



National Projections For Canada And The United States

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Presentation Outline

- Background on how the emission projections are developed
- Overview of the emission control programs
- Overview of the emission sources
- Presentation of the emission projections





How The Emission Projections Are Developed

Projected Emissions =

**Current Emissions * Emission Growth Adjustments *
Emission Control Adjustments**

Emission growth adjustments account for parameters such as population, gross domestic products, technology efficiency improvements, energy consumption, land use, motor vehicle kilometers traveled, etc.

Emission control adjustments account for technological innovations, control technologies, substitution of inputs to production (e.g., fuel switching), equipment turnover, emission controls implemented to satisfy regulations, voluntary programs and other initiatives expected to reduce air emissions, etc.





How The Emission Projections Are Developed

Different datasets are also used in the estimation of the future emissions, which include:

- Outputs from macro-economic models, energy supply and demand models
- National statistics/forecasts for fuel consumption by fuel type and energy sector
- National, state, and provincial trends for different industries
- Industry specific market planning model that addresses capital turnover and economically-motivated fuel switching (eg. power generation)
- Emission estimation models for on-road and non-road vehicles (account for equipment turnover, fuel efficiency, fuel switching)
- Data compiled from continuous emissions monitoring (CEMs)





How The Emission Projections Are Developed

- In Canada the projected emissions are reviewed by sector experts (in government and industries), and reviewed by the provinces and territories before they are finalized
- Similar feedback and review process is likely used also in the United-States





Emission Control Adjustments In the United-States

Nationally implemented rules in effect before 2015 or between 2015 and 2020

- **Electric Generating Utilities (EGU) – reductions for SO₂, NO_x, Hg**
 - Clean Air Interstate Rule (CAIR)
 - Clean Air Mercury Rule (CAMR)
 - Clean Air Visibility Rule (CAVR)

- **Stationary non-EGU sector – Reductions for VOC, NO_x, PM_{10/2.5}**
 - Maximum achievable control technology standards – apply to multiple industries
 - New source performance standards

- **On-road and Nonroad Mobile sectors**
 - Nonroad Diesel Rule
 - Nonroad Engine Rule
 - Tier 2 Vehicle and Gasoline Sulfur Program
 - Heavy Duty Diesel Rule (Trucks & Buses)





Emission Control Adjustments In Canada

- **Acid Rain Program**
 - Cap for SO₂ emissions for the seven eastern-most provinces
 - Reductions of SO₂ and NO_x emissions from Electric Generating Units, metal mining and refining industry, upstream oil & gas, and other industries
- **Ambient Air Quality Standards For Particulate Matter (PM_{2.5}) and Ozone**
 - Requirement for the Federal and Provincial governments to develop emission reduction plans to achieve the standards by 2010
 - Emission regulations, environmental codes of practice for industries, pollution prevention plans
- **New Source Emissions Guidelines for Electric Generating Units**
 - Limits for emissions of SO₂, NO_x, and PM from new power plants starting commercial operation after April 1, 2003.





Emission Control Adjustments In Canada

- **VOC regulation to reduce the VOC emissions from dry cleaners and solvent degreasing operations**
- **Annual caps by 2007 for NOx emissions for Electric Generating Units located in Pollutant Emissions Management Areas (PEMA) in the province of Ontario and Quebec**
- **Various provincial regulations to control SO2 and NOx emissions**
 - Target specific industries of importance in the jurisdiction





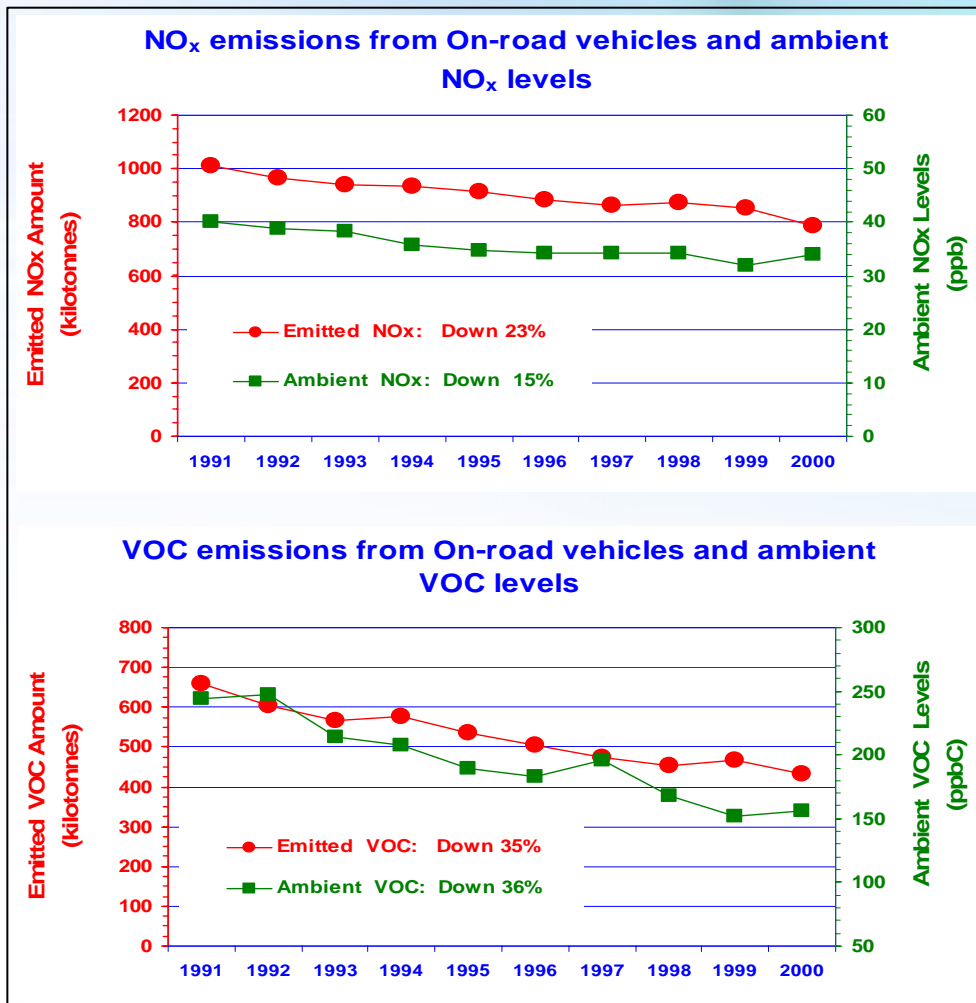
Emission Control Adjustments For Canadian Mobile Sources

- **Gasoline and Gasoline Blend Dispensing Flow Rate Regulations (2001)**
Reduction of VOC emissions by 95% during the refueling of light-duty vehicles and trucks
- **Sulphur in Diesel Fuel Regulations (2002)**
Limit the sulphur content in diesel fuel used in on-road, off-road, rail and marine vehicles
- **On-Road Vehicle and Engine Emissions Regulations (2004)**
New stringent national emission standards for 2004 and later model-year of light-duty vehicles, light-duty trucks, heavy-duty trucks and engines, and motorcycles
- **Off-Road Small Spark-Ignition Engine Emission Regulations (2005)**
Emission standards for 2005 and later model-year engines rated up to 19 kilowatts (e.g. lawn mowers, light duty industrial machines, and light-duty logging machines)
- **Off-Road Compression-Ignition Engine Emission Regulations (2006)**
More stringent emission limits for VOC, CO, and PM from equipment used in construction, agricultural, mining and forestry operations
- **Vehicle Inspection and Maintenance Programs**
Programs in place in the provinces on Ontario and British Columbia





