FINANCIAL ANALYIS OF THE OFF-GRID RENEWABLE ENERGY PROJECTS

Area 3

Contents

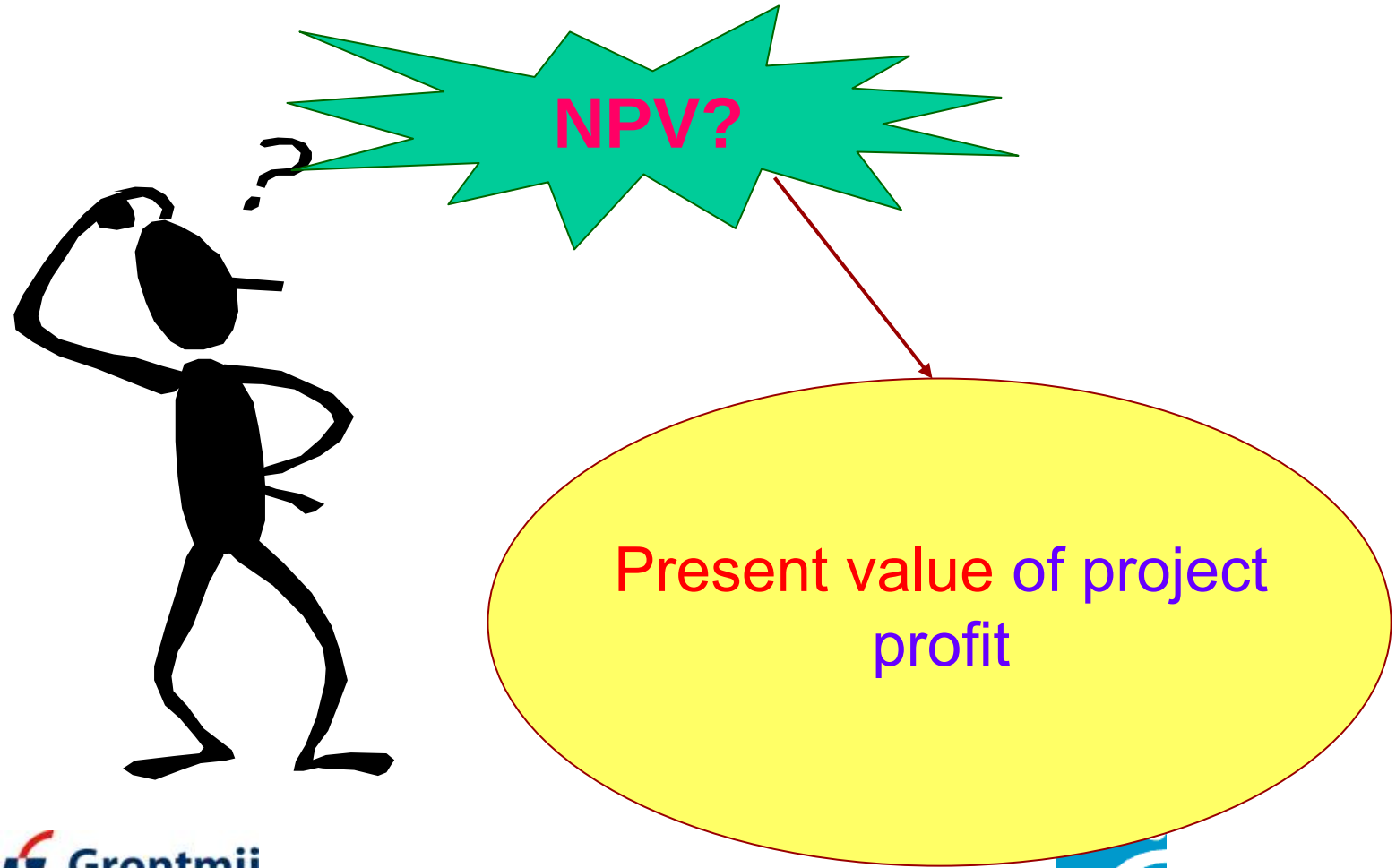
- Tools used in financial analysis
- Cost estimation
- Benefits/revenue estimation
- Cash flow projection
- Financing options
- Risk and sensitivity analysis

TOOLS USED IN FINANCIAL ANALYSIS

Financial analysis

- Financial analysis is Management's basis for making an investment decision
- It is also basis for investor to mobile capital

Net Present value - NPV



NPV (cont.)

- Formula

$$NPV = \sum_{t=0}^{n} (B_t - C_t)(1+i)^{-t}$$

- Abbreviation:
  - B_t cash inflow of year t
  - C_t Cash outflow of year t
  - i Discount rate
  - n Project life time

NPV (cont.)

- Use NPV to select project

NPV > 0	Accept (feasible)
NPV < 0	Not accept (in-feasible)
NPV = 0	Consider
NPV = Max	Best

Net present value - NPV

Note

- It provide information of all project profit at present time
- NPV is calculated by substract PVB the PVC;

  NPV = PVB - PVC
- This criteria is widely used in evaluate investment project
- Value of NPV depend on the value of discount rate i
- The salvage value is considered as cash inflow in year n

