Developing a Common Framework for Economic Analysis

Interim Workshop: December 13, 2002

Prepared for:

Economic Analysis Forum
Western Regional Air Partnership

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Project Overview

Objectives

- Develop a common framework for economic analysis which:
  - Assists WRAP members in analyzing economic aspects of RHR and other air quality issues.
  - Promotes consistency in methods, assumptions and data sources

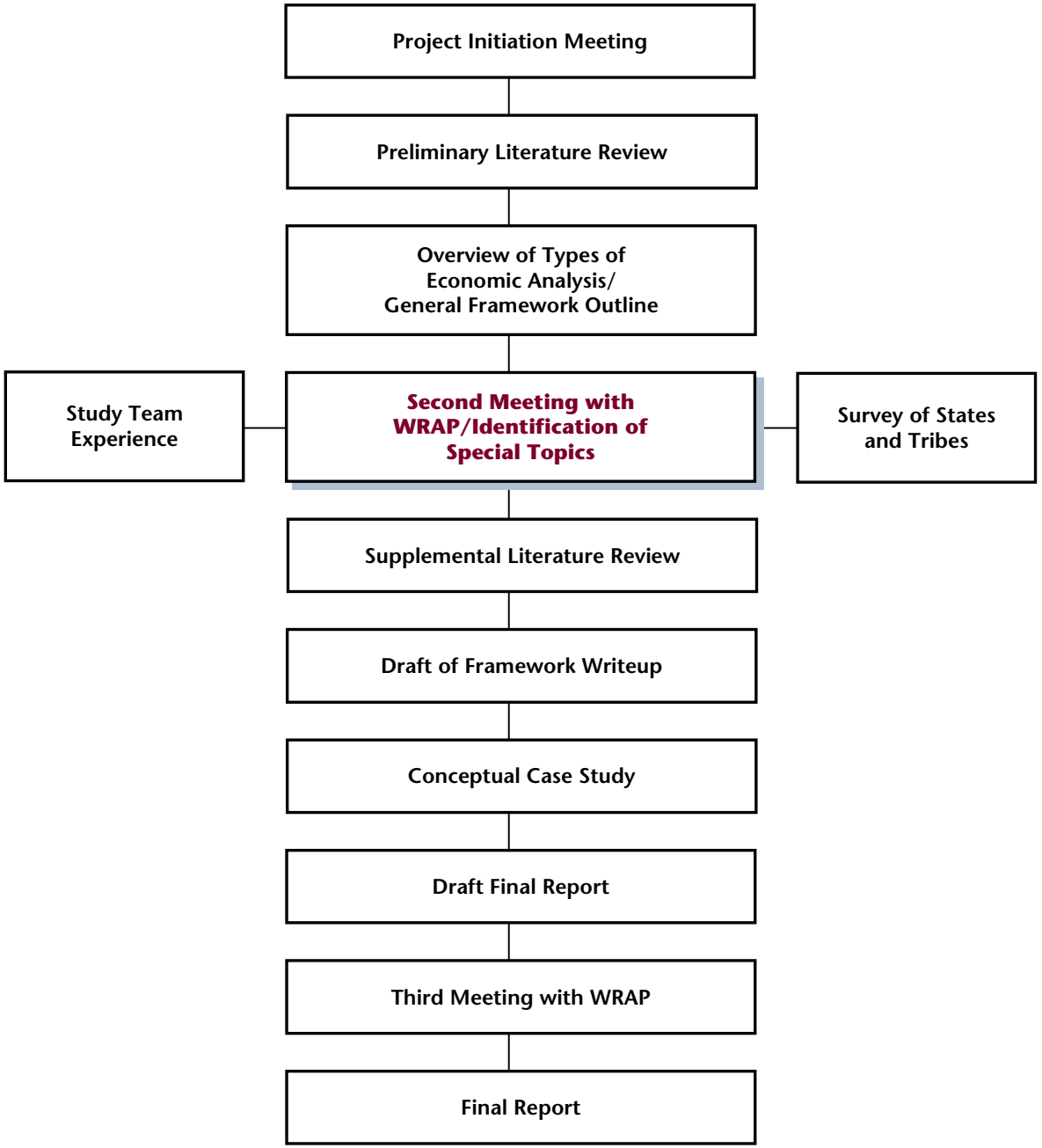
Timeline

- Draft final report for review by March 2002
- Completion in April 2002

Deliverables

- Main report:
  - General framework
  - Special topics
  - Conceptual case study
- Literature review

