Permanent Distributed Load Reduction — A Low-Cost grid capacity solution

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ABSTRACT

The wholesale changeover of inefficient lighting can have a dramatic and sustainable impact on the nation's stressed electric grid through permanent distributed load reductions, or PDLR. PDLR requires the deployment of energy-efficient technology at the point of use, thereby permanently reducing the need to generate, transmit and distribute electricity. The technology to achieve this lofty goal is available today in the form of industrial and commercial lighting, wireless controls and direct renewable solar day-lighting systems. When integrated, these technologies can deliver capacity to the electric grid — particularly during peak hours — and permanently reduce the greenhouse gas emissions associated with electricity generation. The technology has been proven in more than 5,000 facilities nationwide and has already delivered more than 500,000 kilowatts to the grid. The replacement of the 227 million inefficient fixtures in the U.S. would result in displacing more than 55,000 megawatts of power.

Keywords: energy efficiency, lighting, electricity, capacity, renewables

1 INTRODUCTION

Energy efficiency is often dubbed the low hanging fruit by officials like Secretary of Energy Steven Chu[1][1] because it can quickly and effectively reduce consumers' energy costs and impact on the environment.

And while much of the focus of energy efficiency has been on the consumer, utilities stand to equally benefit from energy efficiency in the form of permanent distributed load reductions, or PDLR.

It's a simple concept that has far-reaching effects — from a reduced need for costly infrastructure to the creation of jobs and a strengthened economy.

To achieve PDLR, energy-efficient technology is deployed at the point of use, thereby permanently reducing the need to generate, transmit and distribute electricity.

Because approximately 60 percent of all prime energy is lost in generation, transmission and distributions[2] [2], PDLR is smart grid technology in the truest sense because it permanently eliminates the need to produce the electricity, transmit it or distribute it.

PDLR strengthens also strengthens the economy through reduced energy costs to the user of energy-efficient technologies, and, because it effectively reduces electricity from the grid, utilities won't have to consider costly infrastructure improvements to accommodate growing need on the already strained electric grid.

2 PDLR — HOW IT WORKS

The technology to accomplish permanent distributed load reductions already exists in the form of industrial and commercial lighting, wireless controls and direct renewable solar day-lighting systems. When integrated, these technologies can deliver capacity to the stressed electric grid — particularly during peak hours — and permanently reduce the greenhouse gas emissions associated with fossil-fuel generated power plants.

According to the Energy Information Administration, there were 455,000 commercial or industrial buildings in the U.S. as of 2003 that still utilize inefficient, high-intensity discharge lighting. With an average of 500 light fixtures per facility, more than 227 million tradition HIDs exist in commercial or industrial facilities.

If each of these 455,000 facilities were to complete a wholesale changeover of its inefficient lights to high-intensity fluorescent lighting technology that's proven to reduce energy consumption by 50 percent while significantly increasing light output, the changeover would displace more than 55,000 megawatts of power, or the equivalent of 111 coal-fired power plants.

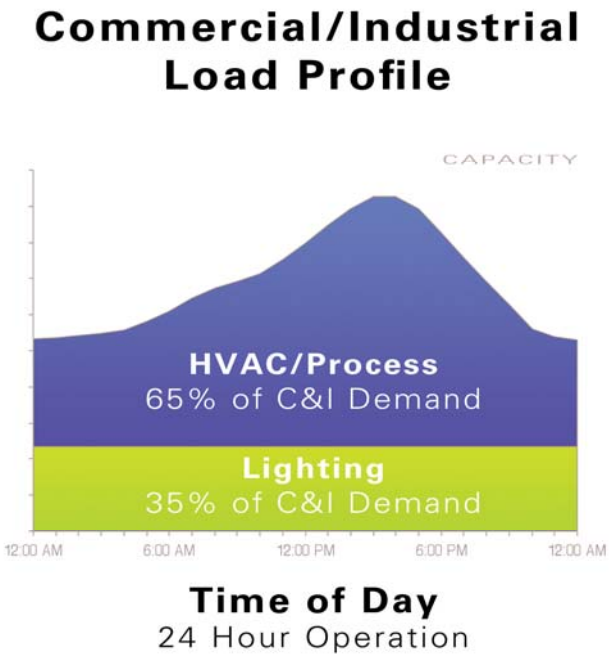
Even more powerful is that when high-intensity fluorescent lighting is integrated with the latest wireless controls and solar day-lighting technology, the capacity delivered to the grid can reach 81,000 megawatts, or more than 160 power plants.

