD, thus consumers would know the relative energy consumption of the model they are selecting whether the model is HD or UHD, and choose accordingly.

Our suggested energy efficiency equation is presented below, and Table 6 presents the suggested EEI values for HD and UHD at Tiers 1, 2 and 3. For this analysis, we assume that the regulation will take effect starting in 2018, with Tier 2 in 2020 and Tier 3 in 2022.

$$EEI = \frac{1 + Power}{3 \times [90 \times \tanh(0.02 + 0.004 \times (Area - 11)) + 4] + 3}$$

Where:

**Power** is the average measured power consumption using the IEC 62087; and

**Area** is the screen size in decimetres squared ($dm^2$).

### Table 6. Suggested EEI values for updated EEI equation, 2016 database

| Tiers | HD requirement | UHD requirement |
|---|---|---|
| Tier 1 (2018) | EEI ≤ 0.88 | EEI ≤ 1.03 |
| Tier 2 (2020) | EEI ≤ 0.74 | EEI ≤ 0.90 |
| Tier 3 (2022) | EEI ≤ 0.60 | EEI ≤ 0.76 |

Figure 3 presents a scatter plot of the HD and UHD models from the CLASP 2016 database, using the new equation presented above and the six different EEI values.

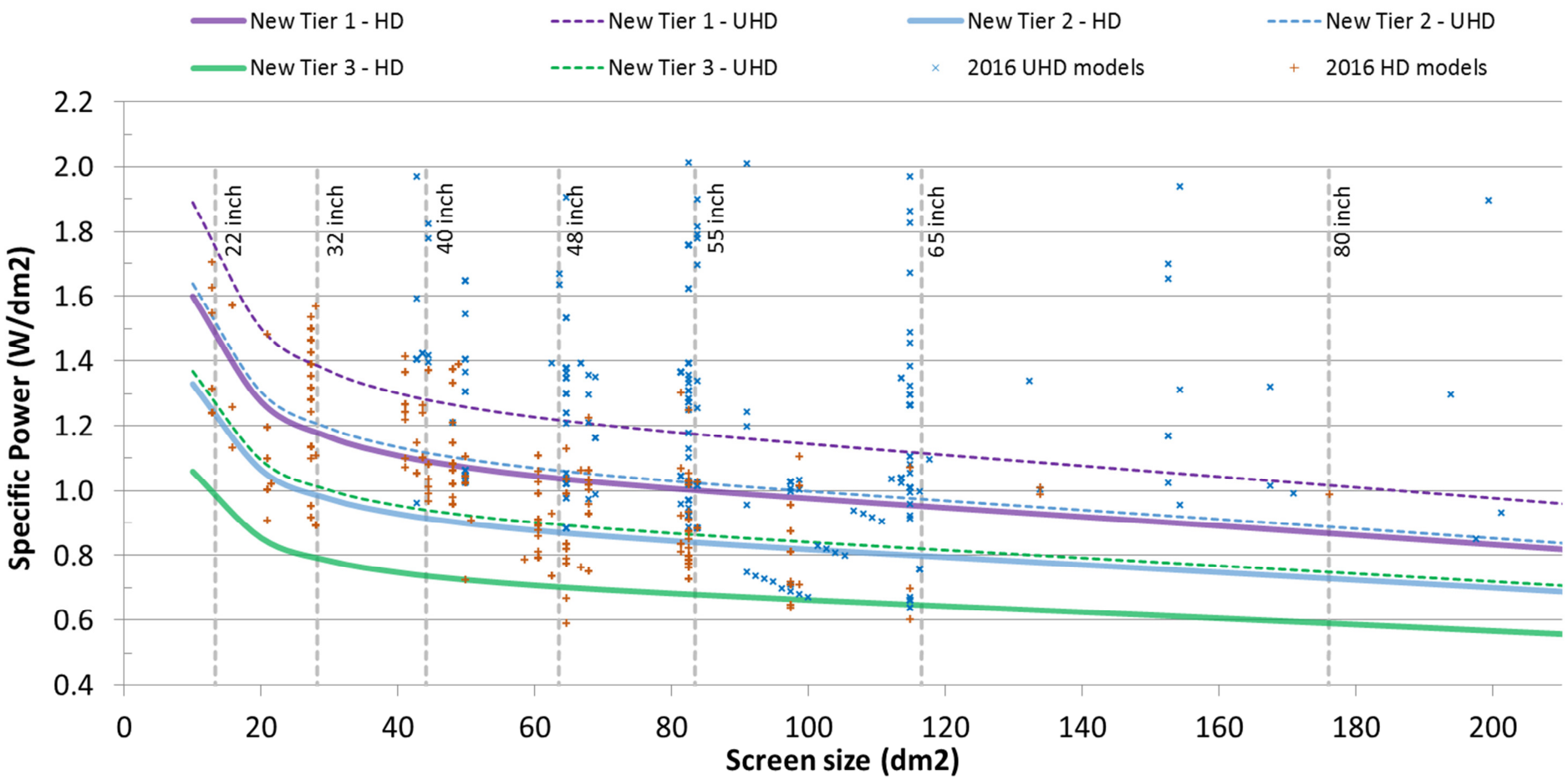



Figure 3. Scatter plot of HD and UHD models in 2016 database with updated equation

Although we are aware of the cost implications of manufacturing large screens, linked to the current manufacturing process, we are not aware of any technological barrier that would prevent the introduction of large screens (i.e., >120 $dm^2$) that would be as efficient as the smaller ones. Moreover, we understand that yield rates are expected to improve with the introduction of direct emissive LED displays, further facilitating the manufacturing of large screen formats.

Table 7 presents the pass-rates for the 2016 database using the above equation and EEI values.[2] This table does not take into account any progression in the technology, which we discussed in Chapter 3 would be approximately 7% per annum. Rather, this table simply presents the pass-rate of the 2016 models relative to Tiers that would take effect in 2018 (Tier 1), 2020 (Tier 2) and 2022 (Tier 3). Due to the fact that televisions only have a 2 to 3 year life in the market, it is not expected that any of the models in the 2016 database will still be for sale by Tier 2 – they will have all been replaced with more efficient models.

### Table 7. Evaluation of the pass-rate by screen size of the Tiers - no technology progression

| | | | | | |
|---|---|---|---|---|---|
| | Proposed EEI – Non UHD | | 0.88 | 0.74 | 0.60 |
| | Proposed EEI – UHD | | 1.03 | 0.90 | 0.76 |
| | **Tier/Label Class:** | **n =** | **Tier 1** | **Tier 2** | **Tier 3** |
| | # of HD Models Passing | 304 | 182 | 79 | 7 |
| | # of UHD Models Passing | 274 | 137 | 82 | 29 |
| | # of Models Passing | 578 | 319 | 161 | 36 |
| | % Models Passing | | 55% | 28% | 6% |
| HD | **% of Models Passing** | 304 | **60%** | **26%** | **2%** |
| HD | 10 to < 25 $dm^2$ | 26 | 77% | 31% | 0% |
| HD | ≤ 25 to < 50 $dm^2$ | 142 | 41% | 7% | 1% |
| HD | ≤ 50 to < 75 $dm^2$ | 66 | 79% | 36% | 3% |
| HD | ≤ 75 to < 100 $dm^2$ | 64 | 78% | 55% | 5% |
| HD | ≤ 100 to < 150 $dm^2$ | 5 | 40% | 40% | 20% |
| HD | ≥ 150 $dm^2$ | 1 | 0% | 0% | 0% |
| UHD | **# of Models Passing** | 274 | **50%** | **30%** | **11%** |
| UHD | 10 to < 25 $dm^2$ | 0 | 0% | 0% | 0% |
| UHD | ≤ 25 to < 50 $dm^2$ | 35 | 29% | 26% | 0% |
| UHD | ≤ 50 to < 75 $dm^2$ | 55 | 38% | 31% | 7% |
| UHD | ≤ 75 to < 100 $dm^2$ | 96 | 54% | 32% | 8% |
| UHD | ≤ 100 to < 150 $dm^2$ | 71 | 68% | 34% | 24% |
| UHD | ≥ 150 $dm^2$ | 17 | 35% | 6% | 0% |

[2] To account for the additional power consumption found for UHD displays, we are suggesting a different EEI requirement for HD and UHD displays under Ecodesign. However, for Energy Labelling, the threshold values for the label classes would be the same for both HD and UHD displays, enabling consumers to view the relative power consumption of HD and UHD at the time of purchase.

Although it looks like many models would be removed from the market, the reality is that with improvements in efficiency, the impact will not be so severe. Table 8 presents the same EEI requirements, however taking into account the progression of 7% per annum (see Chapter 3). The model pass-rates are therefore between 71% and 84% of the expected models on the market in each of the given years – Tier 1 in 2018, Tier 2 in 2020 and Tier 3 in 2022.

### Table 8. Evaluation of the pass-rate by screen size of the Tiers - with 7% annual technology progression

| | | | | | |
|---|---|---|---|---|---|
| | Proposed EEI – Non UHD | | 0.88 | 0.74 | 0.60 |
| | Proposed EEI – UHD | | 1.03 | 0.90 | 0.76 |
| | **Tier/Label Class:** | **n =** | **Tier 1** | **Tier 2** | **Tier 3** |
| | # of HD Models Passing | 304 | 254 | 241 | 215 |
| | # of UHD Models Passing | 274 | 209 | 219 | 203 |
| | # of Models Passing | 578 | 463 | 460 | 418 |
| | % Models Passing | | 80% | 80% | 72% |
| HD | **% of Models Passing** | **304** | **84%** | **79%** | **71%** |
| HD | 10 to < 25 $dm^2$ | 26 | 85% | 81% | 77% |
| HD | ≤ 25 to < 50 $dm^2$ | 142 | 70% | 63% | 51% |
| HD | ≤ 50 to < 75 $dm^2$ | 66 | 98% | 98% | 94% |
| HD | ≤ 75 to < 100 $dm^2$ | 64 | 97% | 95% | 92% |
| HD | ≤ 100 to < 150 $dm^2$ | 5 | 100% | 100% | 40% |
| HD | ≥ 150 $dm^2$ | 1 | 100% | 0% | 0% |
| UHD | **# of Models Passing** | **274** | **76%** | **80%** | **74%** |
| UHD | 10 to < 25 $dm^2$ | 0 | 0% | 0% | 0% |
| UHD | ≤ 25 to < 50 $dm^2$ | 35 | 77% | 77% | 77% |
| UHD | ≤ 50 to < 75 $dm^2$ | 55 | 89% | 89% | 84% |
| UHD | ≤ 75 to < 100 $dm^2$ | 96 | 71% | 78% | 68% |
| UHD | ≤ 100 to < 150 $dm^2$ | 71 | 80% | 85% | 80% |
| UHD | ≥ 150 $dm^2$ | 17 | 47% | 47% | 47% |

When considering these pass-rates, in addition to the expected efficiency improvement over time, one should also take into account the benefit of an extra power allowance for automatic brightness control (ABC). We would suggest that the Commission consider encouraging ABC through its ecodesign policy measure, since experts report that this feature would save energy when enabled and used in a normal domestic setting. Manufacturers could be encouraged to incorporate ABC into their products by offering an adjustment to the energy-efficiency index or some other power allowance.

