

The scope of this study was to investigate the impact of automated exterior and interior fabrics on the energy demand for typical private offices and compare them on a relative basis. A generic private office (4m x 4m x 3m high) with double-glazed low-e windows occupying 80% of the south wall (typical office glass façade) was used for the simulation. The shades close when direct sunlight is incident on the window to protect from glare.

Four interior fabrics and one exterior fabric were considered and compared. In order to accurately model the shading characteristics, the fabric properties (transmittance, reflectance and absorptance) were measured with a spectrophotometer using the ASTM Standard E903 Test Method. The measured values for normal incidence are shown below:

| Fabric - Interior | Solar Reflectance (Rs) | Visible reflectance (Rv) | Solar transmission (Ts) | Visible Transmission (Tv) |
|--|------------------------|--------------------------|-------------------------|---------------------------|
| 8606 | 34.8 | 20.2 | 36.4 | 18.3 |
| 8506 P | 35.7 | 21.2 | 32.1 | 14.3 |
| 8706 Dual (Dual - Light side out) | 40.2 | 37.0 | 43.5 | 32.3 |
| 8406 M (Reflective metallized side) | 48.7 | 47.3 | 12.0 | 9.3 |

| Fabric - Exterior | Solar Reflectance (Rs) | Visible reflectance (Rv) | Solar transmission (Ts) | Visible Transmission (Tv) |
|-------------------|------------------------|--------------------------|-------------------------|---------------------------|
| XT3902 | 37.2 | N/A | 6.7 | 6.6 |

The simulation was performed for 7 locations in North America to include the impact of climate: Toronto, New York City, Chicago, Dallas, Los Angeles, Vancouver and Calgary.

Outputs include:

- Peak cooling load (kW) and peak heating load (kW) without shading and with each fabric applied on the windows
- Annual cooling and heating demand (kWhrs) without shading and with each fabric applied on the windows
- Relative reduction in peak cooling load (%) and annual cooling savings with each fabric applied on the windows

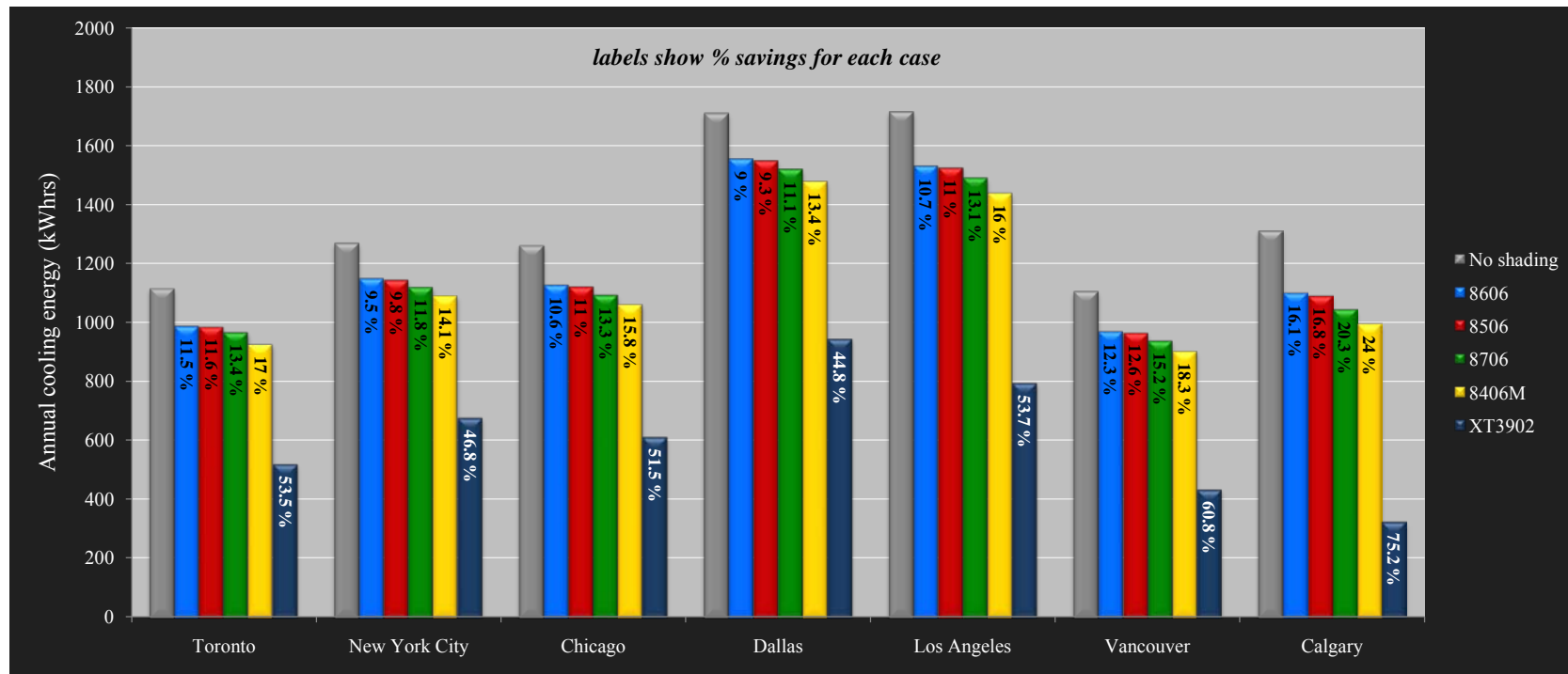
**Note that the objective of this study is not to model whole building energy performance using automated shading but to compare the impact of the selected fabrics on a relative basis.*

