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Cairo University

Project management, techno-economic analysis and finances

Lecture 1, Introduction to the course

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Course Contents

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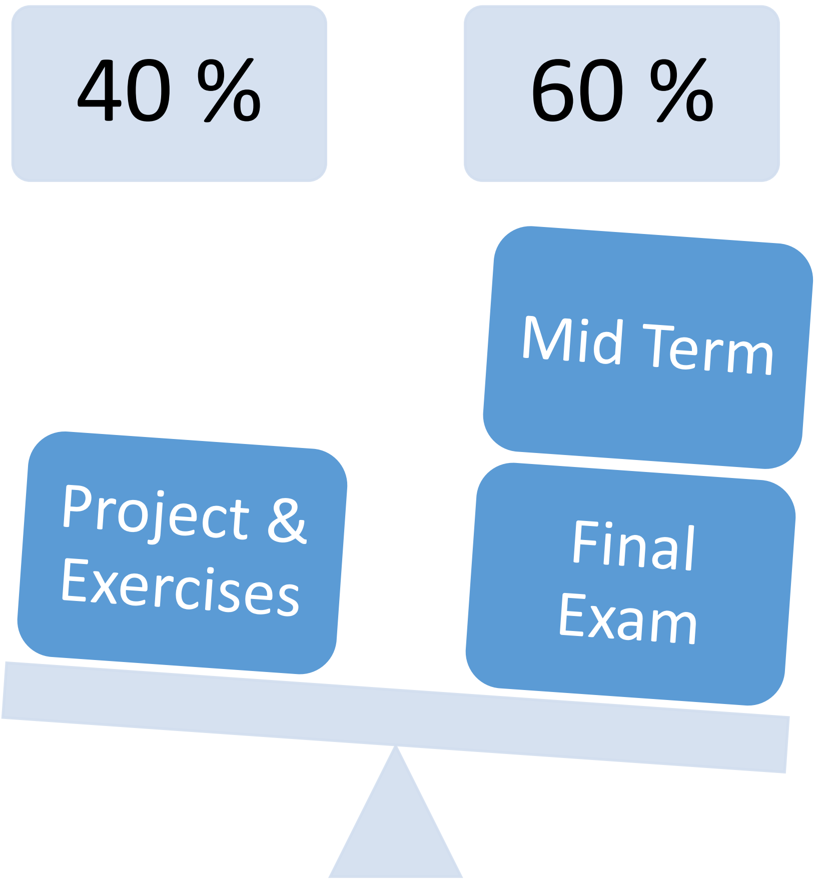
1. Introduction to the course
2. The project and its basics
3. Project Manager & Team Members
4. Deliverables of PM
5. Economy and Finance for the Project
6. Information management, project quality
7. The supply chain & Managing Conflict.
8. Basics of Risk Management

Grades



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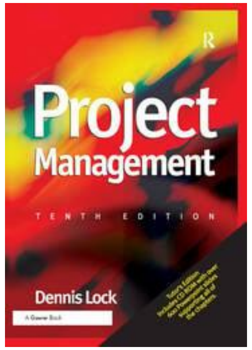

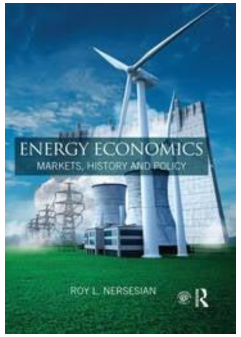

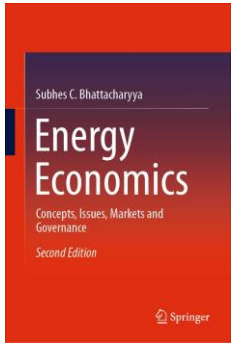

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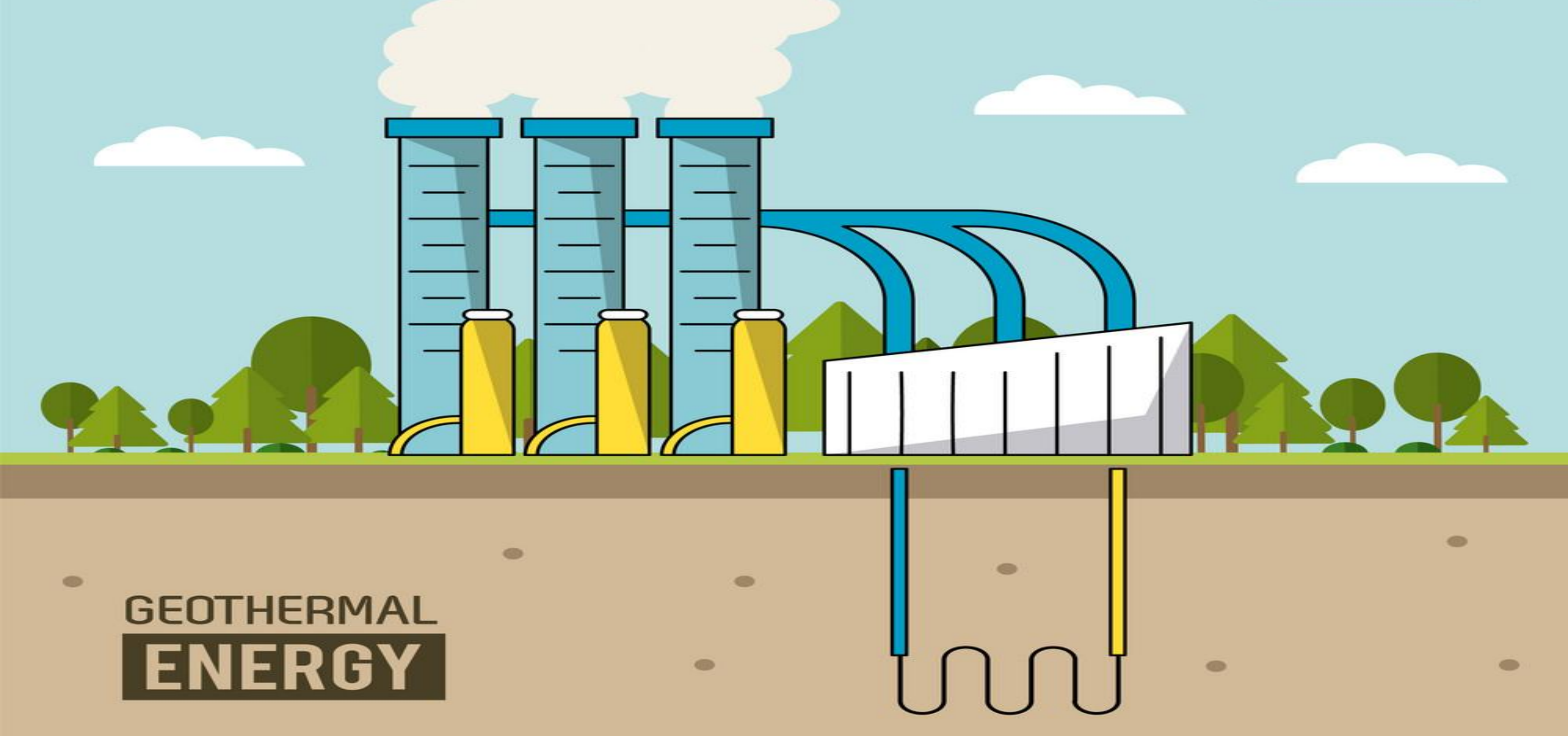

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Lecture 2, Introduction to project management

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What is a project?

"A unique work activity with a specific deliverable aimed at meeting a specific need or purpose."

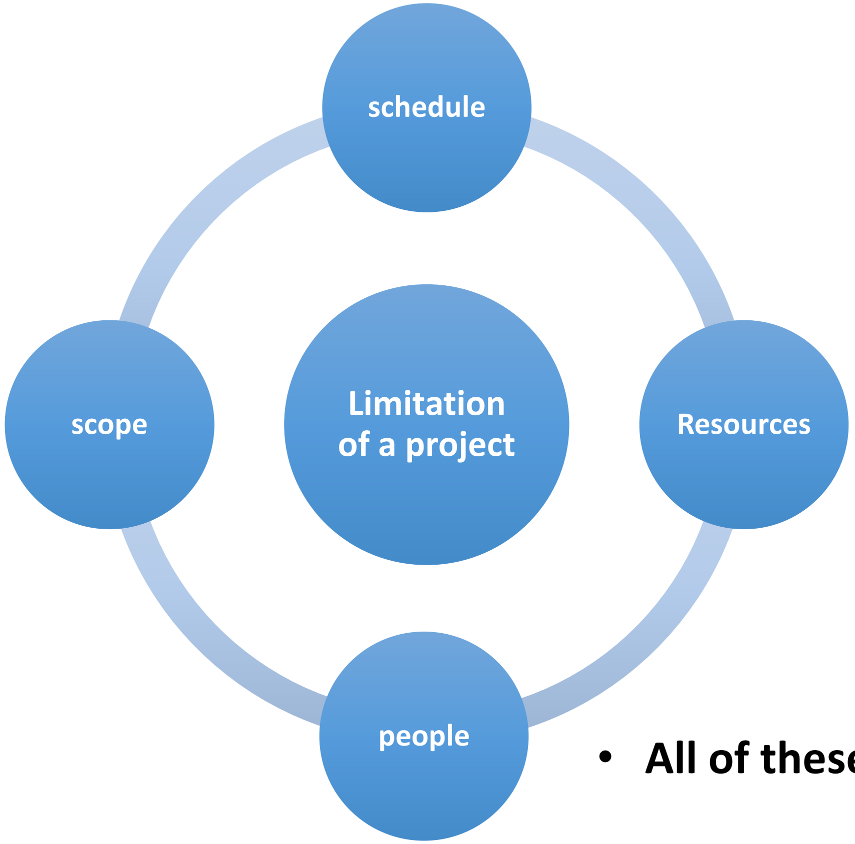
"A project is defined as a sequence of tasks that must be completed to attain a certain outcome."

What is a project?

Characteristics of a project:

- Clear start and end date
- Something new
- Boundaries
- planned, executed and controlled

What is a project?



