Engineering Economics: Session 5

Comparing Alternatives

- **Projects are acceptable if:**
  - **PW > 0 @ MARR**
  - **AW > 0 @ MARR**
  - **IRR > MARR**
- **What if you are considering multiple alternatives which meet these criteria?**
- **How do you select among alternative projects?**

Ensuring Comparability

- Before comparing multiple options, consider whether they are truly equivalent

- Attempt to monetize those factors which differ
- What about Useful Life?

Tackling Alternatives with Different Useful Lives

- **Study period (Planning Horizon) is the time period over which alternatives are to be compared**

Tackling Alternatives with Different Useful Lives (cont)

- **Decision Cases:**
  - **Useful life of all alternatives = Study Period**
    - No adjustments required
  - **Useful life of at least one alternative ≠ Study Period**

Comparing Alternatives: Equivalent Worth

- **If Useful Lives are equal to study period →** *Alternative with greatest equivalent worth is preferred*
- **Transitivity**
  - **If $PW_A > PW_B$, then $AW_A > AW_B$**

Re-examining the Initial Example:
Where Should You Build? Far or Near

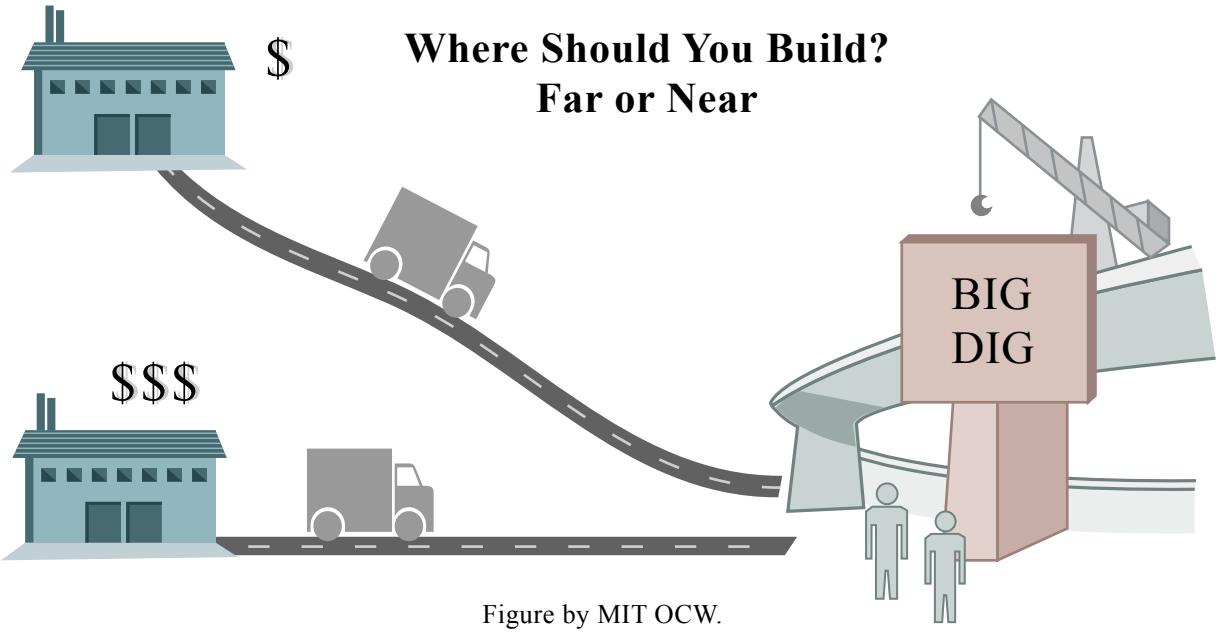


Figure by MIT OCW.

