Assessing the Environmental and Health Impacts of GHG Mitigation

Overview of Analysis Work under Canada's National Implementation Planning Process

Presentation to Washington Ancillary Benefits Workshop

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Introduction - Some Acronyms

- NIS - National Climate Change Implementation Strategy
- NAICC - National Air Issues Coordinating Committee
- IT - Issue Tables
- SIA - Science, Impacts and Adaptation Group

- AMG - Analysis & Modelling Group
- EHI - Environmental and Health Impacts
- CAC's - Criteria Air Contaminants

Purpose of this Presentation

- Outline Canada's approach to climate change and clean air policy
- Describe overall approach to assess EHI and estimate clean air benefits
- Provide status report on work to date
- Discuss key methodology issues
- Outline expected results
- Situate EHI work in policy context

Canada's Approach to Climate Change

- Post-Kyoto process to examine:
  - "the impacts, costs and benefits of implementing the Kyoto Protocol and the various options for implementing ..."
  - **Canada's commitment is -6%**
- Intent is to develop Canada's National Implementation Strategy
  - established 15 "Issue Tables" for most sectors
  - Issue Tables developed options to reduce GHG's
- **Analysis & Modelling Group (AMG)**
  - established to conduct socio-economic analyses and interpret results for decision-makers

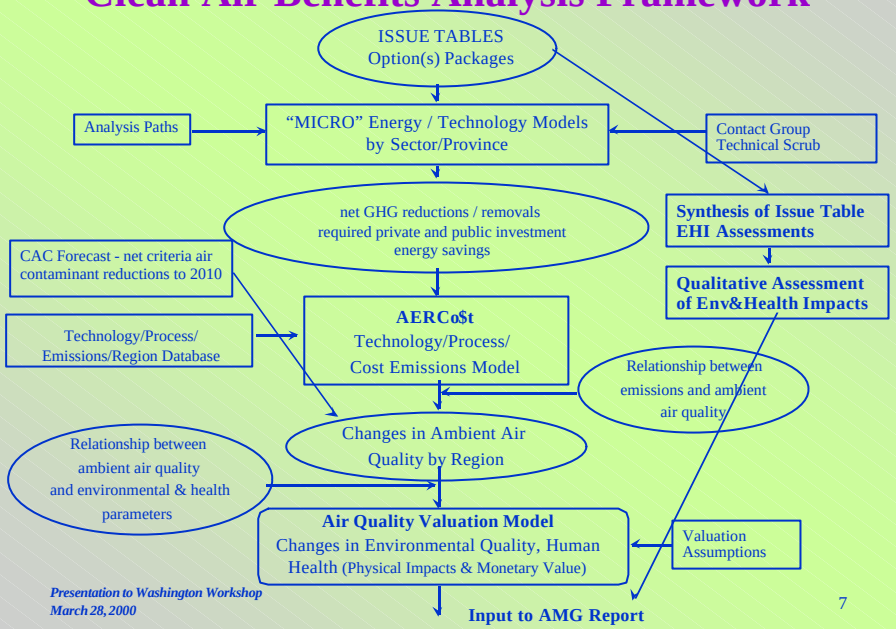
AMG Responsibilities

- Provide analysis guidance to Issue Tables
- Develop energy & emissions reference case
- Obtain stakeholder involvement through CC Economic Analysis Forum (CCEAF)
- "Roll-up" Issue Table "options"
- Conduct & interpret socio-economic analyses
  - **micro** analysis of costs, energy, emission reductions
  - **macro** analysis of national/regional/sector impacts
  - environmental & health impacts of proposed options

Assessing Environmental&Health Impacts
AMG Framework

- Elements include:
  - IT estimates of changes in CAC's for measures
  - IT assessment of other environmental and related health impacts
  - separate assessment of climate change impacts
  - sequential analysis framework to estimate "clean-air" benefits
- EHI Sub-Group reports to AMG
- AMG reports to NAICC/Ministers