Discount rate

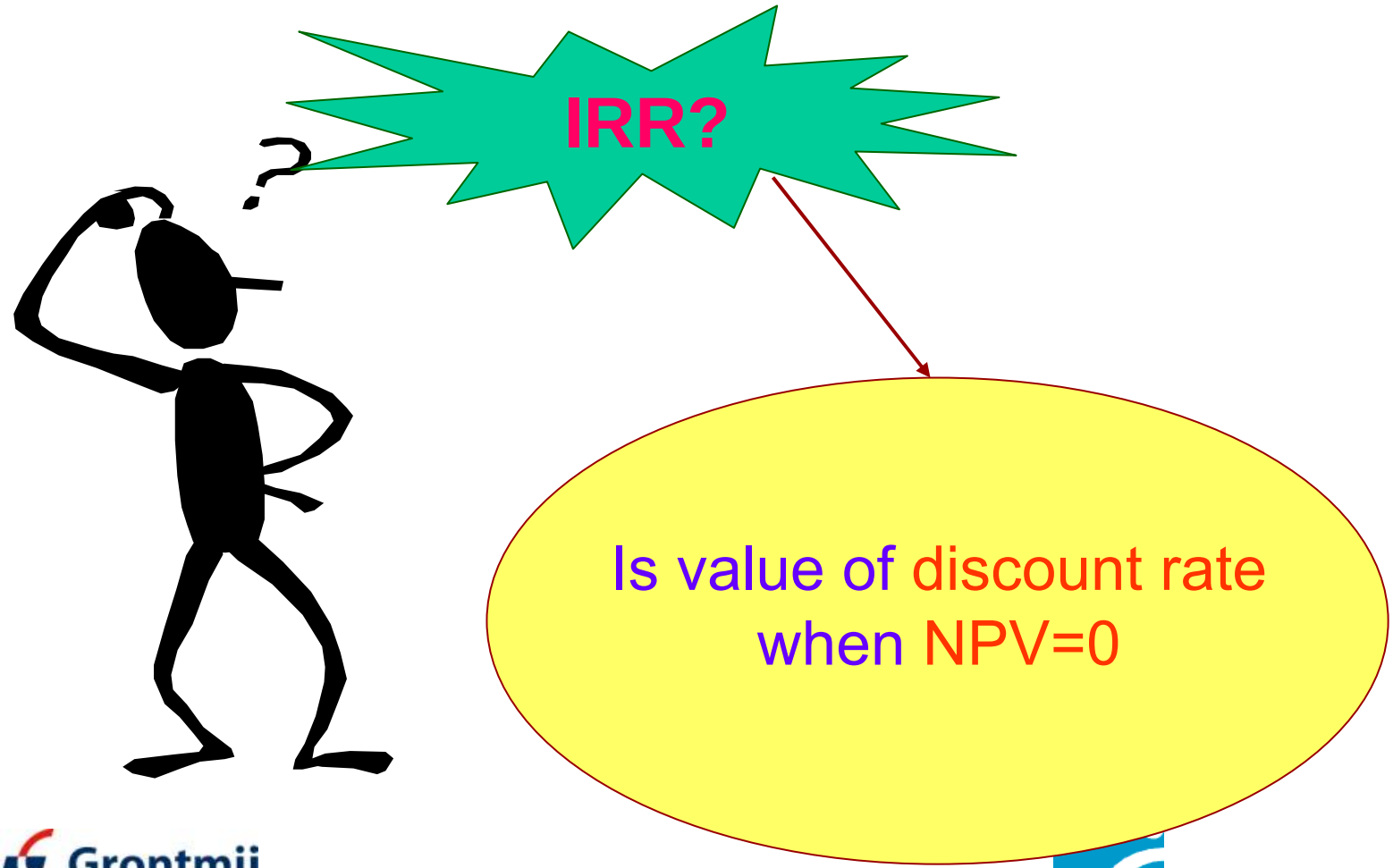
- Discount rate (i) is a relative indicator (%)
- It relect opportunity cost of capital
- Discount rate depend on external and internal factor of a enterprise:
  - External: prevailing interest in the capital market.
  - Internal: minimum interest accepted by the enterprise (investor) called - MARR

Discount rate

- MARR depend on the enteprise perfomance recently.
- WACC can be computed as follow

$$WACC = \text{Interest rate} * t_{loan} * (1 - \text{income tax rate}) + MARR * t_{equity}$$

Internal Rate of Return - IRR



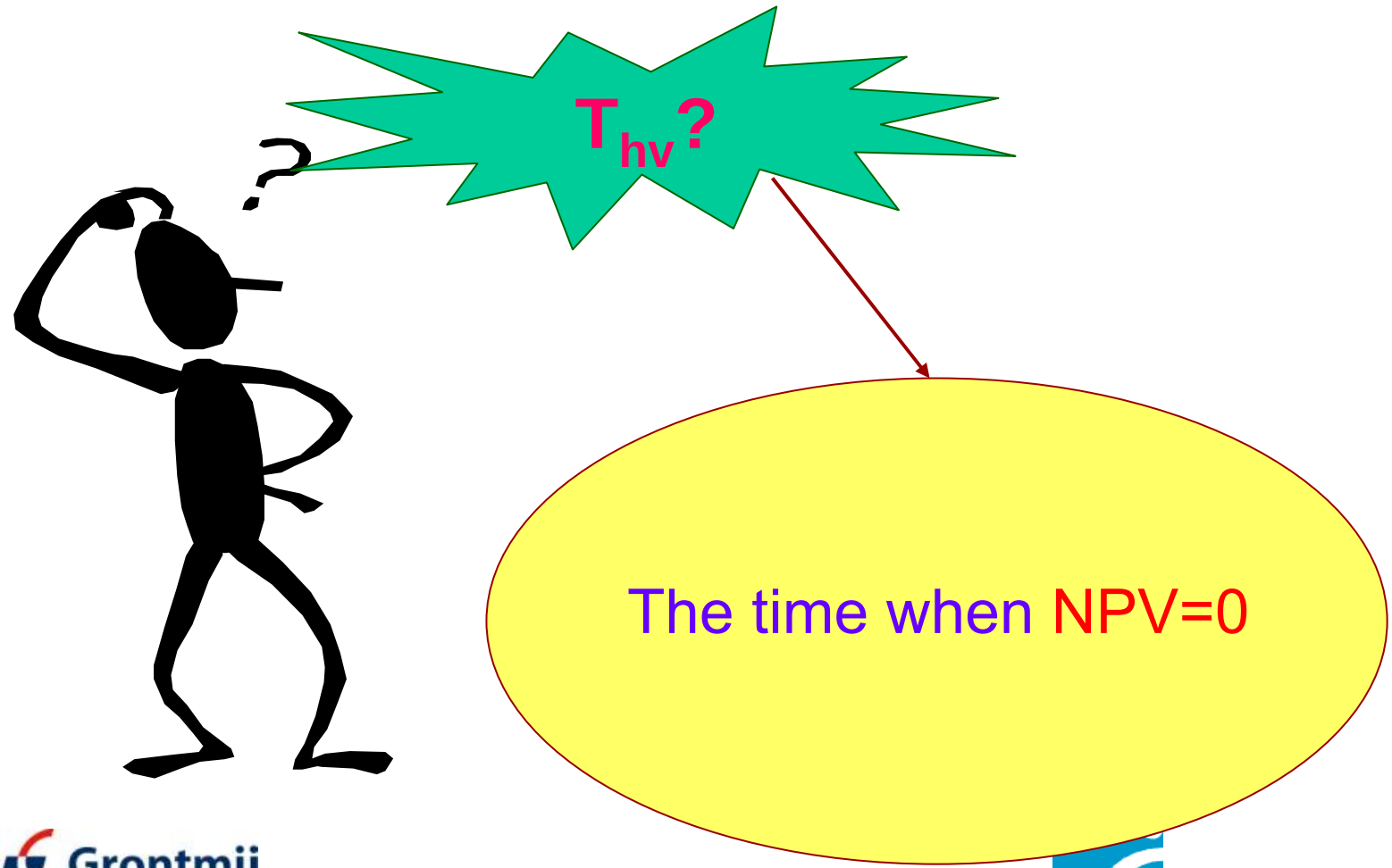
IRR (cont.)

