Publications that Cite EPA's CO-Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool

Publication type	Date Published	Location	Summary	URL	Citation
Article	February 2019	Nevada, United States	Used COBRA to evaluate the health impacts of transitioning from diesel to CNG buses in Clark County, NV. Estimated $0.98-2.48 billion per year in health benefits, 114-258 premature deaths, and >5000 avoided respiratory and cardiovascular illnesses.	https://www.mdpi.com/1660-4601/16/5/720	Olawepo, John O., and L-W. Antony Chen. "Health Benefits from Upgrading Public Buses for Cleaner Air: A Case Study of Clark County, Nevada and the United States." *International Journal of Environmental Research and Public Health* 16, no. 5 (2019): 720.
Article	December 2018	United States	Used COBRA to estimate health impacts of rolling back environmental regulations on coal-fired power plants. Estimated 17,000 - 39,000 increased mortalities per year. Compared impacts by voting patterns in 2016 election.	https://www.sciencedirect.com/science/article/pii/S0301421518306277X	Thomson, Vivian, Kelsey Huelsman, and Dominique Ong. "Coal-fired power plant regulatory rollback in the United States: Implications for local and regional public health." Energy Policy: 123: 558-568 (2018).
Article	September 2018	United States	Used COBRA to evaluate the health impacts of electricity capacity expansion models to incorporate the health impacts into optimization of electricity planning. Estimated $1013 billion in societal costs.	https://www.sciencedirect.com/science/article/abs/pii/S0360544218317584	Rodgers, Mark D., David W. Coit, Frank A. Felder, and Annmarie Carlton. "Generation expansion planning considering health and societal damages–A simulation-based optimization approach." Energy 164 (2018): 951-963.
Report	July 2018	United States	Used COBRA to evaluate the health impacts of electricity capacity expansion models to incorporate the health impacts into optimization of electricity planning.	https://www.sciencedirect.com/science/article/pii/S0038012117302823	Rodgers, Mark, David Coit, Frank Felder, and Annmarie Carlton. "Assessing the effects of power grid expansion on human health externalities." (2018).
Report	July 2018	United States	Added functionality similar to COBRA to Engineering, Economic, and Environmental Electricity Simulation Tool (E4ST). The authors met with Abt Associates to understand the functionality of COBRA, including the S-R Matrix and atmospheric chemistry. Estimated 352-815 premature deaths from additional emissions compared to 24-53 premature deaths when other nuclear power policies are implemented.	http://www.rff.org/files/document/file/RFF%20WP%2018-18.pdf	Shawhan, Daniel, and Paul Picciano. "Retirements and Funerals: The Emission, Mortality, and Coal-Mine Employment Effects of a Two-Year Delay in Coal and Nuclear Power Plant Retirements." (2018)

Note that links to some publications require a subscription.

Publication type	Date Published	Location	Summary	URL	Citation
Article	March 2018	United States	Used COBRA to estimate the projected health effects for the average reduction in SO2 and NOx in 2025 from a $25 carbon tax. Results are on the order of 3,500–8,000 avoided cases of premature mortality and 90,000 avoided cases of exacerbated asthma. This corresponds roughly to a monetized value of $31–71 billion in health benefits (3% discount rate), with the bulk of the benefits accruing in the upper Midwest and East Coast.	https://www.worldscientific.com/doi/pdf/10.1142/S2010007818400031	Barron, Alexander R., Allen A. Fawcett, Marc AC Hafstead, James R. McFarland, and Adele C. Morris. "Policy insights from the EMF 32 study on US carbon tax scenarios." Climate Change Economics 9, no. 01 (2018): 1840003.
Report	March 2018	United States	Listed and described in "Methodologies for Calculating the Damage per Unit of Emissions for Pollutants that Depend on Time and Location" section. Estimated the dollar value per MWh of SO_2 ($52-171), NO_x ($3-12), and $PM_{2.5}$ ($7-22) and the value of avoided emissions from two natural gas power plants ($30-40/MWh).	http://policyintegrity.org/files/publications/Valuing_Pollution_Reductions.pdf	Shrader, Jeffrey, Burcin Unel, and Avi Zevin. "Valuing Pollution Reductions." (2018).
Report	February 2018	United States	Analyzed the health impacts of a hypothetical 15% reduction in energy consumption nationwide. Used AVERT to estimate emission reductions and COBRA to find avoided health harms per capita in states and cities with the highest being $184/per capita in West Virginia and $210/per capita in Pittsburgh. Also found the avoided costs of adult mortality, nonfatal heart attacks, minor restricted-activity days, infant mortality, lost work days, and respiratory-related symptoms totaling $630,431,926.	http://efficiencyforall.org/wordpress/wp-content/uploads/2017/04/h1801.pdf	Hayes, S. and Kubes, C., Saving Energy, Saving Lives. (2018).

