

Analysis of Human Health Valuation Models for NETL Technology Evaluation

Valuing Externalities Workshop

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Agenda

- **Overview of Externality Models Surveyed**
- **Comparison of Design Purpose & Capabilities**
- **Comparison of Human Health Modeling Approaches**
- **Comparison of Availability and Vendor Support**

Overview of Externality Models Surveyed

- **CAPMS – Criteria Air Pollutant Modeling System**
 - Developed by: Abt Associates
 - For: US EPA
- **EcoSense**
 - Developed by: European ExternE Project
 - For: European Union Commission
- **EXMOD – Externality Model**
 - Developed by: Tellus Institute
 - For: NY State Energy Research and Development Authority, NY State Public Service Commission, Empire State Electric Energy Research Corporation, EPRI, and Hagler-Bailey
- **FERET – Fast Environmental Regulatory Evaluation Tool**
 - Developed by: CMU & University of Washington
 - For: Center for the Study and Improvement of Regulation
- **TAF – Tracking and Analysis Framework**
 - Developed by: DOE, NOAA, SAIC, RFF, CMU, NCSU, & Lumina Decision Systems; currently supported by RFF.
 - For: National Acid Precipitation Assessment Program



Criteria Air Pollutant Modeling System (CAPMS)

- **Purpose: Model human exposure to changes in air pollution concentrations and estimates the associated health benefits (incidence and valuation).**
- **Uses “before” and “after” air quality estimates from external modeling source**
- **Used in numerous EPA benefit analyses**
- **Not currently available to the public, but will be available through EPA in the near future**
- **Based on “Damage Function Approach”**

EcoSense Model

- **Purpose: Quantify External Costs and Benefits of Major Electricity Generation Technologies in Europe to Assist in Policy Decisions**
- **Product of the ExternE Project founded by the European Commission**
- **Project Currently Involves:**
 - 30 Teams from Research Institutes & Consultancy
 - 9 Member States of the European Union
 - Other European Countries
- **Based on “Damage Function Approach”**

EXMOD

- **Calculate Externalities associated with Electric Power Supply Alternatives**
- **Built in Demographic and Air Quality Database for New York, adjacent States and Canadian Provinces**
- **Can be adapted to other states or regions by changing underlying environmental and demographic data**
- **Based on “Damage Function Approach”**

Fast Environmental Regulatory Evaluation Tool (FERET)

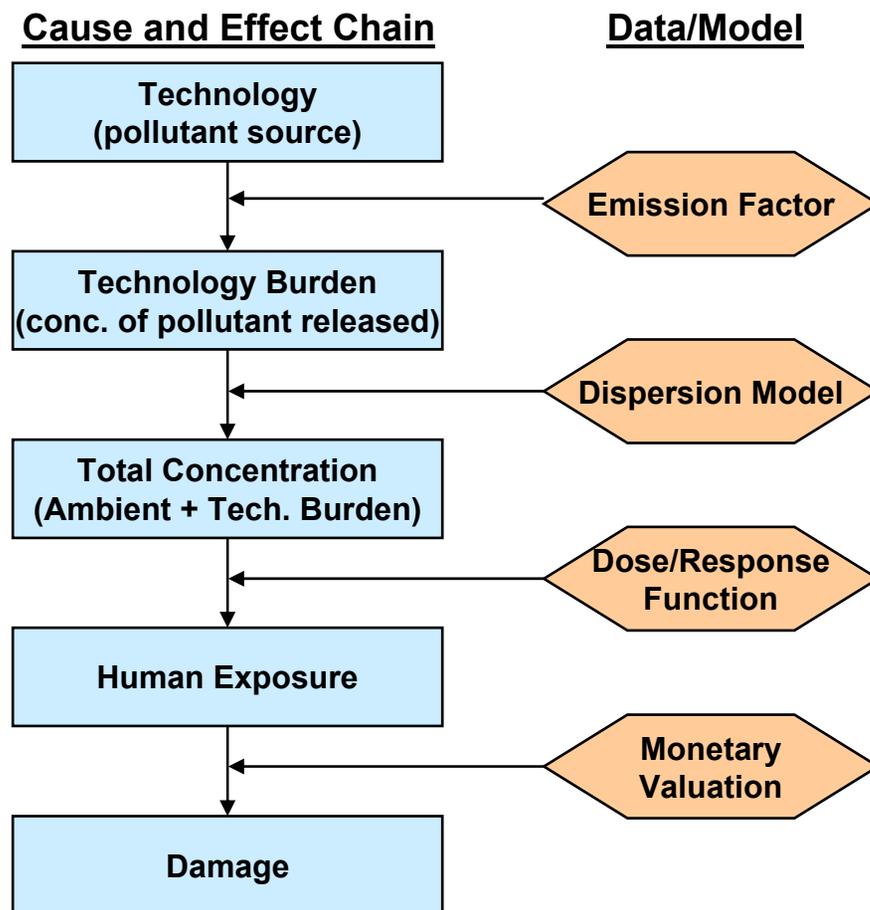
- **Excel-based modeling tool, uses Crystal Ball Add-in for Monte Carlo simulation**
- **Estimates changes in health outcomes relative to changes in baseline pollution concentrations**
- **Based on EPA's prospective analysis of the Clean Air Act**
- **Developed by Carnegie Mellon University and the University of Washington**

