Climate change, in combination with the urban heat island, is expected to exacerbate Toronto’s warming trend and bring about more intense and prolonged heat waves. The summer of 2005, for instance, witnessed a record 37 hot days, compared to an average of 13 hot days in the years from 1971 to 2000. A record number of 48 smog days also occurred in 2005. Under climate change, this situation is expected to become the norm. Projections for Toronto summers are shown in the graph below.

3. **IMPACT OF HEAT ON HEALTH**

Heat waves can pose a great risk to public health, particularly to vulnerable populations such as the elderly, individuals with pre-existing health conditions, and those living without air conditioning and/or in crowded conditions. A heat wave that hit Chicago in 1995 killed an estimated 550 to 800 people (Klinenberg 2002), and in Europe more than 35,000 people died from a heat wave that struck in 2003 (De Bono *et al*. 2004). In Toronto during the summer of 2005, six deaths occurred in rooming houses and shelters (McKeown 2006), where a lack of air conditioning and fire codes that required doors to remain shut raised the air temperature inside these buildings to intolerable levels (Smyer 2006).

Exposure to heat can also cause dehydration, heatstroke, heat cramps, heat exhaustion and fainting in healthy individuals (Carty *et al*. 2004), and can worsen pre-existing health conditions such as cardiovascular illness, diabetes, and respiratory disease.
Hot summer temperatures have also been linked to increased violence and homicides (Anderson 2001).

In response to the growing number of hot days and to prevent heat-related illness and death, the City of Toronto issues “heat” and “extreme heat” alerts. The graph below illustrates the total number and type of heat alerts in Toronto since 2001. Notice the high number of total and “extreme” alerts in 2005 – some of which lasted several days.

Under climate change the number of hot days, associated heat alerts, and heat-related illness and mortality are expected to rise. Toronto Public Health and Environment Canada determined that heat-related mortality in Toronto averaged 120 deaths per year over the last five decades (Pengelly et al, in press). From one year to the next there can be a two- to four-fold difference in heat-related mortality, reflecting the variability of hot weather. Mortality is greatest in July and August when the greatest number of multi-day heat episodes occur. The longer the heat wave, the greater the daily risk for mortality. A study released by Toronto Public Health in 2005 indicated that heat-related mortality is projected to double by 2050 and triple by 2080.

Hotter summer temperatures and prolonged heat waves can also worsen air quality. In hot weather, more people turn to air conditioning for relief, which in turn increases energy consumption. Because peak energy on hot days is supplied by coal-fired generating plants downwind of Toronto, this in turn leads to increased air pollution. Higher temperatures also speed up the series of chemical reactions among air pollutants that produce smog (Nugent 2004).

In Toronto, 1,700 people are estimated to die prematurely each year from acute and chronic exposure to polluted air and 6,000 more are hospitalized (Toronto Public Health
Air pollution has been linked to numerous medical conditions such as asthma and bronchitis (Gauderman 2005), heart attacks and strokes (Clarke 2005), and an increased risk of death (Goodman 2005). Research has also demonstrated that socially isolated seniors, children, newborns and people with pre-existing health conditions, are particularly vulnerable (McKeown 2006).

With the onset of hotter summers under climate change, air pollution-related deaths in Toronto are projected to increase by 20% by 2050, and 25% by 2080 (from 822 to 1070 per year in 2080).

4. IMPACT OF HEAT ON ELECTRICITY USE

Heat waves significantly impact the amount of electricity used. As ambient air temperatures climb, and thermal discomfort in buildings increases, more people turn to air conditioning for relief. Air conditioners discharge hot air outside, adding more heat to ambient air, and furthering the need for cooling. The resultant vicious cycle places the electrical system under great strain, and can lead to neighbourhood and city-wide blackouts or brownouts. This was demonstrated by the transboundary blackout in August 2003, which shut down Toronto’s operations for nearly 3 days, where hot weather and high electricity demand were partially to blame (US-Canada Power System Outage Task Force 2004).

As climate change progresses, hotter summer temperatures will increase the demand for electricity accordingly. This trend is already evident, as illustrated in the graph below. Peak hourly summer demand in Ontario has risen steadily from 1994 through 2002 (Liu 2003).