The boundaries of a project

- **Every project operates within certain boundaries called constraints**

- **All of these project constraints depend on what the project aims to achieve and when**

Project management Vs. General management:

Dimension	***Project Management***	***General Management***
Type of Work Activity	Unique	Routine
Management Approach	Ability to adapt to change	Manage by exception
Planning	Critical	Important
Budgeting	Start from scratch, multiple budget periods	Modify budget from previous budget period
Sequence of Activities	Must be determined	Often predetermined
Location of Work	Crosses organizational units	Within an organizational unit
Reporting Relationships	Informal	Well defined

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The life cycle of the projects:

The life cycle of the projects:

Initiation

- Define project goals
- Create a business case
- Complete the project charter
- List of stakeholder

Planning

- Define the scope
- Create a project plan
- Set a budget baseline
- Define roles and responsibilities

Execution

- Allocate the project resources
- Manage project resources
- Build the product or process
- Regular meeting

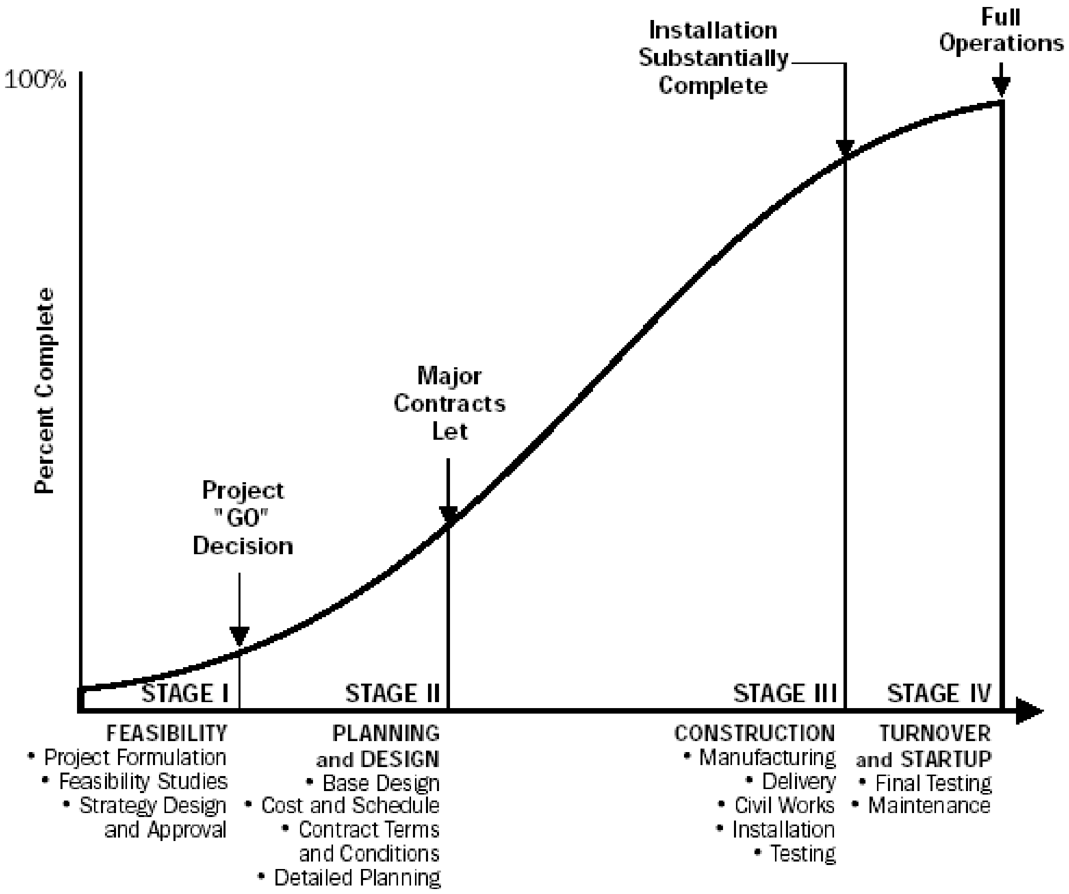
Monitoring and controlling

- Track effort and cost
- Monitor project progress
- Ensure adherence to plan
- Prevent any chances to disruption

Closure

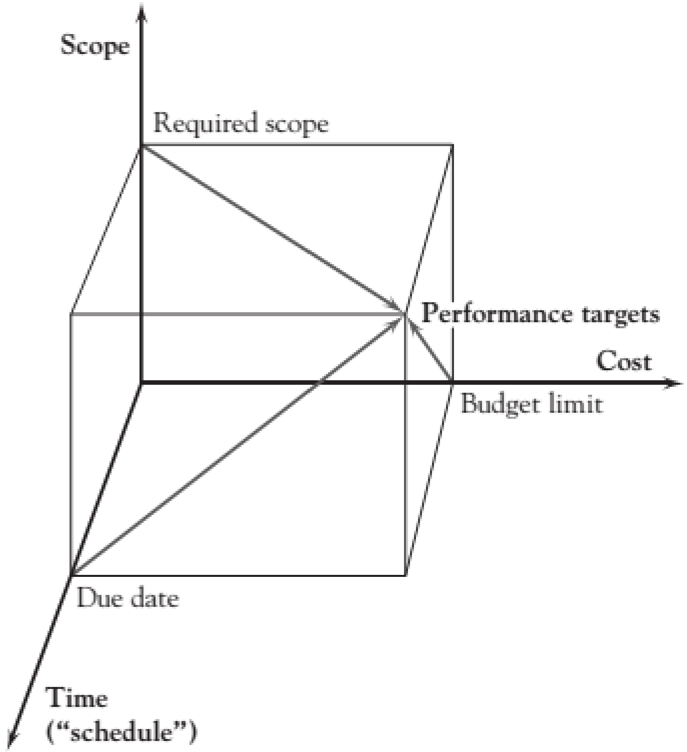
- Hanover deliverables
- Review project deliverables
- Get project results approach
- Document project learning

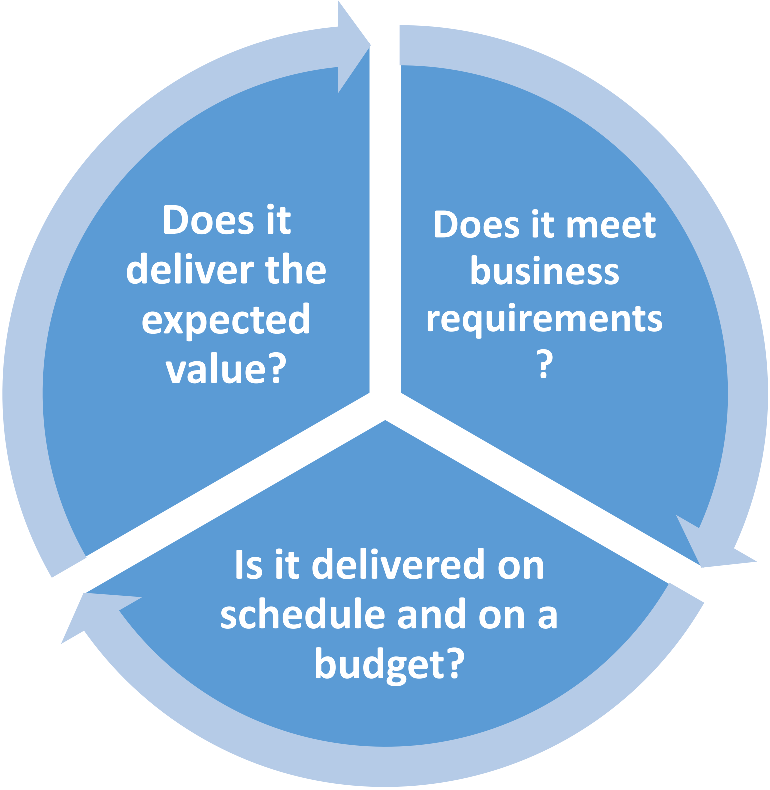
Construction Project Lifecycle



The life cycle of the projects:

When is a project considered a success?





Project scope

Scope Definition: Subdividing the major deliverables into smaller, more manageable components to provide better control.

Project Scope Management: A subset of project management that includes the processes required to ensure that the project includes all of the work required**, and only the work required,** to complete the project successfully.

It consists of :

- scope planning.
- scope definition.
- scope verification.

Project scope

- **Scope Planning:** The process of progressively elaborating the work of the project.

➢ project justification.

➢ Major deliverables.

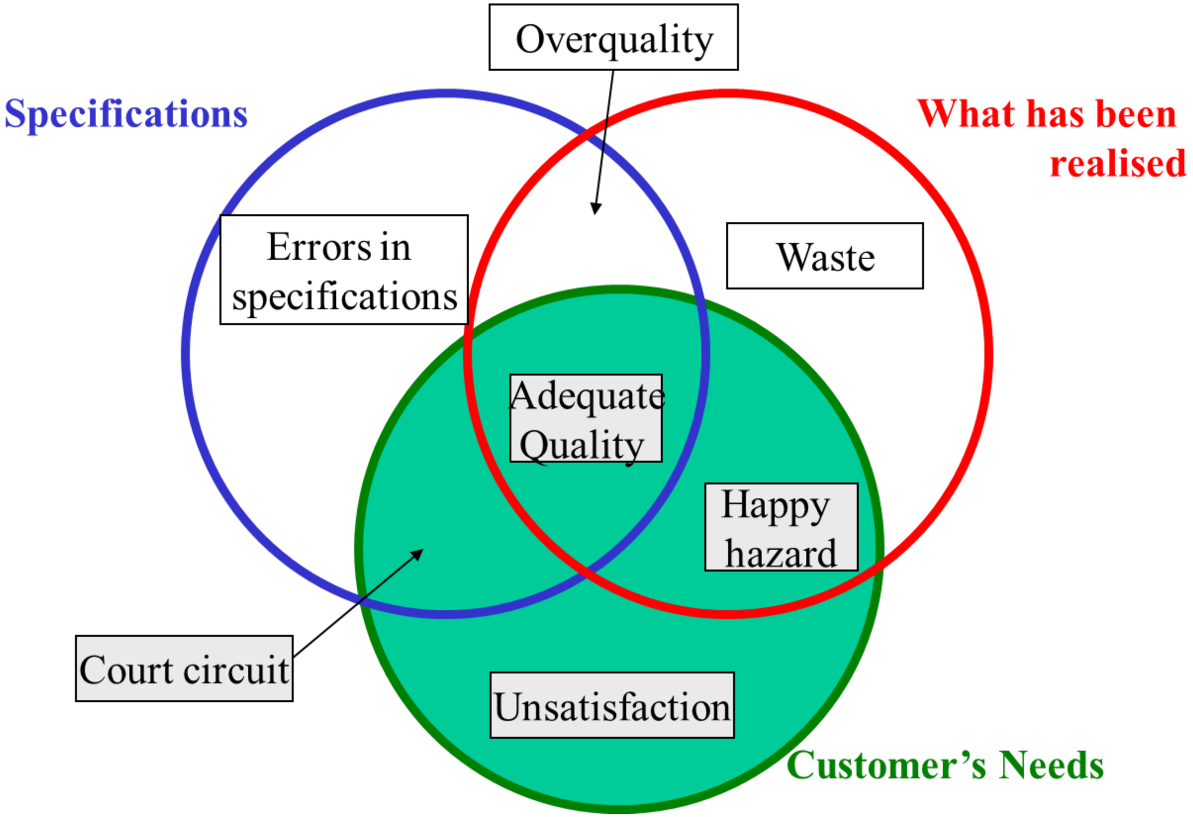
➢ project objectives.