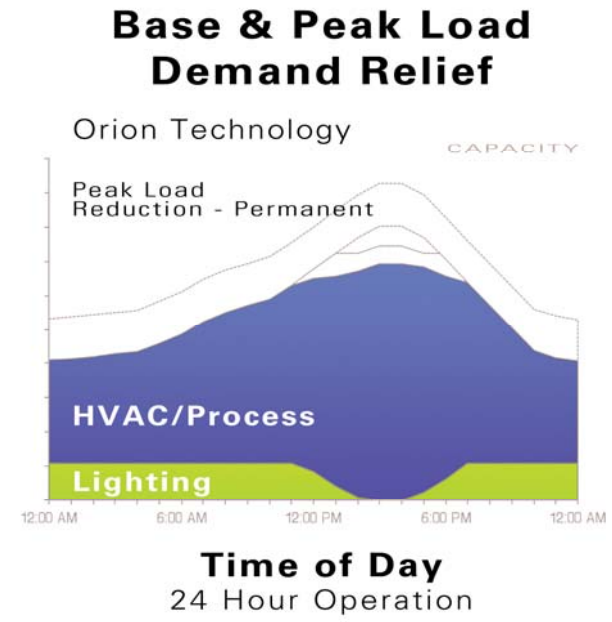
2.1 Environmental Benefits of PDLR

The environmental benefits of replacing inefficient lighting in 455,000 facilities are staggering.

Replacing the HID lighting with efficient, high-intensity fluorescent technology would displace an estimated 418 billion kilowatt-hours annually. The reduction would prevent 275 million tons of carbon dioxide from being emitted into the atmosphere. It also would reduce sulfur dioxide emissions by more than 1 million tons and nitrogen oxides by nearly 405,000 tons annually, according to the Environmental Protection Agency.

The greenhouse gas reductions are the air-scrubbing equivalent of a 76 million-acre forest, or like removing 67.5 million cars from the road, according to the EPA. The





Figures 1 & 2: As seen in the top graph, lighting accounts for approximately 35 percent of a facility's electricity consumption, which spikes during daytime hours when energy is in most demand. The bottom graph illustrates the typical load for a facility that deployed permanent distributed load reductions in the form of energy-efficient lighting, controls and day-lighting devices that reduce a facility's light-related energy costs — sometimes to zero using day-lighting technology during times when the electric grid is at or near capacity and rates are most expensive.

wholesale changeover of inefficient lighting also would be the equivalent of saving 34.5 billion gallons of gas every year.

Add in lighting controls and direct renewable solar day-lighting and the impact can be even greater.

The addition of these technologies would displace more than 605 billion kilowatt-hours, keeping nearly 400 million tons of carbon dioxide from the atmosphere, according to the EPA. Adding controls and day-lighting technology also would keep more than 1.5 million tons of sulfur dioxide and nearly 600,000 tons of nitrogen oxides from the atmosphere.

The reduction in greenhouse gas emissions are the air-scrubbing equivalent of a 111 million-acre forest, or like removing 97.8 million cars from the road, according to the EPA. The reductions also would be the equivalent of saving 50 million gallons of gas every year.

3 ALREADY MAKING AN IMPACT

Until emerging technologies like photovoltaic, wind, biomass, and hydropower become more robust and viable, energy efficiency and PDLR is the bridge to gaining the United States' energy independence.

More then 5,000 facilities nationwide have replaced their tradition inefficient lighting with Orion Energy Systems' lighting technology, saving these facility's more then $782 million collectively and reducing their energy consumption by more than 10 billion kilowatt-hours. As a result these companies have significantly and positively impacted the environment.

These facilities have displaced more than 6.7 million tons of carbon dioxide, nearly 27,000 tons of sulfur dioxide and almost 10,000 tons of nitrogen oxides, according to the Environmental Protection Agency[3][3].

The reductions are the air-scrubbing equivalent of a 1.8 million-acre forest, or like removing 1.6 million cars from the road, the EPA says. It's also the equivalent of saving more than 828 million gallons of gasoline every year.

3.1 Companies reap benefits of PDLR

Some of the companies that are contributing to PDLR include 123 of the Fortune 500 — corporate giants like Coca-Cola Enterprises, Kraft Foods, Sysco Foods and Kimberly-Clark among others.

Coca-Cola Enterprises has retrofitted more than 350 facilities, reducing its energy consumption by more than 128 million kilowatt-hours per year, saving the beverage producer $22.1 million in energy costs. Kraft Foods has replaced inefficient technology in 110 facilities nationwide, saving more than $5.6 million in energy costs, reducing consumption by more than 77 million kilowatt-hours. As a result, Kraft Foods is preventing nearly 51,000 tons of carbon dioxide from the atmosphere annually.

The majority of these projects, because of the energy cost reductions realized at these facilities, often are paid off

in less than two years. The economics of PDLR make sense.

4 COST AND DEMAND ALTERNATIVES

Companies like those listed above are helping relive the strain on the stressed electricity and will have a greater impact as demand continues to increase. By 2030, the electrical utility industry will need to make a total infrastructure investment of $1.5 to $2 trillion to keep up with demands, which is estimated to increase by 25 percent by 2035[4] [4] as developing nations modernize and expand their economic output. This creates a nearly impossible scenario for secure, low carbon energy supplies to keep up with demand.