Clean Air Benefits Analysis Framework



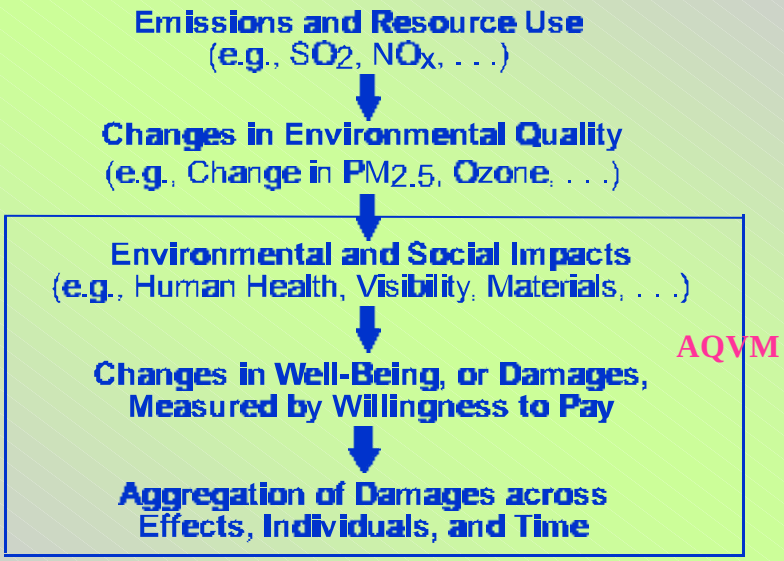
Status of EHI Work

- May 1999 CCEAF methodology workshop
- Established multi-stakeholder advisory group:
  - advice on direction of work
  - interpretation and communication of results
- Status of work to date:
  - Completed work to link GHG, CAC inventories
  - Preliminary base case CAC forecast
  - Synthesis of Issue Table EHI assessments
  - Developing estimates of CAC changes for options
  - Initiated air quality analysis work
  - Reviewing valuation methodology
  - Examining qualitative impacts

Environmental & Health Impacts
Quantitative Estimates

- Focus on quantifying "clean air" benefits due to reduced ambient air concentrations
- Consideration of both health and environmental end-points
  - Quantify in both physical and monetary terms based on concentration-response and incident values from the literature
- Using Air Quality Valuation Model (AQVM) developed for Canada

Damage Function Approach



Air Quality Valuation Model - Approach

- Air quality baseline and changes by location, time period, air pollutant (PM/SO_4, SO_2, O_3)
- Population data by location and time period
- Concentration-response functions for health and environmental endpoints
- Monetary valuation for each endpoint
- Aggregation and discounting procedures
- Treatment of statistical uncertainty and unquantified omissions, biases, and uncertainties
- Sensitivity analyses

Previous Valuation Work in Canada

- Acid Rain Task Group (Nov'94)
- Climate Change National Action Plan (1995)
  - Response Options with Multiple Benefits
- Cleaner Vehicles & Fuels (1995)
- Sulphur in Gasoline (1997)
- Canada Wide Standards for PM&O_3 (1999)
  - estimated control costs and health & environmental benefits
  - established Expert Panel to review methodology due to controversy over analysis approach
  - report expected summer 2000

Health Effects Considered

- Mortality
- non-fatal cancer
- respiratory and cardiac hospital admissions
- asthma symptom days
- restricted activity days
- respiratory symptoms
- chronic bronchitis
- emergency department visits

Ecological Effects Considered

- material damages
- household materials soiling
- visibility
- recreational fishing
- productivity of agricultural crops

Environmental&Health Impact Assessment
AMG Framework

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Quantifying Climate Change Impacts

- Important component of overall EHI framework developed by AMG
- Need to develop and communicate improved understanding of both:
  - expected impacts of climate change that will occur and
  - potential impacts that could be avoided
- State-of-the-art improving but more Canadian effort required