Mobile Source Emissions And Ambient Levels In Canada

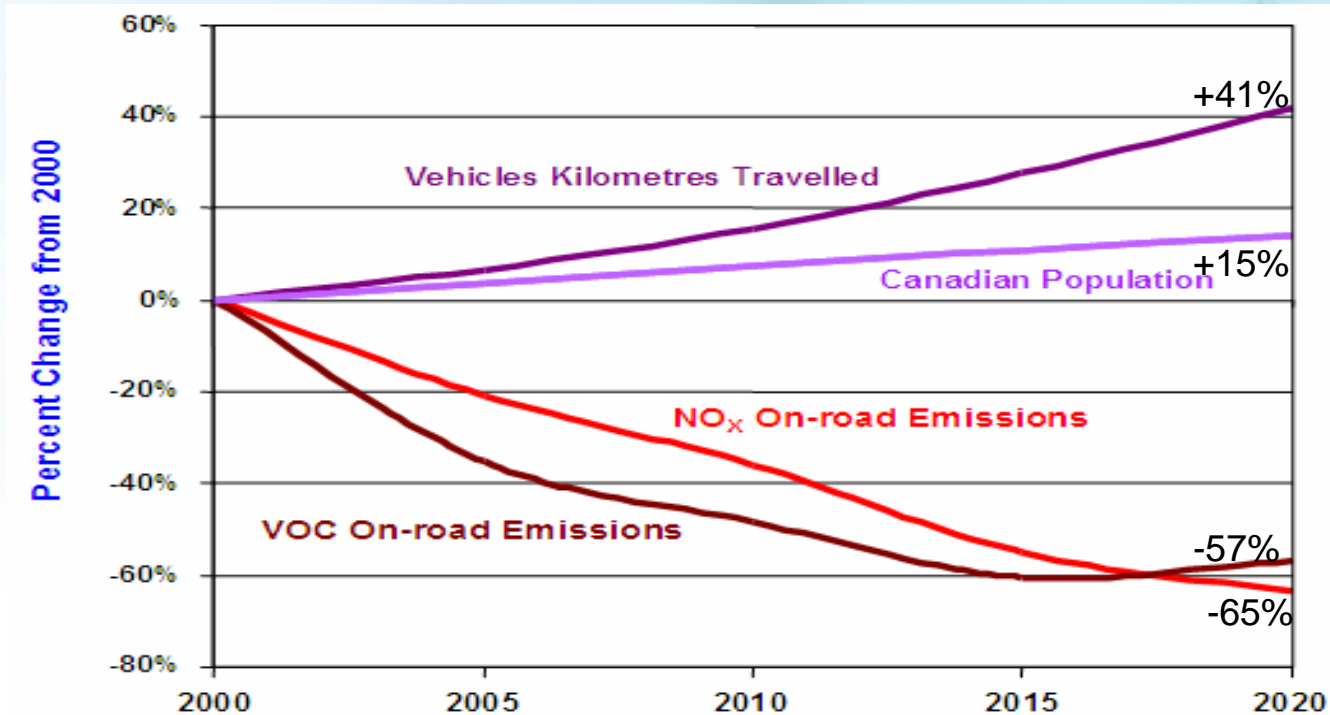


- Reductions in the vehicle engines and fuels for on-road vehicles have resulted in similar reductions in ambient levels in urban areas





Impact Of Regulations On The Canadian Vehicle Emissions



With significant reductions from on-road vehicles over the past decades, smog-forming emissions from marine vessels are projected to surpass those from on-road vehicles in some coastal areas of Canada in the near future.





Air Quality Agreement Between The United-States and Canada

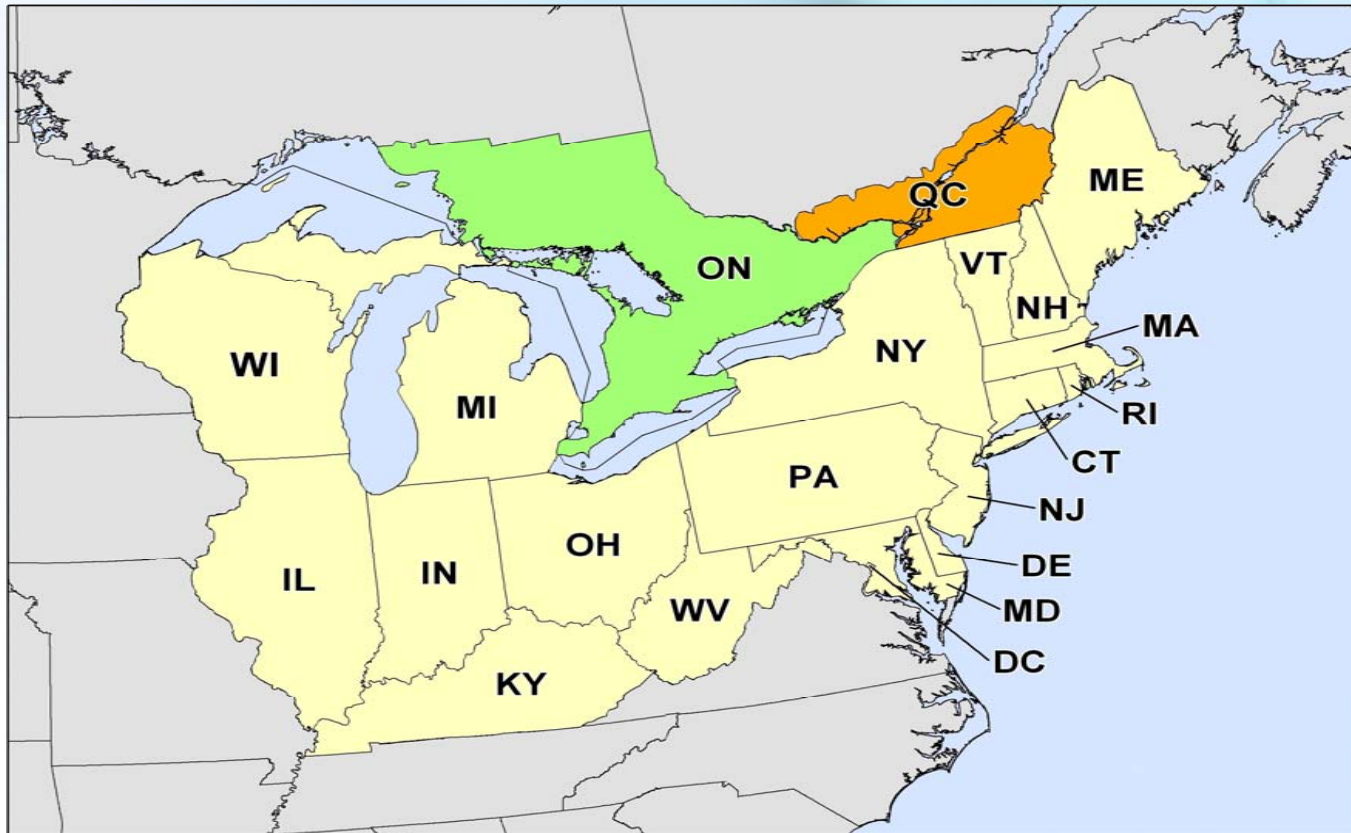
- Established in 1991 and fosters bilateral environmental cooperation to reduce the transboundary flow of pollutants
- The focus is on the reduction of acid rain and the control of ground-level ozone
- Both countries are committed to specific reductions for SO₂, NO_x, and VOC emissions in the Pollutant Emissions Management Areas (PEMA)
- Future extension of the current agreement are being investigated to address issues associated with particulate matter, mercury, and other air pollutants





Air Quality Agreement Between The United-States and Canada

Pollutant Emissions Management Areas (PEMA)

