LESSON MAKER PRO

Resource Return

Compare energy and mineral projects by benefit per dollar spent.

HIGH SCHOOL · EN.ESS3.2

EN.ESS3.2 "Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios on large and small scales.*"

NAME _____ DATE _____

BENEFIT-COST RATIOS

To find a benefit-cost ratio, divide a project's estimated dollar benefits by its dollar costs for the same time period. A higher ratio means more estimated benefit per dollar spent. A ratio does not show which project has the largest total gain or account for effects left out of the estimates.

WORKED EXAMPLE

A lab compares two ways to recover minerals from scrap. Method A has estimated benefits of $110 and costs of $22. Method B has estimated benefits of $156 and costs of $39. Which method has the higher benefit-cost ratio?

1. Method A: $110 / $22 = 5.
2. Method B: $156 / $39 = 4.
3. Compare 5 and 4.

Answer: Method A, with $5 in estimated benefits per $1 spent.

PRACTICE 6 problems

1 A battery-recycling project has estimated benefits of $72 and costs of $18. What is its benefit-cost ratio?

ANSWER _____

2 Over the same 10-year period, which energy project has the higher benefit-cost ratio, or are they equal? Calculate both ratios.

ENERGY PROJECTS

Project	Estimated benefits	Costs
Wind	$2,400	$800
Solar	$2,100	$700

ANSWER _____

3 A mine considers a water-reuse system that costs $45,000. To reach a benefit-cost ratio of 6, how many dollars in estimated benefits must it provide?

ANSWER _____

4 A remote sensor station can use either power system. The estimates cover the same period. Calculate both benefit-cost ratios and choose the system with more estimated benefit per dollar spent.

SENSOR STATION POWER

System	Estimated benefits	Costs
Solar and battery	$6,400	$1,600
Diesel generator	$9,000	$3,000

ANSWER _____

5 An energy-saving pump has estimated benefits of $480. Its cost falls from $120 to $80. What was its benefit-cost ratio before the cost change, and what is it now?

ANSWER _____

6 A mineral-recovery project has estimated benefits of $3,600. What is the greatest cost it can have and still reach a benefit-cost ratio of at least 4?

ANSWER _____

APPLY IT Show your work

1 Your school can fund one project to reduce electricity purchases for its tech lab. Over 10 years, rooftop solar is expected to save $6,000 and cost $2,000. LED lighting is expected to save $4,000 and cost $1,000. Which project offers more savings per dollar spent? Show both ratios.

WORK SPACE

ANSWER _____

2 A city collects old phones in a student tech drive. It can recover their metals locally or ship the same phones to a regional plant. The one-year benefits include metal sales and avoided disposal fees. Which option offers more benefit per dollar spent, and by how much?

PHONE METAL RECOVERY

Option	Estimated benefits	Costs
Local recovery	$90,000	$30,000
Regional plant	$120,000	$60,000

ANSWER _____

CHALLENGE One step up

A county can fund either mineral-recovery plan. Calculate each plan's benefit-cost ratio and net benefit, which equals benefits minus costs. Which plan fits a goal of the most benefit per dollar spent? Which fits a goal of the largest net benefit? Explain why the choices differ.

ONE-YEAR MINERAL-RECOVERY PLANS

Plan	Estimated benefits	Costs
A	$800,000	$200,000
B	$1,500,000	$500,000

WORK SPACE AND ANSWER

Resource Return

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A battery-recycling project has estimated benefits of $72 and costs of $18. What is its benefit-cost ratio?	**4**
2	Over the same 10-year period, which energy project has the higher benefit-cost ratio, or are they equal? Calculate both ratios.	**Wind: 3. Solar: 3. The ratios are equal.**
3	A mine considers a water-reuse system that costs $45,000. To reach a benefit-cost ratio of 6, how many dollars in estimated benefits must it provide?	**$270,000**
4	A remote sensor station can use either power system. The estimates cover the same period. Calculate both benefit-cost ratios and choose the system with more estimated benefit per dollar spent.	**Solar and battery: 4. Diesel generator: 3. Choose solar and battery.**
5	An energy-saving pump has estimated benefits of $480. Its cost falls from $120 to $80. What was its benefit-cost ratio before the cost change, and what is it now?	**Before: 4. Now: 6.**
6	A mineral-recovery project has estimated benefits of $3,600. What is the greatest cost it can have and still reach a benefit-cost ratio of at least 4?	**$900**

PART 2 · APPLY IT

1. **Rooftop solar: 3. LED lighting: 4. Choose LED lighting.** Divide each project's 10-year savings by its cost. LED lighting has the higher ratio, even though solar has greater total savings.
2. **Local recovery: 3. Regional plant: 2. Local recovery provides $1 more in estimated benefits per dollar spent.** Divide benefits by costs for each option. Compare the ratios, 3 and 2, to find the difference per dollar spent.

CHALLENGE

Plan A has a ratio of 4 and a net benefit of $600,000. Plan B has a ratio of 3 and a net benefit of $1,000,000. Choose A for the most benefit per dollar spent and B for the largest net benefit. B produces a larger total gain, but A returns more benefit for each dollar of cost.

Accept ratios written as numbers or as dollars of benefit per dollar spent. These decisions use only the estimates provided; environmental effects not priced in the estimates could change a real-world choice.