The CPAT Mitigation Module: Methods in Brief

What a finance ministry's climate model computes, and how to read its results

CPAT's mitigation module fits in fourteen equations. A carbon price bites on coal far more than on road fuel, and power-sector results rest on two judgment calls that ministries should know about.

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Ministries rely on CPAT, but its method was hard to check

180+

countries covered by the Climate Policy Assessment Tool

57,000

words in the mitigation chapter of the documentation

20

errors in the 2023 edition of the documentation, now corrected

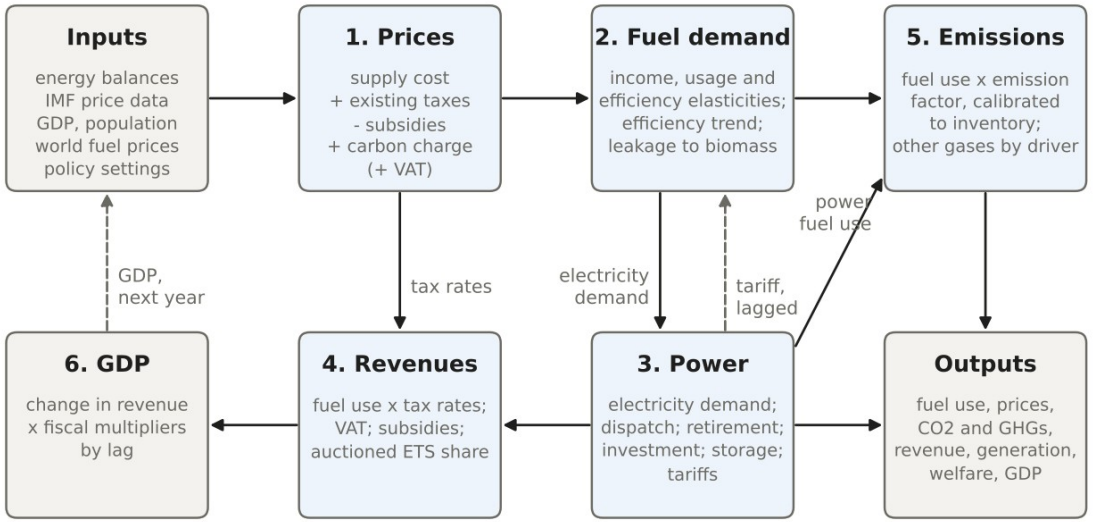
231

bugs found in the legacy workbook, none carried into the rebuild

Rebuilding the model as a tested spreadsheet and in Python stated every equation once and checked it against a running model.

Source: CPAT documentation (2023 edition); CPAT-AI bug register v1.1.0 and corrected documentation (31 Oct 2026).

The module is a one-way chain from prices to revenue, with lagged feedback



Prices: supply cost, plus taxes, less subsidies, plus the carbon charge and VAT on it.

Demand: income, an efficiency trend and two price margins: how much the stock is used, and how efficient it becomes.

Power, emissions, revenue: an engineering model, then accounting; revenue moves output a year later.

Source: Working paper 5.1, Figure 1; CPAT documentation; CPAT-AI equation list.

A $50 carbon price cuts industrial coal use by a third and road fuel by about 6%

Fuel and sector	Price rise	Fall in fuel use
Coal, industry	+118%	−36%
Natural gas, industry	+35%	−20%
Diesel, road transport	+13%	−6%
Gasoline, road transport	+10%	−6%

A charge per tonne of CO_2 is large relative to cheap, carbon-rich coal and small relative to heavily taxed road fuel. Each fuel responds to its own price alone: no switching outside power, cooking and road vehicles.

Source: Working paper 5.1, Table 1. Stylized prices; IPCC (2006) emission factors; CPAT default elasticities, low- and middle-income countries.

Every price and every response can be traced, and the rebuild made the rules explicit

Price controls are asymmetric. A floating tax or subsidy absorbs world-price changes, but a positive tax never falls below its last level, so rises in taxed fuels reach consumers.

Non-price policies act on efficiency only. Standards and feebates enter as shadow prices that cut fuel use without raising the price paid.

Responses are long-run but immediate. A sudden price jump gets its full long-run response in one year; phased reforms are little affected.

Population is treated as income. Total GDP drives demand with one elasticity.

Source: Working paper 5.1, sections on prices and demand; CPAT-AI equation list (M2.2, A2.1, M3.1); issues I62, I71.

