Are CPAT's Price Elasticities Right?

A check of the Climate Policy Assessment Tool's defaults against the evidence

Most defaults are consistent with the evidence and many are cautious; two are too high. The bigger problem is timing: CPAT applies in the first year a response that takes a decade, so near-term cuts are overstated by about half.

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Price elasticities decide the size of CPAT's answers

29%

cut in G20 CO_2 by 2030 from a carbon tax rising to $75/t, with CPAT's default elasticities

7–39%

the same cut with every elasticity moved two standard deviations down or up

2×

an elasticity twice the true value doubles the estimated cut and the speed the tax base erodes

No other parameter in CPAT's sensitivity tests moves the result as much. The defaults were calibrated to one meta-analysis and checked mainly against their own targets.

Source: CPAT documentation, Parameter Sensitivity Analysis (CPAT-AI repository); Brief 5.3.

CPAT turns each price change into fuel use through two margins, all within one year

Usage: how intensively cars, boilers and machines are used (−0.1 to −0.7 by fuel and sector).

Efficiency: how much more efficient the stock becomes (−0.2 to −1.2). Total elasticity = usage + efficiency + their product (rebound).

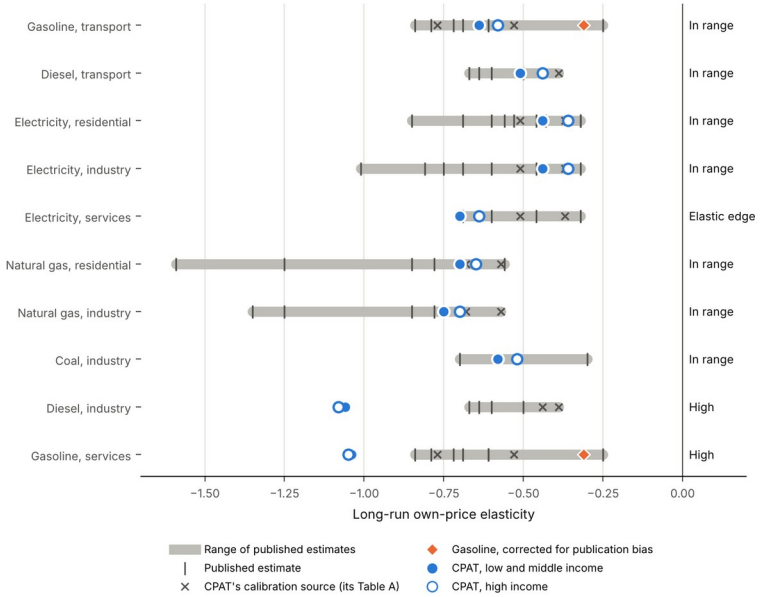
One year: "all the effects take place over the course of one year"; the elasticities are long-run.

Almost no switching: three cross-price terms (biomass for LPG and kerosene; gasoline for diesel). A tax on coal does not move industry to gas.

Calibrated to one meta-analysis, with sector adjustments added to a transport base.

Source: CPAT legacy 1.0pre defaults and documentation (CPAT-AI repository); CPAT Technical Notes (2022).

Eight of ten main defaults lie within the published range; two are too high



Long-run own-price elasticities: published estimates (gray) against CPAT (blue).

Source: Author's calculation; working paper 5.4, Figure 1 and Appendix A.

Six of ten are cautious: less responsive than the median estimate (industrial electricity −0.44 against −0.69).

Too high: diesel in industry (−1.06) and gasoline in services (−1.04), beyond every estimate for the fuel.

At the edge: electricity in services (−0.70).

The two failures come from stretching thin sector evidence across fuels

Fuel, sector	CPAT	Published range	Median	Verdict
Gasoline, transport	−0.64	−0.25 to −0.84	−0.69	In range; 2× bias-corrected
Electricity, industry	−0.44	−0.32 to −1.01	−0.69	In range, cautious
Coal, industry	−0.58	−0.30 to −0.70	−0.50	In range; one study
Electricity, services	−0.70	−0.32 to −0.69	−0.53	At the edge
Diesel, industry	−1.06	−0.39 to −0.67	−0.62	Too high
Gasoline, services	−1.04	−0.25 to −0.84	−0.69	Too high

Sector adjustments estimated over all fuels were applied to fuels with almost no sector studies; CPAT's own panel study flagged both.

Source: CPAT defaults for developing countries; working paper 5.4, Table 1. Medians exclude CPAT's calibration source.