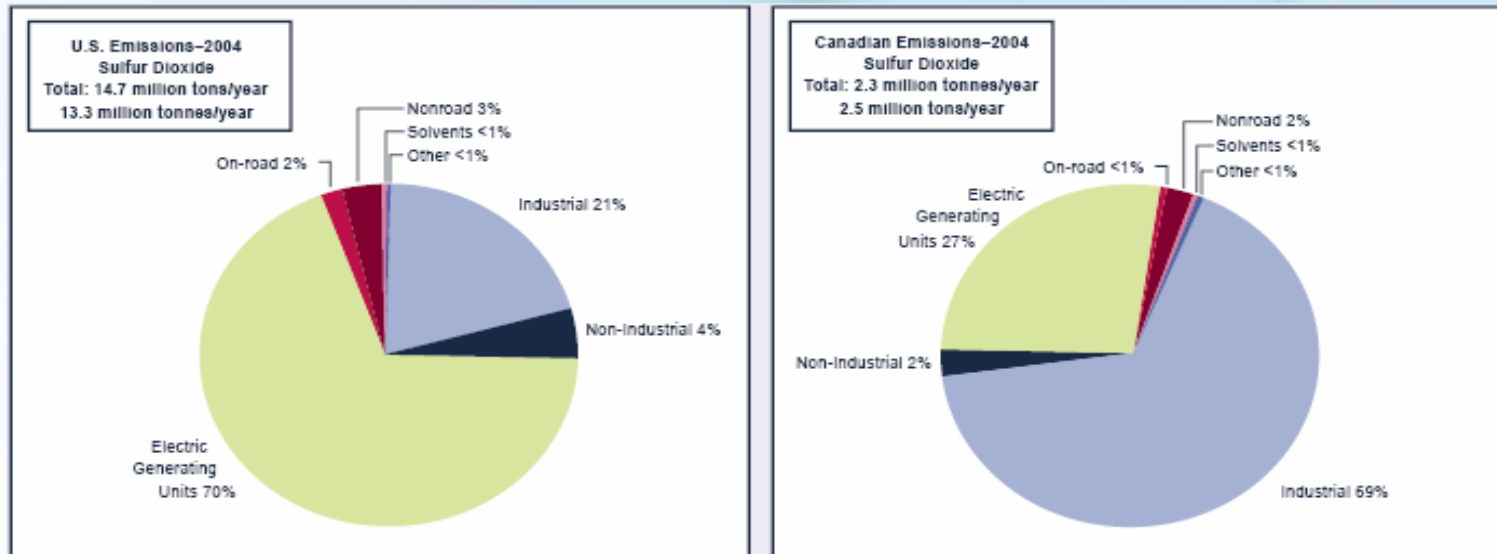


Account for 40% and 50% of the U.S. and Canadian population respectively





Distribution Of The Emission Sources (SO₂ Emissions)

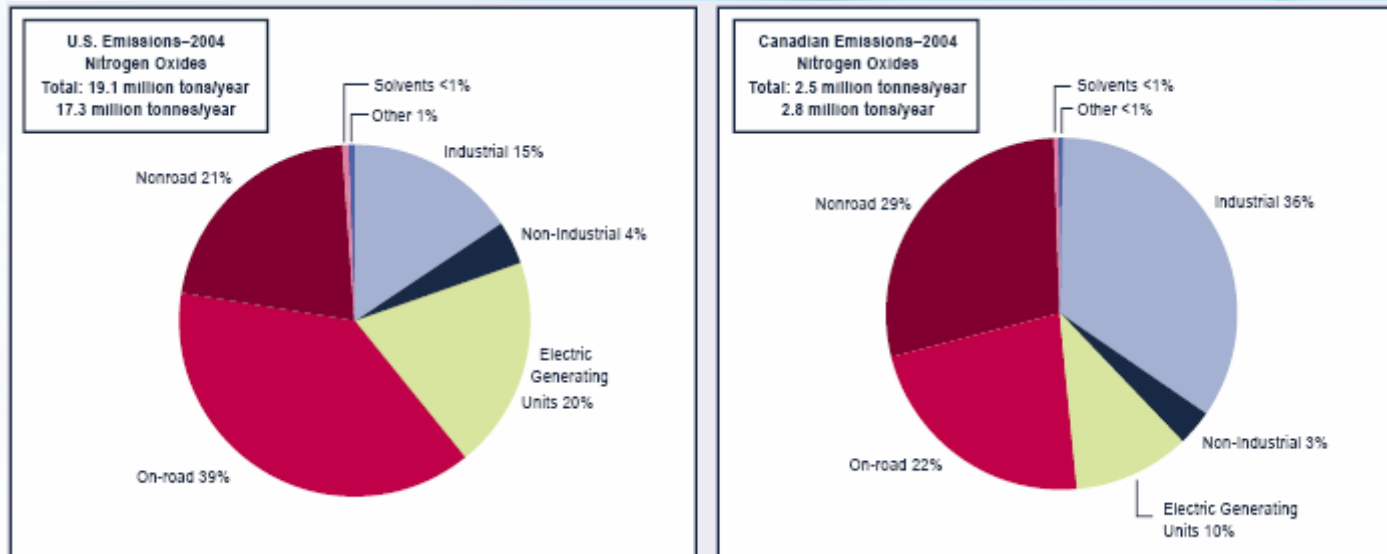


- SO₂ emissions in the United States are mainly from electric generating units using coal
- Canadian SO₂ emissions come mostly from the industrial sector, with fewer emissions from the electric power sector, due to the large hydroelectric capacity in Canada





Distribution Of The Emission Sources (NOx Emissions)

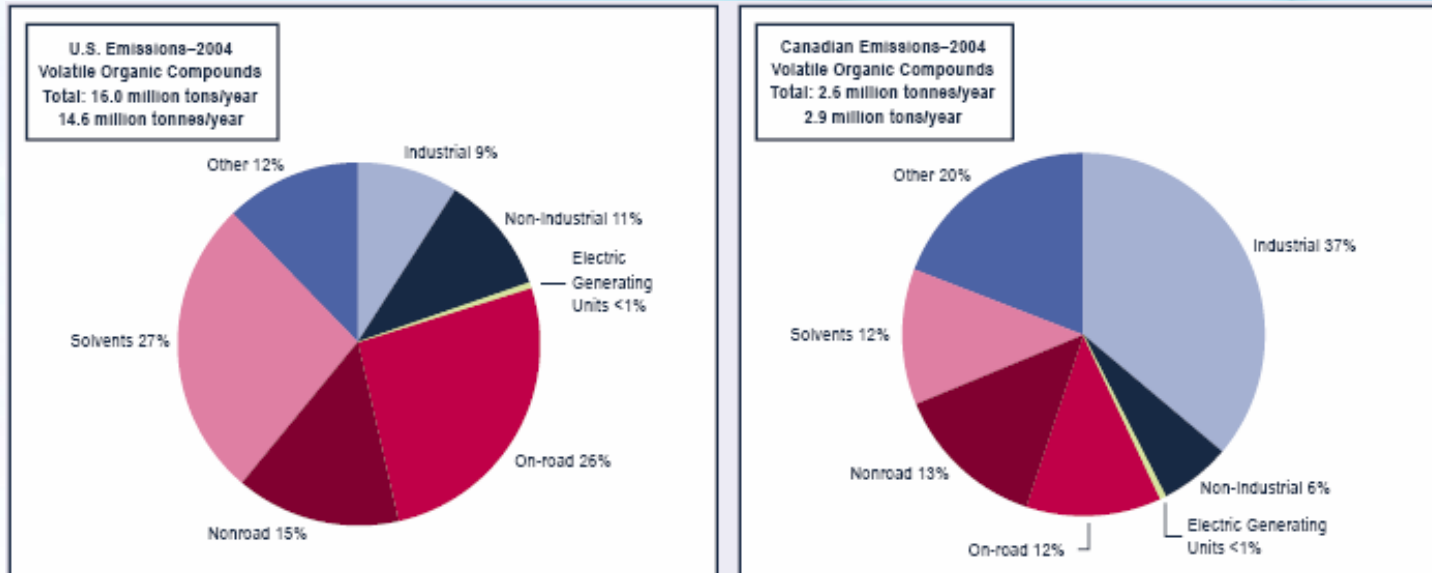


- On-road and non-road vehicles are the major sources of NOx emissions in the two countries





Distribution Of The Emission Sources (VOC Emissions)

