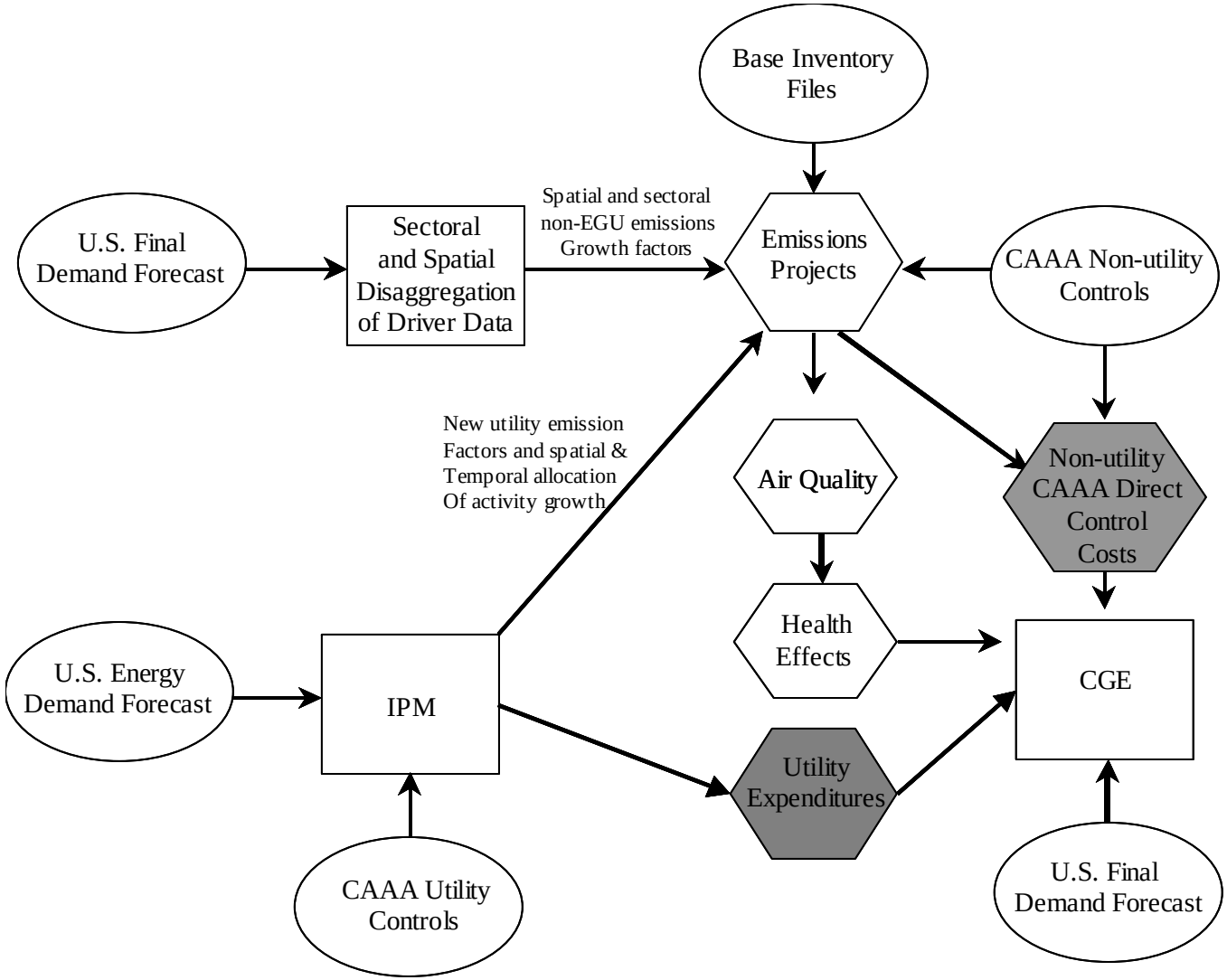
IEc

Second Prospective Section 812 Benefit-Cost Analysis of the Clean Air Act: Presentation of Direct Cost Analysis and CGE Inputs

Jason Price
Senior Associate
IEc

May 5, 2010

Introduction:
Costs in the 812 Analytic Framework



Presentation Overview

- Direct Cost Methods Summary
- Overview of Approach by Sector
- Changes Relative to the 2007 Draft Cost Report
  - Learning curve effects
  - Local controls
- Aggregate Results
- Uncertainties and Sensitivity Analysis
- CGE Cost and Benefit Inputs

Direct Cost Methods Summary

- Costs Evaluated
  - Direct Expenditures on CAAA Compliance
  - Output Impacts (including tax interaction effects) addressed in CGE analysis
- 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 based on a 5 percent discount rate.

