Health Outcome Benefits Estimation Using the COBRA Tool

Rationale:

To assess the impacts of cleaning Michigan's energy grid as part of the clean energy climate action package signed by Governor Whitmer on the city of Detroit by estimating the benefits of transitioning from coal-fired power plant to solar energy using the US Environmental Protection Agency's (EPA) CO-Benefits Risk Assessment (COBRA) tool.

What is COBRA?

The EPA's COBRA is a screening tool that may be used by state, local, and tribal government staff and others interested stakeholders to assess the air quality, health, and related economic benefits of different emissions scenarios. Users may create their own scenarios based on clean energy policies and programs that aim to reduce emissions. COBRA serves as a preliminary screening tool to identify those scenarios that might benefit from further evaluation.

COBRA contains detailed emission estimates of particulate matter 2.5 micrometers or less (PM2.5), sulfur dioxide (SO2), nitrogen oxides (NOx), and volatile organic compounds (VOCs) for the year 2016, and detailed projections for 2023 and 2028 as developed by the U.S. EPA. Users create their own scenario by specifying increases or decreases to baseline emission estimates for one of three analysis years - 2016, 2023, or 2028. Emission changes can be entered at the county, state, or national levels, and outcomes can be modeled nationwide or for smaller geographic areas. Using an approach to estimating avoided health impacts and monetized benefits that is generally consistent with EPA practice, the model translates the ambient PM and ozone changes into human health effects and monetizes them.

There are two versions of COBRA- the desktop application and the web-based edition. Both use the same methodology, although the desktop version offers additional advanced features. In particular, the desktop version is preloaded with input data on emissions, population, and baseline health incidence for 2016, 2023, and 2028; the web edition includes data only for 2024.

Data Sources:

- Baseline emissions: National Emissions Inventory
- Scientific basis of estimates: PM Integrated Science Assessment
- Mortality data: CDC WONDER
- Population data: US Census Bureau

- Hospitalization rates, Emergency Department visits, heart attacks: Healthcare Cost and Utilization Project (HCUP)
- School loss days: National Center for Education Statistics, National Health Interview Survey (Adams et al., 1999)
- Other (acute bronchitis, upper respiratory symptoms, lower respiratory symptoms, asthma, minor restricted activity days (MRAD), work loss days): specific estimates from various studies

Results:

Overall, COBRA demonstrated that the scenario of shifting from coal to solar energy by 23% would lead to improved air quality, public health, and economic benefits for Detroit at a conservative estimated value of $23 million annually, based on 2024 estimates. This includes estimated substantial health improvements, including fewer respiratory and cardiovascular illnesses and premature deaths. The economic valuation shows savings in healthcare costs and increased productivity.

		WAYNE COUNTY	CITY OF DETROIT
	Change in Incidence (annual cases)	Monetary Value (annual dollars)	Monetary Value (annual dollars)
Total Mortality	**4.011 / 7.286**	**$58,550,725**	**$ 21,078,261.00**
		$106,343,114	**$ 38,283,521.04**
Mortality, All Cause (PM)	2.433 / 5.707	$35,512,984	$12,784,674
		$83,305,373	$29,989,934
Mortality, O3 Short-term Exposure (O3)	0.068	$993,831	$ 357,779.16
Mortality, O3 Long-term Exposure (O3)	1.510	$22,043,910	$ 7,935,807.60
Nonfatal Heart Attacks (PM)	**2.087**	**$175,530**	**$ 63,190.80**
Infant Mortality (PM)	**0.030**	**$479,013**	**$ 172,444.68**
Total Hospital Admits, All Respiratory	**0.544**	**$13,066**	**$ 4,703.76**
Hospital Admits, All Respiratory (PM)	0.327	$9,167	$ 3,300.12
Hospital Admits, All Respiratory (O3)	0.217	$3,900	$ 1,404.00
Total Emergency Room Visits, Respiratory	**6.371**	**$10,348**	**$ 3,725.28**

Emergency Room Visits, Respiratory (PM)	1.853	$3,011	$1,083.96
Emergency Room Visits, Respiratory (O3)	4.517	$7,338	$2,641.68
Total Asthma Onset	**17.636**	**$1,345,221**	**$484,279.56**
Asthma Onset (PM)	6.297	$480,307	$172,910.52
Asthma Onset (O3)	11.339	$864,914	$311,369.04
Total Asthma Symptoms	**3008.809**	**$700,541**	**$252,194.76**
Asthma Symptoms, Albuterol Use (PM)	1194.939	$765	$275.40
Asthma Symptoms, Chest Tightness (O3)	499.618	$192,749	$69,389.64
Asthma Symptoms, Cough (O3)	589.561	$227,448	$81,881.28
Asthma Symptoms, Shortness of Breath (O3)	252.233	$97,310	$35,031.60
Asthma Symptoms, Wheeze (O3)	472.457	$182,270	$65,617.20
Emergency Room Visits, Asthma (O3)	**0.024**	**$20**	**$7.20**
Lung Cancer (PM)	**0.157**	**$6,912**	**$2,488.32**
Hospital Admits, Cardio-Cerebro/Peripheral Vascular Disease (PM)	**0.410**	**$11,784**	**$4,242.24**
Hospital Admits, Alzheimers Disease (PM)	**1.087**	**$24,333**	**$8,759.88**
Hospital Admits, Parkinsons Disease (PM)	**0.154**	**$3,668**	**$1,320.48**
Stroke (PM)	**0.132**	**$8,324**	**$2,996.64**
Total Hay Fever/Rhinitis	**115.704**	**$128,918**	**$46,410.48**
Hay Fever/Rhinitis (PM)	40.934	$45,609	$16,419.24
Hay Fever/Rhinitis (O3)	74.770	$83,310	$29,991.60
Cardiac Arrest, Out of Hospital (PM)	**0.032**	**$2,001**	**$720.36**
Emergency Room Visits, All Cardiac (PM)	**0.740**	**$1,596**	**$574.56**
Minor Restricted Activity Days (PM)	**1746.481**	**$219,568**	**$79,044.48**

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School Loss Days (O3)	1108.328	$1,882,288	677,623.68
Work Loss Days (PM)	294.873	$93,274	$ 33,578.64
Total PM Health Effects	3292.967 / 3296.242	$37,077,844	$13,348,024
		$84,870,233	$30,553,284
Total O3 Health Effects	3014.644	$26,579,287	$ 9,568,543.32
Total Health Benefits-LOW		$63,657,131	$22,916,567
Total Health Benefits-HIGH		$111,449,520	$40,121,827

Assumptions:

Some assumptions were made in deciding what to input into COBRA for the scenario, the operation of the model itself, and interpretation of the results:

- That the emissions will decrease by 23% between Phases 1 and 2
- COBRA applies a discount rate to express future economic values in present terms because not all health effects and associated economic values occur in the year of analysis
  - The EPA recommends a 2% rate based on the US Office of Management and Budget Circular No. A-4 guidance
- Incidences and changes in them
  - That the baseline estimates for the city of Detroit and Wayne County are similar
- That Detroit's population represents 36% of all of Wayne County's

Limitations:

Given that COBRA is a free screening tool and not a highly sophisticated model, there are some limitations that users should take into consideration:

- 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
  - Inability to import own baseline
- Relies upon inputs generated elsewhere

Conclusion:

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."

References:

- https://cobra.epa.gov/
- CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA) | US EPA
- Assessing the Economic Impacts of Clean Energy (epa.gov)
- COBRA Revision History | US EPA