GREEN LIGHTING:
TOWARDS SMART ENERGY MANAGEMENT

綠色照明:
節能省錢　人人受惠

A Guide on Energy Saving Initiatives for Cost Conscious Users

精明用家照明節能方案導讀

Hong Kong Productivity Council
香港生產力促進局

Acknowledgement 鳴謝

Hong Kong Productivity Council is grateful to the following organizations for their financial and editorial support in the publication of the booklet.
香港生產力促進局非常感謝以下機構對此小冊子的出版，在經費上及編務上的支持。

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Table of Contents

Smart Energy Management: Pay Less for More
精明節能之道 ： 慳電省錢　亮度依然

Wherever there is human activity, there is a need for lighting. Illumination can be brought about by daylight or man-made luminaries powered by electricity. In most cases, we depend on the latter. Consequently, we ought to bear the recurrent costs incurred in lighting up the premises where we conduct social or economic activities.

Business owners and financial controllers, however, are not too well aware of the energy costs related to lighting in their overheads. Generally speaking, costs of lighting constitute 25-40% to the overall power expenses of a commercial or industrial corporation, depending on the nature of operation and number of operating hours per year.

Nevertheless, few realize that the existing lighting fixtures have ample room for improvement in terms of energy efficacy. Main reasons for current inefficient performance include poor lumen efficacy, short economic life and rapid lumen depreciation of the luminaries. Other contributing factors include gradual deterioration of the reflectors caused by oxidation or dusting, unsatisfactory design or poor maintenance.

With the advent of more energy efficient lighting products and non-conventional reflectors in the market, we can always create phenomenal synergistic effects in energy saving by combining the new products in a creative way. As a result, a new generation of "Green Lighting" products is beginning to appear in the market though there is relatively little public awareness.

Many innovative public and business organizations have employed new technological solutions which help slash their energy costs by 25% to 60%. The estimated net savings are equivalent to a reduction of 8-15% in the original electricity bill. Besides reaping economic gains, lowering energy demand helps alleviate power shortage in South China where over 50,000 Hong Kong and overseas industrialists have their production lines operating round the clock there. The reduction in power demand entails less emission from the power plants and hence alleviates the growing air pollution problem in the Pearl River Delta. These are intangible social benefits.

Politically, China is a signatory nation of the Kyoto Treaty on Global Warming. But at the same time, it ranks second in terms of CO2 emissions among countries in the world. The Chinese government has the statutory and moral obligations to control the amount of emissions of greenhouse gases. We believe it is our responsibilities to make efforts to help our country in fulfilling the international obligations.

凡有人類活動，就有照明的需要，要不是依賴天然光，便是依靠藉電力燃亮的燈具。在絕大部分的情況下，人類的群居和經濟活動都倚賴電燈來照明，如此一來，亦無可避免地要支付因此而產生的經常性能源開支。

企業東主和財務主管，對照明開支佔整體開銷的比例，一般都不大。總的來說，工商類型企業的照明開支，約佔總能源開支25-40%，視乎企業的運作模式和每年營運總時數。

查實，目前的照明產品，在能源效益方面，尚有不少改善空間，而導致照明系統效益欠佳的因素眾多，其中主要包括光源的發光效能 (Luminous Efficacy)，照明體的產品壽命和光通衰退率等。當然，燈盤因為氧化、沾塵、設計不善或維修欠妥而導致反射器效率下降，亦是箇中成因。

隨著時代的進步，照明產品市場出現了越來越多的節能產品和非傳統的反射器。經過精心的選配和結合，市場上湧現了新一代的「綠色照明產品」，其特色就是利用先進燈具組件的創意組合，發揮了驚人的節能協同效應，同時又改善了用家的生產力或視覺舒適度。不過，遺憾的是，這類產品尚未廣為人知，大行其道。

不少有遠見和創意的公私營機構，已採納了新科技照明節能產品，把相關電費削減了25-60%，或相等於機構整體能源開支的8-15%。企業採取節能措施，除了可以有莫大的經濟效益外，更可協助解決華南地區的電力短缺問題。當地目前有逾五萬家外資或中外合資工廠，大都不分晝夜運作。倘若他們落實節能措施，不單令當地發電廠減少排放廢氣的總量，而且可舒緩珠江三角洲日益嚴重的空氣污染情況，這都是源自節能而額外產生的社會效益。

針對全球溫室效應，世界大部分國家都簽署了「京都議定書」，中國既是簽約國之一，同時也是全世界排放二氧化碳量佔第二位的國家。政治上，中央除了要加強監控全國的廢氣排放量外，亦要同時承擔法律上和道義上的責任。我們深信全國上下均有責任協助國家履行相關的國際義務。

How expensive is your lighting bill?
照明費用知多少

Many people have a few misconceptions about lighting. They reckon lighting fixtures are cheap and their power consumption is low, particularly when compared with the equipment and recurrent costs associated with air-conditioning systems. The fact, however, is that lighting consumes a huge amount of power when there are thousands of lamps burning round the clock in manufacturing plants, air freight terminals, car parks, convenient stores and even in supermarkets.

Take a garment manufacturing plant in South China for example.

Assuming:
1. The plant has installed 10,000 pieces of 36W standard T8 fluorescent lamps mounted in pairs on British battens.
2. Lamps are driven by conventional electromagnetic ballasts (consuming 12W in lighting up a 36W lamp).
3. The plant operates 24 hours a day in shift.
4. Electricity tariff is HK$0.8/KWh.

不少人對照明有一個錯覺，以為燈具價廉和耗電量少，特別是跟空調系統設備價格及其經常性能源開支相比，實在是「小巫見大巫」。查實倘若24小時營運的場所，諸如工廠、空運貨站、停車場、便利店或超級市場，每天都亮著成千上萬的燈具時，所耗電費絕對不宜低估。

就以華南地區一家製衣廠為例。我們假定:
1. 工廠安裝了一萬根英式支架，照明體為36W T8螢光燈管。
2. 燈管由傳統電感鎮流器 (俗稱銅線牛) 驅動，而鎮流器本身耗電量為12W)。
3. 工廠每天24小時運作。
4. 電費平均每度為港幣8角。

Table A: Lighting Costs for a Factory
照明費用知多少

	Operating Hours 營運時數		
Power consumption per unit lighting setup: 每組燈管耗用瓦數 48W (=36W+12W)	Per Day (每日): 24 hours (小時)	Per Month (每月): 720 hours (小時) (30 *24 hours)	Per Year (每年): 8,760 hours (小時) (365 *24 hours)
Power consumed over different periods 不同期間耗電量	1.152 KWh (度) (48W *24hr) /1,000	34.56 KWh (度) (48W *30 day *24 hr)/1,000	420.48KWh (度) (48W *365 day X 24 hr)/1,000
Energy cost per unit 每組燈管能源開支 (power consumed *tariff) 耗電量X電費	$0.92	$27.65	$336.40
Energy cost for 10,000 lamps 一萬根燈管電費開支	$9,216	$277,000	$3,364,000

Owners or plant managers who used to be preoccupied with overseas orders, material costs or delivery schedules will be amazed by the millions of dollars incurred in industrial lighting. If halogen lamps or HID lamps are used, the costs could have been even greater. The computation of power consumption in lighting is easy because it is based on a fixed load pattern. Once a lamp is turned on, the lamp and ballast will consume the number of watt specified in their product specifications.

Whether energy savings in lighting can be achieved depends solely on how energy efficient the existing lighting system is. If the system is suffering from poor efficacy, the amount of saving could be substantial. How could we have an objective way to judge whether the system is cost effective?

