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Second Prospective Section 812
Benefit-Cost Analysis of the Clean Air Act:
Presentation of Draft Cost Report

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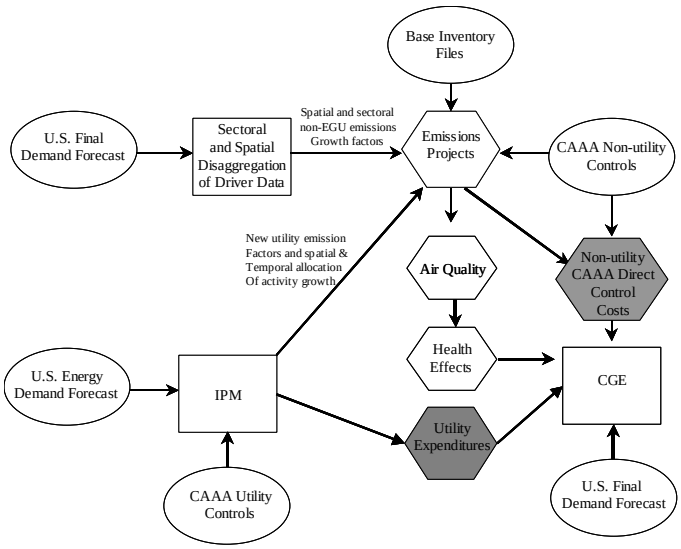
Introduction:
Costs in the 812 Analytic Framework



Overview

- Methods Summary
- Approach by Sector
- Example Cost Analysis
- Key Issues
  - Learning curve effects
  - Choice of discount rate
  - Costs of unidentified measures
  - Treatment of manufacturer profits
- Aggregate Results

Methods Summary

- Costs Evaluated
  - Direct Expenditures on CAAA Compliance
  - Productivity and Output Impacts (including tax interaction effects) addressed at a later date
- Sector-based approach
  - EGUs
  - Non-EGU Point Sources
  - Onroad Vehicles
  - Nonroad Vehicles
  - Nonpoint (area) sources

  } Federal, state, and local measures on the books as of September 2005.
  - Additional local controls necessary to comply with the NAAQS
- Cost estimates consistent with emission reductions estimated in the emissions analysis.
- For most source categories, we estimate incremental CAAA costs rather than estimating with-CAAA and without-CAAA costs separately.
- Costs estimated as total annualized costs for 2000, 2010, and 2020 based on a 5 percent discount rate.

EGU Cost Analysis

- IPM primary tool for estimating EGU costs
- Model estimates costs for with-CAAA and without-CAAA scenarios. Difference represents incremental costs of CAAA.
- IPM Strengths
  - Optimization capabilities.
  - Considers several real-world constraints for EGUs (e.g., transmission constraints).
  - Detailed treatment of the coal market (e.g., captures inter-regional differences in coal sulfur content).
  - Forward-looking.
- IPM Limitations
  - Not ideal for retrospective analysis.
  - Does not capture costs of sunk investments.

EGU Cost Analysis (continued)

Implications of IPM Limitations

- Model does not estimate capital costs for equipment installed between 1990 and 2007 (beginning of model time horizon).
- Separate IPM model run necessary to estimate costs for 2000 target year

Approach for Estimating Annual EGU Costs

- Run IPM to estimate annual fuel costs, other annual O&M, and annualized capital costs of investments made during IPM time horizon.
- External to IPM estimate capital costs associated with emission control devices installed between 1990 and start of IPM time horizon based on IPM cost equations.
- Also, external to IPM estimate capital costs associated with fuel switching capital installed between 1990 and beginning of IPM planning horizon as a result of the Amendments.
- Sum results from the previous three steps to estimate total annual EGU costs.

On-road Vehicle Cost Analysis

On-road vehicle costs reflect three types of CAAA requirements

- Emission standards: Costs= *cost per vehicle sold* x *vehicle sales*
- Fuel requirements: Costs = *cost per gallon of fuel consumed* x *fuel sales*
- I&M requirements: Costs = *cost per registered vehicle* x *expected number of inspections*

Major data sources

- Unit cost estimates largely from EPA RIAs
- Annual vehicle sales, fuel consumption, and registrations estimated based on Section 812 VMT projections and motor vehicle data from AEO 2005.

