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Implementation of the Policy for Banning Incandescent Lamps in the Markets: Review of the Global Situation and Challenges for Mozambique,

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The excessive use of incandescent lamps is one of the main factors in the low energy efficiency of the residential sector in Mozambique. To remedy this situation, some countries are banning the import and sale of incandescent lamps in their markets. The article reviews the status of implementation of these actions worldwide and the challenges for Mozambique. The data is drawn from existing literature on the topic under discussion and selected according to purpose. The literature indicates that Mozambique has a program to promote energy efficient incandescent lamps, but the level of its implementation is still very low. Regarding the implementation of the policy to ban incandescent lamps, it was found that the barriers are universal, namely the lack of funding to support the policy actions, the high price of marketing energy efficient lamps, the deficit and doubtful quality of efficient lamps and the little knowledge of consumers and decision makers about the advantages of using energy efficient lamps. However, these data lead us to conclude that it is premature to think about the implementation of the policy to ban the import and sale of incandescent lamps in Mozambique, as there are actions that should be prioritized at this time, namely, the promotion of low consumption lamps, the dissemination of measures for the rational use of electricity in buildings, consumer awareness, the adoption of labels on household appliances and the drafting of specific legislation.

Keywords: Ban of incandescent lamps; energy efficiency; electricity consumption; residential use; Mozambique

1. INTRODUCTION

Currently, the concern of almost all countries is to develop in a sustainable way and, for this, the energy sector is a sector that has received much attention. In general, the energy solutions advocated for sustainable development follow certain basic reference lines, namely;

(1) the reduction of fossil fuels and greater use of renewable fuels and technologies,
(2) technological development in the energy sector, which includes the production of equipment and materials for the sector,
(3) the development and advocacy of energy policies favorable to the formation of markets for environmentally beneficial technologies, and
(4) the increase of energy efficiency in the sector.[1]

Energy efficiency is achieved by taking measures on the supply side, with the rationalization of electricity production and distribution, as well as on the demand side, with price regulation to reflect the true costs of production and environmental impacts.[2] Energy efficiency actions are important because the consumer can reduce their energy costs or household income and the state can control demand and preserve the environment and/or energy resources for future generations.[3]

However, as stated above, the use of renewable sources and the promotion of the efficient use of energy, either through technological development or by seeking energy efficiency in the production and consumption of electricity, including the use of efficient electrical equipment and in a more rational way (awareness raising), are the current

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1 LB Reis, EAFA Fadigas and CE Carvalho, Energy, natural resources and the practice of development (2th edn, EditoramanoleLtda, Sao Paulo 2012).

2 Ibid. p.88.

3 Yigzaw GoshuYohanis, 'Domestic energy use and householders energy behavior' (2012) 41 Energy Policy<https://doi.org/10.1016/j.enpol.2011-.11.028>accessed 22 March 2017

challenges for the electricity sector.[4] These are actions that should be prioritized because, as is well known, the electricity production process causes several impacts on the environment, mainly the issue of the greenhouse effect, due to the increase in the atmospheric concentration of some gases.[5] These gases cause an increase in the greenhouse effect because they capture part of the infrared radiation, causing an increase in atmospheric temperature and climate change.[6]

Right now, just as an example, the annual emission of greenhouse gases is increasing and over the last 3 decades this emission has increased by an average of 1.6% per year.[7]And with the lack of robust policies to reverse this situation, particularly in Mozambique, the emission of large quantities of gases is evident.

In this regard, in 2007, the US Environmental Protection Agency (US EPA) estimated that primary energy demand could increase by 55% from 2005 to 2030, bringing serious risks to energy security and environmental sustainability.[8] However, the US EPA developed a document recommending the implementation of 25 energy policies to reduce global carbon dioxide emissions by 20% per year by 2030.

The aim of the US EPA recommendations was to conserve energy at low cost, correct market barriers and imperfections in existing energy policies, and stimulate the implementation of energy policies. Construction, transport

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4 Felipe Carlos Bastos, 'Analysis of the policy of banning incandescent lamps in the Brazilianmarket" (Thesis, March 2011) <http://www.ppe.ufrj.br/index.php/pt/publicacoes/dissertacoes/2011/955-analise-da-poli-tica-de-banimento-de-lampadas-incandescentes-do-mercado-brasileiro> accessed September 2018

5 United States Environmental Protection Agency, An official website of the United States government<https://www.epa.gov/laws-regulations≥ accessed 3 November 2020

6 Ibid 4.

7 Intergovernmental Panel on Climate Change, Climate Change 2013: The Physical Science Basis (Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA 2013) p.1535

8 International Energy Agency, Energy Efficiency Policy Recommendations – Worldwide Implementation Now (International Energy Agen-cy, 2020) <https://www.iea.org/≥ accessed 12 December 2020.

and industry were the other areas included in the US EPA's recommendations.[9]

Among the EPA's recommendations are related to lighting, and some countries have instituted the removal of incandescent lamps in their markets.[10] The lighting sector is considered a priority in sustainable development policies because, in addition to emitting over 6% of greenhouse gases, it consumes 20% of the world's electricity[11], 5307GWh in Mozambique.[12] To achieve this goal, the establishment of an implementation schedule was recommended, where countries were urged to coordinate with industry to ensure the supply of good quality and efficient lamps.[13]

Strategies for phasing out incandescent lamps vary according to the financial conditions of each country, and in most cases a phased approach is being adopted. The phase-out of incandescent bulbs began in 2008 in Australia, and in 2012 the strategy was implemented in the United States, Canada and Korea.

The massive sale of incandescent lamps in national markets is a reality and the level of their use in households, particularly in suburban areas, is worrying. In Maputo city, the country's capital, incandescent bulbs of 60 and 100 W are the most used, especially in the peripheral neighborhoods, with a proportion of two bulbs per household.[14] In urban areas, for example, where high income consumers reside, 60W incandescent lamps are in the proportion of one incandescent lamp per household.[15]

It was not possible to obtain data for all national households, but it is understood that the data from Maputo City may reflect the national reality, the massive use of

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9 Ibid.

10 Ibid.

11 Ibid.

12 Electricidade de Moçambique, Annual Statistics Report 2015 (2015) <https://www.edm.co.mz/pt/document/reports-reports-and-accounts/relatorio-anual-de-estatistica-2015> accessed June 2018

13 Ibid 7.

14 Nelson Manuel Alfredo Chapala, Genito AmósMaúre and Carlos Silva 'The Electricity Consumption Forecast in the homes of Maputo City' (2020) 10 (21) RCMNC <https://www.nucleodoconhecimento.com.-br/engenharia-eletrica/consumo-de-eletricidade> accessed 7 January 20-21

15 Ibid.

incandescent lamps in all households and with approximate proportions.

However, in Mozambique, the National Statistics Institute of Mozambique (INE) forecasts that from 2020 to 2024, the population will grow by 50%.[16] According to Electricidade de Moçambique (EDM), this growth is a threat as it will influence the higher demand for electricity in households.[17] As facts, Figure 1 shows that electricity consumption in Mozambique has been growing steadily, reaching 203 kWh per capita in 2015, which is above the average of 155 kWh recorded in the region.[18] The Mozambique National Renewables Status Report (ALER) also indicates that in 2015 the peak demand in the system managed by EDM was 875 MW, which compares with 831 MW in 2014, which corresponds to an increase of 5.3%, after an average annual growth of 11.6% in the previous five years.