Project Status and Purposes of this Workshop



Purposes of this Workshop

- Introduce project to broader WRAP audience
- Discuss preliminary overview of framework
- Help make key choices among analytical approaches
- Finalize choice for case study
- Identify special topics

Types of Economic Analysis

Cost Benefit Analysis

- Do the benefits of the rule/strategy exceed the costs

Economic Impact and Equity/Distributional Analysis

- Market share or "competitiveness" effects
- Who gains
- Who loses
- How much

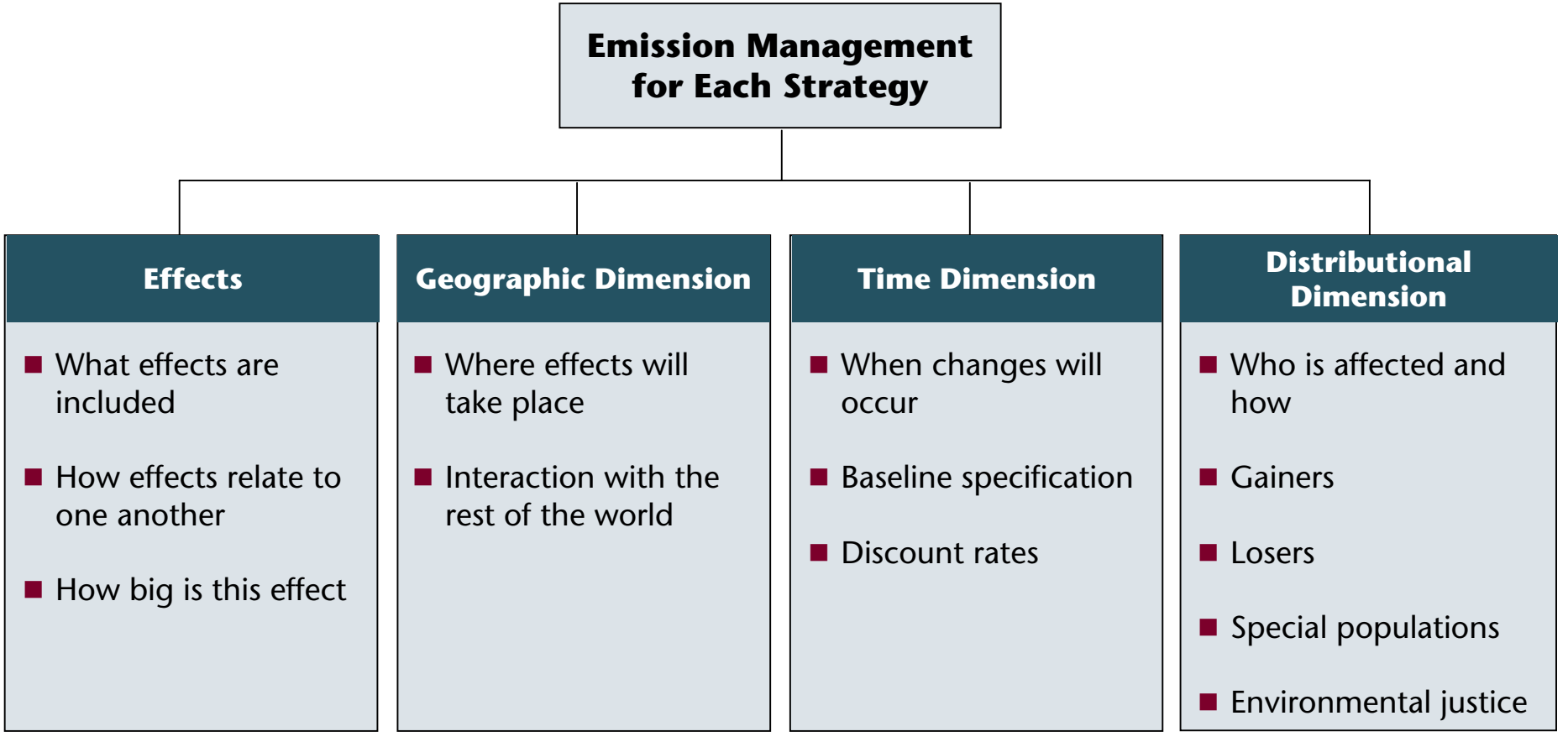
WRAP Survey of Members' Needs/Interests

- States and tribes want the WRAP to help
- Varied interests/needs, including:
  - Interpretation
  - Advice and guidance
  - Actual assistance
  - Tribal focus
- Desire for help in analyzing both benefits and costs

A Key Theme for Today's Discussion: Trade-Offs Among Analytical Approaches

Low Cost	High Cost
Less Comprehensive	More Comprehensive
Less Defensible	More Defensible
Less Consistency	More Consistency
Smaller WRAP Role	Larger WRAP Role

Dimensions of Economic Analysis of Air Quality Management



Geographic Dimension

Definition

- Geographic area within which benefits, costs and impacts are compiled
- Typically, geographic dimension corresponds to regulating entity's jurisdiction
- Distinct sub-areas may also be addressed