Key Assumptions

- Reductions in fuel consumption represent a cost savings.
- Vehicle owner's time for I&M represents a cost.

Non-road Vehicle Cost Analysis

- Costs estimated on a per engine sold basis, with a few exceptions:
  - Nonroad Diesel Sulfur Fuel Standards – costs estimated per gallon of fuel sold.
  - S-I Marine Exhaust, Commercial Marine, and Locomotive Emission Standards – costs estimated per ton of emissions reduced.
- Major data sources
  - Unit cost estimates are rule-specific, derived largely from EPA RIAs.
  - Sales by engine category drawn from EPA RIAs for the relevant rulemaking (plan is to use NONROAD sales for next draft).
  - For costs estimated per ton of emissions reduced, emission reductions taken from Section 812 emissions analysis.
- Key Assumptions
  - Reductions in fuel consumption resulting from CAAA non-road engine and fuel requirements represent a cost savings.

Non-EGU Point and Non-point Source Cost Analysis

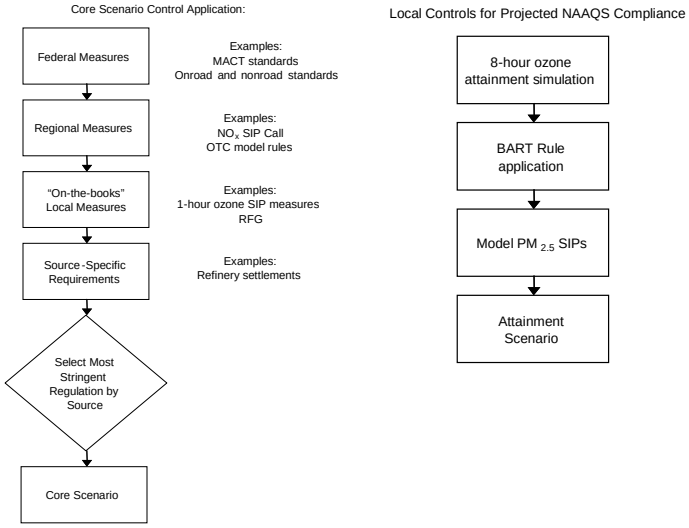
- For many rules and regulations, estimate costs based on $ per ton of reduced emissions.
- AirControlNET primary analytic tool for estimating $/ton.
- AirControlNET Strengths
  - Links control technologies to individual sources and derives $/ton estimate by technology for individual non-attainment areas.
  - Contains detailed cost and control efficiency data.
  - Identifies least-cost strategy for multi-pollutant compliance.
- AirControlNET Limitations
  - Static (not forward looking).
  - Some cost inputs based on older studies that have not been updated.

Non-EGU Point and Non-point Source Cost Analysis (continued)

Summary of Cost Estimation Approach, by Program

Major Program	*Approach*	*Key Data Source*
VOC RACT and CTG	Assumed to be required in moderate and above 1-hour ozone nonattainment areas. Costs estimated based on $ per ton of VOC reduced.	First Prospective
OTC State Model Rules	Apply cost per ton values to emission reductions associated with the OTC model rules for NO_x and VOC.	2001 OTC Analysis
NOx SIP Call	AirControlNET cost equations applied by source category/ expected control technique.	AirControlNET Database
MACT Standards	Annualized costs by MACT Rule	OAQPS MACT Database
Refinery Cases and Settlements	AirControlNET applied SO_2 controls to affected units and estimated costs of these controls.	AirControlNET Database
1-Hour Ozone SIP Measures	AirControlNet analysis to estimate least-cost approach for meeting VOC and NOx reduction targets. SIP reviews for South Coast and Bay Area cost estimates.	AirControlNET Database
PM10 SIP Measures	For serious PM_{10} nonattainment areas, reviewed PM_{10} implementation plans. Typical measures applied to moderate PM_{10} nonattainment areas.	AirControlNET Database

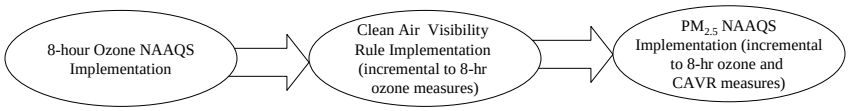
Local Controls Analysis



Local Controls Analysis (continued)

- Sector-specific costs described above reflect Federal, state, and local programs on the books as of Sept. 2005.
- Need to account for additional local measures necessary for 8-hour ozone and $PM_{2.5}$ NAAQS attainment.
- Sequential approach for estimating local control costs.
- Use AirControlNET to estimate costs for each component of local controls analysis.