The specific power consumption and database model pass-rates presented above do not take into account any special allowance for ABC. Should the revised regulation offer an additional allowance for ABC - that could potentially significantly increase the pass-rates presented in this scenario. Experts estimate that the energy savings from the use of ABC in typical conditions would justify an extra allowance of about 10%. We therefore calculated the pass-rates for the revised requirements proposed in this Chapter using the 2016 database and applying a 10% ABC allowance to all models. In reality, the market would fall somewhere between the pass-rates of the technology progression

without ABC allowance (Table 8) and the pass-rates with an extra ABC allowance for all screens (Table 9). Of course, not all screens would offer ABC even with an incentive built into the regulation, but it would be difficult to anticipate the market share of ABC screens, or whether all segments of the market would adopt the same proportion of ABC-enabled screens.

**Table 9. Evaluation of the pass-rate by screen size of the Tiers - with 7% annual technology progression and 10% ABC extra allowance for all screens**

| | | | | | |
|---|---|---|---|---|---|
| | Proposed EEI – Non UHD | | 0.88 | 0.74 | 0.60 |
| | Proposed EEI – UHD | | 1.03 | 0.90 | 0.76 |
| | **Tier/Label Class:** | **n =** | **Tier 1** | **Tier 2** | **Tier 3** |
| | # of HD Models Passing | 304 | 299 | 286 | 254 |
| | # of UHD Models Passing | 274 | 236 | 236 | 235 |
| | # of Models Passing | 578 | 535 | 522 | 489 |
| | % Models Passing | | 93% | 90% | 85% |
| **HD** | **% of Models Passing** | **304** | **98%** | **94%** | **84%** |
| | 10 to < 25 $dm^2$ | 26 | 100% | 100% | 85% |
| | ≤ 25 to < 50 $dm^2$ | 142 | 97% | 88% | 70% |
| | ≤ 50 to < 75 $dm^2$ | 66 | 100% | 100% | 98% |
| | ≤ 75 to < 100 $dm^2$ | 64 | 98% | 98% | 97% |
| | ≤ 100 to < 150 $dm^2$ | 5 | 100% | 100% | 100% |
| | ≥ 150 $dm^2$ | 1 | 100% | 100% | 100% |
| **UHD** | **# of Models Passing** | **274** | **86%** | **86%** | **86%** |
| | 10 to < 25 $dm^2$ | 0 | 0% | 0% | 0% |
| | ≤ 25 to < 50 $dm^2$ | 35 | 83% | 83% | 83% |
| | ≤ 50 to < 75 $dm^2$ | 55 | 95% | 95% | 95% |
| | ≤ 75 to < 100 $dm^2$ | 96 | 83% | 83% | 83% |
| | ≤ 100 to < 150 $dm^2$ | 71 | 92% | 92% | 92% |
| | ≥ 150 $dm^2$ | 17 | 59% | 59% | 53% |

We do not consider that any other extra power allowance for features other than ABC would be justified or should be integrated in the regulation. However, should this be the case, this would further increase the pass-rates compared to what is presented above.

In conclusion to this chapter, the EEI levels that we suggest be considered as an update of the Commission's 2014 proposal – taking into account the technology improvement since 2014 and some of the stakeholders comments following the CF – would represent pass-rates that are expected to the within the ranges presented in Table 10.

**Table 10. Expected range of pass-rates for the proposed update of the Commission's 2014 proposal**

| | HD % of models passing | UHD % of models passing |
|---|---|---|
| *Today (2016), Tier 1* | 60% to 79% | 50% to 64% |
| Tier 1 in 2018 | 84% to 98% | 76% to 86% |
| Tier 2 in 2020 | 79% to 94% | 80% to 86% |
| Tier 3 in 2022 | 71% to 84% | 74% to 86% |

In view of these ranges, the updated levels may not be ambitious enough to significantly push the efficiency of the market. Therefore, the following Chapter presents a CLASP recommended scenario that we believe is both realistic and satisfactory in terms of improving the efficiency of televisions.

# 5. CLASP recommended efficiency requirements

Considering the very high projected pass-rates ranges at each Tier in future years, as presented in Chapter 4, CLASP developed a more ambitious scenario made of slightly more stringent efficiency requirements, but in which approximately one-third of the models would be removed from the market in each year the Tier enter into force.

For the CLASP recommended scenario we maintained the same approach as presented in Chapter 4 with different EEI levels for HD and UHD and the same EEI equation:

$$EEI = \frac{1 + Power}{3 \times [90 \times \tanh(0.02 + 0.004 \times (Area - 11)) + 4] + 3}$$

Where:

**Power** is the average measured power consumption using the IEC 62087; and

**Area** is the screen size in decimetres squared ($dm^2$).

Table 11 below presents the suggested EEI values for HD and UHD at Tiers 1, 2 and 3 for the CLASP recommended scenario. As discussed above, this scenario takes into account requirements that are slightly more ambitious than the previous chapter, removing approximately one-third of the models from the market in each year the Tier enter into force. For this analysis, we assume that the regulation will take effect starting in 2018, with Tier 2 in 2020 and Tier 3 in 2022.

### Table 11. Suggested EEI values for CLASP recommended scenario

| Tiers | HD requirement | UHD requirement |
|---|---|---|
| Tier 1 (2018) | EEI ≤ 0.80 | EEI ≤ 0.92 |
| Tier 2 (2020) | EEI ≤ 0.67 | EEI ≤ 0.80 |
| Tier 3 (2022) | EEI ≤ 0.55 | EEI ≤ 0.67 |

Figure 4 presents a scatter plot of the HD and UHD models from the CLASP 2016 database, using the new equation presented above and the six different EEI values presented in Table 11 (note that Tier 2 and Tier 3 for UHD are respectively the same levels as Tier 1 and Tier 2 for HD).

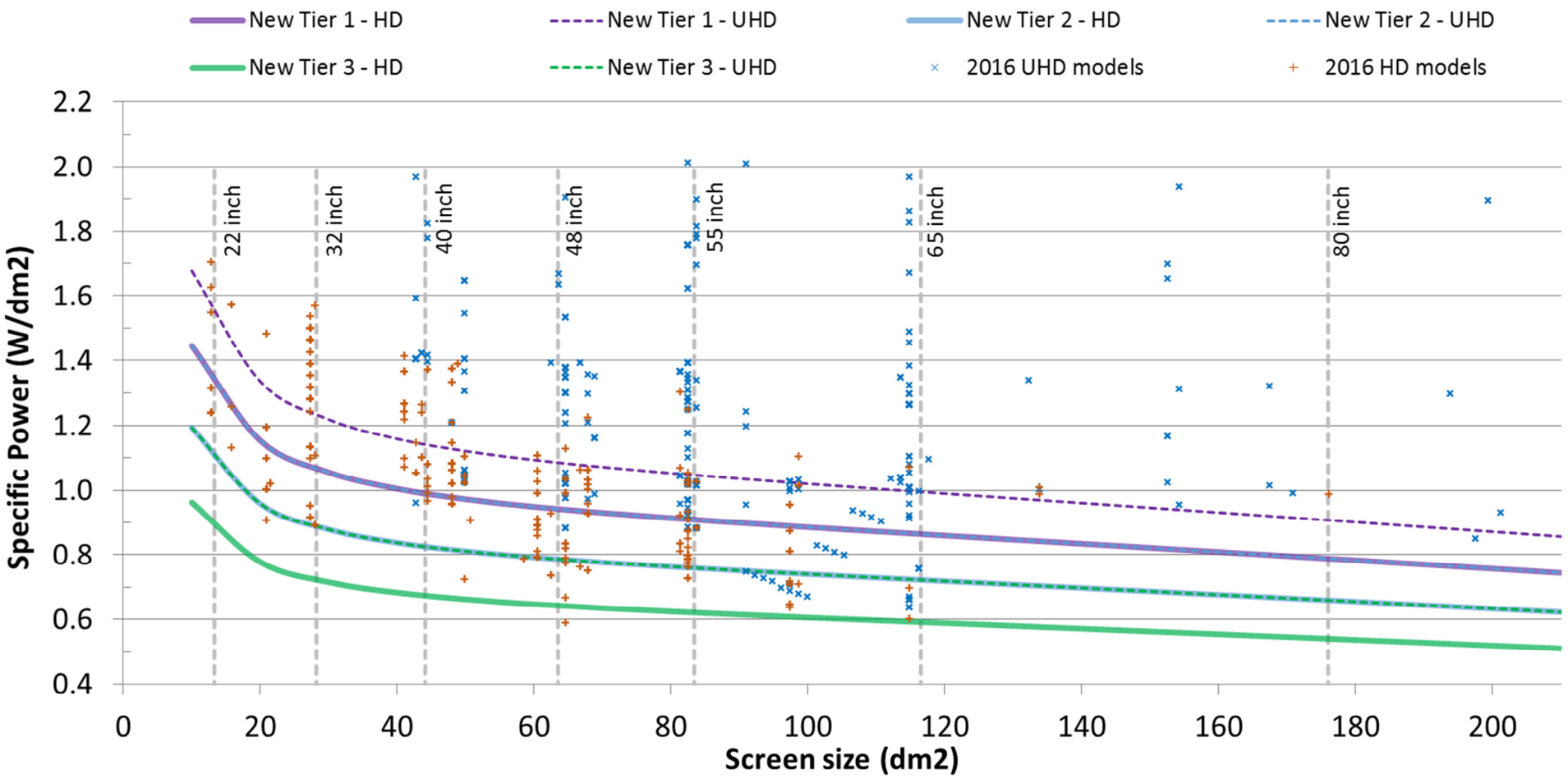



Figure 4. Scatter plot of HD and UHD models in 2016 database with CLASP recommended scenario

Table 12 presents the pass-rates for the 2016 database using the above equation and EEI values.[3] This table does not take into account any progression in the technology, which we discussed in Chapter 3 would be approximately 7% per annum. Rather, this table simply presents the pass-rate of the 2016 models relative to Tiers that would take effect in 2018 (Tier 1), 2020 (Tier 2) and 2022 (Tier 3). Due to the fact that televisions only have a 2 to 3 year life in the market, it is not expected that any of the models in the 2016 database will still be for sale by Tier 2 – they will have all been replaced with more efficient models.