- **Scope Verification:** Formalizing acceptance of the project scope and ensuring that all the work required to complete the project has been accomplished.

Project scope

Scope Statement: The scope statement provides a documented basis for making future project decisions and for confirming or developing common understanding of project scope among the stakeholders. As the project progresses, the scope statement may need to be revised or refined to reflect approved changes to the scope of the project.

Monitoring Project scope during the project



What Is a Deliverable?

A deliverable is an element of output within the scope of a project. It is the result of objective-focused work completed within the project process. Deliverables could be **internal** or **external**.

Internal: within the company.

External: for a client, customer, or stakeholder

Example:

Internal:

You are leaving your current role, and your HR supervisor asks you to prepare a handover document for your successor. This document is an internal deliverable.

External:

You are working for an SEO agency, and you create a website audit for your client to optimize their SEO practices. This audit is an external deliverable.

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Lecture 3, Project Manager & Team Members

Project Manager (PM)

- The first personnel to be hired for a project.
- Makes sure that the project is properly planned, implemented, and completed.

- A PM is usually known to manage trade-offs and risks only. False!

- A PM also has the roles of:
  - Facilitator
  - Communicator
  - Virtual project manager
  - Convener & Chair of meetings

PM’s Responsibilities

- Acquiring Resources
- Fighting Fires and Obstacles
- Leadership
- Negotiation
- Conflict Resolution
- Leadership, Ethics
- Ability to Handle Stress

Selection of PM

- The most important criterion, by far, is that the PM, in the language of salespeople, is a **“closer.”**

“Driven to finish the job”

Project Team Member

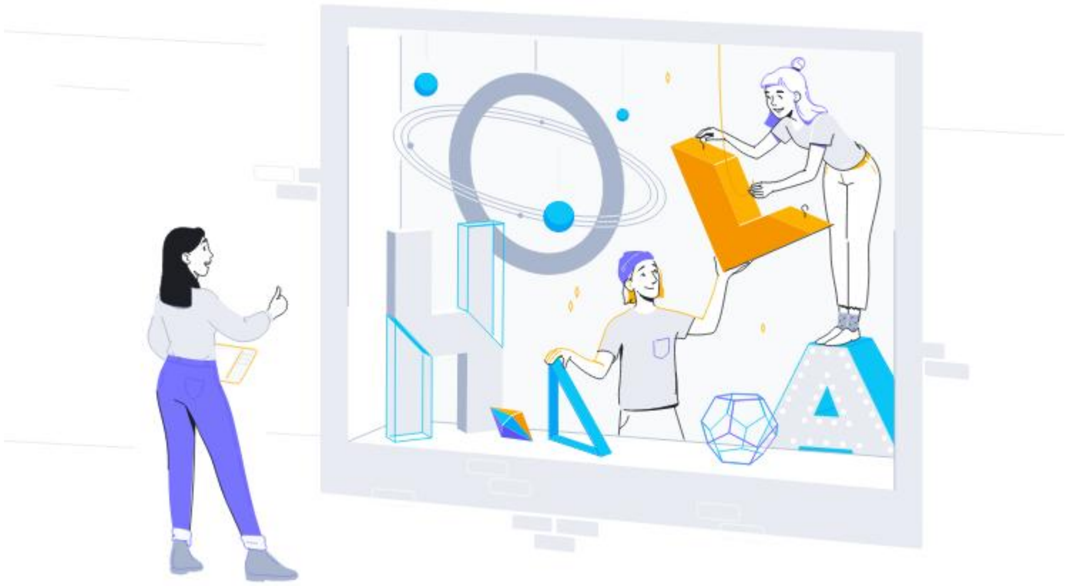
- Effective team members have some characteristics in common:
  - Technically competent
  - Politically sensitive (especially senior members)
  - Strong problem orientation
  - Strong goal orientation
  - High self-esteem

Project Team Members

- Internal team collaboration increases **productivity.**
- Collaborating with external stakeholders increases **innovation.**

Setting up a Team

- Project needs (Scope)
- Skills (Complete each other)
- Capacity (Workload)
- Work styles (Dynamic)



Team Development

- **Forming:**

  Team members come together for the first time and begin learning about their roles and responsibilities.

- **Storming:**

  As project begins, initially the team members tend to work independently, which often leads to conflict.

- **Norming:**

  In this phase, the team members begin to establish team norms and team cohesiveness develops. Individual team members reconcile their behaviors to support the overall team and trust develops.

- **Performing:**

  With norms and trust established, teams function as a cohesive unit focused on accomplishing the goals of the project.

"Tuckman ladder" (Tuckman, 1965)

Exercise 1,

Discuss the project management for geothermal energy development

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Lecture 4, Feasibility Studies

Dynamic Systems and Digitalisation Cluster, ETCC lab

Feasibility *Areas*

Technical Feasibility

- Familiarity with application: Less familiarity generates more risk.
- Familiarity with technology: Less familiarity generates more risk.
- Project size: Large projects have more risk.
- Compatibility: The harder it is to integrate the system with the company's existing technology, the higher the risk will be

Economic Feasibility

- Development costs
- Annual operating costs
- Annual benefits (cost savings and/or increased revenues)
- Intangible benefits and costs

Organizational Feasibility

- Project champion(s)
- Senior management
- Users
- Other stakeholders
- Is the project strategically aligned with the business?

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Technical Feasibility

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Technical Feasibility

- The extent to which the system can be successfully designed, developed, and installed.
- It can be defined as a *technical risk analysis that strives to answer the question: "Can we build it?*

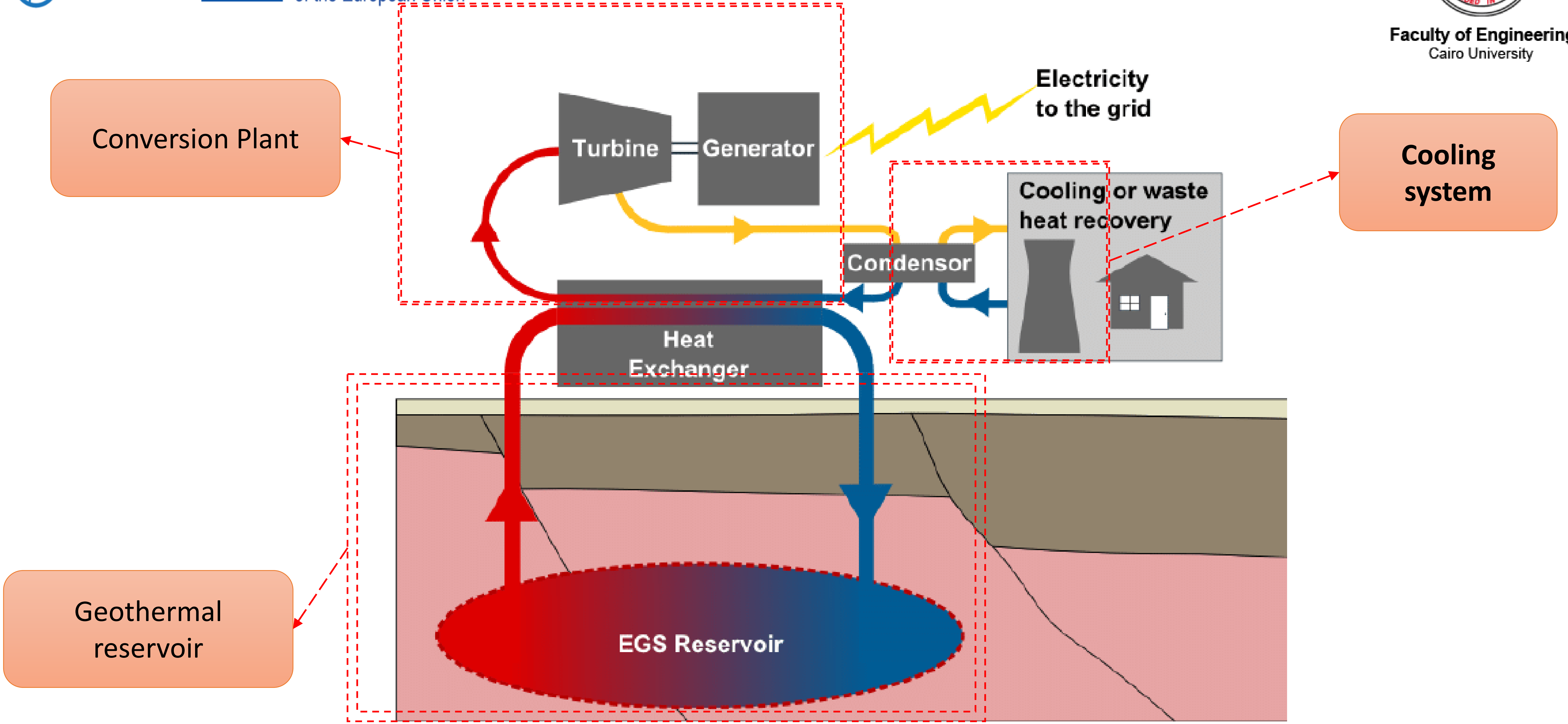
Technical analysis for geothermal systems

Study objective: 1) to generate a required capacity of electricity

2) Or to extract the available energy at a specific depth

Plant Design:

1) *Geothermal resource characteristic* (Hydrothermal/ Enhanced Geothermal Systems)
2) Conversion plant type (binary/ flash)
3) Cooling system



Source: Huddlestone-Holmes, Cameron, and Jenny Hayward. *The potential of geothermal energy*. CSIRO, 2011.