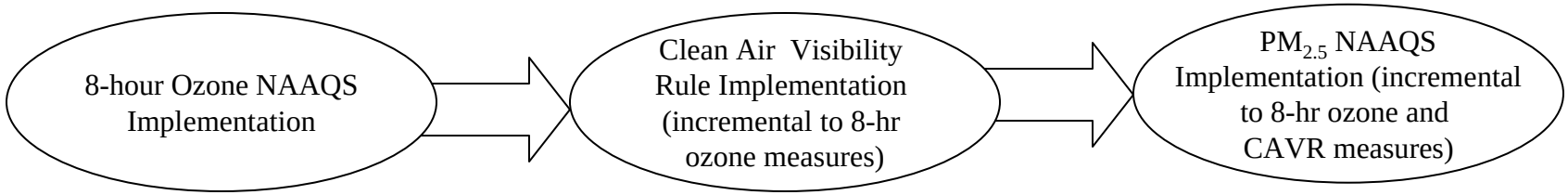
Direct Cost Methods by Sector

- EGUs
  - IPM runs supplemented by estimation of CAAA-related investments that pre-date the model time horizon
- On-road Vehicles
  - Unit costs adapted from EPA RIAs
  - Vehicle and fuel sales derived from AEO 2005
- Non-road engines
  - Unit costs adapted from EPA RIAs
  - Engine sales from NONROAD model
- Non-EGU Point and Nonpoint Sources
  - For many rules, estimate costs on $/ton basis
  - AirControlNET – links individual sources to control technologies

Direct Cost Methods by Sector (continued)

- Local Controls
  - Controls necessary for 8-hour Ozone and $PM_{2.5}$ NAAQS attainment
  - Sequential approach, using AirControlNET

Local Controls Analytic Sequence



Changes Relative to 2007 Direct Cost Report – Learning Curve Effects

- Approach for 2007 Direct Cost Analysis
  - Applied learning rate estimates from the empirical literature to EGU applications of FGD, SCR, and SNCR, as well as motor vehicle engine controls.
  - For other technologies/sectors, we made no adjustments for learning.
- Revised Approach
  - Where possible, use technology- or sector-specific learning rates from the literature.
  - Based on the Council's advise, apply default learning rate of 10 percent to most technologies/sectors for which empirically based learning rates are unavailable.
  - For a few technologies/sectors, opportunities for learning were unclear, so we assumed no learning (e.g., vehicle inspection and maintenance programs).
  - No learning curve adjustments for unidentified controls.

Changes Relative to 2007 Direct Cost Report – Learning Curve Effects (continued)

Control Technology/ Source Category	Learning Rates
EGUs - Flue Gas Desulfurization	Capital Costs: 11% O&M Costs: 22%
EGUs - Selective Catalytic Reduction[2]	Capital Costs: 14% O&M Costs: 21%
EGUs - Selective Non-catalytic Reduction	Capital Costs: 15%[3] O&M Costs: 10%[4]
EGUs - Activated Carbon Injection	Capital and O&M Costs: 10%
Motor Vehicle Engine Controls	Fixed Costs: No Adjustment Variable Production Costs: 13% (limited to two doublings of cumulative production) Vehicle Operating Costs: No adjustment
Motor Vehicle Fuel Rules	All Costs: 10% (limited to two doublings of cumulative production)
Motor Vehicle Inspection & Maintenance Programs	No adjustments for learning
Nonroad Engine Controls	All Costs: 10% (limited to two doublings of cumulative production)
Non-EGU Point Source Controls	All Costs: 10%
Nonpoint Source Controls	All Costs: 10%
Local Controls i. EGUs	 i. All Costs: 10%
ii. Non-EGU Point Sources iii. Nonpoint Sources iv. On-road vehicles v. Non-road engines	ii. All Costs: 10% iii. All Costs: 10% iv. No adjustments for learning v. No adjustments for learning