Key Methodology Issues

- Appropriateness of energy based emissions factors
- Impact of technology on emissions intensity
- Future trends in emissions without policy action
- Geographic changes in emissions, air quality
- Estimating changes in ambient air quality
- Existence of threshold for health effects
- Physical impacts vs. monetary valuation
- Knowledge of relative importance of other potential impacts
- Role of benefit/impact estimates in developing national strategy

Health Effects and Values

Event category	Total avoided health events[1]	Present value benefits (1996$ thousand)[1]	Type of estimate
Cardiac hospital admissions	5,710	$9,949	COI
Respiratory hospital admissions	6,774	$9,274	COI
Emergency dept. visits	31,408	$3,713	COI
Mortality	32.824	$27.914.175	Wage-risk studies
Chronic bronchitis	85,352	$4,709,321	CVM
Child bronchitis	658,256	$42,322	COI
Asthma symptom days	8,868,053	$84,612	CVM
Acute respiratory symptoms	46,826,740	$456,818	CVM
Restricted activity days	97,345,840	$1,474,014	CVM & COI
Total	153,860,957	$34,704,198	

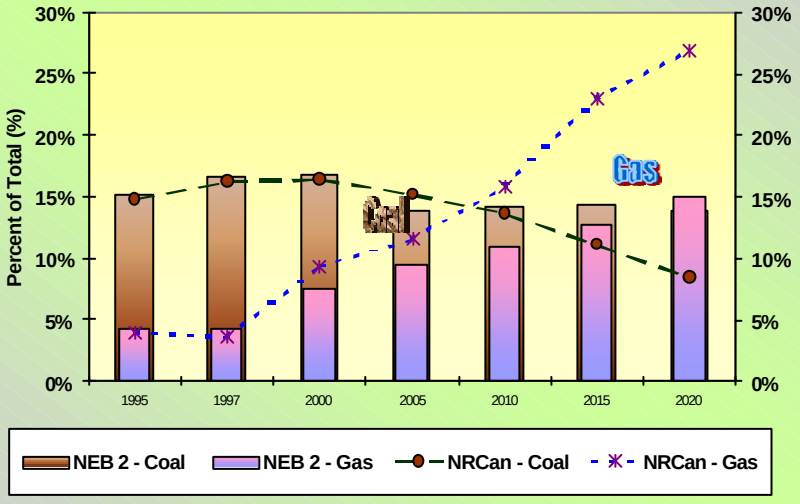
[1] Total avoided health events and present value benefits of achieving alternative reductions in ambient concentration of $PM_{2.5}$ (30 ug/m^3, 24-h) for the period 2005-2035 (1996$ thousand, discount rate 7.5%, and base year 1996)

Analysis Work to Date - Insights (1)

- **Roll-up of Issue Table Options**
  - large potential to reduce emissions at no/low cost
  - wide range of domestic actions needed to meet target
  - higher cost options in industry, transportation
  - electricity: moderate cost options available
  - sector, international flexibility lowers total costs
  - nature of measures influences CAC reductions
- **Energy & Emissions Outlook**
  - larger emissions gap than previous projections
  - ***significant trend to gas fired electricity generation***
  - strong growth in upstream oil&gas emissions

Energy & Emissions Forecasts

Coal/Gas Share of Total Generation



Analysis Work to Date - Insights (2)

- **GHG-CAC Relationship**
  - **energy combustion large contributor to both GHG emissions and common air pollutants**
- Base Case CAC Forecast
  - large reductions in transportation sector base case CAC's due to fuel changes, low emission vehicles
  - significant reductions in SOx, PM from electricity
  - large growth in residential biomass PM, VOC's
- Qualitative EHI Assessments
  - most significant CAC reductions due to fuel switching, largest contribution from transportation sector
  - more focus on relative magnitude of potential impacts

Emissions Share - Key Sectors

SECTOR	GHG	$PM_{2.5}$	SOx	NOx	VOC
Transportation	**25**	5.0	5	**59**	**20.8**
Electric Power	**18**	1.3	**21**	**11**	0
Pulp & Paper	2	3.4	3.5	2	0.5
Mining & Smelting	0.6	0.6	**35**	0.1	0
Iron & Steel	2	2.5	1	0.6	0.7
Petroleum Refining	0.3	0.2	5.6	1.1	1.2
Upstream Oil & Gas	**15**	0.1	**12.1**	**11.5**	**18.6**
Residential Wood	0	**13**	0.7	0.8	**15.3**