Challenges

- Interaction with outside areas often important in gauging market response to regulation
- Distributing air quality benefits to sub-areas requires complex models
- Distributing costs to areas not defined by county boundaries is complex
- "Spillover effects" from application of RHR to other areas difficult to account for

Time Dimension

Definition

- Two key issues
  - Establishing the baseline for analysis
  - Choosing a discount rate

Challenges

- Baseline should reflect full compliance with existing regulations + those coming on-line
- Implicit macroeconomic assumptions should be consistent between regions
- Detailed industry baseline projections often unavailable from local sources
- Intra-generational versus inter-generational discounting
- Varied guidance from official sources (e.g., EPA vs. OMB)

Distributional Dimension

Definition

- Identifies who gains and who loses (and by how much)
- Usually focus of economic impact analysis, not cost-benefit analysis
- Common dimensions:
  - Producers vs. consumers
  - Economic sectors
  - Small businesses
  - Special population groups
  - Geographic sub-areas

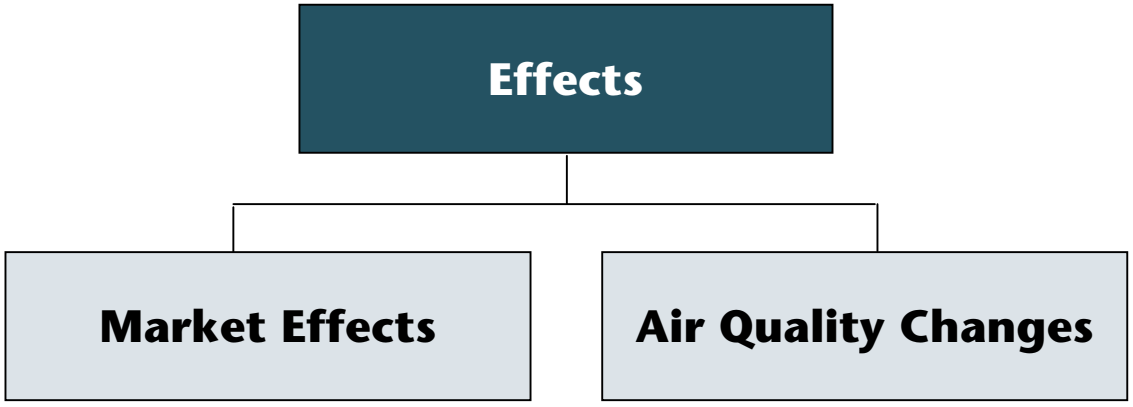
Challenges

- Estimating market response to compliance cost/requirements
- Estimating linked effects
- Allocating impacts to population groups, geographic sub-areas, etc.