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Publication type	Date Published	Location	Summary	URL	Citation
Article	February 2018	United States	Analyzed the general equilibrium costs of climate policies that levy taxes on carbon dioxide (CO2) emissions in the United States and return the revenue in the form of lump-sum rebates and tax relief over the years 2020 to 2040 using the US regional version of the Applied Dynamic Analysis of the Global Economy (ADAGE-US) forward-looking dynamic Computable General Equilibrium (CGE) model. Used COBRA to approximate the value of co-benefits to these policies that arise from concomitant reductions in non-greenhouse gas (GHG) emissions. Found co-benefits per housing including PM2.5 co-benefits ($547-1234), avoided mortality ($539-1217), and avoided morbidity ($3-12).	https://www.worldscientific.com/doi/abs/10.1142/S2010007818400067	Woollacott, Jared. "The economic costs and co-benefits of carbon taxation: A general equilibrium assessment." Climate Change Economics 9, no. 01 (2018): 1840006.
Environ-mental Impact Statement	February 2018	New York, United States	Used COBRA to estimate how the emission reductions from implementation of 2,400 MW of off-shore wind energy in New York State would affect ambient air quality and adverse health impacts throughout the coastal region. Found that the implementation of 2,400 MW of offshore wind energy would result in 8 to 18 fewer premature deaths annually and would avoid multiple adverse health outcomes in 2030 across the northeast United States.	https://tethys.pnnl.gov/publications/draft-generic-environmental-impact-statement-procurement-offshore-wind	New York State Department of Public Service and Ecology and Environment, Inc. "Draft Generic Environmental Impact Statement for Procurement of Offshore Wind" (2018).
Report	January 2018	New York, United States	Used COBRA to estimate how the emission reductions from implementation of 2,400 MW of off-shore wind energy in New York State would affect ambient air quality and adverse health impacts throughout the coastal region. Found that the implementation of 2,400 MW of offshore wind energy would result in 8 to 18 fewer premature deaths annually and would avoid multiple adverse health outcomes in 2030 across the northeast United States.	https://www.nyserda.ny.gov/All-Programs/Programs/Offshore-Wind/Offshore-Wind-in-New-York-State-Overview/NYS-Offshore-Wind-Master-Plan	New York State Energy Research and Development Authority. "New York State Offshore Wind Master Plan: Charting a Course to 2,400 Megawatts of Offshore Wind Energy" (January 2018).

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Publication type	Date Published	Location	Summary	URL	Citation
Public Comments	January 2018	United States	Used results from COBRA in developing public comments on the proposed Glider Vehicles Rule to estimate the potential public health impacts that could occur should glider vehicles go unregulated. Found that controlling emissions of these vehicles would reduce 70-160 premature deaths and generate $0.3-1.1 billion worth of health benefits.	https://www.edf.org/sites/default/files/content/Appendix%20B%20-%20Emission%20and%20Health%20Effects%20of%20Glider%20Vehicles.pdf	Environmental Defense Fund Comment on EPA Proposed Glider Vehicles Rule, Docket ID EPA-HQ-OAR-2014-0827. "Appendix B: Potential Emission and Health Impacts of Glider Kits" (Submitted January 5, 2018).
Report	December 2017	Virginia, United States	Used to analyze the effects of whether Virginia linked to RGGI and established its CO2 Budget Trading Program. The EPA used two sets of assumptions: the RGGI Scenario and the Virginia (VA) Scenario. Found that the RGGI Scenario would reduce mortality 5.3-12 by 2029 and the VA Scenario would reduce mortality 4.4-10 by 2029.	http://townhall.virginia.gov/L/GetFile.cfm?File=C:%5CTownHall%5Cdocroot%5C1%5C4818%5C8130%5CEIA_DEQ_8130_v2.pdf	Virginia Department of Planning and Budget, Economic Impact Analysis (2017).
Article	November 2017	Ohio, United States	Used to estimate the economic value of health effects under various scenarios of opting out of energy efficiency programs. Found the increase health costs of opting out are $564-$1.3 billion in Ohio and $4.1-9.3 billion in the greater region.	https://www.sciencedirect.com/science/article/pii/S1040619017302440	Baatz, Brendon, Grace Relf, and Meegan Kelly. "Consequences of large customer opt-out: An Ohio example" The Electricity Journal
Report	October 2017	United States	Used to calculate avoidable health care costs for acute myocardial infarctions, other cardiovascular diseases, asthma, and respiratory conditions to measure the benefits of urban tree planting. Found that the avoidable annual health care costs could be $13.2 million and work loss costs could be $11.9 million (12.5 percent of the estimated annual costs for tree planning and maintenance).	https://global.nature.org/content/funding-trees-for-health	The Nature Conservancy. McDonald, R., Aljabar, L., Aubuchon, C., Birnbaum, H., Chadler, C., Toomey, B., Daley, J., Jimenez, W., Trieschman, E., Paque, J., Zeiper, M. "Funding Trees for Health: An Analysis of Finance and Policy Actions to Enable Tree Planting for Public Health." October 2017.

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Publication type	Date Published	Location	Summary	URL	Citation
Article	August 2017	United States	Used COBRA to estimate the value of reductions to the pollutants SO2, NOx, and PM2.5, as part of use a suite of models also including EASIUR, the impact factor model developed in Penn et al. and Levy et al., Air Pollution Emission Experiments and Policy analysis model (AP2, formerly APEEP: Muller et al.), and EPA RIA benefits per-tonne estimates. Found cumulative benefits of $29.7-112.8 billion from 3000-12,700 avoided premature mortalities.	https://www.nature.com/articles/nenergy2017134	Millstein, Dev, Ryan Wiser, Mark Bolinger, and Galen Barbose. "The climate and air-quality benefits of wind and solar power in the United States," Nature Energy 6. August 2017.
Disserta-tion	August 2017	United States	Used COBRA to estimate the estimate of air-pollution costs by modes of transportation. Found human health externality unit costs to be $0.57/vehicle mile traveled and $0.91/passenger mile traveled.	http://tigerprints.clemson.edu/all_dissertations/2018/	Sun, Jianan. "External Economic Costs of Intelligent Urban Transportation Systems: A Method to Evaluate the Externalities of Comparative Technology Adoption Pathways in the Urban Mobility Service sector." Clemson University, PhD Thesis. August 2017.
Report	June 2017	Ohio, United States	Used COBRA to estimate the economic value of health effects under various scenarios of opting out of energy efficiency programs. Found the increase health costs of opting out are $564-$1.3 billion in Ohio and $4.1-9.3 billion in the greater region.	https://aceee.org/sites/default/files/publications/researchreports/u1706.pdf	Baatz, Brendon, Grace Relf, and Meegan Kelly. "Large Customer Opt-Out: An Ohio Example." American Council for an Energy-Efficient Economy, Report U1706. June 2017.
Disserta-tion	June 2017	Michigan, United States	Used COBRA to estimate the health impacts from reductions in SO_2 and NO_x due to energy savings from light programs in Michigan. Found benefits from avoided pollutants to be $36-81 million.	http://scholarworks.wmich.edu/dissertations/3145/	Amough, Teryila Ephraim. "A Meta-Analysis of Energy Savings from Lighting Programs in Michigan." Western Michigan University, PhD Thesis. June 2017.
Article	April 2017	N/A	Compared InMAP outputs to outputs from WRF-Chem and COBRA. Found that COBRA performs similarly to InMAP but not as much spatial detail as WRF-Chem.	http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0176131	Tessum, C. W., Hill, J. D., and Marshall, J. D. "InMAP: A model for air pollution interventions." *PloS one*. April 2017.

