April 11, 2008 Draft by two members of the Integrated Nitrogen Committee to Assist Meeting Deliberations. This is a work in progress, does not reflect consensus advice or recommendations, has not been reviewed or approved by the Integrated Nitrogen Committee or the Chartered SAB and does not represent EPA Policy. Do Not Cite or Quote.

ATMOSPHERIC EMISSIONS
Prepared by Lighty and Moomaw (April 11)

Atmospheric emissions of reactive forms of nitrogen often have a higher impact on human health, and the emissions and their associated damage costs cascade through multiple ecosystems as air pollution, acid deposition and land and water deposition that causes eutrophication.

Transport Sector

The transport sector is responsible for contributing both NO_x and, to a lesser extent N_2O to the nitrogen cascade. N_2O is released as the result of incomplete reduction of nitrogen oxides in the catalytic converter, and remains a long-lived gas that contributes powerfully to global warming and to ozone depletion. The release of NO_x moves through the nitrogen cascade causing multiple damages to human health through the formation of ozone and particulates. It damages multiple ecosystems by causing acid precipitation that acidifies freshwater and terrestrial ecosystems, ozone that harms crops and forests, and eutrophication of freshwater, land and estuaries before being denitrified to N_2 and N_2O.

Conventional catalytic converters with electronic controls lower NO_x by 90% for gasoline powered vehicles. New technology and fuels promise to reduce diesel powered vehicle NO_x emissions by comparable amounts; this would result in significant improvements. In addition, some engine manufacturers (e.g. Mercedes) are creating engines which would incorporate SCR with urea, creating further reductions in NOx. Hybrid gasoline-electric vehicles are not only more fuel efficient, but reduce those emissions another 90%, and some of them are rated as Super Ultra Low Emission Vehicles in California. This is a result of, not only electrical power, but also due to improved control systems. However, there remains significant technical potential for reducing NO_x emissions from heavy trucks and off-road sources, including construction equipment, locomotives, marine engines, and 2- and 4-stroke engines. Off-road emissions were found to increase during the 1990 to 2002 time period as compared to other sources (see Section 3.2).

As the US addresses the need for carbon control, more efficient vehicles, additional mass transport, and urban planning which results in reduction in miles driven are likely scenarios. These initiatives, which are anticipated to reduce CO2, will in turn reduce NOx. In the case of transportation, the carbon and nitrogen cycles are related.

Electric power plants and industry

Electric power plants are significant emitters of NO_x when burning fossil fuels. While coal-fired, steam turbine plants are significant, due to their size and the nitrogen in the fuel, oil and higher-temperature natural-gas turbine plants contribute to these emissions as well. Newer power plants have some combination of low NO_x burners or Selective Catalytic Reduction (SCR) technology. Many older plants lack any NO_x controls having been grandfathered under the Clean Air Act Amendments (I have some data from e-

GRID which we could figure this out with). When these older plants are replaced, they will need to meet the tighter NO_x under the New Source Performance Standards as required under the Clean Air Act.

.The median coal powered steam plant in the United States was built in 1964, which means that there is considerable scope for significant reductions in NOx emissions from the power sector, not only from improved NOx control but also from improvements in efficiency. For example, current plants are 30-35% thermal efficiency, where state-of-the art supercritical have efficiencies as high as 45%. (see the comment from Bill in response to my question regarding the fact that new proposed plants are being taken off the burner because of public opposition; these plants would be better in many ways, but my guess is we need guarantees from the utilities to shut them down – they are paid for and making $$).

Comment: I feel that these old plants should be forced to close. Perhaps no new ones can be built unless an older one is shut down. Would we be better without new coal plants as their CO2 reductions are modest compared to old plants. Still they may be inevitable so require carbon dioxide capture and storage, which unfortunately carries a very large energy penalty.

Other Combustion Systems

Industrial emitters include any that produce high temperature heat such as iron and steel, non-ferrous metals, chemicals, refineries cement, brick and glass manufacturers. This is a very disparate group of NO_x emitters. Some chemical production also releases N_2O, which is readily controlled prior to release. While there is some potential for reducing wet and dry reactive nitrogen from each of these sectors, as seen in Figure ??, Nr from these systems has been reduced by almost 40% from 1990 to 2002.