Relative reduction in cooling energy (% savings)

| Fabric /Location | Toronto | New York City | Chicago | Dallas | Los Angeles | Vancouver | Calgary |
|------------------|---------|---------------|---------|--------|-------------|-----------|---------|
| 8606 | 11.5% | 9.5% | 10.6% | 9.0% | 10.7% | 12.3% | 16.1% |
| 8506 | 11.6% | 9.8% | 11.0% | 9.3% | 11.0% | 12.6% | 16.8% |
| 8706 | 13.4% | 11.8% | 13.3% | 11.1% | 13.1% | 15.2% | 20.3% |
| 8406M | 17.0% | 14.1% | 15.8% | 13.4% | 16.0% | 18.3% | 24.0% |
| XT3902 | 53.5% | 46.8% | 51.5% | 44.8% | 53.7% | 60.8% | 75.2% |

Annual cooling energy (kWhrs)

| Fabric /Location | Toronto | New York City | Chicago | Dallas | Los Angeles | Vancouver | Calgary |
|------------------|---------|---------------|---------|--------|-------------|-----------|---------|
| No shading | 1116 | 1270 | 1261 | 1709 | 1715 | 1106 | 1311 |
| 8606 | 987 | 1149 | 1127 | 1555 | 1531 | 970 | 1100 |
| 8506 | 987 | 1146 | 1122 | 1551 | 1526 | 966 | 1091 |
| 8706 | 967 | 1120 | 1093 | 1519 | 1490 | 938 | 1045 |
| 8406M | 927 | 1091 | 1061 | 1480 | 1440 | 904 | 996 |
| XT3902 | 519 | 676 | 611 | 943 | 794 | 433 | 325 |

