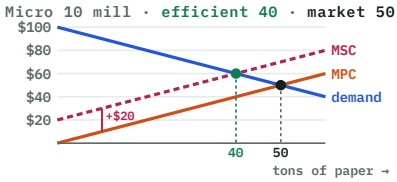
How much pollution is the right amount?

Efficient quantity of pollution = the amount where cleaning one more ton would cost more than the damage it does → the island's total bill (clean-up + damage) is lowest there. **Not zero**, unless the damage is above every clean-up cost. A charge equal to the damage gets the polluter there by itself.

1 The chart you know

Micro 10's mill

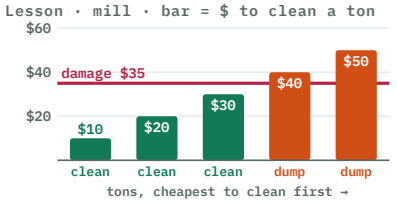
- **External cost** = harm to outsiders, unpaid by the maker · mill: **$20** a ton
- **MPC** (marginal private cost: 1 more ton, to the mill) · `MSC = MPC + external cost` (marginal social cost: to everyone) · market **50** tons, efficient **40** (MSC meets demand), tax **$20** = the external cost
- Second question: Micro 10 cut **paper** → now the **waste**: 5 tons of sludge a day into the lagoon · how many to dump? · **your guess**: never graded

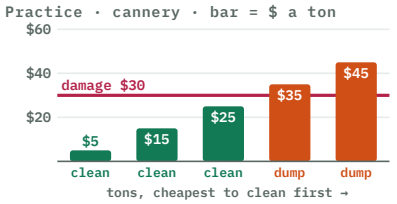


2 Staircase + damage line

ton by ton

- **Abatement** = cleaning pollution up instead of releasing it · cost of each extra ton cleaned = **marginal abatement cost** → cheapest first, it climbs: mill `$10 · $20 · $30 · $40 · $50` · 2 cheapest **$30** · all 5 **$150**
- **Marginal damage** = harm of 1 more ton: lagoon **$35** a ton (fewer fish, closed beach), every ton the same
- Rule: bar **under** the line → **clean** (spend $10 to avoid $35) · bar **above** → **dump** ⇒ clean 3, dump **2**
- Damage ↑ → line ↑ → more bars under it → **less** pollution: dry summer **$45** → 1 dumped
- Practice · cannery `$5 · $15 · $25 · $35 · $45`, damage $30 → dump **2** · only 1 dumped: line between $35 and $45 · damage $10 → 4 dumped
- Practice · same ton, different place: smoke over a school ($20 to clean < $50 damage) → clean · same smoke out at sea ($20 > $5) → leave ⇒ damage depends on **where** the ton lands





3 Why not zero?

the island's bill

- Total bill = clean-up + damage (`tons dumped × $35`) → lowest at **2 dumped: $60 + $70 = $130**
- Zero: **$150** ⇒ +$20 · cleaning the last 2 tons costs `$50 + $40 = $90` to avoid **$70** of damage
- **When zero is right**: a poison with no safe dose → damage line above every bar → a ban is efficient (Lesson 5)
- Practice · cannery: 2 dumped `$45 + $60` = **$105** · zero **$125** (+$20: $80 to avoid $60)

DUMPED	CLEAN-UP	DAMAGE	TOTAL
0	$150	$0	$150
1	$100	$35	$135
2	$60	$70	$130
3	$30	$105	$135
4	$10	$140	$150
5	$0	$175	$175

4 The price that finds it

Pigouvian tax

- **Pigouvian tax** = a charge per ton dumped equal to the damage → the polluter counts the damage as its own cost · **Arthur Pigou**, British economist (1877-1959), Cambridge, *The Economics of Welfare*, **1920**
- $35 a ton: for each ton the mill picks the cheaper of clean it / pay $35 → cleans $10, $20, $30 tons (**$60**) · pays `2 × $35` = **$70** · mill pays **$130** · lands on 2 tons **by itself**, the council never sees the staircase
- Before: mill paid $0, fishers and swimmers bore **$175** · after: lagoon bears $70, mill pays that $70 to the council (what to do with it: Lesson 4)
- Practice · charge set wrong (true damage $30): $10 → 4 dumped, **$125** · $50 → 0 dumped, **$125** · $30 → **$105** ⇒ the best charge **= the damage**
- One price, six sources at $30: the $5, $20, $25 tons cleaned · the $40, $50, $60 tons paid for · chain: charge $30 a ton → each ton cleaned saves $30 → clean every ton under $30 → cheap tons cleaned, costly ones paid for → bill lowest

5 Real world

and where it goes

- **Cuyahoga** River, Cleveland, Ohio: oil slick (oil film on the water) caught fire 22 June 1969 → US **Clean Air Act** 1970 (EPA founded, Dec 1970) · **Clean Water Act** 1972: first national limits
- Legend checked: burned a dozen times since 1868 · 1969 fire ≈ 30 min, ≈ $50,000, no photo (*Time*'s is from 1952) · fish safe to eat, in moderation, since 2019
- **EPA** (US Environmental Protection Agency), 2024: six common air pollutants **−78%** from 1970 to 2023 · GDP (value of all a country produces in a year) **+292%** ⇒ cut most, not all, while the economy grew · each rule worth its cost? studied rule by rule
- Hard part: pricing a beach, a fish, a view → **non-market valuation** · textbook: damage line **climbs** → answer where the two lines cross (= where MSC meets demand, Micro 10)
- **Ten questions to ask about any green policy** (so far): **1** · What does the smoke really cost, and who pays that cost now?

Watch out: efficient ≠ zero pollution (classic exam mistake) · clean a ton only if it costs **less** than its damage · more damage per ton → **less** pollution · the tax goes on the tons **still dumped**, not on all five · a charge too low or too high both cost the island