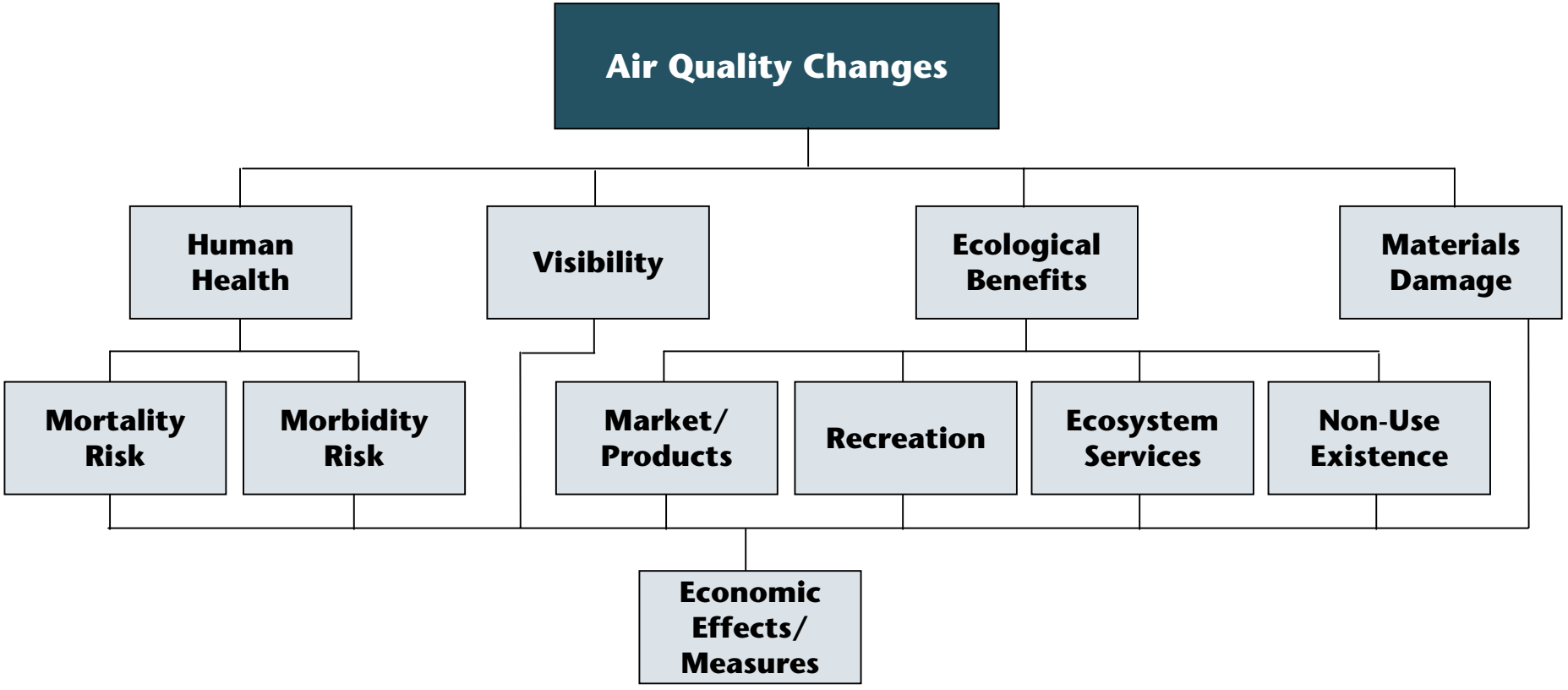
Dealing with Uncertainty

- **Sources of Uncertainty**
  - Forecasting issues
  - Data/analytical issues
- **Potential Responses**
  - Probabilistic analysis
  - Sensitivity analysis
  - Bounding estimates

Strategy Effects — Overview



Air Quality Benefits — Overview



Quantifying Human Health Benefits

DEFINITION

- Monetizing improvements in human health due to reductions in air pollution
- Typically analyzed as reductions in morbidity and mortality
- Less exposure to pollutants = decreased incidence of respiratory and cardiovascular diseases

CHALLENGES

- Value of many human health benefits have not yet been monetized
- Different pollutants have different health impacts
- Health response functions and values can be controversial