Tracking and Analysis Framework (TAF)

- **Analytica-based software tool**
- **Focuses on emissions from power plants, has been adapted for other industrial sectors**
- **Includes modules for atmospheric modeling; estimation and valuation of effects on health, soil/ water quality, and visibility; cost-benefit comparison**
- **Human health effects are modeled at the state level**
- **Funded by DOE and developed by NAPAP, ORNL, Argonne, EPA, NOAA, SAIC, RFF, CMU, NCSU, and Lumina Decision Systems**

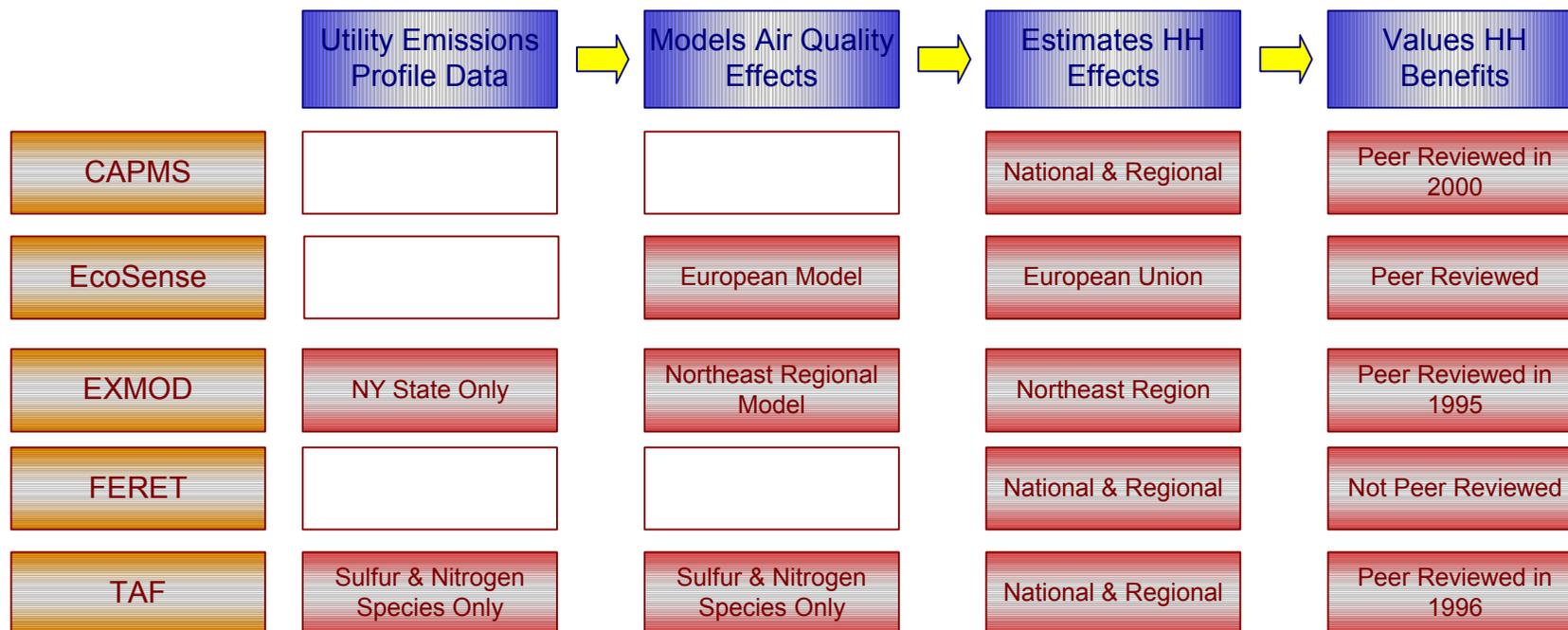
Comparison of Externality Models

- Approach to Monetizing Health Benefits
- Design Purpose and Basic Capabilities
- Modeling Approach
 - Inputs and Outputs
 - Utility Emissions Data and Air Quality Modeling
 - Human Health Effects
 - Valuation of Human Health Effects
- Availability and Vendor Support



Common Approach to Monetizing Health Benefits

Purpose/Capabilities of Externality Models



Model Inputs and Outputs

	CAPMS	EcoSense	EXMOD	FERET	TAF
User Inputs					
Utility Characteristics	√	√	√	√	√
Population Characteristics	√		√	√	√
Air Quality Data	√			√	
Geographical Information	√			N/A	√
C-R Functions					
Valuation Measures	√				
Model Outputs					
Emissions Estimates		√	√		√
Pollutant Concentrations		√	√		√
Changes in Health Effects	√	√	√	√	√
Other Externality Effects	√	√	√	√	√
Value of Health Effects (\$)	√	√	√	√	√

Utility Plant Emissions & Air Quality Modeling

Utility Plant Emissions

- CAPMS and FERET do not model utility emissions
- EXMOD contains database for modeling emissions in New York and surrounding states only
- EcoSense has capabilities specific to Europe
