Development and Evaluation of a Methodology for Determining Air Pollution Emissions Relative to Geophysical and Societal Change

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Objectives

- Develop method to project future emissions based on regional econometric models for Chicago and the Midwest
  - Regional input-output econometric modeling is a “bottom-up” approach based on transactions among economic sectors at the local or regional level. This approach is particularly suited to address economic effects of structural change such as migration of industries or job outsourcing
  - Econometric models driven by Data Resources, Inc. (DRI) model of U.S. economy
  - Projected emissions are based on EPA’s 1999 National Emissions Inventory (NEI99)
  - Status of project is ongoing work in progress

Factors Influencing Emissions

- Economic Factors
  - Population growth
  - Growth in per capita income
  - Economies of scale
  - Economic structural change
- Technological change
  - Emission controls
  - Improved energy efficiency
  - Development of telecommunication technologies
  - Alternate energy sources

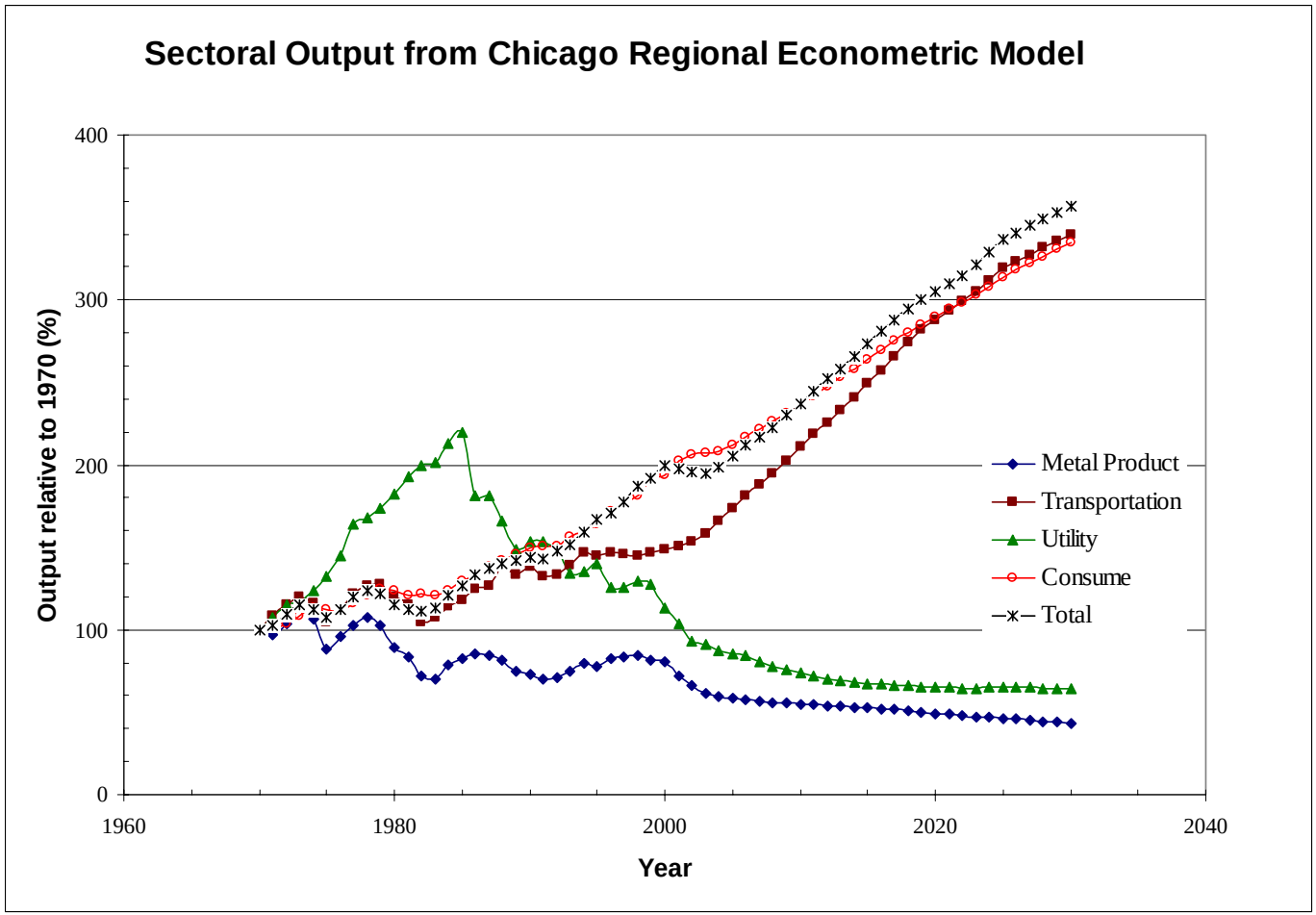
Emissions are by-product of complex mixture of economic and technological factors

