



Should Import Policy Order Be Amended to Make Pakistan an Environmentally Sustainable Country

Muhammad Qasim Khokhar¹, Dr Muhammad Aasim Khokhar²

¹ M.Phil (Electrical Engineering), MBA (Tax Management), Pakistan Customs Service, Pakistan.

Email: qa6m@yahoo.com

² Ph.D (Sociology), AQ Global

Email: aasim.cht@gmail.com

ARTICLE INFO	ABSTRACT
Submission: July 01, 2026 Revised: July 18, 2026 Accepted: August 02, 2026 Available Online: August 14, 2026 Keywords: <i>light pollution, climate change, environmental sustainability, Sustainable Development Goals.</i> Corresponding author: Muhammad Qasim Khokhar Email: qa6m@yahoo.com	Since the invention of the first practical ICL in 1879 by Thomas Edison and Joseph Swan, the significant improvements and inventions in different types of bulbs and their efficiencies are offered in the market. Today, these lamps or lights have become our need and offer efficient lighting. These lights can also be employed in battery, mobiles or generators. The working and use of these lights are different from each other. To conserve energy, we ought to select an efficient light bulb, which is capable of providing the type of lighting needed. The choices are ICLs, CFLs, Halogen Lamps, Neon Lamps, Metal Halide Lamps, Fluorescent Tube, high-intensity discharge lamps and low pressure sodium lamps, and above all LED lights but their effects on health, environment, wildlife, marine life & plants and especially their post-use disposal have not been sufficiently assessed yet. This report was developed considering that point of view that how these lights are affecting our environment and causing degradation with a special focus on disposal problem of CFL. The paper was divided into two sections, critical analysis and conclusions / Recommendations. In the first section, I tried my best to throw academic light on general problems of recycling of materials and their impact on the environment and other factors like Technology Vs Climate Change, Technological Advancement and Opportunity Cost, Electronic Innovations and its Impact on Climate Change, and Plastic use and Climate Change. However, some other factors were discussed, especially related to import policy in the second section like Import of Raw Materials and Basel Convention, Mercury and Minamata Convention, Impact of CFL and ICL on Environment, Some Hazards, Recycling of CFL and ICL and their mutual comparison. The last part was about discussing the S.D.Gs and Lights Pollution, Pros and Cons of light pollution and Responsibility of Manufacturers. The report has drawn valuable conclusions for policy makers which include measuring quantum of hazardous Mercury metal which needs safe disposal in near future, potential of energy conservation if replaced with LED and cost of investment which could have been/can be avoided. This report also has some implementable recommendations to overcome this problem with a special focus on amendment in Import Policy Order suggesting a ban on commercial import of mercury lamps and tubes.

Introduction

Background & Introduction

There is heat emission due to human use of machines and equipment e. g. air conditioner, water heater, boiler, emissions from industrial consumption, etc. Add to this traffic heat emission, deforestation and will realize that human is contributing to global

warming themselves to a great extent.¹ This vulnerable situation can be mitigated, managed or adopted by a holistic approach. Thus a multidisciplinary and cross-disciplinary framework is essential. One item that is affecting a large part of water resources, environment and causing wastage of energy is Mercury Lamps. They are of different kinds e.g. Compact Fluorescent Lamp (CFL), Mercury Vapor Lamp, etc. (MVL). Originally these were widely distributed in Pakistan in 2009 as a measure of saving energy / electricity. At that time, this technology was energy efficient vs. Incandescent lamp (ICL) and Pakistan was facing a severe energy crisis. Every now and then there were roadblocks, arsons, and protests due to load shedding. Thus governments, as well as private sector, promoted their import as a measure of Demand Side Management of Energy Crisis. However, the downside could not attract the attention of relevant stakeholders at that time. That is once the bulb is burned out, the mercury emitted by Mercury Lamps pollutes 26,000 liters of water as per one estimate and makes it not potable. Further in developing countries like Pakistan, there is no safety mechanism available for secure disposal of this mercury or recycling and thus it makes way in water resources, land and homes causing severe hazards like dancing cat disease, impaired Central Nervous System, trembling, weakening of short term memory, cancer, etc.²

Research Scope

Objective and Purpose of Research

This research was conducted to fulfill the requirement of the 28th Mid-Career Management Course as a mandatory assignment to diagnose a social problem and give its evidence-based solution. Since it is academic sort of research to understand the concept and take appropriate decisions in my official life based on evidence and is near to situation analysis. This study is aimed at addressing the emanating issues of mercury lamps through import policy in order to make Pakistan an environmentally sustainable country.

Research Problem

Imports are playing a major role in the economy of Pakistan. From raw materials to machinery, from intermediary to finished goods, a long list of goods is there which is subject to provisions of Import Policy Order, 2016. Thus it would be a pragmatic approach to deter environmentally hazard mercury lamps and parts at import stage and mitigate their hazardous nature by policy interventions. This research paper is aimed at understanding the hazardous nature of the bulbs and on the basis of available knowledge recommends corrective measures suiting the country in preventing global warming in general and warming/degradation of our own environment in particular. This will enhance Pakistan's resilience as it has graduated from 8th most environmentally hit country to 7th most. Pakistan agriculture and energy sectors are most vulnerable to GHG. If environment degradation will not be reduced, it may cost the economy of Pakistan approximately Rs.365 billion annually. This has been happening due to mismanaged and inadequate water supply, compromised sanitation and hygiene. Soil available for agriculture is also being degraded, indoor and urban air pollution is another factor, lead exposure, land degradation, and deforestation are some of the major problems which cause the pollution. Industrial consumers are allowed to import waste, scrap, exhausted batteries, used computers, LCDs, LEDs, etc. Plastic scrap is more dangerous for the environment and not following Basel Convention findings.