Changes Relative to 2007 Direct Cost Report – Cost of Local Controls

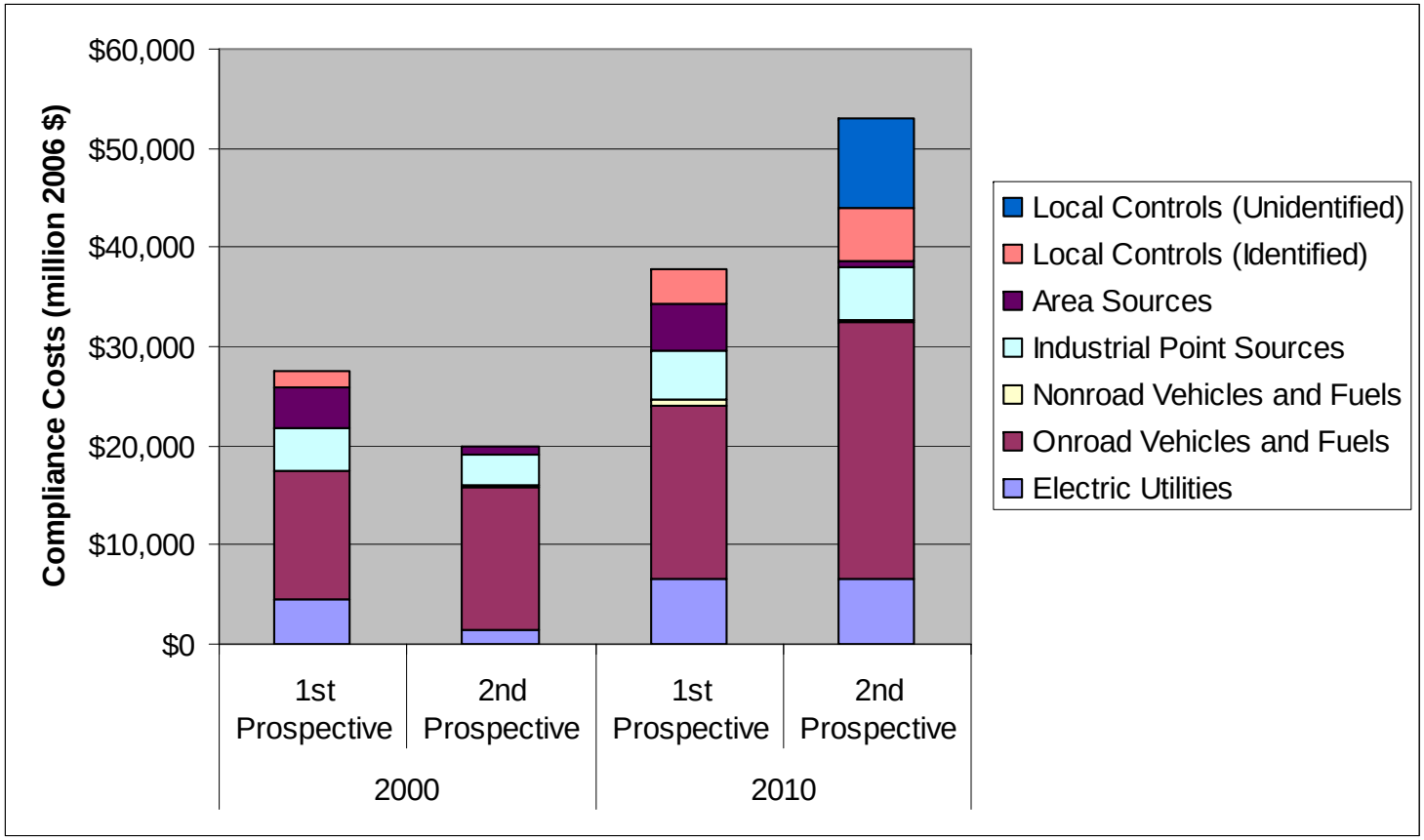
- Approach for 2007 Direct Cost Analysis
  - Cost cap of $10,000 per ton for identified controls
  - Assumed cost of $10,000 per ton for unidentified controls

- Revised Approach
  - Cost cap of $15,000 per ton for identified controls. Available data suggests that many areas have adopted controls in excess of the previous $10,000 per ton.
  - Assumed cost of $15,000 per ton for unidentified controls, consistent with new cap for identified controls.

