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Enlightened Legislation: The Fadeout of the Incandescent Lightbulb

Twisty self-ballasted compact fluorescents have seized center stage in the past few months, appearing on the covers of the New Yorker, featuring in articles from the Economist to Time magazine, and sharing space with David Suzuki on a recent billboard. In late April, the Minister of the Environment John Baird along with Gary Lunn, Minister of Natural Resources, announced the introduction of national lighting efficiency legislation to be enacted by 2012. This, following on the heels of announcements by Ontario, Nunavut and Nova Scotia proposing to ban the sale of incandescent lightbulbs in as little as three years, sets the stage for a sea change in the lighting industry and will have major implications for architectural lighting.

Though not the most efficient lighting source available, fluorescent has been touted as the most appropriate substitute for the widespread incandescent light bulb. Fluorescent sources generate up to four times as much light per watt of power, produce less heat when operated, last roughly ten times longer (approximately 10 000 hours) and are often compatible in size and shape with existing incandescent fixtures. Alternate high efficiency sources frequently produce too much light, operate at extremely high temperature, or are too large in scale to be introduced to a consumer market. Highly efficient and modularly compatible with commercial ceiling systems, the linear fluorescent produced high levels of even illumination at a low cost.

The incumbent incandescent light shares a direct lineage with the hearth fire, both in its physical process and in our material culture. Simply put, a tungsten filament is heated within a glass envelope until it glows, giving off a warm and directional light, similar to that of the fireplace. The light emitted is termed "full-spectrum", having a continuous distribution of the colors which make up white light. Unlike the fluorescent phosphor based technology, no visible wavelength is lacking and most colors are accurately rendered. It is the source most closely resembling sunlight.

Psychologically, we have been conditioned to appreciate the natural glow of the incandescent, and are accustomed to the way it renders natural materials such as wood, cloth and skin tones. If one looks at incandescent lamps from a cost analysis perspective, they are inefficient and have a relatively short life span. However, neither of these drawbacks has deterred homeowners from purchasing incandescent sources due to their low initial cost and psychological affection for the source. While more waste per unit is produced in the disposal of incandescent sources, all of the constituent materials in the light bulb are recyclable and inert.

To understand how fluorescent lighting might substitute for incandescent, it is important to understand how the source functions. Where incandescent involves heating a filament, fluorescent light is generated by exciting a gas that emits ultraviolet light. To complete the process, the ultraviolet light "excites" phosphors applied to the inside of the fluorescent tube, which in turn give off visible light. The key elements in the mix are the phosphors and the ballast, a piece of equipment used to regulate the power to the lamp. By carefully specifying the right Color Temperature and a high Color Rendering Index (CRI) (dictated by the phosphor recipe) a "warm" or "cool" colored light can be produced and the fluorescent can do a reasonable job of replicating incandescent source color. A correctly specified electronic ballast will avoid "buzz" and achieve the highest possible efficiency.

Beyond the color range of fluorescent lamps, an important drawback of fluorescent light is its diffuse nature. Though even and easily directed, the flat quality of fluorescent light is pronounced. Incandescent lamps produce directional light, which results in high contrast rendering of surfaces, the creation of sharp shadows, and the visual construction of depth. Contrast differentiates and defines space, bringing tactile quality to materials and bringing out the distinct shape of volumes. Incandescent light could be compared to direct sunlight, whereas fluorescent shares more qualities with the indirect light of an overcast day.

It seems clear that the current marketing campaign of both the government and the provincial hydro companies is directed at the domestic consumer and aims to replace the incandescent source with CFLs. More specifically, the drive has been towards the adoption of self ballasted CFLs which are compatible with existing sockets and fixtures. The hope is that the current climate of energy awareness will motivate users to pay the higher initial cost in anticipation of a long term energy saving.

A number of problems remain to be resolved with the CFL. Chief among these is the quality of light. Though some products are better than others in this regard, CFLs are still largely non-dimmeable, lack certain color spectrums, and are often optically incompatible with the fixtures in which they are placed. Perhaps most worrisome is the mercury content in the CFL arc tube which renders CFLs non-disposable and requires special hazardous waste recycling provisions. Most of these issues will in all likelihood be resolved as the source achieves better market penetration and higher volume of sales. However, until this point in time, it would be advisable to educate consumers regarding the drawbacks of the source and be aware of which available products adhere to higher standards of quality.

From the perspective of the architectural practitioner, the elimination of incandescent lightbulbs has implications both in residential and institutional practice. If building management is interested in retrofitting their existing lighting, architects should be knowledgeable about ballasts, what constitutes a quality CFL and whether self-ballasted CFLs are compatible with existing fixtures, both in size (ie not hanging out of the fixture) and in light distribution. Perhaps the best way to conserve lighting energy is through design, rather than through specification or engineering. Through a careful consideration of where and what quantity of light is needed, and how light may be varied in sympathy with occupant tasks and natural daylighting, the qualities of space and human individuation can be brought out.

It should be noted that the proposed ban pertains specifically to incandescent sources and does not extended to halogen sources, a cousin of the incandescent which has a longer life and is frequently used in museums, high-end retail, or high ceiling spaces. In addition, architects interested in reducing energy and maintenance costs, should consider metal halide (often called HID) and keep their eye on the evolution of LED sources. Metal halides are an excellent alternative for lighting high ceiling spaces, having a directional distribution and a high efficiency exceeding fluorescent in many cases. LEDs are currently very applicable when coloured light is required, but white light LEDs often have very poor color rendering and experience colour shifts over time. This is sure to change.

The current initiative to save energy and advance lighting technology is well placed, but the implementation quite heavy handed. Typically, regional and local government have adopted existing environmentally sensitive energy codes (see ASHRAE/IES 90.1 and Title 24), which determine lighting wattage allowances by spatial type and use, leaving the designer to decide what source type is appropriate and where higher levels of contrast or special effect are merited. Worksheets are filed locally and permits are issued for compliance. Often spot checks by inspectors ensure additional sources have not been added following permitting.

The advantages of such a system are multiple. As opposed to banning an entire category of technology, to which we are all quite psychologically attached, a “watt allowance” approach permits a gentle phasing in of newer technology, encouraging advances in current efficiency, the gradual retrofitting of current fixtures, and permits the retention of incandescent where its qualities are critical.

Lest I be accused of being a luddite, I am wholly in favour of the adoption of new energy efficient technologies. This said, when it comes to the legislation of a medium that is so intangible, yet so critical to our quality of life, a look beyond the metrics of light per watt and cost savings is merited. Our government owes us a responsible discussion of lighting alternatives, rather than the simplistic scoring of “green” points to accumulate unopposed political capital. There should be

equal copy dedicated to discussions of light quality and money should be set aside for technological development. If consumers and, by extension, architects are to buy into the CFL plan, they should be offered alternatives, not a stick.

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