Research Questions

- Q.1 Is it possible that Pakistan can control environmental degradation adopting innovative strategies?
- Q.2 Is it possible that Pakistan can ensure environmental protection through its import policy (through amendments should need arise) following the Minamata Convention and its recommendations for import of materials containing Mercury?

Hypothesis

The crux of the matter will evolve on the following statement:

The objectives of S.D.Gs can only be achieved if coordinated efforts by the government departments, the private sector, and the international community are put towards protecting environmental degradation in Pakistan especially by focusing on light products.

¹<https://lcluc.umd.edu/hotspot/glacial-retreat-himalayas> accessed on 4.9.19

²<https://www.watercalculator.org/water-use/climate-change-water-resources/> accessed on 5.9.19

Research Boundaries

In this study I have analyzed the available resources and what can be possible for the government to ensure its import policy and get benefitted from S.D.Gs and their achievements. The report is comprising of three sections which were elaborated through various sub-sections followed by conclusion and recommendations. This study focused on comparison of different light products and their environmental potential and progress to be made on import policy. The report may be helpful for my fellow participants, university students, policymakers and policy executors.

Research Limitations

Mostly time and cost are two limitations in conducting research activity, but this is the academic sort of research. So while cost is not to be considered much, time is important to meet the timeline given by the faculty. Fieldwork involves structured or unstructured interviews with local community and policymakers was not a viable option due to the paucity of time and resources. Only few officials, therefore, could have been interviewed for getting first-hand insight into the matter. The limited availability of data and its reliability, especially declarations of importers in Customs documents (especially Goods Declarations) in different formats may also be considered as limitation for the study.

Linkage with Public Policy

The latest version of Import policy was developed in 2016 and later several provisions through orders regarding plastic waste and compounds containing mercury have been added so that the import of these hazardous substances by some importers may be termed illegal or regulated. Pakistan is already focusing to protect the environment, and thus under the Clean and Green Pakistan Program, Pakistan planted more than 10,000,000 trees across the country with special focus to AJ&K and Gilgit Baltistan. Further, Pakistan has already signed Minamata Convention on October 10, 2013 and is now considering ratification according to which it has to phase out the use of Mercury by 2025. This convention has been signed/ratified by 128 countries and we cannot risk facing isolation in the world comity of nations in case we fail.

Literature Review

Khaliq et al. (2017) analyzed that the unnatural brightening absorbs one-fifth of worldwide power. ICLs fulfill 50 to 70 % of household lightening needs. But ICLs are perceived as 90 to 95% inefficacious. For unnatural brightening, the two most common light products are ICL and CFL. Incandescent Lamps transform 90 % of charges and electrons into warmness and are less durable than CFLs. However, CFLs are more power conserving. But the main drawback of Compact fluorescent lamp is that it consists of dangerous element substance Mercury and it is hard to reuse or copy (*Khaliq et al. 2017*).

Khwaja et al. (2013) elaborated that Mercury is a major substance that is present in many lamps prevalent in the market. Mercury enhances the life expectancy of these bulbs and also helps in giving brighter light. Furthermore, CFLs are four folds more illuminating and visible each watt than ICLs. CFLs constitute 80 % of the total mercury present in light-emitting bulbs. Despite that, at present CFLs are adopted in 40 countries globally because they are cheaper and readily accessible in the market. CFLs have witnessed tremendous growth over recent past (*Khwaja et al. 2013*).

Mercury in Compact Fluorescent Light Bulbs (2016) wrote that the fact that CFLs contain mercury may not have an immediate impact, but in the long term it can have adverse environmental consequences. It has been debated that the hazardous fluid mercury is contained within the lamp. The amount of mercury present in a CFL is around 3.5-4 mg on mean. The main problem is that there is no substitute for mercury, which can take its place to generate brightness in CFLs.

Ceaser (2018) examined that in fact a typical CFL may even contain 20 milligrams of mercury. To protect ourselves from the detrimental effect of CFLs, a proper mechanism to discard these lamps and a process for reusing are essential. As CFLs contains mercury if a person is subjected to these lamps for a long time period it may damage health. Especially when these lamps reach their expiry and after a long time, they become deadly dangerous, especially if mercury fumes are released into the air or may contaminate soil and waters in the process of discarding (*Ceaser 2018*).

Thomas Edison experimented more than 10,000 times to invent a safe ICL. Humans have used the same for more than 100 years. Even today, it is found in every nook and corner of the world. However, in view of high energy costs, raised awareness and supply of CFLs by DISCOs, in Pakistan, ICLs are almost phased out. Currently only 4% of the lamps are ICL. The population

of various technologies is given below in Table.³ The reason is that it is environmentally safe and peoples have expertise in the safe disposal of tungsten and glass. But then came a wave to use CFL or Mercury Lamps to save energy through a lot of literature argues that manufacturing a CFL consumes 6 times more energy than ICL, thus negating the very purpose for which it is put to use, in addition to creating the problem of mercury pollution and health hazard.