Methodology

- Compute future economic change using Chicago or Midwest Regional econometric model

- Estimate future technological change based on historical emission trend data

Actual and projected relative economic output for Chicago showing behavior of total economy and different sectors from 1970 – 2030.



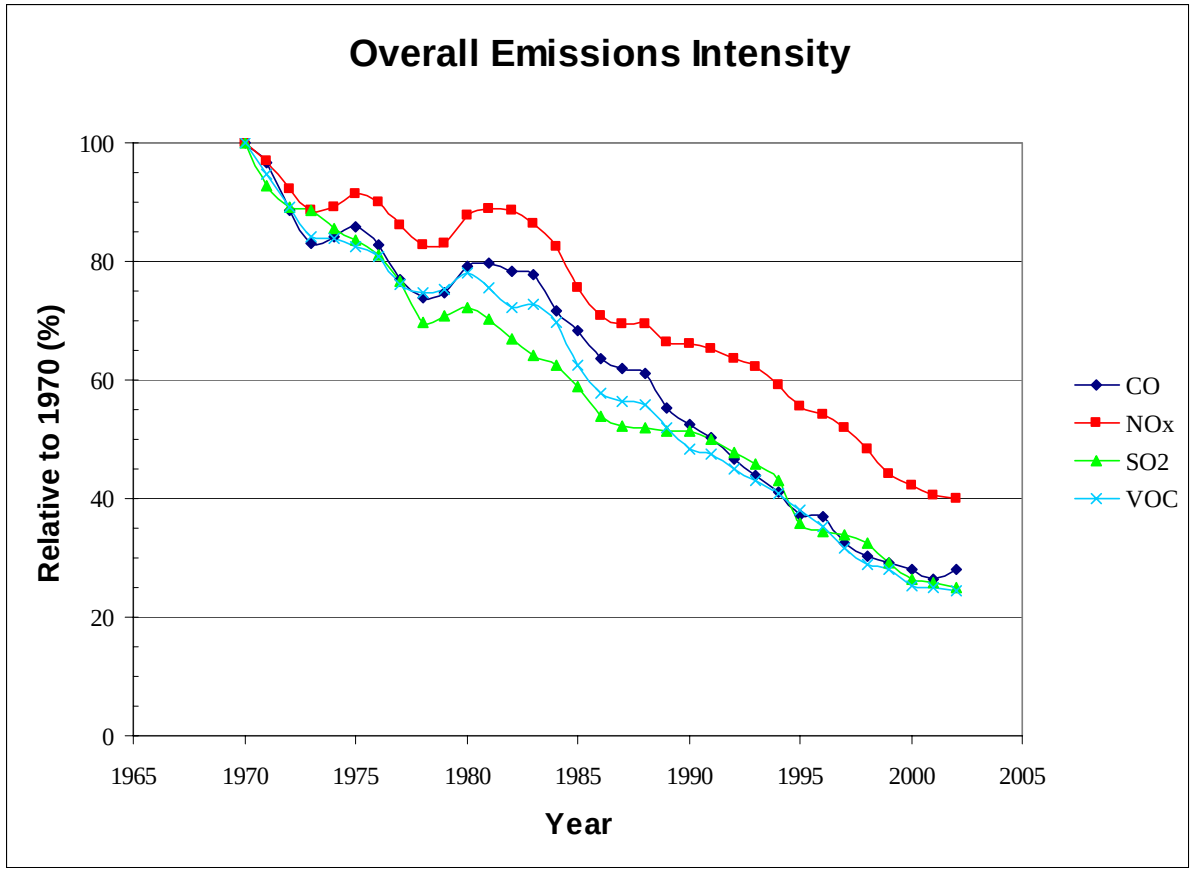
Estimating future emissions

- Map process based inventory to sector based inventory (tons pollutant /sector)
- Backcast econometric model to produce sector based economic output ($)
- Construct sector based emission intensity defined as tons pollutant/$
- Develop future emission intensity based on imposed scenario and compute future emissions for each pollutant as product of future emission intensity and future economic output

Projection of past intensities

- Estimate past **emissions** (1970-2002) based on NEI 99 and National trends data
- Backcast econometric model to compute sector based **output** for 1970-2002
- Compute past annual sector based **emission intensity** for each pollutant as:
  EI(tons/$) = **emissions**/**output**
- Estimate future emission intensity from behavior of past intensity

