Shifting Consumers to Efficient Lighting – South Africa's Lighting Information Label

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Abstract

Rapid technological improvements in residential lighting have yielded large electricity savings for consumers around the world. South Africa distributed over 70 million compact fluorescent lamps (CFL) to households from 2008 to stave off power outages during peak demand periods. The sheer volume and speed with which these lamps were introduced into the market resulted in CFL's becoming the country's *de facto* symbol of energy efficiency. Indeed, research based on 2018 data has found that despite LED's being as prevalent and costing the same, often less than CFL's, South Africans continue to prefer the outdated technology by a ratio of over 2:1 (55% versus 24%) notwithstanding that CFL's consume more electricity, have a shorter lifespan, and whose mercury content has very negative environmental consequences.

The Department of Energy's residential standards and labelling (S&L) program is developing a strategy to correct this. Mandatory technology neutral technical specifications will remove inefficient lamps, however introducing legislation takes time. For the short term, an awareness campaign is being devised to educate consumers at the point of sale. Recognising that lamps are an extremely low engagement commodity item, where the myriad of choices tends to result in consumers buying on a like for like basis, the campaign seeks to develop a communication message to break the cycle. National focus groups and surveys were conducted to develop an information label to influence purchase decisions.

The paper describes the evolution of the design of the South African information residential lighting label from inception to final version (before and after), detailing consumer insights and decision-making criteria of household consumers from all income groups. In an effort to evaluate the effectiveness of the new information label, the authors contacted the original research participants to determine the impact, if any, that the campaign has had on their purchase decisions - the overwhelming majority of whom had a very limited understanding of LED's and were committed users of CFL technology.

Background and Context

Power shortages were first experienced regionally (Cape Town) in 2005 and then nationally in 2007, when for the first time since the mid 1970's the national vertically integrated utility, Eskom was unable to meet demand. The supply shortages led to persistent national rolling blackouts which have had a devastating effect on the economy. Twelve years later, in 2019, Eskom is still not able to guarantee uninterrupted supply. The most severe supply shortages, i.e. rolling blackouts lasting weeks at a time, occurred during three periods – the first was 2007 - 2008, the second 2014 -15 and the third in 2019. Although the power supply has been relatively stable between these periods the threat of the next period of outages weighs heavily on citizens of the country.

Government and Eskom's solution was the construction of new generation plants (9.6GW), which were commissioned in 2005, but such mega-projects take time and thus a medium to long term solution. The plan to address the immediate crisis included upgrading and strengthening the existing, but aging, fleet; re-commissioning out of service power stations; and ramping up what was then a largely neglected Demand Side Management (DSM) Program[1]. The DSM program's primary objective was to manage demand during the morning and afternoon peaks, when the system was most vulnerable. Overall total demand, because of these targeted measures, would decrease but load

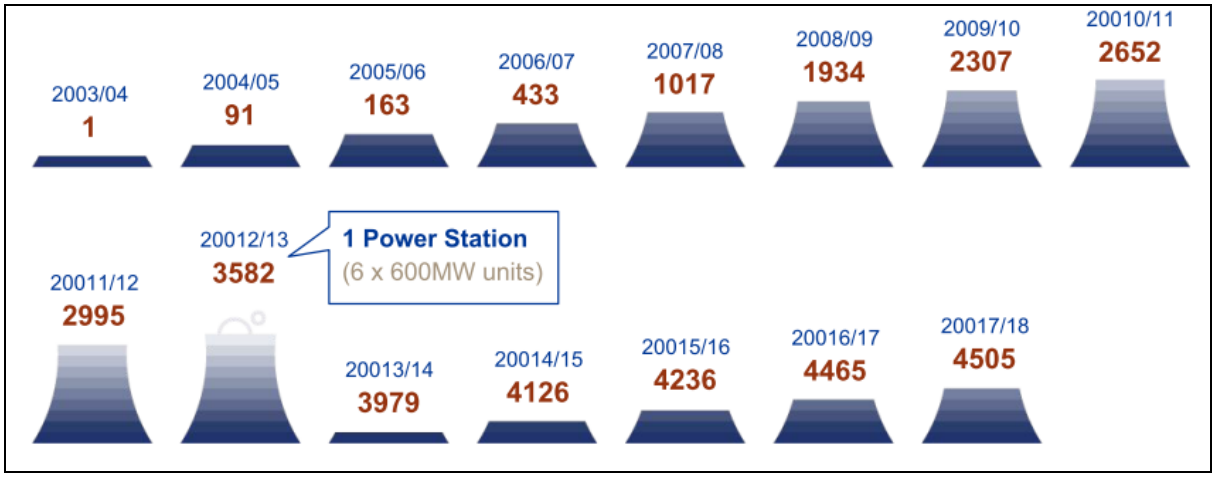
[1] Eskom renamed the DSM Program in 2010 to Integrated Demand Management (IDM)

shifting to reduce the usage of expensive diesel generation was always the priority. Table 1 provides a timeline of key events during Eskom's DSM Program.

Table 1: Timeline of Eskom's DSM Program (2004 – 2015)

Year	DSM / IDM Programs
2004	Regulator (NERSA) ratifies Eskom DSM approach
2005	Eskom undertakes first industrial EE project and CFL mass rollout
2007	Supply constraints cause blackouts – Eskom DSM responds with new CFL rollout and ESCO (Energy Service Company) projects for commercial lighting
2008	National supply crisis – DSM program intensified to alleviate constraints. Solar Water Heater rebate introduced
2012	IDM project expanded beyond single large industry interventions and lighting with Standard Product offering. CFL residential mass rollout extended to middle- and high-income households in the form of direct installations (swop out). Initiative included LED down lighters, electric water blankets, shower heads and timers
2014	CFL rollout ramped up and focus shifted to larger scale efficiency projects via ESCOs
2015	IDM program suspended due to lack of funding and additional generation capacity

Eskom's CFL swop out program, where incandescent lamps of 100, 80 or 60W were replaced with CFL's of 20, 16 or 11W respectively delivered sizable and immediate savings during peak periods. In 2012, Eskom reported that over 70% of the total electricity savings of the IDM program (2 164 MW peak reduction or 4 786 GWh **[1]**) as shown in Figure 1 below, had been derived from the CFL initiative. This translated to more than 7 million tons of GHG emissions mitigated over a ten-year period **[2]**. For the period 2005 to 2018 Eskom calculated that its IDM program delivered electricity savings of 4 521MW – the CFL contribution for these years was 2016 69%, 2017 66%; 2018 95% **[3]**.



