INTRODUCING TECHNOLOGY-NEUTRAL MINIMUM ENERGY PERFORMANCE STANDARDS TO PROMOTE THE UPTAKE OF ENERGY-EFFICIENT LIGHTING IN SOUTH AFRICA

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Overview

South African households purchase roughly 22 million electric lamps per year and the total installed stock is approximately 170 million. While a single electric lamp does not consume a large quantity of electricity, the average household has about 15 lamps. We estimate that lamps used in households collectively consume ~2 900 GWh of electricity per year which amounts to ~1.5% of total national electricity sales.

Regulation of lighting in South Africa has not kept pace with global technological advancements in the industry. Light Emitting Diode (LED) lamps have emerged as the most energy- and cost-efficient form of household lighting – outperforming both compact fluorescent lamps (CFLs) and halogen lamps. While older lighting technologies (CFLs, halogens and incandescent lamps) are regulated for safety, there are currently no safety or performance standards for LEDs in South Africa.

In general, the regulation of household lighting products is justified because of a market failure caused by 'imperfect information', which results in consumers making poor choices. The proliferation of lighting brands and technologies mean that consumers cannot easily compare the quality, life-cycle costs, and performance of different lamps. A lamp is a relatively low-value purchase and consumers are unlikely to invest the time and effort that would be required to accurately compare the options and to make an informed choice.

An analysis of sales data from major retailers from 2016 to 2018, suggests that South African consumers are indeed making irrational choices when purchasing household lamps.[1] The best-selling lamps were those that appeared to be the least expensive based on their upfront purchase price. For example, in the first half of 2018 the two best-selling lamps in the 800 to 1300 lumen range (accounting for ~65% of total sales by volume) were among the least energy-efficient, and consequently the most expensive when measured on a full life-cycle cost basis (Table 1).

South African consumers do not appear to factor the full life-cycle cost of using a lamp into their purchase decisions. To illustrate, in the first half of 2018 the best-selling lamp in the popular 800 to 1300 lumen (lm) category was Osram's 70W BC Eco Halogen lamp, which accounted for 52% of sales (Figure 1). This lamp cost R20 ($US1.40)[2] per unit to purchase but has one of the highest full lifecycle costs. It would have cost a consumer, ~R1 500 ($US104) in electricity and replacement costs over 5 years (assuming an average lifespan of 7 000-hours per lamp). An LED lamp of equivalent brightness cost R35 ($US2.45) upfront but would have cost the only R178 ($US12) to use over the same period. The full life cycle cost of the best-selling 1200 lm, 70W halogen lamp, was therefore more than eight times that of an LED lamp with roughly equivalent brightness. It is not surprising that South African consumers do not consider the lifecycle costs, because information on the comparable costs is scarce.

[1] Data used for the sales analysis was sourced from Nielsen IQ (formerly known as AC Nielsen)

[2] Assuming a R/$US exchange rate of R14.25/$US

Table 1. Top 20 lamps sold by volume in the 800 to 1300 lumen category, in the first half of 2018.