Estimates for 1995 from Canada's GHG & CAC inventories

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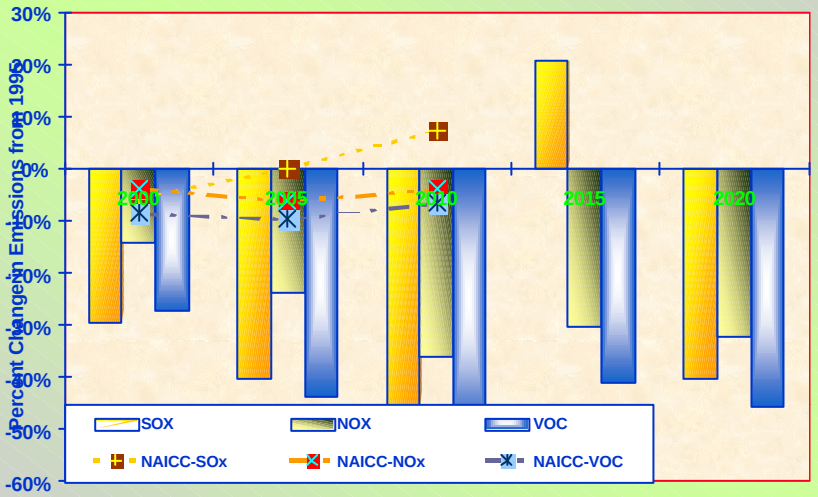
Transportation CAC Forecast Comparison

1996 vs. Preliminary 1999



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Electricity CAC Forecast Comparison

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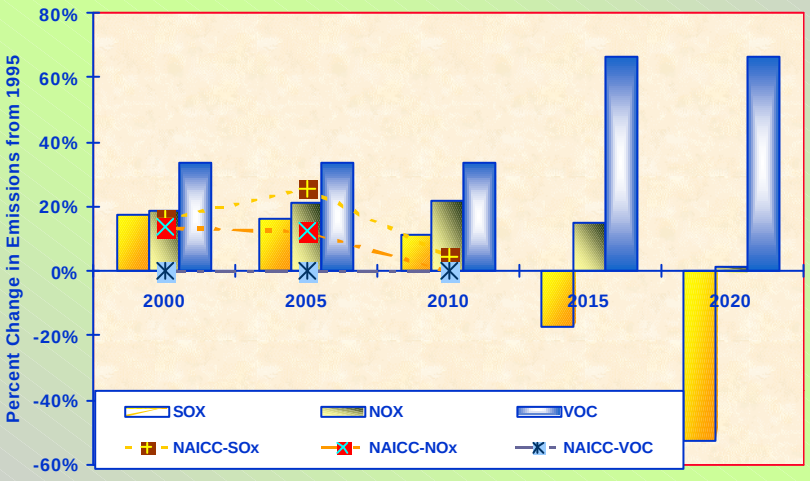

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Environmental & Health Impacts
Qualitative Assessment

- Complementary approach to quantitative assessment of clean air benefits
  - Initial synthesis of IT assessments
  - *Parallel work to examine health impacts*
  - Intend to identify and address important gaps in Issue Table assessments
  - Recognize inability to properly quantify some important impacts
- Comparative framework to identify differences among possible options
  - Experts to help assess relative impacts of options

Concluding Observations

- No consensus yet on **how** to consider potential co-benefits in strategy development
- Expect considerable differences among domestic options in CAC reductions, co-benefit estimates
- Even greater differences among options with more versus less international flexibility
- Actions to reduce GHG emissions will also reduce CAC's at lower costs than end-of-pipe controls
- Time-frame for co-benefits analysis results:
  - target date for preliminary results in June
  - analysis results to inform political decisions Fall 2000