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Publication type	Date Published	Location	Summary	URL	Citation
Report	January 2017	United States	Does not use COBRA, but explains that this inventory of emissions from agriculture and livestock could be coupled with an air quality screening tool such as COBRA to evaluate potential changes in human health from changes in emissions concentrations.	https://energy.gov/sites/prod/files/2017/02/f34/2016_billion_ton_report_volume_2_chapter_9.pdf	U.S. Department of Energy. January 2017. 2016 Billion-Ton Report: Advancing Domestic Resources for a Thriving Bioeconomy, Volume 2: Environmental Sustainability Effects of Select Scenarios from Volume 1. R.A. Efroymson, M.H. Langholtz, K.E. Johnson, and B.J. Stokes (Leads), ORNL/TM-2016/727. Oak Ridge National Laboratory, Oak Ridge, TN.
Report	January 2017	United States	Used COBRA to estimate how changes in NOx and SO2 affect ambient PM2.5. Found the health impacts of the Regional Greenhouse Gas Initiative to be 300-830 lives saved, 8,200 asthma attacks avoided, 39,000 lost work days avoided, and $5.7 billion in health savings and other benefits.	https://www.abtassociates.com/insights/publications/report/analysis-of-the-public-health-impacts-of-the-regional-greenhouse-gas	Abt Associates (2017). Analysis of the Public Health Impacts of the Regional Greenhouse Gas Initiative.
Working Paper	November 2016	United States	Analyzed COBRA as a tool to measure the impacts of energy efficiency in buildings. Found that COBRA had an interactive approach, with a policy scope, was used at the design stage of policy, and had a targeting city focus.	http://www.sustainablesids.org/wp-content/uploads/2016/12/UNEP-Tools-Energy-Efficient-Buildings-2016.pdf	Petrichenko, K., Aden, N., & Tsakiris, A. (2016). Tools for Energy Efficiency in Buildings. A Guide for policy-makers and experts. Working paper, C2E2, Copenhagen and WRI, Washington DC For further information or to provide feedback, please contact Ksenia Petrichenko.
Article	September 2016	United States	Used COBRA to calculate reduced morbidity and mortality outcomes and total monetary value from net emissions changes due to state RPS programs. Found reduced air pollution provide $5.2 billion in health and environmental benefits.	http://www.sciencedirect.com/science/article/pii/S0301421516303408	Barbose, Galen, et al. "A retrospective analysis of benefits and impacts of US renewable portfolio standards." Energy Policy 96 (2016): 645-660.

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Working Paper	September 2016	N/A	Referenced COBRA as "an example of a framework for air quality improvements that can be used to quantify changes in air quality and the resulting calculated health outcomes in both epidemiological and monetary terms. COBRA as well as other work from the US EPA suggests that measures for producing both local air quality and associated GHG co-benefits offer compelling value for health and wellbeing that can be pursued irrespective of a climate change agenda. As understanding grows and data become more readily available, frameworks and analyses can consider additional co-benefits such as ecosystem benefits or avoided material damages, as well as potential economic opportunities to develop and deploy innovative clean technologies (US EPA 2004)."	http://eprints.lse.ac.uk/68876/1/Cobenefits_Of_Urban_Climate_Action.pdf	Floater, Graham, et al. "Co-benefits of urban climate action: a framework for cities." (2016).
Article	September 2016	N/A	Analyzed COBRA as part of a survey of tools to measure ambient air pollution health risks. This paper discusses the differences between tools for factors such as information source, format, and technical complexity.	https://www.ncbi.nlm.nih.gov/pubmed/26742852	Anenberg, Susan C., Anna Belova, Jørgen Brandt, Neal Fann, Sue Greco, Sarath Guttikunda, Marie-Eve Heroux et al. "Survey of ambient air pollution health risk assessment tools." *Risk Analysis* (2015).
Article	July 2016	United States	Used COBRA to analyze the social costs of PM2.5 pollution in 3,000 U.S. counties. Found the marginal social costs for SO_2 ($\$10^4$/t), NOx ($\$10^3$-$10^4$/t) and NH_3 ($\$10^{3.5}$-$10^{4.5}$/t).	http://www.sciencedirect.com/science/article/pii/S1352231016303090	Heo, J., Adams, P. J., & Gao, H. O. (2016). Reduced-form modeling of public health impacts of inorganic PM 2.5 and precursor emissions. *Atmospheric Environment*, *137*, 80-89.
Report	July 2016	Ohio, United States	COBRA was used to model health impacts from each power plant in Ohio using estimated primary PM2.5 and historic NOx and SO2 emissions. Found that $PM_{2.5}$ emissions from power plants account for 940-2130 premature deaths/year and Clean Power Plan implementation would reduce health burdens $8.1-18.2 billion.	https://www.psehealthyenergy.org/wp-content/uploads/2017/04/CPP.OH_1.pdf	PSE Healthy Energy. The Clean Power Plan in Ohio: Analyzing power generation for health and equity. July 2016.