Power-sector results rest on two judgment calls

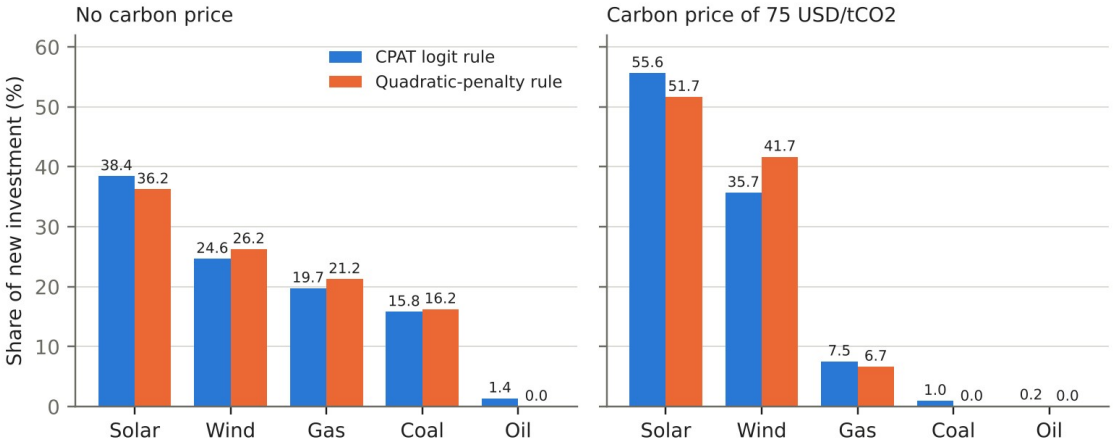
A logit shares new investment by cost. Its curvature was "set subjectively at 2" and has never been estimated; every permitted technology always gets some share.

Build rates are capped. Wind and solar can each add about 2 percentage points of the system a year in most countries; under a large carbon price the cap often decides the answer.

The cost of capital differs by source. The documentation describes 7.5–15% by income group; the model uses a country rate plus a technology premium.

Source: CPAT documentation (2023 edition); CPAT-AI methods notes (Power); working paper 5.1, power-sector section.

The logit is a penalized cost minimum; a quadratic penalty drops uncompetitive technologies to zero



Shares of new investment (%), stylized costs. Blue: CPAT logit. Orange: quadratic-penalty rule.

CPAT's K = 2 acts as an entropy penalty on concentration worth $22.5/MWh here.

With no carbon price, the logit gives oil 1.4% at more than 2.5 times the cost of solar; the alternative, nothing.

Test it behind a switch: a closed form a ministry can check by hand.

Source: Working paper 5.1, Table 2 and Appendix B; Anderson, de Palma and Thisse (1988); Martins and Astudillo (2016).

The rebuild found errors that changed results, and fixed them

Growth effects compounded. Legacy added a policy's one-off effect on output to the growth rate every year (bug L24).

Power plants arrived a year late. New capacity was sized for this year's demand although it comes online next year (L67).

Regulations never acted. Their shadow price was computed but not applied (L87).

The 2023 documentation had twenty errors, including a wrong sign on the electricity markup and no equation for the output feedback; a corrected edition was published on 31 October 2026.

Source: CPAT-AI bug register v1.1.0; CPAT-AI corrected methodology (31 Oct 2026); working paper 5.1, Appendix A.

Read CPAT as a first estimate for phased, medium-term reforms

The strongest objection: a model with no lags, little switching and a fixed world should not guide fiscal decisions.

The answer: its biases mostly have known signs, its elasticities are checked against meta-analyses (paper 5.4), and its responses against other models (paper 5.3).

Take most care with sudden price shocks, coal-to-gas switching in industry, large economies that move world prices, and power paths under high carbon prices.

Source: Working paper 5.1, limitations; papers 5.3 and 5.4.

What to do

What the method shows

Fourteen equations: the whole module, from prices to revenue and output.

Coal bites, road fuel barely: at $50/t, −36% against −6%.

Power rests on judgment: an unestimated logit and build-rate caps.

Errors found and fixed: 231 legacy bugs, 20 documentation errors.

Actions

Finance ministries: ask for the price changes before the quantities, and whether the caps bind.

Teams running CPAT: replace defaults with country evidence; use the corrected model and documentation.

The CPAT team: estimate or replace the investment rule, add gradual adjustment and fuel switching, extend the data to all countries.