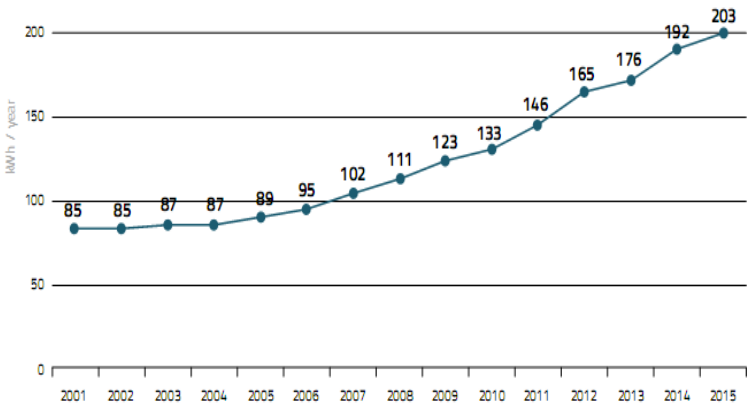

Figure 1.Evolution of electricity consumption per capita.[19] NOTE: The consumption is considered the Gross National

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16 National Institute of Statistics of Mozambique, 'Projection of the Mozambican population 2007-2040'<http://www.ine.gov.mz/estatis-ticas/-estatisticas-demograficas-e-indicadores-sociais/projeccoes-da-po-pulacao/mocambique_projeccoes_2007_2040.xls/view> accessed June 2020

17 Electricidade de Moçambique,_CFL Project Report - Replacement of 500.000 Incandescent Lamps by Compact Fluorescent Lamps (CFL) in the Northern Region of Mozambique (2018)

18 Ibid.

19 Renewables in Mozambique, National Status Report – 2017 (2017) <https: //www.alerrenovaveis.org/contents/lerpublication/aler_2017_oct_relatorio

If we say that from 2020 to 2040 the population will double, this implies that the demand for electricity could also double or triple if the level of use of incandescent lamps is not controlled. In view of the above, it is understood that Mozambique should even implement one of the recommendations of the US EPA to reduce electricity consumption, particularly in lighting, to avoid the collapse of its electricity system.

In this research, the following questions are asked:

(a) What actions are being taken in the world to ban the importation and sale of incandescent lamps in the markets?
(b) What have been the notable gains from implementing this policy?
(c) What are the main obstacles to the implementation of this policy?
(d) And given the scenarios in other countries, is Mozambique in a position to implement this policy? If not, what would be the other strategies to reduce electricity consumption in lighting in Mozambique?

Regarding the material and methods, during the preparation of the document, no studies with the same objective or lineage were found in the literature. Due to this situation, it is understood that the study is both exploratory and descriptive. It is descriptive because there is already a lot of published data in the literature on the challenges of banning incandescent lamps in the markets and the study explored these literatures to find an idea that would somehow help to present some possibilities to reduce the less efficient lamps or electricity consumption in Mozambique. The research adopts a qualitative methodological approach as it is based on the interpretation of literature. It is important to note that inductive reasoning was used to analyse the data, since from the data found in the literature it was possible to fulfill the objective established in the study.

-nacional-ponto-situacao-renovaveis-em-mocambique.pdf> accessed May 2020

The bibliographic survey was the technique and method of data collection used. The texts were selected according to the proposed objective and are scientific works (articles, theses and dissertations), web pages, newspapers and books. The main sources of information used were found in open access digital libraries and international journals, with emphasis on the articles published on the International Energy Agency webpage.

As for the data analysis method, the first activity was to select the literature according to the place of publication (country, publisher or type of event where they were presented) in order to rely on reliable information. Then, the texts were read carefully, where a critical analysis of the content was performed and selected according to the purpose of the article. Finally, the results of the chosen literature were cross-checked and then interpreted.

The article is divided into four sections. After this introduction, section 2 aims to descrexplores the actions and results of policies to ban incandescent lamps in the markets of some countries in all continents. Section 3 examines energy efficiency measures, particularly in lighting, underway in Mozambique and their respective gains. Section 4 presents the main constraints in implementing incandescent lighting ban policies in other countries, and related to the Mozambican reality. Finally, section 5 presents some guidelines that can contribute to overcome existing limitations to the implementation of the ban policy in Mozambique.

2. SOME NOTES FROM INTERNATIONAL EXPERIENCES ON INCANDESCENT LIGHTING POLICIES

Regarding these policies, until 2010, Cuba was the only country recognized for having eliminated almost all

incandescent lamps in its markets.[20] In addition to regulation, more measures have been developed, including market transformation programs, labeling and fiscal/financial incentives.[21][22][23] The Organization for Economic Cooperation and Development (OECD) and the World Environment Fund of the United Nations (UN) have established a global initiative to support the phasing out of incandescent lamps.[24]This effort had an initial focus on China, as it is the dominant producer of compact fluorescent lamps for the global market.[25]

From the literature review, it was possible to understand that, by the end of 2006, at least 30 more countries had already adopted policies for the elimination of incandescent lamps. And so far many others are validating a policy. Countries already committed to phasing out incandescent lamps cover almost all OECD economies and account for more than a third of the global demand for incandescent lamps.[26]

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20 The replacement of incandescent bulbs, 'Cuban experience"/ Presented at Phase-out 2008' (2008)<https://www.energyrating.gov.au-/document/presentation-replacement-incandescent-bulbs-cuban-experience> accessed 12 June 2018

21 Paul Waide, 'Phase Out of Incandescent Lamps: Implications for International Supply and Demand for Regulatory Compliant Lamps' (IEA Energy Papers, 2010) <https://www.oecd-ilibrary.org/ener-gy/phase-out-of-incandescent-lamps_5kmh3nhp62s0-en> accessed September 2018

22 Ibid.

23 Nicolas Lefèvre, Philippine de T'Serclaes and Paul Waide, 'Barriers to technology diffusion: the case of compact fluorescent lamps' (2006) <https://www.oecd.org/env/cc/37671771.pdf> accessed August 2018

24 UNDP, 'Environment & Energy, Phasing-out of Incandescent Lamps and Energy Saving Lamps Promotion in China (Annual Report, 2020) <https://www.cn.undp.org/content/china/en/home/operations/projects/environment_and_energy/phasing-out-of-incandescent-lamps-and-energy-saving-lamps-promot.html>accessed 22 November 2020

25 United States Environmental Protection Agency, 'Energy Technology Perspectives – Scenarios & Strategies to 2050" (United States Environmental Protection Agency, 2006a) <https://www.oecd.org/env/cc/36-349531.pdf>accessed 04 May 2020

26 Katherine Johnson, 'Residential Lighting Technologies in the United States: An Assessment of Programs, Policies, and Practices' (Stanford University, 18 July 2004) <http://large.stanford.edu/courses/2018/ph-240/walter1/docs/johnson-jul18.pdf> accessed June 2020

The experiences of some countries are presented below. However, it is worth noting that the description is brief, as there is already much literature that discusses this topic and can be consulted. Some of this literature is cited in this section of the research.

2.1 Cuba

Cuba is the first country to eliminate incandescent lamps.[27] This happened when the Cuban government realized the benefits of replacing incandescent lamps with compact fluorescent ones.[28] As a result, Cuba was able to reduce national energy demand by 25 MW for every million light bulbs replaced.[29] In order for Cuba to achieve this unprecedented effect, it enacted laws that prohibit the import and sale of incandescent lamps.[30]What is important to note is that, during this program, social workers visited families and replaced the existing incandescent lamps with quality compact fluorescent lamps free of charge.[31]

Due to the results obtained, the Cuban methodology was been adopted in several countries around the world. In June 2008, for example, Cuba would have reached an unprecedented milestone by being able to remove 116 million incandescent light bulbs.[3233]Also that year, Cuba reduced its peak electricity demand by 3,980 MW (i.e. by 34 MW per million lamps replaced).[34]Due to its successful

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27 Ibid 21.

28 Ibid 24.

29 Korea Energy Management Corporation and the Ministry of Commerce, 'Industry and Energy Korea's Energy Standards and Labeling: Market Transformation and Energy Standards & Labeling (Asia Pacific Energy, 2013) <https://policy.asiapacificenergy.org/node/1356> accessed 15 June 2018

30 Yan Sun, 'Replacement of Incandescent Lamps to CFLi in Japan Presented at Phase-out 2008' (Energyrating, 2008)<https://www.energyrating.gov.au/sites/default/files/documents/2008-phase-out-session1-japan_0.pdf> accessed July 2020

31 Ibid 22.

32 Melanie Slade, 'The Phase-out of Inefficient Lighting in East Asia - Presen-ted at Phase-out 2008 (Energy rating, 2008)<https://www.energyrating.gov.au/sites/default/files/documents/2008-phase-out-session1-ms_0.pdf> accessed July 2020

33 Ibid 21.

34 Ibid 25.

implementation of the programme, Cuba would have supported almost all Latin American countries in implementing its policies to ban incandescent lamps.[35]

2.2 European Union (EU)

In March 2007, EU Heads of State reportedly approved a policy to phase out incandescent light bulbs in the European Community.[3637]And for its effective implementation the European Commission has prepared regulations, in accordance with the provisions of the Ecodesign Directive for Energy-using Products, which came into force in 2009.[3839]Even before the implementation of the project, the Commission contracted consultants who carried out a technical assessment and hearing campaign to the EU member states to legitimize or seek consensus on the laws drafted.[4041]

In Europe, as well as other countries, the priority was to define the levels of performance and quality of lamps that replace incandescent.[424344]As part of this, in 2008 the EU set

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35 Ibid.

