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Policy Brief

Distributional Considerations in Policy Evaluation

Key messages

- **Standard benefit-cost analysis treats "a euro as a euro", while in reality environmental harms are much more concentrated among some groups than others.**
- **There are at least two ways to account for distributional concerns: a distribution matrix and an equity-weighted BCA.**
- **It is possible, and recommended, to build equity-consistent weights that are transparent, tractable, and grounded in economic preferences**

To guide health and environmental policy, decision makers need to compute costs and benefits associated with specific plans and determine whether the net effect of a policy is positive or negative. The most prominent approach is the benefit-cost analysis (BCA), which entails both the benefits and the costs being assessed in monetary terms. A way to measure benefits is the maximum willingness-to- pay (WTP), which denotes the highest monetary sacrifice an individual is willing to make to ensure the execution of a proposed project. If the aggregation of individual's benefits, are found to be larger than costs then the project is considered desirable from a societal perspective and should be carried through.

LIMITATIONS OF BCA

Despite its simplicity and usefulness, BCA faces two important critiques: (1) it is distorted by the diminishing marginal welfare effect of money (Robinson & Hammitt, 2016) (2) it does not consider any distributional effects. Diminishing marginal utility of income means that a euro has a greater impact on the welfare of low-income individuals than on high-income individuals. Since BCA assumes constant marginal utility of income, it attributes less weight on the benefits given to low-income individuals compared to high-income individuals. This is closely associated with equity concerns (Heinzerling & Ackerman, 2002); a policy which particularly benefits poor populations may not be considered as efficient because they lack the ability to afford it. Ignoring existing inequalities can lead to sub-optimal resource allocation and policy choices that do not account for societal preferences for fairness and redistribution. If a society has a taste for these traits, it can employ at least two strategies: (a) weighted BCA to overcome these equity concerns; (b) a distributional matrix.

Figure 1: Conceptual framework (authors' illustration)

AIR POLLUTION & SOCIOECONOMIC DISPARITIES

With the global $PM_{2.5}$ Gini Index increased from 0.30 in 2000 to 0.35 in 2020, exposure become more unequally distributed globally. Within the European Union pollutant concentrations in the poorest regions are roughly one-third higher than in the wealthiest regions (Sager, 2024; European Environment Agency, 2025). Poorer and minority communities face higher exposures and higher pollution-attributable mortality (e.g. van den Brekel et al., 2024; Colmer et al., 2020; Jbaily et al., 2022; Kerr et al., 2024), while tax and transfer systems rarely offset these inequities in practice (e.g. Causa & Nørlem Hermansen, 2018; Baudry, 2024; Ruane, 2025).

HOW TO ACCOUNT FOR DISTRIBUTIONAL CONCERNS ?

The disconnect between how BCA is typically implemented-abstracting from distribution-and how environmental harms are distributed-typically highly unequally-raises the question of how to evaluate policy when equity is itself a central concern.

One approach is to present the distribution of costs and benefits across the population. The European Union (EU) guidelines (Sartori et al., 2014) strongly encourage this approach. It is followed up by a qualitative description of the impacts and the affected pollution. The distribution is summarized in a table where each row represents an effect and each column represents a group, detailing the net benefits or net costs at their intersections.

Stakeholders	Group 1	Group 2	Group 3
Effect 1			
Effect 2			
Effect 3			

Another second alternative to consider distributional impacts is to use weighted BCA. Several countries and organizations (USA, France, UK, Netherlands, EU) propose an income-based weighting of benefits and costs to correct for the inherent limitations of BCA. This converts raw money values into welfare-adjusted values that better reflect differences in well-being across the population.

WEIGHTED BCA – A Case Study in France

VALESOR has developed a case study using open data from France to illustrate how such weights can be applied in the context of pollution-reduction policies (based on Herrera-Araujo & Kostopoulou, 2025 WP).

Consider a policy experiment in which alternative $PM_{2.5}$ reduction strategies deliver similar aggregate mortality benefits but differ in the distribution of risk reductions across departments, income quintiles, and age groups. The analysis proceeds from a simple question that is salient for policy makers and economists alike: *how should air-quality policies be evaluated when decision makers care about both efficiency and equity? Can this be done with the data and tools currently available?*

To ground our approach on numbers, we compare four short run $PM_{2.5}$ reduction hypothetical policies for France:

1. **Uniform reduction.** Cut pollution by 7.75% nationwide so everyone gains equally (4.5 deaths averted).

2. **Higher-income priority.** Cut pollution 10% in above-median-income areas and 5% elsewhere (3 deaths averted).