Traditional electricity supply side options are costly. A traditional coal-fired power plant costs approximately $3.5 million to $4.5[5] [5] million per megawatt. Nuclear generation costs approximately $6 million per megawatt[6] [6, 7]. In addition to cost hurdles, these technologies are subjected to strong resistance, or NIMBY — Not In My Backyard.

These demand issues can be alleviated instead through the widespread deployment PDLR.

Consider the following graph, which compares the generation, or in the case of the lighting retrofits, the reduction, of 500 megawatts of power.

Cost Effective Capacity Solution

Every 4,200 Orion fixtures = 1 MW displaced capacity

Orion — PDLR (500 MW)	Traditional coal-fired power plant (500 MW)
Capital Cost: $500 million	Capital Cost: $2.0 billion
Carbon Impact: 3.45 million tons displaced annually	Carbon Impact: 3.45 million tons generated annually
Time to Build: <2 years	Time to Build: 3-7 years
Impact to End Users: $289 million saved annually	Impact to End Users: Higher electricity rates
Siting: Load center	Siting: Not in my back yard (NIMBY)

Table 1: As shown above, PDLR is more cost-effective and its negative impact on the environment is far less than traditional supply-side energy generation when seeking 500 megawatts of electricity. PDLR, through the deployment of energy-efficient lighting technologies alone, costs a quarter of the cost to construct a coal-fired power plant; takes significantly less time to deploy; and displaces 3.45 million tons of greenhouse gases a year, whereas the coal-fired facility generates 3.45 millions tons of greenhouse gases annually.

5 ECONOMIC BENEFITS

While energy efficiency can generate free cash flow for businesses installing efficient technology, the Department of Energy says that for every $92,000 invested in energy efficiencies, there is one job created or retained for the local economy[7], therefore strengthening the economy.

And, of the funds reduced by energy efficiencies, 90 percent of every dollar saved is typically re-invested in the company or in the local economy, according to the American Council for an Energy Efficiency Economy. The opposite of this effect also is true. Every dollar that companies send out of a community to purchase fuel supplies is a dollar lost to the local economy.

For example, according to the Department of Energy, the city of Wooster, Ohio, has a $110 million annual energy bill, of which 90 percent of the funds flow out of the community[8]. This means $99 million dollars worth of income flows out of the community and cannot be employed for the creation of additional income.

It should be noted that the Department of Energy has found that the income creation impact of energy efficiency spending is far higher than many other avenues of income creation. The income multiplier for the investments in energy efficiency is $1.32.[9] This means that the end result of the reinvestment cycle discussed above is that for every $1 spent on energy efficiency by the local development authorities, $2.32 of income is created.

Sector	Multiplier
Manufacturing	1.59
Agriculture, forestry, fishing, and hunting	1.34
Energy Efficiency	1.32
Information	1.28
Finance, insurance, real estate, and rental	1.27
Professional and business services	1.21
Mining	1.17
Transportation and warehousing	1.15
Wholesale trade	1.04
Arts, entertainment, recreation, accommodation, and food services	1.03
Government	1.02
Educational services, and health care	1.01
Retail trade	1.01
Construction	1.01
Utilities	1.00
Economy Average	1.15

Table 2: U.S. Multiplier Effects by Sector[10]

6 CONCLUSION

Many aspects of society stand to greatly benefit from the deployment of permanent distributed load reductions through an improved economy and improved environment.

Nearly 5,400 facilities nationwide have realized the benefits of deploying energy-efficient lighting technologies, saving more than $782 million total and displacing more than 6.7 million tons of carbon dioxide.

The savings generated by these companies help them remain competitive in a global market and create a strong foundation for a recovering economy.

7 REFERENCES

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[1] Chu, p. 1

[2] EIA, Annual Energy Review 2008

[3] U.S. EPA, eGrid Version 1.1, p. 1

[4] EIA, AEO 2010, p. 10

[5] Coal Plant costs based on the proposed Alliant plant in Cassville, Wis., which would have supplied 300 MW of capacity at a construction cost of $1.36 billion or a cost of $4.53 million per MW of capacity.

[6] Swartz, p. 12, and Southern Company, p. 3.

[7] Information provided by the American Public Power Association (APPA) at its May 19-20, 2009, seminar on the EECBG program in Chicago, Ill.

[8] DOE, The Jobs Connection, p. 2.

[9] Department of Energy, Office of Energy Efficiency and Renewable Energy, Available at: www.eren.doe.gov/cities_counties/energyeff.html, pp. 2-3.

[10] Source: United States Department of Commerce, 2006 Annual Input-Output Tables.