36 Prevlen Rambalee, 'South Africa electricity sector: Possible policy reform Policy (2016)<https://repository.up.ac.za/bitstream/handle/2263/52300/Rambalee_South_2016.pdf?sequence=1&isAllowed=y> accessed July 2020

37 United Nations Environment ProgrammeTerminal Evaluation of the Global Environment Facility - UN Environment Project - Phasing out incandescent lamps through lighting market transformation' (United Nations Environment Programme, September 2018) <https://wedocs.unep.org/bitstream/handle/20.500.11822/27335/3755_2018_te_unep_gef_global_cc_fsp_spcc_lighting_market_in_Vietnam.pdf?sequence=1&isAllowed=y> accessed January 2019.

38 EUR-Lex, 'Directive 2009/125/ec of the european parliament and of the council' (21 October 2009) <https://eur-lex.europa.eu/legal-content/EN-/TXT/?uri=celex%3A32009L0125> accessed September 2018.

39 European Commission, FAQ: phasing out conventional incandescent bulbs (2009)<https://ec.europa.eu/commission/presscorner/detail/en/MEMO_09_-368> accessed December 2019.

40 Gunther Bensch, Jörg Peters and Maximiliane Sievert , 'The lighting transition in rural Africa — From kerosene to battery-powered LED and the emerging disposal problem' (2017) 39 Energy for Sustainable Development<https://www.sciencedirect.com/science/article/pii/S0973082616310444?via%3Dihub> accessed 11 June 2019.

41 Ibid 21.

42 Manuel Frondel and Steffen Lohmann, 'The European commission's light bulb decree: Another costly regulation?' (2011) 39 (6) Energy Policy

out a timetable for the phasing out of light bulbs[45]and the withdrawal involved 100 watt bulbs in 2009 (in the first phase), followed by 60 W (in 2010) and 40 W (in 2011) involving 100 watt bulbs in 2009 (in the first phase), followed by 60 W (in 2010) and 40 W (in 2011)[46].

However, it was not possible to obtain the exact number of lamps eliminated across Europe and the amount of energy saved, but the expectation was to reduce 40 TWh and the emission of 15 million tons of carbon dioxide per year. As a way to strengthen the initiative, some EU member states have implemented their domestic policies.[47]

2.3 Japan

In December 2006, JELMA (Japanese Association of Electric Lamp Manufacturers) announced four proposals to replace less efficient lamps with more efficient alternatives.[48]And as a way of solidifying the project, throughout 2007 the government and the lamp manufacturers strongly promoted sales of integrated compact fluorescent lamps (CFLs), which were rewarded with a 22% increase in their sales.[49]

The Japanese government adopted a strategy that, in our opinion, was good, working with local vendors, such as stores, supermarkets and appliance stores to promote fluorescent lamps, making sure that they are always on display to familiarize consumers with these products.[50] In addition, Japan launched a public awareness campaign to switch from incandescent bulbs to low-consumption fluorescent bulbs in order to save more energy in domestic lighting, which accounts for almost 20% of domestic electricity use.

<https://www.sciencedirect.com/science/article/abs/pii/S0301421511001807> accessed April 2017

43 Ibid 21.

44 Ibid 25.

45 Ibid 23.

46 Ibid.

47 Ibid 21.

48 The World of Parliaments, Energy Saving Lighting Efficiency Technologies (Quarterly review No.35, September 2009) <http://archive.ipu.org/news-e/wop/35/1.htm> accessed June 2018

49 Ibid 23.

50 Ibid 32.

Some suppliers have also promoted fluorescent lamps.[51] What was even more interesting was that supermarkets also reduced the cost of low-consumption light bulbs and offered consumers information on energy efficiency and other benefits of fluorescent lamps.[52] The Japanese government's goal was to phase out the country's incandescent and fluorescent lamps by 2020 and convert all lights into LED (Light Emitting Diode).[53]

2.4 The United States

When the Energy Independence and Security Act of 2007[54]came into effect on December 19, 2007, the United States became the first OECD country to pass legislation, specifying how incandescent lamps should be eliminated.[55] The regulations defined the maximum permitted lamp power levels depending on the luminous flux and came into force from January 1, 2012 to January 1, 2014.

In temporal terms, USAs would have determined that, after January 1, 2012, the most common 100 W incandescent lamps could not be manufactured or imported for sale.[56] In 2013, the most common 75 W bulbs were eliminated, while in 2014, the most common 60 W and 40 W bulbs were also excluded.[57]The legislation also specified minimum levels of effectiveness and came into force from 2020.[58]

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51 Ibid 40.

52 Ibid 21.

53 Ledinside of TrandForce, LED Replacements to Peak as China Incandescent Bulb Ban Enters Last Phase (September.6, 2016) <https://www.ledinside.com/news/2016/9/led_replacements_to_peak_as_china_incandescent_bulb_ban_enters_last_phase> accessed June 2018

54 Laws & Regulations, Summary of the Energy Independence and Security Act (2007). <https://www.epa.gov/laws-regulations/summary-energy-independence-and-security-act> accessed November 2020

55 Ibid 21.

56 Ibid.

57 Ibid 40.

58 European Commission, State of the Union: Questions & Answers on the 2030 Climate Target Plan (European Commision Report, 2020) <https://ec.europa.eu/commission/presscorner/detail/en/QANDA_20_1598> accessed 10 November 2020.

2.5 Korea

From 2008 to 2012, Korea was able to significantly increase sales of fluorescent lamps, driven in part by promotional schemes and subsidies.[59] What is important to note is that Korea is the first country to impose efficiency performance requirements for incandescent lamps. In December 2008, the Korean government would have decided to eliminate incandescent lamps by the end of 2013,[60] but Jee-Yeon[61]says that the deadline has been extended to 2014. The Korean government recommends the use of light bulbs with own reactor and LED lamps.

2.6 China

China has an important role in this policy, not only because it is the second largest economy in the world, but also because it stands out as a leading country in the manufacture of lighting products[62]. For example, China's production of compact fluorescent lamps increased 30-fold from 1996 to 2007.[63] Despite the growth, it was understood that, until 2010, there was a considerable imbalance with 2/3 of the compact fluorescent lamps produced in China for export and not for domestic consumption.[64]

The Chinese approach is like that of other countries, of transforming the local market for lighting products and eliminating the production and sale of incandescent lamps. It is from 2012 that China begins to implement this project.

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59 Seo Jee-yeon, 'Korea to ban incandescent bulbs in 2014 - Final transition to energy-efficient lighting spurs competition in LED lighting market' (Koreaherald, 16 July 2013) <http://www.koreaherald.com/view.php?ud=20130716000855> accessed 22 May 2019

60 Ibid 21.

61 Ibid.

62 Ibid 25.

63 United Nations Environment Programme, Facility project "Global Market Transformation for Efficient Lighting" (en.lighten initiative). <https://wedocs.unep.org/bitstream/handle/20.500.11822/25443/3755_2017_te_unenvironment_gef_global_cc_-msp_fsp__global_market_transformation_for_efficient_lighting.pdf?sequence=1&isAllowed=y> accessed July 2019

64 N Kan and N Abas, 'Comparative study of energy saving light sources' (2011) 15 (1) Renewable and Sustainable Energy Reviews<https://www.sciencedirect.com/science/article/abs/pii/S1364032110002522>

Another measure taken was to restrict the sale of smaller lamps.[65] The last phase of the ban on incandescent lamps in China came into force on 30 September 2016.[66] China banned imports and sales of general incandescent lamps 15 W and above from 1 October 2016 and made adjustments based on the results of the provisional assessment.[67]

Also in that framework, a series of recommendations were made for the policy review, where it was decided to support the industry for the development and manufacture of fluorescent lamps and LEDs, the promotion of lighting products in rural areas and tax reform to promote the production and sale of efficient lighting.[68]

There have also been significant developments in expanding the demand for efficient lighting. The project "phasing out incandescent lamps and promoting energy saving lamps in China" worked closely with the Chinese government, where they awarded grants to promote efficient lighting products and facilitated the development of pilot distribution channels in more than 500 cities and villages in rural areas.[69] The production base is changing rapidly, with ten inefficient incandescent lamp manufacturers producing more efficient alternatives, five with project support and five with government support.[70] The two conversions completed so far have already reduced the production of incandescent lamps by 330 million units and produced 77 million energy-saving lamps.[71]

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65 Ibid 59.