- TAF relies on internal database of US plants and user-defined scenarios for comparison

Air Quality Modeling

- CAPMS and FERET do not contain air quality modeling tools
- EcoSense, EXMOD and TAF generate air quality data at designated receptor sites
- TAF models only sulfates and nitrates
- TAF Receptor site information includes demographic and geographic features
- TAF Receptor information is mapped onto air quality estimates

Human Health Effects Estimation

Pollutant	CAPMS	EcoSense	EXMOD	FERET	TAF
Ozone	√	√	√	√	√
PM ₁₀	√	√	√	√	√
PM _{2.5}	√	√	√	√	√
CO	√	√	√	√	√
NO _x	√	√	√	√	√
SO ₂	√	√	√	√	√
NH ₃	√	√	√		√
Hg		√	√		√

Valuation of Human Health Effects

	CAPMS (1990 \$)	EcoSense	EXMOD	FERET (1990 \$)	TAF (multiple year \$)
Mortality	4.8 M	√	√	4.8 M	3.3M
Chronic Bronchitis	260,000	√	√	260,000	200,000
Chronic Asthma	25,000	√	√	25,000	8,900
Hospital Admissions (Respiratory)	6,900	√	√	6,900	5,986
Hospital Admissions (Cardiac)	9,500	√	√	9,500	14,000
Asthma ER Visits	194	√	√	194	292
Acute Bronchitis	45	√	√	45	45
Asthma Attack	32	√	√	32	31
Acute Respiratory Symptoms	18	√	√	18	6
Upper Respiratory Symptoms	19	√	√	19	18
Lower Respiratory Symptoms	12	√	√	12	11
Shortness of Breath	5.3	√	√	5.3	5.72
Work Loss Days	83	√	√	83	83
Mild Restricted Activity Day	38	√	√	38	22
Paresthesia			√		
Psychomotor Retardation			√		
# of other health endpoints					15

Availability and Vendor Stability

	Available?	Cost*	Stable and Supported?
CAPMS		N/A	√
EcoSense	√	\$0	
EXMOD	√	\$2,000	√
FERET	√	\$685	√
TAF	√	\$895	√

*includes fee for supporting software that may be necessary

End of Presentation

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