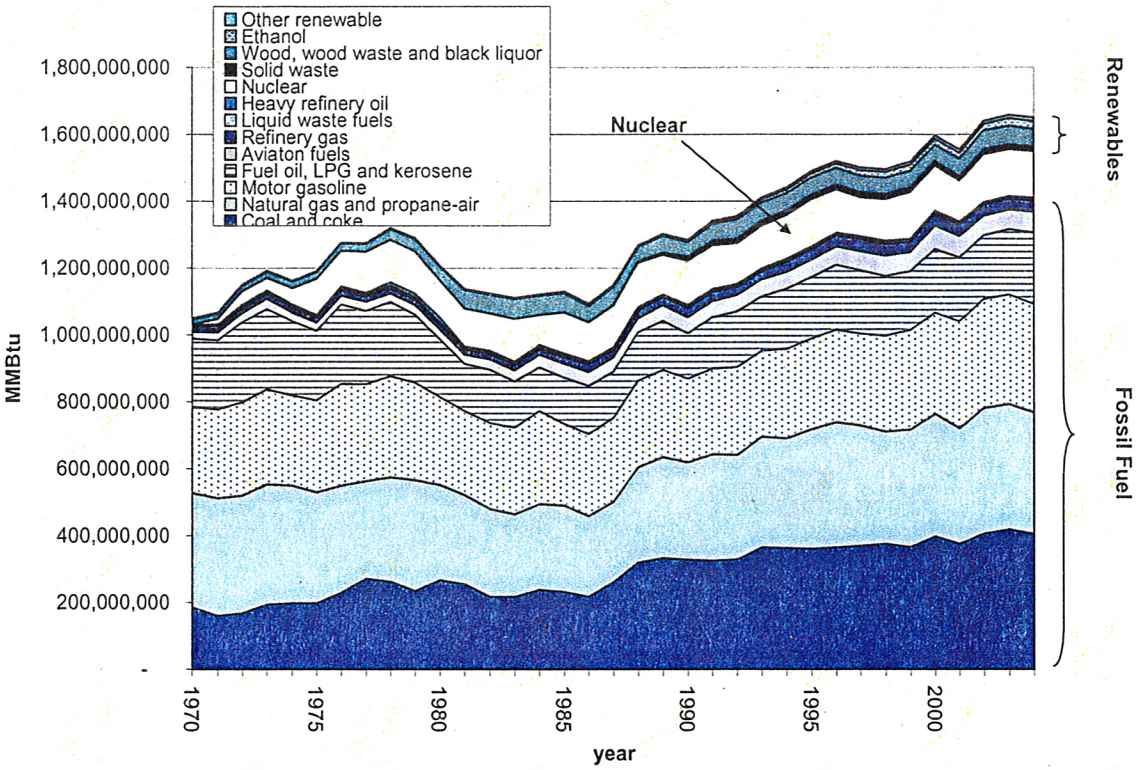
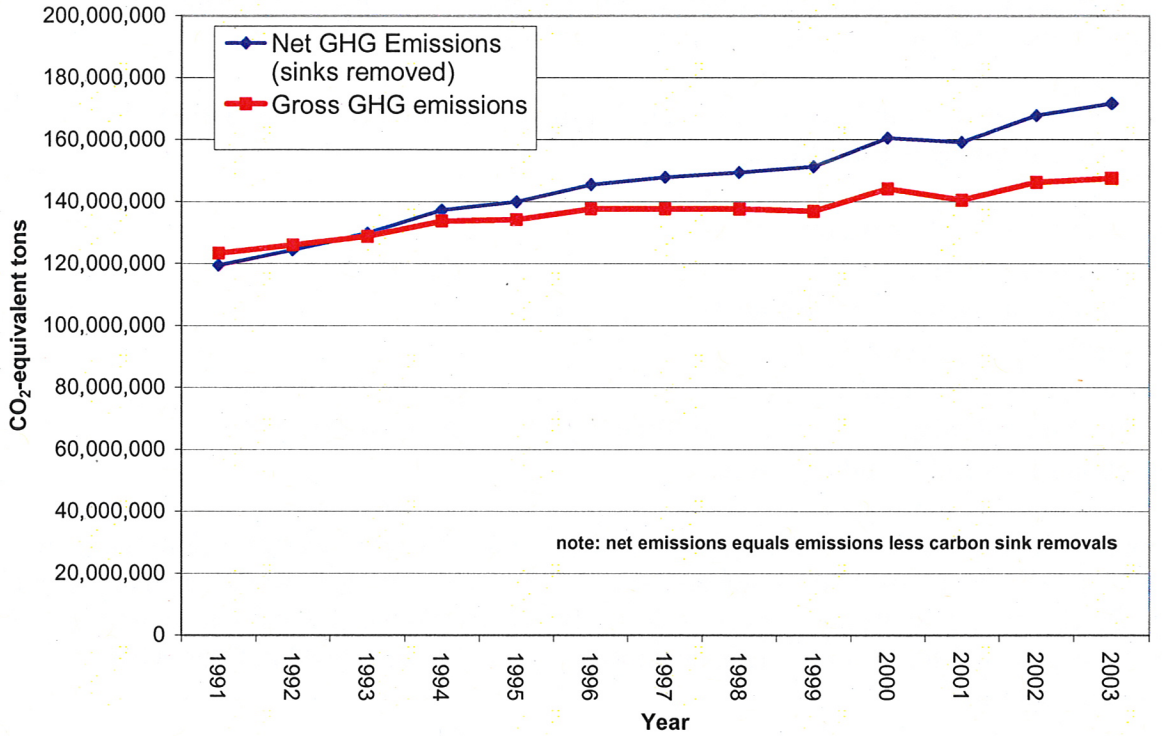
Figure 4. Energy Consumption in Minnesota by Source