Sales Rank	Manufacturer and Lamp	W	Life (hours)	lm	Type	Efficacy (lm/W)	price June 2018	Life Cycle Cost	LCC rank	% of the total	Cumulative % of
1	Osram Globe 70w Bc Eco 1 S	70	2000	1172	Halogen	14	20	1470	6	52%	52%
2	Osram Globe 70w Es Eco 1 S	70	2000	1172	Halogen	53	20	1471	5	13%	65%
3	Philips Ph 14w Es Genie Wwbx 1 S	14	10000	810	CFL	40	28	300	34	8%	74%
4	Globe Led 9w Bc Cw Lumaglo Econo 1 S	9	10000	900	LED	56	22	196	36	2%	76%
5	Bonus Lamp Eco Hal Bc 70w 1 S	70	2000	970	Halogen	55	28	1498	4	2%	78%
6	Osram 14w Energy Saver Bc Box 1 S	14	8000	827	CFL	54	30	307	32	2%	79%
7	Philips Eco Globe 70w Bc Bli 1 S	70	2000	1070	Halogen	53	74	1660	1	2%	81%
8	Flash 11v E/Saver Globe 1 S	20	8000	1150	CFL	53	33	430	16	1%	82%
9	Flash 15v E/Saver Globe 1 S	20	8000	1150	CFL	54	42	438	15	1%	83%
10	Osram 14w Energy Saver Bc Cw 1 S	14	8000	827	CFL	14	32	309	30	1%	84%
11	Bonus Lamp Eco Hal Es 70w 1 S	70	2000	970	Halogen	55	28	1499	3	1%	85%
12	Phillips Ph 50w 12v Dic Hal2p 1 S	50	2000	1200	Halogen	54	52	1183	7	1%	86%
13	Energy Saver 8w Bc Osram Ww 1 S	8	15000	806	LED	85	35	178	38	1%	88%
14	Globe Led 9w Es Cw Lumaglo Econo 1 S	9	10000	900	LED	53	23	196	36	1%	89%
15	Bonus 18w Globes Esl Bc Ww 1 S	18	8000	1000	CFL	14	49	404	19	1%	90%
16	Eurolux 20w Cfl 3u Bc 1 S	20	6000	1155	CFL	53	45	454	11	1%	90%
17	Philips Eco Globe 70w Es Bli 1 S	70	2000	1070	Halogen	53	74	1659	2	1%	91%
18	Bonus 18w Globes Esl Bc Cw 1 S	18	8000	1000	CFL	60	49	404	19	1%	92%
19	Eurolux 16w Coolwhite 2d Tube 1 S	16	8000	1030	CFL	50	69	382	22	1%	93%
20	Energy Saver 8w Es Osram Ww 1 S	8	15000	806	LED	53	35	178	38	1%	93%

Source: Walsh, K., Spazzoli, R., Du Bois, T., Filby, S., & Reeders, C. (2019). Cost-Benefit Analysis of technology-neutral regulations to introduce Minimum Energy Performance Standards for general lighting.

Figure 1. Comparison of the full lifecycle costs of a 70W halogen lamp and an equivalent (in brightness) 8W LED lamp

	Energy Saver 8W BC Osram **LED**	Osram Globe 70w Bc Eco **Halogen**
Price	R35	R20
Life cycle cost Based on 7,000 hours of use	**R178**	**R1,470**
Wattage	8 W	70 W
Lumens	806 lm	1,172 lm
% lamps sold by volume (800 to 1300 lm) in 1H18	**1%**	**52%**

Source: Walsh, K., Spazzoli, R., Du Bois, T., Filby, S., & Reeders, C. (2019). Cost-Benefit Analysis of technology-neutral regulations to introduce Minimum Energy Performance Standards for general lighting.

While sales of LED lamps increased during the first half of 2018, CFLs remained very popular in the household lighting segment in South Africa. CFLs accounted for more than half (52%) of total retail sales over these six months, while halogen lamps accounted for a further 26% of sales. The relatively slow uptake of LED technology can be partly attributed to the widespread misconception among consumers, since Eskom's mass roll-out of CFLs during a nationwide demand-side management campaign in 2010, that CFLs are still the most energy-efficient lamps.

The South African Department of Energy (DoE) is proposing to introduce new regulation to set technology-neutral minimum energy performance standards (MEPS) for household lighting products. The main objective of introducing

MEPS would be to accelerate the adoption of energy-efficient lighting by households and to remove inferior and unsafe lamps from the market. The main energy performance requirement of the draft technology-neutral MEPS is a minimum efficacy of 90 lm/W under the first tier of the regulation and 105 lm/W under the second tier. While incandescent lamps (ICLs) are already banned in South Africa (with minor exceptions), these requirements will also remove halogen and CFL lamps from the market.

In 2019, the DoE and NRCS commissioned Nova Economics to undertake an economic cost-benefit analysis (CBA) of the proposed regulation to set MEPS for household electric lamps.[3] In this paper, I summarise some of the key findings of this study.