66 Ibid 53.

67 Ibid.

68 Bradford Mills and Joachim Schleich, 'Household transitions to energy efficient lighting' (2014) 46 Energy Economics <https://www.sciencedirect.com/science/article/pii/S0140988314002047?via%3Dihub>accessed 11 May 2019

69 UNDP Annual Report 2020, Environment & EnergyPhasing-out of Incandescent Lamps and Energy Saving Lamps Promotion in China (2020)<https://www.cn.undp.org/content/china/en/home/operations/projects/environment_and_energy/phasing-out-of-incandescent-lamps-and-energy-saving-lamps-promot.html> accessed 9 November 2020

70 United Nations Environment Programme, Achieving the Global Transition to Energy Efficient Lighting Toolkit<https://www.unep.org/resources/report/achieving-global-transition-energy-efficient-lighting-toolkit

71 Ibid 63

2.7 South Africa

South Africa was one of seven countries to participate in the World Bank / GEF Efficient Lighting Initiative (ELI)[72] and it is a good example to follow for those who want to implement the project to ban incandescent lamps. Bonesa was the name of the company created to operate ELI in South Africa and operated from 1999 to 2002.[73]Bonesa focused on 50,000 homes and aimed to replace all lamps with compact fluorescent lamps.[7475] One of its main objectives was to reduce the price of compact fluorescent lamps. The information shows that the project was successful: the prices of compact fluorescent lamps went from R60 / 80 per lamp in 1998 to R13 / 20 in 2004.[76] Through the training program for the staff of local communities, Bonesa also managed to increase local experience in technologies and advantages of using compact fluorescent lamps (CFL).

For three years Eskom implemented a residential DSM program,[77] which aimed to reduce the demand for electricity during peak hours, moving the load to off-peak hours, and to reduce the demand for electricity through implementing energy efficiency measures.

The national initiative to implement efficient lighting, part of the DSM program, was launched by Eskom in 2002 and aimed to provide efficient alternatives at low cost.[78] Between 2003 and 2005, approximately 2.5 million compact fluorescent lamps were distributed at subsidized prices.[79]

Similar initiatives were later replicated through regional programs, such as the latest Western Cape initiative launched

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72 International Institute for Energy Conservation, Efficient Lighting Initiative (ELI) (2000-2007). <https://www.iiec.org/ee-dsm/672-regional-a-global/223-efficient-lighting-initiative-eli> accessed June 2020

73 Ibid 24.

74 Ibid.

75 Ibid 37.

76 ESKOM, National Efficient Lighting: Roll-out Initiative (2005)

77 Ibid 24.

78 Ibid.

79 Linda J Sandahl, Theresa L Gilbride, Marc R Ledbetter, Heidi E Steward and Chris Calwell, 'Compact Fluorescent Lighting in America: Lessons Learned on the Way to Market' (2006) <https://www.osti.gov/biblio/882979> accessed June 2019.

in April 2006[80]and this enabled the replacement of more than 4.3 million compact fluorescent lamps in three months[81], mainly through door-to-door donation campaigns, resulting in savings of 193 MW, exceeding the target of 155 MW.[82]

In addition, sales figures in South Africa showed that CFL sales have increased significantly since 2000 (Figure 2).[83] In 2000/2001 sales were approximately 4 million units, while in 2004/2005 they were around 10.5 million, an increase of more than 260% in about six years.[84]

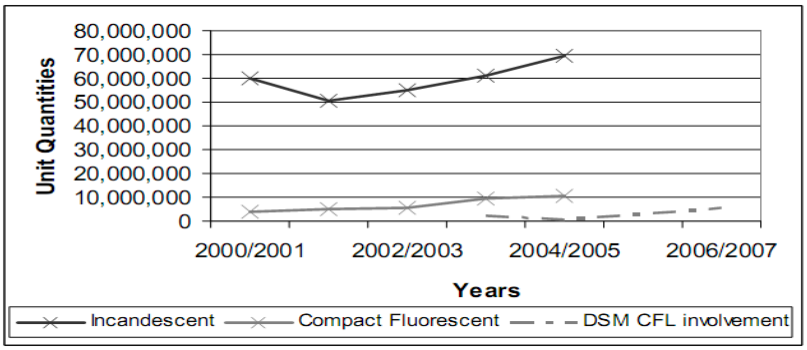

Figure 1. Evolution of CFL and incandescent lamp sales in South Africa[85]

2.8 Ghana

In 2007, in Ghana, electricity consumption for lighting began to decline.[86] And it is due to the fact that the Ghanaian government has introduced a policy of intervention in compact fluorescent lamps (CFL), whereby 6 million

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80 Ibid 20.

81 Information was be accessed from the page of the South African company ESKOM,<https://www.eskom.co.za/OurCompany/CSI/What%20We%20do/Case%20Studies/Pages/default.aspx> accessed June 2019

82 Ibid.

83 Ibid 81.

84 Ibid.

85 Ibid 69.

86 Felix Amankwah Diawuoa, Marriette Sakah, André Pina, Patricia C. Baptista and Carlos A. Silva, 'Disaggregation and characterization of residential electricity use: Analysis for Ghana' (2019) <https://www.sciencedirect.com/science/article/pii/S2210670718318766> accessed 20 February 2020.

incandescent lamps have been replaced in homes and in some selected institutions.[87] Before the intervention, as noted in Diawuo et al.,[88] the Ghanaian Energy Commission conducted a baseline study that showed that incandescent lamps constituted 58% of the lighting technology, linear fluorescent, 21% and CFL, 20%. With the implementation of this policy, the use of incandescent lamps in homes was reduced from 58% to 3%, linear fluorescent lamps from 21% to 17% and while the use of compact fluorescent lamps increased from 20% in 2007 to 79% in 2009.[89]

With the policy, the peak domestic load has been reduced between 200 MW and 220 MW.[90] To emphasize this type of activity, in 2008 Ghana passed legislation that prohibited the manufacture and sale of incandescent lamps.[91]

3. ACTIONS TO REDUCE ELECTRIC CHARGE IN LIGHTING IN MOZAMBIQUE

To begin with, note that the data for this section are taken from the report[92] of the Directorate of Renewable Energy and Energy Efficiency of the company Electricidade de Moçambique (EDM), published on May 28, 2018.

The energy crisis that EDM faces is not unique, as several countries at regional and global levels have faced problems of energy deficit, forcing them to adopt specific measures to guarantee the continuity of the services without compromising the integrity of electrical systems. As a matter of fact, in the last months of 2015, the North Region of the country faced an energy deficit due to the Peak limit of the Northern System (DTNO), in particular the 220kV line

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87 Ibid.
88 Ibid.
89 Ibid.
90 Ibid.
91 Ibid 86.
92 This information was obtained from documents obtained from the company Electricidade de Moçambique (EDM), CFL Project Report 2018

(B08) whose thermal limit is 118MW. In June it reached a peak of 123.7 MW (6/2/2015 - 7:00 pm), in July 125,4 MW (7/22/2015 - 7:00 pm) and 128.3 MW in August (21/08/2015 - 19h00).

It was with this assumption that EDM understood the importance of developing programs aimed at reducing consumption, with actions such as education and awareness for the rationalization of electricity consumption. In lighting, the replacement project was implemented incandescent lamps by CFL (Compact Fluorescent Lamp). The initially anticipated impact pointed to an economy in the order of 25 MW, thus contributing to the alleviation of Transmission / distribution systems as well as postponing investments in infrastructure, allocating them in other priority areas).