Eskom: 2012

Figure 1: Electricity Savings from Eskom's IDM Program

In 2014/15, Eskom suspended the IDM, and with it the efficient lighting program as a consequence of the following. Firstly, the Regulator (NERSA) only granted a portion of the annual electricity tariff increase requested by Eskom. The utility stated that it could no longer sustain an unfunded DSM program **[4]**. Secondly, additional supply (800MW) **[5]**- when the first unit of the new Medupi 4 800MW coal power plant started producing, with the expectation that the remaining units were to come online shortly thereafter. Simultaneously, electricity from the country's Renewable Energy Independent Power Producer Program started feeding power into the grid. Thirdly, there was a genuine belief within Eskom that its power plant maintenance program had eliminated the servicing backlog and that henceforth the output of its existing fleet would increase and be more reliable. The new (additional) power supplies and the stabilization of the existing plants gave renewed hope to the country that the energy crisis was over.

Eskom distributed over 70 million CFL's when it ended the program in 2015 **[6]**. Without any dispute to the immediate reduction in electricity consumption during peak periods achieved by this initiative, which undoubtedly avoided or reduced the severity of electricity blackouts during periods of insufficient supply, Eskom's unconsidered exit strategy however, led to sizable unintended consequences, namely:

1. Nationally, CFL's came to symbolize energy efficient lighting precluding the uptake of next generation of efficient lighting – Light Emitting Diode (LED) lamps;

2. The severity of the electricity crisis allowed Eskom to withdraw general service lamps from the Department of Energy's residential appliance standards and labelling (S&L) program, on the basis that the adoption of mandatory national standards to regulate quality, performance and safety were a priority and could not risk being delayed by the S&L initiative. Regulation VC 9091 and 8043 were duly promulgated in 2014 and 2015 for incandescent and CFL's to set quality performance standards for these lamps. Excluded from the S&L program and Eskom exiting the scene left the general service lamps without a caretaker. Thus, in 2019 there are no mandatory standards to regulate LED lamps and energy performance requirements are technology specific and vary across lighting technologies;

3. Consumers, especially in the lower income groups, are no longer able to access free CFL's and therefore tend to revert to incandescent lamps. A 2015/16 study **[8]** found that retail stores serving these communities had effectively stopped stocking lighting products due to low demand because of free distribution. Moreover, recent evidence suggests that low income households are reverting to illegally imported incandescent lamps which cost a fraction of CFL's ($0.30 versus $1.20) – The Regulator reported that in 2018 they ceased over 2.5 million illegal incandescent lamps **[10]**, noting that they had not come across any meaningful quantities since 2012. Additionally, during visits to low income areas to conduct focus groups for the lighting information label, the researchers reported seeing large quantities of illegal incandescent lamps in informal stores; and

4. To be price competitive, the majority of LED's sold have lower technical specifications and quality attributes. This has the potential to compromise user experience where a premium is paid for a product which does not meet expectations, amongst others: quality, longevity, flicker, light degradation, low power factor. A poor user experience is likely to result in consumers reverting to lamps which they are not only familiar with, namely CFL's, halogen or incandescent but whose upfront cost may be lower.

The South African S&L program, an initiative of the Department of Energy, has recently recognized the high risk of hard gained electricity reductions during peak hours being lost to inefficient lamps and have decided to act. The Department resolved, with the Regulator, to start the process of developing technology neutral technical specifications for general service lamps. By targeting performance rather than a specific technology, all lamps type will need to comply the minimum lumens / watt energy efficiency requirement. This approach makes the regulation non-discriminatory toward specific technologies and avoids the need to develop additional regulations should a new lamp technology enter the market. The second action taken, and the subject of this paper, is the development of a point-of-sale lighting information label to be placed on retail shelves to guide consumers with: 1) Purchasing the a lamp that meets their needs; and 2) Influence to include energy efficiency during the decision making process.

Research Methodology

In order to develop a lighting information label of lamps at point-of-sale to influence consumers to think about energy efficiency and consider purchasing LED technology, it was necessary to understand consumers' perceptions and understanding of lamp technology as well as their needs which drove choice of purchase and shopping destinations. It was also necessary to evaluate the various iterations of information label design for level of comprehension and impact of the intended message. As South Africa has a diverse population of varied ethnicities, languages, education and income levels, it was also required that the final recommended label be understood by all South Africans. As such, a dual or mixed method research approach using both qualitative (exploratory) and quantitative (evaluative) methodologies was recommended **[11]**, which provide flexibility, a sample large enough to achieve a national reach and allow comparison.

The following research methodology was proposed which consisted of three consecutive stages, feeding learnings into each stage and evolving the lighting information label concept accordingly:

1. Stage 1: Primary Qualitative Research – 9 x 2 hour focus groups
2. Stage 2: Primary Quantitative Research – 10 – 12 minute online survey
3. Stage 3: Follow-up Qualitative Research – 3 x 2 hour focus groups

Qualitative research methodology

The qualitative research sample reached 94 respondents against the following agreed recruitment criteria and some interesting observations emerged:

- All purchasers of electricity and lamps for domestic use;
- Age - a spread per group:
  - 18 – 21 vs. 22 – 35 vs. 36 – 49 vs. 50 – 65 years;
- LSM (Living Standards Measure): Sampling for this research opted to use LSM rather than household income as a more stable measure in South Africa's current economic depression. The high level of unemployment and retrenchment, particularly in low and middle-income groups result in variable household income levels month to month. This was particularly evident in LSM 3-5 groups where almost all respondents were unemployed and in LSM 6-7 groups where up to half had recently lost their jobs.
  - LSM 3 - new to electricity in the last few years:
    - Despite available information on original identified areas, when qualitative recruiters arrived many had been electrified for quite some time which necessitated changing the location for Group 5 and Group 9.
  - LSM 4-5 - had electricity for 4 – 10 years;
  - LSM 6-7 – had electricity for as long as could be remembered;
  - LSM 8-10+ - had electricity for as long as could be remembered;
  - LSM 1-2 were excluded for no access to electricity in the home, therefore no need and less awareness of the lamp purchase process;
- Race – all races, either separate or mixed where appropriate;
- Gender – equal split males and females per group:
  - Lower LSM groups skewed towards females and younger males, as older males tend not to do the shopping. The few older males recruited tended to live alone and had to do the shopping.
  - Higher LSM groups were balanced male vs. female with a higher prevalence of shared shopping/home responsibilities as well as single fathers and mothers looking after home and children.
- Regions:
  - Six of the countries nine provinces were visited making the research study national - Gauteng; Western Cape; Kwa-Zulu Natal; Eastern Cape; Free State; Limpopo.