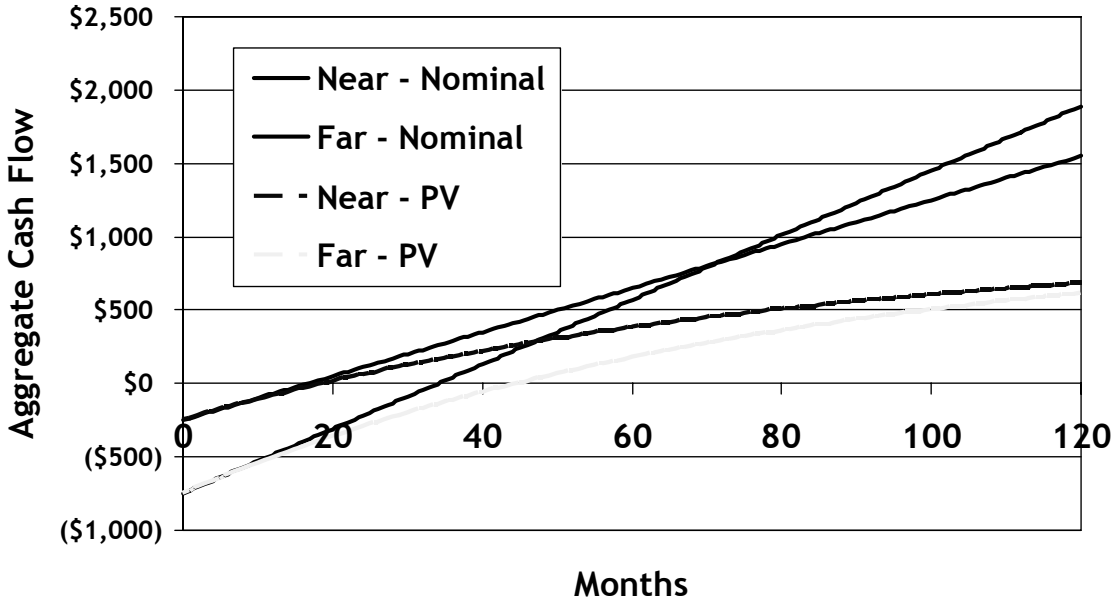
Example: Comparing Alternatives

MARR = 15%, Study Period = 120 Months

Cost	Site A	Site B	
Cost to build @ site	**$250,000**	**$750,000**	
Monthly Costs			
Average Hauling Distance	**10**	**3**	**miles**
Hauling Expense	**$5**	**$5**	**/mile**
Shipments	**200**	**200**	**/month**
Monthly Cost	**$10,000**	**$3,000**	
Monthly Revenue	**$20,000**	**$20,000**	**/month**

Present Worth	**$679k**	**$614k**

Near vs Far Cash Flows



Comparing Alternatives: IRR

- As for all alternatives, lower investment is preferred, unless additional investment provides sufficient returns
  - Each increment of capital must produce a return > MARR
  - Select a higher investment only if the incremental investment provides returns > MARR

Comparing Alternatives IRR

- **Do NOT compare the IRRs of alternatives**
- **Only compare IRRs against MARR**

IRR Example 2 - Efficient Light Bulbs

- **Are energy efficient light bulbs worth it?**
- **Bulb types**

	Expected Lifetime	Lumens	Wattage	Purchase Cost
Incandescent	750	585	60	$0.50
Halogen	3,750	570	50	$3.25
Compact Fluorescent	7,500	600	15	$13.50
Compact Fluor2	7,500	600	14	$14.00

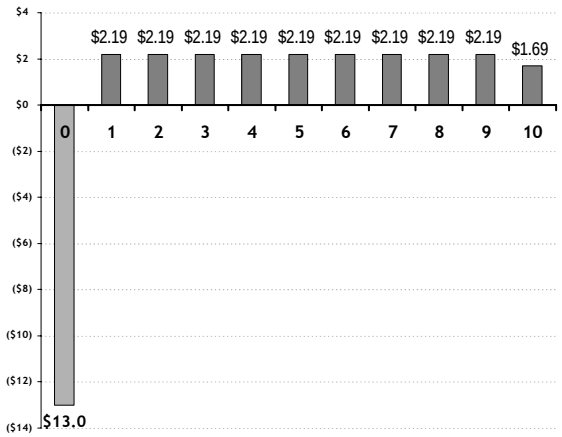
IRR Example 2 - Efficient Light Bulbs

Year	Incandescent	Halogen	CF	CF2	Difference Hal-Incand	Difference CF-Incand	Difference CF2-Incand
0	$0.50	$3.25	$13.50	$15.00	-$2.75	-$13.00	-$14.50
1	$2.75	$1.88	$0.56	$0.53	$0.88	$2.19	$2.23
2	$2.75	$1.88	$0.56	$0.53	$0.88	$2.19	$2.23
3	$2.75	$1.88	$0.56	$0.53	$0.88	$2.19	$2.23
4	$2.75	$1.88	$0.56	$0.53	$0.88	$2.19	$2.23
5	$2.75	$5.13	$0.56	$0.53	-$2.38	$2.19	$2.23
6	$2.75	$1.88	$0.56	$0.53	$0.88	$2.19	$2.23
7	$2.75	$1.88	$0.56	$0.53	$0.88	$2.19	$2.23
8	$2.75	$1.88	$0.56	$0.53	$0.88	$2.19	$2.23
9	$2.75	$1.88	$0.56	$0.53	$0.88	$2.19	$2.23
10	$2.25	$1.88	$0.56	$0.53	$0.38	$1.69	$1.73

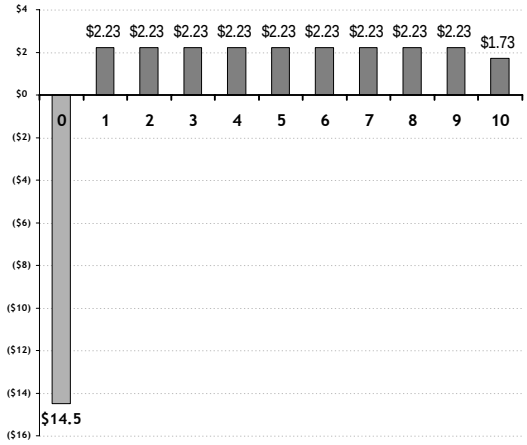
Assumptions: Usage = 750 hrs / year; Electricity = $0.10 / kWh; Study Period = 10 years