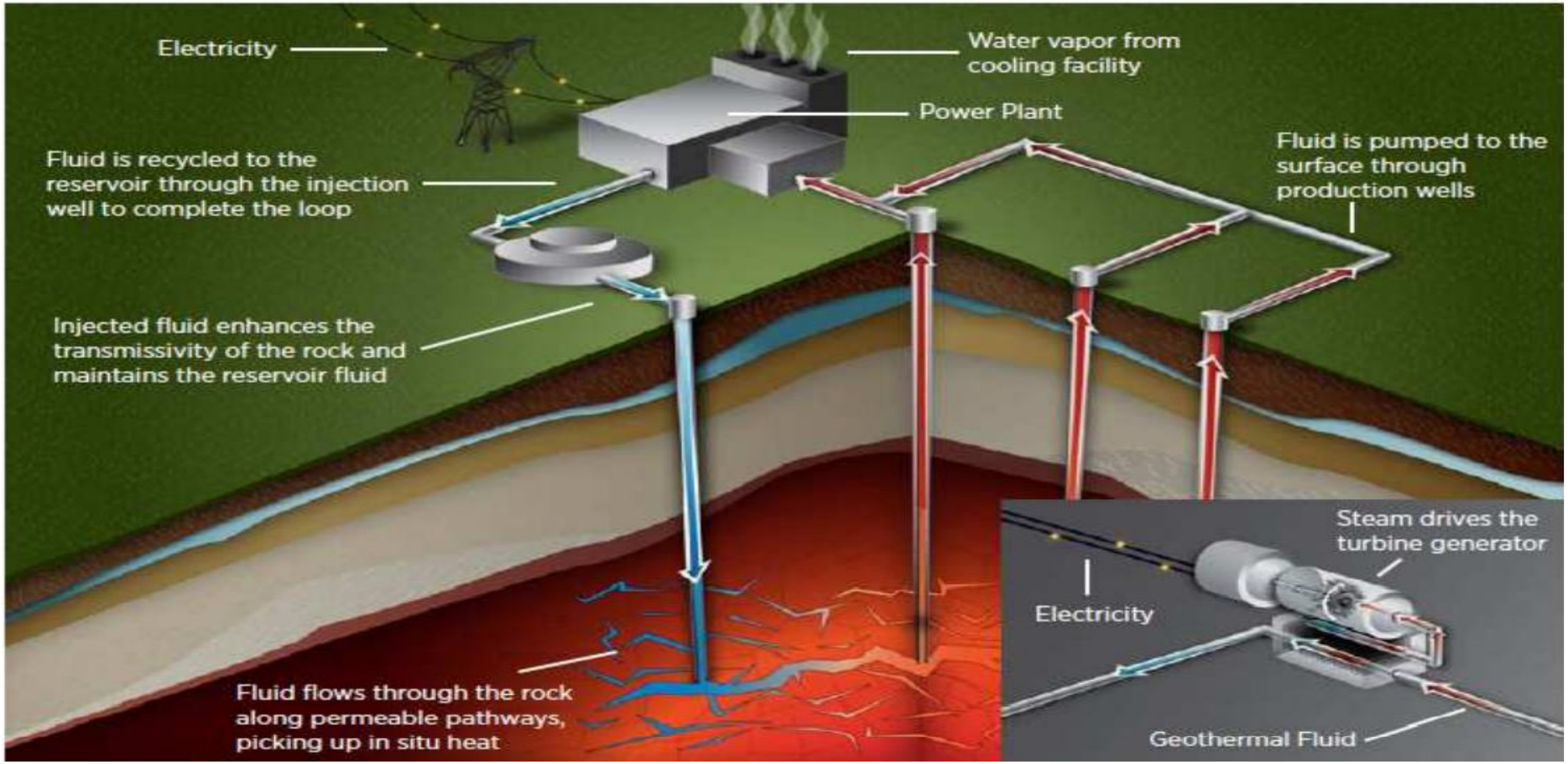
Enhanced Geothermal Systems (EGS):

- The *EGS* concept is to extract heat by creating a subsurface fracture system to which water can be added through injection wells. Creating an enhanced, or engineered, geothermal system requires improving the natural permeability of rock. Rocks are permeable due to minute fractures and pore spaces between mineral grains. Injected water is heated by contact with the rock and returns to the surface through production wells, as in naturally occurring hydrothermal systems. *EGS* are reservoirs created to improve the economics of resources without adequate water and/or permeability.

- In principle, *Enhanced Geothermal Systems* may be approximated as “closed-loop” systems whereby energy is extracted from the hot fluid produced by production wells (namely, a heat exchanger for binary plants) and cooled fluid is reinjected through injection wells. However, the circulation system is not exactly closed because water is lost to the formation; this lost water must be made up from surface water supplies

- *Enhanced geothermal systems* use more water than conventional geothermal systems, because they require water to be injected into the ground to reopen fractures (or create new ones) and create permeability. These systems are extremely useful and can expand the electricity-generating capacity of geothermal resources. **Enhanced geothermal systems rely on binary system technologies once the fractures are created.**

Enhanced Geothermal Systems (EGS):



Source: https://www.thermopedia.com/es/content/10316/

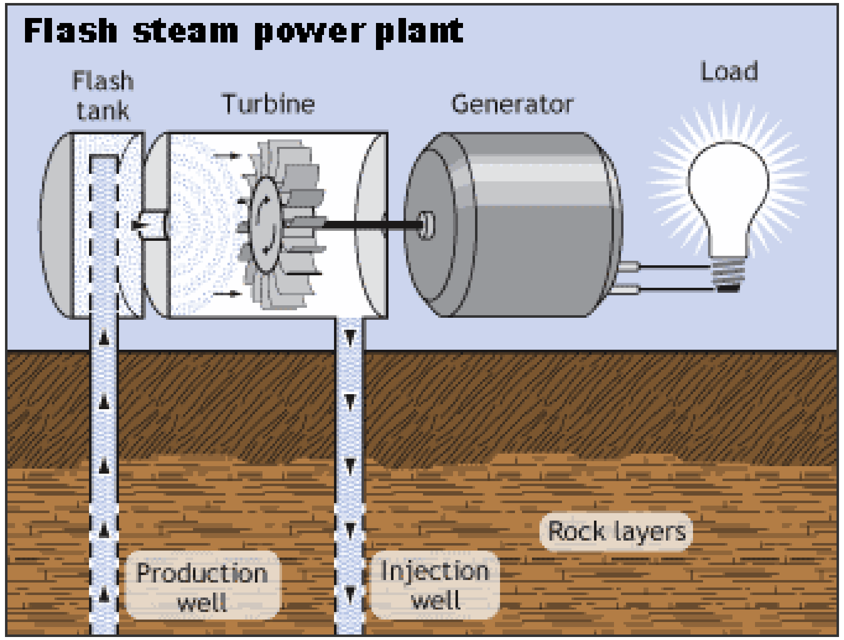
Conventional Hydrothermal Flash System:

- A power plant where water is pumped under great pressure to the surface. When it surfaces, the pressure is reduced and as a result some of the water changes to steam. This creates a blast of steam that drives generator turbines. When the steam cools, it condenses to water, the water is then returned to the earth to be heated up by geothermal rocks again. Most geothermal power plants are flash steam plants.

- Hydrothermal *flash systems* use hydrothermal fluids above 182°C. This fluid is quickly "flashed" or vaporized from the well by a dramatic decrease in pressure to a tank, and the vapor is used to drive a turbine, which drives a generator and produces electricity. The liquid that remains in the tank will be vaporized again to produce as much electricity as possible. This type of system is an open loop system, so the vapor is generally released into the atmosphere and the condensed liquid is injected back into the well.

Conventional Hydrothermal Flash System:

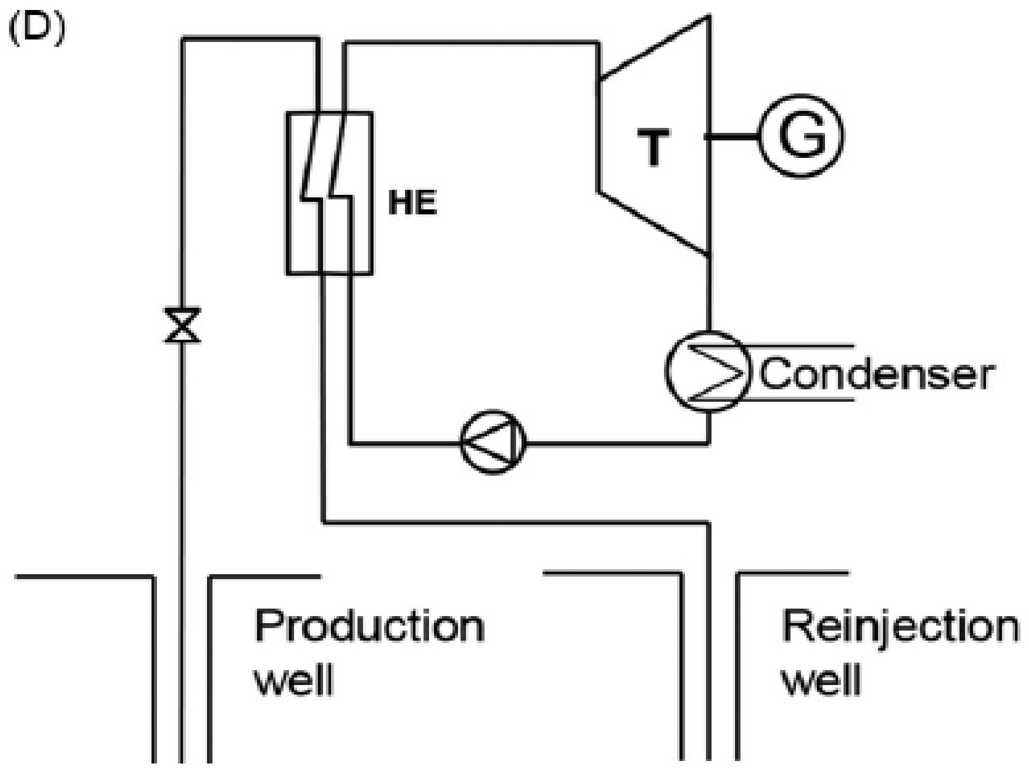
- Steam with water is extracted from the ground
- Pressure of mixture drops at surface and more water "flashes" to steam
- Steam is separated from water and then drives turbine blades that later drives an electric generator
- The plant uses from 6 to 9 tones of steam per hour and generates between 5 and 100 MW



Source: https://www.eia.gov/energyexplained/geothermal/geothermal-power-plants.php

Binary Cycle (Organic Rankine Cycle)

- Organic Rankine Cycle is a technology that convert low-temperature heat sources into a mechanical energy, and it can be used to produce electrical energy in a closed system.
- The heat sources can be received from renewable energy such as geothermal, solar, and biomass.