In lighting design, different kinds of premises have varied levels of luminance and they are decided by the nature of there activities. Building service engineers have recommended a range of lighting intensity for specific premises. For example, in an office setting, the requirement is 500 lx whereas in a garment factory 1,000 lx. For identical areas requiring the same level of brightness, the premises using lower power per unit area is said having a high energy efficacy. The standard used internationally is called "Lighting Power Density" (LPD) which is expressed in watt/sq. m. LPD is used by users to assess whether they are spending more on their lighting bill.

Improving Energy Efficacy = Cost Savings
改善「能源效益」 用家馬上得益

In China, the recommended lighting level for an A Grade office is 500 lx whereas the prevailing LPD is 18 W/sq. m. China is requesting electrical and mechanical consultants to improve the current standard to 15W/sq. m. in the near future. As revealed later in this booklet, newly developed luminaires can deliver the required brightness at 9W/sq. m. which help users reduce half of their energy costs.

一般工廠東主或廠長平日都會為解決訂單、物料成本和付貨問題而周張，因而忽視了每年開支可高達數以百萬元計的工業照明效益研究。燈管能源效益已算上佳，如果廠房採用的燈具為鹵素燈或高強度氣體放電燈(俗稱HID強光燈)，電費開支則會更厲害。計算照明開支十分簡易，因為燈具組合在產品規格中對電費瓦數均有清楚說明，只要一接駁上電源，便會按規格標明的固定瓦數消耗電能，不會因環境因素而改變。

如果我們擬減低照明系統經常性開支，首先便要知道當前系統的能源效益有多高，效益越低，則改善空間便越大，能節省的金額便越龐大。那麼，我們如何能客觀地評估照明系統的能源效益哩?

在照明設計中，不同類型的場所對室內照度都有不同的要求，視乎用家的實際需要。屋宇設備工程師對不同性質的場所都會推薦不同的照度指引。例如辦公室一般是500 lx，而製衣廠則為1000 lx。在同一面積，同一照度要求的情況下，能夠用最少的瓦數來達到指標的照明系統，就是最具效益的系統。在國際照明行業中，這個標準名叫「照明功率密度」(Lighting Power Density) 往往以「瓦數/平方米」為量度單位，瓦數越低，節能效率越高。

在中國，甲級辦公樓照明的國家標準為500 lx，而當前普遍照明系統的功率密度為18W/m2。有關當局已要求機電工程顧問在設計新項目時，把密度降低至15W/m2。這個要求看似強人所難，但查實科技發達，這本小冊子容後就會提及某些嶄新設計燈具系列，可把整個系統的照明功率密度壓低至9W/m2，亦即是說馬上為用家節省了一半照明能源開支。

What do we mean by "energy efficacy" ? In layman terms, "energy efficacy" refers to the extent of work output an electrical appliance can deliver by utilizing the least amount of energy input. In lighting, the amount of light energy a luminary produces is call "luminous flux" which is measured in terms of "lumen" (lm). To find out the lumen efficacy of a luminary, we use the following lumen output per watt or lm/W. When a lighting fixture uses less energy to generate the same amount of lumen output, we describe the fixture as having a higher "lumen efficacy". The most frequently quoted examples are energy saving lamps which have been rapidly replacing the inexpensive incandescent lamps (commonly known as light bulbs) over the past decade. The principal reason, as illustrated in the following test, is the huge economic benefits energy saving lamps can bring to the users.

何謂「能源效益」? 用普通人的語言來解釋，「能源效益」就是指如何使用最少的電力，去驅動一件電器發揮最高的效能。在照明行業中，發光體輸出的光能叫做「光通量」，通常以「光通」(1m)為量度單位。要評估燈具的「光效」，我們會用以下的方程式: 光通量/瓦數 (1m/W)。當我們利用較小的瓦數，便能產生同樣的光通量，那麼這款燈具便具備了較高的「光效」。我們日常生活中最常用的例子，便是近年越來越多人用來取代白熾燈 (俗稱燈泡) 的節能燈膽 (俗稱慳電膽)，箇中原因當然就是節能燈膽能為用家帶來的巨大經濟效益，詳情見下圖:

Table B: Basic Product Specifications 產品規格

Types of Lamp 發光體種類	Energy Saving Lamp 節能燈膽	Light Bulb 燈泡
Power consumption (Watt) 耗電瓦數	20W	100W
Lumen Output (1m) 光通量	1,200	1,200
Lamp Life (hrs) 產品壽命	10,000	1,000
Lumen Efficacy (lm/W) 光通效率	60	12

Table C: Running costs for 10,000 hours (assuming tariff = $1.00/KWh)
一萬小時的總開支(假定每度電費為港幣1元)

Cost Breakdown 成本細算	Energy Saving Lamp 節能燈膽	Light Bulb 燈泡
Retail Price (per pieces) 每件零件售價	$48.00	$5.00
No. of Lamps required 所耗燈管數量	1	10
Cost of Lamps 燈具成本	$48.00	$50.00
Energy Cost 能源開支	$200.00	$1,000.00
Total Cost 總開支	$248.00	$1,050.00
Net Savings 節省金額	$802	-

As one can easily see from the above tables:

1. A luminary with high lumen efficacy will incur a substantial saving in the long run despite its higher initial acquisition cost.
2. A luminary with short lamp life, despite its relatively cheap acquisitions cost, will eventually end up costing the same as a more expensive energy saving lighting fixtures. If the labor costs incurred in the replacement is taken into account, it is much more costly than one may have ever thought.

根據上述數據，馬上可下兩個結論:

1. 高「光效」的照明體，儘管成本較高，但長遠來說，節能本領高強，能省下更大的電費。
2. 壽命較短的照明體，儘管價格較便宜，可是損耗量大，最終開支與較貴的節能燈膽相若。如果計算更換的人工成本，更得不償失。

Guidelines for Energy Efficient Luminaires
選購高能源效益燈具竅門

1. Lumen Efficacy

Among the most commonly used luminaries in the commerce and industrial sectors, fluorescent lamps have been ranking number one for decades in terms of sales turnover. Their consumed quantities are estimated to take up over 70% of the lighting products in the world market with billions installed in offices, car parks, warehouses, retail stores and manufacturing plants.

The primary reason for their high popularity is their intrinsic high lumen efficacy which is considered extremely energy efficient among non-HID lamps or those consuming under 100W.

1. 燈具必須具備高「光效」

在全球工商界最常使用的照明體中，在過去數十年銷量歷久不衰，高佔市場份額超過70%以上的，可算是螢光燈管了。目前世界各地估計在辦公樓、停車場、倉庫、零售店舖和工業廠房內合共安裝了數以十億的燈管，數量之大，可謂「獨領風騷」！箇中原因不外乎螢光燈管本身具備的先天優勢，就是極高的光效 (特別是跟耗電在100W以下的發光體比較)。

Table D: Comparison of Lumen Efficacy among the Most Popular Luminaries
市場上最普遍的發光體「光效」排名表

Lamps Type 發光體種類	Average Lumen Efficacy (Lm/W) 平均光效	Energy Efficacy Ranking 能源效益排名
Incandescent Lamps 白熾燈(燈泡)	15	7
Halogen Lamps 石英鹵素	15 - 25	6
Energy Saving Lamps 節能燈膽	50 - 60	5
Compact Fluorescent Lamps 節能螢光燈管(筷子管)	70 - 85	3
Standard T8 Fluorescent Lamps 傳統螢光燈管	70 - 80	4
Extra Bright T8 Fluorescent Lamps (Tri-phosphor) 特亮燈管 (三基色燈管)	80 - 100	2
T5 Fluorescent Lamps (HE & HO) 特幼螢光燈管	83 - 104	1

The top two most energy efficient luminaries belong to the fluorescent lamp family which offers a lumen efficacy of over 80 lm/W. The key to success of fluorescent lamps lies in fact that they generate relatively little heat as compared with, say, light bulbs, compact fluorescent lamps or halogen lamps. In other words, a greater proportion of electrical energy is converted into light energy and hence enhances the cost-benefits for the users.