**Table 12. Evaluation of the pass-rate for CLASP recommended scenario, by screen size of the Tiers - no technology progression**

| | | | | | |
|---|---|---|---|---|---|
| | Proposed EEI – HD | | 0.80 | 0.67 | 0.55 |
| | Proposed EEI – UHD | | 0.92 | 0.80 | 0.67 |
| | **Tier/Label Class:** | **n =** | **Tier 1** | **Tier 2** | **Tier 3** |
| | # of HD Models Passing | 304 | 123 | 25 | 1 |
| | # of UHD Models Passing | 274 | 92 | 34 | 16 |
| | # of Models Passing | 578 | 215 | 59 | 17 |
| | % Models Passing | | 37% | 10% | 3% |
| HD | **% of Models Passing** | 304 | **40%** | **8%** | **0%** |
| HD | 10 to < 25 $dm^2$ | 26 | 58% | 4% | 0% |
| HD | ≤ 25 to < 50 $dm^2$ | 142 | 13% | 1% | 0% |
| HD | ≤ 50 to < 75 $dm^2$ | 66 | 62% | 15% | 2% |
| HD | ≤ 75 to < 100 $dm^2$ | 64 | 72% | 17% | 0% |
| HD | ≤ 100 to < 150 $dm^2$ | 5 | 40% | 40% | 0% |
| HD | ≥ 150 $dm^2$ | 1 | 0% | 0% | 0% |
| UHD | **# of Models Passing** | 274 | **34%** | **12%** | **6%** |
| UHD | 10 to < 25 $dm^2$ | 0 | 0% | 0% | 0% |
| UHD | ≤ 25 to < 50 $dm^2$ | 35 | 26% | 3% | 0% |
| UHD | ≤ 50 to < 75 $dm^2$ | 55 | 31% | 7% | 0% |
| UHD | ≤ 75 to < 100 $dm^2$ | 96 | 42% | 13% | 8% |
| UHD | ≤ 100 to < 150 $dm^2$ | 71 | 35% | 24% | 11% |
| UHD | ≥ 150 $dm^2$ | 17 | 6% | 0% | 0% |

Although it looks like many models would be removed from the market, the reality is that with improvements in efficiency, the impact will not be so severe. Table 13 presents the same EEI requirements, however taking into account the progression of 7% per annum (see Chapter 3). The model pass-rates are therefore between a half and two thirds of the expected models on the market in each of the given years – Tier 1 in 2018, Tier 2 in 2020 and Tier 3 in 2022 – both for HD and UHD.

[3] To account for the additional power consumption found for UHD displays, we are suggesting a different EEI requirement for HD and UHD displays under Ecodesign. However, for Energy Labelling, the threshold values for the label classes would be the same for both HD and UHD displays, enabling consumers to view the relative power consumption of HD and UHD at the time of purchase.

**Table 13. Evaluation of the pass-rate for CLASP recommended scenario, by screen size of the Tiers - with 7% annual technology progression**

| | | | | | |
|---|---|---|---|---|---|
| | Proposed EEI – HD | | 0.80 | 0.67 | 0.55 |
| | Proposed EEI – UHD | | 0.92 | 0.80 | 0.67 |
| | **Tier/Label Class:** | **n =** | **Tier 1** | **Tier 2** | **Tier 3** |
| | # of HD Models Passing | 304 | 216 | 200 | 152 |
| | # of UHD Models Passing | 274 | 140 | 141 | 137 |
| | # of Models Passing | 578 | 356 | 341 | 289 |
| | % Models Passing | | 62% | 59% | 50% |
| **HD** | **% of Models Passing** | 304 | **71%** | **66%** | **50%** |
| | 10 to < 25 $dm^2$ | 26 | 77% | 77% | 69% |
| | ≤ 25 to < 50 $dm^2$ | 142 | 51% | 49% | 25% |
| | ≤ 50 to < 75 $dm^2$ | 66 | 94% | 88% | 73% |
| | ≤ 75 to < 100 $dm^2$ | 64 | 92% | 78% | 75% |
| | ≤ 100 to < 150 $dm^2$ | 5 | 40% | 40% | 40% |
| | ≥ 150 $dm^2$ | 1 | 0% | 0% | 0% |
| **UHD** | **# of Models Passing** | 274 | **51%** | **51%** | **50%** |
| | 10 to < 25 $dm^2$ | 0 | 0% | 0% | 0% |
| | ≤ 25 to < 50 $dm^2$ | 35 | 29% | 29% | 29% |
| | ≤ 50 to < 75 $dm^2$ | 55 | 44% | 44% | 38% |
| | ≤ 75 to < 100 $dm^2$ | 96 | 54% | 55% | 54% |
| | ≤ 100 to < 150 $dm^2$ | 71 | 68% | 68% | 68% |
| | ≥ 150 $dm^2$ | 17 | 35% | 35% | 35% |

Table 12 and Table 13 present the pass-rates respectively without and with technology improvements over time, but none of these two tables accounts for additional allowances associated to specific features. As explained in Chapter 4, Our suggestion is that a 10% extra allowance for ABC enabled televisions would be justified, however we cannot predict what share of the market and what segments will offer ABC. We therefore calculated the pass-rates with a 10% extra allowance applied to all models, acknowledging that reality is expected to be somewhere between the scenario with no allowance and the scenario with allowance for all. Table 14 presents the pass-rates by size with this 10% allowance.

### Table 14. Evaluation of the pass-rate by screen size of the Tiers - with 7% annual technology progression and 10% ABC extra allowance for all screens

| | | | | | |
|---|---|---|---|---|---|
| | Proposed EEI – HD | | 0.80 | 0.67 | 0.55 |
| | Proposed EEI – UHD | | 0.92 | 0.80 | 0.67 |
| | **Tier/Label Class:** | **n =** | **Tier 1** | **Tier 2** | **Tier 3** |
| | # of HD Models Passing | 304 | 256 | 242 | 222 |
| | # of UHD Models Passing | 274 | 206 | 206 | 172 |
| | # of Models Passing | 578 | 462 | 448 | 394 |
| | % Models Passing | | 80% | 78% | 68% |
| **HD** | **% of Models Passing** | 304 | **84%** | **80%** | **73%** |
| | 10 to < 25 $dm^2$ | 26 | 92% | 81% | 77% |
| | ≤ 25 to < 50 $dm^2$ | 142 | 70% | 63% | 52% |
| | ≤ 50 to < 75 $dm^2$ | 66 | 98% | 98% | 97% |
| | ≤ 75 to < 100 $dm^2$ | 64 | 97% | 95% | 95% |
| | ≤ 100 to < 150 $dm^2$ | 5 | 100% | 100% | 60% |
| | ≥ 150 $dm^2$ | 1 | 100% | 0% | 0% |
| **UHD** | **# of Models Passing** | 274 | **75%** | **75%** | **63%** |
| | 10 to < 25 $dm^2$ | 0 | 0% | 0% | 0% |
| | ≤ 25 to < 50 $dm^2$ | 35 | 77% | 77% | 57% |
| | ≤ 50 to < 75 $dm^2$ | 55 | 85% | 85% | 64% |
| | ≤ 75 to < 100 $dm^2$ | 96 | 70% | 70% | 64% |
| | ≤ 100 to < 150 $dm^2$ | 71 | 80% | 80% | 68% |
| | ≥ 150 $dm^2$ | 17 | 47% | 47% | 47% |

As mentioned in Chapter 4, we do not consider that any other extra allowance for other features than ABC would be justified or should be integrated in the regulation. Should this however be the case, that would of course also increase the pass-rates compared to what is presented above. In conclusion to this chapter, the EEI levels proposed for the CLASP recommended scenario would represent pass-rates that are expected to be within the ranges presented in Table 10.

### Table 15. Expected pass-rates ranges for the CLASP recommended scenario

| | HD % of models passing | UHD % of models passing |
|---|---|---|
| *Today (2016), Tier 1* | 40% to 65% | 34% to 49% |
| Tier 1 in 2018 | 71% to 84% | 51% to 75% |
| Tier 2 in 2020 | 66% to 80% | 51% to 75% |
| Tier 3 in 2022 | 50% to 73% | 50% to 63% |

In view of these ranges, although the pass-rates of the CLASP recommendation look impressively low when applied to the current database of 2016 products without taking into account any technology improvement nor extra allowance, these levels seem very reasonable when projecting the pass-rates in a way that better reflect the reality of implementation if the proposed Tiers.

# 6. Conclusion

CLASP downloaded hundreds of product fiche files from the manufacturer's European websites and prepared a database of television models offered on the market in 2016. We compared 2012, 2014, 2015 and 2016 databases and derived an average annual improvement rate of 7% per annum which was applied to the 2016 datasets in order to project the expected energy performance of display technologies in 2018, 2020 and 2022.

Our conclusion following the analysis of this new data is that the Commission's 2014 proposal is outdated and would have virtually no effect on the market until 2022. We therefore strongly recommend that the Commission revise this proposal. As examples of what the Commission might consider, we developed two scenarios: an update to the Commission's proposal and a CLASP recommended level.

CLASP assessed the model pass-rate of the Commission's proposal from the last Consultation Forum, both in the year it was proposed and applying a 7 percent annual performance improvement to determine the percentage model pass-rates in Tiers 1, 2 and 3. When updating the requirements of the Commission's proposal to be based on the 2016 database, we were consistent with the level of ambition applied in the Commission's 2014 proposal. However, we did take into account some of the comments that were made in response to the Commission's 2014 proposal, thereby arriving at more evenly spaced Tiers, with a higher percentage of models that meet the Tier 3 requirements.

In the 2014 proposal, the Commission had separate equations with maximum power ratings for each of the three Tiers, and these requirements were applied to both HD and UHD models. CLASP has considered this approach, but in this proposal, we recommend using one equation, converting to an energy efficiency index (EEI), and using different EEI values for HD and UHD displays, in recognition of the 13% higher specific power consumption of UHD displays. Our updated Commission proposal and CLASP recommended scenario are both structured around this approach of one equation and different EEI values.

Given all of the above, this report presents three scenarios which are summarised below:

- Scenario 1. Commission's draft 2014 option – separate equations for Tiers 1, 2, 3 and combined HD and UHD requirements (see Chapter 1);
- Scenario 2. Updated Commission option – keeping the same degree of ambition (i.e., approximately equivalent pass-rates for models, except less ambition for Tier 3), update the requirements by using one equation and different EEI values for Tiers 1, 2, 3 and separate EEI levels for HD and UHD (see Chapter 4); and
- Scenario 3. CLASP recommended option – keeping the same structure as the updated Commission proposal, CLASP recommends a higher level of ambition using the same single equation but more ambitious EEI values for Tiers 1,2, 3 and keeping different requirements for HD and UHD (see Chapter 5).

The scenarios above are given in order of increasing ambition, and the expected pass-rates of these three scenarios are presented below, using the 2016 database and applying a technology progression of 7 percent per annum improvement from 2016.