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Publication type	Date Published	Location	Summary	URL	Citation
Report	July 2016	Pennsylvania, United States	COBRA was used to model health impacts from each power plant in Pennsylvania using estimated primary PM2.5 and historic NOx and SO2 emissions. Found that power plant emissions contribute to 1,000-2,300 premature deaths and the Clean Power Plan would reduce health burdens $8.9-20 billion.	https://www.psehealthyenergy.org/our-work/publications/archive/our-air-health-and-equity-impacts-of-pennsylvanias-power-plants/	PSE Healthy Energy. The Clean Power Plan in Pennsylvania: Analyzing power generation for health and equity. July 2016.
Report	June 2016	California, United States	COBRA was used to estimate the health effects from reduced SO2 or NOx emissions resultant from the California Energy Commission's 2016 proposed efficiency standards for computers, computer monitors, and signage displays. Estimated health benefits to be $4.7-10.6 million from 2018-2030.	http://www.dof.ca.gov/Forecasting/Economics/Major_Regulations/Major_Regulations_Table/documents/SRIA_APPEFF_2016_All.pdf	Roland-Host, David; Evans, Samuel; Han Springer, Cecilia; Emmer, Tessa; Prepared for California Energy Commission. "Standardized Regulatory Impact Assessment: Computers, Computer Monitors, and Signage Displays." June 2016.
Article	May 2016	United States	Used COBRA as part of a reduced-form model to estimate the mortality costs per tonne of PM2.5 inorganic air pollution. Estimated the aggregate social costs to be $1.0 trillion.	http://pubs.acs.org/doi/abs/10.1021/acs.est.5b06125	Heo, J., Adams, P. J., & Gao, H. O. (2016). Public Health Costs of Primary PM2. 5 and Inorganic PM2. 5 Precursor Emissions in the United States. *Environmental science & technology*, *50*(11), 6061-6070.
Public Comments	May 2016	District of Columbia, United States	COBRA was used to estimate the effect of reduced air pollution on premature deaths and economic growth due to improved health outcomes. Found clean energy measures will prevent 27-60 premature deaths and increase regional economic growth by $253-572 million from better health outcomes.	http://chesapeakeclimate.org/wp/wp-content/uploads/2016/05/CCAN_B21-0650_testimony_DC-RPS.pdf	Chesapeake Climate Action Network. Comments on B21-0650 – Renewable Portfolio Standard Expansion Amendment Act of 2016.
Article	May 2016	United States	COBRA was used to quantify the health and economic impacts of extra NOx emissions attributable to non-compliant Volkswagen vehicles in the U.S. Found extra NOx emissions for one year equal 5-50 premature deaths, 247-1061 episodes of respiratory symptoms, 3-14 cardiovascular hospital emissions, 3-13 emergency asthma visits, 687-17,526 work days with restricted activity, and economic costs of $43,479-432,268,502.	http://www.mdpi.com/1660-4601/13/9/891/html	Hou, Lifang; Zhang, Kai; Luthin, Moira A.; Baccarelli, Andrea A. (2016). Public Health Impact and Economic Costs of Volkswagen's Lack of Compliance with the United States' Emission Standards. *Int. J. Environ. Res. Public Health.* 13(9): 891.

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Report	May 2016	United States	COBRA was used to estimate air quality benefits of the 20 GW of solar power installed by the end of 2014 by region or state. Found emissions reductions would result in $420-1,590 million per year in benefits, higher in regions with high population densities and greater power-sector emissions (e.g., Great-Lakes-Mid-Atlantic).	https://www.nrel.gov/docs/fy16osti/65628.pdf	Wiser, Ryan, Trieu Mai, Dev Millstein, Jordan Macknick, Alberta Carpenter, Stuart Cohen, Wesley Cole, Bethany Frew, and Garvin Heath. On the Path to Sunshot: The Environmental and Public Health Benefits of Achieving High Penetrations of Solar Energy in the United States. Lawrence Berkeley National Laboratory (LBNL) and National Renewable Energy Laboratory (NREL). Powered by SunShot U.S. Department of Energy. May 2016.
Report	January 2016	United States	Used COBRA to calculate reduced morbidity and mortality outcomes and total monetary value from net emission changes. Found health and environmental benefits (primarily from SO2, NOx, and PM2.5 reductions) to be between $4-10 billion. Additional benefits include avoiding 160-290 emergency room visits for asthma, 195-310 hospital emissions for respiratory and cardiovascular symptoms, 40-560 non-fatal heart attacks and 38,000-64,000 lost work days.	https://emp.lbl.gov/sites/all/files/lbnl-1003961.pdf	U.S. Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab) and National Renewable Energy Laboratory (NREL) January 2016 "A Retrospective Analysis of the Benefits and Impacts of U.S. Renewable Portfolio Standards, released January 2016" https://emp.lbl.gov/sites/all/files/lbnl-1003961.pdf
Report	January 2016	United States	COBRA was used to calculate reduced morbidity and mortality outcomes and total monetary value from net emissions changes due to state RPS programs. Found health and environmental benefits (primarily from SO2, NOx, and PM2.5 reductions) to be between $4-10 billion. Additional benefits include avoiding 160-290 emergency room visits for asthma, 195-310 hospital emissions for respiratory and cardiovascular symptoms, 40-560 non-fatal heart attacks and 38,000-64,000 lost work days.	http://www.nrel.gov/docs/fy16osti/65005.pdf	Wiser, R., G. Barbose, J. Heeter, T. Mai, L. Bird, M. Bolinger, A. Carpenter, G. Heath, D. Keyser, J. Macknick, A. Mills, and D. Millstein. 2016. *A Retrospective Analysis of the Benefits and Impacts of U.S. Renewable Portfolio Standards*. Lawrence Berkeley National Laboratory and National Renewable Energy Laboratory. NREL/TP-6A20-65005.
Conference proceeding	November 2015	United States	COBRA was used to estimate the health co-benefits from different scenarios of renewable energy deployment in the United States by converting changes in air pollutant emissions to changes population health outcomes.	https://apha.confex.com/apha/143am/webprogram/Paper336283.html	Bast, E. (2015, November). Analyzing the health co-benefits of renewable energy deployment in the United States. In *2015 APHA Annual Meeting & Expo (Oct. 31-Nov. 4, 2015)*. APHA.