Mukhtar (2010) assessed that in Pakistan the main motive for using CFLs in place of ICLs was to preserve power worth 2.2 billion \$ by using 30 million incandescent lamps with Compact Fluorescent Lamps. But this would come at a cost. CFL is potentially harmful, especially if blazed, as it contains mercury discarding it into grounds can pollute the clay and discarding in oceans or sea waters can harm marine life (Mukhtar 2010). Currently there is no proper mechanism to safely discard these lamps in Pakistan. The 30 million lamps proposed in this initiative carry a humongous amount of 100 to 120 kilograms of toxic mercury. Mercury is an element that can have severe consequences on human health; it can impact brain, liver, kidneys and can derail growth in kids if emitted into breathing air through cracking or spills (Mukhtar 2010).

Mr. Baqir Bilal Hussain, CEO of Get Technologies, a pioneer manufacturer of LED lights in Pakistan and President of Energy Conservation Society of Pakistan argued in his interview that the CFL is no longer energy efficient but energy guzzler. He confirmed that LED consumes half of energy via CFL to produce an equal level of luminance, hitherto there is no mechanism being practiced for safe disposal of Mercury. He opines that only effective method to tackle this problem is banning its import and reducing the cost of LEDs for immediate promotion and acceptance by the public. He says further there is an immediate need of replacing street lights with LED to save more than 200MW of energy and make Pakistan inch towards the goal of environmental sustainability.

Mr. Engr. Asad of Energy Conservation Fund says that due to the environmental advantages of LED, it is making rapid inroads in the market with a current market share of 53% with a population of 227.7 Million. He was of the opinion that banning CFL will multiply the speed of attrition of CFL market. presently holding a share of 43%.

Ahmed Hassnain, National Project Manager, of the project "Delivering the Transition to Energy Efficient Lighting in Residential, Commercial, Industrial and Outdoor Sectors in Pakistan." On phone and later on through email opined that "lighting alone accounted for approximately 15% of the total electricity produced. By employing usage of Energy Efficient (EE) Lighting appliances (like quality LED), the load of demand on the national grid can be reduced considerably that will in turn will reduce the production of electricity, which is mostly produced by burning fossil fuels like furnace oil and coal and will cause reduction in emission of Green House Gases (GHG), thus achieving the ultimate goal of this Global Environment Facility (GEF) funded project." He further explained that LED light has also its own issues and thus only LED compliant with MEPS should be encouraged.

The MEPS Specialist from United for Energy (U4E) - Dr. Lafitte accessed through Ahmed Hassnain explained the benefits of defining MEPS and described each parameter in detail. This followed by the proposals for minimum requirements for performance as MEPS for each category of LEDs. It was also observed that the local market is attuned to higher Correlated Color Temperature (CCT) products. The cause of popularity of the higher color was due to the long and hot summers. The lower color temperatures, which are called warm-white, give an uneasy feeling of adding heat to the hot weather. Therefore, the market at present, demands lamps with higher color temperatures, which are called cool day-light blue and use 7700 Kelvin CCT. Dr. Lafitte had proposed a CCT of 5000K, who explained that – according to latest research – blue light was considered to have harmful effect on humans as well as flora and fauna.

He proposed that the CCT of 5000 Kelvin will be implemented in 2 phases. For the time being the upper limit of CCT should be set at 6500 Kelvin.

Research Methodology

Research methodology is primarily the specific procedures or the techniques to be employed by the researchers to identify, select, process, and analyze information about the certain topic in hand. So long as research paper is concerned, the research methodology section permits or guides the reader/evaluator to evaluate the study submitted by the researcher critically with respect to overall validity and reliability.

It has eight types. Out of which the most important methodological choice researchers veer towards is founded on the distinction between qualitative and quantitative data. The qualitative data make use of descriptions based on language or images, while

³ UNEP-NEECA Lighting Project

quantitative data adopts the shape of numbers. Qualitative data is richer and is usually subjective. Qualitative research helps a thorough discernment of the situation investigated. However, it is usually subjected to time constraints, and thus involves a small sample of participants. For this reason, the findings are constrained to the sample studied and their generalization to wider populations is inhibited. Popular methods based on qualitative data include but are not limited to semi-structured or unstructured interviews, participant observations and document analysis. Qualitative analysis is costly in terms of the time invested vs. quantitative analysis.

Quantitative data affords much ease in collection and analysis but sample of participants is quite big. Quantitative methods are objective in nature for the reason observation and findings are measured with and in numbers. The data is analyzed through numerical comparisons and statistical analysis. So it pops up as more scientific with a profound appeal to researchers and evaluators. Further, edge of possibility of use of softwares makes quantitative analysis speedy. It is also generalized to wider populations as the findings are based on very large samples. Trendy methods based on quantitative data may entail questionnaires and organizational statistical records etc. The choice of which methodology to be adopted will base on research questions, the framework of which is thereupon enlightened by research perspective. Generally, unstructured or semi-structured interviews give rise to qualitative data and questionnaires culminate in quantitative data, but this is not a case always.

Keeping the afore-referred aspects in view, the research assigned was carried out on the basis of printed literature and its review, data analysis of import data provided by Pakistan Customs, documentary analysis, meetings with concerned officials concerned at NEECA, PEECA, Energy Conservation Department of K-Electric and my fellow participants either in person or on phone. The strategy was adopted to complete the assignment while using *Mixed Method or Methodological Triangulation* since it involved more than one method for data acquisition and prepare the report on evidence-based data. In order to extract meaningful and actionable conclusions, a variety of approaches were adopted. The following steps (not in sequential order) were adopted to address this issue; Obtaining relevant information and documents from concerned officials of the Planning Division/Energy Division/Department/NEECA and Pakistan Customs as part of primary source, examining government documents available in the Library, Literature review to gain an understanding of different issues relevant to present study. This study combines the two approaches of collecting data either qualitative or quantitative during its journey.