3. **Lower-income priority.** Reverse the gradient: target below-median-income areas with larger cuts (4.7 deaths averted).

4. **Younger-area priority.** Cut pollution 10% in areas with younger populations (below-median share age 65+), and 5% elsewhere (4.3 deaths averted).

Using the official French VSL (Quinet, 2013), conventional BCA prefers Policy 3, the one with the higher number of averted deaths.

Applying distributional weights yields a set of equity-adjusted net benefits that can be compared directly to those implied by conventional, unweighted BCA. There are two weighted-BCA approaches: the income-based weighted BCA, dubbed utilitarian, and the prioritarian-based. Under the utilitarian approach, individuals' WTP is scaled by the diminishing marginal utility of income, giving priority to the poorer population. The key parameter in a utilitarian approach is how quickly utility falls with income. The parameter is the elasticity of the marginal utility to income (γ) and is typically estimated to lie between 1 and 2.

Prioritarian weighting assign higher value to benefits received by groups with worse overall well-being -captured by lower incomes, higher mortality risks, or fewer remaining life-years. It does so by multiplying the individual's marginal utility of income with the social marginal value of utility. The latter depends on the inequality-aversion parameter η, a normative choice that expresses how strongly society prioritizes the worse-off.

For comparability, we adopt the convention of calibrating policy costs to match the conventional BCA benefits. That is, any policy evaluated would yield zero net benefits under conventional BCA. We then evaluate the outcomes under utilitarian and prioritarian criteria in two steps: (i) we compute WTP at the department–age level for one representative person per group using three methods (official, model-based, and survey-based) (ii) we allocate policy costs equally per-capita basis, regardless of the policy's targeting rule.

These three methods let us assess how current practice differs from our proposed approach. In France, policy appraisal typically relies on a single official VSL ("official"), which already embeds an implicit weighting choice (Farrow, 2025). We compare this benchmark with (i) an approach that explicitly models individual preferences ("model-based") and (ii) one that elicits them from French respondents.

RESULTS

Equity-weighted BCA is empirically feasible using routinely available data and leads to policy rankings that differ systematically from those implied by standard BCA.

Table 1 reports on the gross benefits and net utilitarian welfare by policy and by WTP method. As compared to a standard BCA, utilitarian SWF with equal per-capita costs yields negative net welfare under all WTP approaches. This comes from the fact that younger individuals pay more than the value of the risk reduction they receive, while older individuals receive more than they pay. Utilitarian weighting magnifies the losses of poorer individuals, aka the younger in our setting, so the aggregate evaluation turns negative

Table 1: Gross benefits and net utilitarian welfare by policy and WTP approach

		Policy 1	Policy 2	Policy 3	Policy 4
BCA benefits Π_p^a	Quinet	24.8	16.5	25.7	23.6
	Calibrated	39.5	26.3	40.1	37.6
	Survey-based	12.3	8.20	12.4	11.9
Net utilitarian NU_p^a	Quinet	-38.2	-25.5	-39.7	-35.9
	Calibrated	-64.8	-43.2	-65.9	-61.5
	Survey-based	-15.8	-10.5	-16.1	-15.1

Second, the size of the welfare losses depends on how we value risk reductions (the WTP approach). The calibrated WTP schedule produces the most negative utilitarian totals because it amplifies differences in willingness to pay across age and income, increasing the influence of groups that end up with negative net benefits. By contrast, the Quinet and survey-based approaches compress these differences, which dampens distributional swings and leads to less negative net utilitarian values overall. Yet, the policy recommendation is clear. Under utilitarian SWF, neither policy is recommended.

A prioritarian SWF gives much greater weight to mortality risk reductions for low-income individuals and, within income groups, somewhat greater weight to reductions for older people with fewer remaining life-years. As a result, equity-weighted BCA tends to favor departments that are both poorer and older on average, without mechanically preferring all low-income departments when their populations are substantially younger.

Table 2: Best policy by parameter range and WTP approach (Prioritarian)

Parameter range	WTP approach	Best policy
$[1.1, 1.7]$	Quinet	Policy 2
	Calibrated	Policy 2
	Survey-based	Policy 2
$[1.8, 3.0]$	Quinet	Policy 3
	Calibrated	Policy 3
	Survey-based	Policy 3

Note: The switch from Policy 2 to Policy 3 occurs around $\eta \approx 1.8$ for all WTP approaches.