**Table 16. Pass-rates for the three scenarios applied to the 2016 Model Database projected forward to 2018, 2020 and 2022 assuming a 7% annual energy performance improvement**

| Scenario | Screen Resolution | Pass-rates for proposed Tier 1 in 2018 | Pass-rates for proposed Tier 2 in 2020 | Pass-rates for proposed Tier 3 in 2022 |
|---|---|---|---|---|
| 1. Commission's 2014 Consultation Forum proposal | HD | 100% | 100% | 66% |
| | UHD | 97% | 88% | 26% |
| 2. Update to Commission's proposal using 2016 data | HD | 84% to 98% | 79% to 94% | 71% to 84% |
| | UHD | 76% to 86% | 80% to 86% | 74% to 86% |
| 3. CLASP recommended, higher ambition | HD | 71% to 84% | 66% to 80% | 50% to 73% |
| | UHD | 51% to 75% | 51% to 75% | 50% to 63% |

The Commission's 2014 proposal will not achieve the objectives of ecodesign if it is kept as originally proposed in 2014 and applied to the market in 2018, 2020 and 2022, in that it will have practically no impact on the efficiency of the models put on the market until 2022.

However, the other two scenarios are both reasonable possibilities – either the updated Commission's proposal, which keeps the same degree of ambition (in terms of model pass-rates) and applies them to the updated database; or the CLASP recommended level which goes slightly further in ambition, recognising the importance of $CO_2$ savings, the Paris Agreement and the global leadership Europe needs to demonstrate on energy-efficiency.

The equation below is used in Scenarios 2 and 3, with different EEI values for Tiers 1, 2 and 3 of ecodesign. For this analysis, we assume that the regulation will take effect starting in 2018, with Tier 2 in 2020 and Tier 3 in 2022.

$$EEI = \frac{1 + Power}{3 \times [90 \times \tanh(0.02 + 0.004 \times (Area - 11)) + 4] + 3}$$

Where:

**Power** is the average measured power consumption using the IEC 62087; and
**Area** is the screen size in decimetres squared ($dm^2$).

**Table 17. Suggested EEI values for updated equation, Scenarios 2 and 3**

| Tiers | Scenario 2. Updated Commission | | Scenario 3. CLASP Recommended | |
|---|---|---|---|---|
| | HD | UHD | HD | UHD |
| Tier 1 (2018) | EEI ≤ 0.88 | EEI ≤ 1.03 | EEI ≤ 0.80 | EEI ≤ 0.92 |
| Tier 2 (2020) | EEI ≤ 0.74 | EEI ≤ 0.90 | EEI ≤ 0.67 | EEI ≤ 0.80 |
| Tier 3 (2022) | EEI ≤ 0.60 | EEI ≤ 0.76 | EEI ≤ 0.55 | EEI ≤ 0.67 |

# Annex A. Copy of the 2016 Database

This annex provides the anonymised television models that were used in the analysis.

### Table A.1. High Definition Displays - 2016 Model Database

| ID Number | Area (dm²) | Watts | EEI | Energy class | Specific Power |
|---|---|---|---|---|---|
| ID#001 | 27.35 | 37.00 | 1.00 | A | 1.35 |
| ID#002 | 27.35 | 37.00 | 1.00 | A | 1.35 |
| ID#003 | 27.35 | 41.00 | 1.11 | A | 1.50 |
| ID#004 | 27.35 | 40.00 | 1.08 | A | 1.46 |
| ID#005 | 27.35 | 40.00 | 1.08 | A | 1.46 |
| ID#006 | 27.35 | 41.00 | 1.11 | A | 1.50 |
| ID#007 | 27.35 | 40.00 | 1.08 | A | 1.46 |
| ID#008 | 27.35 | 31.00 | 0.82 | A+ | 1.13 |
| ID#009 | 27.35 | 31.00 | 0.82 | A+ | 1.13 |
| ID#010 | 27.35 | 40.00 | 1.08 | A | 1.46 |
| ID#011 | 27.35 | 40.00 | 1.08 | A | 1.46 |
| ID#012 | 27.35 | 31.00 | 0.82 | A+ | 1.13 |
| ID#013 | 27.35 | 31.00 | 0.82 | A+ | 1.13 |
| ID#014 | 27.35 | 40.00 | 1.08 | A | 1.46 |
| ID#015 | 27.35 | 40.00 | 1.08 | A | 1.46 |
| ID#016 | 27.35 | 40.00 | 1.08 | A | 1.46 |
| ID#017 | 27.35 | 36.00 | 0.97 | A | 1.32 |
| ID#018 | 41.04 | 44.00 | 0.85 | A+ | 1.07 |
| ID#019 | 48.01 | 51.00 | 0.86 | A+ | 1.06 |
| ID#020 | 48.01 | 52.00 | 0.88 | A+ | 1.08 |
| ID#021 | 48.01 | 52.00 | 0.88 | A+ | 1.08 |
| ID#022 | 48.01 | 52.00 | 0.88 | A+ | 1.08 |
| ID#023 | 48.01 | 52.00 | 0.88 | A+ | 1.08 |
| ID#024 | 60.51 | 64.00 | 0.90 | A+ | 1.06 |
| ID#025 | 60.51 | 54.00 | 0.75 | A+ | 0.89 |
| ID#026 | 60.51 | 54.00 | 0.75 | A+ | 0.89 |
| ID#027 | 60.51 | 54.00 | 0.75 | A+ | 0.89 |
| ID#028 | 60.51 | 55.00 | 0.77 | A+ | 0.91 |
| ID#029 | 67.84 | 68.00 | 0.86 | A+ | 1.00 |
| ID#030 | 67.84 | 51.00 | 0.64 | A+ | 0.75 |
| ID#031 | 67.84 | 51.00 | 0.64 | A+ | 0.75 |
| ID#032 | 82.56 | 85.00 | 0.92 | A+ | 1.03 |
| ID#033 | 82.56 | 85.00 | 0.92 | A+ | 1.03 |
| ID#034 | 82.56 | 85.00 | 0.92 | A+ | 1.03 |
| ID#035 | 82.56 | 66.00 | 0.71 | A+ | 0.80 |
| ID#036 | 82.56 | 63.00 | 0.68 | A+ | 0.76 |
| ID#037 | 64.65 | 67.00 | 0.89 | A+ | 1.04 |
| ID#038 | 97.43 | 85.00 | 0.81 | A+ | 0.87 |
| ID#039 | 97.43 | 85.00 | 0.81 | A+ | 0.87 |
| ID#040 | 67.84 | 63.00 | 0.80 | A+ | 0.93 |
| ID#041 | 41.04 | 52.00 | 1.01 | A | 1.27 |
| ID#042 | 67.84 | 63.00 | 0.80 | A+ | 0.93 |
| ID#043 | 67.84 | 63.00 | 0.80 | A+ | 0.93 |
| ID#044 | 82.56 | 72.00 | 0.78 | A+ | 0.87 |
| ID#045 | 82.56 | 72.00 | 0.78 | A+ | 0.87 |
| ID#046 | 64.65 | 67.00 | 0.89 | A+ | 1.04 |
| ID#047 | 64.65 | 67.00 | 0.89 | A+ | 1.04 |
| ID#048 | 64.65 | 38.00 | 0.49 | A | 0.59 |
| ID#049 | 66.77 | 51.00 | 0.65 | A+ | 0.76 |
| ID#050 | 27.35 | 36.00 | 0.97 | A | 1.32 |
| ID#051 | 48.01 | 51.00 | 0.86 | A+ | 1.06 |

| ID Number | Area (dm²) | Watts | EEI | Energy class | Specific Power |
|---|---|---|---|---|---|
| ID#052 | 48.01 | 51.00 | 0.86 | A+ | 1.06 |
| ID#053 | 27.35 | 40.00 | 1.08 | A | 1.46 |
| ID#054 | 48.01 | 52.00 | 0.88 | A+ | 1.08 |
| ID#055 | 67.84 | 63.00 | 0.80 | A+ | 0.93 |
| ID#056 | 82.56 | 72.00 | 0.78 | A+ | 0.87 |
| ID#057 | 20.94 | 25.00 | 0.81 | A+ | 1.19 |
| ID#058 | 12.93 | 21.00 | 0.97 | A | 1.62 |
| ID#059 | 20.94 | 25.00 | 0.81 | A+ | 1.19 |
| ID#060 | 27.35 | 40.00 | 1.08 | A | 1.46 |
| ID#061 | 27.35 | 31.00 | 0.82 | A+ | 1.13 |
| ID#062 | 27.35 | 31.00 | 0.82 | A+ | 1.13 |
| ID#063 | 27.35 | 40.00 | 1.08 | A | 1.46 |
| ID#064 | 27.35 | 40.00 | 1.08 | A | 1.46 |
| ID#065 | 41.04 | 52.00 | 1.01 | A | 1.27 |
| ID#066 | 41.04 | 52.00 | 1.01 | A | 1.27 |
| ID#067 | 60.51 | 52.00 | 0.72 | A+ | 0.86 |
| ID#068 | 60.51 | 54.00 | 0.75 | A+ | 0.89 |
| ID#069 | 60.51 | 54.00 | 0.75 | A+ | 0.89 |
| ID#070 | 67.84 | 63.00 | 0.80 | A+ | 0.93 |
| ID#071 | 82.56 | 72.00 | 0.78 | A+ | 0.87 |
| ID#072 | 97.43 | 69.00 | 0.65 | A++ | 0.71 |
| ID#073 | 97.43 | 69.00 | 0.65 | A++ | 0.71 |
| ID#074 | 27.35 | 38.00 | 1.02 | A | 1.39 |
| ID#075 | 27.35 | 38.00 | 1.02 | A | 1.39 |
| ID#076 | 42.73 | 45.00 | 0.84 | A+ | 1.05 |
| ID#077 | 42.73 | 45.00 | 0.84 | A+ | 1.05 |
| ID#078 | 49.84 | 52.00 | 0.85 | A+ | 1.04 |
| ID#079 | 49.84 | 52.00 | 0.85 | A+ | 1.04 |
| ID#080 | 64.65 | 54.00 | 0.71 | A+ | 0.84 |
| ID#081 | 64.65 | 54.00 | 0.71 | A+ | 0.84 |
| ID#082 | 82.56 | 65.00 | 0.70 | A+ | 0.79 |
| ID#083 | 82.56 | 65.00 | 0.70 | A+ | 0.79 |
| ID#084 | 27.35 | 39.00 | 1.05 | A | 1.43 |
| ID#085 | 48.01 | 46.00 | 0.78 | A+ | 0.96 |
| ID#086 | 67.84 | 69.00 | 0.88 | A+ | 1.02 |
| ID#087 | 82.56 | 65.00 | 0.70 | A+ | 0.79 |
| ID#088 | 27.35 | 39.00 | 1.05 | A | 1.43 |
| ID#089 | 48.01 | 46.00 | 0.78 | A+ | 0.96 |
| ID#090 | 67.84 | 69.00 | 0.88 | A+ | 1.02 |
| ID#091 | 82.56 | 65.00 | 0.70 | A+ | 0.79 |
| ID#092 | 27.35 | 38.00 | 1.02 | A | 1.39 |
| ID#093 | 42.73 | 45.00 | 0.84 | A+ | 1.05 |
| ID#094 | 49.84 | 52.00 | 0.85 | A+ | 1.04 |
| ID#095 | 64.65 | 54.00 | 0.71 | A+ | 0.84 |
| ID#096 | 82.56 | 65.00 | 0.70 | A+ | 0.79 |
| ID#097 | 60.51 | 55.00 | 0.77 | A+ | 0.91 |
| ID#098 | 48.01 | 49.00 | 0.83 | A+ | 1.02 |
| ID#099 | 81.37 | 106.00 | 1.17 | A | 1.30 |
| ID#100 | 48.01 | 47.00 | 0.79 | A+ | 0.98 |
| ID#101 | 60.51 | 53.00 | 0.74 | A+ | 0.88 |
| ID#102 | 82.56 | 65.00 | 0.70 | A+ | 0.79 |
| ID#103 | 41.04 | 45.00 | 0.87 | A+ | 1.10 |
| ID#104 | 48.01 | 49.00 | 0.83 | A+ | 1.02 |
| ID#105 | 67.84 | 65.00 | 0.83 | A+ | 0.96 |
| ID#106 | 82.56 | 64.00 | 0.69 | A+ | 0.78 |
| ID#107 | 97.43 | 69.00 | 0.65 | A++ | 0.71 |
| ID#108 | 133.87 | 132.00 | 1.01 | A+ | 0.99 |
| ID#109 | 27.35 | 38.00 | 1.02 | A | 1.39 |
| ID#110 | 48.01 | 49.00 | 0.83 | A+ | 1.02 |