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Article	September 2015	Utah, United States	Used COBRA to estimate the benefits associated with a seasonal gas tax to reduce vehicle trips in Cache Valley, Utah. Estimated the total health benefit to be $782,750.	http://link.springer.com/article/10.1007/s10640-015-9968-z	Moscardini, Leo and Arthur J. Caplan (2015) "Controlling Episodic Air Pollution with a Seasonal Gas Tax: The Case of Cache Valley, Utah." Environmental and Resource Economics
White Paper	July 2015	New York, United States	COBRA was used to estimate the marginal cost in health effects of SO2 or NOx emissions. The authors ran a scenario for each pollutant by specifying a reduction of a fixed amount of emissions from the COBRA control case for electricity generating units in NY. Found the dollar/MWh value for SO_2, NO_x, and CO_2 for 2017-2035. 2035 estimates are $42-78/MWh.	http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/26be8a93967e604785257cc40066b91a/$FILE/Staff_BCA_Whitepaper_Final.pdf	New York Department of Public Service. Staff White Paper on Benefit-Cost Analysis in the Reforming Energy Vision Proceeding (14-M-0101). July 2015.
Article	March 2015	N/A	References COBRA as a computational tool to evaluate energy policy and planning alternatives in order to determine which scenarios are most likely to meet climate and energy goals.	http://www.sciencedirect.com/science/article/pii/S2214629614001364	Bridges, A.; Felder, F.A.; McKelvey, K.; Niyogi, I. (2015). Uncertainty in energy planning: Estimating the health impacts of air pollution from fossil fuel electricity generation. Energy Research & Social Science 6, 74-77.
Report	February 2015	California, United States	Used COBRA model for the Energy Commission's first "Standardized Regulator Impact Assessment" for appliance efficiency standards division. Estimated proposed standards would avoid $1.0-2.3 million in health impacts in the first year. By 2025, the range increases to $5.8 -14.8 million.	https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=15-AAER-01	REVISED STANDARDIZED REGULATORY IMPACT ASSESSMENT OF 2014 PROPOSED APPLIANCE EFFICIENCY REGULATIONS: Regulations for Toilets, Urinals, Faucets, Dimming Ballasts, Air Filters, and Heat-Pump Water-Chilling Packages
Book	January 2015	N/A	COBRA was used to value the avoided health impacts from the reduction in air quality pollutants from electric drive vehicles.	http://www.routledge.com/books/details/9781138811102/	Link, A.N., O'Connor, A.C., & Scott, T.J. (2015). Battery Technology for Electric Vehicles: Public Science and Private Innovation. Abingdon, UK: Routledge.
Article	January 2015	N/A	Results from InMAP, a comprehensive air quality model for estimating the air pollution health impacts of emission reductions and other potential interventions, were compared against COBRA because it is an existing reduced-form model.	http://www.geosci-model-dev-discuss.net/8/9281/2015/gmdd-8-9281-2015.pdf	C. W. Tessum, J. D. Hill, and J. D. Marshall. (2015). InMAP: a new model for air pollution interventions. Geosci. Model Dev. Discuss., 8, 9281–9321. Doi: 10.5194/gmdd-8-9281-2015.

