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Rethinking Electric Vehicle Externalities: Global Emissions and Distributional Equity

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2026 Transportation Engineering, Economics, and Policy Workshop
January 29, 2026

Electric vehicles are low-emission in use but emissions-intensive in production

- Electric vehicles (EVs) are crucial for decarbonizing transportation
- But EVs are not zero emission technologies (Weis et al. (2016); Holland et al. (2016))
  - Nickel-based battery production identified as major contributor to life-cycle emissions of EVs (Bruchon et al. (2024))
- Existing research relies on simplified assumptions and U.S.-based valuation parameters
  - Value of a statistical life (VSL)

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In this project, we will tackle these issues head-on

1. What are the criteria air pollutant emissions from the global EV supply chain?
2. What are the mortality impacts of these production emissions?
3. How can we incorporate equity concerns when valuating these emission-related mortalities?

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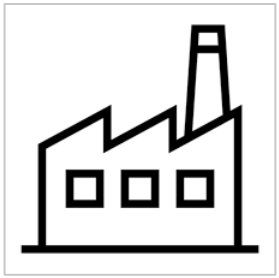
Methodological flow of project



Satellite-based emissions

Fioletov et al. (2020)

Global InMap (ΔPM2.5)

Thakrar et al. (2022)

Concentration-response function

Burnett et al. (2014)

Valuation methods

Viscusi et al. (2017)
&
Adler (2024)

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Case study: Nickel smelting in Norilsk, Russia versus Sudbury, Canada

Nornickel smelter in Norilsk, Russia (Reuters)

Glencore smelter, Sudbury, Canada (Vale)

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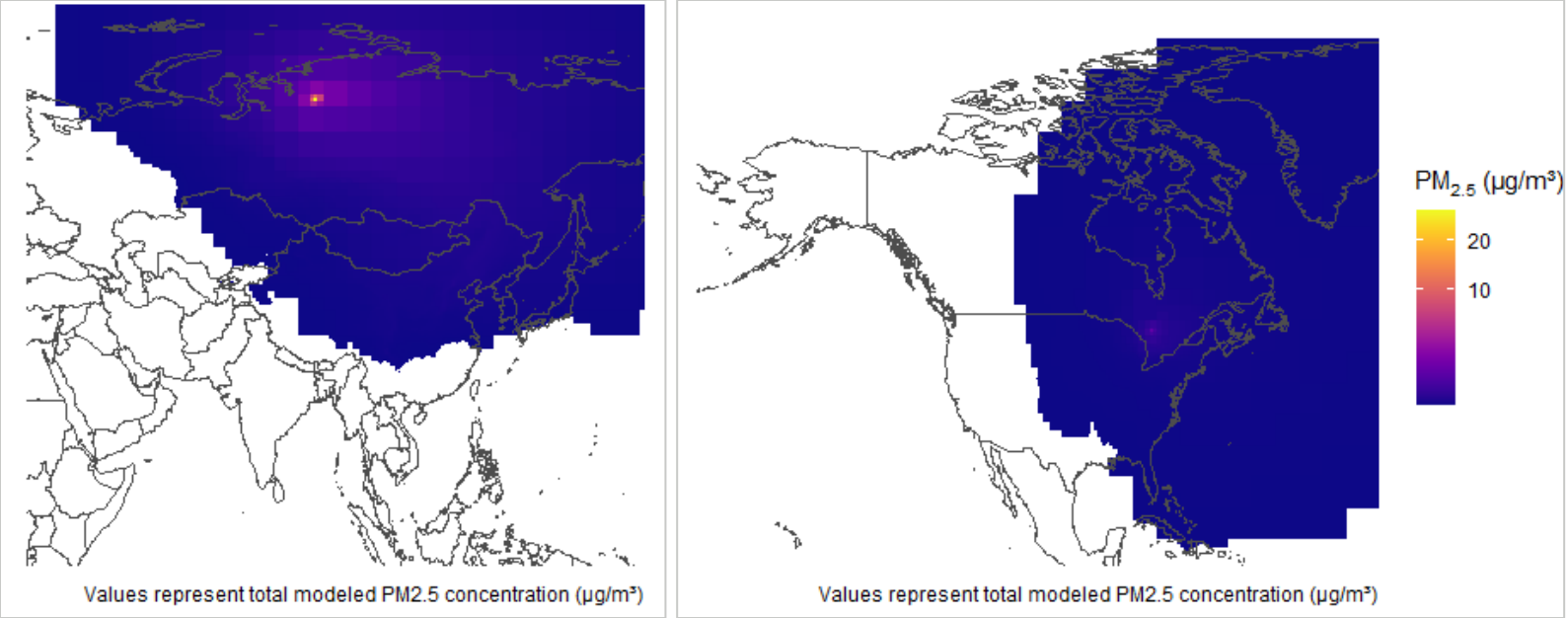
Global InMap estimates of air quality impacts from Norilsk vs Sudbury smelters