Formula

$$NPV = \sum_{t=0}^{n} (B_t - C_t)(1 + IRR)^{-t} = 0$$

- Use IRR for selecting project
  - IRR > IRR* Accept
  - IRR < IRR* Not accept
  - IRR = IRR* Consider
  - IRR = Max Best
  - IRR* Desired IRR
  - Discount rate does not effect the value of IRR but effect the selection of the project used IRR indicator

Pay back period - T_{hv}



T_{hv}

Formula

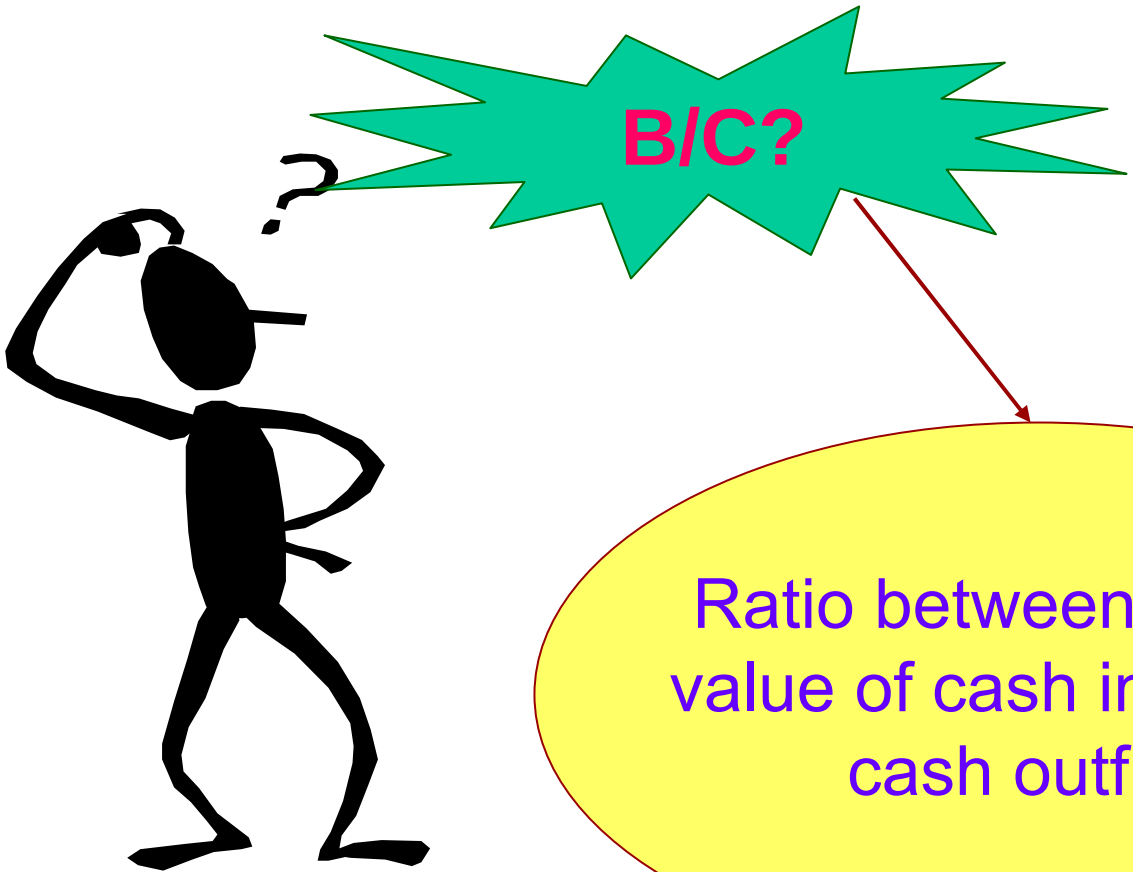
$$NPV = \sum_{t=0}^{T_{hv}} (B_t - C_t)(1+i)^{-t} = 0$$

- Use T_{hv} for selecting project
  - $T_{hv} < T_{hv}^*$ accept
  - $T_{hv} > T_{hv}^*$ Not accept
  - $T_{hv} = T_{hv}^*$ Consider
  - $T_{hv} = \text{Min}$ Best
  - T_{hn}^* is desired pay-back period of the investor

T_{hv}

- This shows the time when project get back all the investment.
- It does not take into account the cash flow after the pay back time. There are case when project A has shorter payback period than project B, but NPV of project B is higher than NPV of project A
- This indicator is widely used to evaluate projects with high risk

Cost/benefit ratio



B/C (cont.)

- Formula

$$\frac{B}{C} = \frac{\sum_{t=0}^{n} B_t (1+i)^{-t}}{\sum_{t=0}^{n} C_t (1+i)^{-t}}$$

B/C (cont.)

- Use B/C to select project

B/C > 1	Accept
B/C < 1	Not cccept
B/C = 1	Consider
B/C = Max	Best

B/C (cont.)

- B/C is relative ratio. It shows that 1 present value of cost will generate how much revenue in term of present value
- This ratio is widely used in assessing investment projects with different scale.

COST ESTIMATION

Principles for project cost estimation

- Understand everything about the project very well before estimating a project cost
  - Why is this project being done?
  - What is the project management structure?
  - When is it starting and how long it will take to complete?
  - Does it require foreign currencies?
  - What are the possible regulatory/tax issues?
- All likely cost elements have been directly taken into consideration and sufficient margin is left for unpredictable cost elements (contingencies) too

Principles for project cost estimation (cont.)

- What to do when there are lot of missing data
  - Do not be alarmed
  - Always “assume” when you do not know (should not ignore these data)
  - Always revise cost estimation with each new information

Cost components of a project?

- Investment cost
- Additional operating cost
- Other costs

Investment cost

- Consultation cost
- Cost for purchasing equipment (include imported taxe to imported equipment and transportation cost to the enterprise)
- Cost for other small purchasing (wires, cables, switches…)
- Installation cost
  - Cost for dismounting old equipment
  - Incremental Labor cost
- Training cost
- Cost for disruption to work
- Commisioning cost

Investment Costs

Estimated investment costs for small-scale hydropower plants:

Civil works	1,500 to 3,000 USD/kW
Electro-mechanical equipment	400 to 1,300 USD/kW
Transmission lines, transformation, grid connection	50 to 200 USD/kW
Project planning and design, site supervision, project management	50 to 500 USD/kW
Total:	**2,000 to 5,000 USD/kW**

Operating cost

- Labour cost
- Maintenance and repair cost
- Energy and material cost
- Management cost…

Fixed Operation and Maintenance Costs

Cost item	Description	Annual O&M costs in % of capital cost
a) Personnel	Operators, linesmen, revenue collectors (if applicable)	according to local salary levels
b) Administration	Insurance, customer service costs, land rent, taxes, water fees, other duties	according to local rules and regulations
c) Maintenance of civil works and access roads, powerhouses, fuel tanks, etc. of diesel power stations	materials (paint, cement, etc.) and local manpower	0.2 to 1 % of capital costs of the civil works

Fixed Operation and Maintenance Costs (cont.)