At the regional level (SAPP), Mozambique has a target of 3,000,000 incandescent lamps to be replaced, where to ensure compliance with this, the EDM Board of Directors has taken significant steps through the deliberation to replace 2,000,000 incandescent lamps with internal funds, given the cost-benefit advantages that this project presents.[93] As part of the fulfillment of this resolution, only the first phase of the project started, involving 500,000 CFL, and the next phases would be implemented in areas where the project justified. The project to replace incandescent lamps with CFL was subdivided into three locations, namely Nampula (200,000 CFL), Nacala (200,000 CFL) and Pemba (100,000 CFL).

In order to assess the results of the project, metering systems in the main delivery points (substations) have been assured, namely line B08, Nampula Central Substation, Nacala Substation and Pemba Substation. Also within the context of this programme, 350,000 CFL of 15W and 150,000 CFL of 20W (totalling 500,000 low consumption lamps) was purchased according to EDM technical specifications 484,080 incandescent light bulbs were replaced by CFL, which allowed 22MW reduction and detection of 225 frauds in energy-consuming installations, as well as avoiding the cost of acquiring emergency energy for the northern region in the order of 5.8 million dollars, having been avoided the emission of around 50 thousand tons of CO2/year. All

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93 Ibid.

incandescent lamps removed from consumer facilities were destroyed by professionals in local municipalities

3.1 Selection of areas to be covered by the Project and Awareness

For the selection of areas to be covered by the project, the following assumptions were followed: High fraud rates; Distribution networks in good condition (rehabilitated / new networks); Customers with low power purchasing rates; Distribution transformers in overload; Poor quality of power supply (voltage drop, outages).

For the success of the project, actions were taken to raise awareness among the people in the selected areas, including community leaders, to ensure that the project goes smoothly and that there are greater adherences. The awareness was extended to traders so that they knew the advantages of the commercialization of low consumption technologies, in particular CFL in local markets. These awareness actions allowed EDM to have an idea of what type of consumers we are dealing with, and to design a more comprehensive awareness program using the different media channels (TV, Radio, Newspapers, TV spots, banners, etc.) to spread messages with focus on reducing energy consumption.

3.2 Replacement of Incandescent Lamps by Compact Fluorescent Lamps

Table 1 illustrates the amount of CFL installed in each project implementation area, as well as the preliminary theoretical results shown in the graphs of the load profiles represented in Figure 3. Of the expected reduction, of 25MW in the Northern System, 22MW was possible, and this is due to several factors, described in 4.

Table 1. Summary of the implementation of the CFL project

SUMMARY OF THE CFL INSTALATION						
CITY	INCANDESCENT LAMPS		CFL		TEORICAL RESULTS	
	40W+60W	75W+100W	15W	20W	TOTAL	SAVINGS [MW]
NACALA	116,708	49,411	108,264	57,424	165,688	8
NAMPULA	177,507	69,584	177,566	67,393	244,959	11
PEMBA	54,846	25,076	55,033	29,894	84,927	4
TOTAL	**349,061**	**144,071**	**340,863**	**154,711**	**495,574**	**22**

Source[94]

The forecast for the CFL installation in the city of Pemba was 100,000, but due to the population's poor perception of efficient lighting technology (energy efficient lamps), there was a lot of theft of lamps and subsequent sale in areas outside the scope of the analysis, which undermined the cost-benefit assessment as well as compromising the objectives that would have been previously stated.

3.3. Results

3.3.1. Analysis of the Load Profile of Line B08 before and after the Project (Measurement and Verification - M&V)

For a real assessment of the impact of the project, it was necessary to collect basic data to assess the load situation before the implementation of the project so that through its measurement and verification it is possible to measure its results. Accordingly, Figure 3represents the load profile of the main electricity transmission line in the north corridor, before and after the implementation of the project.

In essence, Figure 3 illustrates the comparison of two load profiles of the B08 line before and after the implementation of the project. As can be seen, the difference shown by the graph represents energy savings of 21 MW with a significant increase at peak time. This representation obviously illustrates the impact of the project in reducing consumption and improving the quality of electricity supply in the North

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[94] Supra note 92

Region, as well as the trend towards stabilization of the energy distribution system.

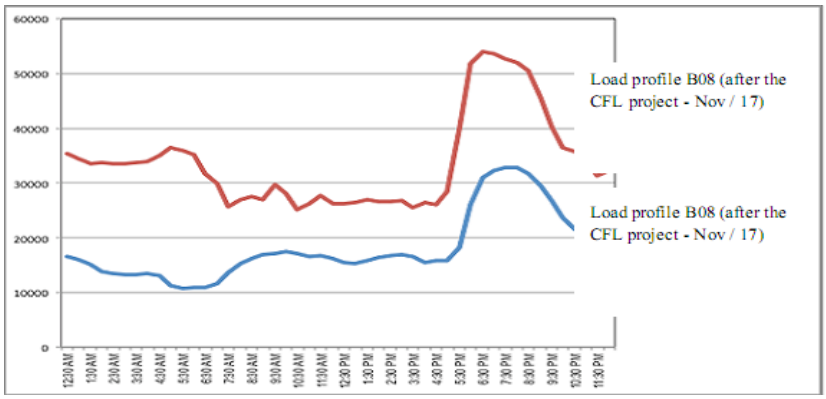

Figure 2. Load Profile Line B08 just before project implementation (July 2016) and after project implementation (November 2017).[95]

3.3.2. Project Cost-Benefit Analysis

In the overall context, the project to promote incandescent light bulbs allowed reducing 22 MW of power in the north power system, having contributed greatly to the relief of the distribution systems, as well as avoiding costs in the order of 34 MUSD for the implantation of a thermal power plant with equivalent capacity of 22 MW. It also made it possible to avoid the emission of around 45,000 tonnes of CO2 / year into the environment. Assessing the amount with penalties that EDM use to pay, it should be noted that this project has also prevented the cost of penalties during peak hours in the order of 5.2 MUSD / Year.

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[95] Supra note 92

4.0 ANALYSIS OF BARRIERS AND STRATEGIES FROM GLOBAL AND MOZAMBICAN PERSPECTIVE

4.1 Lack of funding

From the literature consulted, such as that of Lefèvre et al.,[96] it became clear that implementing the policy of prohibiting the sale and import of incandescent lamps in the markets is a great challenge and a partnership is necessary, especially for poor countries, like Mozambique where 66% of its population is rural[97] and always need help from the government to meet some of their basic needs.

Even in the city of Maputo, capital of the country, many people have low incomes and can hardly invest in 200 MT to buy an efficient lamp. It is based on these situations that countries end up distributing energy saving light bulbs to the vulnerable population in order to reduce the demand for electricity.

However, they are worthwhile investments. Note that if the Mozambican government offers at least three 60 W incandescent bulbs to each consumer, it can reduce 156 MW of load (or 351 GWh) and avoid the emission of approximately 351 thousand tons of carbon dioxide.[98] It is true that it would be necessary to invest a lot of money, about 800 million MT, but it is necessary to think that building a power plant with this capacity (156 MW) can cost 20 billion MT, 20 times more than investing in the distribution of incandescent lamps. For the City of Maputo, for example, with this action, the State can lighten the electrical load in the order of 75% (up to 29MW), consumption corresponding to 99 GWh, and save about 3 billion MT and avoid the emission of around 62 250 tons of CO2].[99]

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96 Ibid 24.
97 Supra note 16
98 Ibid 14.
99 Ibid.

In the EDM strategy,[100]it is stated that over the next 8 years EDM will rely on the potential of residential consumers to save electricity by sensitizing them to use efficient lighting. However, this is not enough, this commitment must come from the Government, the energy companies and all Mozambicans, not just EDM. There must be a combination of efforts between the government and the energy companies operating in Mozambique. Often companies are only concerned with billing[101] and forget that resources run out and Mozambique may suffer from it in the coming years.