Methods

The methodological framework that we used to assess the potential economic impacts of introducing MEPS for general service lamps is cost-benefit analysis (CBA). CBA is a method that enables one to systematically identify and quantify (where possible), the costs and benefit of introducing regulation under alternative scenarios. We also drew specifically on the guidelines provided by the United Nations Environment Programme (UNEP) in a guidance note on MEPS for lighting for policymakers[4] and on a recent study by Australian and New Zealand Governments – "Decision: Regulation Impact Statement: Lighting".[5]

There were four main inputs to our cost-benefit analysis – market analysis, stakeholder consultation, economic modelling, and lamp testing. We analysed the market for electric lamps in South Africa based on retail trade data sourced from Nielsen IQ and import statistics from the South African Revenue Service. We augmented the retail data from Nielsen IQ by adding information on technical lamp specifications (e.g., lumens and lifetime hours) based on data sourced from manufacturers product catalogues and store visits. We also conducted an extensive stakeholder consultation process and interviewed representatives of five main groups – public sector, technical and regulatory experts, large suppliers, local manufacturers, and industry associations[6] – to gauge the sentiment towards regulation, validate key assumptions and inputs to the model, and to obtain qualitative insights on the likely economic impact of MEPS.

We began the CBA process by defining the costs and benefits that would be associated with introducing MEPS. The main categories of cost and benefit that were considered, are summarised in Table 2. The key benefits include the electricity cost savings that are expected to accrue to consumers, and the associated environmental benefit of reducing electricity consumption and greenhouse gas (GHG) emissions. Consumers were also expected to benefit from a reduction in lamp replacement costs.

The costs of introducing MEPS would be incurred mainly by lamp suppliers. The supplier costs include indirect costs, such as the management and administration required for compliance. Direct costs to suppliers include letter of authority (LOA) fees and levies payable to the regulator for importing lamps under the compulsory specifications and the costs of testing for performance and safety. The regulator would also incur costs including the additional human resource capacity required for monitoring, verification and enforcement, the cost of crushing for non-compliant lamps. The costs the regulator would incur however are partly offset by the revenue it obtains from the LOA fees and lamp levies.

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[3] Walsh, K. S., Filby, S., Du Bois, T., & Reeders, C. (2019). Cost Benefit Analysis of technology-neutral regulations to introduce Minimum Energy performance standards for general lighting. Report prepared for the United Nations Development Programme.

[4] Scholand, M. 2015. Developing minimum energy performance standards for lighting products. *Guidance Note for Policymakers*. UNEP DTIE and UNEP-GEF en. lighten initiative.

[5] Australian Department of the Environment and Energy. 2018. *Decision Regulation Impact Statement: Lighting*.

[6] Over 35 stakeholders, representing five main stakeholder groups (public sector, core technical group, large suppliers, local manufacturers, and other).

Table 2 Summary of the expected costs and benefits of introducing MEPS.

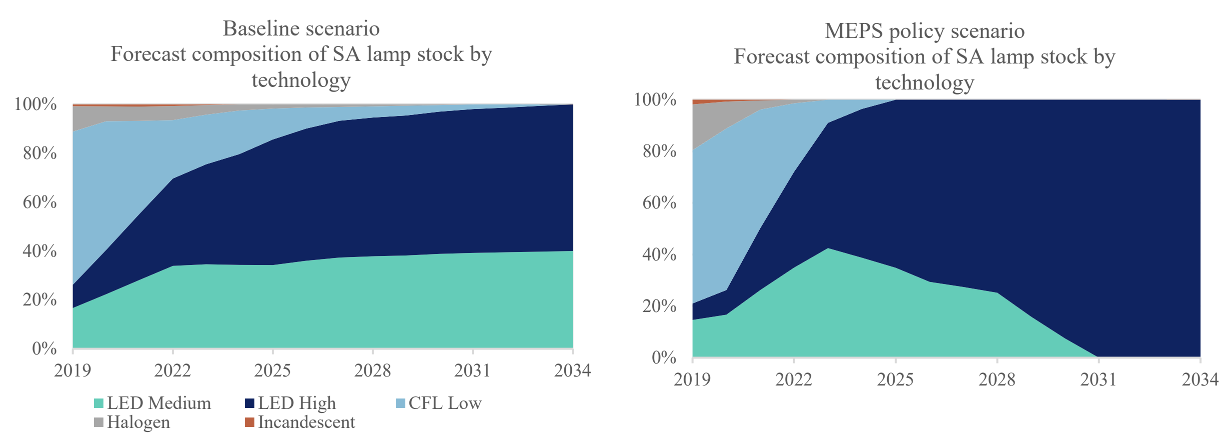
Expected Costs	Potential benefits
Suppliers	**Consumer**
• Indirect costs of compliance (e.g., Administration and management) • Cost of lamp testing and obtaining LOAs. • Levies on imported CFL and LED Lamps	• Electricity cost savings will accrue to consumers as they switch to more efficient lamps. • Reduction in lamp replacement costs for consumers since LED lamps last much longer than older technologies.
The regulator	**Environmental**
• The net cost of regulation which is the levies received from suppliers on imported lamps less the costs of implementing and enforcing the regulation.	• Lower carbon and other greenhouse gas emissions due to reduced electricity consumption.