Aggregate Results

SOURCE CATEGORY	ANNUAL COST (MILLION 2006$)		
	2000	2010	2020
Electric Utilities	$1,370	$6,640	$10,400
Non-EGU Industrial Point Sources	$3,130	$5,190	$5,140
Onroad Vehicles and Fuels	$14,400	$25,700	$28,300
Nonroad Vehicles and Fuels	$298	$359	$1,150
Area Sources	$663	$693	$766
Local Controls	$0	$5,260	$6,180
Sub-Total Excluding Unidentified Measures	$19,900	$43,900	$52,000
Additional Estimated Costs for Unidentified Controls for 8-Hour Ozone Compliance			
Non-California areas		$8,700	$8,500
California areas		$318	$5,030
TOTAL	**$19,900**	**$53,000**	**$65,500**
Note: All values are rounded to no more than three significant digits.			

Comparison with First Prospective Results



Uncertainties/Sensitivity Analysis

- Sensitivity analyses related to:
  - Local control cost cap and cost of unidentified local controls
  - Learning rate
  - Composition of vehicle sales and fuel efficiency implications
  - Failure rate of I/M tests

- Uncertainties not quantified
  - Economic activity (size and composition of the economy)
  - Productivity impacts of the CAAA
  - Technological innovation
  - Input substitution

Uncertainties/Sensitivity Analysis (continued)

- Alternative assumptions for local controls
  - Cap of $10,000 per ton on identified controls.
  - Cost of $10,000 per ton for unidentified controls.
- Learning curve effects
  - Estimated costs with alternative learning rates of 5% and 20% for sectors where the default of 10% was applied
- Composition of motor vehicle sales and fleet fuel efficiency
  - AEO 2008: light-duty vehicle fleet 15% more fuel efficient in 2020 than projected by AEO 2005.
  - AEO 2008: passenger cars make up 49% of fleet in 2020, compared to 42% in AEO 2005.
- Failure rate for I&M tests
  - Primary cost estimates reflect 14% failure rate for annual dynamometer-based I&M programs.
  - 2001 NRC report suggests failure rate is 2.1%.

Uncertainties/Sensitivity Analysis (continued)

Results of Sensitivity Analysis for 2020

PROVISION	2020 PRIMARY COST ESTIMATE (BILLIONS 2006$)	DESCRIPTION OF SENSITIVITY ANALYSIS	ALTERNATIVE ESTIMATE FROM SENSITIVITY ANALYSIS (BILLIONS 2006$)	PERCENT CHANGE FROM PRIMARY COST ESTIMATE
Local Controls (Identified and Unidentified)	$20.39	$10,000/ton cap on identified controls and $10,000/ton for unidentified controls	$16.79	-17.60%
Motor Vehicle Costs	$28.28	Use AEO 2008 projections of motor vehicle sales and fleet fuel efficiency	$27.25	-3.60%
Motor Vehicle Costs	$28.28	Use Inspection Failure Rates reported by the National Research Council	$24.82	-12.20%
Total Costs (All Source Categories)	$65.48	Use alternate default learning rate of 5 percent	$67.60	3.20%
Total Costs (All Source Categories)	$65.48	Use alternate default learning rate of 20 percent	$61.54	-6.00%

Inputs for EMPAX-CGE Analysis

- Background
  - CGE analyses for EPA rulemakings: cost side effects only
  - Second Prospective: assessment of cost- and benefit-related impacts
- Cost inputs
  - Private expenditures
- Benefit inputs
  - Premature mortality impact on household time endowment
  - Morbidity impact on household time endowment
  - Change in medical expenditures from pollution-related morbidity

Cost Inputs for EMPAX-CGE

- Key differences relative to direct cost estimates
  - Inclusion of excise taxes
  - Industry-specific discount rates
  - Exclusion of motorist waiting time related to I&M programs

SUMMARY OF COMPLIANCE EXPENDITURES AND DIRECT COSTS (MILLIONS OF 2006$)