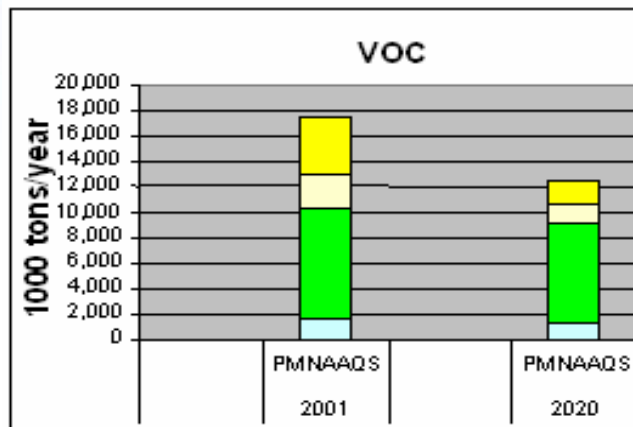
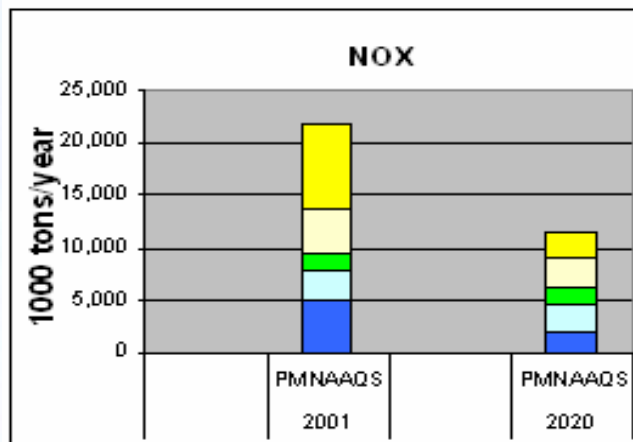


- The distribution of the VOC emissions is quite different.
- The oil & gas and the tar sands operations are the main sources of VOC emissions in Canada





Projected Emissions In The United States For NO_x And VOC



■ EGU Point ■ nonEGU Point ■ Stationary Nonpoint ■ Nonroad Mobile ■ On-road Mobile

- Projected emission reductions of ~50%
- Main reductions from on-road and non-road vehicles, and electric generating units
- Projected emission reductions of ~30%
- Main reductions from on-road and non-road vehicles, and stationary nonpoint sources, and industries

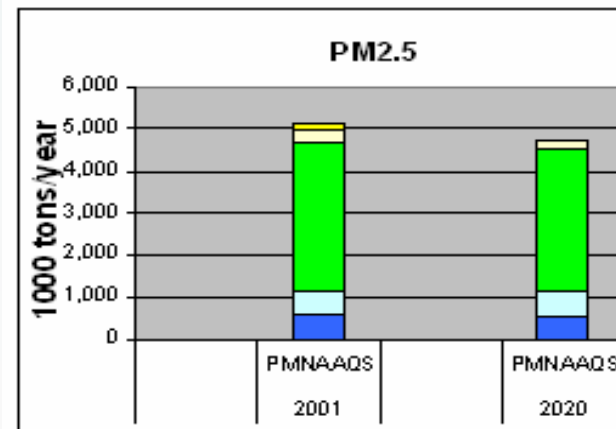
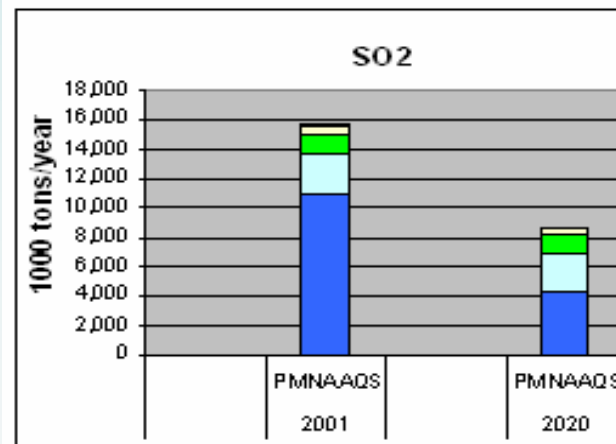
Source: Comparison of NO_x, SO₂, VOC, and PM_{2.5} Emission Projections for PM NAAQS Analysis





Projected Emissions In The United States For SO2 And PM2.5

- Projected emission reductions of ~50%
- Main reductions from electric generating units, non-road vehicles, and industries
- Projected emission reductions of ~10%
- Reductions from on-road and non-road vehicles, EGU, and other sources
- Small increase in the emissions from non-EGU point sources



■ EGU Point ■ nonEGU Point ■ Stationary Nonpoint ■ Nonroad Mobile ■ On-road Mobile

Source: Comparison of NOX, SO2, VOC, and PM2.5 Emission Projections for PM NAAQS Analysis

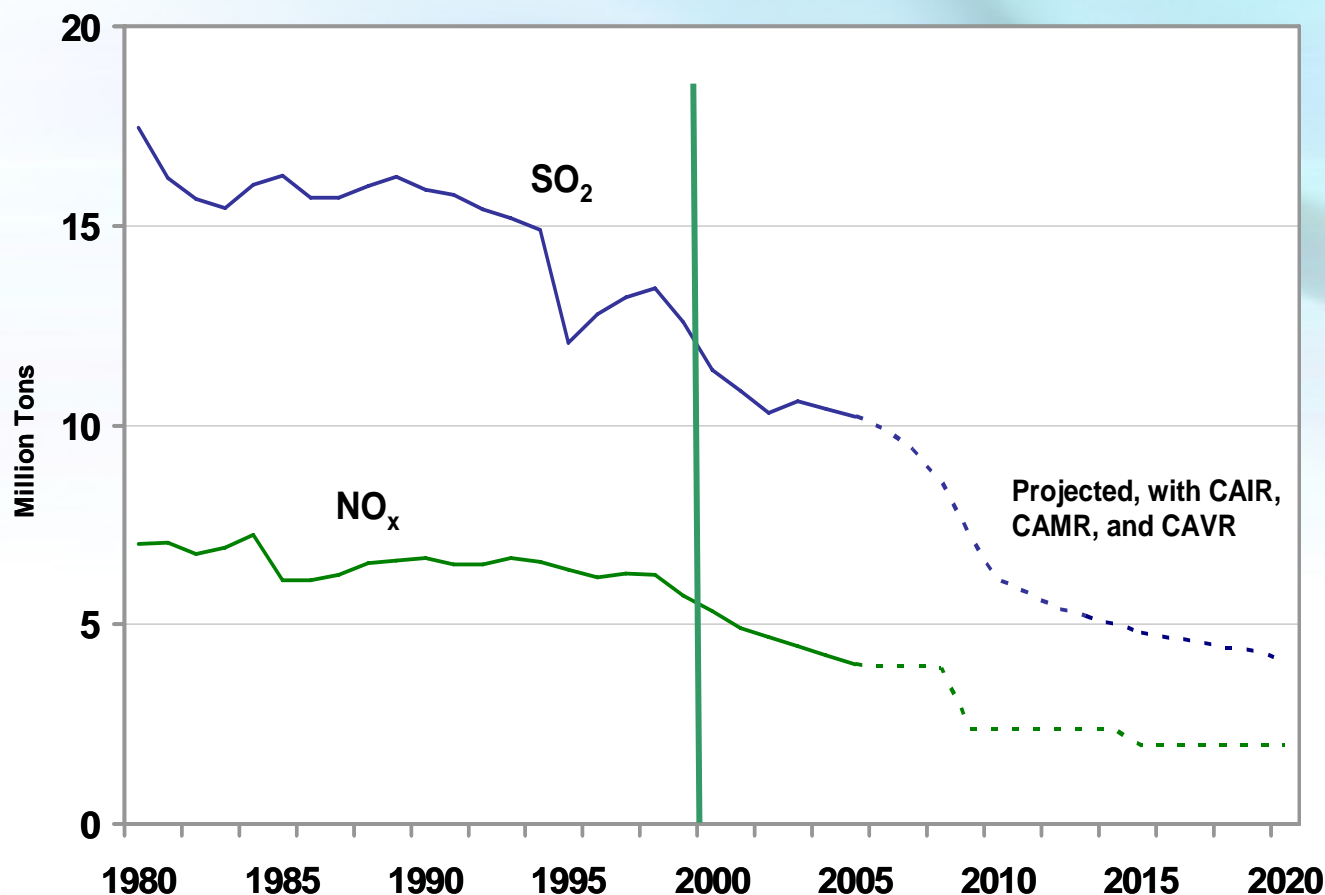


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Trends and Projected SO₂ and NO_x Emissions For Power Generation In The United States



