Design in context

Theme C · SL and HL

A phone you can open

> Design a product around its whole life, from the mine to the recycling plant.

- Battery, screen and camera replaced with one screwdriver.
- Traced minerals and better wages.
- This unit: **sustainability** $\rightarrow$ circular design $\rightarrow$ markets $\rightarrow$ cost $\rightarrow$ ethics.

The triple bottom line

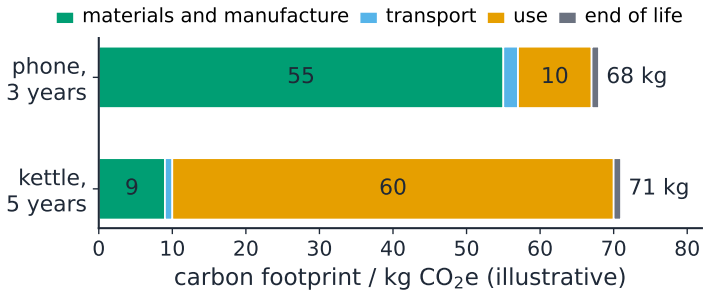
Kind	Concerns
Environmental	Resources, energy, pollution, waste
Social	Health, safety, rights of people
Economic	Affordable to buy, profitable to make

Five life-cycle stages

> Raw materials $\rightarrow$ manufacture $\rightarrow$ distribution $\rightarrow$ use $\rightarrow$ end of life.

- **Embodied energy**, energy before use.
- **Carbon footprint**, kg CO_2e over the life.

Where is the footprint?



- Phone, 81 % from materials and manufacture.
- Kettle, 85 % from use.

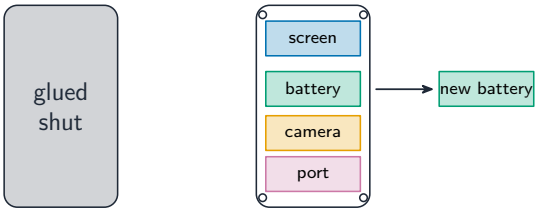
Keeping a phone longer

1. **3 years.** $68 \div 3 \approx 23$ kg per year
2. **6 years.** $(68 + 5 + 10) \div 6 \approx 14$ kg per year
3. **Kettle.** Cut energy in use instead

Decision

Act on the stage with the biggest impact

Glued or modular?

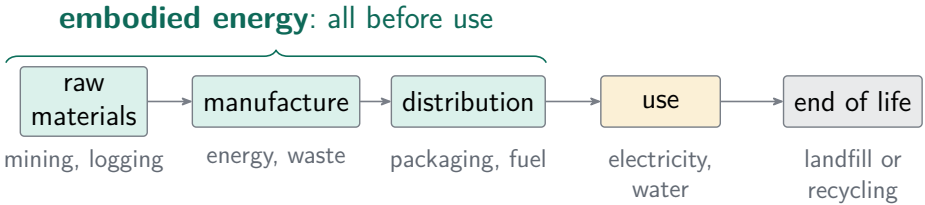


one part fails:
replace the phone

modular, screws:
the owner swaps one part

> Design for repair extends a product's life

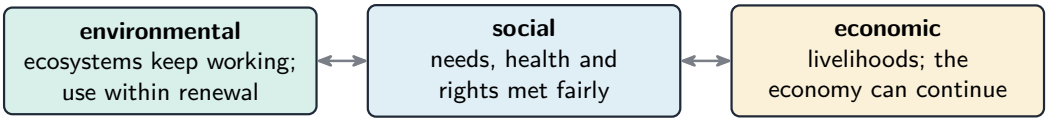
Where a product's footprint comes from



the **carbon footprint** adds up the emissions of all five, in kg CO_2e

A **carbon footprint** adds all five stages

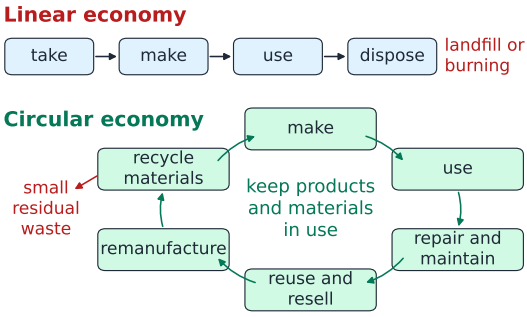
Three pillars of sustainability



Brundtland (1987): meet present needs without compromising the ability of future generations to meet their own