在排名表上佔第一和第二位的發光體，均屬於近年開始流行的三基色螢光燈管系列，兩者的光效均超過81m/W。主要原因是它們在發出光能時產生的熱量，遠較燈泡、節能燈膽或石英鹵素燈(Halogen Lamp) 為低。換言之，輸入發光體的電能，絕大部分被轉化為光能，因而對用家產生相對較大的效益。

2. Lamp life

In choosing a luminary, many purchasing officers who have little training in the fundamentals of lighting would tend to buy less expensive lighting fixtures in order to minimize acquisition costs in each purchase. They do so with good intentions but at the same time, they commit a grave mistake in failing to realize the hidden expenses to be incurred in using cheaper yet less efficient luminaries.

In general, two types of cost are incurred, namely, material cost of the burnt-out lamps and the labor cost for the replacement. The shorter the lamp life of a luminary, the more frequent replacement is needed. As indicated in the earlier example, one needs to use 10 light bulbs in order to burn 10,000 hours but one single energy saving lamp is good enough to deliver the same performance continuously without bothering the replacement problem. Even though the material cost ends up more or less the same, the labor cost involved in replacing a light bulb for 9 times is truly remarkable particularly in places where labor costs are high. This hidden cost must be borne in mind.

2. 發光體產品壽命

各公私機構的採購部職員由於缺乏照明專業知識，通常在採購買發光體時，都傾向採購訂價較低廉的產品。雖然他們用心良苦，嘗試為企業減低採購開銷，可是，他們卻不經意地犯上了一個莫大的錯誤，就是忽視了因為使用廉價而低能源效益發光體所帶來的龐大隱性開支。

一般來說，這類發光體會帶來兩種開銷，首先就是不斷更換發光體的工資成本。發光體的壽命越短，更替次數就越頻密。就以前述燈泡為例，要維持照明10,000小時，就得更換10個燈泡，但是使用了一個節能燈膽，就可一勞永逸，免除了經常更換燈具的麻煩。即使兩者物料總開支相差不多，可是，試想多換9個燈泡的工資成本，肯定絕對不輕，尤其是在勞動力工資較高的地方，就要特別留意。

Table E : Comparison of Lamp Life (Related Average Life)
發光體產品壽命比較(平均產品壽命)

Lamp Type 發光體種類	Rated Average Life (Hours) 平均產品壽命	Ranking 排名
Incandescent Lamps 白熾燈(燈泡)	1,000	7
Halogen Lamps 石英射燈	2,000 - 4,000	6
Energy Saving Lamps 節能燈膽	6,000 - 10,000	5
Compact Fluorescent Lamps 節能螢光燈管(筷子管)	8,000 - 13,000	3
Standard T8 Fluorescent Lamps 傳統螢光燈管	6,000 - 12,000	4
Extra Bright T8 Fluorescent Lamps 特亮燈管 (三基色燈管)	12,000 - 20,000	1
T5 Fluorescent Lamps (HE & HO) 特幼螢光燈管	6,000 - 20,000	2

* Rated average life refers to the number of hours when 50% of a batch of lamps burn out after all of them are lit up at the same time.

* 平均壽命是指當同一批發光體同一時候亮起後，要經過多少時數就有半數損耗的情況。

It is apparent that extra bright T8 and T5 fluorescent lamps again are the top performers, particularly the former which can offer an extra lumen output of 15-20% over T5 lamps for comparable models based on length of the lamp. As their lamp life can reach 20,000 hours (i.e. operating round the clock for 27.4 months), it is, therefore, highly cost effective in using them in premises with long operating hours.

上圖很明顯地告訴我們，特亮T8螢光燈管和特幼T5燈管(兩者均屬於三基色螢光燈管)平均都較耐用。前者的光通量更比後者強15%-20%。由於兩者壽命配電子鎮流器均高達2萬小時(若應用於24小時運作場所，壽命可維持約27個月)，因此它們最適用於有長期照明需要的地方。

3. Lumen Depreciation

Last but not least is the performance of a luminary over time. Despite the advancement in technology, all lighting fixtures, like human beings, cannot get away from the onslaught of ageing. Luminaries usually deliver their best performance in the beginning of their specified lamp life and gradually lose their luster. This process is called "lumen depreciation" whereby lamps getting dimmer everyday. When the total lumen output falls below 70% of their original designed output, the lamps are said to have ended their economic life and must be replaced at once.

In reality, lamps are not replaced until they got burnt. By this time, it is not uncommon that the lumen output will have dropped by more than 50%. However, the power they consume remains the same. In other words, the users are paying twice for what they are getting. This is totally uneconomical. Unfortunately, very few users are aware of the huge economic loss arising from an oversight of the lumen depreciation problem.

The most common case happens in an office setting where standard T8 fluorescent lamps are used. When the office is newly furnished, the brightness level is up to the designed standard. There is little complaint about the brightness but after a year or so, the room illumination would quickly fall below the designated lux level. It is because the luminous flux of lamps drops 20% in the first 5,000 hours and over 30% in 15,000 hours. If no action is taken, lumen depreciation will continue until the lamps are burnt out. During this process, the productivity of office workers is likely to be lowered and eye sight adversely affected not to mention the extra energy costs the management is paying.

Among the more popular luminaries used in the commercial and industrial sectors, it is well known that light bulbs, halogen lamps and HID lamps have the fastest lumen depreciation rate. Standard fluorescent lamps come next. Top performers are T5 fluorescent lamps and extra bright T8 fluorescent lamps, both of which claim that their lumen depreciation is within 10% throughout their lamp life. This explains why more and more smart users are switching to energy efficient luminaries. In Hong Kong, they include Hong Kong Productivity Council, Standard Charted Bank, Dahsing Financial, Hong Kong Air Cargo Terminals Limited (HACTL), MTRC and the supermarket chain stores.

3. 流明衰退

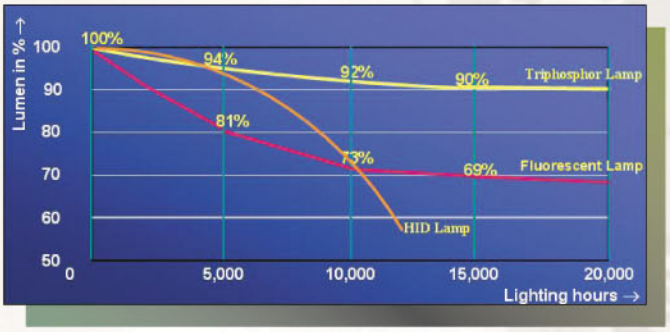
最後，挑選發光體最重要的準則，就是要看發光體長時間的表現。儘管科技日新月異，所有發光體都如人類一樣，逃不掉「歲月催人」的殘酷命運。一般發光體在燃點初期，都表現非凡，可是，隨著時光流逝，就會逐漸失去光彩，這個過程叫做「流明衰退」，體現了發光體日漸轉暗的不變現實。當輸出光通量低於原規格的70%時，發光體的經濟壽命便告結束，也是要被馬上更替的適當時候了。