SOURCE CATEGORY	2010		2020	
	COMPLIANCE EXPENDITURES (USED FOR EMPAX ANALYSIS)	DIRECT COSTS	COMPLIANCE EXPENDITURES (USED FOR EMPAX ANALYSIS)	DIRECT COSTS
Electric Utilities	$8,470	$6,640	$13,000	$10,400
On-road Sources	$24,800	$25,800	$27,200	$28,300
Non-road Sources	$750	$359	$1,620	$1,150
Industrial Point Sources	$5,580	$5,180	$5,600	$5,140
Area Sources	$693	$693	$768	$767
Local Controls (Identified)	$5,590	$5,250	$6,790	$6,180
Unidentified Local Controls	$9,020	$9,020	$13,500	$13,500
TOTAL	$54,900	$52,900	$68,500	$65,500

Benefits Inputs for EMPAX-CGE: Labor Force Impact of Premature Mortality

- PM effects only
- Effect estimated as percent change in labor and leisure time for individuals participating in the formal labor force
- Approach
  - Use dynamic population simulation model to estimate annual changes in population by age and gender based on changes in ambient $PM_{2.5}$ concentration
  - Apply age- and gender-specific labor force participation rates from BLS to estimated change in population to estimate annual change in the labor force

Benefits Inputs for EMPAX-CGE: Labor Force Impact of Morbidity

- PM and ozone impacts
- Approach
  - Developed standardized estimates of work days lost per case, based on the literature.
  - Estimated total work days lost per year by applying work days lost per case to the annual number of cases, as derived from BenMAP.
  - Incidence versus Prevalence
  - Convert to work years lost based on 235-day work year.
  - Express as percent change in labor force

Benefits Inputs for EMPAX-CGE: Labor Force Impact of Morbidity

WORK DAYS LOST PER CASE, BY PM MORBIDITY ENDPOINT

Acute Myocardial Infarction	Age <25: 0 Age 25-34: 17.7 days Age 35-44: 14.5 days	Age 45-54: 23.7 days Age 55-65: 137.0 days Age>65: 0 days
Chronic Bronchitis	Age <25: 0 days Age 25-34: 50.3 days Age 35-44: 42.2 days	Age 45-54: 55.5 days Age 55-65: 73.5 days Age >65: 0 days
Hospital Admissions, Cardiovascular	Age 0-14: 0 days Age 15-44: 18.3 days	Age 45-64: 17.9 days Age >64: 7.0 days
Hospital Admissions, Respiratory	Age 0-14: 0 days Age 15-44: 30.7 days	Age 45-64: 30.1 days Age >64: 7.5 days
Emergency Room Visits, Respiratory	Average across all age groups: 0.2 days	
Work Loss Days	Average among working age population: 1 day	

Benefits Inputs for EMPAX-CGE: Labor Force Inputs

CHANGE IN LABOR FORCE DUE TO CAAA-RELATED CHANGES IN AIR QUALITY (PERCENT CHANGE IN WORKER TIME ENDOWMENT)

	2010	2020
Pollution-related Change in Worker Time Endowment	**0.34%**	**0.57%**
PM Mortality Subtotal	*0.18%*	*0.31%*
PM Morbidity Subtotal	*0.15%*	*0.25%*
Acute Myocardial Infarction	0.06%	0.09%
Chronic Bronchitis	0.05%	0.11%
Work Loss Days	0.04%	0.05%
Other PM Endpoints	<0.01%	<0.01%
Ozone Morbidity Subtotal	*0.01%*	*0.02%*

Benefits Inputs for EMPAX-CGE: Medical Expenditures

CAAA-RELATED CHANGES IN MEDICAL EXPENDITURES (MILLION 2006$)

	2010	2020
Pollution-related Change in Medical Expenditures	**$12,900**	**$21,000**
PM Morbidity Subtotal	*$12,500*	*$20,500*
Acute Myocardial Infarction	$10,200	$16,600
Chronic Bronchitis	$422	$1,010
Emergency Room Visits, Respiratory	$32	$42
Hospital Admissions, Cardiovascular	$1,340	$2,050
Hospital Admissions, Respiratory	$513	$739
Ozone Morbidity Subtotal	*$313*	*$579*
Emergency Room Visits, Respiratory	$2	$4
Hospital Admissions, Respiratory	$311	$575

IEc

INDUSTRIAL ECONOMICS, INCORPORATED

617.354.0074