The main source of data were two organizations. Pakistan Customs was approached to provide data of import of CFL for last three years. Accordingly, it provided data for last 3 Fiscal years from 01-07-2016 to 30-06-2019. In some entries, unit of measurement was mentioned as 1 or 2 or 3 which in fact meant lots. i.e 3 lots may contain 3000 CFLs or 2 lots may contain 2000 CFLs. Thus exact quantity could not be determined and we had followed the Customs Act ,1969 by taking 1 or 2 or 3 as quantity in numbers. But this issue was faced regarding only 39 observations out of 4967. Also for 5 observations, quantity was given in Kg instead of numbers or pieces. These 44 observations out of 4967 make only 0.8% keeping findings within limits of being 'statistically significant'. This quantity does not include the quantity imported in different parts which are locally assembled to manufacture CFL.

Thumping majority of import Goods Declaration (GDs) have no information about wattage of each CFL. There is mentioned just Energy Saving Lamp or Tube. Wattage of each CFL is not mentioned in any separate column in the data acquired by Customs. In fact, importers mentioned this along with 'Description' of the item. It ranges from 9W to 80W in different sizes like 12W,24W,36W etc. There are a few cases where it is mentioned in range terms usually 1Wto 9W. Thus it is assumed that each unit has wattage of 24 Watts. which has the widest use in Pakistan.

The data provided by NEECA was a summary of population of different kind of bulbs/lights and was in table shape. No special issue has been faced in treating this data.

Climate Change Mitigation Caused By Technological Innovation

Technology vs Climate Change

With respect to climate change, technology has been playing its interesting role and its first major impact thundered during the 2nd industrial revolution in 1880 which is correctly christened as the technological revolution. At that time, coal was used to power for the functioning of factories as well as homes demand. With this new technology, we have seen the consequences of more carbon emissions and life became difficult for living things on earth. Now there are about 22 more technologies being used to generate electricity. Technological advancements of the present era are now greener and more environmentally responsible vs. the past. "A fresh wave of technological advancement is more deepening our understanding of tough environmental challenges — and also giving us new ways to solve them". Hundreds of representatives from every walk of life

who can influence policy or influence by policy sit every now and then for a paradigm shift of manufacturing process to make it climate oriented by innovation and introducing superior technologies which are less heat or energy-intensive or produce less hazardous. The major concern is Global Warming and its potent causes i.e GHG especially methane whose one Kg causes almost 80 times more warming of the earth or climate than the more notorious Carbon Dioxide. World Economic Forum estimates that nearly 25% of the warming human race is facing now is result of methane emitted by human race itself.⁴

Carbon Emissions and Modern Transportation Modes

While Modern transportation modes like cars, buses, ships, aero planes etc, have eased our journey to every nook and corner of the inhabitable world almost throughout the year, it has raised the number of travelers and carbon emissions exponentially. New technological advancements such as electric transportation are helping to alleviate the impact of carbon-emitting modes of transportation. To sustain the economy of Pakistan, we need to be cooler, greener and efficient in consumption to minimize or even stop the use of fossil fuels. The Engineers, scientists and policy makers all are calling to check the global warming immediately by switching to Electric or hybrid cars, using hydrogen, Carbon dioxide and other renewables as fuel to curtail methane emissions and cutting carbon footprints so that we make both -the planet and technological innovation -sustainable.⁵

Electronic Innovations and its Impact on Climate Change

While the prime purpose of every technology including Electronics is to make human life easier, faster and comfortable, the abundance or easy availability has created behavioral problems. These problems become especially acute when the technology for disposal or recycling is either immature or has not gathered momentum or acceptance. So when disposed of the electronic gadgets release toxic materials in the environment destroying food and water sources along with poisoning the air. To add fuel to the fire, the quantity is multiplying days in and days out. Though there is increasing awareness about 'reduce, reuse and recycle' but quality and brand-conscious consumers are unable to resist the temptation of getting cooler and better and newer. The problem is more severe in Personal Computers, Laptops, iPad, iPhones, Tablets and CFL, etc. which generate huge waste. Further their useful period is also shortening in the mad race of increasing sales and thus profits. The need of the hour is to put an end to consumers' frenzy of jumping to newer models by taxation and encourage circular economy.

Plastic Use and Climate Change

The razzle dazzle of single-use plastic across the globe has a catastrophic effect on already rising global warming and should be arrested. This reckless use has roots in our behavior and can be minimized by small changes in our life style. The impact would be immense as greenhouse gas emissions are emitted at every stage of its value chain as well as its use and disposal. Thus we see many states in many countries including Pakistan and India have banned it out rightly as its major impediment to meet the targets of the Paris climate agreement.⁶

⁴<https://www.weforum.org/agenda/2018/08/how-technology-is-driving-new-environmental-solutions/> accessed on 6.9.19

⁵<https://www.ucsusa.org/our-work/global-warming/solutions/global-warming-solutions-reduce-emissions>