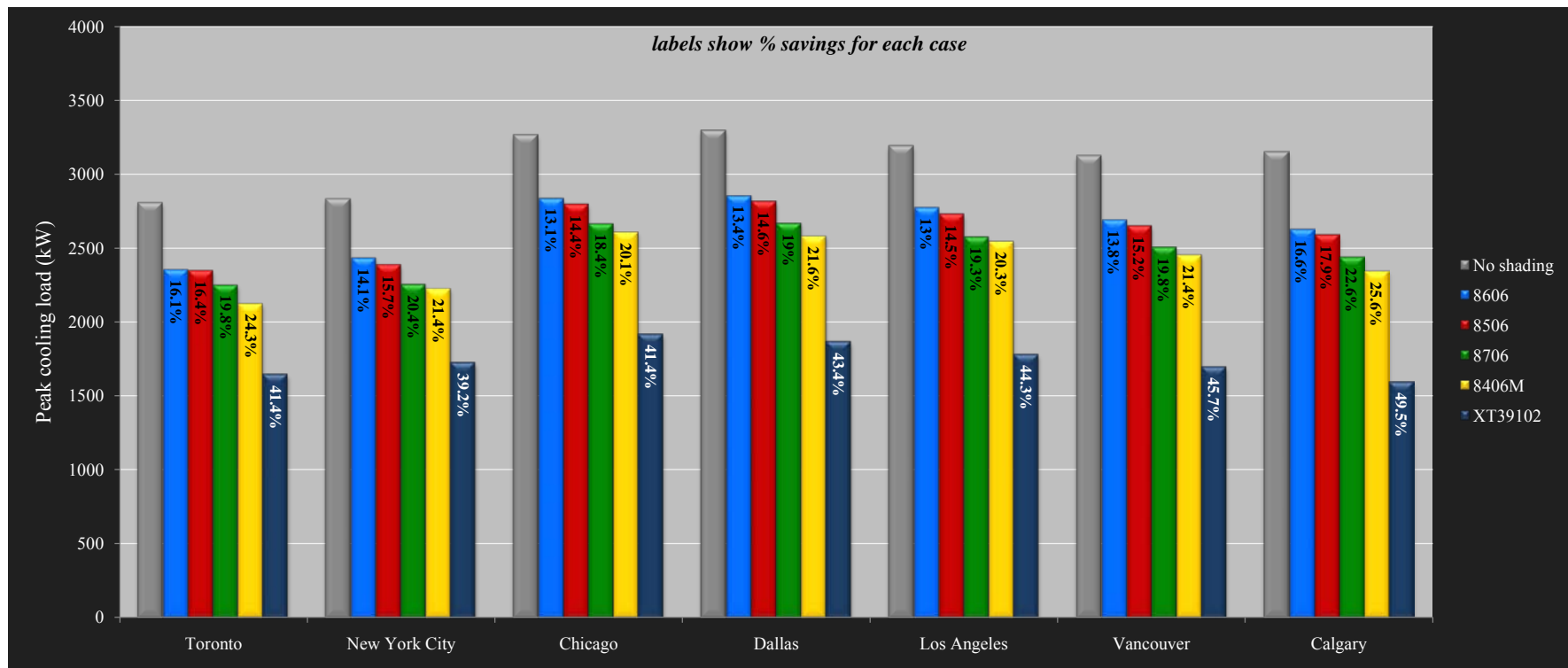


Relative reduction in peak cooling load (%)

| Fabric /Location | Toronto | New York City | Chicago | Dallas | Los Angeles | Vancouver | Calgary |
|------------------|---------|---------------|---------|--------|-------------|-----------|---------|
| 8606 | 16.1% | 14.1% | 13.1% | 13.4% | 13.0% | 13.8% | 16.6% |
| 8506 | 16.4% | 15.7% | 14.4% | 14.6% | 14.5% | 15.2% | 17.9% |
| 8706 | 19.8% | 20.4% | 18.4% | 19.0% | 19.3% | 19.8% | 22.6% |
| 8406M | 24.3% | 21.4% | 20.1% | 21.6% | 20.3% | 21.4% | 25.6% |
| XT3902 | 41.4% | 39.2% | 41.4% | 43.4% | 44.3% | 45.7% | 49.5% |

Peak cooling load (kW)

| Fabric /Location | Toronto | New York City | Chicago | Dallas | Los Angeles | Vancouver | Calgary |
|------------------|---------|---------------|---------|--------|-------------|-----------|---------|
| No shading | 2809 | 2835 | 3267 | 3298 | 3194 | 3126 | 3152 |
| 8606 | 2357 | 2436 | 2840 | 2857 | 2778 | 2694 | 2629 |
| 8506 | 2349 | 2389 | 2797 | 2816 | 2730 | 2651 | 2589 |
| 8706 | 2252 | 2257 | 2667 | 2670 | 2577 | 2508 | 2440 |
| 8406M | 2126 | 2229 | 2611 | 2584 | 2547 | 2456 | 2345 |
| XT3902 | 1645 | 1724 | 1916 | 1867 | 1780 | 1696 | 1593 |



| TORONTO | | kW | | kWhrs | |
|----------------|-------------------|-------------------------|-----------------------|----------------------------|--|
| | Peak cooling load | Peak load reduction (%) | Annual cooling energy | Cooling energy savings (%) | |
| 8606 | 2357 | 16.1% | 987 | 11.5% | |
| 8506 | 2349 | 16.4% | 987 | 11.6% | |
| 8706 | 2252 | 19.8% | 967 | 13.4% | |
| 8406M | 2126 | 24.3% | 927 | 17.0% | |
| XT3902 | 1645 | 41.4% | 519 | 53.5% | |
| No shading | 2809 | | 1116 | | |