Since CBA is a comparative approach, ‘the policy option’ - a scenario where MEPS for household lighting products is introduced must be compared to a baseline or ‘business-as-usual scenario. In the baseline scenario, we assumed that consumers would continue to adopt LED lamps at a gradual pace and that there would be no further regulation of the household lighting products.

If the draft MEPS for lighting are introduced, new sales of CFL and halogen lamps will cease. This would drive a far more rapid shift in the composition of South Africa’s national lamp stock towards LEDs, than under the baseline scenario. MEPS would effectively force the consumer to adopt the most energy-efficient and cost-effective lamp technologies. Our assumptions regarding the annual change in the composition of the lamp stock with and without MEPS are compared in Figure 2.

To produce these forecasts, we assumed that the lamp stock increases at a rate of 0.8% per annum. From the base stock, we subtracted the number of lamps of each technology type that are likely to have failed and add forecast new sales, to arrive at a revised annual estimate of the composition of the lamp stock. It is the accelerated adoption of LED technology under the MEPS scenario (relative to the baseline) that generates significant electricity and replacement cost saving for consumers.

Figure 2: Lamp stock composition per year (2019-2034) in baseline vs MEPS scenarios



Source: Walsh, K., Spazzoli, R., Du Bois, T., Filby, S., & Reeders, C. (2019). Cost-Benefit Analysis of technology-neutral regulations to introduce Minimum Energy Performance Standards for general lighting.

Finally, we also sent a sample of ten LED lamps from nine different suppliers for testing. The lamp samples were purchased from retail outlets and tested at Eskom’s laboratory to obtain an indication of (i) the quality of lamps currently in the market, and (ii) the consistency of products with the information provided on the packaging.

Results

The results of the CBA suggested that introducing MEPS for general lighting could yield significant, positive net economic benefits for the South African economy. Under the central assumptions, the net economic benefit of the project is expected to amount to R11.7 billion (USD811 million) over the 15 years (Table 3). The benefit-cost ratio is 27.4 to 1 - in other words, the present value of the project benefits exceeds the present value of the costs 27-fold.

Table 3: Summary CBA results, Discount rate of 2.3%

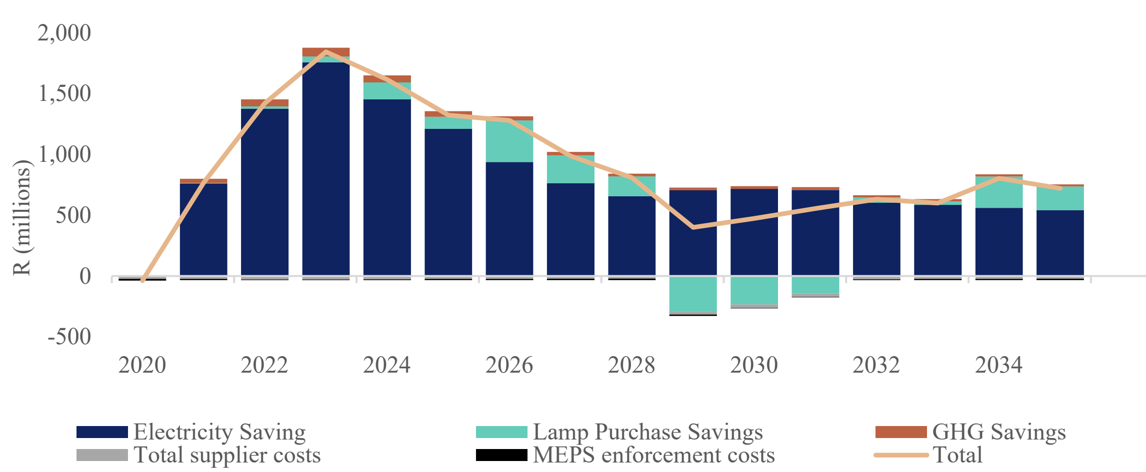
Summary of Impact Measures	Central Scenario
Total Benefits (PV)	R 12 130 115 225
Total Supplier (PV)	(R327 189 547)
Total Regulator Costs (PV)	(R115 619 493)
Economic Net Present Value (ENPV)	R 11 687 306 185
Benefit Cost Ratio	27.4

Source: Walsh, K., Spazzoli, R., Du Bois, T., Filby, S., & Reeders, C. (2019). Cost-Benefit Analysis of technology-neutral regulations to introduce Minimum Energy Performance Standards for general lighting.