| ID Number | Area (dm²) | Watts | EEI | Energy class | Specific Power |
|---|---|---|---|---|---|
| ID#111 | 60.51 | 55.00 | 0.77 | A+ | 0.91 |
| ID#112 | 82.56 | 64.00 | 0.69 | A+ | 0.78 |
| ID#113 | 48.01 | 46.00 | 0.78 | A+ | 0.96 |
| ID#114 | 48.01 | 46.00 | 0.78 | A+ | 0.96 |
| ID#115 | 48.01 | 46.00 | 0.78 | A+ | 0.96 |
| ID#116 | 60.51 | 48.00 | 0.66 | A+ | 0.79 |
| ID#117 | 60.51 | 48.00 | 0.66 | A+ | 0.79 |
| ID#118 | 60.51 | 48.00 | 0.66 | A+ | 0.79 |
| ID#119 | 82.56 | 66.00 | 0.71 | A+ | 0.80 |
| ID#120 | 82.56 | 66.00 | 0.71 | A+ | 0.80 |
| ID#121 | 48.01 | 46.00 | 0.78 | A+ | 0.96 |
| ID#122 | 60.51 | 48.00 | 0.66 | A+ | 0.79 |
| ID#123 | 82.56 | 66.00 | 0.71 | A+ | 0.80 |
| ID#124 | 48.01 | 46.00 | 0.78 | A+ | 0.96 |
| ID#125 | 48.01 | 46.00 | 0.78 | A+ | 0.96 |
| ID#126 | 60.51 | 48.00 | 0.66 | A+ | 0.79 |
| ID#127 | 60.51 | 48.00 | 0.66 | A+ | 0.79 |
| ID#128 | 82.56 | 66.00 | 0.71 | A+ | 0.80 |
| ID#129 | 82.56 | 66.00 | 0.71 | A+ | 0.80 |
| ID#130 | 97.43 | 62.00 | 0.59 | A++ | 0.64 |
| ID#131 | 114.93 | 69.00 | 0.58 | A++ | 0.60 |
| ID#132 | 64.65 | 50.00 | 0.66 | A+ | 0.77 |
| ID#133 | 97.43 | 63.00 | 0.59 | A++ | 0.65 |
| ID#134 | 64.65 | 50.00 | 0.66 | A+ | 0.77 |
| ID#135 | 82.56 | 63.00 | 0.68 | A+ | 0.76 |
| ID#136 | 97.43 | 63.00 | 0.59 | A++ | 0.65 |
| ID#137 | 82.56 | 64.00 | 0.69 | A+ | 0.78 |
| ID#138 | 27.35 | 40.00 | 1.08 | A | 1.46 |
| ID#139 | 42.73 | 49.00 | 0.92 | A | 1.15 |
| ID#140 | 49.84 | 51.00 | 0.84 | A+ | 1.02 |
| ID#141 | 64.65 | 53.00 | 0.70 | A+ | 0.82 |
| ID#142 | 82.56 | 60.00 | 0.65 | A++ | 0.73 |
| ID#143 | 49.84 | 36.00 | 0.58 | A++ | 0.72 |
| ID#144 | 64.65 | 43.00 | 0.56 | A++ | 0.67 |
| ID#145 | 64.65 | 51.00 | 0.67 | A+ | 0.79 |
| ID#146 | 82.56 | 60.00 | 0.65 | A++ | 0.73 |
| ID#147 | 97.43 | 93.00 | 0.89 | A+ | 0.95 |
| ID#148 | 12.93 | 16.00 | 0.71 | A+ | 1.24 |
| ID#149 | 20.94 | 23.00 | 0.74 | A+ | 1.10 |
| ID#150 | 27.35 | 35.00 | 0.94 | A | 1.28 |
| ID#151 | 48.01 | 52.00 | 0.88 | A+ | 1.08 |
| ID#152 | 12.93 | 16.00 | 0.71 | A+ | 1.24 |
| ID#153 | 20.94 | 23.00 | 0.74 | A+ | 1.10 |
| ID#154 | 27.35 | 35.00 | 0.94 | A | 1.28 |
| ID#155 | 48.01 | 52.00 | 0.88 | A+ | 1.08 |
| ID#156 | 48.01 | 52.00 | 0.88 | A+ | 1.08 |
| ID#157 | 12.93 | 16.00 | 0.71 | A+ | 1.24 |
| ID#158 | 20.94 | 19.00 | 0.60 | A+ | 0.91 |
| ID#159 | 64.65 | 53.00 | 0.70 | A+ | 0.82 |
| ID#160 | 82.56 | 60.00 | 0.65 | A++ | 0.73 |
| ID#161 | 97.43 | 93.00 | 0.89 | A+ | 0.95 |
| ID#162 | 48.01 | 52.00 | 0.88 | A+ | 1.08 |
| ID#163 | 49.84 | 51.00 | 0.84 | A+ | 1.02 |
| ID#164 | 114.93 | 80.00 | 0.67 | A++ | 0.70 |
| ID#165 | 27.35 | 35.00 | 0.94 | A | 1.28 |
| ID#166 | 48.01 | 52.00 | 0.88 | A+ | 1.08 |
| ID#167 | 27.35 | 35.00 | 0.94 | A | 1.28 |
| ID#168 | 49.84 | 51.00 | 0.84 | A+ | 1.02 |
| ID#169 | 49.84 | 51.00 | 0.84 | A+ | 1.02 |

| ID Number | Area (dm²) | Watts | EEI | Energy class | Specific Power |
|---|---|---|---|---|---|
| ID#170 | 49.84 | 51.00 | 0.84 | A+ | 1.02 |
| ID#171 | 27.35 | 25.00 | 0.65 | A+ | 0.91 |
| ID#172 | 27.35 | 25.00 | 0.65 | A+ | 0.91 |
| ID#173 | 49.84 | 51.00 | 0.84 | A+ | 1.02 |
| ID#174 | 27.35 | 35.00 | 0.94 | A | 1.28 |
| ID#175 | 27.35 | 35.00 | 0.94 | A | 1.28 |
| ID#176 | 12.93 | 22.00 | 1.02 | A | 1.70 |
| ID#177 | 20.94 | 31.00 | 1.02 | A | 1.48 |
| ID#178 | 27.35 | 41.00 | 1.11 | A | 1.50 |
| ID#179 | 48.01 | 55.00 | 0.93 | A | 1.15 |
| ID#180 | 27.35 | 41.00 | 1.11 | A | 1.50 |
| ID#181 | 48.01 | 64.00 | 1.09 | A | 1.33 |
| ID#182 | 41.04 | 51.00 | 0.99 | A | 1.24 |
| ID#183 | 60.51 | 67.00 | 0.94 | A | 1.11 |
| ID#184 | 12.93 | 16.00 | 0.71 | A+ | 1.24 |
| ID#185 | 20.94 | 21.00 | 0.67 | A+ | 1.00 |
| ID#186 | 27.35 | 36.00 | 0.97 | A | 1.32 |
| ID#187 | 41.04 | 56.00 | 1.09 | A | 1.36 |
| ID#188 | 48.01 | 66.00 | 1.13 | A | 1.37 |
| ID#189 | 60.51 | 60.00 | 0.84 | A+ | 0.99 |
| ID#190 | 82.56 | 84.00 | 0.91 | A+ | 1.02 |
| ID#191 | 97.43 | 79.00 | 0.75 | A+ | 0.81 |
| ID#192 | 12.93 | 16.00 | 0.71 | A+ | 1.24 |
| ID#193 | 20.94 | 21.00 | 0.67 | A+ | 1.00 |
| ID#194 | 48.01 | 66.00 | 1.13 | A | 1.37 |
| ID#195 | 27.35 | 36.00 | 0.97 | A | 1.32 |
| ID#196 | 27.35 | 42.00 | 1.14 | A | 1.54 |
| ID#197 | 41.04 | 56.00 | 1.09 | A | 1.36 |
| ID#198 | 48.01 | 66.00 | 1.13 | A | 1.37 |
| ID#199 | 60.51 | 60.00 | 0.84 | A+ | 0.99 |
| ID#200 | 82.56 | 84.00 | 0.91 | A+ | 1.02 |
| ID#201 | 97.43 | 79.00 | 0.75 | A+ | 0.81 |
| ID#202 | 12.93 | 17.00 | 0.76 | A+ | 1.32 |
| ID#203 | 20.94 | 21.00 | 0.67 | A+ | 1.00 |
| ID#204 | 27.35 | 41.00 | 1.11 | A | 1.50 |
| ID#205 | 41.04 | 50.00 | 0.97 | A | 1.22 |
| ID#206 | 48.01 | 51.00 | 0.86 | A+ | 1.06 |
| ID#207 | 60.51 | 54.00 | 0.75 | A+ | 0.89 |
| ID#208 | 82.56 | 70.00 | 0.76 | A+ | 0.85 |
| ID#209 | 48.01 | 58.00 | 0.99 | A | 1.21 |
| ID#210 | 60.51 | 60.00 | 0.84 | A+ | 0.99 |
| ID#211 | 82.56 | 77.00 | 0.83 | A+ | 0.93 |
| ID#212 | 97.43 | 79.00 | 0.75 | A+ | 0.81 |
| ID#213 | 12.93 | 17.00 | 0.76 | A+ | 1.32 |
| ID#214 | 20.94 | 21.00 | 0.67 | A+ | 1.00 |
| ID#215 | 27.35 | 41.00 | 1.11 | A | 1.50 |
| ID#216 | 41.04 | 51.00 | 0.99 | A | 1.24 |
| ID#217 | 48.01 | 55.00 | 0.93 | A | 1.15 |
| ID#218 | 60.51 | 67.00 | 0.94 | A | 1.11 |
| ID#219 | 82.56 | 87.00 | 0.95 | A | 1.05 |
| ID#220 | 27.35 | 41.00 | 1.11 | A | 1.50 |
| ID#221 | 41.04 | 58.00 | 1.13 | A | 1.41 |
| ID#222 | 48.01 | 64.00 | 1.09 | A | 1.33 |
| ID#223 | 60.51 | 62.00 | 0.87 | A+ | 1.02 |
| ID#224 | 82.56 | 85.00 | 0.92 | A+ | 1.03 |
| ID#225 | 48.01 | 49.00 | 0.83 | A+ | 1.02 |
| ID#226 | 60.51 | 49.00 | 0.68 | A+ | 0.81 |
| ID#227 | 82.56 | 68.00 | 0.73 | A+ | 0.82 |
| ID#228 | 97.43 | 70.00 | 0.66 | A++ | 0.72 |