Binary Cycle (Organic Rankine Cycle)

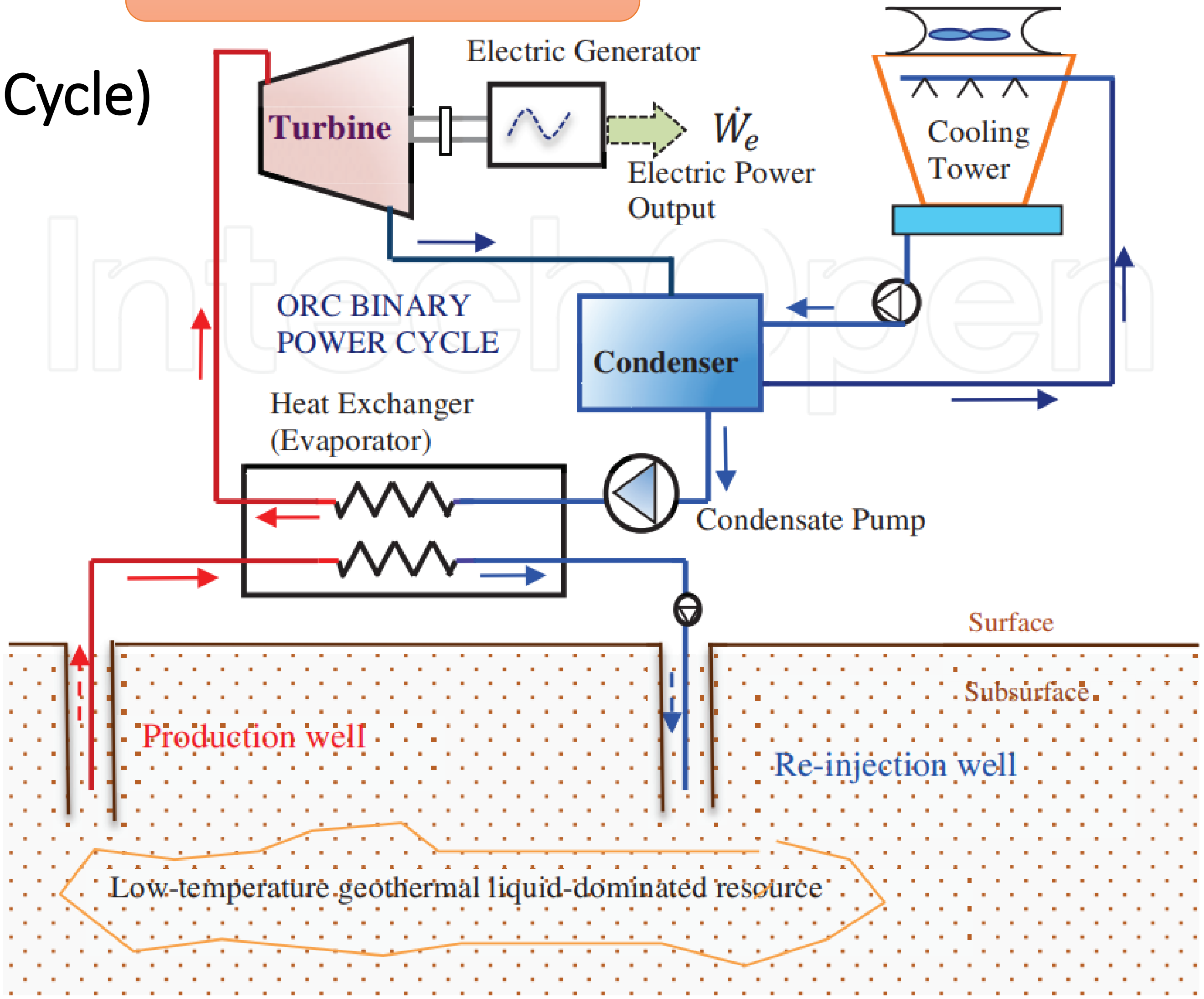
Energy conversion aspects of ORC-based low-temperature geothermal power generation

- The first (primary) fluid being the geo-fluid (brine) is extracted from the low-temperature geothermal resource through the production well.
- The geo-fluid carries the heat from the liquid dominated resource and efficiently transfers this heat to the low-boiling point (BP) organic working fluid
- The low-boiling point organic liquid absorbs the heat which is transferred by the geothermal fluid and boils at a relatively much lower temperature, and as a result develops significant vapor pressure sufficient to drive the turbine.

Conversion Plant

Binary Cycle (Organic Rankine Cycle)

A schematic diagram showing the basic concept of a low-temperature geothermal binary ORC system for electrical power generation.



Source: Ismail, B.I., 2013. ORC-Based Geothermal Power Generation and CO2-Based EGS for Combined Green Power Generation and CO2 Sequestration. *New Developments in Renewable Energy*, pp.303-328.

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Conversion Plants

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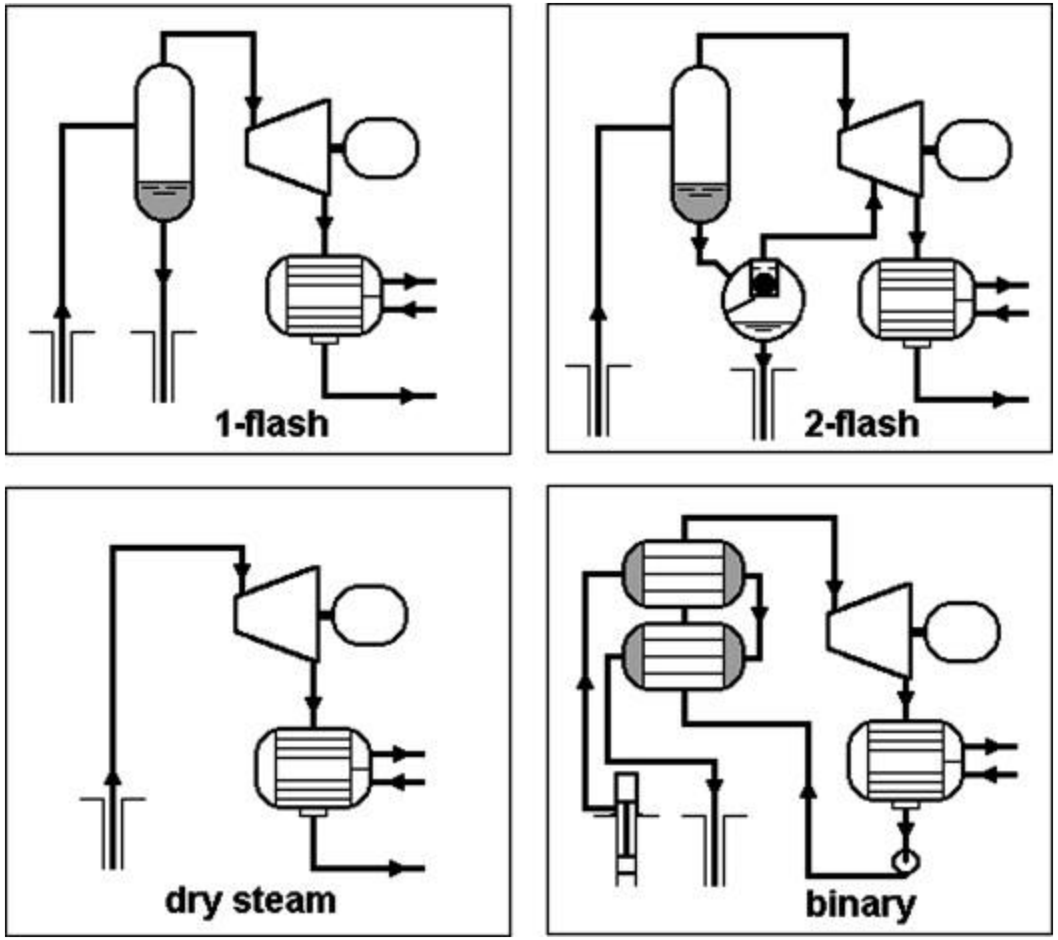

Source: DiPippo, Ronald. *Geothermal power plants: principles, applications, case studies and environmental impact*. Butterworth-Heinemann, 2012.

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Economic Feasibility

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Economic Analysis of Geothermal Plants:

- To estimate the costs of generating electrical power from geothermal energy
- To assess the economic benefits of implementing geothermal energy projects
- Cost comparison with other energy sources

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Techno-economics Analysis

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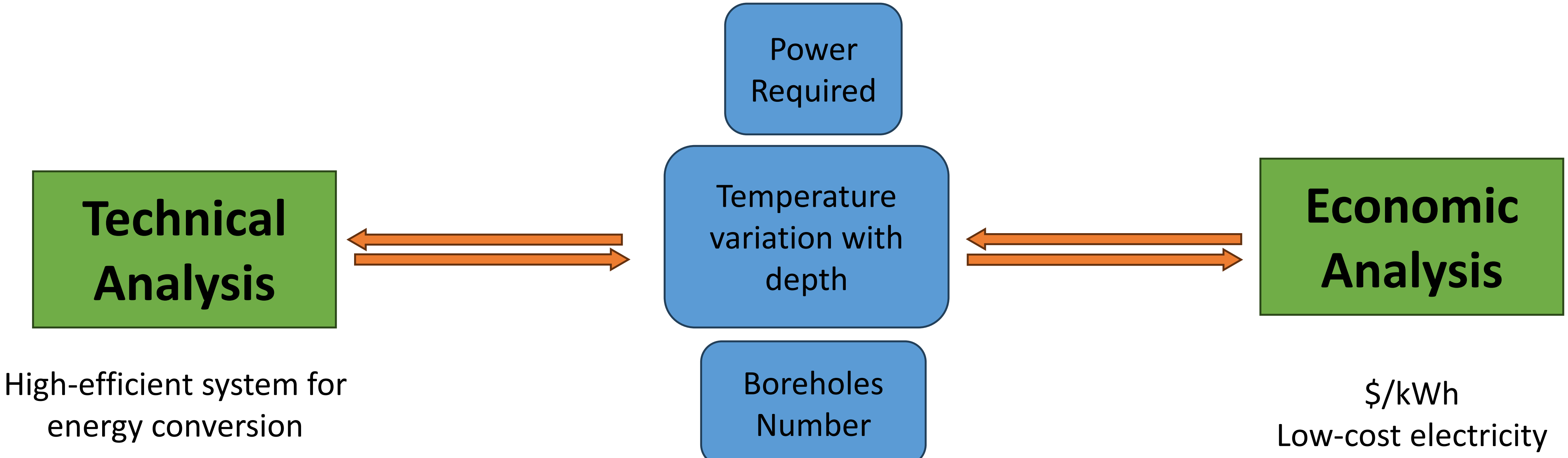

- The basis of most design decisions is economics. Designing a system that functions properly, is only a part of an engineer's task. The system must also be economical and show an adequate return on the investment. In the power plant design, the engineer will search for the design that will have the minimum investment cost or will be able to generate electricity at the lowest overall cost.