Local Controls Analytic Sequence



Local Controls Analysis (continued)

8-Hour Ozone NAAQS (VOC and NOx)

- RACT
- I/M
- RFP
- Additional NOx and VOC Reductions to meet reduction targets

Clean Air Visibility Rule (SO2 and NOx)

- Assumed "medium stringency" scenario from CAVR RIA.
- Applies to facilities built between 1962 and 1977 that have the potential to emit more than 250 tons of NOx and SO2 combined.
- $4,000 per ton limit, consistent with CAVR RIA medium stringency option.

$PM_{2.5}$ NAAQS

- Model SIP approach (no emission targets).
- Controls for NO_x, SO_x, and direct PM emissions.
- $10,000 per ton upper limit on costs for NO_x and SO_x controls.

Detroit-Ann Arbor Example

Detroit-Ann Arbor Example (continued)

Provision	Annual Cost (Million 1999$) Nonpoint	Onroad	Nonroad	NonEGU	EGU	Total
Electric Utility Controls					82.1	**82.1**
Title I and II Standards:	-	-	-	-	-	**-**
National VOC Rules	4.2	-	-	1.1	-	**5.3**
Motor Vehicle/Fuels	-	-	-	-	-	**-**
Motor Vehicle Emission Standards	-	111.8	-	-	-	**111.8**
Fuels	-	58.1	-	-	-	**58.1**
Nonroad Engines/Vehicle Standards	36.5	-	-	-	-	**36.5**
Area Specific	-	-	-	-	-	**-**
California LEV	-	-	-	-	-	**-**
Motor Vehicle I/M programs	-	-	-	-	-	**-**
RACT and New CTGs	3.0	-	-	6.0	-	**9.0**
NOx SIP Call	-	-	-	0.3	-	**0.3**
Ozone Transport Commission Model Rules	-	-	-	-	-	**-**
Refinery Settlements	-	-	-	-	-	**-**
1-Hour Ozone NAAQS	12.0	-	-	70.9	-	**82.9**
PM_{10} NAAQS	-	-	-	-	-	**-**
8-Hour Ozone NAAQS	22.7	132.0	-	0.2	-	**154.9**
$PM_{2.5}$ NAAQS	-	2.9	0.5	21.6	3.7	**28.6**
Clean Air Visibility Rule	-	-	-	15.1	-	**15.1**
Additional Estimated Cost for Unidentified Controls (@$10,000/ton)						
Residual 8-Hour Ozone Reductions						**-**
TOTAL						**584.5**

Key Issues - Learning

- Background
  - Analytic Plan Proposal
  - The SAB Council's Advice
- Overview of Project Team's Approach
  - Selective application of learning curve adjustments.
  - Adjustments to backcasted and projected cost estimates.
  - Motor vehicle learning curve adjustments capped to two doublings in cumulative production, consistent with mobile source RIAs.

Control Technology/ Source Category	Learning Rates	Cumulative Production Metric
Flue Gas Desulfurization	Capital Costs: 11% O&M Costs: 22%	Cumulative EGU FGD capacity
Selective Catalytic Reduction	Capital Costs: 14% O&M Costs: 21%	Cumulative EGU SCR capacity
Selective Non-catalytic Reduction	Capital Costs: 15% O&M Costs: No adjustment	Cumulative number of SNCR installations
Motor Vehicle Engine Controls	Fixed Production Costs: No adjustment Variable Production Costs: 13% Vehicle Operating Costs: No adjustment	Cumulative vehicle production

Key Issues – Learning (continued)

- Impact on Cost Estimates
  - Effect small for EGUs but more significant for motor vehicles.
  - Overall effect: Total costs 6 percent lower than without learning curve adjustments

	Onroad Vehicle Engine Controls* (billions of dollars)			***Electric Utilities (billions of dollars)***		
Year	*With Learning*	*Without Learning*	*% Difference*	*With Learning*	*Without Learning*	*% Difference*
2000	$4.4	$5.4	-24.9%	$1.2	$1.1	1.2%
2010	$8.7	$10.8	-24.6%	$5.6	$5.7	-2.5%
2020	$8.8	$11.1	-25.5%	$8.9	$9.3	-4.8%

* Onroad vehicle engine control costs do not include costs for CAAA fuel programs (e.g., reforumulated gasoline) because we made no learning curve adjustments for the costs associated with these programs.