| ID Number | Area (dm²) | Watts | EEI | Energy class | Specific Power |
|---|---|---|---|---|---|
| ID#229 | 28.04 | 44.00 | 1.17 | A | 1.57 |
| ID#230 | 44.46 | 61.00 | 1.11 | A | 1.37 |
| ID#231 | 44.46 | 61.00 | 1.11 | A | 1.37 |
| ID#232 | 27.35 | 34.00 | 0.91 | A | 1.24 |
| ID#233 | 15.90 | 20.00 | 0.79 | A | 1.26 |
| ID#234 | 81.37 | 87.00 | 0.96 | A | 1.07 |
| ID#235 | 64.65 | 73.00 | 0.97 | A | 1.13 |
| ID#236 | 81.37 | 68.00 | 0.74 | A+ | 0.84 |
| ID#237 | 64.65 | 64.00 | 0.85 | A+ | 0.99 |
| ID#238 | 27.35 | 40.00 | 1.08 | A | 1.46 |
| ID#239 | 81.37 | 68.00 | 0.74 | A+ | 0.84 |
| ID#240 | 64.65 | 64.00 | 0.85 | A+ | 0.99 |
| ID#241 | 43.59 | 54.00 | 1.00 | A | 1.24 |
| ID#242 | 98.72 | 70.00 | 0.66 | A++ | 0.71 |
| ID#243 | 66.77 | 71.00 | 0.92 | A+ | 1.06 |
| ID#244 | 81.37 | 75.00 | 0.82 | A+ | 0.92 |
| ID#245 | 64.65 | 64.00 | 0.85 | A+ | 0.99 |
| ID#246 | 81.37 | 66.00 | 0.72 | A+ | 0.81 |
| ID#247 | 43.59 | 55.00 | 1.02 | A | 1.26 |
| ID#248 | 27.35 | 40.00 | 1.08 | A | 1.46 |
| ID#249 | 43.59 | 48.00 | 0.88 | A+ | 1.10 |
| ID#250 | 43.59 | 48.00 | 0.88 | A+ | 1.10 |
| ID#251 | 27.35 | 26.00 | 0.68 | A+ | 0.95 |
| ID#252 | 27.35 | 26.00 | 0.68 | A+ | 0.95 |
| ID#253 | 176.09 | 174.00 | 1.13 | A+ | 0.99 |
| ID#254 | 133.87 | 135.00 | 1.03 | A+ | 1.01 |
| ID#255 | 98.72 | 109.00 | 1.03 | A+ | 1.10 |
| ID#256 | 98.72 | 100.00 | 0.95 | A+ | 1.01 |
| ID#257 | 98.72 | 100.00 | 0.95 | A+ | 1.01 |
| ID#258 | 67.84 | 70.00 | 0.89 | A+ | 1.03 |
| ID#259 | 67.84 | 70.00 | 0.89 | A+ | 1.03 |
| ID#260 | 67.84 | 83.00 | 1.06 | A | 1.22 |
| ID#261 | 58.49 | 46.00 | 0.65 | A | 0.79 |
| ID#262 | 50.77 | 46.00 | 0.74 | A+ | 0.91 |
| ID#263 | 48.01 | 49.00 | 0.83 | A+ | 1.02 |
| ID#264 | 48.92 | 68.00 | 1.14 | A | 1.39 |
| ID#265 | 48.92 | 68.00 | 1.14 | A | 1.39 |
| ID#266 | 27.35 | 35.00 | 0.94 | A | 1.28 |
| ID#267 | 44.46 | 48.00 | 0.87 | A+ | 1.08 |
| ID#268 | 62.56 | 58.00 | 0.79 | A+ | 0.93 |
| ID#269 | 49.84 | 55.00 | 0.90 | A+ | 1.10 |
| ID#270 | 67.84 | 72.00 | 0.92 | A+ | 1.06 |
| ID#271 | 67.84 | 72.00 | 0.92 | A+ | 1.06 |
| ID#272 | 67.84 | 72.00 | 0.92 | A+ | 1.06 |
| ID#273 | 82.56 | 75.00 | 0.81 | A+ | 0.91 |
| ID#274 | 82.56 | 75.00 | 0.81 | A+ | 0.91 |
| ID#275 | 114.93 | 123.00 | 1.04 | A+ | 1.07 |
| ID#276 | 49.84 | 55.00 | 0.90 | A+ | 1.10 |
| ID#277 | 27.35 | 38.00 | 1.02 | A+ | 1.39 |
| ID#278 | 44.46 | 44.00 | 0.79 | A+ | 0.99 |
| ID#279 | 62.56 | 46.00 | 0.62 | A++ | 0.74 |
| ID#280 | 44.46 | 43.00 | 0.77 | A+ | 0.97 |
| ID#281 | 62.56 | 46.00 | 0.62 | A++ | 0.74 |
| ID#282 | 27.35 | 31.00 | 0.82 | A+ | 1.13 |
| ID#283 | 82.56 | 103.00 | 1.12 | A | 1.25 |
| ID#284 | 44.46 | 48.00 | 0.87 | A+ | 1.08 |
| ID#285 | 44.46 | 45.00 | 0.81 | A+ | 1.01 |
| ID#286 | 27.35 | 35.00 | 0.94 | A | 1.28 |
| ID#287 | 83.75 | 74.00 | 0.79 | A+ | 0.88 |

| ID Number | Area (dm²) | Watts | EEI | Energy class | Specific Power |
|---|---|---|---|---|---|
| ID#288 | 83.75 | 74.00 | 0.79 | A+ | 0.88 |
| ID#289 | 28.04 | 31.00 | 0.81 | A+ | 1.11 |
| ID#290 | 21.54 | 22.00 | 0.69 | A+ | 1.02 |
| ID#291 | 21.54 | 22.00 | 0.69 | A+ | 1.02 |
| ID#292 | 15.90 | 25.00 | 1.01 | A | 1.57 |
| ID#293 | 15.90 | 25.00 | 1.01 | A | 1.57 |
| ID#294 | 28.04 | 25.00 | 0.64 | A+ | 0.89 |
| ID#295 | 28.04 | 25.00 | 0.64 | A+ | 0.89 |
| ID#296 | 28.04 | 25.00 | 0.64 | A+ | 0.89 |
| ID#297 | 28.04 | 25.00 | 0.64 | A+ | 0.89 |
| ID#298 | 28.04 | 25.00 | 0.64 | A+ | 0.89 |
| ID#299 | 83.75 | 86.00 | 0.92 | A+ | 1.03 |
| ID#300 | 27.35 | 31.00 | 0.82 | A+ | 1.13 |
| ID#301 | 27.35 | 30.00 | 0.80 | A+ | 1.10 |
| ID#302 | 15.90 | 18.00 | 0.70 | A+ | 1.13 |
| ID#303 | 44.46 | 46.00 | 0.83 | A+ | 1.03 |
| ID#304 | 12.93 | 20.00 | 0.91 | A | 1.55 |