事實上，在大部分情況下，發光體一天不自動熄滅，也不會被替換。到了那個時候，光通量大都已下跌了5成以上。不過它們耗用的電量卻依舊不變。換言之，用家那陣子是「出了半斤力，僅拿回四兩」，就經濟效益而言，絕對吃了大虧。很可惜，曉得這個道理的用家寥寥可數，大部分都會白白地蒙受莫大的經濟損失而不自知。

這個情況最常見於辦公樓內，在新入伙時，採用的傳統螢光燈管剛剛開始點燃，正值「盛年」，當然能達到原設計照明標準，用家自然無怨言。可是，當發光體在點燃了5,000小時後，光通量便會下跌20%，過了15,000小時，便會下跌超過30%，室內照度自然迅速下降。若坐視不理。流明衰退會持續下去，直至發光體壽命終結。在這個過程中，在辦公樓內工作的職工生產力很可能會降低，而視力亦會變壞。管理階層因此而要付出額外的能源開支，更不在話下了。

在工商界企業常用的發光體中，眾所周知，流明衰退得最快的就是燈泡、石英鹵素燈和HID強光燈。其次，便是傳統的T8螢光燈管。至於流明衰退率最低的，莫過於特亮T8螢光燈管和特幼T5螢光燈管，兩者一生的衰退率都不超過10%，因此越來越多聰明的用家，都開始採用上述能源效益較高的發光體，當中包括了香港生產力促進局、渣打銀行、東亞銀行、大新金融、香港超級一號貨運站、地下鐵路以及各大超級市場。

Lumen Depreciation of Different Types of Luminaries
常用發光體流明衰退比較



Common Trends in Energy Management for Lighting
照明節能主流趨勢

By now, it is clear that the use of fluorescent lamps is considered the most cost effective option in general lighting, and, for good reasons.

With the advent of the extra-bright T8 fluorescent lamp series (e.g. Philips Super 80, Osram Luminlux, GE Polylux and Hitachi Hi-Lumic) and T5 fluorescent lamps (High Efficiency and High Output series), their applications will become more sophisticated and popular. It is envisaged that fluorescent lamps will eventually play a more significant role in energy saving solutions when they are used in conjunction with new breeds of control gears or reflectors.

As of today, the most common approaches in achieving energy conservation involving fluorescent lamps are as follows:

1. Use energy efficient control gear (e.g. electronic ballast to reduce power consumption.)
2. Use energy efficient lamps to reduce power consumption (e.g. T5 fluorescent lamps) or gain extra brightness over a long period of time (e.g. extra bright T8 fluorescent lamps)
3. Use non-conventional reflectors with excellent reflectance to increase effective light output.
4. Use external electrical device to reduce voltage after lighting up the fluorescent lamps. (at the expense of lighting quality)
5. Combined use of the approaches outlined in (1) - (4).

由上觀之，用家樂於採用螢光燈管是有充分理由的，因為他們從中可獲最大的經濟效益。

隨著照明產品製造商，陸續大量生產特亮T8螢光燈管(例如飛利浦的Super 80，歐斯朗的LUMILUX，通用電器的POLYLUX和日立的HI-LUMIC)等系列產品和特幼T5燈管(包括HO和 HE系列)，它們的應用勢將一日千里，配合市場上出現嶄新品種的鎮流器和反射器，T8和T5三基色螢光燈在新開發照明節能方案中，將會扮演舉足輕重的角色。

當今照明市場上涉及螢光燈管的節能方案，可歸納於下列五種趨勢:

1. 利用高能源效益的鎮流器(例如利用電子鎮流器去減少耗電)。
2. 利用高能源效益的發光體(例如特幼T5燈管)去減少瓦數，或者維持長期不衰的照度(例如特亮T8燈管)。
3. 利用效能卓越的非傳統反射器去提高燈管的光效使用率。
4. 利用外置的機電儀器，讓燈管亮著後，降低電壓以收節能之效(此舉勢必減低燈管發出的光通量)。
5. 聰明地結合上述(1)至(4)項各自的優勢。

Option 1: Using Electronic Ballasts

This is a simple and straight forward way in achieving energy saving by means of replacing the conventional "electromagnetic" ballast.

With electronic ballast, the average saving rate in terms of "system energy" (i.e. total power consumed by lamp and ballast) is around 20-25%. This method can only apply to T8 fluorescent lamps. Material cost alone is now affordable ($30-$80) for average grade ballast. However, the labor cost which requires the input of a qualified electrical technician is inhibitive. The combined cost amounts to around $100-$150. The pay back period for such an initiative (assuming it is a 24-hour operation) would be 12-20 months. In the case of an office setting with shorter operating hours, the pay back period would be prolonged to 25-48 months.

主流方案(1): 善用電子鎮流器

傳統螢光燈管大都利用電感鎮流器(俗稱銅線牛)，但由於耗電量較大，因此若改為電子鎮流器(俗稱電子牛)，則可直接達致節能效果。一旦採用了電子鎮流器，燈具的系統耗電量(即燈管連同鎮流器合共消耗的瓦數)，可馬上節省20-25%，但只局限於T8或較粗的燈管系列。按今天的市場價格，一般質量的電子鎮流器，可謂十分相宜(由港幣$30—$80)。不過要動用一位合資格的有牌照電器工人去進行更換鎮流器的費用卻相對不菲，合共約港幣$100-$150。若果企業是每天24小時營運模式(即全年運作8,760小時)，那麼投資回本期約為12-20個月，即在此期間節省的電費，可抵消前期的投資成本。若換上辦公樓的工作環境(每年約運作3,000小時)，回本期就要延長至25-48個月時間。

Table G: Cost-Benefit Analysis for a 36W Lamp
成本效益分析

Material cost (A) 物料開支	Labor cost (B) 人工開支	Total cost (C) 總開支 (KWh) (D)	Reduction in Power Consumption 省回電量	Net Saving (E) 節省電費 投資回本期	Pay back period (F) = C/E
$60	$80	$140	87.6 KWh (10W *24 hr *365 day)	$87.6 (10W *24 hr *365 day *$1/KWh)	19.2 months

Note: Power consumed by a conventional electromagnetic ballast driving a 36W T8 lamp is 12W whereas an electronic ballast 2W. The net saving is therefore 10W. Tariff is assumed at $1/KWh

註: 假定驅動一根36W燈管的電感真流器需耗電12W，而電子鎮流器則為2W，因此節省10W，電費則設定為每度港幣$1。

Option 2: Using Energy Efficient Fluorescent Lamps

This approach can be applied in two different scenarios and bring about varied benefits. First, by replacing standard T8 fluorescent lamps with extra bright T8 lamps, users gain an instant 20-30% increase in brightness and enjoy a prolonged and stable lighting environment. There is no reduction in power consumption or instant saving in the electricity bill. But if the premises need brightness enhancement, this is the most cost-effective way as compared with the installation of new lamps as it does not entail any additional energy cost.

