# Doing it in the Suites: Saving Energy in Commercial Buildings

Commercial building energy use differs significantly from residences. Such buildings tend to contain more people per square foot than homes. Lighting accounts for the most energy use. Climate control (especially air conditioning) and office equipment contribute heavily as well. The following table lists selected efficiency technologies:

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| Electronic ballast fluorescent lights backed by reflectors so the number is reduced by 40%. Using variable lighting, workers may dim or brighten fixtures as they please; each person gets ambient lighting they want. Add electronic ballast compact fluorescent lights on goosenecks so each person gets the exact point source they want. People who prefer dimmer light will more than make up for those who prefer brighter[241]. | 80% reduction in lighting energy; also reduce maintenance costs, and air conditioning |
| Superwindows prevent both heat buildup, and heat loss, let in the visible spectrum of light (while reducing glare); pay for themselves in reduced air conditioning heating, lighting and lamp maintenance costs. | Significant |
| Heat exchanging ventilators, as in residential buildings, reduce space heating and cooling, and help prevent sick building syndrome by dehumidifying; so do operable windows. Insulate unglazed spaces | Around 60% climate conditioning costs |
| Monitoring – otherwise energy wasting setting go undetected as in Austin green building that ran air condition and heating at same time until monitoring caught it. | At least 15% |
| Energy efficient appliances including energy star printers with efficient standby modes; turn off workstations or at least monitors at night; laptops don't pay for themselves in energy, but may pay for themselves in space saved and flexibility. For low volume B&W printing and medium volume low quality color, inkjets are comparable in per page cost with lasers and much more energy efficient[242]. | Significant |
| In new buildings – under floor services, displacement ventilation – avoids air recirculation, makes heat recovery easier, pays for itself by making adds, moves and changes easier – even major changes can be done without rebuilds. In tall buildings also lets you squeeze in extra floors | |

The greatest benefit of green buildings is increased worker productivity. According to a survey of the literature on this subject by the San Francisco Department of the environment, study after study shows that better quality light, especially increased sunlight, better quality air, and more worker control over their environment (being able to open windows, adjust light to personal needs, etc.) combine to increase productivity by between 2% and 16%[243]. A similar review sponsored by the state of Massachusetts gives a wider range up to 34%[244]. A recent confirmation of this was a report developed for the Sustainable Building Task Force, a group of over forty California government agencies[245]. In case some MBA type wonders, a short appendix, *The Hawthorne Effect*, deals with the question of whether productivity increase are actually due to improved physical conditions.

Unlike residential construction, there is no point in covering commercial examples on a technology by technology basis (other than the examples already given). A major cost of green building is extra design costs, money for architects and engineers. Money paid for design will not exceed that for total construction, but may well be the single largest cost. Obviously, the only way to show cost effectiveness is to give examples of both new construction and rehab projects that saved a large percent of their energy consumption cost effectively.

Normally, the plural of anecdote is not data. But the point here is not to show that something is widespread - merely possible. For those purposes, multiple examples do constitute good evidence.

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| In cold dark Amsterdam, NDB (now ING) bank built an integrated, light, airy, lovely, sunlit, plant-filled building. It uses around 35,246 BTU per month[246], compared to a U.S. average consumption of 119,500 BTU per commercial square foot in 2002[247] Energy reductions alone saved the bank around $2.4 million U.S. dollars annually. The $700,000 additional investment the building cost over an average building its size in the Netherlands repaid costs within four months. When NDB first moved into the building they saw absenteeism drop by ten percent as an additional bonus. | 69% saving |
| Anglia Polytechnic University (APU) Learning Resources Centre, 'The Queen's Building', 41,842 BTU per square foot[248]. Net capital saving of £240,750 – before the first savings in operation. | 63% saving |
| Leeds City Office Park 39,306 BTU per square foot[249]: £437,000 capital investment provides energy cost reductions of £72,603 per year | 66% saving |
| Enschede tax office (Netherlands) 35,185 BTU per square foot - at an additional capital cost of 421,972 NLG[250]: annual saving 67,097 NLG. | 69\|% saving |
| Sukkertoppen office building, owned by Employees Capital Pension Fund. retrofit, rented commercially to small computer companies and educational organizations[251]. 30,114 BTU per square foot; cost data proprietary, but successful commercial venture. | 74% saving |
| Ridgehaven Office building renovation City of San Diego Environmental Services Department. 27,296 BTU per square foot: simple payback rate of 30%.[252]. | 76% saving |
| [253]Bloomington, Illinois Amtrak passenger station, insulation, outdoor shading, passive solar heating, - 2.4- kilowatt rooftop solar array, efficient lighting. Simple five year payback of about $100,000 in costs | 75% saving |
| The Pennsylvania Department of Environmental Protection's Cambria Office less than 40,000 BTU per square foot[254]. Capital savings in climate control equipment paid for all or most of efficiency measures[255]. Costs/ft$^2$ within normal range for area[256] | 65% saving |
| National Resources Defense council office on two floors of the already efficient American Association for the Advancement of Science in Washington D.C. - already included efficient air conditioning system, and low-e windows operable windows that saved more than half of climate control energy. Buildout combined daylighting with low energy electric lighting systems, to save 75% of normal lighting bills[257]. A stairway between the two floors reduces elevator use; energy star office equipment saves computer costs. Green materials were used in construction as well. "Green premium" on order of $10 per square foot; energy savings combined with productivity increases should yield a four year payback or less. | 70% saving |

Again this is data mining; the examples are well executed new buildings and rehab projects with large secondary energy savings, and good economic rates of return. This would be meaningless in showing a trend. As a means of demonstrating that something is possible, this is a valid methodology.

We have demonstrated we can save between two-thirds and three-quarters of the energy in both existing and new commercial buildings (compared to the current average) with a simple payback ranging from less than no time (energy saving techniques lower capital costs) to seven years. Longer payback periods typically do not include gains in productivity, which is the major economic benefit in both new construction and rehabilitation.

Therefore, it is a conservative assumption that average payback will be five years or less if productivity gains are included, probably a pessimistic one. Similarly, a seventy-percent or more savings at this payback rate is most likely pessimistic. Again, it is pessimistic not in terms of what is usually done (which it greatly exceeds), but in terms of what it is possible to do.

Given a 70% energy savings, a productivity gain at least equal in value to that savings, and a five year simple payback, and a 6.5% discount rate, this means we can pay ~2.84 times current cost for the remaining energy used and still break even.

# End Notes

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Table 1.3.4 - Commercial Delivered and Primary Energy Consumption Intensities, by Year

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