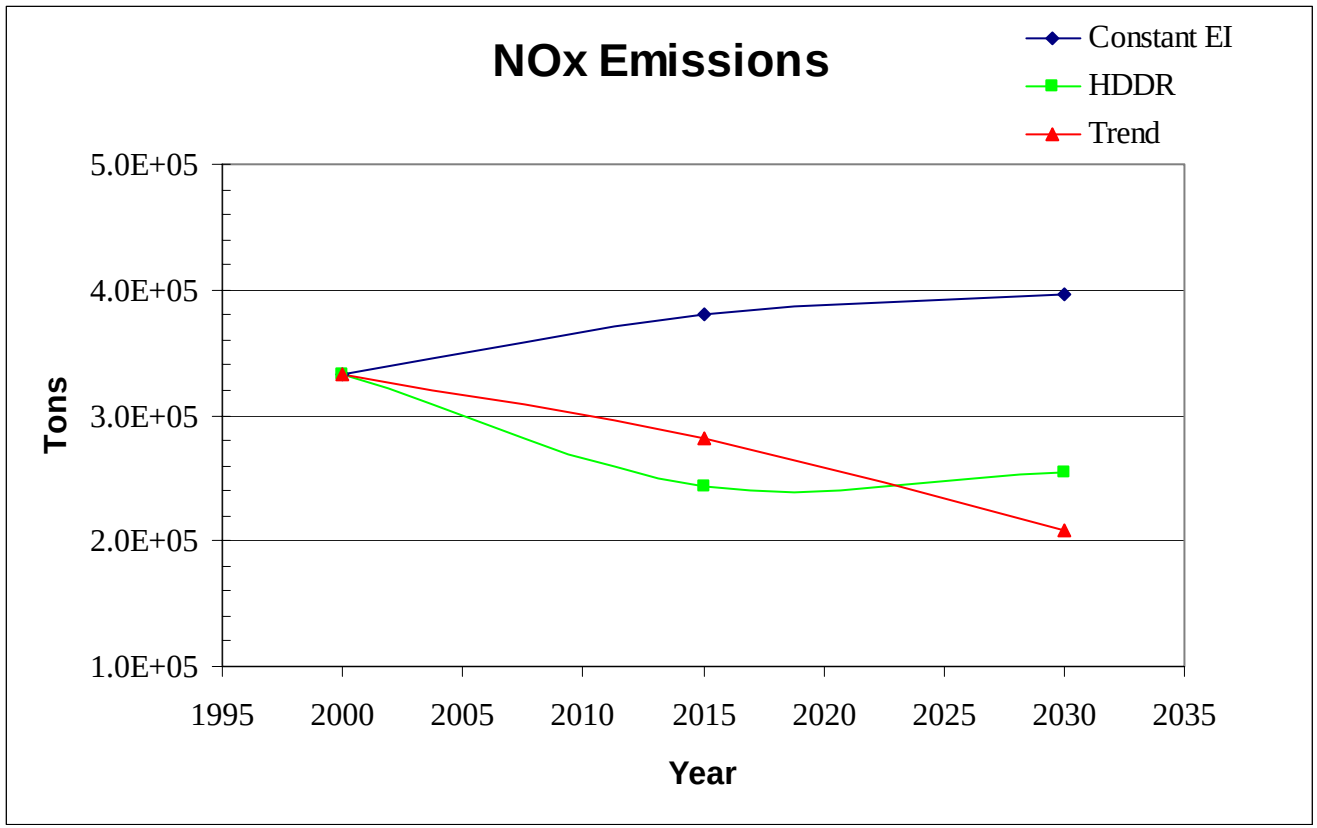
Historic Emission Intensities