主流方案 2: 善用高能源效益螢光燈管

這個方案可以發揮兩大效能，分別就是加光和節能。若應用於前者，用家一旦更換了一根特亮T8燈管，室內亮度一般可增加20-30%，而且流明只會慢慢衰退，締造了一個穩定而明亮的環境。雖然燈管更替並不能為用家減省電費開支，但若果原來的營運場所根本照度不足，那麼這個方法就是最佳的「間接節能辦法」，因為一旦要安裝額外燈管，用家日後自然要負擔因此而產生的電力開支。

Table H: Comparison of Lumen Output of T8 Fluorescent Lamps
T8螢光燈管輸出光通量比較

Watt 瓦數	Color Temperature (K) 色溫	Philips Standard Lamps TLD (lm) 飛利浦常用TLD系列	Philips Super 80 Extra Bright Lamps (lm) 飛利浦Super 80 特亮燈管系列
18W (600mm)	2900	1250	1350 (+8%)
	4100	1200	1350 (+12.5%)
	6200	1050	1300 (+23.8%)
30W (900mm)	2900	2175	2400 (+10.3%)
	4100	2100	2400 (+14.3%)
	6200	1825	2300 (+26%)
36W (1200mm)	2900	2975	3350 (+12.6%)
	4100	2850	3350 (+17.5%)
	6200	2500	3250 (+30%)
58W (1500mm)	2900	4700	5200 (+10.6%)
	4100	4600	5200 (+13%)
	6200	4000	5000 (+25%)

Source: Philips Lighting Products Catalogue 2005
來源：飛利浦2005年照明產品目錄

The second scenario is that users replace standard T8 lamps with T5 lamps. However, users will have to pay a relatively large amount of upfront investment in buying and installing brand new T5 fittings. This is because the length of T5 lamps is 20mm shorter than corresponding T8 lamps. Moreover, different types of T5 lamps (e.g. 14W, 21W or 28W) require specific model of ballasts. This entails a complete overhaul of the existing lighting system.

Despite a 30% saving in subsequent operating hours, the initial T5 lighting systems are regarded by many users as too expensive and their pay back period of over four years is too long.

至於利用特幼T5螢光燈管來達致節能目標，也是一個可行辦法。不過，用家在更替燈管時必須先墊支一筆較鉅大的投資費用，因為特幼T5燈管的長度，較T8燈管平均短了20mm，而且一般而言，不同瓦數的T5燈管，需要配合同一牌子生產編號的電子鎮流器，才能發揮最佳效益，所以用家基本上是更新了整個照明系統。

儘管更換了T5照明系統後，可節省高達30%的能源開支，很多用家嫌啟動費用過份昂貴，而且回本期超過四年，略嫌太長。

Cost Benefit Analysis of T5 Luminaires
採用T5燈盤的成本效益分析

Table I: Saving in power consumption 節省電量

Lighting 燈盤	Fitting Power (W) consumed by 各組件耗電瓦數			Net saving in power (W) 節省電量	Net Saving($) 節省電費 (24-hr operation) 24小時運作
照明配搭	Lamp 燈管	Ballast 鎮流器	Total 總計		
Original: 原T8燈盤 T8 (3 x 36W)	108	36	144	-	-
New: 新T5燈盤 T5 (3 x 28W)	84	12	96	48	420

Table J: b. Computation of Pay Back Period 回本期計算辦法

Cost of T5 luminaires (A) T5燈盤價格	Installation cost including realignment of grid (B) 安裝費用(包括調整天花骨架開支)	Total investment (C) 總投資	Total savings (D) 每年節省電費	Pay back period (E) = C/D 回本期
$680	$250	$930	$420	26.5 month

In addition, T5 lamps are a relatively new lighting product (appearing in the market for less than 10 years) and there is ample room for improvement in the production technology. Since they are regarded as "something in vogue", many lamp manufacturers rush to produce them without bothering about imposing stringent quality control and hence product quality varies a great deal. Many users have reported unusual lamp or ballast failure within short periods after installation.

除此之外，特幼T5燈管系列在市場上出現的時間較短（在香港不夠10年）屬於時尚產品，生產技術仍大有改善空間。可是它們在照明市場卻被視為「新寵」，不少生產商都為了趕上潮流而一窩蜂去搶佔市場份額，造成了產品質素很參差。不少用家據報都抱怨在轉用疑質量欠佳的T5燈盤後，不時遇上燈管或鎮流器失靈的情況，大大增加了原來的維修開支。

Option 3: Using Unconventional Reflectors

In conventional luminaire design, metallic reflectors with high reflectance surface dominate the lighting market as they increase the effective light output from a luminary instantly and substantially. Measuring at standard work plane level, a perfect reflector could increase the measured brightness of a lamp mounted on a bare batten by up to 66%. Therefore, the employment of a good reflector delivering continuous and stable performance is crucial in masterminding energy saving initiatives.

However, traditional metallic reflectors, whether they are made of high quality polished aluminum or other metallic alloy, suffer from oxidation overtime. The deterioration rate depends on the quality of metal reflector and the humidity of the operating environment. The impact of dusting also affects the reflective performance considerably.

Regular maintenance is the most inexpensive way to keep reflectors in their best performance conditions but experience shows that little attention has ever been drawn to this aspect. Consequently, reflectors gradually lose their luster and coupled with the ageing of lamps, illumination falls to an unacceptable level unnoticed.

Recently, the lighting market has witnessed the emergence of a new generation of reflectors which are entirely different from the conventional ones. First, they are made of non-metallic materials with the aid of nano-scale technology. Second, the design of new reflectors is tailor-made for individual fluorescent lamps. There are known as "Single Lamp Reflectors" which are directly affixed to fluorescent lamps by supporting accessories. Third, they are easy to install and remove and provide a lot of flexibility for energy saving initiatives. Fourth, they usually possess excellent reflectance property which outperforms conventional metal reflectors. Fifth, they are very durable and easy to maintain and thus able to guarantee a reasonable long and stable performance in the course of time.

The employment of excellent reflectors alone can improve the effective light output ratio of a luminary but one must be reminded that reflectors do not produce energy. They merely re-direct the luminous flux to the work space. Therefore, to leverage the economic benefits of a good reflector, a top performing luminary is deemed imperative.

主流方案(3): 善用一反傳統用料和設計的反射器

在傳統燈盤的設計中，有良好光學反射性能的金屬反射器，幾乎壟斷了整個市場，因為它們可以協助提高發光體的有效使用率高達66%，因此懂得如何利用性能卓越的反射器，去維持發光體光效歷久不衰，是任何照明節能措施的關鍵因素。

不過，傳統的金屬反射器，不論它們是由高質磨光鋁片或其他高反射合金製成都逃不出一個致命的弱點，就是金屬長期暴露在空氣中產生的氧化問題。反射器失效的速度，視乎所用金屬的質量及營運場所的濕度。當然，反射器沾上塵埃也會嚴重響金屬的反射性能。

查實，只要用家能夠定期潔淨燈具，反射器的表現理應可經常保持最佳狀態，而且相關費用不高。不過，實際上，這點往往被完全忽略，反射器效能逐漸衰失，加上燈管流明不斷衰退，室內照度不知不覺地便會變壞到不合標準的狀態，受害的當然是用家本身了。

近年來，照明市場上湧現了新一代反射器，採用物料與傳統的金屬制品迥然不同。首先，他們採用了非金屬物料，再輔以當今最熱門的納米技術，使原來物料具備了特異和反傳統的功能。第二，這類反射器，設計獨特利用特製夾子直接依附在個別螢光燈管上端，故又稱為「燈管連體反射器」。第三，安裝方法簡單容易，極具彈性，可直接應用在現有燈盤上而無需任何機電方面的改動。第四，它們的反射性能有極超卓的表現，比傳統金屬反射器還要強。第五，它們十分耐用而且容易保養，可以保証長時間使用效能不減。

利用反射能力卓爾非凡的反射器，不錯能大大改善發光體的光效使用率。可是，我們切記反射器本身並不能產生光能，它們只是捕截發光體發射出來的光能，然後有效地引導到工作間，讓人類享用。因此，若要發揮這類反射器最高的經濟效益，必須要與高能源效益的燈管相互配合，才能產生異常的協同效應。

Reflectance of Different Materials Used in Reflectors
反射器常用物料的全反射率

Highly Polished Aluminum 磨光鋁片	95%
Average Grade Aluminum 普通鋁片	80%
Nickel 鎳	75%
White Paint 白漆	70%
Chemical Film Coating 化學薄膜 (e.g. 3M)	98%
Reflective Foam Materia發泡膠片 (e.g. LEJ)	98%
Ipoxy 樹脂	75%

Option 4: Using Electrical Device to Reduce System Power Consumption

The principle behind this approach is to achieve saving by reducing the voltage of the lighting circuit once the fluorescent lamps are turned on. It is estimated that saving ranging from 20 to 25% can be achieved. The gadget is usually installed by the side of the MCB which controls the lighting system. Each device is able control up to 100 lamps. This approach is rather controversial among building service engineers because the overall luminance level will drop around 10% which is considered an unacceptable deterioration of the lighting quality.