⁶ Ibid

Environmentally Sustainable Pakistan & Its New Import Policy Recommendations

Import of Raw Materials and Basel Convention

The Basel Convention is a treaty among nations to minimize trans-border shifting of perilous waste, with a special focus on preventing migration of such waste from the developed world to less developed world (LDCs). However, this Convention is also envisioned to reduce the quantity and poisonousness of wastes, to ensure their management in environmentally responsible manner closest to the point of generation, and to help LDCs in the management of their hazardous and other wastes in the environmentally responsible manner. The living environment of Pakistan is faced with some noteworthy challenges. Pollution caused by garbage, heavy industries, and vehicles producing smoke, rising temperatures, natural disasters, floods, heavy rainfalls, heat waves, global warming, worldwide climate change, and water scarcity and last but not the least is the light pollution caused by ICLs/CFLs. The environmental challenges are serious in Pakistan; it is evident from the fact that Karachi city is now one of the worst cities to live in as ranked by global agencies.⁷



Minamata Convention on Mercury

It is a planetary treaty for safeguarding human health and the environment from pollutants resulting from human activity, discharges of Mercury & Mercury Compounds. The name was given from the Japanese City of Minamata which suffered from horrible mercury poisoning. It is hoped that this treaty will lead to reduction of Mercury from the environment by controlling a number of products containing mercury, the manufacture, import and export of which will be altogether prohibited by 2020, except where signatories have applied an exemption for an initial 5-years. These products range from certain types of batteries, compact fluorescent lamps (CFLs), thermometers, and blood pressure devices, relays, soaps, cosmetics, and Dental fillings.

Minamata Convention on Mercury

The Minamata Convention on Mercury is an international treaty designed to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. [Wikipedia](#)

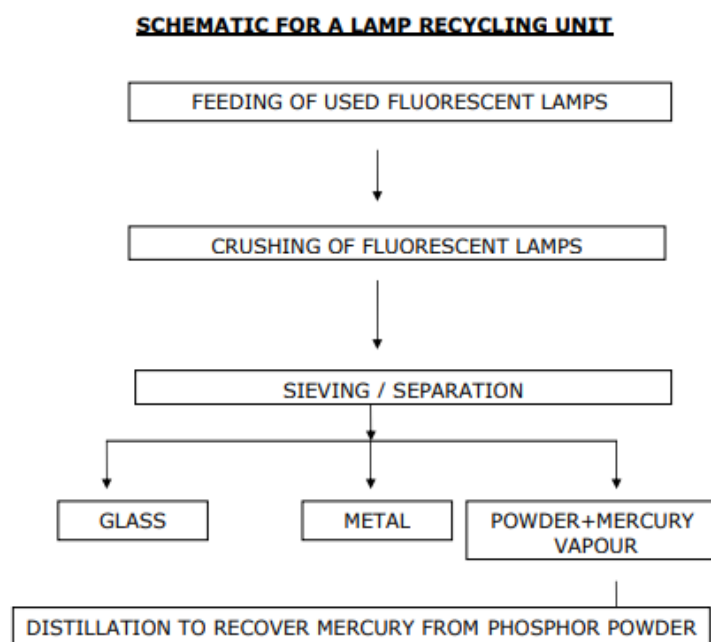
Signatories: 128
Effective: 16 August 2017
Signed: 10 October 2013
Location: Kumamoto, Japan

Impact of CFL and ICL on Environment

Compact Fluorescent Lights (CFLs) are a technologically advanced, brighter and cost-effective lighting system. Whereas Incandescent Lamp (ICL) is another technology that has dominated the lamp industry for more than 100 years is now going down in popularity due to more electricity it consumes. Either it is CFLs or ICLs both have environmental implications and health hazards for humans. ICL is energy eater and highly inefficient as it wastes more than 90% of energy into heat instead of light whereas CFL contains and discharges toxic mercury in an environment which can cause terminal diseases and creel

⁷<https://www.dawn.com/news/1026043> accessed on 22.9.19

nourishment in the country. “There are certain technologies that can minimize the hazards of CFLs use in case we take precautionary measures. While using CFLs at home, extreme care is required that the lamp does not break which is containing hazardous mercury within it. Similarly, we avoid holding CFLs from the tube and not applying extra pressure. CFLs consume less power so they minimize greenhouse gas from production facilities using nonrenewable energy and hydrocarbon. Also as usually CFLs are long-lasting thus fewer in quantity so it means less wastage in form of wrapping and bulbs in lands and water.”⁸ But CFL has lost its utility as energy saver once LED has become commercial. A 24W CFL can be replaced with 12W LED as has been explained below in the Table 1. Thus use of CFL when a better technology is available is impeding progress to Sustainable Development Goal Number 6 (Clean Water) and 13 (Climate Action).



Some Hazards

Energy saver bulbs Unsafe disposal hazardous (2011) asserted that this issue regarding CFLs has not gone unnoticed in Pakistan. Pakistan Environment Protection revealed brutal consequences and health hazards caused by mercury present in the bulbs as e.g it can cause affliction and hurt the knees and other junctures of the body. Mercury present in the CFLs is in the gas form used for lightening. When someone disposes CFLs in trash cans without care, lamp breakage can spread the mercury in breathing in form of gas and fumes. This mercury penetrates in human body or flesh, it can result in Minamata ailment.⁹ It can also damage eyesight, listening, talking and other neural sensual disorders. Pak-EPA issued a regulation that binds CFL traders to mention in on the wrapper of lamps measures to safely dispose of and educate about repercussions of mercury present in the lamps. Also the purchasers are required to give the lamp back to seller on becoming dysfunctional on which he will be rewarded. Furthermore, if they are recycled, then in a way we can minimize the harmful effect of mercury as direct contact with mercury is more harmful like Inhalation, Ingestion, Skin Contact, Eye Contact, and some more Chronic Exposures”.¹⁰

⁸ <https://www.encyclopedia.com/environment/energy-government-and-defense-magazines/compact-fluorescent-light-bulbs> accessed on 20.9.19

⁹ <https://www.bu.edu/sustainability/minamata-disease/>

Minamata ailment is a neurological syndrome provoked by severe mercury poisoning manifested by include ataxia, numbness in the hands and feet, general muscle weakness, narrowing of the field of vision and challenged hearing and speech.