Source: Authors' calculations using satellite-based emissions estimates (Fioletov et al. (2020) and Global InMap (Thakrar et al. 2022)

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We valuate mortality impacts using VSLs, with or without equity weighting

$$D^{EW} = \sum_{c \in C} \overbrace{w_c}^{\text{Weight}} \times \overbrace{VSL_c \times M_c}^{\text{Impact}}$$

$$\text{where, } w_c = \left(\frac{I_c}{I_{U.S.}}\right)^{-\eta}$$

- If $\eta = 0$, $w_c = 1 \; \forall c$
- If $\eta = 1$, an identical mortality impact receives twice the social welfare weight in a country with income X vs a country with income 2X

(For an introduction to equity weighting, see Prest et al. (2024))

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Context

Research questions

Methods

Preliminary results

Unweighted: mortality impacts of Norilsk are 18 times larger than Sudbury yet just 4 times the welfare impacts

Table 1. Norilsk VSL results (top four impacted countries)

Country	Statistical lives lost	Costs using VSLs (MUSD)
China	332	650
Russia	284	585
Japan	23	130
Korea	8	40
TOTAL	**700**	**1400**

Table 2. Sudbury VSL results (top four impacted countries)

Country	Statistical lives lost	Costs using VSLs (MUSD)
Canada	24	185
U.S.	12	137
Germany	< 1	1
Great Britain	< 1	1
TOTAL	**40**	**330**

Equity-weighted: weights $(\eta = 1)$ offset VSL differences but impose normative assumptions

Table 1. Norilsk equity-weighted results (top four impacted countries)

Country	Statistical lives lost	Equity weight
China	332	5.9
Russia	284	5.6
Japan	23	2.1
Korea	8	2.3
TOTAL (weighted)	**700**	**7500**

Table 2. Sudbury equity-weighted results (top four impacted countries)

Country	Statistical lives lost	Equity weight
Canada	24	1.5
U.S.	12	1.0
Germany	< 1	1.5
Great Britain	< 1	1.7
TOTAL (weighted)	**40**	**420**

Citations

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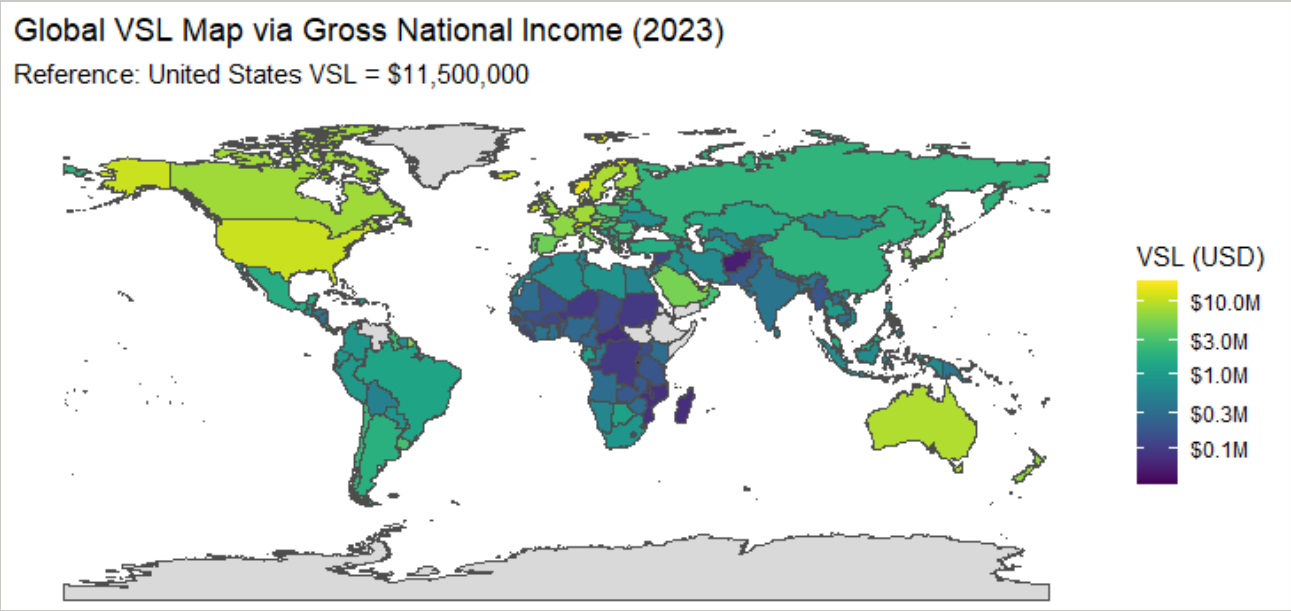
Valuate mortality impacts from emissions using country-specific VSLs



Source: Authors' calculations following (Viscusi et al. (2017))

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