Innovative Cost-effective Energy Saving Solutions

Business operators, who are looking for effective energy management solutions, are always beset by the "seemingly long" pay back period offered by existing approaches. Based on random surveys among users, it is found that energy saving initiatives whose pay back period lasting over two years is seldom considered. Businesses having long operating hours are most motivated to undertake energy management programs because they can recoup their upfront investment fast and achieve substantial long-term saving in energy costs.

主流方案(4)： 調校電壓減少用電

市場上採用這種方法節能的措施，背後的原理就是讓照明系統在啟動之後，降低整個系統所需的電壓，估計可節省20-25%電力開支。這種做法十分簡易，只需要在控制照明系統的電制表房內加裝變壓儀器，而每組最多可控制100根燈管。不過，房宇設備工程師對這個取巧做法多持異議，因為電壓降低後，整個照明系統的光通輸出量會自動減少約10%，令室內照明度變差，易受用家非議。

有創意兼有能源效益的照明節能方案

企業主管在找尋高效益節能方案時，往往對前述的四大主流方案都不盡滿意，因為他們都嫌每一種方法的回本期「過長」。根據市場非正式統計，任何回本期超過兩年的節能措施都會被認為欠缺吸引力，而最主動去找尋節能方案的企業就是那些營運時間特長的機構，因為他們不但可以很快回收早前一次性的投資金額，而且之後便可長期省回非常可觀的能源開支。

Lighting Retrofits
原地進行的照明節能方案

According to the in-house assessment conducted by energy auditors of Hong Kong Productivity Council, it is found that the most cost-effective strategy is to combine two or more of the four options outlined in the previous section. The synergy generated by the combined use of energy efficient lighting products can always produce amazing effects and, in some instances, even enable de-lamping to take place without downgrading the existing level of lighting quality. Under these circumstances, energy saving rates ranging between 33% and 67%, are easily attainable.

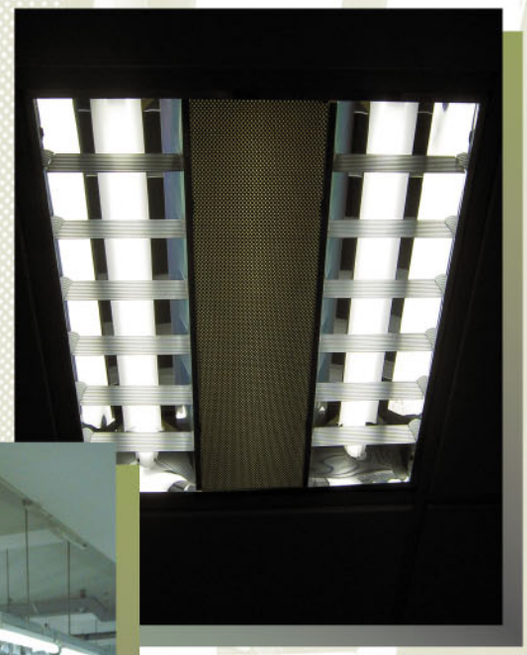
Many may wonder why such huge savings can be achieved. The main reason is that new initiatives exploit the poor utilization and maintenance factors of the existing lighting fixture including low lumen efficacy, rapid lumen depreciation and unsatisfactory light output ratio.

Case Analysis
Based on HKPC computations, different combinations of the aforementioned available options offer varied saving rates and hence pay back period. What follows is an account of three scenarios accompanied by a cost-benefit analysis based on a descending order.

根據本局的能源審計專家內部評估，最有成本效益的節能策略，就是巧妙地結合上述四個主流方案，來產生神奇的協同效應，當中某些組合甚至可以做到大幅減少燈管數量，而不影響原本室內的照度和照明環境質素。若能善用這些組合，節能比率可由33%增加至67%，而且執行上並不困難。此外回本期也可以大幅縮短。

很多人或會不明箇中原因，但查實內情並不神奇，只是新組合方案，可以大幅改善現時照明系統內的光效使用率和維護系數，包括提高光效、減慢發光體的光衰速度，以及提昇有效使用光能的比率。

個案研讀
根據本局的測算，利用上述四大主流方案的不同組合，可產生不同程度的節能效應。下列三個案例就是按實情所做的成本效益分析。次序由最具經濟效益的組合方案開始，順序而下。



Hong Kong Productivity Council
香港生產力促進局

Scenario A: Energy Saving Target 60%
組合主流方案 (A): 節能目標60%
(Option 1 + Option 2 + Option 3)
[方案(1)+(2)+(3)結合而成]

Basic Facts 案例細節

Nature of Operation 營運種類	Garment Factory 製衣工場
Location 地點	Dongguan 東莞
No. of Lamps 燈管數量	20,000
Lamp Model 燈管種類	4' conventional fluorescent lamp 普通4尺燈管
Lamp Watt 燈管瓦數	36W
Ballast Watt 鎮流器瓦數	12W
Installation method 安裝模式	Mounted in pairs over work stations 車間上端，雙管排列
Tariff 電費(每度)	$0.8/KWh
Operating Hours 每天運作時數	24 hours (小時)

Procedures 執行程序:

Step (1): Option 2 + Option 3 (第二+第三主流方案)
Use an unconventional reflector and an extra bright fluorescent lamp to replace the existing pair to achieve 50% direct savings in lamp power consumption.

Step (2): Option 1 (第一主流方案)
Use an electronic ballast to replace the two electromagnetic ballasts to achieve 92% saving in ballast power consumption.

第一步: 利用非傳統高效能反射器，配合一根特亮T8螢光燈，取代原有兩根，普通燈管節能50%。

第二步: 利用一枚電子鎮流器取代原來兩枚電感鎮流器比原耗電量節省92%。

Overall Saving in System Power Consumption
原有照明系列總耗電量縮減情況

	Original set up 原來配搭 (2 x 36W standard T8 lamp) (兩根36W普通T8光管)	Proposed Energy Saving Solution 新節能配搭 (1 x 36W extra bright lamp + 1 electronic ballast + reflector) (一根特亮燈管 +電子鎮流器 + 高效能反射器)
Power Consumption by Lamp 燈管耗用瓦數	72W (2 x 36W)	36W (50% saving)
Power Consumption by ballast 鎮流器耗用瓦數	24W (2 x 12W)	2W (92% saving)
System Power 系統共用瓦數	96W	38W (60% saving)
Net Saving in Power 節能瓦數	58W	
Total Annual Saving 每年淨省金額	$406	

Cost Benefit and Pay Back Analysis
成本效益及投資回本分析

Unit Rate 每單元成本	Ballast cost (A) 鎮流器成本	Reflector cost (B) 反射器成本	Lamp cost (C) 燈管成本	Labor cost (D) 工資成本	Total cost E(A+B +C+D) 總成本	Annual Saving (F) 每年淨省金額	Pay back period (G) =E/F 回本期
Unit Price	$60	$150	$12	$80	$302	$406	9 months

Conclusion 結論:

The factory owner invests $3.02 million (10,000 x $302) to conduct an overhaul of the lighting system and the invested amount will be recouped in 9 months. Starting from the tenth month, he will enjoy a monthly saving of $338,000 or an annual saving of $4.06 million. In 10 years, he saves $40.6 million.