- Key Question: Applicability of learning rates identified by the project team to other technologies/sectors.
  - Application of the EGU FGD learning rate to FGD units installed at industrial boilers.
  - Application of motor vehicle learning rate to non-road vehicles and engines.

Key Issues – Discount Rate Choice

- 5 Percent Discount Rate.
  - Used for estimating annualized social costs.
  - Not used for predicting the behavior of firms or for estimating private costs as perceived by individual firms (i.e., the simulation of investment decisions).
  - Represents reasonable central value.
  - Consistent with First Section 812 Prospective.
- Sensitivity analyses to be conducted based on discount rates of 3 and 7 percent.

Key Issues – Unidentified Measures

- Defining the Problem
  - Existing air pollution control technologies insufficient to bring some areas into full compliance with the ozone NAAQS.
  - Potential need for unidentified measures for $PM_{2.5}$ NAAQS.
- Assumption in current analysis: cost of $10,000 per ton for emission reductions associated with unidentified measures for ozone.
- Alternatives
  - Different variants of fixed cost approach
  - Extrapolation approach
  - Progress ratio approach

Key Issues – Manufacturer Profits

- Some of the mobile source cost estimates represent projected changes in retail prices faced by consumers. In many cases, these price increases reflect a cost mark-up on O&M for manufacturer overhead and profit.
- At issue: whether profit mark-ups should be counted as a social cost of the CAAA.
- Available Guidance:
  - Importance of distinguishing between accounting profit and economic profit.
  - Transfers should not be counted in social costs.
  - Purchase prices for pollution control equipment represent social costs.
- In case of mobile sources, application of available guidance unclear because consumers rather than manufacturers are the ultimate users of the pollution controls.

Summary of Results

Source Category	Annual Cost (Million 1999$) 2000	2010	2020
Electric Utilities	**1,154**	**5,583**	**8,911**
Onroad Vehicles and Fuels	**12,874**	**23,677**	**25,900**
Motor Vehicle Emission Standards	3,751	6,468	6,575
California and National LEV	610	2,197	2,236
Fuels	4,700	9,914	11,156
Motor Vehicle I/M programs	3,813	5,098	5,933
Nonroad Vehicles and Fuels	**245**	**1,200**	**2,309**
Nonroad Engines/Vehicle Standards	245	1,001	1,567
Fuels	N/A	199	742
Non-EGU Point Sources	**2,710**	**4,705**	**4,882**
National VOC Rules	250	291	353
RACT and New CTGs	350	398	477
NOx SIP Call	6	116	118
Refinery Settlements	0	255	289
1-Hour Ozone NAAQS	822	968	968
PM10 NAAQS	130	130	130
MACT Stanards	1,152	2,547	2,547
Nonpoint Sources	**503**	**610**	**739**
RACT and New CTGs	339	389	473
Ozone Transport Commission Model Rules	102	159	204
1-Hour Ozone NAAQS	62	62	62
Local Controls	**0**	**3,380**	**4,387**
8-Hour Ozone NAAQS	0	2,629	2,849
PM2.5 NAAQS	0	751	542
Clean Air Visibility Rule	0	0	996
TOTALS	**17,486**	**39,155**	**47,128**

Comparison with First Prospective Results

Ttile	2000 Cost (Billion 1999$) First Pros.	Second Pros.	% Difference	2010 Cost (Billion 1999$) First Pros.	Second Pros.	% Difference
Title I - NAAQS Attainment	$9.4	$6.5	-31%	$14.4	$13.4	-7%
Title II - Mobile Source Provisions	$8.9	$8.7	-2%	$10.9	$17.6	62%
Title III - Hazardous Air Pollutants	$0.9	$1.2	23%	$1.0	$2.5	153%
Utilities (Title IV and Title I)	$3.7	$1.2	-69%	$5.4	$5.6	3%
TOTAL	$23.2	$17.5	-25%	$32.1	$39.2	22%

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