All group survey sessions were 2 hours long and moderated by one of two specialist moderators for continuity of insights and learning, as well as to accommodate the various home languages across South Africa. Moderators followed a discussion guide designed to guide each discussion with a consistent flow, however as the information label evolved, so did the discussion guide of which there were 3 versions by the end of the research. Each discussion comprised 7 or 8 respondents recruited against specific demographics (Ref. figure 3) and each was given a cash incentive and meal for participation. Discussions were audio recorded from which transcripts were produced, which alongside observations made in the field, formed the basis of a content and discourse analysis.

Quantitative research methodology

Respondents in the quantitative research online sample were screened as having purchased lamps for domestic use within the last year. The chart below demonstrates the demographics of the quantitative sample achieved.

For the quantitative stage, use was made of a single, cross-sectional, descriptive methodology using a structured online questionnaire designed and informed by the findings and preferred language from

the qualitative consumer research. Convenience sampling was used to contact participants through purchasing lists. As response rates are generally low for online surveys, efforts were made to improve the rate of response by offering an incentive in the form of a lucky draw for three cash prizes of R1 000 ($70), R500 ($35) and R300 ($20) respectively. Invitations to participate were sent out to the list of potential respondents with email addresses via the selected online survey program, Qualtrics. In line with the Protection of Personal Information (PoPI) Act, those to whom an invitation was sent were given the option to opt out of the research. A total of 12,122 invitations were sent out to which the successfully completed response rate was 2,1% (255 participants) and the average complete time was 12 minutes, including screening and demographic questions.

Consistency checks were carried out on the data and 254 usable questionnaires were obtained upon which to run the analysis using descriptive statistics, frequency distribution and cross-tabulation to provide insights into the data.

Results were analysed in total and by the main demographics breaks of age (four groups), gender (males and females) and gross monthly household income (four groups). As most of the responses came from Gauteng, base sizes were not large enough in other provinces to analyse the data by province. The results for all questions used a rating scale to analyse data by excluding the 'don't know/cannot answer' responses. Figure 2 below shows details of the final sample achieved.

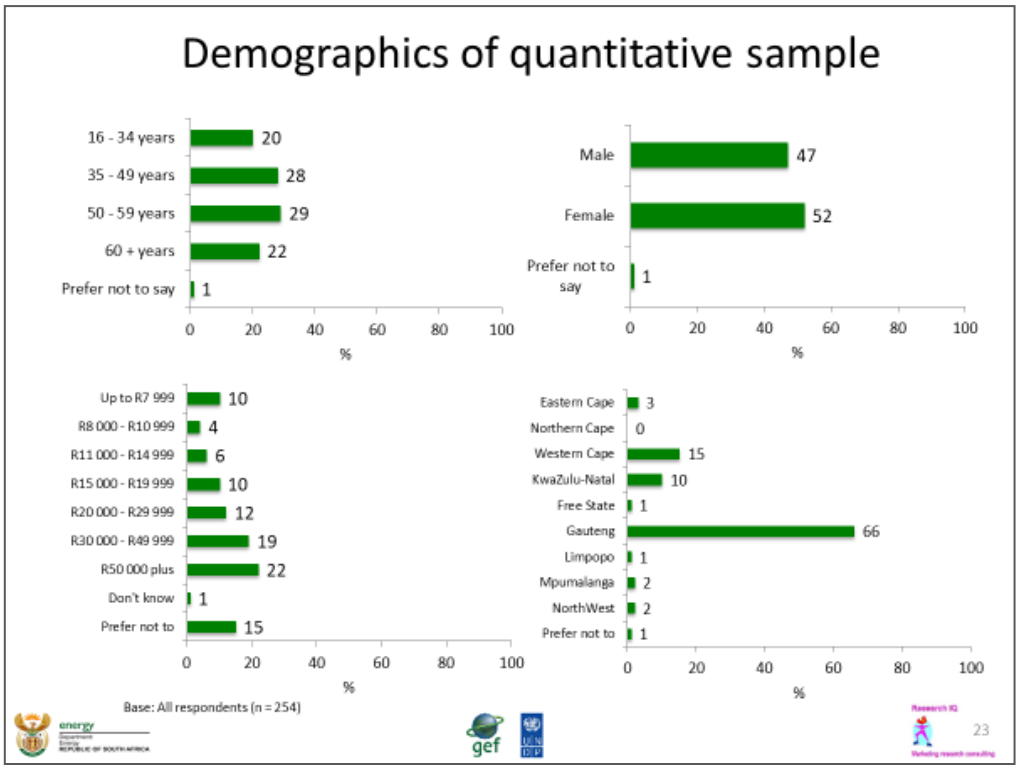


Figure 2: Quantitative sample demographics

Final research sample and reports delivered

As the final information label needed to be understood by all South Africans, the overall research sample was designed to be nationally representative, with the qualitative focus groups focusing more on lower LSMs 3 – 6, with only 2 groups for LSM 7-10 and the quantitative survey focusing more on the latter. This was to account for low reach of online methodologies to lower LSMs with less frequency of smartphones and access to internet. The first 5 focus group discussions however represented LSM 3-10 to gauge level of comprehension across the market to the originally proposed information label and to determine the extent to which it required upweighting of messaging elements.

As the original information label performed so poorly across the market, requiring a complete re-design, the qualitative sample for the remaining focus group discussions also needed adjustment so that the second version of the information label could again be tested qualitatively across the entire market for comprehension levels. Interim reports were delivered for Stage 1 and Stage 2 with a full report after Stage 3. Figure 3 demonstrates the final and revised sample for all three stages of research.