Approaches Human Health Benefits

Potential Approaches	Basis	Pros	Cons
Epidemiological Effects			
Ozone – Urban Airshed Model + Regional Human Exposure II Model	EPA, South Coast, others	Most accurate accounting – worker productivity, asthma, respiratory/cardio-vascular problems	Off-the-shelf models, not area specific, does not capture premature mortality or aging of lungs
PM – PM10 Model or Source-Receptor Matrix + REHEXII	EPA, South Coast	Evaluates premature mortality, worker loss days, others	Off-the-shelf, does not capture infant mortality, morphological effect
Valuation			
Benefits transfer, past studies	EPA, South Coast, others	More affordable, data readily available, generally accepted	Transferability questionable, not area or rule specific
WTP, avoided costs of treatment	EPA, South Coast	Area and situation-specific	Cost and expertise requiring individual study questionable

Quantifying Visibility Benefits

DEFINITION

- Monetizing improvements in visibility due to reduced emissions
- Typically analyzed as increases in deciviews
- Willingness-to-pay to enjoy improved visibility = value of emissions reduction

CHALLENGES

- Different pollutants have different impacts on visibility
- Contingent valuation method tricky to do well, controversial
- Limited data available for benefits transfer

Approaches for Visibility Benefits

Potential Approaches	Basis	Pros	Cons
Quantifying Visibility Change			
WRAP Regional Modeling Center: REMSAD and CMAQ Models	WRAP	Designed specifically to meet WRAP needs	Still under development
PM – Source-Receptor Matrix + Climatological Regional Dispersion Model	EPA	Comprehensive for entire nation, provides input for visibility assessment	Overestimates fugitive dust emissions, not much observational data to verify
Regional Haze Model based on PM S-R input	EPA	Assesses visibility changes for Class I areas and residential (all other) areas, by region	May overestimate visibility impacts if PM estimates are too high
Monetizing Visibility Benefits			
Benefits transfer from CVM method	EPA - Chestnut & Rowe (Class I) McClelland (residential), Abt Assoc	Class I study generally accepted	Residential study more controversial Class I study did not measure NW
WTP through housing prices model (hedonic pricing)	South Coast, US Office of Management and Budget (OMB)	Assesses visibility impacts based on WTP for housing	Limited applicability outside Los Angeles

Quantifying Ecological Benefits

Definition

- Monetizing improvements in ecological health and productivity
- Agricultural or forest productivity, recreational value, ecosystem services and nonuse existence values
- Reduction in emissions = less pollutants injuring ecosystem

Challenges

- Quantification of ecological impacts difficult; models do not adequately address
- Most ecological benefits not yet monetized
- Different pollutants have different impacts on various aspects of ecological health and productivity

Approaches for Ecological Benefits

Potential Approaches	Basis	Pros	Cons
Quantifying Impacts			
Ozone – Urban Airshed Model + Agricultural Response Functions	EPA, South Coast	Estimates reduced crop damage	Off-the-shelf, no forest productivity or ecosystem functions
NOx – Regional Acid Deposition Model	EPA	Estimates reductions in nitrogen loading	No C-R functions to relate to ecosystem function, no WTP to assess values
Monetizing Impacts			
AGSIM Model	EPA, Abt Assoc	Estimates value of reduced damage to crops using C-R functions with NCLAN	Off-the-shelf, no forest productivity measures
WTP, travel cost, hedonic pricing, CVM methods	EPA, OMB	Captures values for non-market ecosystem services (aesthetics, clean water, etc)	Some disagreement on methods' validity
Avoided costs or losses of value	State of Washington	Captures avoided costs of cleanup, avoided loss of ecosystem values	Not widely used to assess ecosystem values

Quantifying Materials Benefits

Definition

- Monetizing improvements in materials damage and household soiling
- Reductions in costs of repainting, replacing, repairing or cleaning building materials and rubber products
- Less material exposure to pollutants = decreased incidence of damages

Challenges

- Emissions models do not yet have strong links to materials damage
- Different pollutants have different impacts on various types of materials

Approaches for Materials Benefits

Potential Approaches	Basis	Pros	Cons
Quantifying Impacts			
Ozone – Urban Airshed Model/ PM – PM10 Model + response functions from prior studies	South Coast	Good estimates of damages	Does not capture household soiling
Monetizing Impacts			
Direct Measurement	South Coast	Uses current costs of cleaning and repair to estimate values	Does not capture household soiling