Table 2 reports on the best policy by parameter range and WTP approach, once a prioritarian approach is implemented. The extent of this weighting depends on the parameters γ and η. In our results, we use $\gamma = 1.5$ and consider a range of values for η. Across all three valuation approaches, the policy ranking is strikingly stable: what drives the preferred option is not the choice of WTP method, but how much weight policymakers place on inequality.

When equity concerns are weak, targeting higher-income areas (Policy 2) tends to come out on top because higher-income groups place a higher value on a given risk reduction, so concentrating benefits there maximizes the aggregate social measure.

As equity concerns strengthen, the preferred option switches to targeting below-median income areas (Policy 3), because benefits accruing to lower-income groups receive greater social weight. In this setting, uniform reductions (Policy 1) and Policy 4 are never the prioritarian-optimal choice.

DISCUSSION

Many policy guidelines now call for distributional analysis, and weighted BCA offers a structured way to incorporate who gains and who loses into welfare metrics. But the method also brings important limitations. Weighted results depend heavily on the chosen social welfare parameters (γ and η), which embody explicit value judgements about inequality. Changes in valuation methods mainly affect the size of gains and losses, not the ranking of policies, suggesting that clearer guidance is needed on the welfare criteria themselves rather than on technical valuation choices.

Applying equity weights also increases data demands and exposes analysts to several practical pitfalls. Income data must accurately reflect real living standards: disposable income is preferred, but often unavailable; unadjusted gross income can misstate inequality. Data gaps can therefore make weighted BCA uncertain. In addition, extremely low reported incomes-common in surveys-can generate implausibly large weights that distort results. Thresholds or caps can limit these effects, but they are typically arbitrary and inconsistent across studies. These issues underscore the need for clearer national guidance on data choices, parameter values, and threshold rules, supported by systematic sensitivity or simulation analysis.

Our work in VALESOR shows that this approach is feasible with standard data and can even reverse the sign of net benefits or re-order policy priorities—highlighting that efficiency-only BCA is often not enough. It is therefore important to develop a range of complementary methods and make their use routine, so that policy impacts can be assessed from multiple perspectives and not hinge on a single analytical framework.

POLICY RECOMMENDATIONS

⇒ Equity-weighted BCA is empirically feasible using routinely available data and can flip the sign of net welfare and re-order policies.

⇒ Guidance built around an efficiency-oriented BCA can be complemented by social-welfare-function-based distributional analysis.

⇒ Different WTP methods do not change the ranking of policies - regulators should focus on making explicit and consistent decisions about the welfare criteria to be used.

⇒ Results vary with how quickly utility falls with income (γ) and how strongly society prioritizes the worse-off (η) - guidance should rely on country-specific evidence for these parameters and include sensitivity analysis

REFERENCES.

Baudry, E. (2024). The tax redistribution gap. *Colum. J. Tax L.*, 16, 86.

Causa, O., & Nørlem Hermansen, M. (2018). Income redistribution through taxes and transfers across OECD countries (Tech. Rep.). LIS Working Paper Series.

Colmer, J., Hardman, I., Shimshack, J., & Voorheis, J. (2020). Disparities in PM2.5 air pollution in the United States (Working Paper No. 26659). National Bureau of Economic Research.

European Environment Agency. (2025). Environmental health inequalities related to air pollution (Briefing). EEA.

Farrow S. Be Brief, Be Consistent, Be Neutral: Comments on US Draft Circular A-4, "Regulatory Analysis." Journal of Benefit-Cost Analysis. Published online 2025:1-13. doi:10.1017/bca.2025.12

Jbaily, A., Di, Q., Kim, E., et al. (2022). Air pollution exposure disparities across US population and income groups. *Nature*, 601, 228–233.

Kerr, A. C., et al. (2024). Increasing racial and ethnic disparities in ambient air pollution burdens in the United States. *Environmental Health Perspectives*.

Ruane, S. (2025). Redistribution and the tax system: A social policy perspective. *Social Policy and Society*, 1–14.

Sager, L. (2024). Global air quality inequality over 2000–2020 (Working Paper No. 10990). CESifo.

Sartori, D., Catalano, G., Genco, M., Pancotti, C., Sirtori, E., Vignetti, S., & Del Bo, C. (2014). *Guide to cost-benefit analysis of investment projects for cohesion policy 2014–2020*. European Commission. https://ec.europa.eu/regionalpolicy/en/information/publications/guides/2014/guide-to-cost-benefit-analysis-of-investment-projects-for-cohesion-policy-2014-2020

Van den Brekel, E., et al. (2024). Ethnic and socioeconomic inequalities in air pollution exposure: A nationwide study in the Netherlands. *The Lancet Planetary Health*.

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