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Working Paper	November 2014	N/A	Explained COBRA's use in calculating morbidity endpoints including mortality, chronic bronchitis, non-fatal heart attaches, respiratory hospital admissions, and acute bronchitis, among others.	http://www.theicct.org/sites/default/files/publications/ICCT_morbidities_20141112.pdf	Chambliss, S. et al. (2014). Morbidities Calculation: Guidelines and Walkthrough. The International Council on Clean Transportation. Working Paper 2014-10.
Working Paper	November 2014	United States	Used COBRA to measure the health impacts from current electricity generation infrastructure. SO_2 and NOx pollutant were expected to add $125 billion to health care costs in 2013, leading to 18,000 premature deaths, 27,000 cases of acute bronchitis, 240,000 episodes of respiratory distress, and 2.3 million lost work days.	https://www.edf.org/sites/default/files/edf_laitner-mcdonnell-energy-efficiency-as-a-pollution-control-technology.pdf	Laitner, J.A.; McDonnell, M.T. (2014). Energy Efficiency as a Pollution Control Technology and a Net Job Creator under Section 111(d) Carbon Pollution Standards for Existing Power Plants. Working paper prepared for the Environmental Defense Fund.
Report	August 2014	United States	Used COBRA to evaluate the health impacts of energy efficiency and renewable energy research and development programs. Found avoided incidences and monetary benefits of adult and infant mortality, heart attacks, hospital admissions, respiratory symptoms, and work loss days, resulting in $17.7-45.2 million in benefits.	https://energy.gov/sites/prod/files/2015/05/f22/evaluating_realized_rd_mpacts_9-22-14.pdf	O'Connor, Alan C., and Ross J. Loomis. "Evaluating Realized Impacts of DOE/EERE R&D Programs." (2014).
Report	April 2014	United States	Used COBRA to measure the health impacts of four state policies to improve energy efficiency. Found ACEEE scenario would avoid over 147,000 asthma attacks, 5000 premature deaths, and $100 million due to lost work days.	http://climateandenergy.org/resources/ACEEE111droleofefficiency.pdf	American Council for an Energy-Efficient Economy. (2014). Change Is in the Air: How States Can Harness Energy Efficiency to Strengthen the Economy and Reduce Pollution.
Master's Thesis	January 2014	Utah, United States	COBRA was used to estimate Cache County's potential public health savings from a seasonal gas tax. Found benefits to be $479,403-1,086,075.	http://digitalcommons.usu.edu/etd/3870	Moscardini, Leo A., "Estimating the Effectiveness of a Seasonal Gas Tax for Controlling Episodic PM2.5 Concentrations in Cache County, Utah" (2014). All Graduate Theses and Dissertations. Paper 3870.
Report	December 2013	United States	Used COBRA to quantify and monetize the value of changes in the incidence of avoided adverse health events associated with emissions reductions. Found avoided incidences and economic value for mortality, respiratory and cardiovascular measures, and work loss days, total $1.76-45.2 million.	https://www1.eere.energy.gov/analysis/pdfs/2013_bca_vto_edvs.pdf	Link, Albert N., et al. "Benefit-Cost Evaluation of US DOE Investment in Energy Storage Technologies for Hybrid and Electric Cars and Trucks." (2013).

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Article	February 2013	California and Idaho, United States	Used COBRA to calculate the benefits of wind energy derived from two locations: a 580 MW wind farm at Altamont Pass, CA, and a 22 MW wind farm in Sawtooth, ID. The turbines in CA will likely avoid $560 million-$4.38 billion in health costs and the ID turbines will likely avoid $18-104 million.	https://www.sciencedirect.com/science/article/pii/S0301421512009690X	McCubbin, D. and Sovacool, B.K. (2013). Quantifying the health and environmental benefits of wind power to natural gas. Energy Policy 53, 429–441.
Book	January 2013	N/A	Analyzed COBRA as a tool for program evaluation to discuss the many factors that affect the utility of each technique and how that impacts the technological, economic and societal forecasts of the programs in question.	https://www.e-elgar.com/shop/handbook-on-the-theory-and-practice-of-program-evaluation	O'Connor, A. et al. "Estimating avoided environmental emissions and environmental health benefits" Chapter 9, *Handbook on the Theory and Practice of Program Evaluation* (2013): 247.
Article	November 2012	United States	"In this example, the original air quality modeling entailed a significant investment of time and resources, but the resulting benefit per ton estimates enable analysts to quickly estimate benefits. In other approaches, a simplified air quality model is developed based on the responsiveness of ambient pollutant levels to changing emissions. These source–receptor relationships are then used to calculate health impacts and benefits. Though the development of the air quality model is resource intensive, its subsequent application to various policy scenarios is not." Found the value of reducing directly emitted $PM_{2.5}$ and $PM_{2.5}$ ranges between approximately $1300 for reducing a ton of NO_x from Ocean-Going Vessels to about $450,000 for reducing a ton of directly emitted $PM_{2.5}$ from Iron and Steel facilities.	http://www.sciencedirect.com/science/article/pii/S0160412012001985	Fann, N., Baker, K. R., & Fulcher, C. M. (2012). Characterizing the PM 2.5-related health benefits of emission reductions for 17 industrial, area and mobile emission sectors across the US. *Environment international*, *49*, 141-151.
Working Paper	July 2012	North Carolina, United States	Used COBRA to determine the portion of Clean Smokestacks emissions reduction benefits realized in North Carolina under the Clean Smokestacks Act. Found mortality benefits from reduced SO_2 emissions to equal $6.365-$16.032 million.	http://nicholasinstitute.duke.edu/climate/policydesign/benefits-of-early-state-action-in-environmental-regulation-of-electric-utilities/	Hoppock, David, et al. "Benefits of early state action in environmental regulation of electric utilities: North Carolina's clean smokestacks act." *Nicholas Institute for Environmental Policy Solutions, Duke University: Durham, NC* (2012).