Under the MEPS scenario assumptions, households save between 300GWh and 700GWh of electricity annually. We found that households could expect to realise total electricity cost and lamp replacement cost savings of around R12.1 billion (USD839 million) over the next 15 years (in present value terms).

The composition of the expected economic benefits is illustrated in Figure 3. Initially, the net impact is negative, as some costs related to the implementation of MEPS and training of human resources are incurred before the regulation takes effect. Electricity costs savings are realised from 2021 when we assumed the regulation would become effective. Electricity cost savings peak in 2023 when the more stringent requirements for efficacy in lm/W begin to take effect. We estimated that the reduction in electricity consumption by households would be associated with a 4 105 kt reduction in CO_2e emissions over the 15 years, which at a carbon price of R120 per tonne was worth R410 million (in present value terms).

Figure 3 Composition of net benefits of introducing MEPS, central scenario, 2019 to 2035.



Source: Walsh, K., Spazzoli, R., Du Bois, T., Filby, S., & Reeders, C. (2019). Cost-Benefit Analysis of technology-neutral regulations to introduce Minimum Energy Performance Standards for general lighting.

Based on stakeholder consultation we identified that the two key risks to the economic case for the introduction of MEPS were firstly, a potential delay in the implementation of the regulation and secondly, poor enforcement of the compulsory specifications. We estimated that if the implementation of MEPS was delayed by three years (from 2021 to 2024), the total net benefit associated with introducing MEPS would fall from R11.6 billion (USD804 million) to R1.9 billion (USD132 million) and the benefit-cost ratio would fall from 27.4 to 5.3 Under the low enforcement scenario where we assume that only 33% of retail outlets comply, the expected net benefit is reduced by more than two-thirds. However, as documented in the original report, there are however several measures that could be introduced to improve the monitoring verification and enforcement of the compulsory specifications.

Conclusion

The results of the cost-benefit analysis provide a strong positive case for introducing MEPS to accelerate the uptake of energy-efficient lighting in South Africa. Under the central scenario, we estimated that the proposed compulsory specification for general service lamps would generate a total net economic benefit of R11.7 billion (in present value terms) and estimated that the benefits would greatly exceed the costs – by 27-fold.

Sensitivity tests on the analysis suggest that the economic case for implementation of MEPS remains robust under a range of alternative assumptions, including higher discount rates, lower enforcement and delaying implementation by three years. The results of the 'low enforcement scenario' however reinforce the views expressed by several stakeholders, that the lack of adequate market surveillance and enforcement of compulsory specifications in South Africa is one of the major risks to the successful implementation of MEPS.

On 1 March 2021, on the recommendation of the National Regulator for Compulsory Specifications (NRCS), the Department for Trade, Industry and Competition (DTIC) published the proposed compulsory specifications for Energy Efficiency and Functional Performance Requirements and Safety Requirements of general service lamps in the government gazette.[7] The NRCS are currently in the process of responding to public comments. If the board of the NRCS subsequently recommends the introduction of the proposed specifications, the minister of the DTIC will declare the standard in the government gazette.

[7] Republic of South Africa. Department of Trade, Industry and Competition. 2021. National Regulator for Compulsory Specifications act (act no. 5 of 2008), as amended through legal Metrology act (act No. 9 of 2014). Compulsory specification for energy efficiency and functional performance requirements of General service lamps (GSLs) - vc 9109. Government Gazette no. 44210, 1 March.

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Walsh, K., Spazzoli, R., Du Bois, T., Filby, S., & Reeders, C. (2019). *Cost-Benefit Analysis of technology-neutral regulations to introduce Minimum Energy Performance Standards for general lighting.* Report prepared for the United Nations Development Programme.