> Meeting present needs without compromising future generations

Linear and circular



- Repair keeps all the **embodied energy**.
- Recycling saves only the material.

The six Rs



> Work through the six Rs as a checklist for every redesign.

Design for disassembly

Easy to take apart	Hard to take apart
Standard fasteners, common tools.	Glue, welds, mixed materials.
Parts can be replaced or sorted.	Whole product thrown away.

Planned obsolescence

Kind	**Example**
Functional	Glued-in battery
Technological	No more software updates
Style	Last year's colour

Cost per year of service

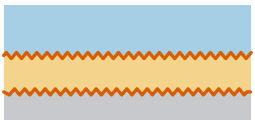
1. **A.** $120 \div 2 = ¥60$ per year
2. **B.** $(200 + 40) \div 8 = ¥30$ per year
3. **Waste.** A quarter as many kettles

Decision

Cheaper in the shop is not cheaper in use

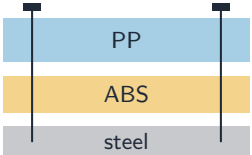
Two parts, two fates

glued, mixed, coated



layers cannot be separated:
landfill or burning

screwed, marked, one material each

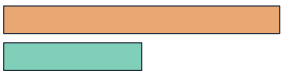


common tools take it apart:
repair, replace or sort to recycle

> Parts that come apart can be repaired or recycled

Kettle costs, drawn

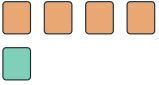
cost per year of service



A: $120 \div 2 = ¥60$ per year

B: $(200 + 40) \div 8 = ¥30$ per year

kettles used over 8 years



A: 4 kettles

B: 1 kettle, 1 repair

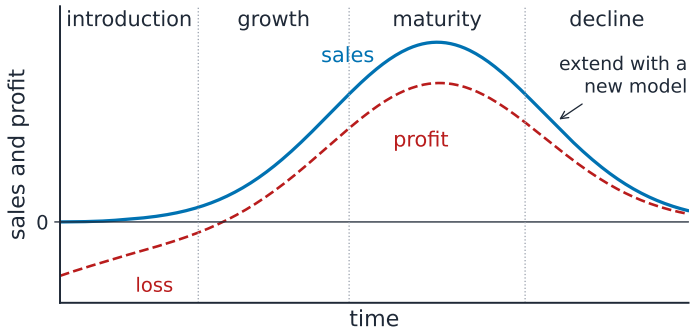
Dearer in the shop, half the cost per year and a quarter of the waste

> The dearer, repairable kettle costs half as much per year

Kinds of innovation

Kind	Example
Incremental	A better camera each year
Radical	The first touch-screen smartphone
Disruptive	Steel mini-mills moving upmarket

Product life cycle

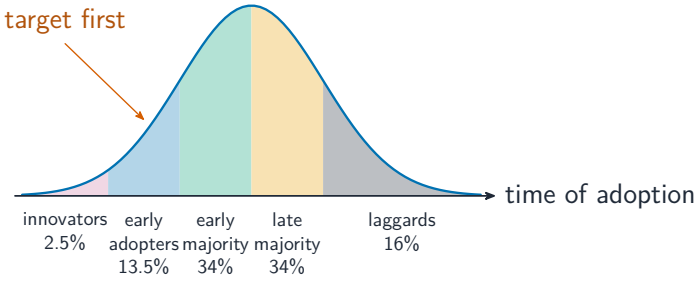


- Introduction, growth, maturity, decline.
- A new model extends the life.