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Article	January 2012	California, United States	Used COBRA to estimate the health impacts of plug-in electric vehicles in California. Estimated the value of benefits at $750 to $1,500 per vehicle in an expected PEV penetration scenario and $1,000 to $2,500 per vehicle in an aggressive penetration scenario.	https://journals.sagepub.com/doi/10.3141/2287-19	Witt, M. et al. (2012). Plug-in Vehicles in California: Review of Current Policies, PEV-Related Emissions Reductions for 2020, and Policy Outlook.
Book	January 2012	N/A	Used COBRA to measure the health impacts from decreases PM2.5, SO2, and NOx from public investments in energy technologies. Found adverse health incidences to be $90,500 (on-grid centralized systems), $11.8 million (grid-connected distributed systems), and $28.7 million (off-grid systems).	https://www.e-elgar.com/shop/public-investments-in-energy-technology	Gallaher, Michael P., Albert N. Link, and Alan O'Connor. *Public Investments in Energy Technology*. Edward Elgar Publishing, 2012.
Article	November 2011	United States	Used COBRA to estimate the health benefits of wind power. The turbines in CA will likely avoid $560 million-$4.38 billion in health costs and the ID turbines will likely avoid $18-104 million.	http://www.sciencedirect.com/science/article/pii/S1040619011002351	McCubbin, Donald, and Benjamin K. Sovacool. "The hidden factors that make wind energy cheaper than natural gas in the United States." *The Electricity Journal* 24.9 (2011): 84-95.
Book	January 2011	United States	Used COBRA to estimate the health costs of air pollution by mode of transportation including road, rail, air, and water. Estimated air-pollution costs by road (LDVG: 0.91¢/pmt; HDVD: ¢1.55/tm), rail (¢0.35/tm), air (¢0.39/pmt; ¢1.88/tm) and water (¢1.74/tm).	https://escholarship.org/uc/item/13n8v8gq	Delucchi, Mark, and Don McCubbin. "External costs of transport in the United States." Chapter 15 in *A Handbook of Transport Economics* (2011): 341.
Report	August 2010	United States	Used COBRA to calculate the health benefits of reductions in air pollutants resulting from using PV systems rather than the next best technology alternative for electricity production. Estimated environmental health benefits to be to be $237 million.	https://energy.gov/sites/prod/files/2015/05/f22/solar_pv.pdf	O'Connor, Alan C., Ross J. Loomis, and Fern M. Braun. "Retrospective Benefit-Cost Evaluation of DOE Investment in Photovoltaic Energy Systems." *RTI International* (2010).

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Report	August 2010	United States	RTI International (2010): RTI, for the U.S. Department of Energy (DOE), estimated health benefits associated with two types of geothermal technologies in which DOE has invested using COBRA. The study calculated a net reduction in PM, NOx, and SO2 associated with geothermal energy produced by geothermal plants that otherwise would have been produced by fossil fuel plants. Total environmental health benefits are estimated to be $155.7 million.	https://www.energy.gov/sites/prod/files/2014/02/f7/gtp_benefit-cost_eval_aug2010.pdf	Retrospective Benefit-Cost Evaluation of U.S. DOE Geothermal Technologies R&D Program Investments: Impacts of a Cluster of Energy Technologies
Report	June 2010	United States	Used COBRA to quantify and monetize the value of changes in the incidence of avoided adverse health events associated with emissions reductions from electric vehicle investments. Found $1,107,053 in avoided mortality and health care incidents.	https://www1.eere.energy.gov/analysis/pdfs/wind_bc_report10-14-10.pdf	Retrospective Benefit–Cost Evaluation of U.S. DOE Wind Energy Program: Impact of Selected Energy Technology Investments
Report	May 2010	United States	"Health benefits associated with reduced diesel fuel consumption and reduced NOx, PM, and Sox emissions are quantified in monetary terms using the COBRA." Found $53.7 million in health benefits from reduce environmental emissions.	https://www1.eere.energy.gov/analysis/pdfs/advanced_combustion_report.pdf	May 2010 - USDOE EERE Prepared by Albert Link, UNC at Greensboro Dept of Economics, Retrospective Benefit-Cost Evaluation of US DOE Vehicle Combustion Engine R&D Investments: Impacts of a Cluster of Energy Technologies
Report	May 2010	Utah, United States	Mentions COBRA as an option for estimating the co-benefits of emissions reductions from energy efficiency and renewable energy. Found mortality benefits to be $7.39-7.79/MWh and mobility benefits to be $0.48/MWh.	http://www.synapse-energy.com/sites/default/files/SynapseReport.2010-05.UT-EO.Utah-Co-Benefits.08-064.pdf	Fisher, Jeremy, et al. "Co-Benefits of energy efficiency and renewable energy in Utah." *Synapse Energy Economics* (2010).
Report	January 2010	Iowa, United States	Physicians for Social Responsibility, a non-profit organization, used COBRA to estimate the health benefits of a scenario in which the percentage of Iowa's electricity generation derived from coal was reduced from its current level of 72% to the national average of 47%. Health benefits totaled $71.8 million, of which 92.1% were derived from reduced mortality	https://iowaenvironmentalfocus.org/tag/iowa-coal-health-a-preliminary-mapping-study/	Iowa Coal & Health: A Preliminary Mapping Study

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Article	January 2010	United States	"To estimate health effects from changes in air pollution emissions attributed to the program cluster evaluated, the US Environmental Protection Agency's (EPA) COBRA model (Co-Benefits Risk Assessment Model, described in US EPA [6]) is used. To apply COBRA, it is necessary to enter the estimated changes in air emissions of particulate matter (PM), sulphur dioxide (SO2), nitrogen oxide (NOx), and volatile organic compounds (VOCs) into the model. Because not all air pollutants are taken into account by the model, the results obtained from using COBRA for the analysis is taken as a lower bound estimate of impact of health effects and their economic value. Table 2 shows the health effects included in COBRA, by type of effect. The model provides estimates of the incidence of each type of effect and related healthcare costs.	https://www.witpress.com/Secure/elibrary/papers/EEIA10/EEIA10009FU1.pdf	Ruegg, R. T., and G. B. Jordan. "New benefit-cost methodology for evaluating renewable and energy efficiency programs of the US Department of Energy." *WIT Transactions on Ecology and the Environment* 131 (2010): 95-106.
Article	July 2009	United States	"For each power plant, we estimated the relationship between emissions and incremental contribution to ambient concentrations using a S-R matrix. S-R matrix is a reduced-form model based on the Climatological Regional Dispersion Model, a sector-averaged Gaussian dispersion model that includes wet and dry deposition and first-order chemical conversion of SO2 and NOx to sulfate and nitrate particles. More detail about the model is available elsewhere" Found the economic valuation premature mortality to be $5.5 million.	http://onlinelibrary.wiley.com/doi/10.1111/j.1539-6924.2009.01227.x/full	Levy, J. I., Baxter, L. K., & Schwartz, J. (2009). Uncertainty and variability in health-related damages from coal-fired power plants in the United States. *Risk Analysis*, *29*(7), 1000-1014.
Report	July 2009	California, United States	COBRA was analyzed as part of an effort to identify methodological alternatives for quantifying the benefits of renewable energy, including the pros and cons of the tool.	http://www.nrel.gov/docs/fy09osti/45639.pdf	Mosey, Gail, and Laura Vimmerstedt. *Renewable electricity benefits quantification methodology: a request for technical assistance from the California Public Utilities Commission*. National Renewable Energy Laboratory, 2009.