For road fuels, the published averages themselves overstate the response

−0.69 → −0.31

long-run gasoline elasticity before and after correcting for publication bias

−0.25

long-run gasoline elasticity in 32 fuel-subsidizing economies

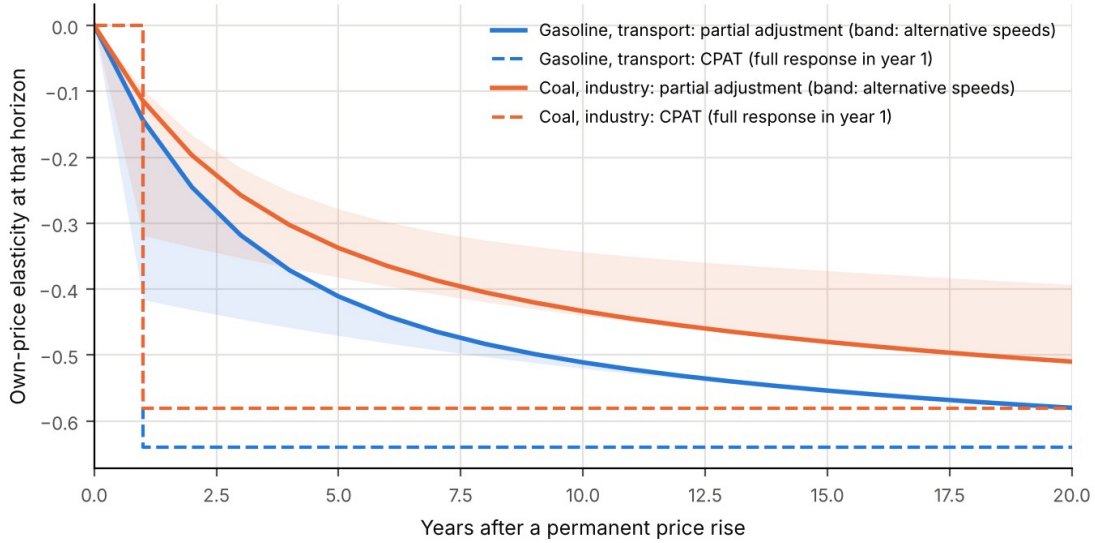
−0.64

CPAT's road gasoline value for developing countries: twice the corrected mean

Journals publish large, significant estimates more readily. Tax salience pulls the other way (in Sweden the carbon-tax elasticity was three times the price elasticity), so show a low-elasticity case beside the central result rather than cutting the defaults.

Source: Havranek, Irsova and Janda (2012); Arzaghi and Squalli (2015); Andersson (2019).

CPAT applies in year one a response that takes a decade



Own-price elasticity by years after a permanent price rise: CPAT (dashed) against gradual adjustment (solid; bands: other speeds).

Use adjusts in a year or two; equipment only as it wears out: cars about 7% a year, buildings 1–2%.

After one year about a fifth of CPAT's response has happened; after five, about 60%.

CPAT's developers list the missing short-run response as a known issue.

Source: Author's calculation; Black et al. (2022), Annex C; CPAT Technical Notes (2022), section 3.1.8.6.

Five years out, CPAT overstates the response by about half, and by up to double

Fuel, sector	CPAT	After 5 years	Overstatement	Other speeds
Gasoline, transport	−0.64	−0.41 (64%)	56%	36%
Diesel, transport	−0.51	−0.32 (62%)	62%	41%
Electricity, households	−0.44	−0.29 (67%)	50%	29–67%
Coal, industry	−0.58	−0.34 (58%)	72%	52–108%
Diesel, industry	−1.06	−0.73 (69%)	45%	32–68%

Early cuts are overstated and early carbon-tax revenue understated; for subsidy reform, the fall in consumption arrives too early. Phasing prices in reduces the error but does not remove it.

Source: Author's calculation, working paper 5.4, Table 3. Central speeds: use 30% a year, equipment 6.7% a year; alternatives: use within the year, equipment 2% a year.

Comparisons across policies and countries hold up better than forecasts of tonnes

Levels move: in paper 6.1's stylized economy, CPAT's demand elasticities raise the cut from a $30 tax from 13.4% to 17.5%.

Ratios barely move: the Total Effective Carbon Price of a policy mix goes from $36.9 to $33.1 per tonne, about a tenth, because a common error cancels.

Use CPAT for ranges and rankings; treat near-term tonnes and revenue with care.

The power sector carries much of CPAT's cut and runs on a separate model, outside this check (Brief 5.3).

Source: Author's calculation with paper 6.1's model; working paper 5.4, Table 4; Brief 6.1.

What to do

What the check shows

Levels: 8 of 10 in range; 6 cautious; 2 too high.

Bias: road gasoline twice the corrected mean.

Timing: five-year response overstated by about half.

Comparisons: Total Effective Carbon Price moves about a tenth.

Actions

Users: read near-term cuts as upper bounds; show a case with road fuel elasticities halved.

Maintainers: fix industrial diesel and services gasoline and electricity; add separate speeds for use and equipment.

Every update: run the eight-step validation protocol and publish the evidence register.