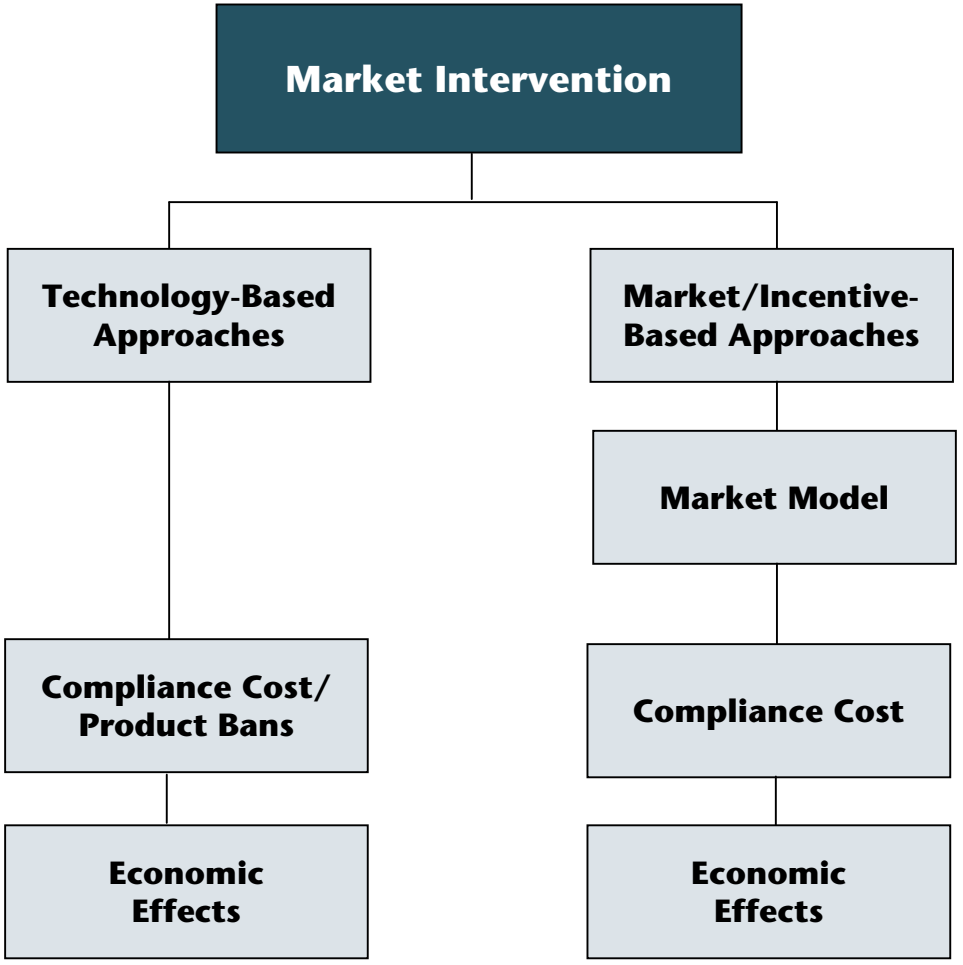
Benefits Estimation Options

Approaches

- Benefits transfer
- Existing models
- Ad hoc (original modeling)

Key Question — Decentralized vs. centralized application?