Cost item	Description	Annual O&M costs in % of capital cost
d) Maintenance of E/M equipment	spare-parts and salaries of local fitters, electricians	1 to 3 % of capital costs of e/m equipment of MHP
e) Maintenance of electrical gear of diesel generators	spare parts and repairs of switch gear, control panels, transformers	1 to 3 % of capital costs of diesel generator panels, switch gear, transformers
f) Maintenance of transmission & distribution works	bush cutting, fuses, insulators, cross-arms, poles	1 to 3 % of capital costs of T&D
g) Overheads of electricity utility or local operator	communications, postage, staff housing, head office charges, management costs	according to local conditions

Variable Operation and Maintenance Costs

Cost item	Description	Specific costs
High-speed diesel generators	a) Fuel consumption of high-speed diesel generators	0.28 - 0.40 l/kWh of diesel fuel (costs for fuel transport, storage and handling to be included)
	b) Lubricants of high speed diesel generators	1 % of fuel costs
	c) Maintenance of high speed diesel generators (filters, belts, gaskets, spare parts and manpower for overhauls)	US$ 0.03 to 0.10 / kWh
SHP plants		no energy-related / variable costs

Others

- Tax
- Interest during construction period
- Additional management cost

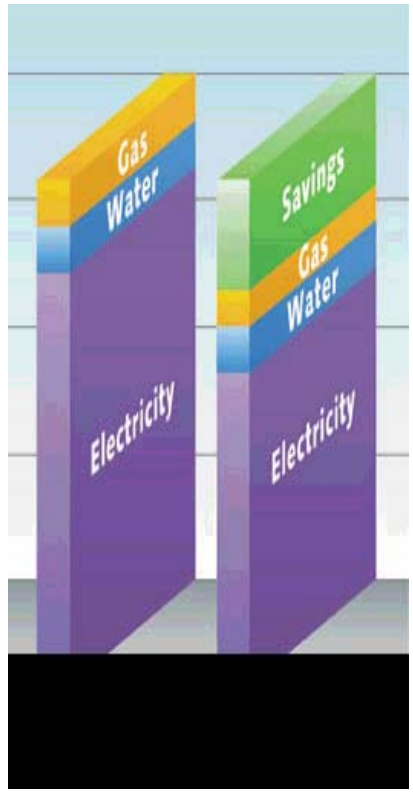
BENEFIT/REVENUE ESTIMATION

Principles for project benefit estimation

- Understand everything about the project very well before estimating a project benefit
- Project all benefits of the project
- Always revise benefit estimation with each new information
- List all the non-monetary benefits. Sometime these benefit are long-term purpose of the project

Components of cash inflow

- Pperating business
  - Sales of electricity
- Other
  - From selling replaced equipment



Other benefits not readily quantified

- Supply electricity to the poor and remote off-grid people, intellectual improvement
- Job creation
- Improve income for the poor
- Protect environment, reduction in emission
- …..

CASH FLOW PROJECTION

Purpose of the cash flow projection

- Will provide the data needed to conduct financial appraisal of the project
- Will indicate if loan repayments can be made from cash available
- It will show if the project is financially sustainable Cung cấp số liệu cần thiết khi thực hiện đánh giá tài chính dự án

Cash inflow

- From selling electricity
- From replaced equipment

Cash outflow

- Investment cost
- Operating cost
- Tax
- Principal and interest payment

Income tax

Income tax ($TNCT_t$) = B_t-C_t- KH_t-L_t

B_t : Revenue of year t

C_t : Cost of year t

KH_t : Depreciation value of year t

L_t : Interest of year t

TTN_t = $TNCT_t$ * income tax rate

TTN_t : Income tax of year t

Cash flow after tax - CFAT

$CFAT_t = B_t - C_t - G_t - L_t - TTN_t$

B_t : Revenue of year t

C_t : Cost of year t

G_t : Principal of year t

L_t : Interest of year t

TTN_t : Income tax of year t

Points to Remember

- Accurate forecasts require detailed research costing considerable time and money
- At the initial identification stage it will be inappropriate to incur such cost. It is likely that rough preliminary estimates will be prepared.
- The purpose is to have the reasonable data not the most detailed data

Points to Remember

- Once the project is taken forward with a view to undertaking detailed considerations, then the preliminary estimates will need to be adjusted and refined. A more detailed engineering, production and financial data will be required.

FINANCING OPTIONS

Important Considerations in Financing Decision Making

- Are you happy with the estimated Project Cost?
- How well the current capital?
- Do your client has other project financing needs?
- How good is your client's present balance sheet?

Different financing options

- Equity financing
- Debt financing
- Financing from other sources
  - From equipment supplier
  - Equipment leasing (finance and equipment leases)

Equity financing

- Owners of the company invest new/ additional money (equity) into the project
- It is the most simple, quick and hassle free financing
- Equity is called risk capital since it is recovered after all other liabilities are paid and therefore is most risky
- Therefore equity requires the highest return

How to source equity financing?

- Internally Generated Funds- income realized by the business and reinvested into the business to acquire additional assets
- Decrease in Assets- sale of assets to buy a more efficient one
- To issue new shares –additional funds from investors

Consideration between debt and equity

- Simplest financing option is to spend clients own money-This is called “equity financing”
- Whilst using client’s money has an “Opportunity Cost” to him using bank’s money has a direct Cost-Interest
- Raising debt generally involves discussions, delays, legal documentation, collateral issues etc.
- Possible quantity of debt is limited by Client’s cash flow

Debt financing

- Lenders usually have a cap on maximum Debt; around 60%-70% of Project Cost
- Debt has a price-interest rate. Some lenders prefer a variable rate. It is a must to do a sensitivity analysis to find out the effect of interest on returns to the client
- Consider the loan repayment period. Try to match it with the payback period of the EE Project

How can get debt financed?