Steps to Conduct and Economic Feasibility

Identify	Assign	Determine	Assess
Identify Costs and Benefits	Assign Values to Costs and Benefit	Determine Cash Flow	Assess Project's Economic Value • Return on Investment (ROI) • LCOE • Net Present Value (NPV)

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COST TO ESTIMATE

- Any project includes cost component, each components consists of several cost elements

Project

Initial Investment or First Cost				AOC (Annual Operating Costs) or M&O			
Equipment cost	Installation cost	Delivery charges	Insurance coverage	Maintenance (daily, periodic, repairs, etc.)	Direct materials	Direct labor cost for operating personnel	Rework and rebuild

Terminology and notations

P value or amount of money at a time designated as the present or time *0.*
Also, ***P*** is referred to as present worth (*PW*), present value (*PV*)

F value or amount of money at some future time. Also, **F** is called future worth (*FW*) and future value (*FV*); dollars

i interest rate per time period; percent per year, percent per month
Interest is the manifestation of the time value of money, and it essentially represents "rent" paid for use of the money. Computationally, interest is the difference between an ending amount of money and the beginning amount.

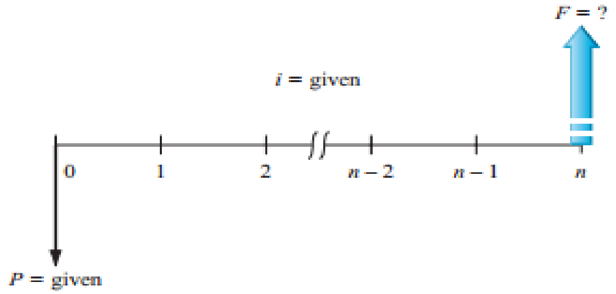
How time and interest affect money?

- F given P.

This could be explained as follows

F is the result of investing **P** amount at ***i*** interest rate in ***n*** year, such that

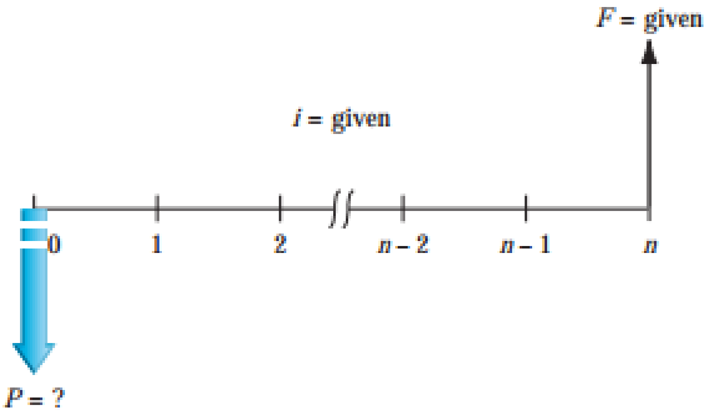
$$F = P(1+i)^n$$



- P given F

The investor can estimate the principal ***P*** which gives ***F*** value in future at an interest rate ***i*** in ***n*** years.

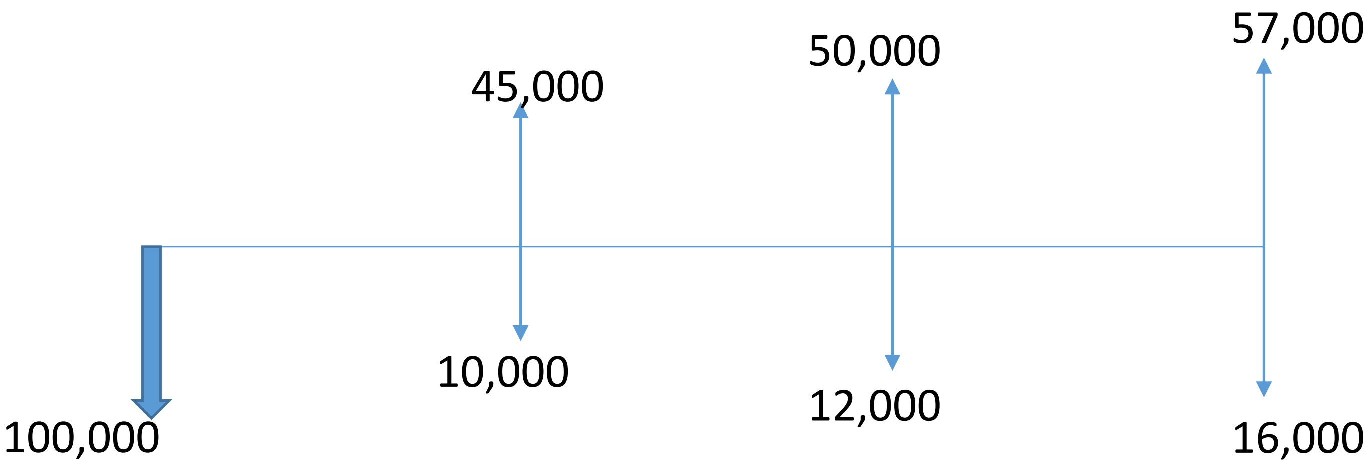
$$P = F(1+i)^{-n}$$



Cash Flow Analysis

• Cash Flow Diagrams are simple graphical representations of financial transactions. It represents the movement of money in and out of a company.
• Cash received signifies inflows, and cash spent is outflows.

	Year 0	Year 1	Year 2	Year 3	Total
Total benefits		45,000	50,000	57,000	152,000
Total costs	100,000	10,000	12,000	16,000	138,000
Total cash flow	-100,000	35,000	38,000	41,000	14,000
Cumulative cash flow	-100,000	-65,000	-27,000	14,000	



Return on Investment (ROI)

- The return on investment (ROI) is a calculation that measures the average rate of return earned on the money invested in the project.

$$ROI = \frac{Total\ benefits - total\ costs}{Total\ Costs}$$

$$ROI = \frac{152{,}000 - 138{,}000}{138{,}000} = \frac{14{,}000}{138{,}000} = 10.14\%$$

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Break-even Point (BEP) Or Payback period

- Is defined as the number of years it takes a firm to recover its original investment in the project from net cash flows.
- BEP is in the year in which Cumulative cash flow turns positive.

$$= The\ number\ of\ yearsof\ negative\ cash\ flow + \frac{that\ years's\ net\ cash\ flow - that\ year's\ cumulative\ cash\ flow}{Thar\ year's\ net\ cash\ flow}$$

$$= 2 + \frac{41{,}000 - 14{,}000}{41{,}000} = 2.68\ years$$

Net present value (NPV)

- Is used to compare the present value of all cash inflows and outflows for the project in today’s dollar terms.
- It is converting the total cash flow into its equivalent present value.

A project's net present value (NPV) is a measure of a project's economic feasibility that includes both revenue and cost. In general, given the discount rate you assume, a positive NPV indicates an economically feasible project, while a negative NPV indicates an economically infeasible project.

Example on NPV

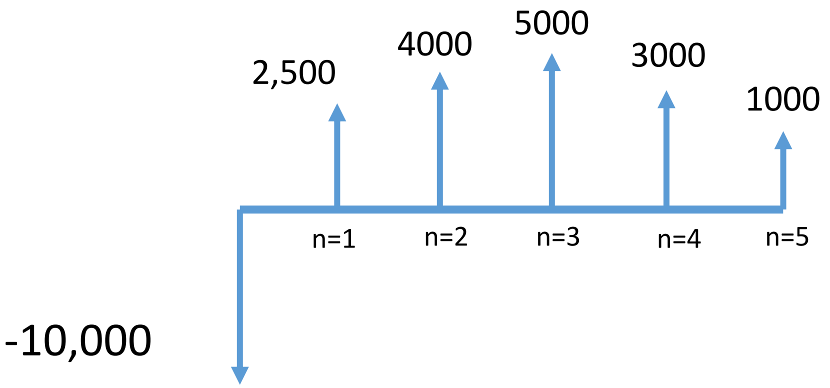
$$\boldsymbol{P = F(1+i)^{-n}}$$

$$NPV = -10{,}000 + \frac{2500}{1.06} + \frac{4000}{1.06^2} + \frac{5000}{1.06^3} + \frac{3000}{1.06^4} + \frac{1000}{1.06^5}$$

NPV = outflow + inflow

NPV = -10,000 + 13,239= 3,239 $

- The project is economically feasible



Levelized cost of electricity LCOE

$$LCOE = \frac{Total\ Lifetime\ Cost}{Total\ Lifetime\ output} = \$/kWh$$

In power plant design, many technical and economic factors vary from year to year.
To compare various design alternatives, it is often desirable to have the equivalent, but the constant term that can represent the factor that changes throughout the plant life.
This term is frequently called the levelized value of this factor

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SAM software

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SAM Software

Estimate:

- The levelized cost of energy (LCOE) for a geothermal power plant, given a known configuration and resource
- How does changing the design of the plant affect its output and LCOE?
- The required plant size to meet an electric capacity requirement?
- The plant's electric capacity at a given known number of wells

Technical Inputs for SAM

1) Resource characterization (Hydrothermal/ Enhanced Geothermal Systems)
2) Total resource potential
3) Resource temperature
4) Resource depth
5) Pressure change across the reservoir
6) Plant output/ number of wells
7) Conversion plant type (binary/ flash) and its efficiency
8) Pumping parameters
9) Power generation design (pressure, inlet, and outlet temperature)
10) Type of cooling system

Costs in SAM

SAM organizes the costs into installation and operating costs:

Installation Costs are in Year 0 of the project cash flow:

•Direct capital costs for equipment purchases and installation labor

•Indirect capital costs for permitting, engineering, and land-related costs

Operating costs are in Years 1 and later of the cash flow:

•Costs for labor, equipment, and other costs associated with operating and maintaining the project

You can also specify costs associated with financing the project on the ***financial parameters*** page: Construction loan, Project loan, Taxes, and insurance

Net Capital Cost

The net capital cost is the total installed cost from the **installation costs** page **less** any cash investment-based and capacity-based **incentives** from the incentives page **plus** any additional **financing costs** and fees from the **financial parameters** page.