¹⁰ <http://www.mercury.org.cn/zcfg/gj/201109/P020121211402574073858.pdf> accessed on 22.9.19

Recycling of CFL and ICL

Pakistan

There is no proper mechanism to safely dispose of hazardous CFLs without damaging the environment. It is noteworthy that CFLs have a population of 182.3 Million in Pakistan which forms 43% of market share¹¹(Current population of all three technologies is given in Table 2). Incandescent bulbs are still not totally out of the equation because they seem more environmentally friendly and also momentum of habit coupled with dirt cheap rate is keeping those around though in negligible quantity. Does the advantage of CFL outweigh its consequences? To avoid repercussions of mercury and its health impact, recycling of CFLs can be a good option.¹²

India

Recycling of CFL/ICP bulb is only possible at a large scale automated recycling unit. It is only safe to recycle if it is done with machines. But the problem is that there is no system to collect and transport such hazardous products for recycling. Manufacturers have taken back the used lights give a discount of RS.10 on new purchases and collected all used blubs and recycled them properly. This method was practiced under the “Extended Producer Responsibility” scheme.¹³ Further, the BEE in cooperation with EESL completed a project of replacement of 750,000 ICL and CFL with LED bulbs. This bulk purchased reduced the cost of LED from Rs 400/- to Rs 310/-. Further though no data could be gathered to prove this, but it is assumed that the bulk collection made recycling and safe disposal of Mercury easier and reliable. Emboldened by this, this JV completed another replacement program of 2 million CFLs/ICLs in the state of Andhra Pradesh which reduced price of LED bulb to only Rs 210. Now BEE/EESL are thinking to make a bulk purchase and distribute LED at just Rs 10/- . The remaining cost would be recovered from Distribution company in a time frame of 8-10 years. This will make safe disposal of CFL very easy. Further huge benefit in the form of environmental sustainability will accrue as LED consumes 50% less energy than CFL.¹⁴

Comparison of ICL, CFL and LED

Energy Conservation potential

A comparison of Energy conservation potential and other relevant parameters is given as under among all three kinds of lighting is given in the table below.¹⁵

¹¹Project Documents of GEF Funded UNEP-NEECA Project “Delivering the transition to Energy Efficient Lighting in Residential, Commercial, Industrial and Outdoor Sectors in Pakistan”

¹²https://ec.europa.eu/health/scientific_committees/opinions_layman/mercury-in-cfl/en/mercury-cfl/ accessed on 25.9.19

¹³<https://www.conserve-energy-future.com/why-is-recycling-important.php> accessed on 25.9.19

¹⁴<https://www.downtoearth.org.in/news/led-bulbs-to-be-available-at-rs-10-instead-of-rs-400-47011> accessed on 09-10-2019

¹⁵Adopted from <https://www.downtoearth.org.in/news/led-bulbs-to-be-available-at-rs-10-instead-of-rs-400-47011>

Table 1. Savings potential comparison of an LED bulb with CFLs and incandescent lights

		Technology		
				
Parameter	Units	ICL	CFL	LED
Life	hours	1,500	10,000	50,000
Capacity/Load	watts	60	14	6
Energy Consumption / hour	Kilowatt-hour (kWh)	0.06	0.014	0.006
Cost of usage for one hour @PKR 12 per kWh (Average Tariff)	rupees	0.72	0.168	0.072
Cost of usage for 50000 hours	rupees	36000	8400	3600
Bulbs needed for 50000 hours of running	no of bulbs	33	5	1
Bulb Cost	rupees	15	120	400
Cost of replacement	rupees	500	600	400
Total 50000 hour lighting cost	rupees	36500	9000	4000
Ratio of cost	ratio	9.125	2.2	1.0

Current Population**Table 2. The Present Population of above three technologies is given in following table (NEECA, 2019).**

Sr	Description	Domestic	Commercial	Industrial	Total	Share
1	LED Lights	207,946,153	13,093,965	6,700,150	227,740,268	53
2	CFL	63,086,788	20,480,304	2,639,843	86,206,935	20
3	Fluorescent Tube light	30,253,184	62,335,841	3,465,395	96,054,420	23

4	ICL	11,834,334	3,636,209	569,908	16,040,451	4
5	Others	0	0	472,204	472,204	0
6	Total	313,120,459	99,546,319	13,847,500	426,514,278	100

Critical Analysis

S.D.Gs and Lights' Pollution

The world made Sustainable Development Goals (S.D. Gs) and showed the willingness of the nations to exert for clean energy and tackle pollution in the world whatever its source. These are given as under!



SDG 7 is dedicated to 'affordable and clean energy'. Therefore, it has also brought to light an issue hitherto unheard but indispensable– light pollution. Humans required cheap electricity which put them to unrestricted use of artificial lights. The use of such lights resulted in problems and a degraded environment. Although humans have conquered the devils of darkness and invested lights for our neighborhoods but its causal effect was not calculated. "The simplest way that light pollution can be defined is the introduction, consciously or unconsciously, of man-made (artificial) light into the environment". Contrary to what we may think, this light pollution does not start when we turn the switch on or dissipates when we switch the light off. However, the effects are long and lingering. The disturbance to the environment has reached such levels that man-made light is now competing with starlight in the night sky, and in the process interfering with ecosystems, resulting in ill-health effects. However, it is also threatening the science of astronomy, which is progressively being pushed out of urban centers of learning. Moreover, light pollution is the result of poor understanding of artificial light by the human. Indoor and outdoor advertising, building lighting, factories, street lighting, and sporting arenas have artificial light that is poorly designed to meet the needs and is thus polluting the environment.