- Prepare a good EE Implementation proposal
- Prepare a Cashflow based on a loan scenario
- Note that interest is tax deductible
- Consider the Collateral the Client has to offer (Projects with large Fixed Assets can easily find adequate Collateral)

Types of principal and interest payment

1. Equal principal
2. Principal pay at the end of the loan term, monthly interest
3. Equal amount of principal and interest

COMMENTS

- Value of interest will effect to the selection of loan payment type (principal and interest)
- Different type of loan payment (principal and interest) will lead to different level of risk of borrower and lender
- Commercial interest
  - Try to pay principal soon (equal principal)
- Incentive interest
  - Negociate to pay principal and interest later (principal payment at the end of loan term)

Financing from other sources

- From equipment supplier financing
  - Don't have to pay for equipment immediately
  - Very short term-usually maximum 12 months
  - Interest is usually hidden in an increased purchase price
  - Limited to the equipment dealt by the Vendor
- Equipment leasing
  - Finance leases
  - Operating leases

RISK AND SENSITIVITY ANALYSIS

Sensitivity analysis

- **All projects** should be subjected to **sensitivity analysis** as it is the most effective tool for analyzing the risks and uncertainties of projects

- Sensitivity analysis is to project performance results when changing input variables.

Sensitivity analysis

- Sensitivity analysis
  - Will show the extent to which Major Risks will affect the outcome of a project
  - Will allow to watch out and effectively manage Major Risks during implementation and monitoring
  - Will enable adequate risk mitigation measures be taken at the outset