GETEM (Geothermal electricity technology evaluation model) estimates the capital costs for the following phases of the project developmer

- Exploration
- Drilling to complete well field
- Field gathering systems for the geofluid
- Power plant construction

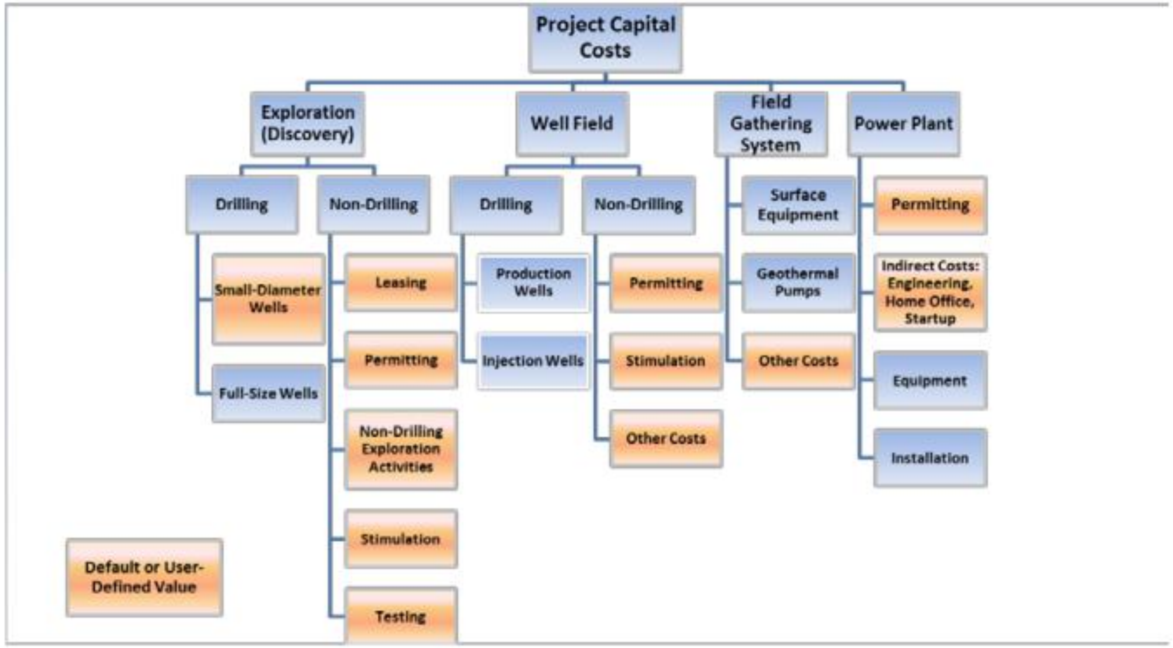

Figure 3. Capital costs included in GETEM's determination of an LCOE.

Source: Mines, Gregory L. "GETEM user manual." ***INL: Idaho Falls, ID, USA*** **(2016).**

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SAM Software Results

Metric	Value
Annual AC energy (year 1)	261,324,800 kWh
Capacity factor (year 1)	99.4%
PPA price in Year 1	8.00 ¢/kWh
PPA price escalation	1.00 %/year
LPPA Levelized PPA price nominal	8.61 ¢/kWh
LPPA Levelized PPA price real	6.95 ¢/kWh
LCOE Levelized cost of energy nominal	8.01 ¢/kWh
LCOE Levelized cost of energy real	6.46 ¢/kWh
NPV Net present value	$13,862,941
IRR Internal rate of return	14.43 %
Year IRR is achieved	20
IRR at end of project	15.19 %
Net capital cost	$150,274,192
Equity	$69,926,888
Size of debt	$80,347,312
Debt percent	53.47%

Cash Flow

	0	1	2	3	4	5	6	7	8	9	10	11	12
ENERGY													
Electricity to grid (kWh)	0	261,324,800	258,104,352	254,858,448	251,588,592	248,296,192	244,982,672	241,649,392	238,297,744	234,929,024	231,544,528	228,145,536	224,733,280
Electricity from grid (kWh)	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity to grid net (kWh)	0	261,324,800	258,104,352	254,858,448	251,588,592	248,296,192	244,982,672	241,649,392	238,297,744	234,929,024	231,544,528	228,145,536	224,733,280
REVENUE													
PPA price (cents/kWh)	0	8	8.08	8.1608	8.24241	8.32483	8.40808	8.49216	8.57708	8.66285	8.74948	8.83698	8.92535
PPA revenue ($)	0	20,905,984	20,854,832	20,798,488	20,736,958	20,670,240	20,598,340	20,521,256	20,438,994	20,351,558	20,258,946	20,161,168	20,058,226
Curtailment payment revenue ($)	0	0	0	0	0	0	0	0	0	0	0	0	0
Capacity payment revenue ($)	0	0	0	0	0	0	0	0	0	0	0	0	0
Salvage value ($)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total revenue ($)	0	20,905,984	20,854,832	20,798,488	20,736,958	20,670,240	20,598,340	20,521,256	20,438,994	20,351,558	20,258,946	20,161,168	20,058,226
Property tax net assessed value ($)	0	124,376,784	124,376,784	124,376,784	124,376,784	124,376,784	124,376,784	124,376,784	124,376,784	124,376,784	124,376,784	124,376,784	124,376,784
OPERATING EXPENSES													
O&M fixed expense ($)	0	0	0	0	0	0	0	0	0	0	0	0	0
O&M production-based expense ($)	0	0	0	0	0	0	0	0	0	0	0	0	0
O&M capacity-based expense ($)	0	5,742,381	5,885,941	6,033,090	6,183,916	6,338,514	6,496,978	6,659,402	6,825,887	6,996,534	7,171,448	7,350,734	7,534,502
Electricity purchase ($)	0	0	0	0	0	0	0	0	0	0	0	0	0

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Organizational Feasibility

Dynamic Systems and Digitalisation Cluster, ETCC lab

Organizational Feasibility

- How well the system ultimately will be accepted by its users and incorporated into the ongoing operations of the organization.

Ways to assess the organizational feasibility

- Strategic Alignment

  is the fit between the project and business strategy—the greater the alignment, the less risky the project will be, from an organizational feasibility perspective.

- Stakeholder analysis.

  a person, group, or organization that can affect (or can be affected by) a new system.

Important Stakeholders

	Role	To Enhance Organizational Feasibility
Champion	A champion: • Initiates the project • Promotes the project • Allocates his or her time to the project • Provides resources	• Make a presentation about the objectives of the project and the proposed benefits to those executives who will benefit directly from the system. • Create a prototype of the system to demonstrate its potential value.
Organizational Management	Organizational managers: • Know about the project • Budget enough money for the project • Encourage users to accept and use the system	• Make a presentation to management about the objectives of the project and the proposed benefits. • Market the benefits of the system, using memos and organizational newsletters. • Encourage the champion to talk about the project with his or her peers.
System Users	Users: • Make decisions that influence the project • Perform hands-on activities for the project • Ultimately determine whether the project is successful by using or not using the system	• Assign users official roles on the project team. • Assign users specific tasks to perform, with clear deadlines. • Ask for feedback from users regularly (e.g., at weekly meetings).

References

[1] Blank, Leland T., and Anthony J. Tarquin. “Basics of Engineering economy.“, McGraw-Hill*, (2008).*

[2] Mines, Gregory L. "GETEM user manual." *INL: Idaho Falls, ID, USA* (2016).

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Lecture 5,

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Economy and Finance for the Project

Budgeting Projects

- **A budget** must be developed in order to obtain the resources needed to accomplish the project's objectives.
- **A budget** is simply a plan for allocating organizational resources to the project activities.
- **A budget** acts as a tool for upper management to monitor and guide the project.

METHODS OF BUDGETING

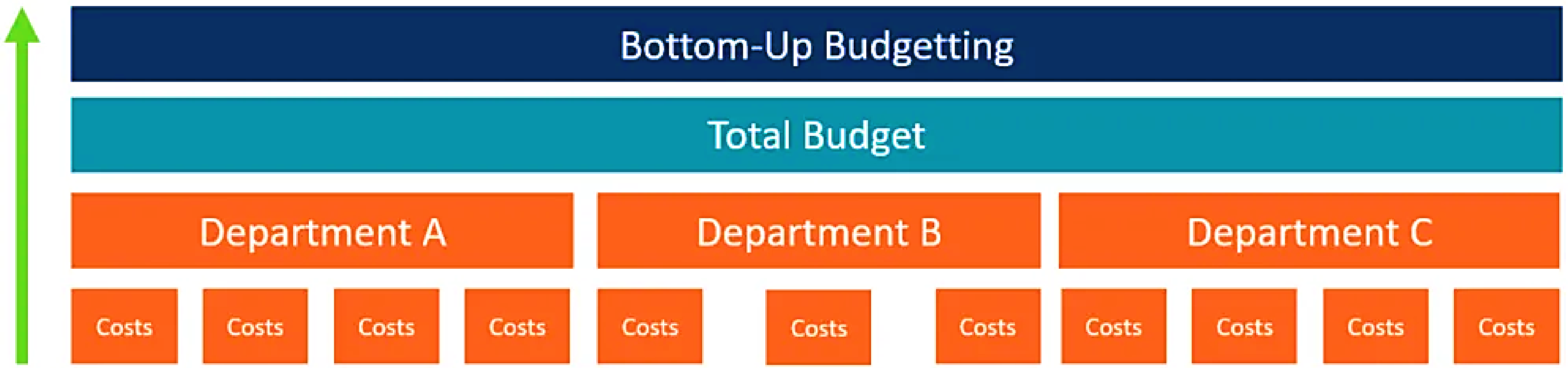
- **Budgeting** is simply the process of
    - forecasting what resources the project will require,
    - what quantities of each will be needed,
    - when they will be needed,
    - and how much they will cost.