Pros and Cons of Light Pollution

"The consequences as a result of these lights are more related to financial, health and of course, environmental degradation. Economically, the problem is enormous, yet is not being addressed by any of the nations in the world. Global lighting is using

one-fourth of all electricity consumed in the world in year. The glow of poorly designed street lights often ends up in our bedrooms, causing immense irritation and in Pakistan, these are on in day time. Other health-related issues include worker fatigue, medically defined stress and increase in anxiety. Some of the studies have documented a correlation between night shift work and the increased incidence of breast and prostate cancer. Light pollution destroys nitrate radicals, thus preventing the normal night time reduction of atmospheric smog produced by fumes emitted from cars and factories. For plants and animals, artificial light has caused critical problems, thus leading to problems for humans as well. Light pollution poses a serious threat to nocturnal wildlife. It is known to have caused confusion to animal navigation, and change predator-prey relations among other things. Light pollution around lakes prevents zooplankton from eating surface algae, causing algal blooms that can kill off the lakes' plants and lower water quality. The science of astronomy has been one of the biggest victims of light pollution. Light intrusion can impact observations when artificial light directly enters the tube of the telescope and is reflected from non-optical surfaces until it eventually reaches the eyepiece. This direct form of light pollution causes a glow across the field of view which reduces contrast".

Responsibility of Manufacturers

Consumers have a variety of options while buying a lamp either it is ICLs, CFLs or LED lamps which are available in the market. CFLs become a popular choice due to affordability. These power conserving lamps are thought as an effective means to avert energy crisis in Pakistan by saving 75% to 80% power energy. The two most prominent brands of CFLs in Pakistan are Chinese brands Osaka and Phillips. China is a major CFL manufacturer and makes 70% of total produced globally. But these lamps have no precautionary measures or instruction of how to use them without any harm and discard them upon becoming dysfunctional. Incandescent lamps were once the most popular lamps and there were no competitors. The greatest advantage of Incandescent lamps is the fact that they can be discarded off in soil ground without any special precautions. CFLs also release greenhouse gases which can multiply ozone layer.

Conclusion

Both ICLs/CFLs are potentially damaging to the environment. Steps need to be taken to reduce mercury footprints left by these lamps. These should be replaced with LED bulbs for energy conservation due to energy crisis and expensive electricity. LEDs are environmentally friendly, long-lasting and also produce very bright light. Mercury hazards to the environment especially water resources can be reduced by banning the import of CFLs for effective implementation of the Minamata Convention and by increasing awareness to safely handle and use these lamps for our public already vulnerable as Pakistan is among the countries having the highest health burden due to poor air quality. And fumes of Mercury released from broken CFL are adding fuel to the fire.¹⁶

LEDs are slightly expensive. However, their cost is recovered in few months by saving due to almost half of consumption vs. CFL. Promoting use of LED and discouraging use of CFL would also make our cities more sustainable for unchecked use of CFL is affecting SDG number 6,7,11,12 &13.

Further analysis of data provided by Pakistan Customs leads to the following findings

1. The total quantity of CFLs imported in the last 3 Fiscal years (ending on 30.06.2019) is 119,242,438 units. Thus there is a potential danger of 476,969mg of heavy metal of mercury having entered as vapors in our environment or in water resources through seepage of landfills or through canal or rivers.
2. The luminance of One Unit of 24W CFL can be provided by an existing non-hazardous technology LED of 12W. And thus 12 Watt energy is saved. Thus $119,242,438 \times 14W = 1,431MW$ of connected load could have been saved.
3. If one CFL runs for 5 hrs approximately, it is $1,431MW \times 5 = 7,155,000$ KWH (7,155 MWH) or units of electricity generation that could have been avoided.
4. The cost of installation of coal based Generation Plants under CPEC is around 1.44 Million US\$/MW. Based on this, we can safely conclude that by banning CFLs, Pakistan would have saved 2 Billion US\$ in installation cost. There is no

¹⁶<https://tribune.com.pk/story/2022165/6-promoting-affordable-clean-energy/> accessed on 09-10-2019

data available for the cost of transmission and distribution, so we have avoided delving into the calculation of these costs as these might have led to so many assumptions.¹⁷

5. There are 182 million CFLs/Fluorescent Tubes as per Table 2 which would burn out sooner or later leading to release of 729,000mg of heavy metal of mercury. Thus arrangements for safe disposal or recycling of such huge quantity needs to be done.
6. If afore-referred population of 182 million of CFL is immediately replaced with CFL, it would lead to saving of $182 \times 12W = 2,184MW$ of connected load. This would lead to saving of $2,184 \times 5 = 10,920$ MWH or 10.9 Million electric units of energy. It can save $2,184 \times 1.44 = 3BUS\$$ of investment in electricity generation.

Based on these findings, Hypothesis statement of this report that “the objectives of S.D. Gs can only be achieved if coordinated efforts by the government departments, private sector and the international community put toward protecting environmental degradation in Pakistan especially by focusing on light products” is found valid and more relevant.