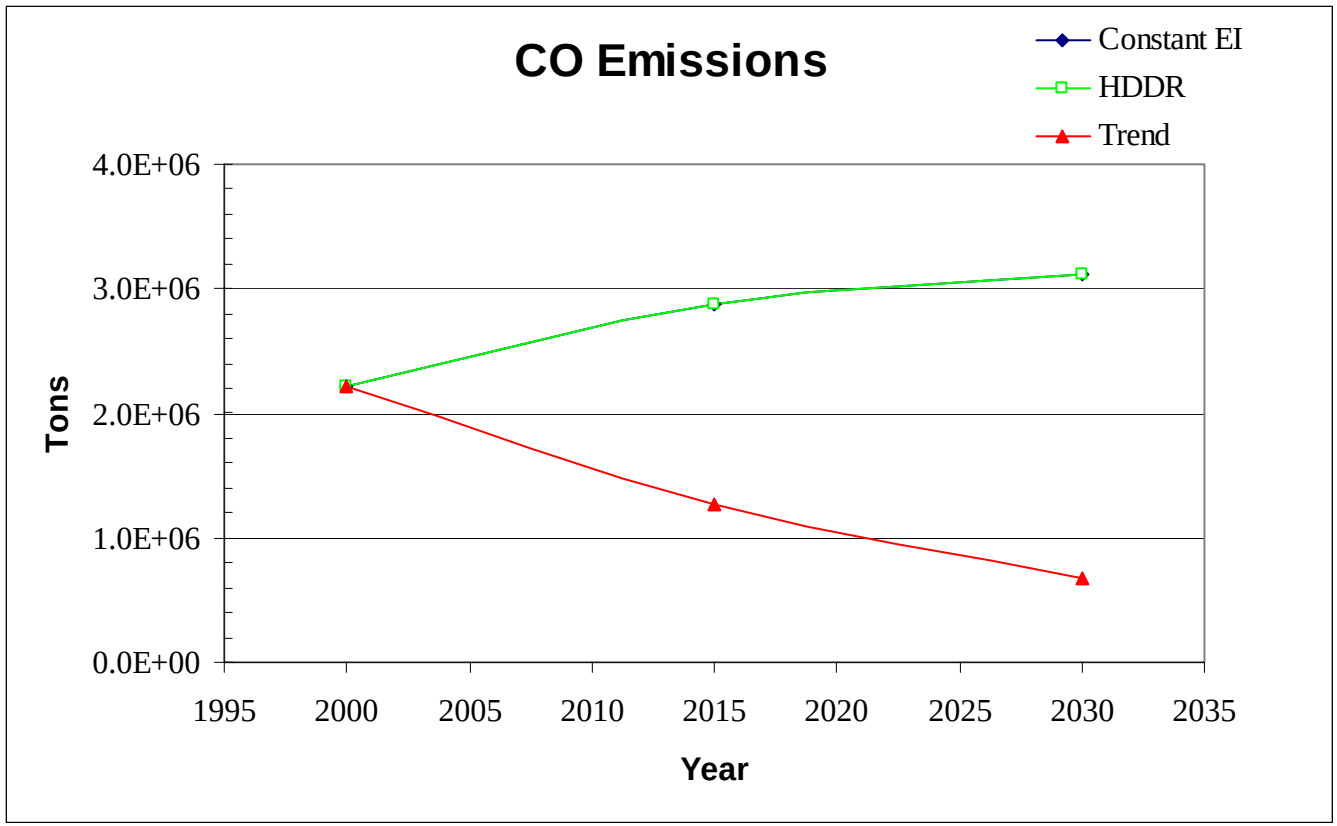
Future Scenarios Considered (Chicago)