Source: EPA's National Emissions Inventory and the Integrated Planning Model

- Historical reductions of ~30% for SO₂ and ~30% for NO_x between 1980 and 2000
- Projected emission reductions greater than 60% between 2000 and 2020

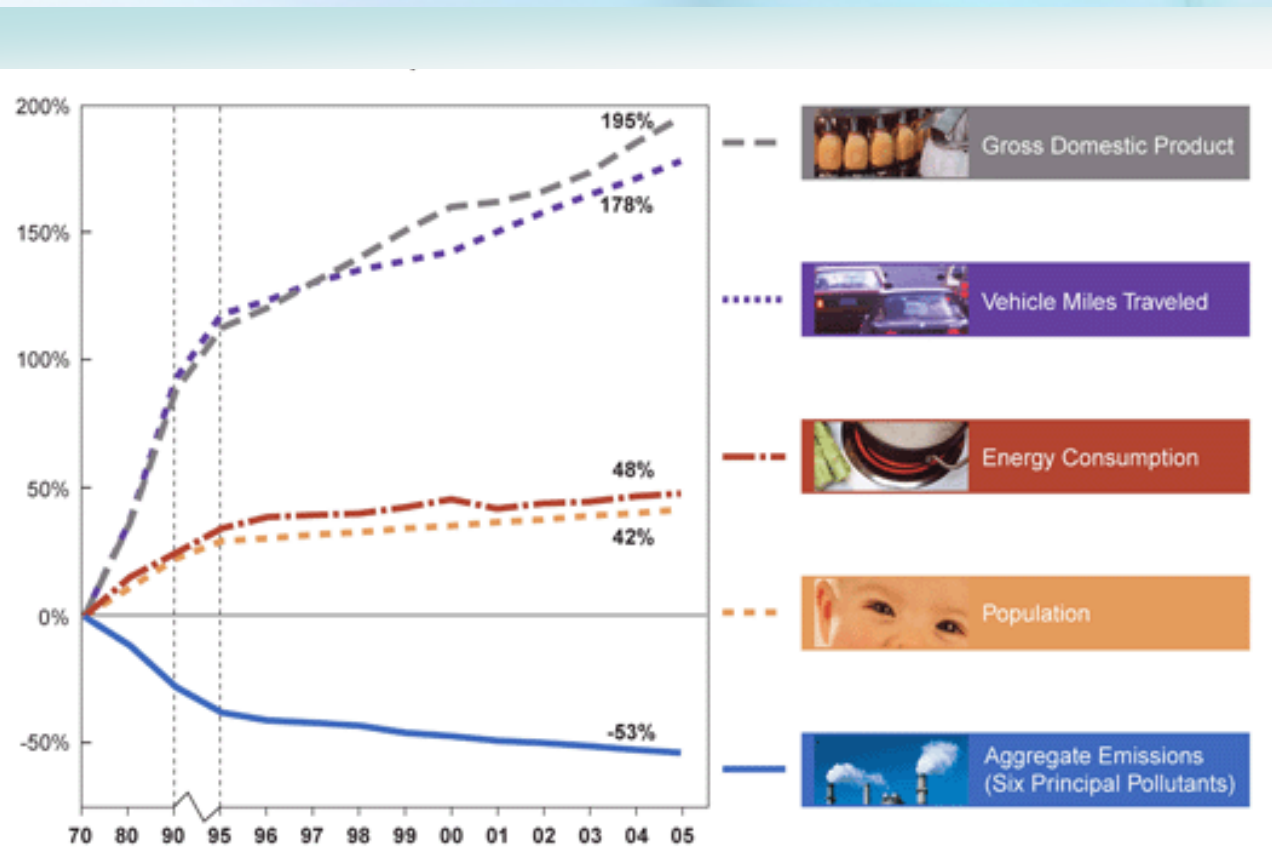


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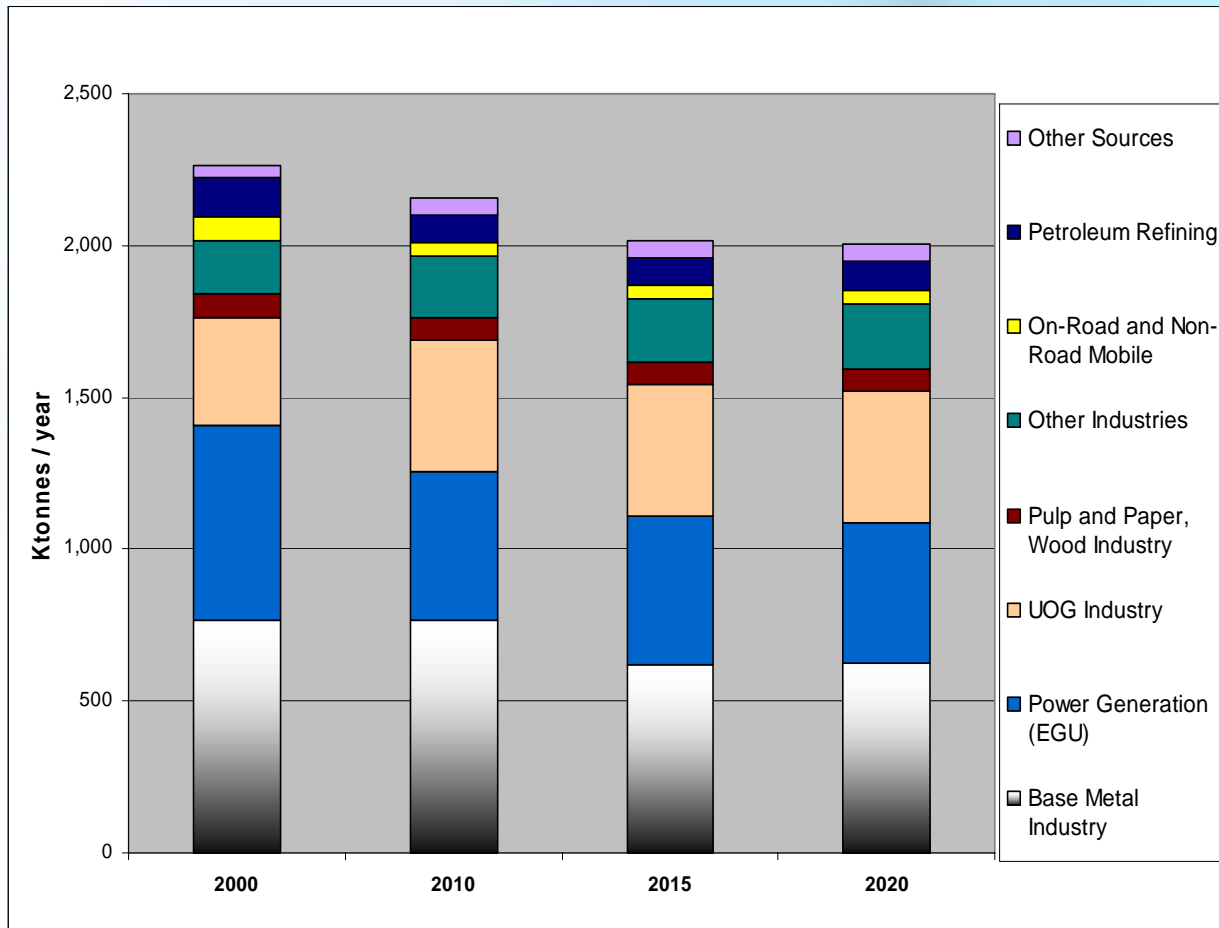
Comparison Of The Emissions And Socio-Economic Parameters In The United States



Data Sources: US Department of Commerce, Bureau of Economic Analysis, US Dept. of Transportation, Federal Highway Administration, US Census Bureau, and US Department of Energy.