How innovations spread

Group	Share
Innovators	2.5 %
Early adopters	13.5 %
Early and late majority	34 % each
Laggards	16 %

Who buys first?



Target the early adopters first

Choosing a method

1. **Equation.** $600 + 4n = 100 + 9n$
2. **Solve.** $500 = 5n$, $n = 100$
3. **Choice.** B below 100 items, A above

Decision

Quality and end of life can still change it

Break-even with a price

1. **Contribution.** $70 - 30 = ¥40$ per lamp
2. **Break-even.** $20\,000 \div 40 = 500$ lamps
3. **Sell 800.** $800 \times 40 - 20\,000 = ¥12\,000$ profit

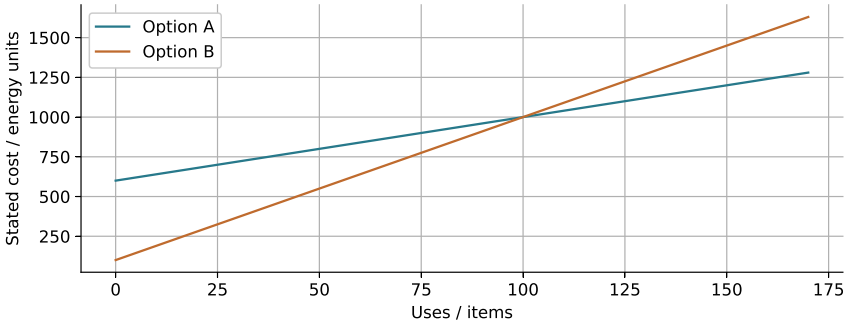
Decision

Every lamp after 500 adds ¥40 profit

Intellectual property

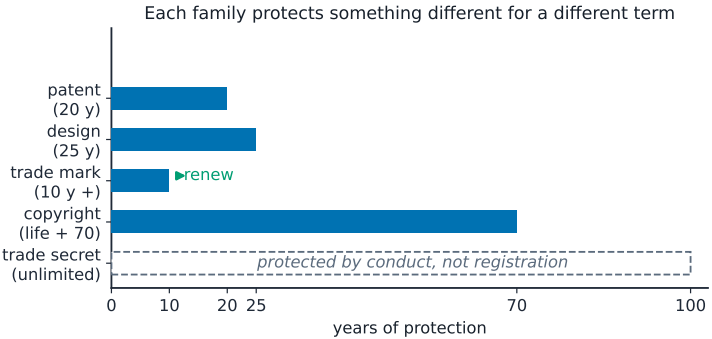
Protection	**Protects**
Patent	How an **invention** works
Registered design	How it looks
Copyright	Drawings, text, software
Trademark	Names and logos

Which option is cheaper?



The lines cross at 100 items: above that, A is cheaper

How long protection lasts



Trade secret: as long as it stays secret

Responsible design

> Designers' choices affect people who never meet them.

- Safety, workers, materials, culture, honesty.
- **Greenwashing**, claims without evidence.

Appropriate technology

Appropriate	Inappropriate
Local materials and skills.	Imported spare parts.
Affordable, low energy.	Needs reliable electricity.

Check: which protection?

Your turn

A rival copies the shape of your new chair. Which protection helps most?

A. Patent
B. Registered design
C. Trademark
D. Copyright on the manual

Exam tips

> Give an environmental, a social and an economic point.

- Find the biggest life-cycle impact first.
- Repair beats recycling; say why.
- Sales life cycle is not the environmental life cycle.

Check yourself

Try these

Toaster A costs ¥90 and lasts 3 years; B costs ¥240 plus a ¥30 repair and lasts 10 years. Compare the cost per year.

A bag sells for ¥150; fixed costs ¥45 000, variable ¥60. Find the break-even.

Evaluate a bottle labelled eco-friendly because it has 30 % recycled plastic.