As a reference for joint actions, the Brazilian government in coordination with the Ministry of Mines and Energy (MME) created a program called "Procel". The program is run by Eletrobras and the government has defined that at least 1% of the energy companies' revenues should be used to promote the use of low consumption light bulbs and to combat waste. The government of China, as a way of encouraging support, decided to support the industry for the development and manufacture of compact fluorescent lamps and LEDs, the promotion of lighting products in rural areas and the tax reform to promote the production and sale of efficient lighting.[102] Still in China, a project for the phasing out of incandescent lamps and energy saving lamps was created, which worked closely with the Chinese Government to support, subsidize and promote efficient lighting products and facilitate the development of pilot distribution channels in more 500 rural cities and towns.[103]

These are experiences worth noting, and for the case of Mozambique, perhaps it would be important to create a program or agency, and the government, from the state

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100 EDM Strategy 2018-2028 <https://www.edm.co.mz/sites/default/files/do-cu-ments/Reports/EDM_STRATEGY_2018_2028.pdf> accessed April 20-19.

101 Ibid 1.

102 Zhongguo Li et al.,Zhongguo Li, Puqi Jia,Fu Zhao and Yikun Kang, 'He Development Path of the Lighting Industry in Mainland China: Execution of Energy Conservation and Management on Mercury Emission' (2018)15 (12) <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6313470/> accessed May 2020

103 Ibid 68.

budget, and all the energy companies will support in their activities to promote low consumption lamps. For the mobilization of funds, a strong collaboration between the countries of the Southern region and Africa in general is also necessary.

4.2 The cost of energy saving lamps

In reality the costs of CFLs vary depending on where they are produced and the quality. The reality, at least in Mozambique, shows that the initial cost of efficient lighting is 20 times higher than incandescent lamps.[104] Table 2 shows the life cycle cost for an end user of incandescent and compact fluorescent lamps[105]. The cost assumptions adopted in this exercise are conservative.[106]

Although as shown above on a life cycle basis, compact fluorescent lamps are much more economical than incandescent lamps, the higher initial cost remains an important barrier to the wide diffusion of compact fluorescent lamps.[107]Incandescent lamps are the dominant technology in most countries, mainly because they are very cheap.[108] On the other hand, higher-income consumers often consider disposable incandescent lamps.[109] In this case, therefore, the higher initial cost / Higher life cycle cost characteristic of compact fluorescent lamps is a market barrier due to incomplete or inaccurate consumer awareness of competing technologies and limited confidence in the new technology.[110]

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104 Ibid 58.
105 Ibid 21.
106 Ibid 58.
107 Ibid 63.
108 Ibid 63.
109 Ibid 21.
110 International Energy Agency, Light's Labour's Lost: Policies for Energy Efficient Lighting (2006) <https://www.oecd-ilibrary.org/energy/energy-efficiency-policy-profiles_19900694> accessed 26 June 2017

Table 2. The economics of CFLs compared to incandescent lamps

	Incandescent lamp	*CFL*
Initial cost of bulb (USD)	0.50	10
Light output (lm)	900	900
Lamp power (W)	75	15
Efficacy (lm/W)	12	60
Lifespan of bulb (h)	1000	10 000
Calculation over a 10 000h operating period, assuming an electricity tariff of USD 0.1/KWh		
Electricity consumption (kWh)	750	150
Cost of electricity (USD)	75	15
Cost of lamps (USD)	5	10
Total cost of lamp and electricity (USD)	80	25
Total savings for CFL (USD)		55

Source[111]

In Mozambique, good quality compact fluorescent lamps are sold for a minimum price of 100 MT, a cost too high for the reality of many families. Because of this, people prefer incandescent lamps, available in the black markets and at a price six times lower than compact fluorescent lamps. However, to ban incandescent lamps, it would be necessary for the Mozambican government to guarantee the import and sale of quality lamps at a reasonable price and to guarantee that low-income families will get for free or at a subsidized price the efficient lamps. And there is no doubt that with this exercise, distribution of lamps, the government would have to invest a lot, since families with low income are many, be worth it.

Meanwhile, these are actions implemented by the countries that have banned incandescent bulbs and are still working to secure quality compact fluorescent bulbs for needy families.

Integrated compact fluorescent lamps (CFLi) are one of the most used, both in Europe as well as in China and the USA.[112] Until 2010, the cost of this type of lamp, for example, in OECD member countries was 3 to 4 dollars and in Europe a little more.[113] And, including imports, what would be the price of these lamps in Mozambique? Two or even three times more expensive.

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111 Ibid 101.
112 Ibid 19.
113 Ibid 36.

It was noted that within the scope of these policies, other substitute GLS halogen lamps for xenon mains voltage have appeared, which use a G9 halogen burner, but do not include coatings or IR reactors, also sold at high prices. In 2010, in the United States, the cost of this type of lamp was 5 dollars, equivalent to 300 MT.[114][115] This cost is high for a Mozambican, even for those with an average income. Note that, including possible fees and price speculation, an individual with a residence that uses 5 lamps would have to invest at least $ 25 (1750 MT). That money is a lot and, without a doubt, it is a great barrier for Mozambique to think about banning incandescent lamps. The impression is that it is not feasible to ban incandescent bulbs and then allow the importation and sale of efficient bulbs without quality, and those of quality sell them at very high prices. In study after study consumers pointed to price as their number one obstacle to purchasing a CFL.[116]These adversities or the high cost of the CFL is of more concern in Africa. Another example, in addition to Mozambique, we have the Nigerian market, where the price of CFL ranges from N800 to N1000, while on the other hand, prices of incandescent lamps range from N30 to N100,[117] a big difference.

Still in Europe, just to get an idea of how expensive quality fluorescent lamps are, in 2009 halogen xenon lamps were used, which were direct replacements for 40 W, 60 W, 75 W and 100 W GLS, 25 W reflectors and 40 W and 25 W candles[118]. And the initial retail price of these lamps was estimated to be between 9 and 10 Euros each. We are talking about 800 MT each lamp. And the minimum salary for a

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114 Ibid 19.

115 Ibid 68.

116 Kadiri K. O. and Opasina S.A, 'An assessment of the use of compact fluorescent lamp in some residential buildings in ile-ife'(2014) 3 (1) Research Journal in Engineering and Applied Sciences <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.687.1502&rep=rep1&type=pdf> accessed August 2018.

117 Ibid.

118 Commission Regulation implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for nondirectional household lamps <https://ec.europa.eu/energy/sites/ener/files/documents/sec_2009_327_impact_assesment_en.pdf> accessed June 2017.

Mozambican is approximately 4500 MT and if this person has 5 lamps, they would have to use their entire monthly income to ensure efficient lighting. What Lafévre et al.[119] said it is true, poor countries usually import or receive lamps with low quality, but this can discredit policies. The facts are these, for the poorest households, the capital cost of compact fluorescent lamps are even the substantial barrier, even if they end up saving money.[120]Many will always opt for the cheaper option if there is a price differentiation. In this case, the higher initial cost of compact fluorescent lamps is a purely financial barrier.[121]

4.3 Lamp Quality and Reliability

In the previous subsection it was said that underdeveloped countries tend to receive lower quality products.[122][123] And it is on the basis of this reflection that these countries must discuss deeply the quality of light bulbs whenever the intention is "to implement the policy of banning incandescent lamps". The world is aware of this and to solve these performance or quality problems, manufacturers are encouraged to work to further improve the quality of the lamps.[124] The quality of the lamps is distinguished from the quality of the light, heating time, maintenance of the lumen and several other factors.[125]However, the service life has a big impact on sales, for example CFLi were the bestselling lamps in Europe that last twice as long as normal CFLs.[126][127] And the useful life is, therefore, a fundamental factor when considering the influence of the unit's sales on the

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119 Ibid 21.
120 Ibid 64.
121 Ibid 68.
122 Ibid 19.
123 Ibid 42.
124 Ellis Yan, 'Replacement Technologies-CFLs : Presented at Phase-out 2008' (2008)<https://www.energyrating.gov.au/sites/default/files/documents/2008-phase-out-session5-yan_0.pdf>accessed June 2020.
125 M.M. Aman, G.B. Jasmon, H. Mokhlis and A.H.A. Bakar, 'Analysis of the performance of domestic lighting lamps' (2013) 52 Energy Policy <https://www.sciencedirect.com/science/article/abs/pii/S0301421512008506> accessed February 2020.
126 Ibid 59.
127 Ibid 19.

composition of the future stock of installed lamps and the expectation of increasing the useful life of low consumption lamps will always be greater.[128] That is why countries that have adopted the ban on incandescent lamps are prioritizing the lamp life, establishing quality requirements.