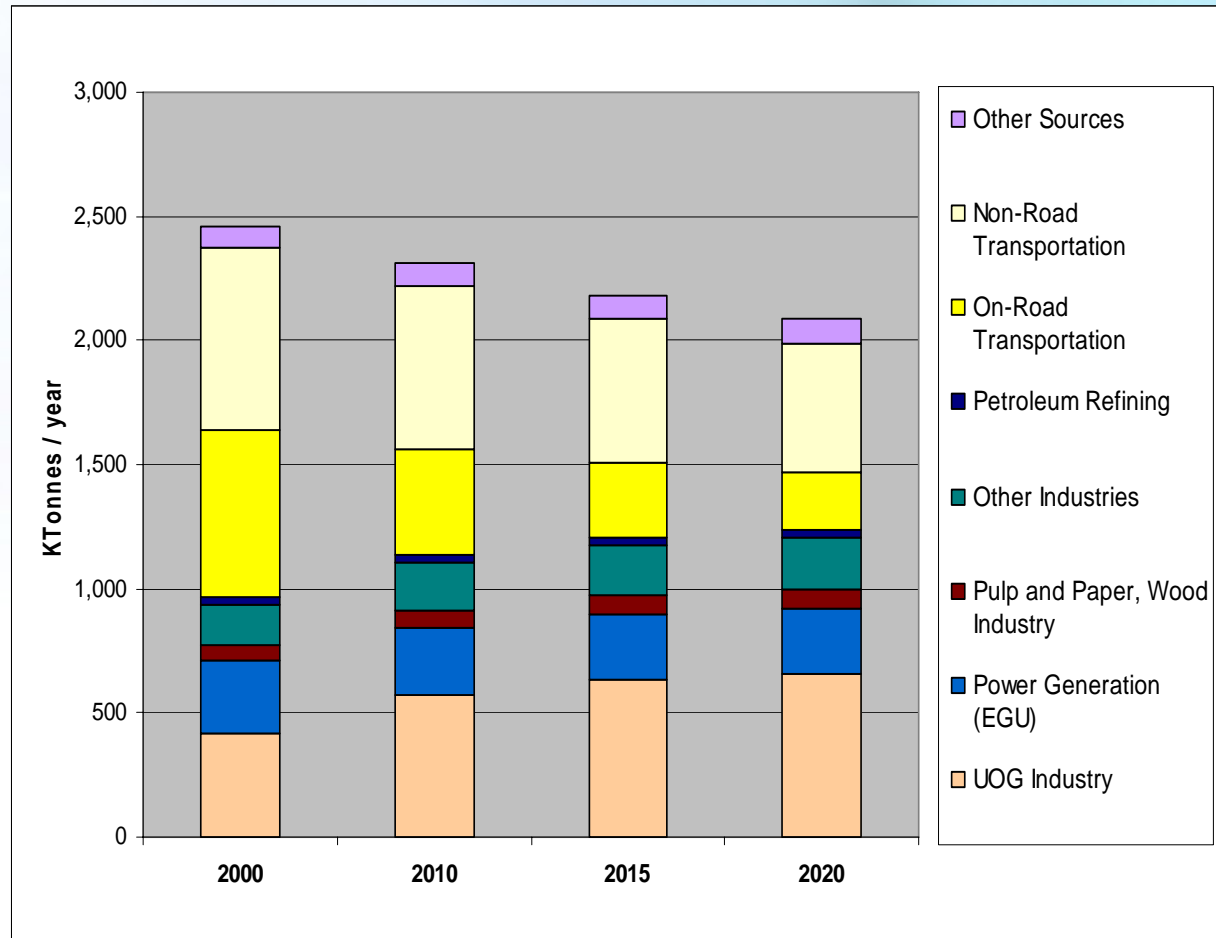
Projected SO_x Emissions In Canada



- Projected emissions reductions of ~12% between 2000 and 2020
- Main reductions from power generation, base metal industry
- *Reduction of 51% between 1980 and 2000*
- *Reduction of 65% in the eastern provinces of the country to reduce the acid rain*
- Increases in the emissions from the upstream oil & gas industry, oil sands, and other industries



Projected NO_x Emissions In Canada

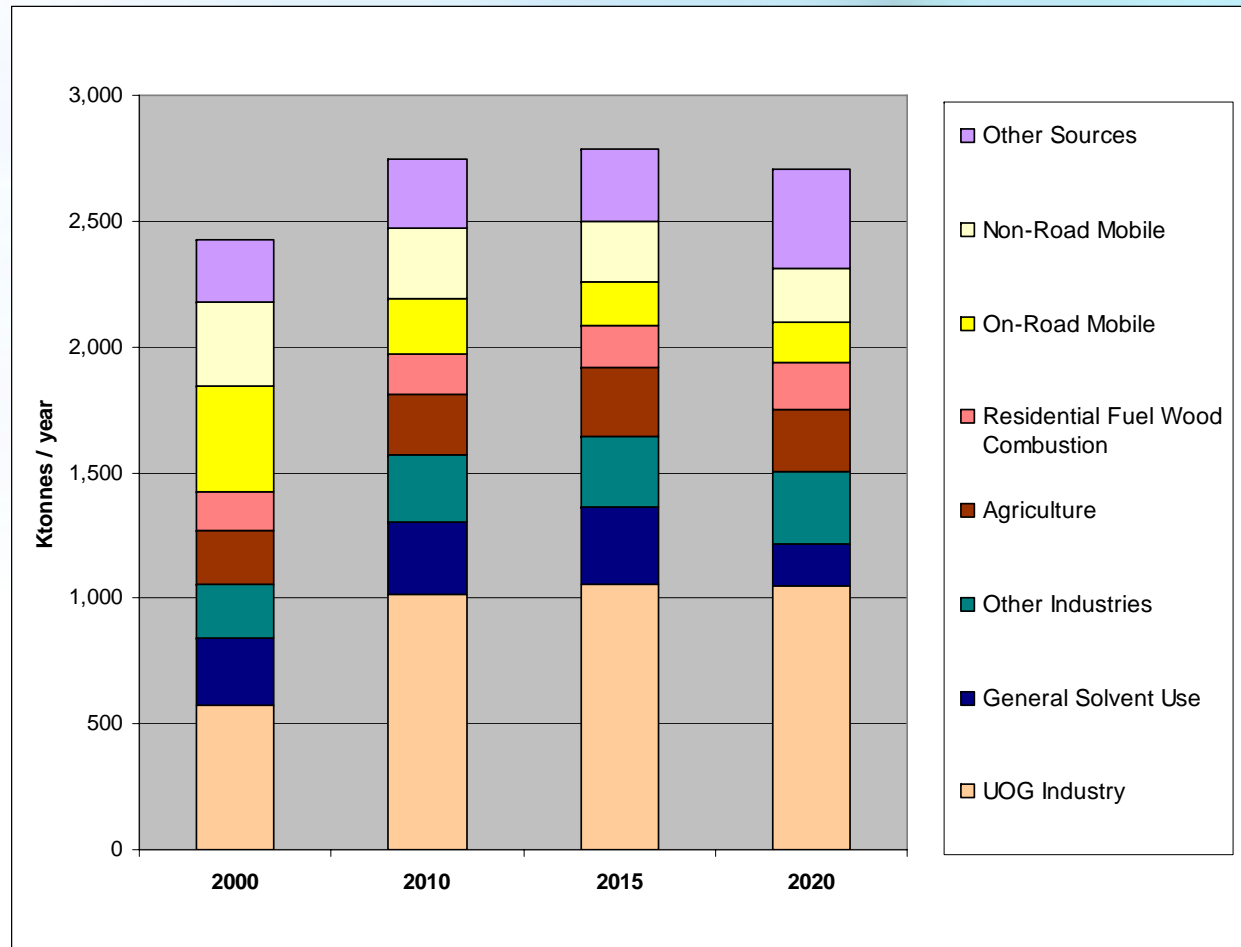


- Projected emissions reductions of ~15% between 2000 and 2020
- Main reductions from on-road, non-road vehicles, and electric generating units
- Increase in the emissions from the upstream oil & gas industry, oil sands, and many other industries