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| NEW YORK CITY | | kW | | kWhrs | |
|----------------------|-------------------|-------------------------|-----------------------|----------------------------|--|
| | Peak cooling load | Peak load reduction (%) | Annual cooling energy | Cooling energy savings (%) | |
| 8606 | 2436 | 14.1% | 1149 | 9.5% | |
| 8506 | 2389 | 15.7% | 1146 | 9.8% | |
| 8706 | 2257 | 20.4% | 1120 | 11.8% | |
| 8406M | 2229 | 21.4% | 1091 | 14.1% | |
| XT3902 | 1724 | 39.2% | 676 | 46.8% | |
| No shading | 2835 | | 1270 | | |

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| DALLAS | | kW | | kWhrs | |
|---------------|-------------------|-------------------------|-----------------------|----------------------------|--|
| | Peak cooling load | Peak load reduction (%) | Annual cooling energy | Cooling energy savings (%) | |
| 8606 | 2857 | 13.4% | 1555 | 9.0% | |
| 8506 | 2816 | 14.6% | 1551 | 9.3% | |
| 8706 | 2670 | 19.0% | 1519 | 11.1% | |
| 8406M | 2584 | 21.6% | 1480 | 13.4% | |
| XT3902 | 1867 | 43.4% | 943 | 44.8% | |
| No shading | 3298 | | 1709 | | |

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| LOS ANGELES | | kW | | kWhrs | |
|--------------------|-------------------|-------------------------|-----------------------|----------------------------|--|
| | Peak cooling load | Peak load reduction (%) | Annual cooling energy | Cooling energy savings (%) | |
| 8606 | 2778 | 13.0% | 1531 | 10.7% | |
| 8506 | 2730 | 14.5% | 1526 | 11.0% | |
| 8706 | 2577 | 19.3% | 1490 | 13.1% | |
| 8406M | 2547 | 20.3% | 1440 | 16.0% | |
| XT3902 | 1780 | 44.3% | 794 | 53.7% | |
| No shading | 3194 | | 1715 | | |

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VANCOUVER

| | Peak cooling load | | Annual cooling energy | Cooling energy savings (%) |
|------------|-------------------|-------|-----------------------|----------------------------|
| 8606 | 2694 | 13.8% | 970 | 12.3% |
| 8506 | 2651 | 15.2% | 966 | 12.6% |
| 8706 | 2508 | 19.8% | 938 | 15.2% |
| 8406M | 2456 | 21.4% | 904 | 18.3% |
| XT3902 | 1696 | 45.7% | 433 | 60.8% |
| No shading | 3126 | | 1106 | |

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CALGARY

| | Peak cooling load | | Annual cooling energy | Cooling energy savings (%) |
|------------|-------------------|-------|-----------------------|----------------------------|
| 8606 | 2629 | 16.6% | 1100 | 16.1% |
| 8506 | 2589 | 17.9% | 1091 | 16.8% |
| 8706 | 2440 | 22.6% | 1045 | 20.3% |
| 8406M | 2345 | 25.6% | 996 | 24.0% |
| XT3902 | 1593 | 49.5% | 325 | 75.2% |
| No shading | 3152 | | 1311 | |

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CHICAGO

| | Peak cooling load | | Annual cooling energy | Cooling energy savings (%) |
|------------|-------------------|-------|-----------------------|----------------------------|
| 8606 | 2840 | 13.1% | 1127 | 10.6% |
| 8506 | 2797 | 14.4% | 1122 | 11.0% |
| 8706 | 2667 | 18.4% | 1093 | 13.3% |
| 8406M | 2611 | 20.1% | 1061 | 15.8% |
| XT3902 | 1916 | 41.4% | 611 | 51.5% |
| No shading | 3267 | | 1261 | |

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