Estimating the Co-Benefits of Clean Energy Policies

State and Local Climate and Energy Program

Co-Benefits Risk Assessment (COBRA) Screening Model: **How COBRA Works**

Air Quality | Human Health | Societal Benefits

EPA United States Environmental Protection Agency

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What is COBRA?

- The Co-Benefits Risk Assessment (COBRA) model is a peer reviewed screening tool that inexpensively and quickly estimates the air quality, human health, and associated economic impacts of various state- and county-level emission reduction scenarios.
  - The model estimates and maps the health effects and related economic value of the effects by county for state, region, U.S.
- COBRA is based on rigorous methods used by EPA health benefits assessments and adapted for use as a screening model.
- COBRA enables users to obtain a first order approximation of costs and benefits of different emission scenarios that can be used to narrow a long set of promising options to a smaller list which can be evaluated using more sophisticated air quality models.

How Does COBRA Work?

Users enter emissions change(s) and discount rate for 2017

- PM2.5, SO2, NOx, NH3, VOCs

COBRA:

Quantifies Changes in Air Quality

- Uses a simple air quality model, the Source Receptor (S-R) Matrix, to estimate effects of changes on ambient particulate matter.

Calculates Change in Health Outcomes

- Uses "canned" concentration response functions to link the changes in particulate matter to epidemiological studies[1]

Calculates Monetary Value

- Uses "canned" values based on willingness-to-pay, cost of illnesses , value of a statistical life and direct medical costs.

Outputs = Tables and maps of illnesses and deaths avoided and the related economic value.

[1] COBRA excludes benefits beyond particulate matter-related ones and may be conservative in that respect.

Human Health Effects in COBRA

- COBRA estimates the number of health incidences avoided AND the related economic value for the following:
  - Adult Mortality,
  - Infant Mortality,
  - Non-fatal Heart Attacks,
  - Respiratory Hospital Admissions,
  - Cardiovascular-related Hospital Admissions,
  - Acute Bronchitis,
  - Upper Respiratory Symptoms,
  - Lower Respiratory Symptoms,
  - Asthma Exacerbations (attacks, shortness of breath, & wheezing),
  - Asthma Emergency Room visits,
  - Minor Restricted Activity Days,
  - Work Loss Days

Economic Values of Effects: Unit Values

Health Incident Avoided	Economic Value ($2010)	
	3% discount rate	7% discount rate
Adult Mortality	$8,434,924	$7,512,853
Infant Mortality	$9,401,680	$9,401,680
Non-Fatal Heart Attacks	$33,259 - $263,795	$31,446 - $253,247
Hospital Admissions	$15,430 - $41,002	$15,430 - $41,002
Asthma ER Visits	$388 - $464	$388 - $464
Acute Bronchitis	$477	$477
Respiratory Symptoms	$21 - $33	$21 - $33
Asthma Exacerbations	$57	$57
Minor Restricted Activity Days	$68	$68
Work Loss Days	$160	$160

Economic Values of Effects: Sources

Health Incident Avoided	Source of Value
Adult Mortality	VSL*
Infant Mortality	VSL*
Non-Fatal Heart Attacks	Cost of Illness (COI) = Direct medical costs, opportunity cost (OC)
Hospital Admissions	COI = Hospital charges, OC
Asthma ER Visits	COI = Costs to the hospital
Acute Bronchitis	WTP = Coughing and chest tightness (CT) or restricted activity day
Respiratory Symptoms	WTP = Symptoms such as coughing, head/sinus congestion, eye irritation, CT, coughing up phlegm, and/or wheeze
Asthma Exacerbations	WTP = Bad asthma day
Minor Restricted Activity Days	WTP = Combination of coughing, throat congestion, and sinusitis
Work Loss Days	WTP = Median annual earnings divided by (5 × 52)

* For more background on the VSL, see: http://yosemite.epa.gov/EE%5Cepa%5Ceed.nsf/webpages/MortalityRiskValuation.html.

Strengths of COBRA

- Enriches discussion of co-benefits and supports a balanced decision-making process that considers both the potential costs and benefits of policy choices.
- Easy-to-Use screening tool
  - Requires minimal inputs
  - Includes “canned” equations and approaches generally consistent with EPA practices
  - Detailed User’s Guide describes all assumptions and equations
- Flexible for User
  - Can enter data for a single county, group of counties, statewide, outside of state, and/or group of states
  - Can enter reductions in absolute terms or as percentage change
- Inexpensive (free!) compared to rigorous air quality models
  - Results from COBRA approach have fared well in informal comparisons;
  - Enables analysts to narrow a list of options at no/low cost and then devote resources to analyzing only those options with the best prospects using more expensive air quality models.
- Quick to generate results
- Mapping of results facilitates visualization of impacts
  - Provides very localized health effects and valuations: county level

Limitations of COBRA

- EPA is a free, screening tool not a highly sophisticated model.
  - Air Quality (AQ) model is "quick and dirty"
    - COBRA is best used as screening tool, followed up with comprehensive AQ analysis and health impact assessment
  - Somewhat inflexible and simple
    - Limited timeframe for analysis (currently 2017 only)
    - Inability to import own baseline
    - Must use "canned" equations (C-R functions, economic values)
    - Does not address cap issues
  - Relies upon inputs generated elsewhere
    - Assumptions about statewide % reductions may be an oversimplification
- While there are limitations that users should understand, technical peer reviewers found COBRA to be "a valuable model that produces a screening tool that can contribute to policy analysis and public dialogue."

How can I learn more?

Visit Our Website to find all of the documentation for COBRA and to download the model:

http://www.epa.gov/statelocalclimate/resources/cobra.html

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