Some consumers have little time to think and this contributes to the fact that their decisions about lighting efficiency are often unfavorable to them.[129] Given the need to prioritize, many choose to invest in other directions and live the consequences of poorly made decisions about lighting.[130]

Many consumers are quite rightly concerned about the lack of performance and reliability of compact fluorescent lamps.[131] On the one hand this is happening because some previous or initial models of efficient lamps were of a lower standard and the bad reports quickly passed from consumer to consumer.[132] Many manufacturers have also promoted compact fluorescent lamps based on their lifetime, and therefore the consumer expected all lamps to meet the advertised life expectancy estimate, but the reality shows otherwise.

What is noted is that some fail early, disappointing consumers. Like many energy-efficient technologies, consumers who have had a bad experience tend to be shy about compact fluorescent lamps, although many of the initial problems have been reduced significantly[133]. It is agreed that consumers often seek guarantees or guarantees

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128 Ibid 118.

129 Niamh O'Connell, Pierre Pinson, Henrik Madsen and Mark O'Malley, 'Benefits and challenges of electrical demand response: A critical review' (2014) 39Renewable and Sustainable Energy Reviews<https://www.sciencedirect.com/science/article/abs/pii/S1364032114005504?via%3Dihub> accessed July 2020

130 Carole G. Bozworth, 'Challenges and Choices: Time Effectiveness — Prioritizing Your Time' (2016) <https://extension.missouri.edu/publications /gh-6653> accessed June 2019.

131 Robert Byrne, 'Climate Technology & Development Case study: Compact Fluorescent Lamps (CFLs)' (2020) <https://www.semanticscholar.org /paper/Climate-technology-and-development-case-study%3A-Byrne/996064fd95ff33832e9e3a543acdbe2d9407e327> accessed December 2020

132 Frank A. Wolak, 'Carbon Markets: An International Business Guide' (2010) 34 (4) <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.14778947.2010.01332.x> accessed August 2017

133 Ibid 68.

that the products they buy will achieve the promised results, especially if they pay a high initial cost compared to the prices of other less efficient products.[134] The consumer is frustrated when he invests in an efficient lamp in the expectation that it will work according to the prescribed useful life, but that does not happen.

Another aspect to be highlighted is that the demand for energy for lighting in the residential sector is also influenced by occupancy patterns and lifestyle factors.[135] There are consumers who prefer the light of incandescent lamps and even say that it focuses more and it is difficult to convince them to use other types of lamps. In this case change is always slow and it is up to the companies or industries to produce lamps that can convince consumers or satisfy their wishes.

When it comes to the quality and reliability of efficient lamps, it is important to consider the quality of electrical installations and electricity supply.[136]These two factors can influence consumers not to trust the quality of the energy-saving lamps that are being adopted.[137]

In Mozambique, EDM[138]states that the quality of electricity supply is considered low and bad for many electricity consumers. This is not a good thing, as it can contribute to the lamps to not last longer and consumers may prefer incandescent lamps. The poor quality of electrical installation in homes is a fact and it is difficult to think of convincing strategies if not to reinforce inspection for new consumers.

Another aspect that calls into question the quality of the lamps is the type of painting on the walls of the homes. An

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134 Ibid 125.

135 Ibid 68.

136 Jessika Luth Richter and Carl Dalhammar, 'Optimal durability in least life cycle cost methods: the case of LED lamps' (2018) 12 Energy Efficiency<https://link.springer.com/article/10.1007/s12053-018-9662-4#citeas≥ accessed 12 November 2020.

137 Matthias Rodemeier, Andreas Löschel and Roland Kube,'Casting light on energy efficiency: evidence on consumer inattention and imperfect information' (2017) 24 (21) Applied Economics Letters <https://www.tandfonline.com/doi/abs/10.1080/13504851.2017.1332742?journalCode=rael20> accessed June 2019.

138 Ibid 86.

LED lamp cannot be expected to perform well in a room whose walls are painted red. However, it is important that consumers are informed.

4.4 Deficit of efficient lamps in the markets

The deficit of low consumption lamps is one of the major barriers. The deficit is global, that is, even in the international market there is a risk of deficit.[139]And EE policies must be implemented with this in mind. The unprecedented adherence to international policy with regard to the elimination of incandescent lamps is of such magnitude that it may represent a risk to the security of the supply of CFL in the international market.[140] As an example, after Cuba banned the sale and import of incandescent lamps in its markets, Latin America had a deficit of fluorescent lamps.[141]

With this, is Mozambique prepared to ban the sale and import of incandescent lamps? It is believed not to. Fluorescent lamps or quality LEDs are found in supermarkets and in a few specialized stores. And what to do with consumers who live in districts without supermarkets? It should be noted that even in the city of Maputo, capital of the country, neighboring South Africa, which is very advanced in the implementation of EE measures, low consumption lamps are rare, unlike the incandescent that are for sale in all canteens of neighborhoods.

And the above thought is ratified by the UN, with this source adding that a shortage of efficient light bulbs can undermine public confidence in energy efficiency and efforts to reduce greenhouse gases (GHG) in general, so measures must be taken to prevent this from happening.

In 2004, McKinsey [142]assessed the expected demand profile for lamps and came to the conclusion that the risk of regulatory induced lamp shortages arises because of:

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139 Ibid 37.

140 Ibid 21.

141 Ibid 19.

142 McKinsey e company, Lighting the way: Perspectives on the global Lighting market <https://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/automotive%20and%20assembly/lighting_the_way_perspectives_on_global_lighting_market_2012.ashx> accessed December 2020.

increased demand for lamps, where in compliance with regulation, industries may be unable to meet it; demand may be short-lived and industries may have little economic incentive to invest in the production facilities necessary to meet peak demand. Another possibility is to meet demand, but the quality of available lamps does not meet consumer expectations.

However, as we said earlier, barriers are common and have made it difficult for diffusion of compact fluorescent lamps. As seen in Figure 4, until 2005, compact fluorescent lamps represented only a fraction of light production in the residential sector and approximately at the same level as light production as incandescent lamps in the commercial sector[143].More information on the trend of evolution in the production of fluorescent lamps, CFLi in particular, can be found in Waide[144] and IEA publications.

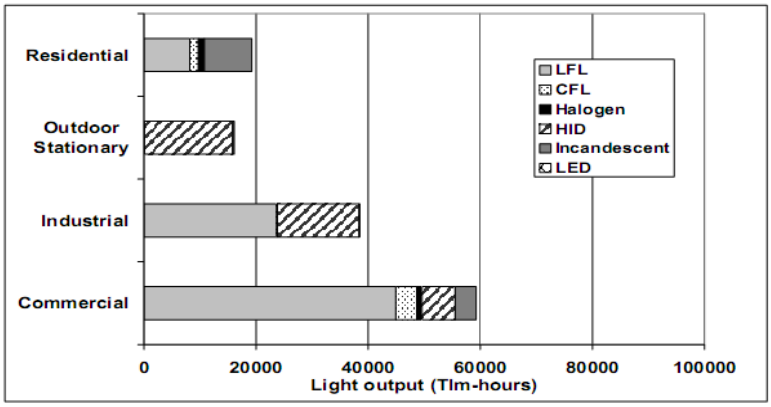

Figure 4. Estimated light production by user sector and lamp type and (2005).[145]

Legend: LFL = Linear Fluorescent Lamps; HID = High-Intensity Discharge Lamps; LED = Light-Emitting Diodes

Within the scope of the energy efficiency policy, many governments are therefore developing measures to overcome the main barriers to the widespread diffusion of compact