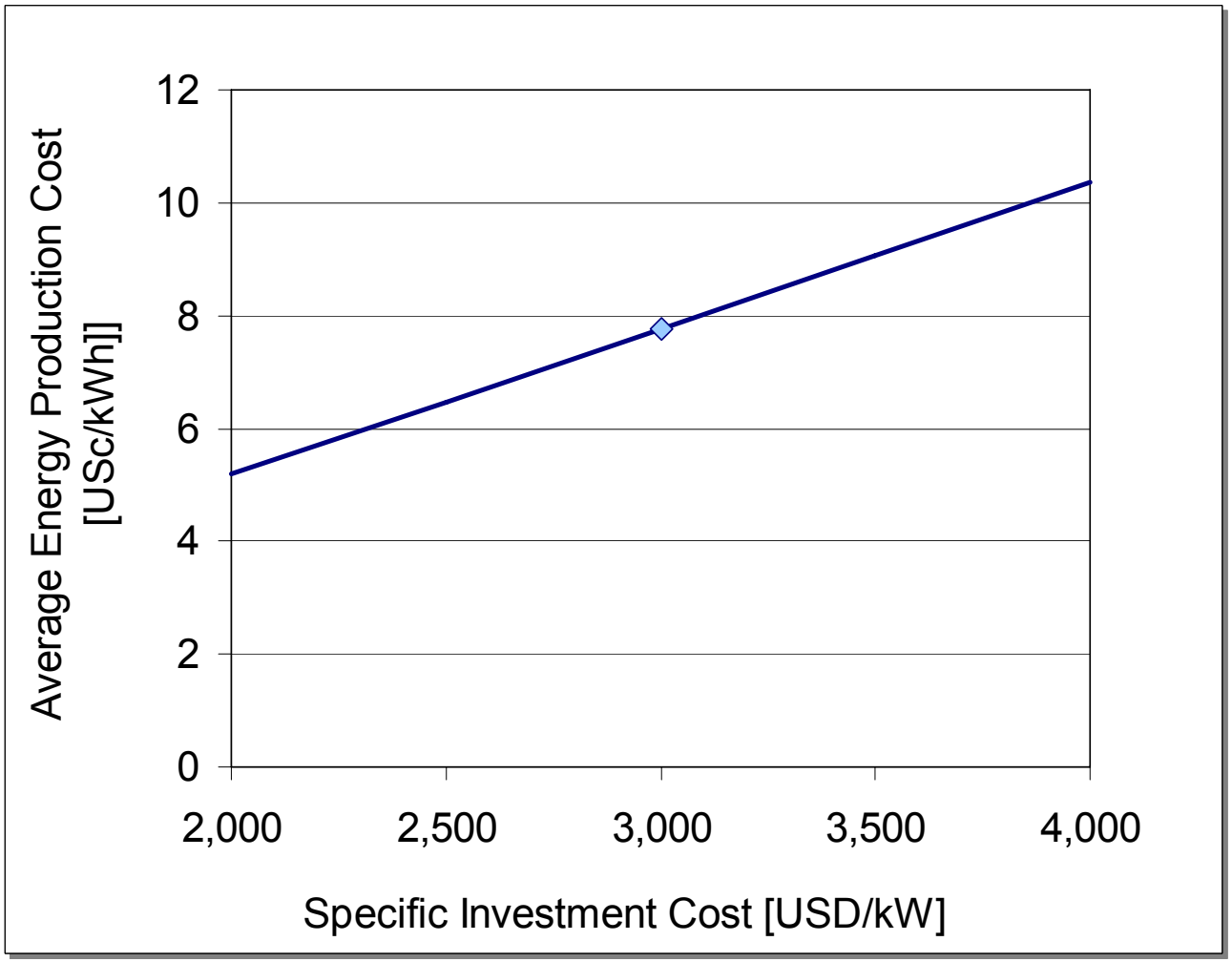
Methodology for sensitivity analysis

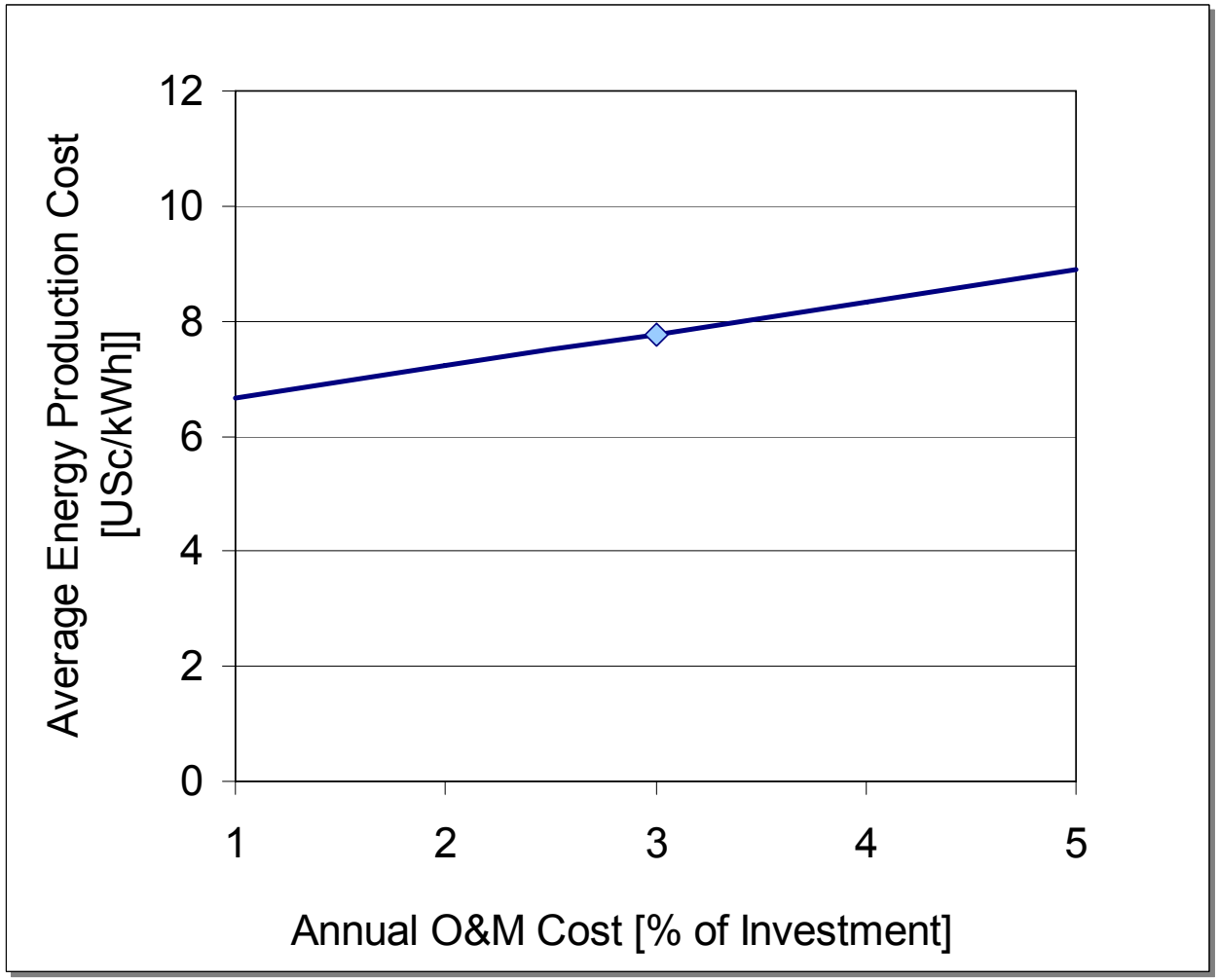
- Do the complete Financial Analysis for the base case.
- Identify the critical variables - identification of "Critical Variables" is the key to a good Sensitivity Analysis.
- Typically, variables whose values are uncertain or Project is sensitive to (ex. capital cost, discount rate, electricity demand…) are identified as "Critical Variables" at this stage

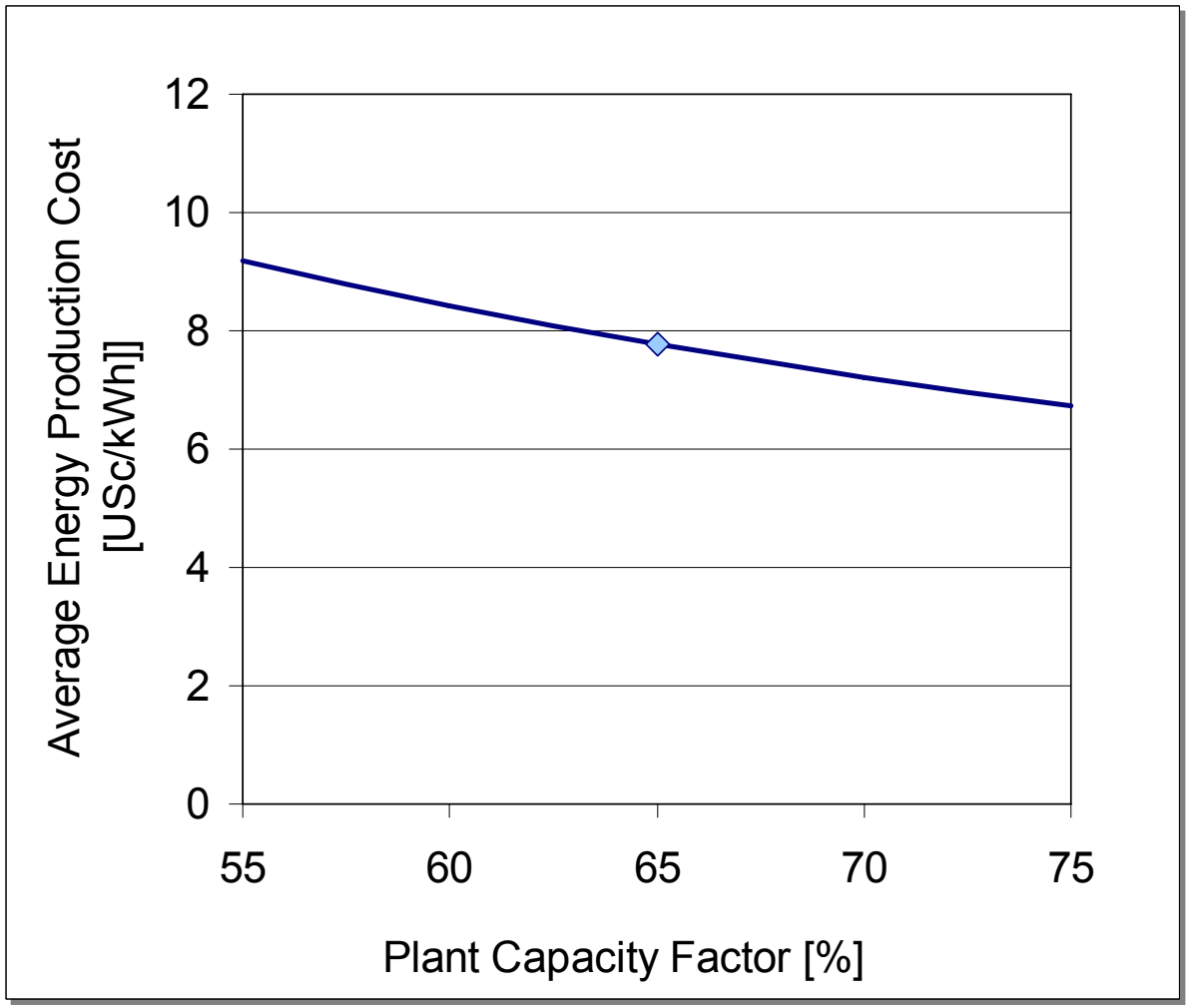
Methodology for sensitivity analysis

- Select key performance measures (profit, NPV, IRR…)
- Vary variables by ± 10% , ± 25% or other reasonable ranges as determined by historical behavior, forecasts by experts etc
- Recalculate performance measures by re-working the entire spread sheet for each change

