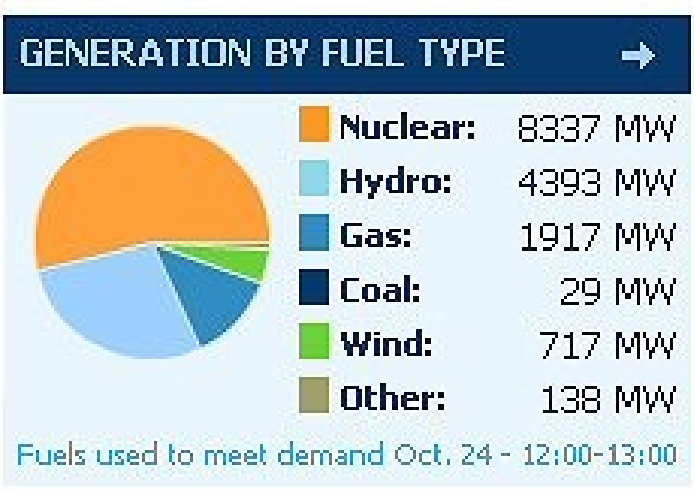
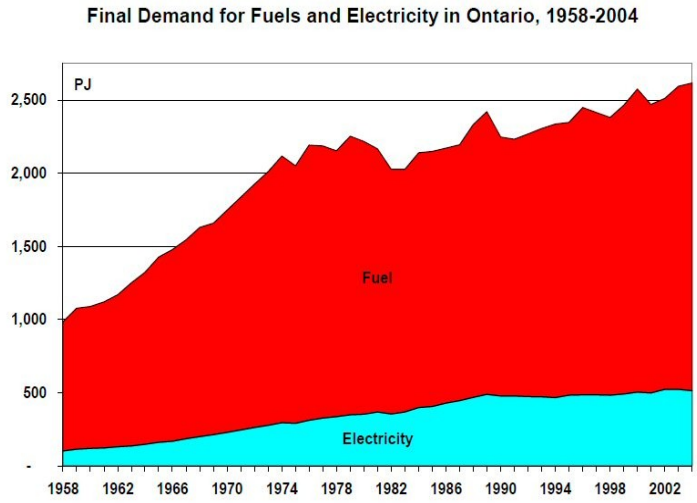
Power sans CO_2

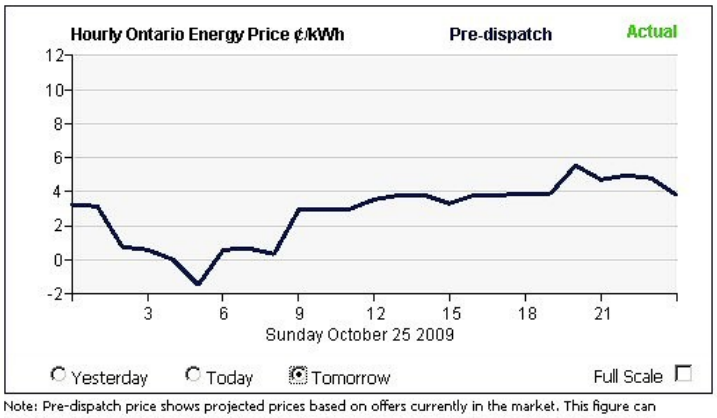
(from http://sustainability-journal.ca for Oct. 2009)

The pie chart shows a typical breakdown of the energy sources used for power generation (for Oct. 24, 2009). Note that fossil fuels accounted for only 12.7% of the power production on that particular day, and that electricity accounts for only a small part of the demand for energy in Ontario (Figure 2). Media reports commonly equate energy and electricity as if it were the primary form of energy and our primary source of CO_2, neither of which is even remotely true. However, it is a contributor to the GHG total so this note shows how that contribution can be almost completely eliminated.





Fossil fuels accounted for 1946 MW of power on that particular day. If we want to get rid of them then wind, solar, hydro and nuclear sources will need to pick up that total. (Actually storable fuel extracted from residential, industrial and agricultural waste should be included in that group). To illustrate the points we can consider using just nuclear power for that role for the sake of simplicity.



Note: Pre-dispatch price shows projected prices based on offers currently in the market. This figure can fluctuate as new offers are submitted and demand changes.

Figure 3 illustrates one of the problems that Ontario faces daily – the value of electricity falls very nearly to zero for about 8 hours on most nights and can even range below zero (as shown for Oct 25), which presents a very severe problem in that the nuclear plants need to operate at a constant power with a 2.5% tolerance.

AE-Street systems offer a very simple and inexpensive solution to this problem. If they were widely used their storage capacity in Ontario would amount to about 700 petajoules, which grossly exceeds the storage required to handle any excess power generation, so the nighttime power can simply be stored in the form of heat that is injected in the ground. The demonstration unit in Kingston incorporates this feature. If the AE-Street systems are managed by municipalities then the management of the injection is a trivial problem.

The AE-Street systems cannot convert the heat back to electricity but they can make good use of the heat for heating buildings and a copious year round supplemental supply of heat simplifies their design.. The electricity would be made up by adding more reactors (or wind turbines, etc.) that can generate surplus power at will because there will always be sufficient storage to handle any excess.

Power demand fluctuates throughout the day, from day to day, and from season to season, so each mix of energy sources needs to be individually analyzed to ensure that these fluctuations can be handled. In the case of the nuclear expansion the hydro power would continue to handle much of the daily variations and either of the new AECL power station designs could increasingly handle the seasonal power variations because they are designed to cope with seasonal variations in load demands.

For other sources like wind power this energy storage concept is even more attractive because most renewable energy sources add large supply variations that need to be addressed in addition to the load variations.