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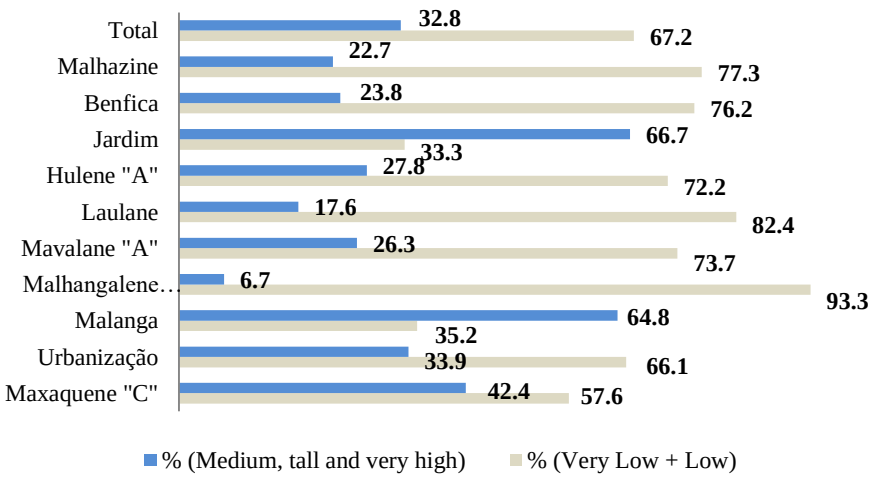
143 Ibid 102.
144 Ibid 19.
145 Ibid 102.

fluorescent lamps as substitutes for incandescent lamps.[146] The research by Lefèvre et al.[147] is recommended, as it analyzes a series of such efforts and proposes some strategies to improve the design of future CFLs and other programs for the diffusion of this technology. Further updated data on the manufacture of efficient lamps can be found in reportlinker.[148]

4.5 Consumer expectations

Consumers expect markets to provide viable alternative light bulbs, and because of this, regulators have a responsibility to ensure that this is the case. Although the service life of compact fluorescent lamps depends on the market, so that they have an average service life of around 4,500 hours in China, 6,000 hours in Europe and 8,000 hours in the United States.[149] And it is frustrating for consumers to buy fluorescent lamps and not last as prescribed. In a way, as we said earlier in this section, this can contribute to the non-acceptance of the ban policy.



146 Ibid 21.
147 Ibid.
148 Kevin Rubin, 'The Business Benefits of Artificial Intelligence' <https://www.stratospherenetworks.com/blog/the-business-benefits-of-artificial-intelligence-ai/> accessed 4 June 2020.
149 Ibid 37.

Figure 5. The level of knowledge of EE measures in Maputo. Source: Chapala, ongoing research

Finally, we agree with Lefèvre et al.[150] that the other factor that contributes to the failure of the implementation of the policy to ban incandescent lamps is the lack of information. And the other authors, such as Allen and Janda (2006)[151] and Michel (2007)[152], confirm that many EE strategies have failed due to lack of information on the part of consumers. As an example, Figure 5 illustrates the low level of knowledge of electricity rationalization measures in Maputo residences. Maputo is a city with more than 20 radio stations, 10 television channels, people who use social networks and where more newspapers circulate. Even so, the level of knowledge of EE measures is low. This implies that in other provinces the level of information on measures is worrying.

The high operating costs of incandescent lamps are, for example, often misinterpreted.[153] Most consumers receive electricity bills infrequently and have no way of knowing what part of the bill is accounted for by lighting. Often, information is also not readily available at the point of sale, making it even more difficult for consumers to make informed choices[154]. The lack of information hinders the decision-making process and often leads consumers to prefer known and customary technologies.[155][156][157][158]In developed countries, this problem has been overcome with the use of

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150 Ibid 21.

151 ACEEE, The effects of household characteristics and energy use consciousness on the effectiveness of real-time energy use feedback: A pilot study<https://www.eceee.org/library/conference_proceedings/ACEEE_buildings/2006/Panel_7/p7_1/> accessed November 2020.

152 Climate Protection Strategies using Advanced Power Meters Part II" <https://energycentral.com/> accessed September 2019.

153 Bchydro, Billing & payments<https://app.bchydro.com/accounts-billing/bill-payment.html> accessed March 2019.

154 Ibid 137.

155 Ibid 148.

156 Ibid.

157 Ibid 21.

158 Grischa Perino and Thomas Pioch, 'Banning incandescent light bulbs in the shadow of the EU Emissions Trading Scheme' (2017) 17 (5) Climate Policy <https://www.tandfonline.com/doi/full/10.1080/14693062.2016.1164657> accessed March 2020.

smart meters, which provide information to the consumer in real time or allow two-way communication between the consumer and the company providing electricity.[159]

4.6 Legislation

Another important feature of the lighting market is that, generally, who decides on lighting equipment is not the one who pays directly for the use of the system's energy and, therefore, has no incentive to minimize operating costs, much less to approve something about EE.[160] Countries that are doing well with the policy of banning incandescent lamps have established specific laws. And this approach has not yet been adopted by Mozambique and other countries, such as Thailand, which prefer that the replacement of incandescent lamps be voluntary.[161] The voluntary approach creates many limitations in the implementation of EE actions, until they are devalued.

Financing for the implementation of prohibition policies and the best quality standards and low cost of lamps must be regulated by law. Mozambique is still far from this.

4.7 Researches

The lack of detailed research on the consumption of electricity, household appliances and household appliance usage habits, at the national level, also contributes to a cautious conclusion as to whether or not it is opportune to implement the incandescent lamps prohibition policy in Mozambique. Thus, research with these approaches is needed to, on the one hand, obtain real data on the quality, deficit and real cost of lamps that are sold in Mozambique and, on the other hand, to assess the possible reaction of consumers if the importation and sale of incandescent lamps is banned. And that is what other countries have done. Ghana, for example, the government

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159 Ibid 148.
160 Ibid 92.
161 Ibid 137.

first instructed its Energy Commission to research the situation in terms of how electricity was being used in the country.[162] Research has shown that in 2000, about two thirds of the residential electrical charge was used for lighting.[163]And based on the research, Ghana concluded that the most commonly used lamps were incandescent, extremely inefficient and short-lived, and then the Ghanaian government was able to track actions accordingly and was successful.[164]

5.0 RECOMMENDATIONS AND CONCLUSIONS

The implementation of the incandescent lamp ban policy is a major challenge for any country, especially the poor, and the main obstacles have been discussed in section 4 and 6. In the same sections, suggestions for the implementation of this policy are presented, but it is worth stressing that consumer education and awareness actions, including promotion of labels on household appliances or other measures of rational use of electricity, should be prioritized at this time. It is necessary to explore television programs, such as the program "BalançoGeral" on Miramar Television, the most preferred by consumers, particularly consumers in suburban areas of Maputo city. The media and other means of communication should also be well exploited for this purpose.

Awareness-raising measures, as well as those mentioned in section 6, should be supported by a robust energy efficiency law and studies that can identify electricity consumption habits in Mozambican buildings, the specifications of lamps that are sold in local markets, and other energy efficiency actions.

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162 Ebenezer Nyarko Kumi, 'The Electricity Situation in Ghana: Challenges and Opportunities'(2017) policy paper <https://www.cgdev.org/publication/electricity-situation-ghana-challenges-and-opportunities> accessed June 2019.

163 Ibid.

164 Ibid.

The first barrier to implementing a policy to ban incandescent lamps in Mozambique is the high cost of energy-saving lamps in the markets, as more than 60% of the population is low-income. However, even if the country distributes the low energy bulbs to these families, this situation may continue because as soon as they burn out, they may buy incandescent bulbs again. One solution would be to implement a policy of selling energy-saving light bulbs to poor families at subsidized prices, an action that should be supported by the government, energy companies and other business sectors.

The lack of quality and reliability and unavailability of energy-saving light bulbs is another major barrier to implementing, even gradually, the policy of banning incandescent lamps in Mozambique. Note that it would be difficult to force consumers to buy energy-saving lamps before the government, particularly the Ministry of Industry and Commerce, ensures the sale and availability of quality lighting products. Reality shows that the quality low energy bulbs are sold only in supermarkets and only middle and high income earners get there. In other places, lamps of Chinese origin are sold and some of them two in two days lose their luminotechnical power. To get out of this, it may be necessary to set up lamp factories, but to do so, the state must attract international investors, discounting the appropriate taxes that these could pay.

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