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Report	January 2009	Virginia, United States	Abt Associates performed an analysis of the health effects impacts of a proposed coal-fired power plant in Wise County, Virginia. The study estimated that the plant would contribute to two to five premature mortality events annually in Virginia, and five to fourteen premature mortality events nationwide. Total annual economic impacts of health effects in Virginia ranged from $16 to $52 million, and $44 to $135 million nationwide.	https://www.abtassociates.com/insights/publications/report/assessing-the-economic-impact-of-dominion-virginia-powers-coal-fired	Assessing the Economic Impact of Dominion Virginia Power's Coal-Fired Power Plant in Wise County, Virginia (2009), Abt Associates, Prepared for: Wise Energy for Virginia Coalition c/o Appalachian Voices
Working Paper	November 2007	United States	"For a tool for calculating co-benefits, see Mulholland (2007). For estimates of damages from releases of particulates, sulfur dioxide, and nitrogen oxides in the U.S., see Muller and Mendelsohn (2007)."	http://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1121&context=peri_workingpapers	Boyce, James K., and Matthew Riddle. "Cap and dividend: how to curb global warming while protecting the incomes of American families." (2007).
Article	May 2007	United States	Used COBRA to model the public health benefits and the change in the spatial inequality of health risk for a number of hypothetical control scenarios for power plants in the United States to determine optimal control strategies. Benefits ranged from 17,000–21,000 fewer premature deaths per year.	http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1867973/	Levy, Jonathan I., Andrew M. Wilson, and Leonard M. Zwack. "Quantifying the efficiency and equity implications of power plant air pollution control strategies in the United States." Environmental health perspectives (2007): 743-750.
Memoran-dum	April 2007	Wisconsin, United States	Used COBRA to determine the public health benefits of implementing the NOx RACT rule. The benefits amount was compared to compliance costs. Found the NOx RACT rule would provide $80,000,000/year in public health benefits.	http://dnr.wi.gov/about/nrb/2007/April/04-07-3A1.pdf	DATE: April 9, 2007; TO: Members of the WI Natural Resources Board ; FROM: Scott Hassett, Secretary; SUBJECT: Reasonably Available Control Technology (RACT) program for major sources of nitrogen oxides (NOx) in the moderate ozone nonattainment; http://dnr.wi.gov/air/pdf/AM1705.pdf

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Article	February 2007	United States	"The S–R matrix is a regression-based derivation of output from the Climatological Regional Dispersion Model (CRDM) which uses assumptions similar to the Industrial Source Complex Short Term model (ISCST3). It was developed by Pechan and Associates for Abt Associates and used in past regulatory impact analyses (US Environmental Protection Agency, 1999d). S–R matrix provides a database of transfer factors that summarize the impact that mobile source PM2.5 and precursor emissions from any one county have on ambient PM2.5 concentrations in that county as well as all other counties (Abt Associates, 2003)"	http://www.sciencedirect.com/science/article/pii/S1352231006009654	Greco, S. L., Wilson, A. M., Spengler, J. D., & Levy, J. I. (2007). Spatial patterns of mobile source particulate matter emissions-to-exposure relationships across the United States. *Atmospheric Environment*, *41*(5), 1011-1025.
Article	April 2006	N/A	Other options include the CoBenefits Risk Assessment (COBRA) model,34 which features built-in source-receptor atmospheric sensitivity matrices in place of atmospheric modeling by the user to allow quick estimates of the health impacts from various emission sources; the Ozone Risk Assessment Model,35 which operates in a similar fashion to BenMAP; and the Air Strategy Assessment Program, currently under development by EPA to link BenMAP with AirControlNET costing software36 for full-stream assessment of both costs and benefits of attainment options (B. Hubbell, EPA, personal communication, March 8, 2005). These and other tools, along with an improved understanding of the potential role of benefit analysis in integrated air quality management, could provide the necessary impetus for its greater incorporation in upcoming SIP development. Estimated net benefits of alternative control strategies to be between $1.5-1.6 million.	http://www.tandfonline.com/doi/abs/10.1080/10473289.2006.10464524	Chestnut, Lauraine G., David M. Mills, and Daniel S. Cohan. "Cost-benefit analysis in the selection of efficient multipollutant strategies." *Journal of the Air & Waste Management Association* 56.4 (2006): 530-536.

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Report	November 2004	Connecticut, United States	REMI, for EPA and the State of Connecticut, analyzed the impacts of oil and natural gas conservation policies in Connecticut. The study integrated estimates of reduced mortality and the value of health improvements from COBRA into a simulation of the impacts of these policies on the state's economy.		Economic Impact of Oil and Natural Gas Conservation Policies, Regional Economic Models, Inc. (2004). Prepared for U.S. EPA and the State of Connecticut.

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