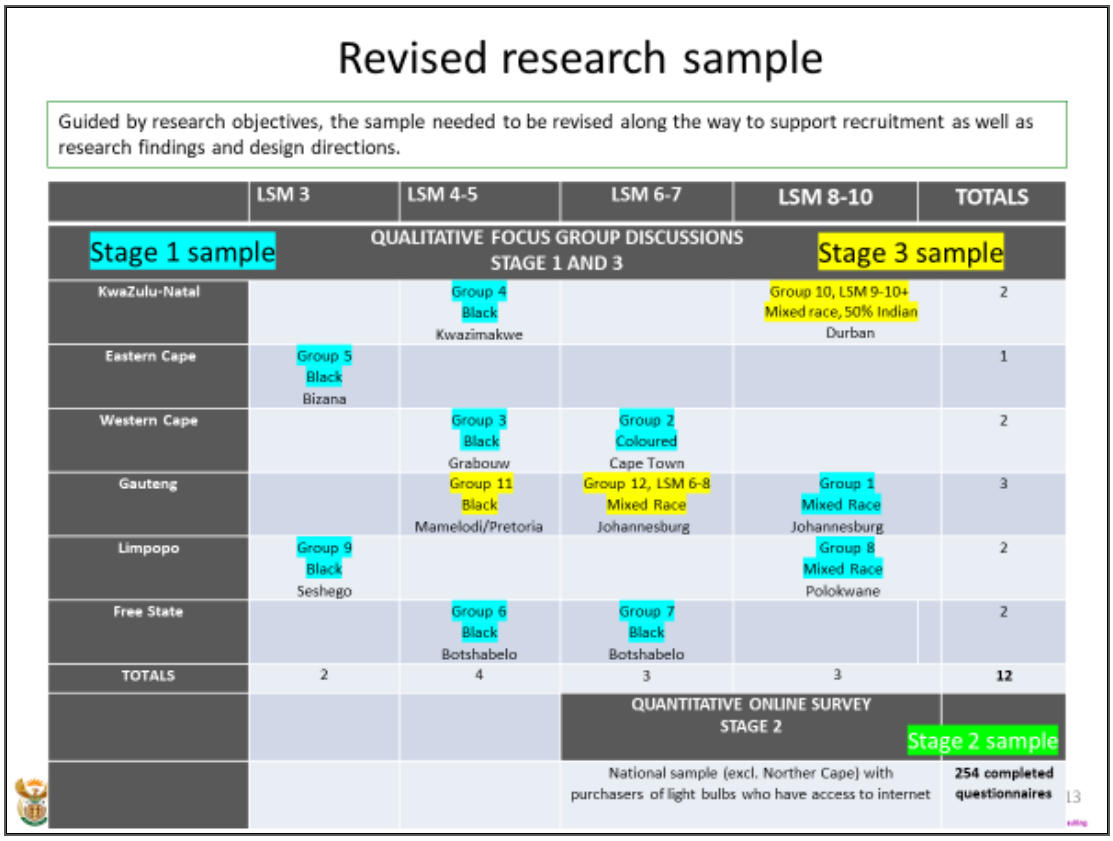


Figure 3: Revised overall research sample

Follow up impact interviews

As the lighting information label had not yet been rolled out to retail point-of-sale, the research team re-contacted a small, yet nationally representative sample of research participants to establish impact of the communication material in the purchase decision making process of lamps. 5 – 10 minute qualitative telephonic discussions were conducted with 14 research participants in June 2019.

Key findings of the research and design journey

Growing opportunity and desire for educational energy efficiency campaigns

There is an almost unanimous sentiment amongst consumers that South Africa needs to use electricity more efficiently, with high awareness of SA's electricity shortage and therefore increasing cost of the resource. However, it's a 'catch 22' scenario as whilst high misuse exists, mainly through illegal connections and unnecessary wastage, there is a growing need for bright outdoor security lighting at night given the increasing crime rate. Consumers ensure they have sufficient units of electricity to power outdoor security lighting throughout the night and will compromise indoor lighting or other electricity needs if necessary, to keep the outdoor lighting on.

Consequently, there is a strong opportunity and desire for educational energy efficient campaigns, both to curb wastage of a dwindling, yet critical resource and to reduce overall electricity costs in the home, particularly in the current economic downturn where overall living costs continue to increase.

Further, in comparison to the foundation research conducted in 2011 **[7]** there is substantial growth in what are now regarded as energy saving practices by residential consumers. Particularly pertinent to this research concerning lighting - although low level - is some awareness and usage of LED, exterior sensor lights, solar lights and even one mention of using a wind turbine to power lights.

Limited knowledge of efficient lighting technologies despite varied needs and access

Needs for lighting are as varied as level of access to lighting technology options between urban and rural consumers, but the level of awareness and knowledge is not as variable. One of the key insights is that the 'gap' in knowledge of lighting technologies is not as wide as might be expected between low and high LSM consumers.

Those exposed to lighting and purchasing of lamps for many years have formed their knowledge around incandescent technology and purchase on wattage = brightness, i.e. that 100W is brighter than 60W which is brighter than 40W. Whereas those new to electricity in the last couple of years have been exposed to CFL first where energy saving is a more dominant purchase driver. In some cases, albeit limited, even some LSM 3 consumers know more about LED than upper income LSM 8-10 consumers.

Through the Eskom swop out campaign, the need to use a more energy efficient technology took hold in the market with the technology growing in popularity – consumers stating CFL is their preference, either purchasing or wanting to purchase the technology **[8] [9]** (Ref. figure 4). But a significant barrier is the lack of understanding of how to purchase 'like brightness' in comparison to the 100W/60W incandescent, resulting in the perception of 'dim' performance that prevents its use for outdoor security and high brightness areas such as kitchen and bathroom. Additional barriers include perceived high cost and lack of in-store availability in rural and peri-urban areas. Consequently, these factors encourage continued use of incandescent and halogen lamps, particularly in middle to lower income homes, but not excluding some upper income consumers.