Projected VOC Emissions In Canada

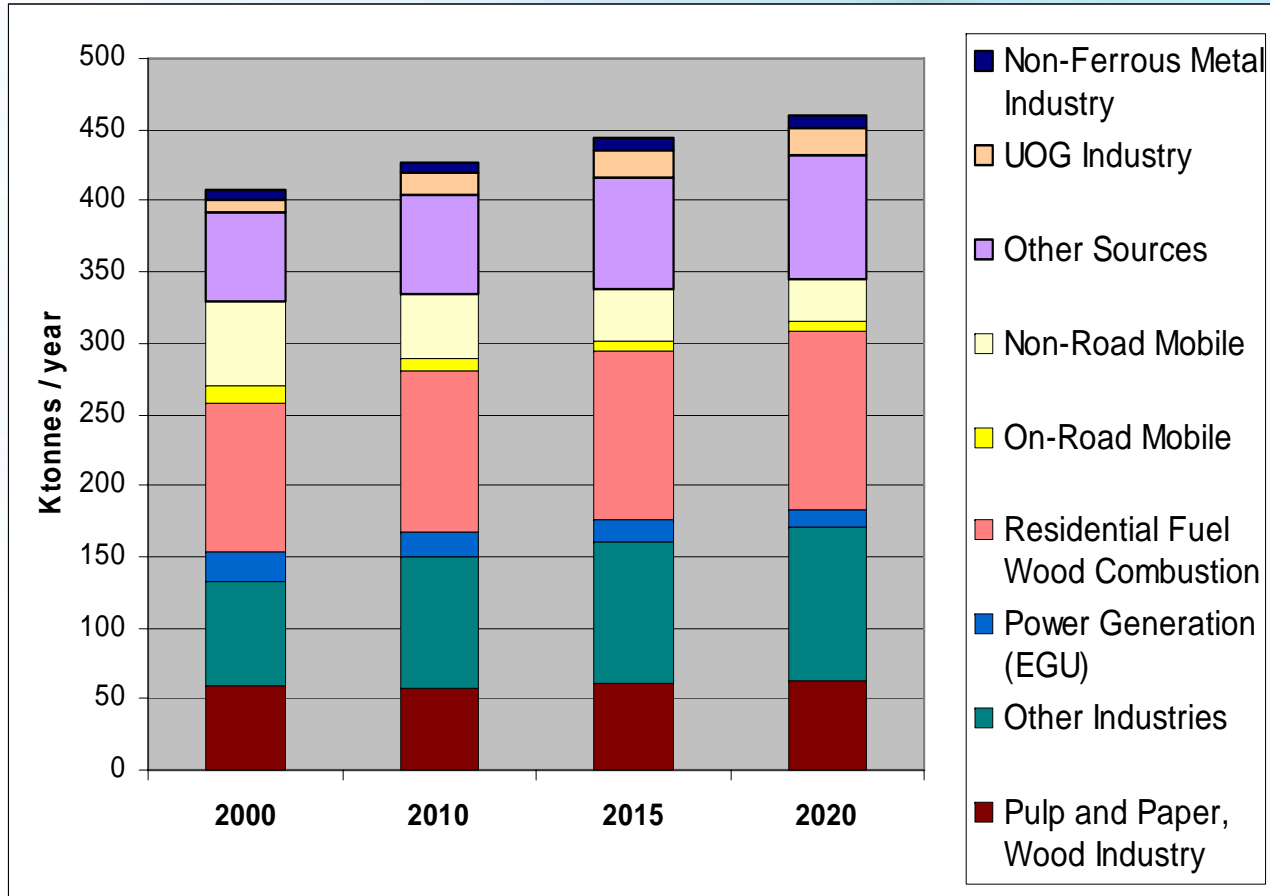


- Projected emissions increases of ~12% between 2000 and 2020
- Main increase in the emissions from the upstream oil & gas, oil sands, and other industries
- Reductions from on-road and non-road vehicles, general solvent use





Projected PM2.5 Emissions In Canada

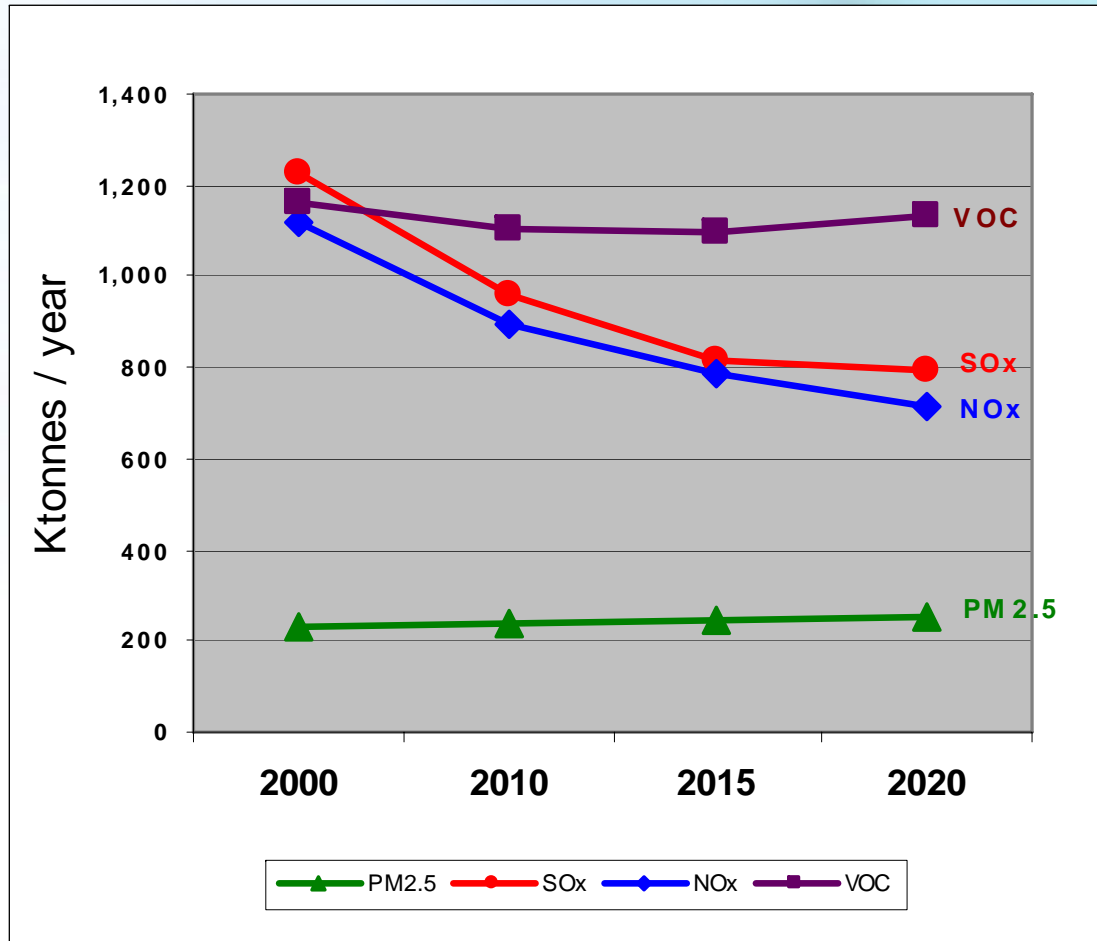


- Projected emissions increase of ~13% between 2000 and 2020
- Increase in the emissions from various industries and sources, including residential fuelwood combustion
- Reductions from electric generating units, on-road, non-road vehicles (40 to 50%)