1. No future technological change – changes in future emissions based solely on economic change (constant future emission intensity)
2. Emissions projected in accord with EPA's Heavy Duty Diesel Rule (HDDR)
3. Emissions based on projection of historic emission intensities
4. Emission intensity resulting in constant future emissions (Capped scenario)

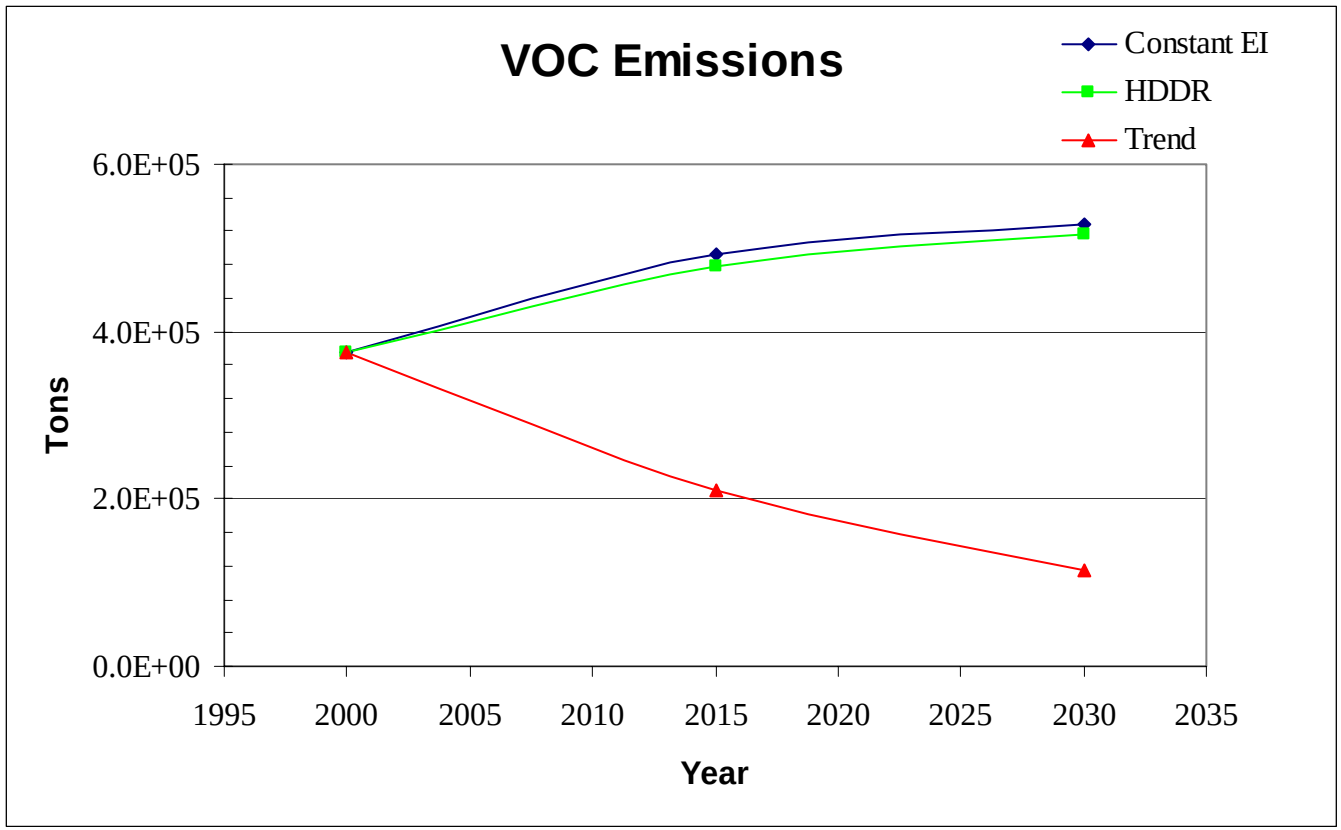
Projected Chicago NO_x emissions based on constant emission intensity, implementation of the diesel rule, and projection of historic emission intensity trend