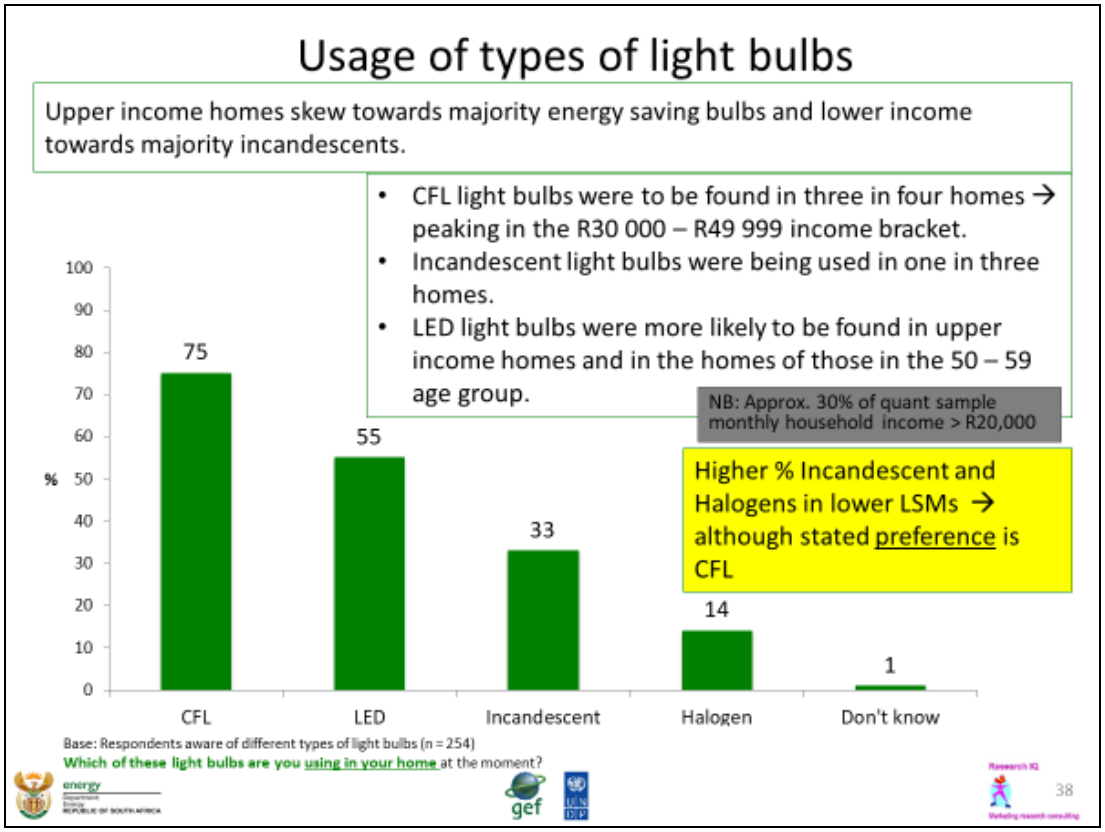


Figure 4: Usage of General Service Lamps in South Africa

Very few consumers know about halogen technology, which is known to be a higher quality incandescent lamps as the shapes of both are identical. Those few who know to differentiate between the technologies opt for halogens in outdoor security lighting areas as they deliver good levels of brightness, last longer and use less electricity.

The 100W incandescent is most popular for its brightness and perceived by most to serve outside security lighting needs better than CFL, with 60W and 40W offering affordable levels of brightness throughout the home.

Perceptions of LED are the most polarized in the market, with accurate knowledge more limited to upper income, older homes and dependent on engagement and purchase in the category. Across the market, LSM 3 – 10+, are those who either know very little or nothing about LED. For the limited few who have up-traded to LED it is a preferable option to CFL in terms of value, taking overall life expectancy and energy efficiency into consideration, with awareness of 'bright' LED options to replace incandescent and halogen as well as experiencing LED as cheaper at point-of-sale than CFL. But, for the majority with little experience of LED it is dismissed for perceived expense and not delivering the same level of relative brightness of 100W and 60W incandescent equivalents.

Whilst General Service Lamps (GSL) appear to be the most frequently shopped category in comparison to other appliances, it is also the least understood and therefore a very low engagement category. Most consumers do not understand the product information supplied on GSL packaging, such as light output levels, colour rendering, life expectancy and energy usage, such that purchasing a new type of lamp is very confusing. Consequently, most consumers continue to buy what is familiar, rather than learning about new and better options. Assistance from small 'spaza' shops in rural and peri-urban areas as well as general retail grocers is not on hand in comparison to outdoor and speciality lighting stores in urban stores who may make recommendations on what to purchase if requested.

Reactions to the first information label concepts

Consequently, the first lighting information label concept (Figure 4) exposed to Group 1, an LSM 8-10 pilot group, was completely rejected as consumers were unable to understand the information pertaining to the value proposition of each lighting technology.

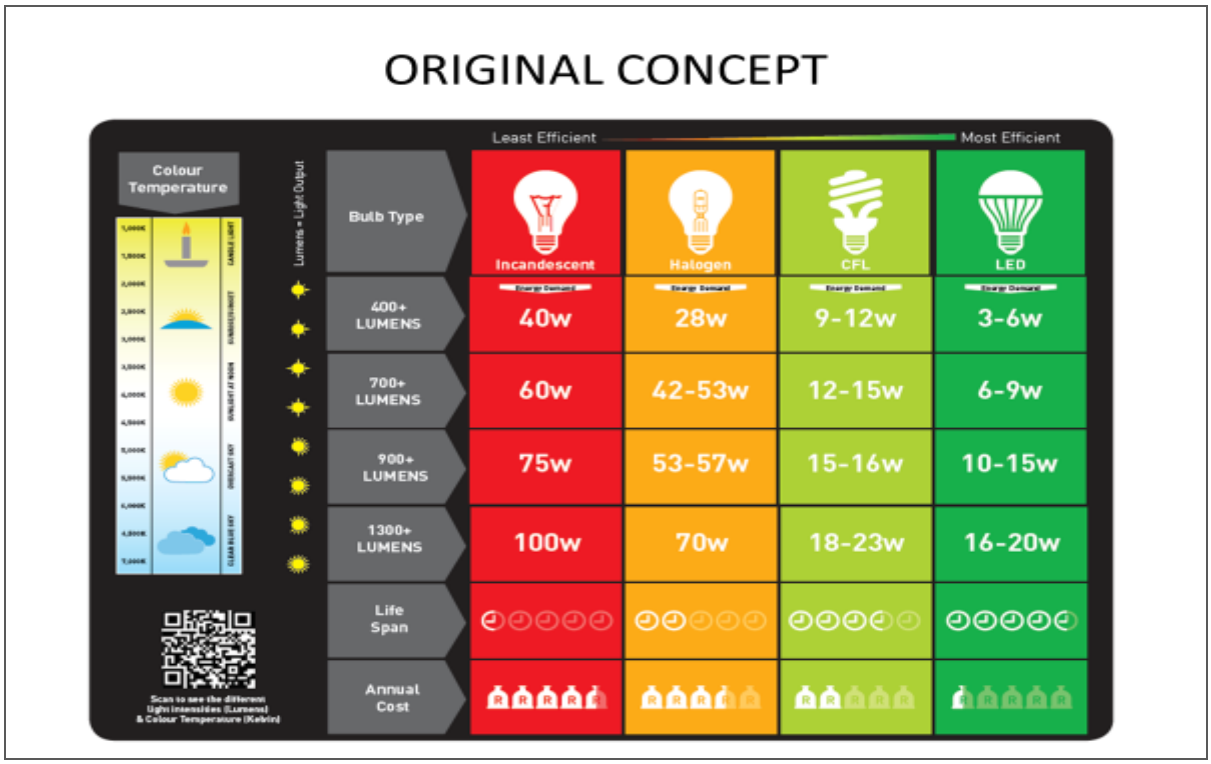


Figure 5: Original lighting information concept

Between Group 1 and Group 2, the layout was revised (Figure 5) to improve comprehension, but the content was mostly kept the same. Likewise, Group 2 to Group 5 found the material as complicated and confusing as the lamp package (box), where the information completely failed to engage new learning or interest.