Installed Capacity	1,000	kW
Specific Investment Cost MHP Scheme	3,000	USD/kW
Total Investment Cost MHP Scheme	3,000,000	USD
Average Annual Inflation rate	0	%
Average Interest/Discount Rate	10	%
Inflation Corrected Interest Rate	10	%
Service Life MHP Scheme	25	years
Annuity of Investment	330,504	USD
Annual Cost Operation & Maintenance	3.0	% of Investment
Annual Cost Operation & Maintenance	90,000	USD
Plant Availability	95	%
Average Plant Factor	65	%
Average Annual Energy Production	5,409,300	kWh
Average Energy Production Cost	**7.77**	**US¢/kWh**


Average Energy Production Cost [USc/kWh]]
12
10
8
6
4
2
0
2,000
2,500
3,000
3,500
4,000
Specific Investment Cost [USD/kW]





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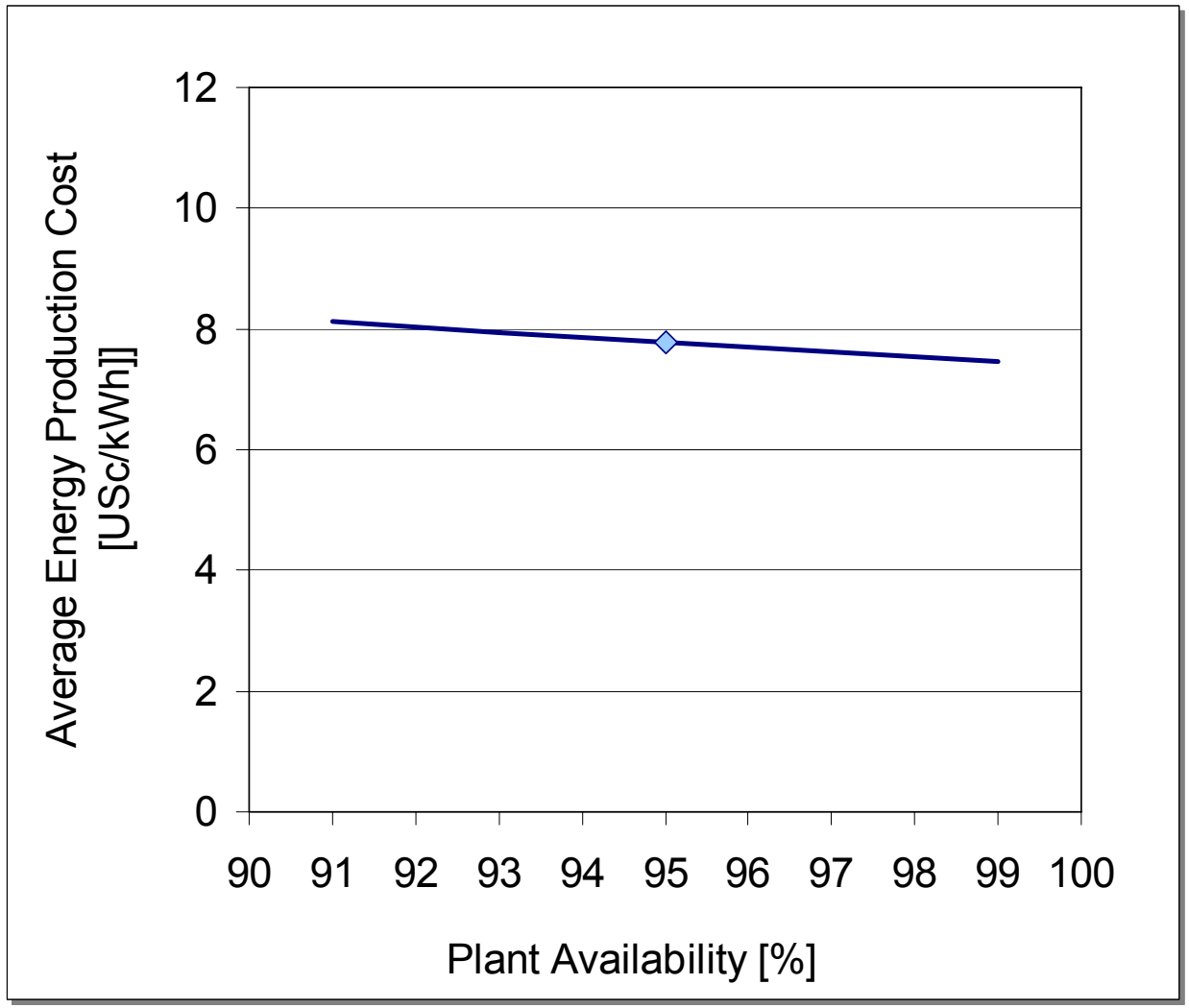

