



# What is the right price of pollution?

Two factories must cut CO<sub>2</sub>: why one price per ton makes the cheapest cuts first, tax vs cap and trade, and what Sweden and the EU saw.

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## Problem · tool

external cost

- **Problem** → CO<sub>2</sub> warms the planet, harm falls on **others** (**external cost**, Micro 10) ⇒ price of goods leaves it out ⇒ firms do not cut alone
- **Tools** → **rule** (same cut for all) · **carbon price** = price on each ton given off, by **tax** or by **cap and trade** (permits)

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## Model

cost of cutting

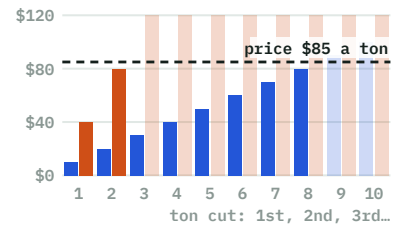
- 2 factories, each gives off **10 tons** a day · goal: cut 10 in all
- **Marginal cost of cutting** rises ton by ton → **A** n-th ton **\$10 · n** · **B** n-th ton **\$40 · n**
- Rule **5 each** → A \$150 + B \$600 = **\$750** · move 1 ton B → A: saves \$200 – \$60 = **\$140**

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## One price

cut if cost < price

- Each factory cuts **every ton that costs less than the price**, pays for the rest
- \$85 → A cuts **8**, B cuts **2** = 10 tons · cost **\$480** vs \$750 ⇒ saves **\$270** · last cuts cost \$80 each ⇒ no swap saves more = **cost-effective**
- \$75 → A 7 + B 1 = **8** tons · \$280 + \$40 = **\$320** vs 4 each \$500 ⇒ saves **\$180** · \$65 → A 6 + B 1 = **7** tons



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## Right price

= harm per ton

- **Social cost of carbon** = harm of 1 more ton ⇒ right price (Pigou, Policy 4) · toy model **\$85** · real estimates differ a lot
- Cut a ton only if **cost < harm** · harm \$45 → cut A's 4 tons + B's 1 = **5** · cost \$100 + \$40 = **\$140** · harm avoided 5 × \$45 = \$225 ⇒ net **+\$85**
- All 10 tons: cost \$480 > harm avoided \$450 ⇒ net **-\$30** → goal is not zero CO<sub>2</sub> at any cost

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## Tax or cap

price vs tons

- **Cap and trade** → state prints permits (1 ton each) = the **cap** · firms trade · market sets the price
- 10 permits, 5 each → B buys **3** from A · price ≈ **\$85** · same 8 + 2 as the tax
- Cut 6 tons: 14 permits, 7 each · A cuts 5 (sells 2) · B cuts 1 (buys 2) · permit \$55 → B pays **\$110** vs \$240 cutting 3 tons ⇒ saves **\$90 (gains from trade)**
- Tax fixes the **price** · cap fixes the **tons** → cold winter: cap ⇒ permit price ↑ · tax ⇒ CO<sub>2</sub> ↑
- Tax \$75 on 12 tons left ⇒ state collects **\$900** · free permits ⇒ **\$0**

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## Evidence

Sweden · EU

- **Sweden 1991** · tax ≈ **\$26** a ton → ≈ **\$126** by 2020 (highest in the world) · greenhouse gases **-27%** (1990-2018) · income per person **+50%**
- Fall ≠ proof → other changes too ⇒ need a **comparison group** (similar countries, no tax) · Andersson 2019: transport CO<sub>2</sub> ≈ **-11%**, mostly the tax
- **EU permits** · 2005 start · ≈ **40%** of EU emissions · 2007 price ≈ **0** (too many permits ⇒ not **scarce**) · cap tightened ⇒ 2023 plants ≈ **-47%** vs 2005

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## Trade-off

policy card

- Energy costs more, can weigh more on small incomes ⇒ **carbon dividend** = money paid back equally · Switzerland: CHF 120 a ton, ⅔ back, CHF 61.80 each (2025)
- Factory moves abroad (**carbon leakage**) ⇒ EU charge on imported steel, cement... (CBAM, from 2026)
- **FOR** cuts where cheapest, firms choose how · **AGAINST** dearer energy today, right price uncertain · **positive** (data can test) ≠ **normative** (values)
- Policy card: problem **CO<sub>2</sub> harm left out** → tool **price per ton** → model **10 tons for \$480, not \$750** → evidence **Sweden -11%, EU -47%** → trade-off **cheap cuts vs dearer energy**