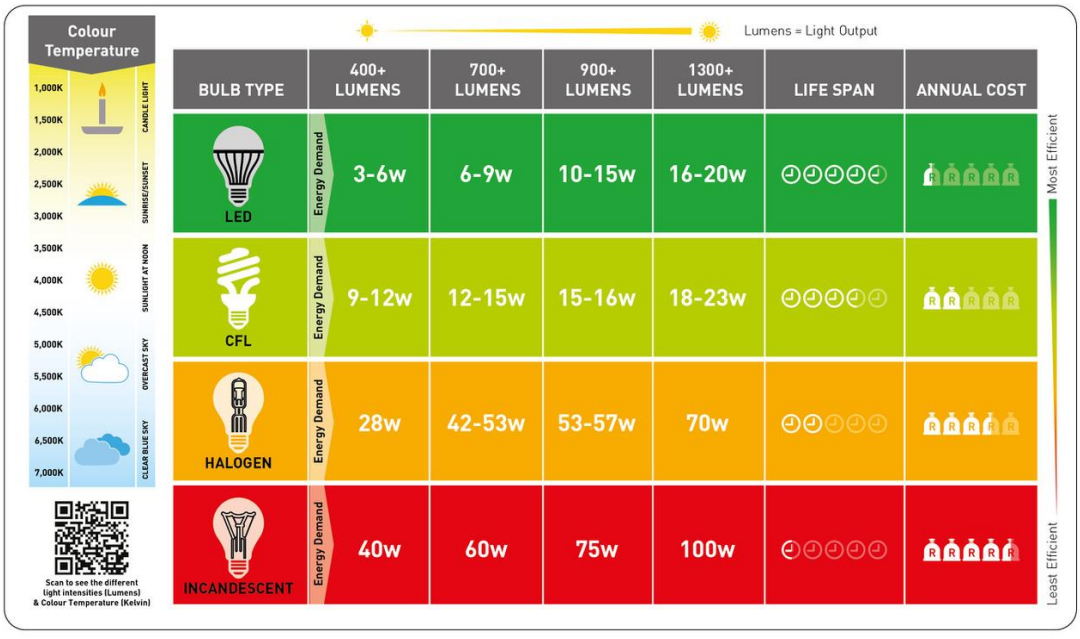


Figure 6: Revised lighting information concept

The focus group participants unanimously agreed that the initial concepts were visually off-putting, with content that was too technical and a layout that was cluttered and difficult to understand. It did not tell a story to engage in the learning process. Initial reactions confirmed that the baseline knowledge of lighting technologies across the target market, up to and including some LSM 10+ respondents, is immature. However, through explanation of the material's content and intent, awareness and knowledge levels shifted, indicating a desire to learn more about lighting to make better energy efficient lamp choices.

In such a low engagement category, an unsuccessful lighting information label that did not engage interest, will not shift consideration away from familiar 'type' choices, which for the majority of the target market are incandescent or halogen lamps, selected for price and brightness or CFLs as the longer lasting option. Important knowledge gaps that needed to be addressed came to the fore:

1. High familiarity and frequent engagement with incandescent technology has established a mental conceptual framework that *brightness equates to the number of watts*. Therefore, the information label needed to educate on Lumens for consumers to believe than a low watt LED lamp can deliver the same level of brightness as a 100W/60W equivalent.
2. Similarly, high wattage incandescent (and halogen) lamps are associated with lamp heat and ability to 'warm a room', i.e., referencing colour temperature as 'warm' vs. 'cool' white results in literal take-out, preventing majority from understanding colour rendering as mood/tone. Therefore, the information label needed to also build both awareness and relevance of colour rendering, measured by Kelvins.

Reactions to the infographic lighting information label concepts

These insights, together with those gleaned from perceptions and behaviors in the category from Group 1 to Group 5, led to the development of an infographic lighting information label (Figure 6). The intention was to tell a straightforward story, building from common and familiar knowledge (e.g. screw vs. 'pin') towards introducing new information and terminologies to make it an easier journey in choosing a lamp that best meets consumers' needs, whilst also raising influence of energy efficiency and performance. Additionally, the order of the instructions (Step 1, Step 2 etc.) dealt with the consumers primary needs before introducing new concepts, again prioritizing the purchasing of the right size and type of lamp (Step 1), then introducing the different technologies (Step 2), then quality (Step 3) and so on.

The first iteration of the new infographic concept was tested in Group 6 to Group 9 (LSM 3 to 10) and was successful in spontaneously engaging attention and raising awareness of LED. In particular, it helped the following new awareness and knowledge emerge for many:

- There are different fitting sizes for lamps;
- New lighting technologies are available;
- Higher awareness of LEDs and that the LED value proposition is a better option.

The communication however was not sufficiently strong enough to:

- Shift the belief that brightness is dependent on watts rather than Lumens: Consequently, low watt (in comparison to equivalent incandescent) LED lamps would be interpreted as having very 'dim' lighting capability and would be overlooked as not satisfying lighting needs. Further, the perceived expense of high wattage LED's would continue to deter engagement with the category, even if in reality, the mainstream target market does not need speciality lamps such as these.
- Drive further understanding of colour rendering: The need for tone/mood created through lighting was not a high priority or frequently mentioned need in the mainstream. It was only important for some LSM 10/10+ where there was low level understanding of how to determine this from packaging. As the concept needed to be legible on an A4 layout for research purposes, the recommendation was made to exclude further testing of colour rendering at this point and rather redesign and introduce for final production. It was more a priority to address the Watt/Lumen issue.

At this point in the research, it was clear that the lack of understanding around lumens was priority, which if unaddressed, would prevent widespread adoption of LED technology.

Prior to Stage 2 of the research, the stimulus material was revised and the second iteration of the infographic (Figure 8) tested in the quantitative online survey, followed by further in-depth discussion in Group 10 to Group 12 (LSM 4 – 10+).