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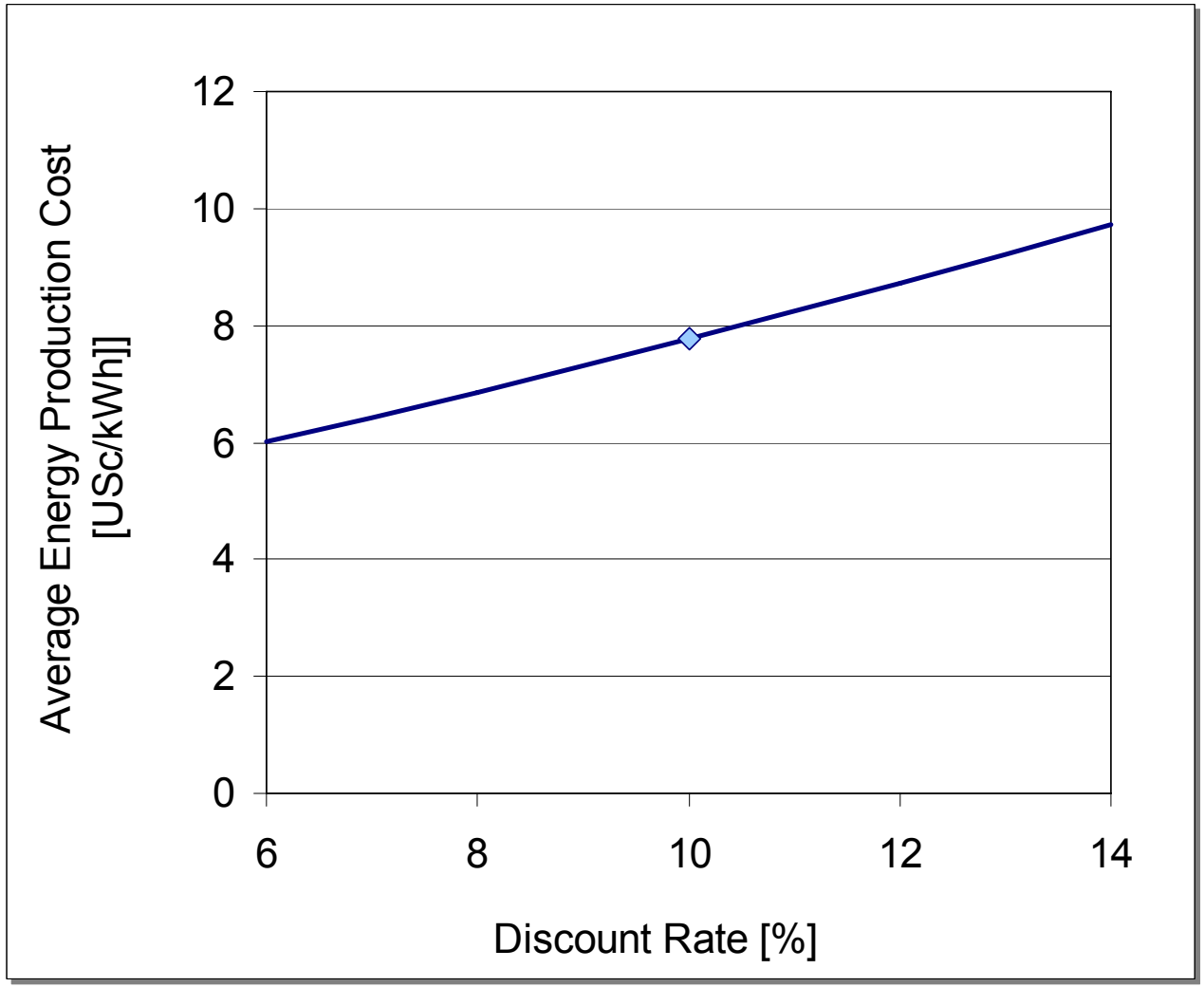

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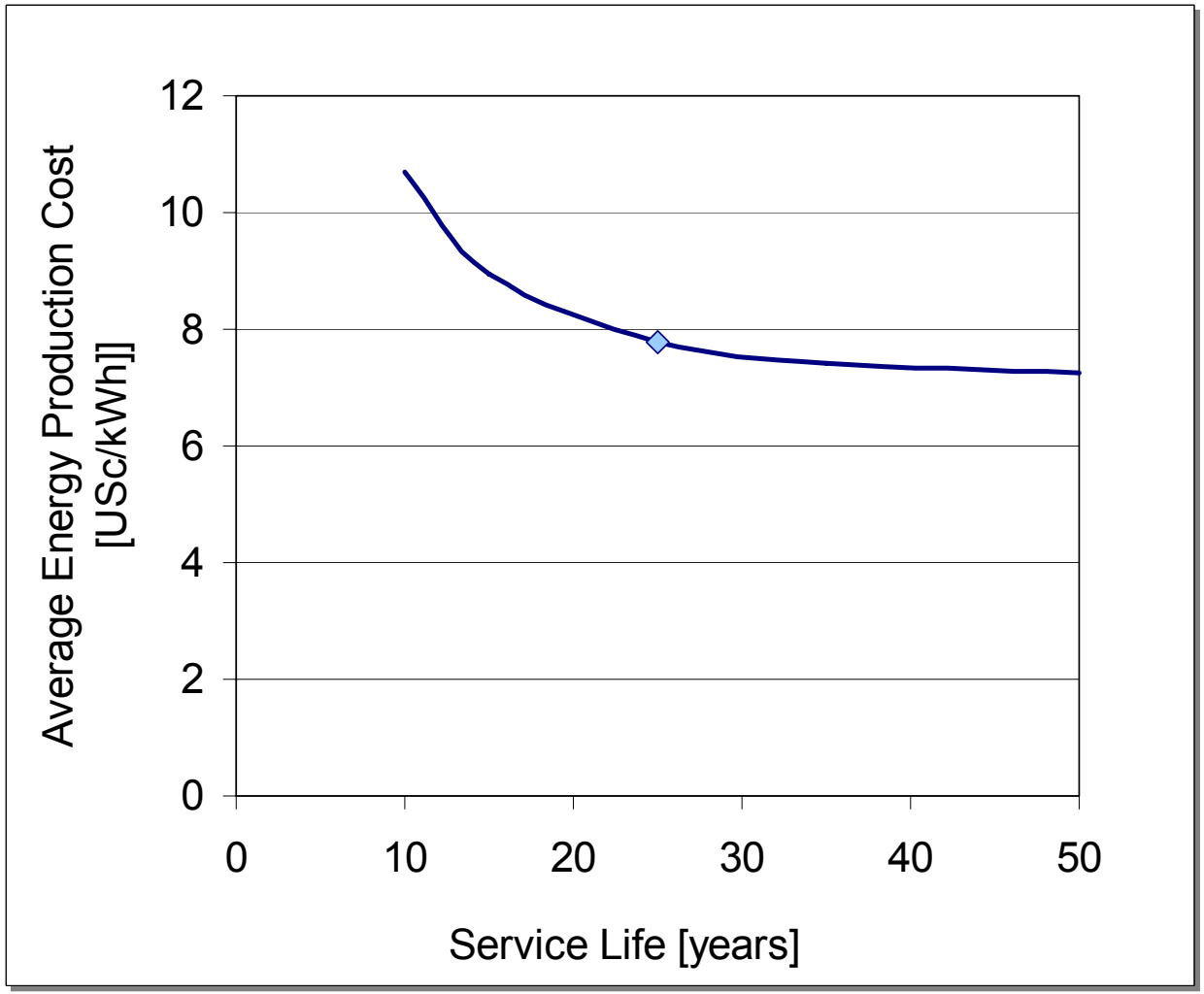
Average Energy Production Cost [USc/kWh]]
12
10
8
6
4
2
0
0
10
20
30
40
50
Service Life [years]

Common deficiencies in financial analysis

- Cost estimates incomplete
  - missing items such as land acquisition, interconnection equipment, transportation and installation of equipment, training and connection equipment…
- Absence of rationale used to select key parameters, such as interest rates or term of loans…
- Interest during construction not taken into account
- Escalation of project costs not considered
- No discussion of “negative cash flow” and its impact on the financial feasibility of a project

Thank you for your attention!