Way Forward/Policy Recommendations

- Using occupancy sensors as well as lights of correct intensity, focus and Color Rate Index.
- Volunteer organizations like the “International Dark-Sky Association” may be invited to solve the problem and collect the used lights and dispose of them properly. At least these organizations can trigger safe disposal and build capacity. The community can be educated and motivated and make them responsibilities for use of lights and their disposal codes and norms.
- EPAs are required to prescribe rules to implement the use of lights and their safe disposal when they become useless especially those have used mercury.
- Extended Producer Responsibility should be used as a policy tool and implemented in letter and spirit.
- Manufacturers should collect burnt CFLs back for recycling by issuing an incentive of Rs 10-20 per piece and/or incentive of providing one LED light in exchange of one dozen spent CFL can be introduced.
- Govt./PEPCO/DISCOs should promote LED bulbs for environmental protection and protection of water reserves. They should distribute 5 pieces per house and recover the cost in bills over a period of 3-5 years. The bulk purchase would reduce the cost of LED to a bare minimum. Also, the consumer would be paying from the savings accrued due to less consumption of energy. This would be a wonderful Win-Win strategy for consumers, DISCOs, Governments, and manufacturers.
- Accordingly, it is recommended to Ministry of Commerce, Government of Pakistan to allow the import of CFLs only for R&D purposes and thus incorporate following Sr. No 77 as given hereunder after Sr. No 76 of Appendix-B, Part-I of Import Policy Order, 2016 (or in vogue) as

Table 3: Amendment proposal in Import Policy Order 2016

Sr.No	PCT Codes	Commodity Description	Conditions
(1)	(2)	(3)	(4)
77	8539.3110 8539.3210	Energy Saving Lamp (CF Lamp)	Import shall be allowed in favor of Research and Development Organizations/Institutes and manufacturers of light products in limited quantity for research and development against undertaking that they have sufficient facilities for safe disposal of mercury.

¹⁷ worked out from costs of different CPEC power projects given on <http://cpec.gov.pk/energy>

8539.3120 Energy Saving
Tube(CF Tube)
8539.3220

BIBLIOGRAPHY

1. Agrawal, K. K., 2015. *LED bulbs to be available at Rs 10 instead of Rs 400.* [Online] Available at: <https://www.downtoearth.org.in/news/led-bulbs-to-be-available-at-rs-10-instead-of-rs-400-47011> [Accessed 02 October 2019].
2. Anon., 2008. *Guidelines for Environmentally Sound Mercury Management in Fluorescent Lamp Sector*, Delhi: Central Pollution Control Board Ministry of Environment of Forests .
3. Anon., 2013. *Light pollution and its repercussions.* [Online] Available at: <https://www.dawn.com/news/1026043> [Accessed 10 October 2019].
4. Anon., 2017. *Delivering the Transition to Energy Efficient Lighting in Residential, Commercial, Industrial and Outdoor Sectors in Pakistan.* [Online] Available at: http://www.enercon.gov.pk/newsbb2c.html?news_id=47 [Accessed 26 October 2019].
5. Anon., 2018. *How technology is leading us to new climate change solutions.* [Online] Available at: <https://www.weforum.org/agenda/2018/08/how-technology-is-driving-new-environmental-solutions/> [Accessed 16 October 2019].
6. Anon., 2018. *THE IMPACT OF CLIMATE CHANGE ON WATER RESOURCES.* [Online] Available at: <https://www.watercalculator.org/water-use/climate-change-water-resources/> [Accessed 13 October 2019].
7. Anon., 2019. *Climate Solutions We need to act now..* [Online] Available at: <https://www.ucsusa.org/climate/solutions> [Accessed 27 October 2019].
8. Anon., 2019. *Compact Fluorescent Light Bulbs.* [Online] Available at: <https://www.encyclopedia.com/environment/energy-government-and-defense-magazines/compact-fluorescent-light-bulbs> [Accessed 24 October 2019].
9. Anon., 2019. *Global Warming Solutions: Prepare for Impacts.* [Online] Available at: <https://www.ucsusa.org/resources/global-warming-solutions-prepare-impacts> [Accessed 27 October 2019].
10. Anon., 2019. *Pan-Canadian Framework on Clean Growth and Climate Change.* [Online] Available at: <https://www.canada.ca/en/services/environment/weather/climatechange/pan-canadian-framework/climate-change-plan.html> [Accessed 19 October 2019].
11. Anon., n.d. *Glacial retreat in the Himalayas.* [Online] Available at: <https://lcluc.umd.edu/hotspot/glacial-retreat-himalayas> [Accessed 10 October 2019].
12. Anon., n.d. *Mercury in Compact Fluorescent Lamps.* [Online] Available at: https://ec.europa.eu/health/scientific_committees/opinions_layman/mercury-in-cfl/en/mercury-cfl/ [Accessed 02 October 2019].

13. Anon., n.d. *Minamata Disease.* [Online]
Available at: <https://www.bu.edu/sustainability/minamata-disease/>
[Accessed 03 October 2019].
14. Anon., n.d. *What is Recycling?.* [Online]
Available at: <https://www.conserve-energy-future.com/why-is-recycling-important.php>
[Accessed 05 October 2019].
15. Panhwar, N. A., 2019. *Promoting affordable and clean energy.* [Online]
Available at: <https://tribune.com.pk/story/2022165/6-promoting-affordable-clean-energy/>
[Accessed 20 October 2019].



2026 by the authors; Journal of Global Social Transformation (JGST). This is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (<http://creativecommons.org/licenses/by/4.0/>).