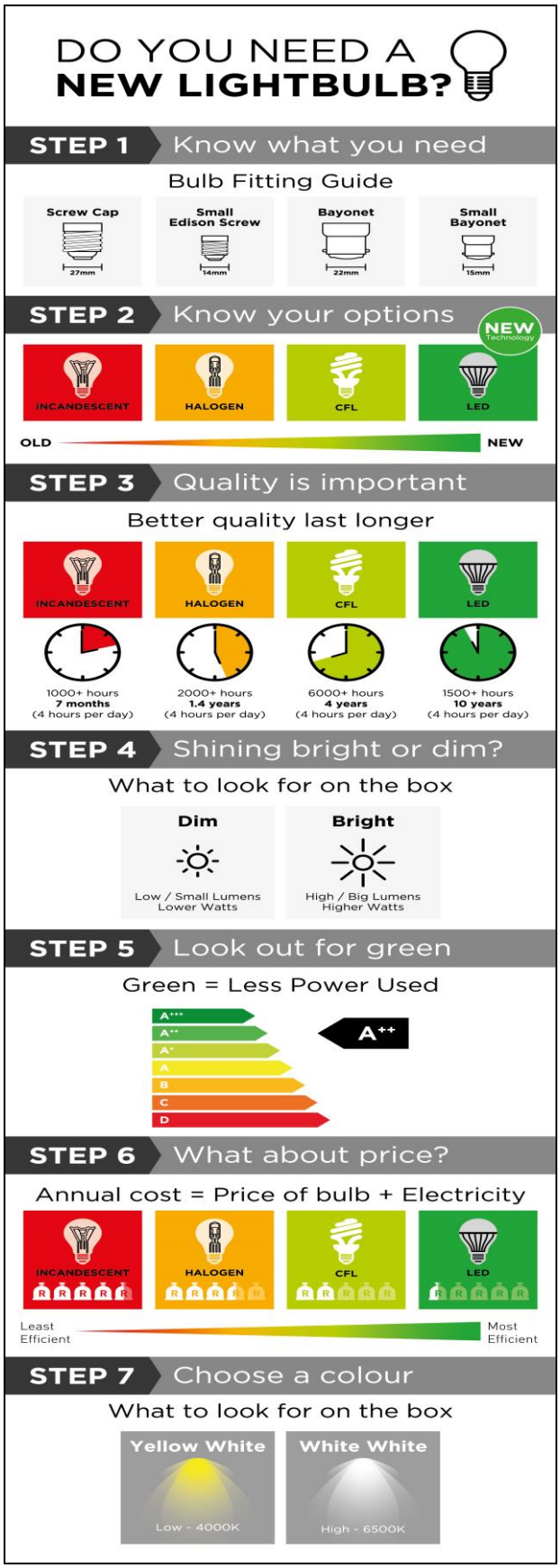


Figure 7: First iteration of infographic information label

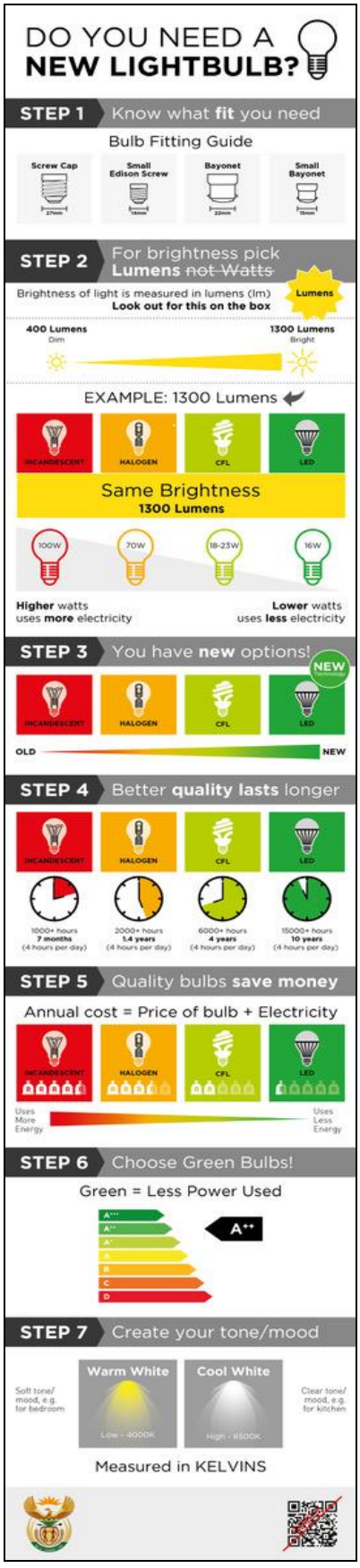


Figure 8: Second iteration of infographic information label

Overall response to the second infographic information label was very positive (Ref: Figure 9), with 91% agreement that the information displayed was useful and easy to understand, especially amongst younger respondents, females and those in the lowest income group.