工廠東主投資了港幣$302萬($302 X of 10,000套)來改造整個照明系統，投資金額可在9個月內全部回收。由第10個月開始。每月可節省$338,000電費。每年高達$406萬。十年合共節省$4,060萬。

Scenario B: Energy Saving Target 50%
組合主流方案 (B): 節能目標50%
(Option 2 + Option 3)
[方案(2)+(3)結合而成]

An electronics factory in Shenzhen with 12,000 pieces of 36W fluorescent lamps operating in an air conditioned setting. To avoid electro-magnetic interference, electronic ballast is not recommended.

深圳一家電子廠原安裝了12,000根36W燈管，全廠空調，為了避免電子鎮流器可能對廠內精密儀器產生干擾，此方案不推薦採用。

Basic Facts 案例細節

Nature of Operation 營運種類	Electronic Factory 電子工場
Location 地點	Shenzhen 深圳
No. of Lamps 燈管數量	12,000
Lamp Model 燈管種類	4'conventional fluorescent lamp 普通4尺燈管
Lamp Watt 燈管瓦數	36W
Ballast Watt 鎮流器瓦數	12W
Installation method 安裝模式	Mounted in pairs over production lines 沿生產線，雙管並排
Operating Hours 每天運作時數	24 hours (小時)
Air conditioning 空調裝置	Yes 全日啟動
Coefficient of Performance (COP) 空調功率系數	4
Tariff 每度電費	$0.8/KWh

Procedure 執行程序:

Replace two conventional lamps by an extra bright lamp with a high reflectance "single lamp reflector". No electrical technician is required.
利用特亮T8燈管，配合高效能「燈管連體反射器」，取代原來兩根普通燈管不用電工執行。

Overall Saving in System Power Consumption
原照明系統耗電量縮減情況

	Original set up 原來配搭 (2 x 36W standard T8 lamp) (兩根36W普通T8光管)	Proposed Energy Saving Solution 新節能配搭 (1 x 36W extra bright lamp + single lamp reflector) (一根36W特亮燈管 +連體反射器)
Power Consumption by Lamp 燈管耗用瓦數	72W (2 x 36W)	36W (50% saving)
Power Consumption by ballast 鎮流器耗用瓦數	24W (2 x 12W)	12W (50% saving)
System Power 系統共用瓦數	96W	48W (50% saving)
Direct Saving (due to de-lamping) 直接省回瓦數 (因減少燈管)	48W	
Indirect Saving due to decrease in cooling load = Direct saving /COP 間接省回瓦數(燈管減少，空調負荷相應降低)	12W	
Total Power Saving	60W	
合共省回瓦數 Total Annual Saving 每年淨省金額	$420	

Cost Benefit and Pay Back Analysis
成本效益及投資回本分析

Unit Rate 每單元成本	Reflector cost (A) 反射器成本	Lamp cost (B) 燈管成本	Labor cost (C) 工資成本	Total cost (D) 總成本	Amount Saving (E) 每年淨省金額	Pay back period (D/E) 回本期
Unit Price	$150	$12	$10	$172	$420	4.9 months

Conclusion 結論:
The pay back period is shorter than that achieved in Scenario A for two reasons. One is the smaller amount of upfront investment and the other is the windfall benefit because of the decrease in cooling load due to the retirement of 6,000 heat-generating lamps.
The factory owner benefits from both direct saving from the retirement of half of the existing lamps and indirect saving from the reduced load of the air-conditioning system The investment for replacing 6,000 lamps is merely $1,032,000 and he can recover the invested amount within 5 months. Starting from the sixth month, he begins to enjoy a monthly saving of $210,000 or an annual saving of $2.52 million. In 10 years, he saves $25.2 million.

回本期比組合方案 (A) 更短，當中有兩大原因，其一是投資入金額較細，其二是因為拔掉了6,000根燈管，廠房減少了發熱體，導致空調負荷減低，間接再減省了電費。東主僅投資了$1,032,000，五個月後馬上回本，第六個月後開始，每月節省$21萬，即一年節省 $252萬。十年合共節省 $2520萬。

Scenario C: Energy Saving Target 37.5%
組合主流方案 (C): 節能目標37.5%
(Option 1 + Option 2)
[方案(1)+(2)結合而成]

Basic Facts 案例細節

Nature of Operation 營運種類	Bank 銀行
Location 地點	Hong Kong 香港
No. of Lamps 燈管數量	6,000 (2 in each luminaire) (每個燈盤有2根普通4尺燈管)
Lamp Model 燈管種類	4'conventional fluorescent lamp 普通4尺燈管
Lamp Watt 燈管瓦數	36W
Ballast (Electromagnetic) 鎮流器瓦數	12W
Installation method 安裝模式	Ceiling mounted recessed mounted luminaire (天花暗裝燈盤)
Operating hours per year 每年運作時數	3,500 hours (小時)
Air conditioning 空調裝置	Yes
Coefficient of Performance (COP) 空調功率系數	4
Tariff 每度電費	$1.0/KWh

Procedure 執行程序:
Change T8 lamps into T5 lamps with the aid of a retrofit adaptor affixed to the lamp-base. The gadget is designed to help converted T8 lamps into T5 lamps without having to replace the ballast or luminaire. This is a very cost-effective method to switch to T5 system.

利用市場上特別為由T8燈管過渡到T5燈管的微型電子鎮流器，只需插在原T8燈腳處工序，即完成不用電工，是照明系統過渡到T5的高效益方案。

Overall Saving in System Power Consumption
原照明系統耗電量縮減情況

	Original set up 原來配搭 (2 x 36W conventional lamps) (兩根36W普通T8光管)	Proposed Energy Saving Solution 新節能配搭 (T5 lamp + retrofit adaptor) (一根T5特亮燈管 + 連體反射器)
Power Consumption by Lamp 燈管耗用瓦數	72W (2 x 36W)	56W (2 x 28W)
Power Consumption by ballast 鎮流器耗用瓦數	24W (2 x 12W)	4W (2 x 2W)
Total System Power 系統共用瓦數	96W	60W (37.5% saving)
Net direct saving per luminaire 每個燈盤省回瓦數	36W	
Indirect Saving (Direct Saving/COP) 空調間接減少耗電瓦數	9W	
Total Power Saving 合共省回瓦數	45W	

Cost Benefit and Pay Back Analysis
成本效益及投資回本分析

Unit Rate 每單元成本	Retrofit adaptor & ballast cost (A) 微型電子鎮流器淨	T5 Lamp cost (B) T5燈管成本	Labor cost (C) 工資成本	Total cost (D) 總成本	Total annual saving per luminaire (E) 每燈盤省金額	Pay back period (F) = D/E 回本期
Unit Price	$120	$30	$10	$160	$157.5	24 months
Total Price	$240	$60	$20	$320		

Conclusion 結論:
The bank spends $960,000 to upgrade the T8 lighting system to T5 system and achieves an annual saving of $472,500. As there is no de-lamping happening, the pay back period is around two years and is the longest among the three scenarios. If original T5 electronic ballast is used, the material and installation costs would be double and the payback period would be prolonged to over 4 years.

銀行花了$96萬把原T8照明系統，變成了特幼T5燈管系統，每年節省了$472,000電費，由於沒有減少燈管數量，因此回本期約為2年，是三個組合方案中，回本期最長的一個。若果採用全新T5燈盤，物料和工資成本將會倍增，回本期將會延長至4年以上。

Efficiency Enhancement in New/Renovation Projects
如何應用創意節能組合於照明工程項目?