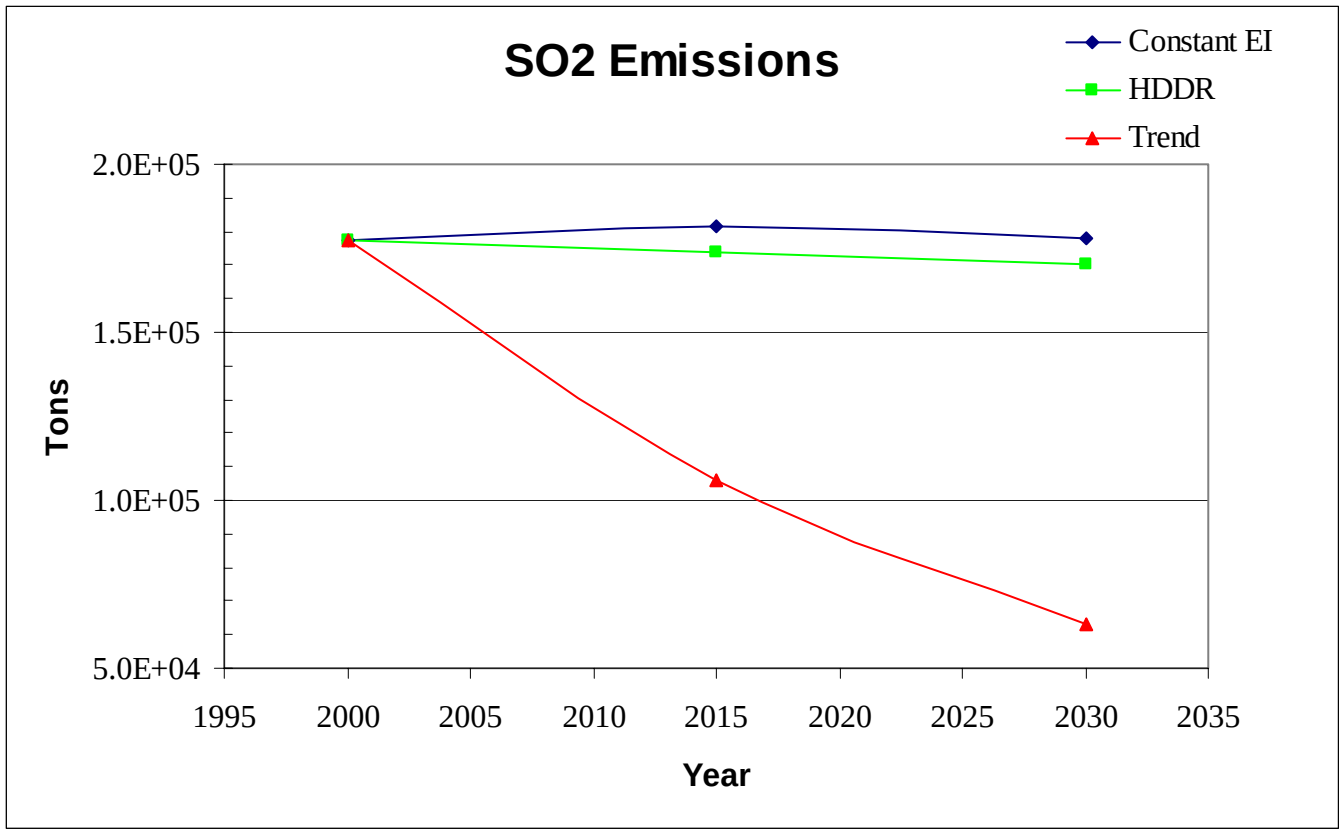
Projected Chicago CO emissions based on constant emission intensity, implementation of the diesel rule, and projection of historic emission intensity trend



