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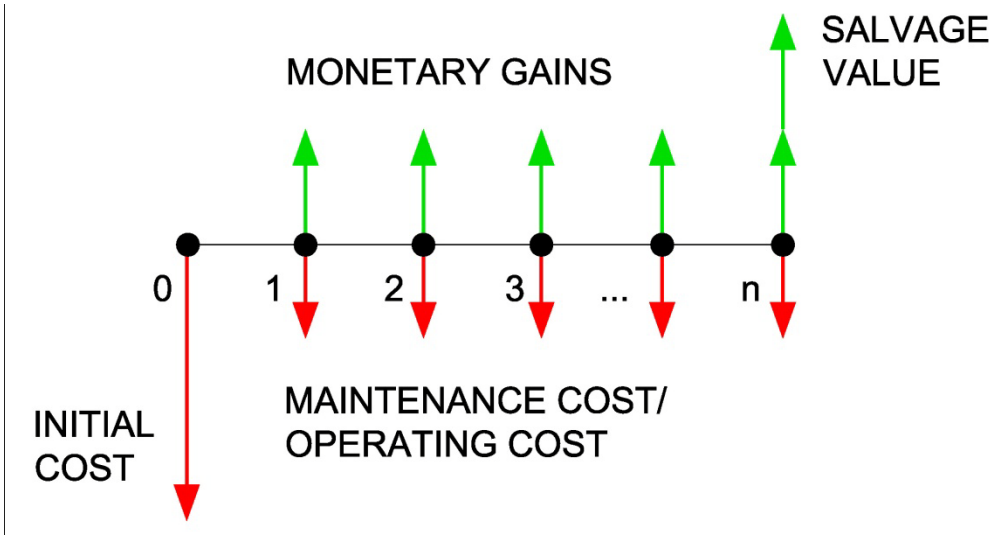
4.3 Equipment Type Questions

In the HVAC & Refrigeration field, often times the engineer must develop an economic analysis on purchasing one piece of equipment over another. In this event the engineer will use terms like present value, annualized cost, future value, initial cost and other terms like salvage value, equipment lifetime and rate of return.

Salvage value is the amount a piece of equipment will be worth at the end of its lifetime. Lifetime is typically given by a manufacturer as the average lifespan (years) of a piece of equipment. Looking at the figure below, initial cost is shown as a downward arrow at year 0. Annual gains are shown as the upward arrow and maintenance costs and other costs to run the piece of equipment are shown as downward arrows starting at year 1 and proceeding to the end of the lifetime. Finally, at the end of the lifetime there is an upward arrow indicating the salvage value.



As previously stated, the most important thing in engineering economic analysis is to **convert all monetary gains and costs to like terms**, whether it is present value, future value, annual value or rate of return. Each specific conversion will be discussed in the following sections.

Each of the sections will use the same example, in order to illustrate the difference in converting between each of the different terms.

Example: A new chiller has an initial cost of $50,000 and a yearly maintenance cost of $1,000. At the end of its 15 year lifetime, the chiller will have a salvage value of $5,000. It is estimated that by installing this new chiller, there will be an energy savings of $5,000 per year. The interest rate is 4%.

PROBLEM 8 - ECONOMICS

Background: An existing A/C control system is inefficient and you are researching whether or not to replace system. You develop a new system that will cost $30,000 and require an ongoing maintenance of $1,000 per year, but it will save $4,000 per year in energy savings. The new A/C control system will have a lifetime of 30 years.

Problem: If the minimum rate of return is 8%, what will be the annual cost of the new system? Economically, should the new system be installed?

(a) -665, Yes, it provides a negative annual cost at the minimum rate of return.

(b) -335, No it provides a negative annual cost at the minimum rate of return

(c) 335, Yes, it provides a positive annual cost at the minimum rate of return.

(d) 665, No, it provides a positive annual cost at the minimum rate of return.

PROBLEM 9 - ECONOMICS

Background: A new high efficiency chiller with a lifetime is planned on being purchased. It has an initial cost of $200,000 and an ongoing maintenance cost of $2,000. However, this chiller will provide an energy savings of $10,000 per year. The chiller has a lifetime of 25 years and the minimum attractive rate of return is 4%. At the end of its lifetime, the chiller will have a salvage value of $25,000.

Problem: What is the annual cost of the chiller at the minimum attractive rate of return? What is the simple payback?

(a) -$8,210, 25 years

(b) -$4,202, 25 years

(c) -$4,202, 20 years

(d) -$2,820, 20 years

Solution 9 - Economics

Background: A new high efficiency chiller with a lifetime is planned on being purchased. It has an initial cost of $200,000 and an ongoing maintenance cost of $2,000. However, this chiller will provide an energy savings of $10,000 per year. The chiller has a lifetime of 25 years and the minimum attractive rate of return is 4%. At the end of its lifetime, the chiller will have a salvage value of $25,000.

Problem: What is the annual cost of the chiller at the minimum attractive rate of return? What is the simple payback?

First convert all terms to annual values.

Maintenance cost and energy savings are already annual values.

$$A_{maint} = -\$2{,}000$$

$$A_{savings} = \$10{,}000$$

Convert initial cost/ (present value) and salvage value (future) to annual value.

$$A_{initial\ cost} = -\$200{,}000 * (\frac{A}{P}, 4\%, 25)$$

Refer to economics tables for value.

$$A_{initial\ cost} = -\$200{,}000 * (.06401)$$

$$A_{salvage\ value} = \$25{,}000 * (\frac{A}{F}, 4\%, 25)$$

$$A_{salvage\ value} = \$25{,}000 * (.02401)$$

$$A_{total} = A_{maint} + A_{savings} + A_{salvage\ value} + A_{initial\ cost}$$

$$A_{total} = -\$2{,}000 + \$10{,}0000 + 600.25 - \$12{,}802$$

$$A_{total} = \$ - 4{,}202$$

$$Simple\ Pay\ Back = \frac{initial\ cost}{yearly\ gain} = \frac{\$200{,}000}{\$10{,}000 - \$2{,}000} = 25\ years$$

Correct Answer: B) $335; Yes, it provides a positive annual cost at the minimum rate of return.