Owner-occupiers have long been conscious about the energy bills of their buildings. Today, even corporate tenants are getting conscious about energy costs for the premises they are leasing, particularly those with long leases. They have started demanding their facility managers or building services engineers to look into all possible opportunities that can help reduce their energy costs.

The mindset of lighting designers is shaped by their professional training and work experience. Self-motivated designers tend to update themselves with the most contemporary lighting products in the world market. In lighting, conscious designers have started sourcing energy efficient luminaires for them to be used in renovation works or new projects.

With the advent of innovative energy efficient lighting products, manufacturers are cashing in on the energy conservation trends prevailing in the business sector. Their designers have started integrating energy efficient gadgets available in the market and target them to open-minded or aggressive users.

Instead of focusing on competitive prices they position themselves as Original Design Manufacturer (ODM) or even Original Brand Manufacturer (OBM) and ask for a premium price in return for saving capability of up to 60%. Besides the popular light fittings for offices, factories and retail outlets, they are also tapping a niche in the HID lamp and task lighting products market. They are combining the use of electronic ballast, T5 High Output (HO) lamps, LED lamps, CDM-T lamps, extra long life fluorescent lamp and top performing non-metal reflectors to create a brand new series of powerful luminaires which are deemed the most economical in term of maintenance costs and least expensive in terms of energy costs. One of the growing popular models in the Asia Pacific region is Super Saving LEJ Luminaires Series, which offer up to 60% reduction in power consumption when compared with conventional models. Below are two self-explanatory examples illustrating the long term saving potential of high efficient luminaires.

物業自用東主一直以來都會極度關注自己物業的能源開支。此外，租用人家物業的大機構，也開始留意本身的電費開支，尤其是與業主簽了長約的企業。兩者近年來已責成自己的物業或設施管理人員，盡一切辦法把能源開支壓到最低。

照明設計師的思維模式往往備受他們專業訓練和工作經驗所規限。進取的設計師會不斷自我增值，在世界照明市場上搜索最新的設計趨勢和產品，配合環保和追求綠色照明的呼籲，努力發掘高能源效益的燈具，應用在他們手上的照明項目上，希望盡量減低整個場所的照明功率密度，從而節省電力開支。

從供應商的角度來看，為了順應工商界要求減少能源開支的強大呼聲，他們已盯著市場上各式各樣的嶄新照明產品，再加上他們的創意，生產極具能源效益的新一代節能燈具。

這一群有靈敏市場觸角的供應商，往往把自己的定位，設定為原設計生產商 (ODM)和甚至為原品牌生產商 (OBM)。他們利用手上可節能高達60% 的創意燈具設計，針對有強烈節能意識的用家，以高於市場相類似產品價格出售，賺取創意的溢價。

除了針對一般辦公樓、工廠和零售店的照明需要外，他們亦正在部署進攻HID燈具市場和特殊照明產品，當中會巧妙地利用具備最新功能的電子鎮流器、特長壽命燈管、特幼T5(HO)螢光燈、LED射燈、CDM-T太陽燈、高效能非金屬反射器等等去創造新一代照明產品，目標就是盡量降低用家的能源開支，以及日後的維修和更換費用。在亞太地區正開始流行的其中一款高效益創意燈具，就是LEJ超級節能燈盤系列。

其節能效益，比同類型的傳統燈具高達60%。以下兩個不說自明的案例說明了高效能燈具可帶來莫大的節能效益。

Case 1: Lighting Retrofits At An Air Cargo Terminal
案例(一): 香港一家空運貨站照明系統更新工程

Nature of Operation 營運種類	Air Cargo Terminal 航空貨運	
Location 地點	Hong Kong International Airport 香港國際機場	
Annual operating hours 每天運作時數	8,760 (365 x 24)	
Bulk User Tariff ($/KWH) 大量用户電費(每度)	0.65	
Lighting Configuration 照明裝置	Original Design 原設計	Lighting Retrofits 更新燈具
Luminaire Model 燈具型號	Metal Halide Lamp 鹵素燈 (wrapped in a spherical acrylic diffuser) (球型外殼為半透明膠片)	SS-LEJ 58W-2WP (2 x 58W fluorescent lamps mounted in clear dustproof polycarbonate case) (防塵支架內藏2根58W特亮T8燈管和弧型反射器)
Number of Lamps 燈管數量	2,700	2,700
Lamp Watt 燈管瓦數	250	116
Ballast Watt 鎮流器瓦數	50	4
System Power 系統共用瓦數	300	120 (60% less)
Annual Power Consumption (KWh) 全年號用電力	7.10 million	2.84 million
Energy Costs (HK$) 每年能源開支	4.6 million	1.8 million (60% less)
Annual Savings (A) 每月省回金額	-	2.8 million
Costs of Retrofits (B) 系統更新成本	-	2.5 million
Pay Back Period (B/A) 回本期	-	10.7 months
Savings in 10-year 十年內省回金額	-	$28 million

Case 2: Light Fittings in a New Production Plant
案例(二): 新廠房全新照明系統

Nature of Operation 營運種類	Electronics 電子廠	
Location 地點	Shenzhen 深圳	
Annual operating hours 每天運作時數	8,760 (365 x 24)	
Local Tariff ($/KWH) 當地電費(每度)	0.85	
Lighting Configuration 照明裝置	Original Design 原設計	Super Saving Luminaire 節能照明燈盤
Number of Lamps 燈管數量	10,000	5,000
Lamp Watt 燈管瓦數	72W (2 x 36W)	36W
Ballast Watt 鎮流器瓦數	24W (2 x12W)	2W
System Power 系統共用瓦數	96W	38W (60% less)
Annual Power Consumption (KWh) 全年號用電力	4.2 million	1.66 million
Energy Costs (HK$) 每年能源開支	3.57 million	1.41 million (60% less)
Annual Savings (A) 每月省回金額	-	2.16 million
Initial investment (B) 一次性投資	-	1.5 million
Pay Back Period (B/A) 回本期	-	8.3 months
Savings in 10-year 十年內省回金額	-	$21.6 million

To Change or Not to Change: A Challenge of Mindset:

Advancement in technologies has brought about breakthroughs in the design and energy efficiency of lighting products. Cost conscious users are usually the first who will be benefited because they are fully aware of the long term savings of energy efficient electrical appliances. From the choice of a particular type of lamp to the choice of a reflector lies the wisdom of a smart user. It is crucial to recognize the importance of maintaining long term performance of a lighting fixture before one makes a decision.

As long as users adopt an open mind and remain receptive to new ideas, they stand to benefit substantially from the power of technological innovation and human creativity.

The principles laid out in this booklet are simple and straight forward. The most difficult part in reaping the benefits of innovation is nothing but the mindset of the users — to change or not to change.

開放心胸迎新意　樂收節能　「大利是」

科技一日千里，帶來了照明產品無限突破。無論在產品設計或者能源效益方面，都令人有意外驚喜。通常首先獲益的用家，就是那些對控制成本意識較高的企業主管。因為他們明白到真正節能的電器用品，長期可為他們帶來的龐大的利益，由挑選一根燈管到採用燈具的反射器，其實著著反映了一個聰明用家的智慧。因為他們知道燈具內每一個組件都會影響到燈具的長期整體表現。

只要用家對新生事物採取開明和開懷的態度，結合人類創意和創新科技所帶來的社會及經濟效益，他們一定可以率先受惠。

這本小冊子臚列的節能原則清楚易明，但用家最終能否受惠，就是要克服自己內心的障礙，變或不變，隨著尊便。