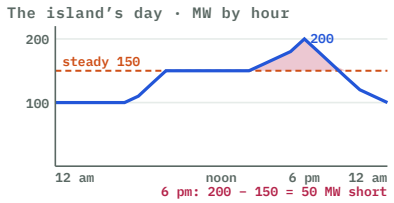
Why is electricity such a strange market?

A grid (wires + plants) has **no shelf**: every megawatt is made the second it is used → the **peak** hour sets the price and pays for the plants · the sun is free at noon and gone at 6 pm → the **duck curve** · storage is the missing shelf. Hourly or flat price: the council's choice, no side picked.

1 No shelf

made the second it is used

- **Megawatt (MW)** = a million watts = 10,000 bulbs of 100 W · **MWh** = that for one hour · a plant = Micro 5's **fixed cost** (the oven, paid running or not) + **marginal cost** (fuel per MWh) · price = fuel all day → oven never paid (Digital 3)
- Bread keeps on a shelf; power can't be stored cheaply at this scale (yet) → supply = demand **every second**, or the lights go out
- **Load** = what the island draws · **baseload** = load there day and night (Coralia `100 MW`) · **peak** = top of the day (`200 MW` at 6 pm, an hour or two) · steady plants `150 MW` → one $20 price all day: **50 MW short** at 6 pm
- Practice · ten years on: night 120, peak **240** at 7 pm, steady 180 → **60 short**, 4 short hours (5-8 pm)



2 Two plants

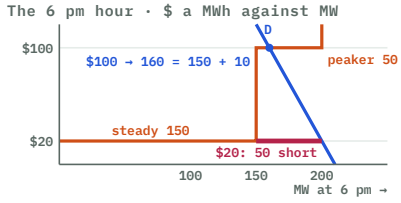
each has its hours

- Per MW a day: **steady** `$400` to own + `$20` a MWh · **peaker** (gas turbine ≈ jet engine) `$40` + `$100` a MWh
- Used 1 h: steady `$420` vs peaker `$140` → peaker · used 24 h: `$880` vs `$2,440` → steady
- **Merit order**: plants run cheapest fuel first; the **dearest one needed** sets the hour's price
- Practice · Palmera: steady $300 + $20, peaker $60 + $100 → 1 h $320 vs $160 · 6 h $420 vs $660 · same at `240 ÷ 80 = 3 h` ($360) → peaker for the peak, steady for the night load

3 The peak price

one hour as a market

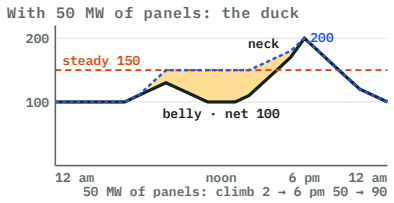
- 6 pm: island wants `Q = 210 − P ÷ 2` (P = price, $) → 200 MW at $20, 160 at $100 (price ×5 → use −⅕: Micro 3's **inelastic** demand)
- **Peak price** `$100` = the peaker's fuel → 150 steady + **10** peaker = 160, nobody short · the other **40 MW move to the night** (dishwasher at midnight)
- What pays for the oven: `150 × ($100 − $20) = $12,000` over fuel in that hour → the peak hours pay for the plants that run all day
- **Your guess** (never graded or saved) → the market: **×5**, for one hour
- Practice · 7 pm, `Q = 250 − P ÷ 2`, steady 180, peaker 50 at $120 → at $120: **190** = 180 + **10**, 50 MW to the night, `180 × $100 = $18,000`



4 The sun and the duck

free at noon, gone at 6 pm

- **Net load** = what the island draws − sun and wind = what the plants must still make · sun: marginal cost `$0`
- 50 MW of panels: noon `150 − 50 = 100` · 6 pm still `200` · climb 2 → 6 pm **90** (50 without) → the sun moves the problem to the evening climb
- **Duck curve** = belly at noon + neck to the evening peak · CAISO (California's grid operator), **2013**
- **Negative price** = the seller pays to have its power taken: a plant with costly restarts keeps running (EIA, US energy statistics, 2017) · California, hours below $0: **2.6%** (2023) → **8.8%** (2024) → a negative noon ≠ free power
- **Storage** = battery, hill lake filled by a pump, hot tank: buys at noon, sells at the peak · California batteries: **0.2 GW** (2018) → 4.9 (Apr 2023) → **16.9 GW** (Nov 2025) · 1 GW = 1,000 MW
- Practice · ten years on, 100 MW of panels: noon **60**, 7 pm **240**, climb 80 → **160** · chain: panels → noon load ↓ → noon price → $0 → battery fills → sells at 7 pm, climb ↓



5 Can it wait?

question 6

- **Can move**: dishwasher · scooter charging · tank pump | **can't**: dinner · hospital · the 6 pm match · fixes: **move the use** · **make more** (peaker, cable) · **store it** (battery, lake)
- **Time-of-use tariff** = home price that follows the hour (Digital 5's rain surge in ride prices, for the grid) · **for**: moves the 40 MW, fewer peakers, pays the batteries · **for a flat price**: simple, kinder to whoever can't move dinner (Behavioral 7: fairness) → the peak paid another way · the council's choice, not the lesson's
- Palmera bans peakers, $20 all day → fine on the average day, **50 MW short** at 6 pm · university: "capacity markets" (plants for rare hours)
- **Ten questions to ask about any green policy** (so far): **1** · What does the smoke really cost, and who pays that cost now? · **2** · Who owns the resource? · **3** · Does it cut where cutting is cheapest? · **4** · Price or quantity, and which mistake is worse here? · **5** · The cheap fix, the visible one, or the next invention? · **6** · **Does it work at the peak, or only on the average day?**

Watch out: "power costs $20 **on average**, so the 6 pm unit costs $20" → no: the 6 pm unit costs the **peaker's fuel** ($100), and that hour pays for the plants · the sun lowers noon, **not** the 6 pm peak