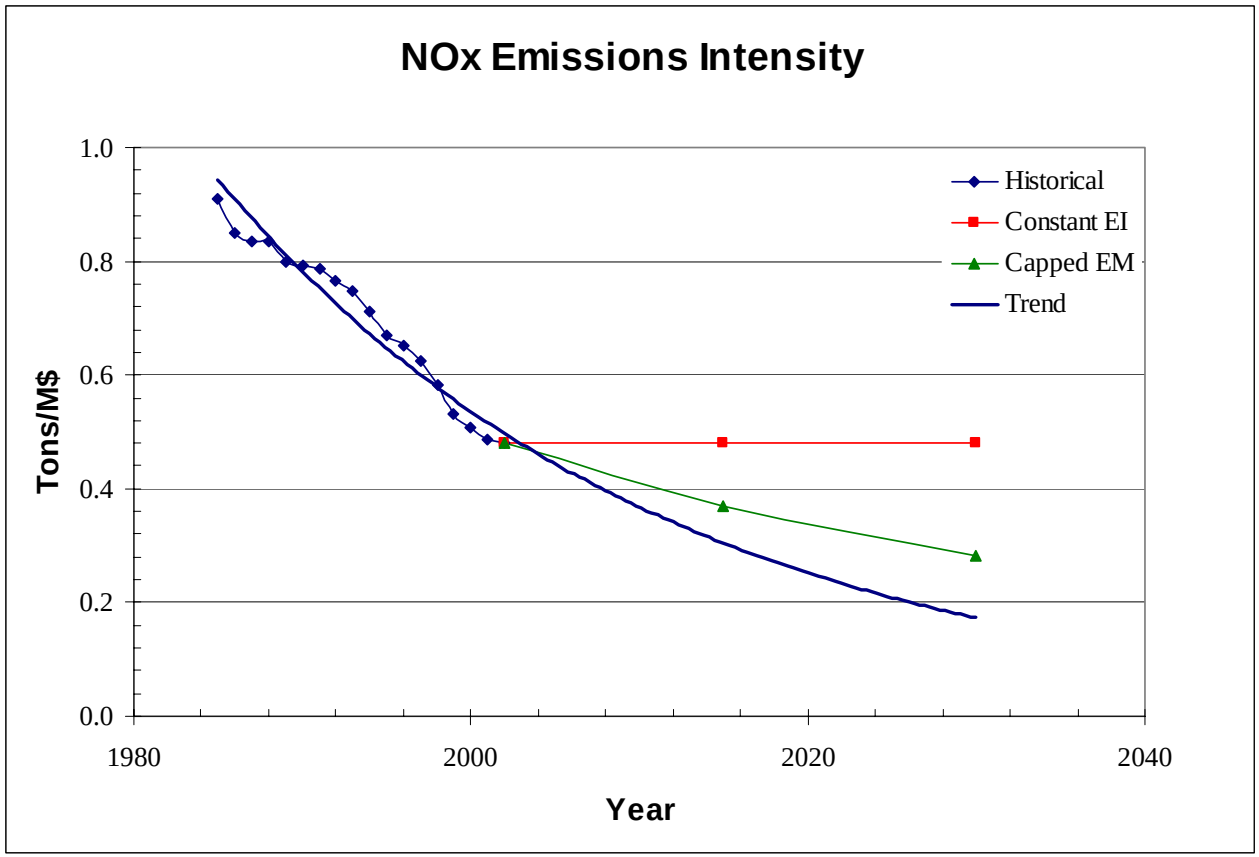
Projected Chicago VOC emissions based on constant emission intensity, implementation of the diesel rule, and projection of historic emission intensity trend



Projected SO_2 emissions based on constant emission intensity, implementation of the diesel rule, and projection of historic emission intensity trend



Future Emission Intensity Scenarios



Conclusions

- Emissions based on a scenario of pure economic change result in percentage increases of 19, 40,41 and <1 for NOx, CO, VOC and SO_2 respectively between 2000 and 2030.
- Projections for implementation of the diesel rule show 2030 emission reductions of 23% for NOx and 4% for SO_2.
- Based on the present extrapolation of the historic emission intensity from 1985-2002 percentage future emissions are projected to decrease by 37, 70,70 and 65 for NOx, CO, VOC and SO_2 respectively between 2000 and 2030.

Future Direction

- Improved time dependant or continuous economic model output
- Consider episodes where the impact of a shock to the economy can be taken into account
- Improve calculation of past emission inventories to more accurately account for trends of emission intensity for each economic sector.