## Table A.2. Ultra High Definition Displays - 2016 Model Database

| ID Number | Area (dm²) | Watts | EEI | Energy class | Specific Power |
|---|---|---|---|---|---|
| ID#305 | 82.559 | 134.00 | 1.47 | B | 1.623 |
| ID#306 | 83.751 | 142.00 | 1.54 | A | 1.696 |
| ID#307 | 91.083 | 68.00 | 0.68 | A | 0.747 |
| ID#308 | 92.335 | 68.00 | 0.67 | A | 0.736 |
| ID#309 | 93.596 | 68.00 | 0.66 | A | 0.727 |
| ID#310 | 94.865 | 68.00 | 0.66 | A | 0.717 |
| ID#311 | 96.142 | 67.00 | 0.64 | A+ | 0.697 |
| ID#312 | 97.429 | 67.00 | 0.63 | A+ | 0.688 |
| ID#313 | 98.723 | 67.00 | 0.63 | A+ | 0.679 |
| ID#314 | 100.027 | 67.00 | 0.62 | A+ | 0.670 |
| ID#315 | 101.338 | 84.00 | 0.78 | A+ | 0.829 |
| ID#316 | 102.659 | 84.00 | 0.77 | A+ | 0.818 |
| ID#317 | 103.988 | 84.00 | 0.76 | A+ | 0.808 |
| ID#318 | 105.325 | 84.00 | 0.75 | A+ | 0.798 |
| ID#319 | 106.671 | 100.00 | 0.89 | A+ | 0.937 |
| ID#320 | 108.026 | 100.00 | 0.88 | A+ | 0.926 |
| ID#321 | 109.389 | 100.00 | 0.88 | A+ | 0.914 |
| ID#322 | 110.760 | 100.00 | 0.87 | A+ | 0.903 |
| ID#323 | 112.141 | 116.00 | 1.00 | A+ | 1.034 |
| ID#324 | 113.529 | 116.00 | 0.99 | A+ | 1.022 |
| ID#325 | 114.927 | 116.00 | 0.98 | A+ | 1.009 |
| ID#326 | 116.332 | 116.00 | 0.97 | A+ | 0.997 |
| ID#327 | 117.747 | 129.00 | 1.07 | A+ | 1.096 |
| ID#328 | 82.559 | 85.00 | 0.92 | A+ | 1.030 |
| ID#329 | 64.646 | 57.00 | 0.75 | A+ | 0.882 |
| ID#330 | 114.927 | 77.00 | 0.65 | A++ | 0.670 |
| ID#331 | 42.730 | 41.00 | 0.76 | A+ | 0.960 |
| ID#332 | 64.646 | 84.00 | 1.12 | A | 1.299 |
| ID#333 | 97.429 | 98.00 | 0.94 | A+ | 1.006 |
| ID#334 | 114.927 | 114.00 | 0.96 | A+ | 0.992 |
| ID#335 | 64.646 | 57.00 | 0.75 | A+ | 0.882 |
| ID#336 | 64.646 | 57.00 | 0.75 | A+ | 0.882 |
| ID#337 | 64.646 | 57.00 | 0.75 | A+ | 0.882 |
| ID#338 | 49.840 | 52.00 | 0.85 | A+ | 1.043 |
| ID#339 | 49.840 | 52.00 | 0.85 | A+ | 1.043 |
| ID#340 | 49.840 | 52.00 | 0.85 | A+ | 1.043 |
| ID#341 | 82.559 | 76.00 | 0.82 | A+ | 0.921 |
| ID#342 | 82.559 | 76.00 | 0.82 | A+ | 0.921 |
| ID#343 | 82.559 | 76.00 | 0.82 | A+ | 0.921 |
| ID#344 | 82.559 | 76.00 | 0.82 | A+ | 0.921 |
| ID#345 | 97.429 | 69.00 | 0.65 | A++ | 0.708 |
| ID#346 | 49.840 | 51.00 | 0.84 | A+ | 1.023 |
| ID#347 | 64.646 | 66.00 | 0.87 | A+ | 1.021 |
| ID#348 | 82.559 | 73.00 | 0.79 | A+ | 0.884 |
| ID#349 | 114.927 | 76.00 | 0.64 | A++ | 0.661 |
| ID#350 | 114.927 | 76.00 | 0.64 | A++ | 0.661 |
| ID#351 | 82.559 | 106.00 | 1.16 | A | 1.284 |
| ID#352 | 114.927 | 110.00 | 0.93 | A+ | 0.957 |
| ID#353 | 91.083 | 87.00 | 0.87 | A+ | 0.955 |
| ID#354 | 67.838 | 66.00 | 0.84 | A+ | 0.973 |
| ID#355 | 152.636 | 178.00 | 1.26 | A | 1.166 |
| ID#356 | 152.636 | 178.00 | 1.26 | A | 1.166 |
| ID#357 | 114.927 | 76.00 | 0.64 | A++ | 0.661 |
| ID#358 | 114.927 | 76.00 | 0.64 | A++ | 0.661 |
| ID#359 | 49.840 | 52.00 | 0.85 | A+ | 1.043 |
| ID#360 | 201.211 | 187.00 | 1.14 | A+ | 0.929 |
| ID#361 | 48.011 | 58.00 | 0.99 | A | 1.208 |

| ID Number | Area (dm²) | Watts | EEI | Energy class | Specific Power |
|---|---|---|---|---|---|
| ID#362 | 82.559 | 108.00 | 1.18 | A | 1.308 |
| ID#363 | 82.559 | 108.00 | 1.18 | A | 1.308 |
| ID#364 | 42.730 | 60.00 | 1.13 | A | 1.404 |
| ID#365 | 64.646 | 87.00 | 1.16 | A | 1.346 |
| ID#366 | 82.559 | 108.00 | 1.18 | A | 1.308 |
| ID#367 | 64.646 | 87.00 | 1.16 | A | 1.346 |
| ID#368 | 64.646 | 87.00 | 1.16 | A | 1.346 |
| ID#369 | 64.646 | 78.00 | 1.04 | A | 1.207 |
| ID#370 | 82.559 | 85.00 | 0.92 | A+ | 1.030 |
| ID#371 | 97.429 | 97.00 | 0.93 | A+ | 0.996 |
| ID#372 | 114.927 | 106.00 | 0.90 | A+ | 0.922 |
| ID#373 | 133.869 | 134.00 | 1.02 | A+ | 1.001 |
| ID#374 | 49.840 | 53.00 | 0.87 | A+ | 1.063 |
| ID#375 | 49.840 | 53.00 | 0.87 | A+ | 1.063 |
| ID#376 | 49.840 | 53.00 | 0.87 | A+ | 1.063 |
| ID#377 | 82.559 | 78.00 | 0.85 | A+ | 0.945 |
| ID#378 | 81.375 | 78.00 | 0.86 | A+ | 0.959 |
| ID#379 | 114.927 | 73.00 | 0.61 | A++ | 0.635 |
| ID#380 | 114.927 | 73.00 | 0.61 | A++ | 0.635 |
| ID#381 | 82.559 | 145.00 | 1.59 | B | 1.756 |
| ID#382 | 82.559 | 145.00 | 1.59 | B | 1.756 |
| ID#383 | 114.927 | 145.00 | 1.23 | A | 1.262 |
| ID#384 | 82.559 | 145.00 | 1.59 | B | 1.756 |
| ID#385 | 82.559 | 145.00 | 1.59 | B | 1.756 |
| ID#386 | 114.927 | 145.00 | 1.23 | A | 1.262 |
| ID#387 | 114.927 | 145.00 | 1.23 | A | 1.262 |
| ID#388 | 114.927 | 145.00 | 1.23 | A | 1.262 |
| ID#389 | 64.646 | 63.00 | 0.83 | A+ | 0.975 |
| ID#390 | 64.646 | 63.00 | 0.83 | A+ | 0.975 |
| ID#391 | 114.927 | 145.00 | 1.23 | A | 1.262 |
| ID#392 | 114.927 | 145.00 | 1.23 | A | 1.262 |
| ID#393 | 82.559 | 145.00 | 1.59 | B | 1.756 |
| ID#394 | 82.559 | 145.00 | 1.59 | B | 1.756 |
| ID#395 | 82.559 | 145.00 | 1.59 | B | 1.756 |
| ID#396 | 114.927 | 145.00 | 1.23 | A | 1.262 |
| ID#397 | 114.927 | 145.00 | 1.23 | A | 1.262 |
| ID#398 | 114.927 | 145.00 | 1.23 | A | 1.262 |
| ID#399 | 64.646 | 66.00 | 0.87 | A+ | 1.021 |
| ID#400 | 64.646 | 66.00 | 0.87 | A+ | 1.021 |
| ID#401 | 64.646 | 66.00 | 0.87 | A+ | 1.021 |
| ID#402 | 64.646 | 66.00 | 0.87 | A+ | 1.021 |
| ID#403 | 64.646 | 66.00 | 0.87 | A+ | 1.021 |
| ID#404 | 64.646 | 66.00 | 0.87 | A+ | 1.021 |
| ID#405 | 82.559 | 80.00 | 0.87 | A+ | 0.969 |
| ID#406 | 82.559 | 80.00 | 0.87 | A+ | 0.969 |
| ID#407 | 82.559 | 80.00 | 0.87 | A+ | 0.969 |
| ID#408 | 82.559 | 80.00 | 0.87 | A+ | 0.969 |
| ID#409 | 82.559 | 80.00 | 0.87 | A+ | 0.969 |
| ID#410 | 82.559 | 80.00 | 0.87 | A+ | 0.969 |
| ID#411 | 97.429 | 100.00 | 0.96 | A+ | 1.026 |
| ID#412 | 97.429 | 100.00 | 0.96 | A+ | 1.026 |
| ID#413 | 97.429 | 100.00 | 0.96 | A+ | 1.026 |
| ID#414 | 97.429 | 100.00 | 0.96 | A+ | 1.026 |
| ID#415 | 97.429 | 100.00 | 0.96 | A+ | 1.026 |
| ID#416 | 97.429 | 100.00 | 0.96 | A+ | 1.026 |
| ID#417 | 114.927 | 116.00 | 0.98 | A+ | 1.009 |
| ID#418 | 114.927 | 116.00 | 0.98 | A+ | 1.009 |
| ID#419 | 114.927 | 116.00 | 0.98 | A+ | 1.009 |
| ID#420 | 114.927 | 116.00 | 0.98 | A+ | 1.009 |

| ID Number | Area (dm²) | Watts | EEI | Energy class | Specific Power |
|---|---|---|---|---|---|
| ID#421 | 114.927 | 116.00 | 0.98 | A+ | 1.009 |
| ID#422 | 114.927 | 116.00 | 0.98 | A+ | 1.009 |
| ID#423 | 82.559 | 84.00 | 0.91 | A+ | 1.017 |
| ID#424 | 64.646 | 88.00 | 1.17 | A | 1.361 |
| ID#425 | 64.646 | 68.00 | 0.90 | A+ | 1.052 |
| ID#426 | 114.927 | 116.00 | 0.98 | A+ | 1.009 |
| ID#427 | 97.429 | 100.00 | 0.96 | A+ | 1.026 |
| ID#428 | 82.559 | 84.00 | 0.91 | A+ | 1.017 |
| ID#429 | 64.646 | 67.00 | 0.89 | A+ | 1.036 |
| ID#430 | 49.840 | 68.00 | 1.13 | A | 1.364 |
| ID#431 | 49.840 | 65.00 | 1.08 | A | 1.304 |
| ID#432 | 42.730 | 60.00 | 1.13 | A | 1.404 |
| ID#433 | 42.730 | 60.00 | 1.13 | A | 1.404 |
| ID#434 | 42.730 | 60.00 | 1.13 | A | 1.404 |
| ID#435 | 42.730 | 60.00 | 1.13 | A | 1.404 |
| ID#436 | 42.730 | 60.00 | 1.13 | A | 1.404 |
| ID#437 | 82.559 | 110.00 | 1.20 | A | 1.332 |
| ID#438 | 114.927 | 127.00 | 1.08 | A | 1.105 |
| ID#439 | 64.646 | 123.00 | 1.65 | B | 1.903 |
| ID#440 | 82.559 | 111.00 | 1.21 | A | 1.344 |
| ID#441 | 82.559 | 106.00 | 1.16 | A | 1.284 |
| ID#442 | 114.927 | 152.00 | 1.29 | A | 1.323 |
| ID#443 | 170.920 | 169.00 | 1.12 | A+ | 0.989 |
| ID#444 | 193.862 | 251.00 | 1.56 | A | 1.295 |
| ID#445 | 114.927 | 127.00 | 1.08 | A | 1.105 |
| ID#446 | 83.751 | 149.00 | 1.62 | B | 1.779 |
| ID#447 | 199.361 | 378.00 | 2.33 | B | 1.896 |
| ID#448 | 152.636 | 252.00 | 1.78 | B | 1.651 |
| ID#449 | 44.456 | 81.00 | 1.49 | B | 1.822 |
| ID#450 | 63.599 | 106.00 | 1.44 | B | 1.667 |
| ID#451 | 83.751 | 152.00 | 1.65 | B | 1.815 |
| ID#452 | 44.456 | 79.00 | 1.45 | B | 1.777 |
| ID#453 | 63.599 | 104.00 | 1.41 | B | 1.635 |
| ID#454 | 83.751 | 150.00 | 1.63 | B | 1.791 |
| ID#455 | 83.751 | 159.00 | 1.73 | B | 1.898 |
| ID#456 | 64.646 | 84.00 | 1.12 | A | 1.299 |
| ID#457 | 82.559 | 115.00 | 1.26 | A | 1.393 |
| ID#458 | 82.559 | 115.00 | 1.26 | A | 1.393 |
| ID#459 | 64.646 | 84.00 | 1.12 | A | 1.299 |
| ID#460 | 42.730 | 68.00 | 1.29 | B | 1.591 |
| ID#461 | 114.927 | 214.00 | 1.83 | B | 1.862 |
| ID#462 | 114.927 | 226.00 | 1.93 | B | 1.966 |
| ID#463 | 91.083 | 183.00 | 1.86 | B | 2.009 |
| ID#464 | 91.083 | 113.00 | 1.14 | A | 1.241 |
| ID#465 | 67.838 | 82.00 | 1.05 | A | 1.209 |
| ID#466 | 114.927 | 159.00 | 1.35 | A | 1.383 |
| ID#467 | 91.083 | 109.00 | 1.10 | A | 1.197 |
| ID#468 | 67.838 | 88.00 | 1.13 | A | 1.297 |
| ID#469 | 42.730 | 84.00 | 1.60 | B | 1.966 |
| ID#470 | 114.927 | 105.00 | 0.89 | A+ | 0.914 |
| ID#471 | 114.927 | 121.00 | 1.02 | A | 1.053 |
| ID#472 | 82.559 | 97.00 | 1.06 | A | 1.175 |
| ID#473 | 82.559 | 97.00 | 1.06 | A | 1.175 |
| ID#474 | 82.559 | 105.00 | 1.15 | A | 1.272 |
| ID#475 | 82.559 | 105.00 | 1.15 | A | 1.272 |
| ID#476 | 82.559 | 105.00 | 1.15 | A | 1.272 |
| ID#477 | 82.559 | 91.00 | 0.99 | A | 1.102 |
| ID#478 | 64.646 | 89.00 | 1.19 | A | 1.377 |
| ID#479 | 64.646 | 89.00 | 1.19 | A | 1.377 |