IRR Example - Efficient Light Bulbs, MARR = 5%

Net Cash Flows for Compact Fluorescent

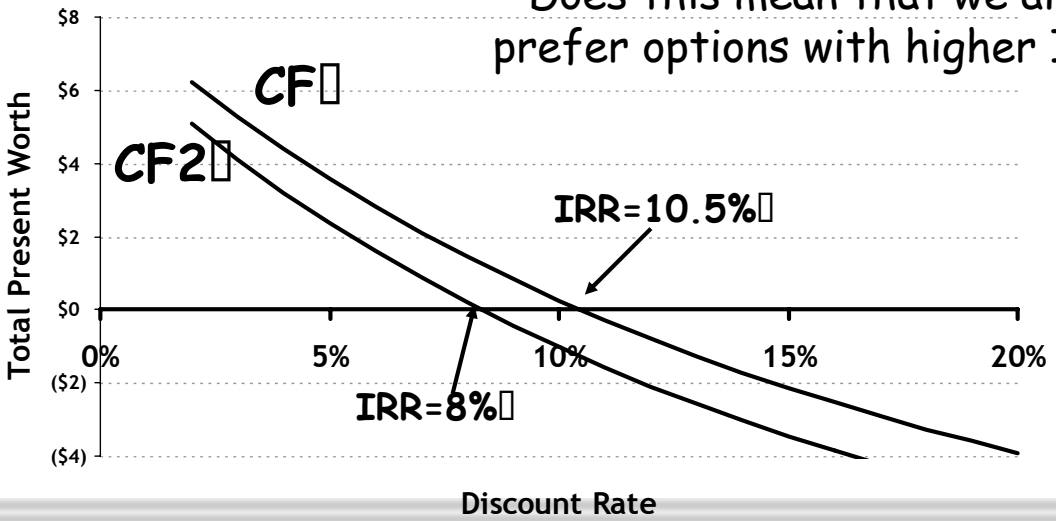


Net Cash Flows for Compact Fluor2

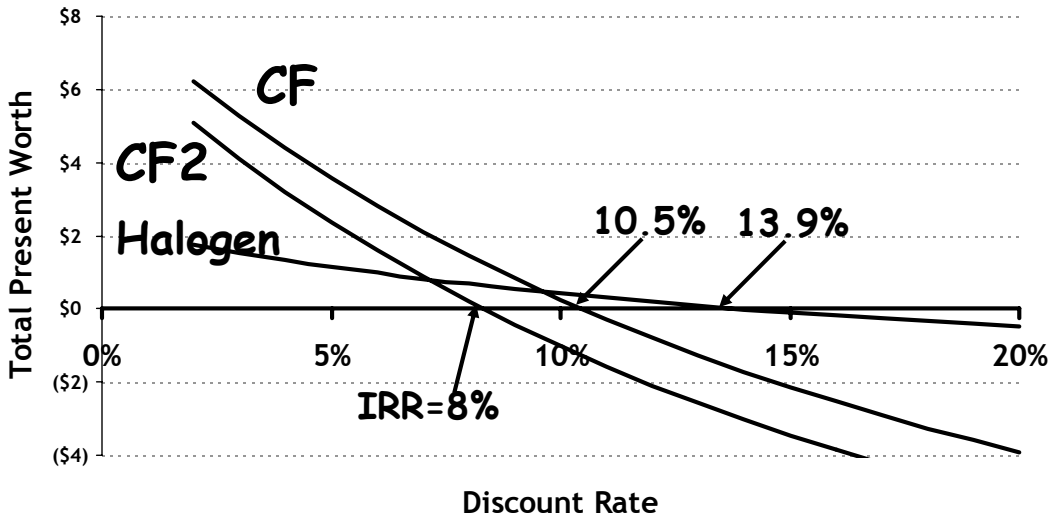


IRR Example 2 - Efficient Light Bulbs

We found that $PW_{CF}>PW_{CF2}$
Also, $IRR_{CF}>IRR_{CF2}$
Does this mean that we always prefer options with higher IRR?



IRR Ranking Does Not Always Match PW



IRR Ranking Procedure

1) **Rank acceptable (IRR>MARR) alternatives based on investment**
2) **Find lowest investment acceptable (IRR>MARR) alternative (Base Alternative)**
3) **Develop Incremental Cash Flow for Next Alternative** (i.e., in ranked list)
   a) **Next Alternative Cash Flow – Base Alternative Cash Flow**
4) **Is Incremental Cash Flow acceptable (IRR>MARR)**
   a) **If yes, this is new Base Alternative**
   b) **If no, keep Base Alternative**
5) **Move to next alternative in ranked list and restart at 3**