Market Effects — Overview



Quantifying Costs of Environmental Policy/Strategies

DEFINITION

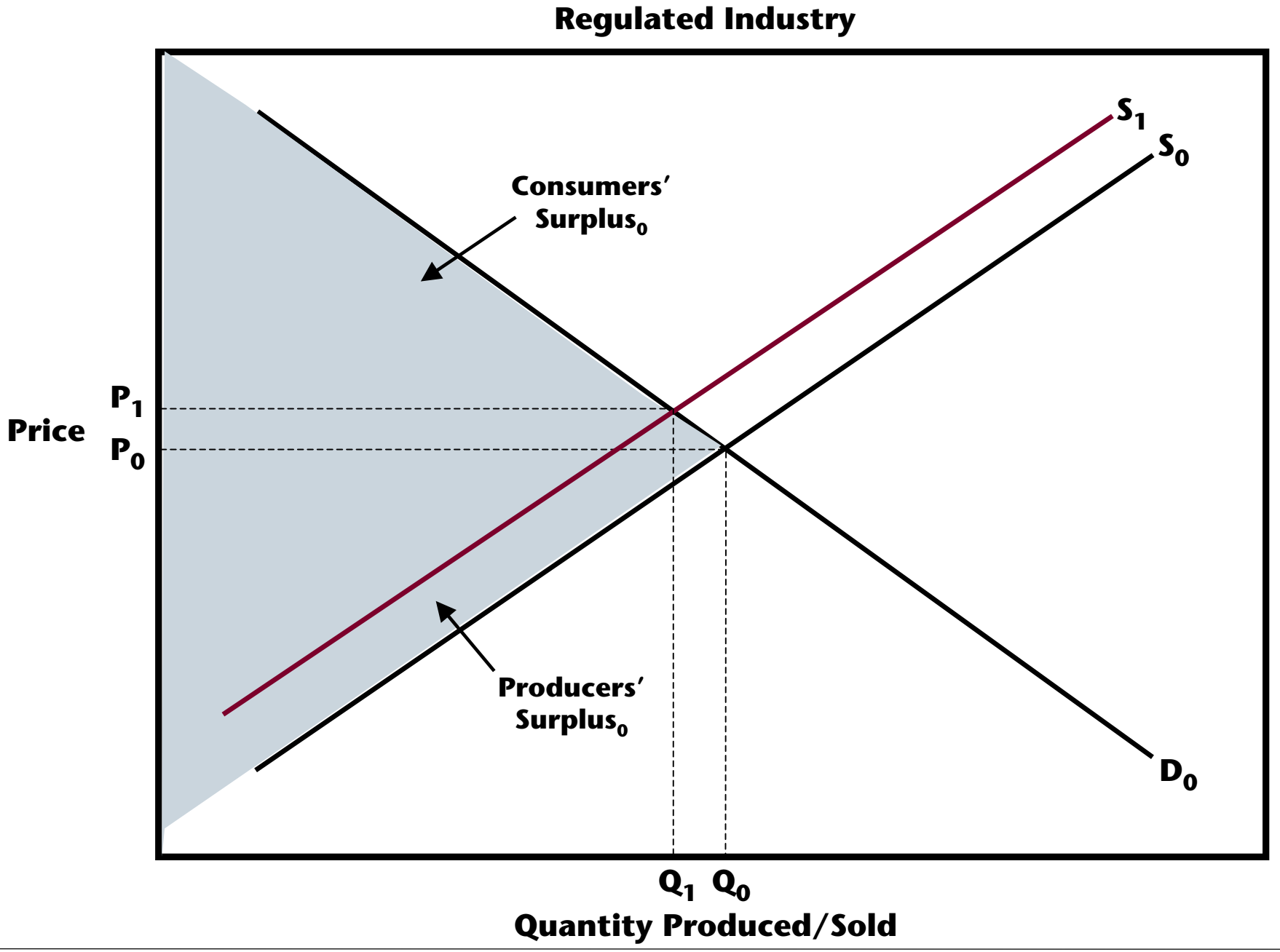
Private Compliance Costs	■ Capital costs of new equipment ■ Operations and maintenance of new equipment ■ Costs of changes in production processes or inputs
Government Regulatory Costs	■ Training and administration ■ Monitoring and reporting ■ Enforcement and litigation ■ Permitting
Social Welfare Losses	■ Higher production costs – loss of producer surplus ■ Higher consumer prices – loss of consumer surplus ■ Legal and administrative costs
Transitional Costs	■ Unemployment ■ Firm Closings ■ Resource shifts to other markets ■ Transaction costs
Indirect Costs	■ Increased market concentration or decreased competitiveness ■ Less productive labor and capital ■ Discouraged investment in research and development

Quantifying Costs of Environmental Policy/Strategies

CHALLENGES

- Estimating compliance costs challenging for non-traditional approaches
- Analyzing market response requires significant effort or expensive models
- No ideal model available