Long-term biogenic storage (or storage in housing) acts to draw down the atmospheric stock of carbon through photosynthetic activity and attendant plant growth, and represents a net GHG emission reduction. Inversely, carbon is lost from forested land (or landfills, structures, wood products etc.) at the expense of the atmosphere. Carbon losses from these systems can be thought of as a net CO_2 emission.

In estimating the average annual change in carbon storage on Minnesota forestland, a polynomial equation was fit to the USFS-FIA data, resulting in a parabola-shaped trend in carbon storage, peaking about 1996. Adding this to the inventory data yields a net GHG emission trajectory that departs markedly from that of Figure 1. Incorporating the trend in carbon storage acts to strongly suppress net GHG emissions early in the trend period (e.g., 1970-1985), but also to add a new emission source between 1990 and 2004. According to this calculation, by 2004 this new source of emissions might be equal to some 25 million CO2-equivalent tons annually (see figure 5 below).

Figure 5. Gross and Net Greenhouse Gas Emissions from Minnesota 1991-2003



There is some debate whether biogenic carbon sequestration and emission should be included in GHG inventories. Emissions of long-lived GHGs are evaluated using, among other things, well defined residence times of these compounds in the atmosphere. By definition, the persistence of any small changes in aggregate carbon storage in biological systems is uncertain; it is possible that what now appears to be a net emission of carbon from Minnesota forestland could turn about in the next decade and become a net gain in storage. Given that, it has been suggested that it is inappropriate to treat short-term gains or losses of carbon from biological systems on the same basis as emitted fossil CO_2, with its reasonably well understood 200-year atmospheric lifetime.

Caution should be taken with emission inventory estimates for 2002 to 2004. Some of the underlying data are preliminary in nature and subject to revision. In some cases current year activity data were not available, in which case data for the most recent year that was available were used. In addition, in some cases, estimates for GHG emissions for earlier years have been updated and/or corrected using new quantification methods and revised historical information on activity levels.[1] Caution should be taken in comparing the inventory information above with earlier estimates released by the MPCA.

[1] Historical activity level data are frequently 'corrected' by the collecting Federal agencies. Changes to the inventory are made annually to reflect the most recent Federal data revisions. In the MPCA GHG inventory, methodological changes are rolled into the inventory each year as they become available.

There are questions about the comparability of recent and earlier USFS-FIA estimates of green tons of biomass (hence changes in carbon storage) on forestlands. Thus the results for net emissions shown in Figure 5 should be viewed as provisional.

Finally, not included in this analysis are a number of yet unresolved GHG emission sources and sinks. Principal among these include:

- eutrophied surface waters
- commercial chillers
- industrial waste-water treatment
- wetlands conversion
- agricultural drainage
- agricultural tillage (with regard to soil organic carbon loss or gain)
- urban soils and the urban forests.

It is possible that a number of these emission sources or sinks could be large. Additionally, it may be that the use of biochemical models for estimating soil emissions would yield substantially higher GHG emission totals that are given above, largely due to the high carbon content of our agricultural soils and soil wetness. This factor may need to be considered in future GHG emission inventories.