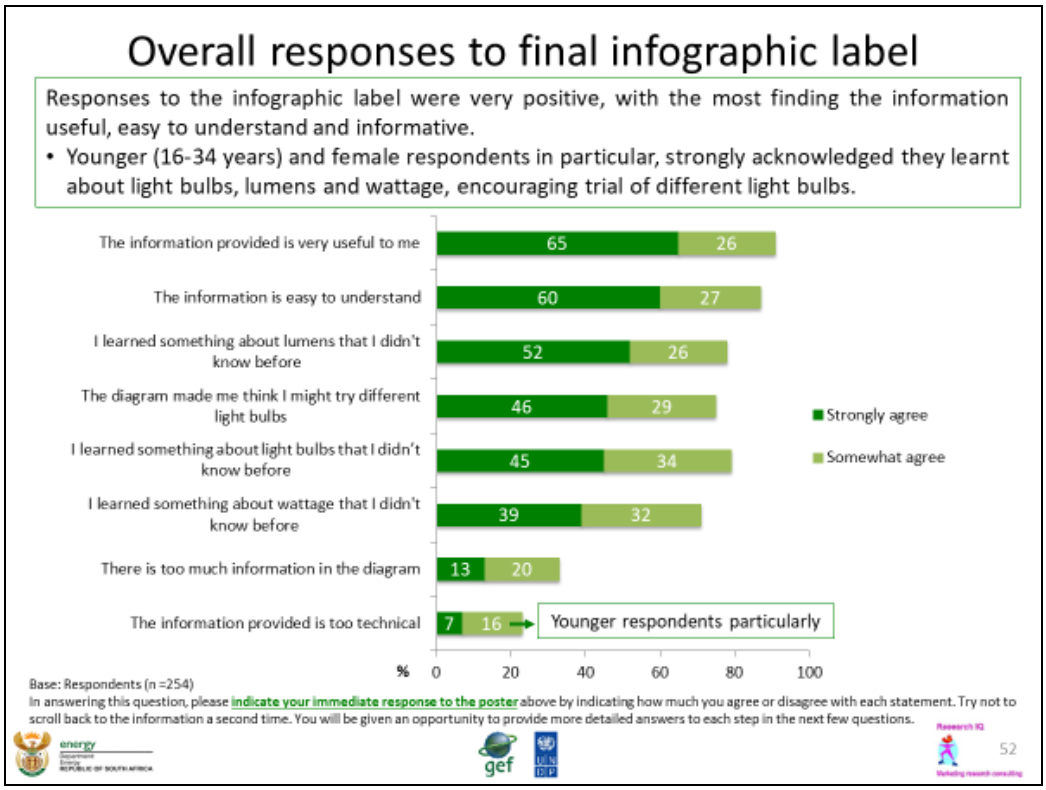


Figure 9: Overall responses to final infographic lighting label

The communication is particularly successful (Ref. Figure 10) in increasing awareness and new understanding that impacts a shift in purchase drivers around:

- The role of lumens as indicators of brightness, which increased fivefold, from 11% to 55%. post exposure whilst the role of watts decreased by 19%. Some grasp the information quicker than others, depending on literacy levels, age and previous experience in the category, but repeat exposure to material will assist in building knowledge over time;
- New and innovative lighting technologies, that offer higher quality, higher performing lamps that use less electricity (increase of 12%) and last longer (increase of 6%).

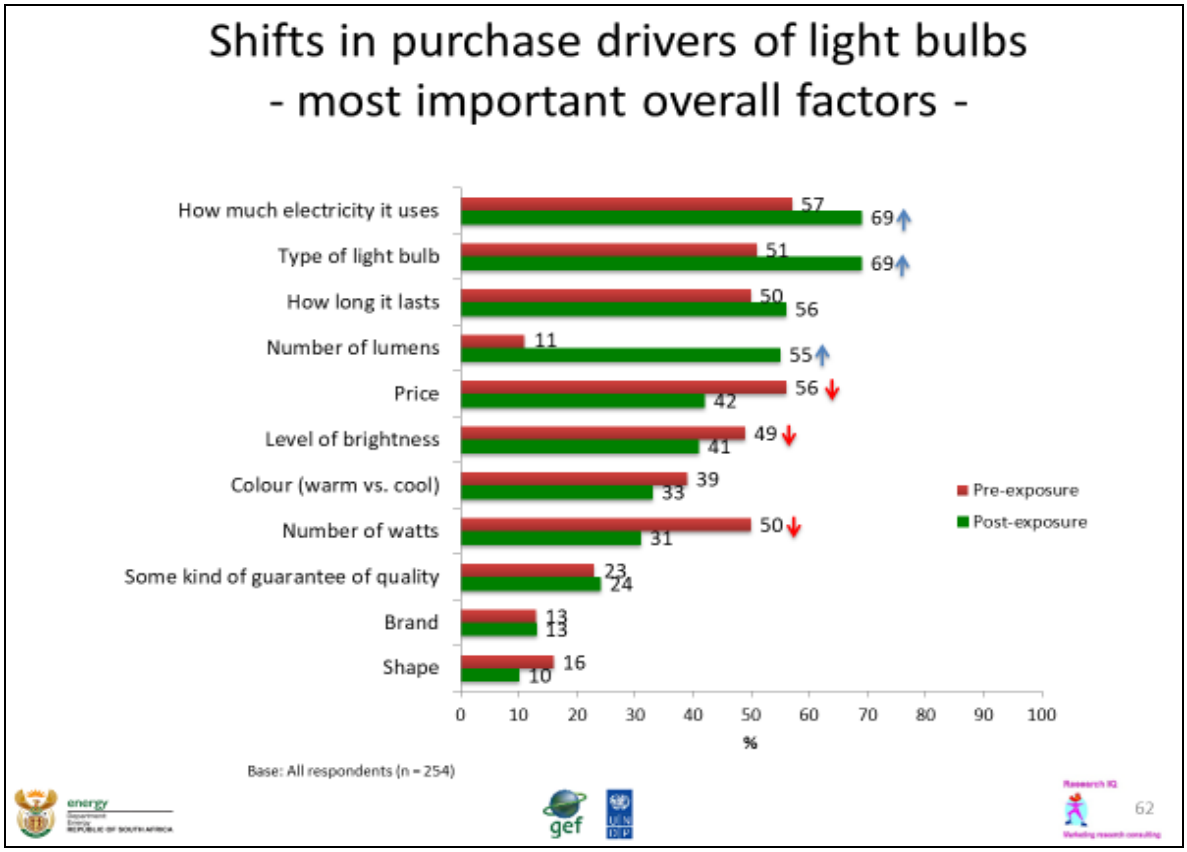


Figure 10: Impact of exposure to infographic lighting label

Even without knowing that LED pricing has reduced, consumers stated their consideration of LED in the next purchase cycle will be stronger than CFL or incandescent, particularly but not exclusively amongst upper LSMs.

Impact of exposure to communication 10 months later in June 2019

The research team telephonically re-contacted 14 participants in the qualitative research, LSM 3-10+, of which 12 have either shifted purchase choice completely to LED, or a mix of LED and CFL over CFL and incandescent. Some have started shopping for LED in different stores that stock them and have shared their knowledge with others. All have noticed that the LED lasts longer and some reported a reduction in electricity usage. However, many commented on the how the light 'starts dim' then gets brighter and that LED light is less harsh than that of incandescent.

Interestingly, the two respondents who have not shifted purchase choice were exposed to the original and revised concepts, not the infographic information label, but one of these was already purchasing CFL and claims the high price of LED offers no extra value.

Conclusion

The infographic information label strongly drives the desire to trade up to LED through outlining the LED value proposition by targeting performance of all technologies, rather than focusing on a particular technology. However, the reality of South Africa's current economic situation means that pricing of LED may still remain a barrier for some who cannot afford the up-trade and that those purchasing cheaper LED are trading off cost saving benefit or performance against a lesser quality brightness. However, a highly iterative and collaborative process between research, design and strategy emerged based on what was learnt throughout the research. The success of the final information label is underpinned by the agility of this collaboration resulting in a highly impactful piece of communication material.

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