Costs — Some Basic Concepts and Terminology



Compliance Costs for Direct Control Policies

Strategy Type	Private Compliance Costs	Government Costs
Technology Standards	General framework: sum of investment costs plus present value Costs and affected firms may be well documented for existing technologies Costs may be uncertain, be affected by technological change	Monitoring and enforcement costs
Emission Standards	Use sampling techniques to address technology-choice among large numbers of firms	Monitoring and enforcement costs
Production Bans (real or effective)	Lost wages due to unemployment Residual value of obsolete capital Loss of producers/consumers surplus Loss of surplus in linked markets	Monitoring and enforcement costs Costs to re-employ displaced workers (not including unemployment benefits or other transfers)

Compliance Costs for Incentive-based Policies

	Private Compliance Costs	Government Costs
Marketable Permits	Estimating private costs requires simulating market for permits Estimated permit price determines firms that incur costs for pollution control Permit trades are counted as transfers, not social costs	Administrative and enforcement costs
Emissions Taxes	Unit cost of pollution is set by the tax Requires a supply/abatement cost function for regulated firms to estimate new production levels and pollution reductions	Administrative and enforcement costs
Subsidies and Cost-Sharing	Private costs are estimated net of subsidies	Shifts a share of private costs to the government

Approaches for Estimating Social Costs

Approach	Basis	Pros	Cons
Count only direct compliance costs	Common Federal guidance (OMB, GAO) Common practice (EPA, states)	Simple, least cost	Does not reflect transitional + indirect costs Not applicable to production bans
Use "partial equilibrium" model(s) of affected markets	EPA's "standard approach" for national, one-industry rules	Better captures transitional + indirect costs Applicable to production bans	Technical demands, time and cost for ad hoc modeling
Strive to measure "general equilibrium" effects	Theoretically best approach	Comprehensive view of costs throughout economy	No "magic bullet" model available

What Level of Analysis is Advised/ Used by Agencies

Agency	Direct Costs	Partial Equilibrium Effects	General Equilibrium Effects
EPA	Existing data/literature Engineering estimates Industry/vendor data Agency plans/budgets (administrative costs)	Ad-hoc market models Elasticities from literature	Ad-hoc, occasional CGE modeling Multi-market models
South Coast (AQMD)	Existing data/literature Engineering estimates Agency plans/budgets (administrative costs)		REMI model
CARB	Engineering estimates Industry/vendor data	Ad hoc "competitiveness" impacts models "Boundary case" analysis of price/quantity effects	Not used
OMB	Existing data/literature Engineering estimates	Not advised (for lack of available data)	Not used
CDPHE (Colorado)	Engineering estimates Agency estimates (administrative costs)	Not used	Not used
Washington State Department of Ecology	Engineering estimates	Not used	Not used

Cost Estimation Options

Approaches

- Focus on compliance costs
- Adapt an existing model
- Ad hoc modeling

Key Question — Decentralized vs. centralized application

How Do Costs and Benefits Come Together?

OMB's "Accounting Statement" approach:

Category	Primary Estimate	Minimum Estimate	Maximum Estimate
Benefits			
Annualized Monetized:			
Annualized Quantified, but Non-Monetized			
Unquantified			
Costs			
Annualized Monetized:			
Annualized Quantified, but Non-Monetized			
Unquantified			

Next Steps

- Incorporate insights from this workshop in making analytical recommendations
- Add more details and specifics to general framework
- Identify special topics and research them
- Conceptually apply framework to case study role, identify required resources
- Draft reports and review with EAF

Potential Special Topics for Detailed Examination

- Analyzing economic aspects of Tribal Implementation Plans or Federal Implementation Plans
- Analyzing market response to compliance costs/requirements
- Benefits transfer approaches and values for monetizing air quality benefits
- Assessing impacts on industry health
- Evaluation of fiscal effects
- Evaluating incentive-based programs to improve air quality
- Feasibility and desirability of centralized approach

Conceptual Case Study Selection

Criteria

- Involves wide array of benefit, cost and economic impact issues
- Simple enough to help illustrate and clarify, not add confusion
- Relevant to actual issues/strategies WRAP members may consider

Candidates Considered

- Fire programs
- Local strategies
- SO_2 annex
- Point source reduction

Recommendation

- NO_X reductions from stationary sources