| ID Number | Area (dm²) | Watts | EEI | Energy class | Specific Power |
|---|---|---|---|---|---|
| ID#480 | 64.646 | 99.00 | 1.32 | B | 1.531 |
| ID#481 | 64.646 | 99.00 | 1.32 | B | 1.531 |
| ID#482 | 64.646 | 99.00 | 1.32 | B | 1.531 |
| ID#483 | 64.646 | 87.00 | 1.16 | A | 1.346 |
| ID#484 | 49.840 | 77.00 | 1.28 | B | 1.545 |
| ID#485 | 114.927 | 124.00 | 1.05 | A+ | 1.079 |
| ID#486 | 49.840 | 65.00 | 1.08 | A | 1.304 |
| ID#487 | 113.529 | 153.00 | 1.31 | A | 1.348 |
| ID#488 | 113.529 | 118.00 | 1.01 | A+ | 1.039 |
| ID#489 | 81.375 | 111.00 | 1.23 | A | 1.364 |
| ID#490 | 64.646 | 89.00 | 1.19 | A | 1.377 |
| ID#491 | 49.840 | 70.00 | 1.16 | A | 1.404 |
| ID#492 | 132.360 | 177.00 | 1.37 | A | 1.337 |
| ID#493 | 43.589 | 62.00 | 1.15 | A | 1.422 |
| ID#494 | 66.766 | 93.00 | 1.21 | A | 1.393 |
| ID#495 | 81.375 | 111.00 | 1.23 | A | 1.364 |
| ID#496 | 212.492 | 280.00 | 1.68 | A | 1.318 |
| ID#497 | 167.519 | 221.00 | 1.48 | A | 1.319 |
| ID#498 | 167.519 | 170.00 | 1.14 | A+ | 1.015 |
| ID#499 | 113.529 | 118.00 | 1.01 | A+ | 1.039 |
| ID#500 | 81.375 | 85.00 | 0.93 | A+ | 1.045 |
| ID#501 | 64.646 | 84.00 | 1.12 | A | 1.299 |
| ID#502 | 152.636 | 156.00 | 1.10 | A+ | 1.022 |
| ID#503 | 113.529 | 118.00 | 1.01 | A+ | 1.039 |
| ID#504 | 81.375 | 85.00 | 0.93 | A+ | 1.045 |
| ID#505 | 64.646 | 84.00 | 1.12 | A | 1.299 |
| ID#506 | 49.840 | 70.00 | 1.16 | A | 1.404 |
| ID#507 | 64.646 | 89.00 | 1.19 | A | 1.377 |
| ID#508 | 81.375 | 111.00 | 1.23 | A | 1.364 |
| ID#509 | 113.529 | 118.00 | 1.01 | A+ | 1.039 |
| ID#510 | 43.589 | 62.00 | 1.15 | A | 1.422 |
| ID#511 | 113.529 | 118.00 | 1.01 | A+ | 1.039 |
| ID#512 | 98.723 | 102.00 | 0.97 | A+ | 1.033 |
| ID#513 | 81.375 | 85.00 | 0.93 | A+ | 1.045 |
| ID#514 | 64.646 | 84.00 | 1.12 | A | 1.299 |
| ID#515 | 64.646 | 89.00 | 1.19 | A | 1.377 |
| ID#516 | 81.375 | 111.00 | 1.23 | A | 1.364 |
| ID#517 | 49.840 | 70.00 | 1.16 | A | 1.404 |
| ID#518 | 64.646 | 89.00 | 1.19 | A | 1.377 |
| ID#519 | 81.375 | 111.00 | 1.23 | A | 1.364 |
| ID#520 | 43.589 | 62.00 | 1.15 | A | 1.422 |
| ID#521 | 66.766 | 93.00 | 1.21 | A | 1.393 |
| ID#522 | 81.375 | 85.00 | 0.93 | A+ | 1.045 |
| ID#523 | 98.723 | 99.00 | 0.94 | A+ | 1.003 |
| ID#524 | 113.529 | 118.00 | 1.01 | A+ | 1.039 |
| ID#525 | 81.375 | 111.00 | 1.23 | A | 1.364 |
| ID#526 | 64.646 | 89.00 | 1.19 | A | 1.377 |
| ID#527 | 113.529 | 153.00 | 1.31 | A | 1.348 |
| ID#528 | 81.375 | 111.00 | 1.23 | A | 1.364 |
| ID#529 | 64.646 | 89.00 | 1.19 | A | 1.377 |
| ID#530 | 82.559 | 166.00 | 1.83 | B | 2.011 |
| ID#531 | 114.927 | 192.00 | 1.64 | B | 1.671 |
| ID#532 | 154.255 | 299.00 | 2.10 | B | 1.938 |
| ID#533 | 114.927 | 210.00 | 1.79 | B | 1.827 |
| ID#534 | 152.636 | 259.00 | 1.83 | B | 1.697 |
| ID#535 | 273.510 | 413.00 | 2.29 | B | 1.510 |
| ID#536 | 82.559 | 112.00 | 1.22 | A | 1.357 |
| ID#537 | 114.927 | 171.00 | 1.46 | A+ | 1.488 |
| ID#538 | 49.840 | 82.00 | 1.37 | B | 1.645 |

| ID Number | Area (dm²) | Watts | EEI | Energy class | Specific Power |
|---|---|---|---|---|---|
| ID#539 | 64.646 | 80.00 | 1.06 | A | 1.238 |
| ID#540 | 49.840 | 82.00 | 1.37 | B | 1.645 |
| ID#541 | 64.646 | 80.00 | 1.06 | A | 1.238 |
| ID#542 | 49.840 | 82.00 | 1.37 | B | 1.645 |
| ID#543 | 82.559 | 93.00 | 1.01 | A | 1.126 |
| ID#544 | 82.559 | 115.00 | 1.26 | A | 1.393 |
| ID#545 | 114.927 | 149.00 | 1.27 | A | 1.296 |
| ID#546 | 114.927 | 149.00 | 1.27 | A | 1.296 |
| ID#547 | 82.559 | 115.00 | 1.26 | A | 1.393 |
| ID#548 | 82.559 | 115.00 | 1.26 | A | 1.393 |
| ID#549 | 67.838 | 92.00 | 1.18 | A | 1.356 |
| ID#550 | 154.255 | 147.00 | 1.03 | A+ | 0.953 |
| ID#551 | 197.519 | 168.00 | 1.03 | A+ | 0.851 |
| ID#552 | 82.559 | 103.00 | 1.12 | A | 1.248 |
| ID#553 | 114.927 | 149.00 | 1.27 | A | 1.296 |
| ID#554 | 154.255 | 202.00 | 1.42 | A | 1.310 |
| ID#555 | 114.927 | 167.00 | 1.42 | B | 1.453 |
| ID#556 | 82.559 | 134.00 | 1.47 | B | 1.623 |
| ID#557 | 83.751 | 105.00 | 1.13 | A+ | 1.254 |
| ID#558 | 116.332 | 88.00 | 0.73 | A+ | 0.756 |
| ID#559 | 83.751 | 74.00 | 0.79 | A+ | 0.884 |
| ID#560 | 83.751 | 112.00 | 1.21 | A | 1.337 |
| ID#561 | 116.332 | 88.00 | 0.73 | A+ | 0.756 |
| ID#562 | 116.332 | 88.00 | 0.73 | A+ | 0.756 |
| ID#563 | 68.919 | 80.00 | 1.01 | A | 1.161 |
| ID#564 | 83.751 | 85.00 | 0.91 | A+ | 1.015 |
| ID#565 | 83.751 | 85.00 | 0.91 | A+ | 1.015 |
| ID#566 | 44.456 | 62.00 | 1.13 | A | 1.395 |
| ID#567 | 116.332 | 88.00 | 0.73 | A+ | 0.756 |
| ID#568 | 83.751 | 74.00 | 0.79 | A+ | 0.884 |
| ID#569 | 83.751 | 85.00 | 0.91 | A+ | 1.015 |
| ID#570 | 116.332 | 88.00 | 0.73 | A+ | 0.756 |
| ID#571 | 68.919 | 80.00 | 1.01 | A | 1.161 |
| ID#572 | 68.919 | 80.00 | 1.01 | A | 1.161 |
| ID#573 | 83.751 | 74.00 | 0.79 | A+ | 0.884 |
| ID#574 | 68.919 | 93.00 | 1.18 | A+ | 1.349 |
| ID#575 | 68.919 | 68.00 | 0.85 | A+ | 0.987 |
| ID#576 | 83.751 | 86.00 | 0.92 | A+ | 1.027 |
| ID#577 | 44.456 | 63.00 | 1.15 | A | 1.417 |
| ID#578 | 62.561 | 87.00 | 1.19 | A | 1.391 |