Emission Projections For Eastern Canada

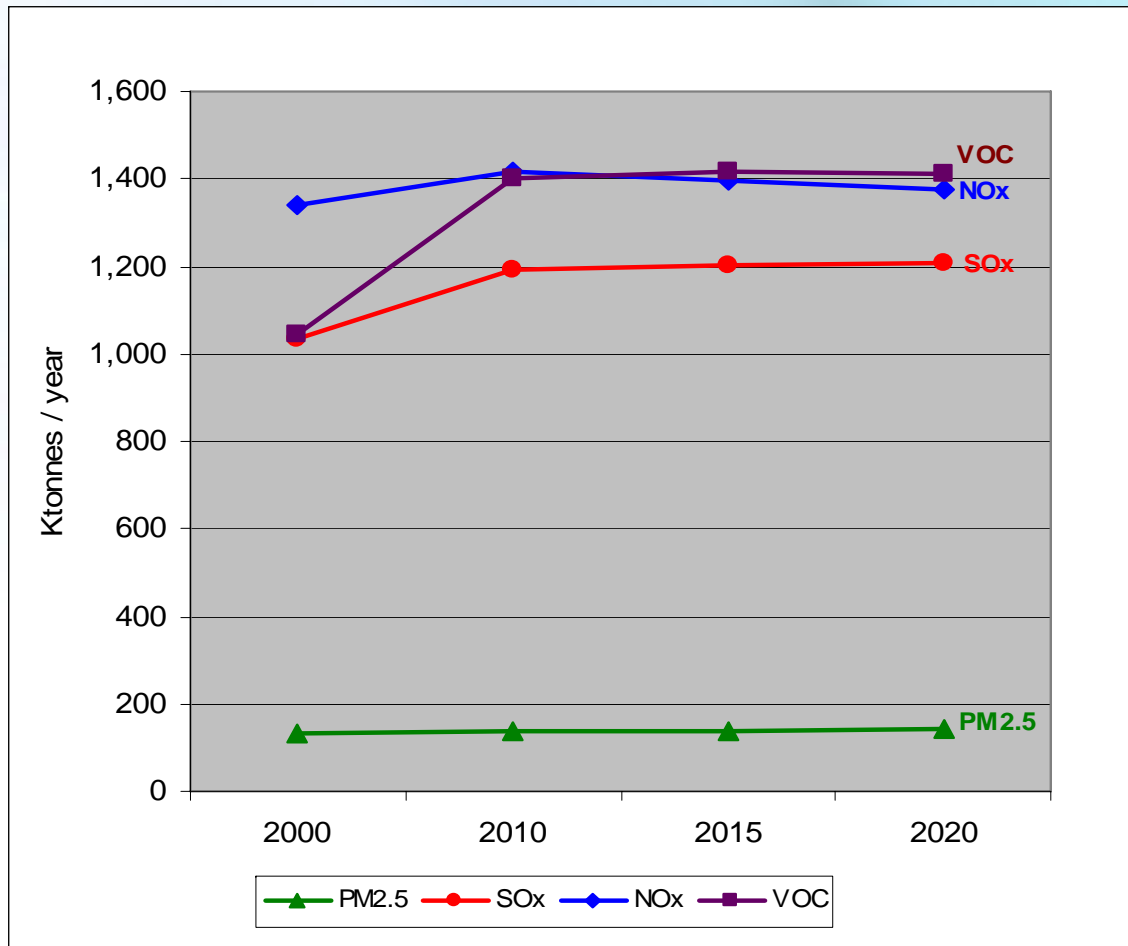


- Decrease in SOx and NOx emissions of ~36%
- Small decrease in VOC emissions of ~3%
- Increase in PM2.5 emissions of ~9%





Emission Projections For Western Canada

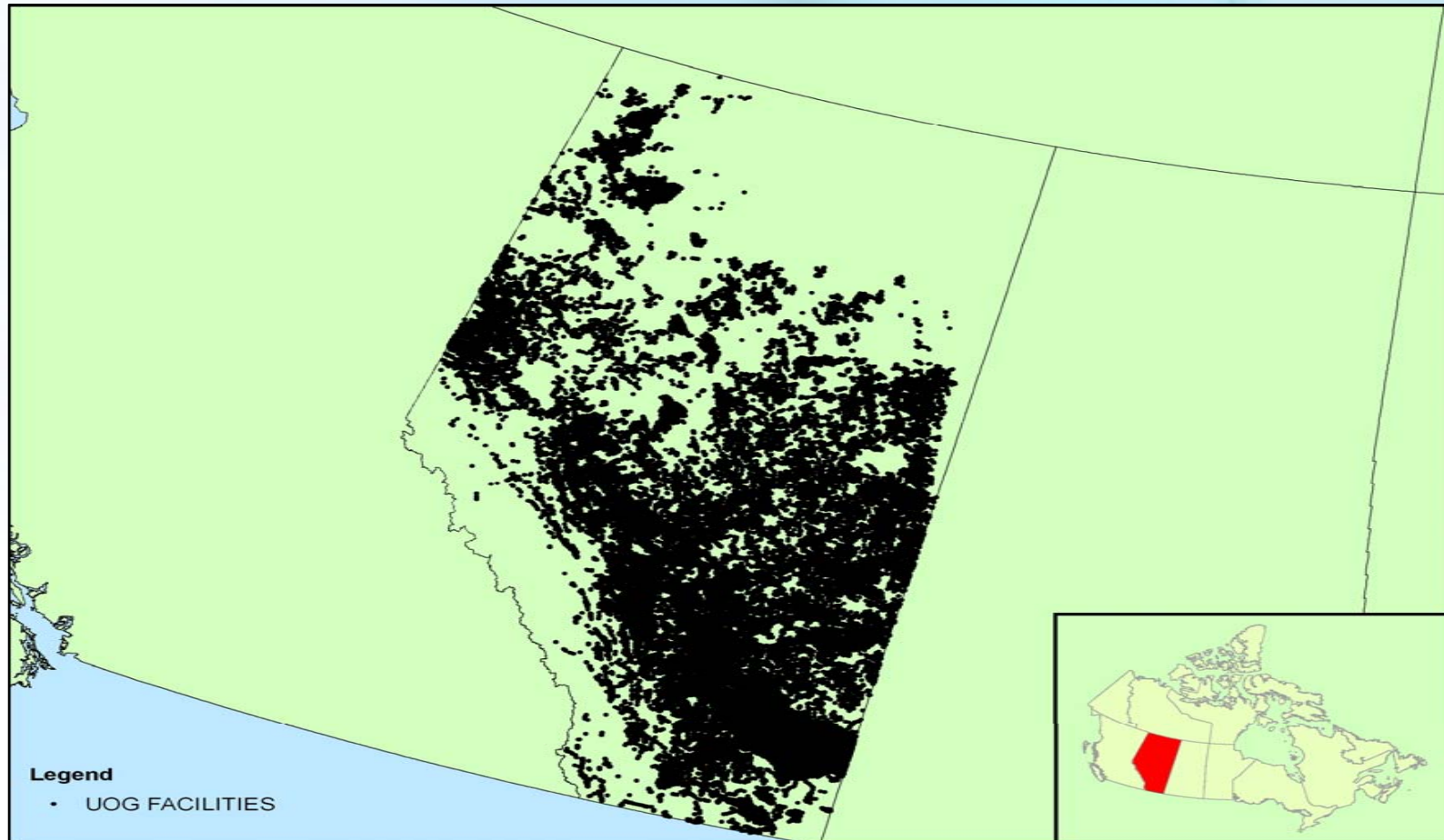


- Increase in SOx emissions of ~17%
- Increase in NOx emissions of ~3%
- Increase in VOC emissions of ~35%
- Increase in PM2.5 emissions of ~7%





Magnitude Of The Oil & Gas And Oil Sands Industry In Canada





Summary

- In the United-States
 - Large reductions in the SO₂ and NO_x emissions have been achieved since the 1980s
 - A number of emission reduction rules are currently in place and are expected to further decrease the emissions for smog causing pollutants (SO₂, NO_x, VOC, PM_{2.5}) in the future

- In Canada
 - A number of regulations and initiatives have allowed for large reductions in the emissions for SO₂ and NO_x during the past two decades
 - New regulations and initiatives will provide additional reductions SO₂ and NO_x
 - Increases in the emissions for VOC and PM_{2.5} are expected due to increases in the industrial emissions and residential fuel combustion
 - New emission reduction regulations and initiatives are currently being developed, which will provide further emission reductions in the future