METHODS OF BUDGETING

- Top-Down Budgeting

METHODS OF BUDGETING

- Bottom-Up Budgeting



COSTS ARE …

Direct Costs

- Human
- Machines
- Materials

Indirect costs

- Support functions
- Utilities
- Management
- Taxes

EXAMPLE 1

An entrepreneur named DK was considering the money-making potential of chartering a bus to take people from his hometown to an event in a larger city. DK planned to provide transportation, tickets to the event, and refreshments on the bus for his customers. He gathered data and categorized the predicted expenses as either fixed or variable.

DK's Fixed Costs		DK's Variable Costs	
Bus rental	$80	Event ticket	$12.50 per person
Gas expense	75	Refreshments	7.50 per person
Other fuels	20		
Bus driver	50		

Develop an expression of DK's total fixed and total variable costs for chartering this trip.

SOLUTION

- DK's fixed costs will be incurred regardless of how many people sign up for the trip (even if only one person signs up!). These costs include bus rental, gas and fuel expense, and the cost to hire a driver:

Total fixed costs = 80 + 75 + 20 + 50 = $225

- DK's variable costs depend on how many people sign up for the charter, which is the level of activity. Thus, for event tickets and refreshments, we would write

Total variable costs=12.5+7.5=$20 per person

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Costs Flow calculation

- Fix the payment periodicity.
- Group the use of resources by periods.

Resource\Month	1	2	3	4	5	6	7	8	9
Analyst									- - -
Designer									- - -
Programmer									- - -
Consultant									- - -
Tester									- - -

Payment Flow

Income Flow calculation

- Accumulate the total received incomes.

Resources/Month	1	2	3	4	5	6	7	8	9
Client	I_{11}	I_{12}	I_{13}	I_{14}	I_{15}	I_{16}	I_{17}	I_{18}	…
Subvention	I_{21}	I_{22}	I_{23}	I_{24}	I_{25}	I_{26}	I_{27}	I_{28}	…
Commisions	I_{31}	I_{32}	I_{33}	I_{34}	I_{35}	I_{36}	I_{37}	I_{38}	…
…	I_{41}	I_{42}	I_{43}	I_{44}	I_{45}	I_{46}	I_{47}	I_{48}	…
Income flow	$\sum I_{i1}$	$\sum I_{i2}$	$\sum I_{i3}$	$\sum I_{i4}$	$\sum I_{i5}$	$\sum I_{i6}$	$\sum I_{i7}$	$\sum I_{i8}$	…

Cash-Flow calculation

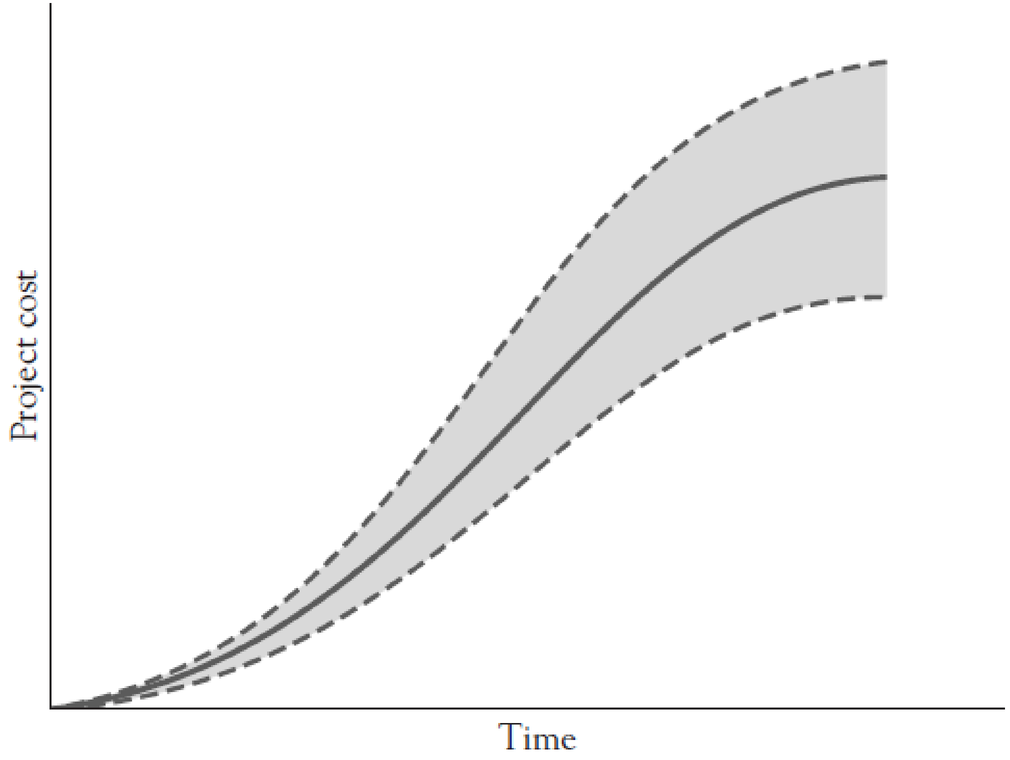
- Subtracting the payment flow to the income flow.

Cash Flow Statement Company XYZ
FY Ended 31 Dec 2017
All Figures in USD

Cash Flow From Operations		
Net Earnings		2,000,000
Additions to Cash		
Depreciations		10,000
Decrease in Accounts Receivable		15,000
Increase in Accounts Payable		15,000
Increase in Taxes Payable		2,000
Subtractions From Cash		
Increase in Inventory		(30,000)
Net Cash From Operations		2,012,000
Cash Flow From Investing		
Equipment		(500,000)
Cash Flow From Financing		
Notes Payable		10,000
Cash Flow for FY Ended 21 Dec 2017		1,522,000

Budget Uncertainty

The PM sees the uncertainty of the budget like the shaded portion of Figure, where the actual project costs may be either higher or lower than the estimates the PM has derived. However, it seems that more things can go wrong in a project and drive up the cost than can go right to keep down the cost.



Budget Uncertainty

- Reasons for cost uncertainty:
  - Prices may escalate,
  - Different resources may be required,
  - The project may take a different amount of time than we expected,

Changes in Budget

- Main Causes:
  - due to errors the cost estimator made about how to achieve the tasks identified in the project plan.
  - the project team or client learns more about the nature of the scope of the project or the setting in which it is to be used.
  - A new law is passed.

Handling Changes

- Accept a negative change? Take a loss?

OR

- Prepare for change ahead of time by including provisions in the original contract for such changes?

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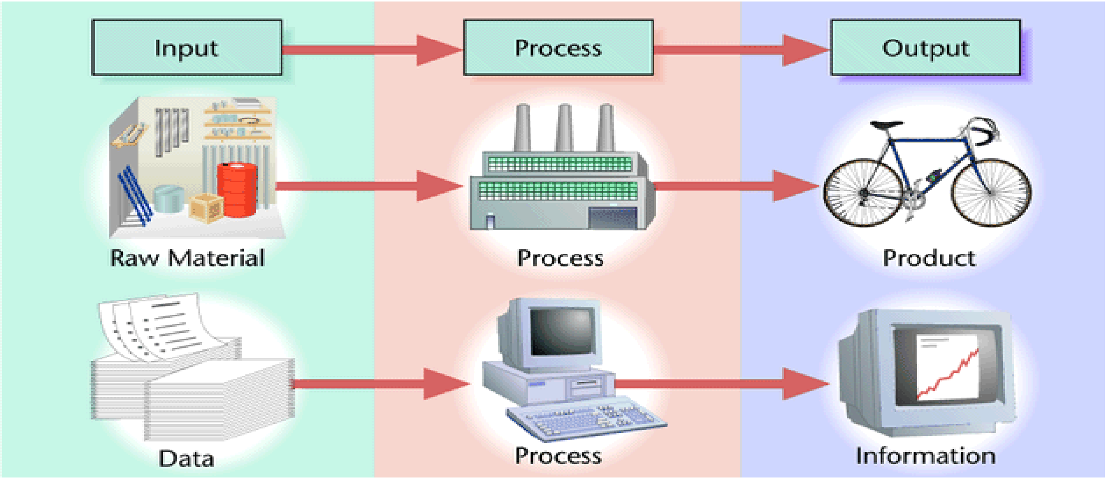
Information management& project quality

Data, Information, and Systems

Data vs. Information

Data
- A "given," or fact; a number, a statement, or a picture
- Represents something in the real world.
- The raw materials in the production of information

Information
- Data that have meaning within a context
- Data in relationships
- Data after manipulation



Information management (IM)

Definitions

Is the collection and management of information from one or more sources and the distribution of that information to one or more audiences. This sometimes involves those who have a stake in or a right to that information.

Management means the organization of and control over the structure, processing, and delivery of information.

Quality for the project

Quality management applies to :

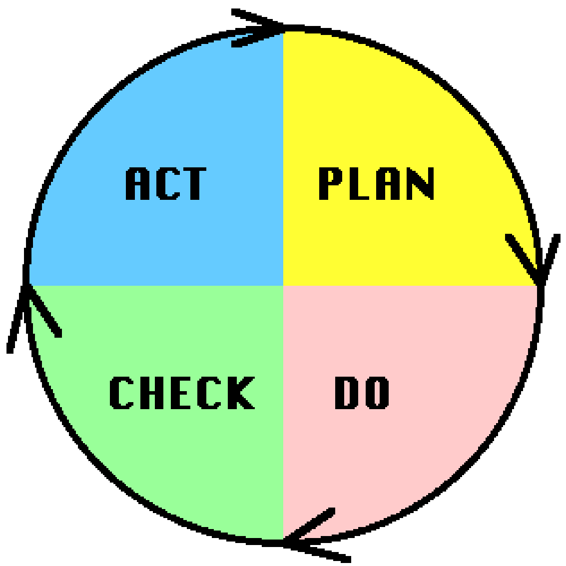
project activities and project results (deliverables, components) to fulfil quality objectives.

PLAN Design or revise business process components to improve results

DO Implement the plan and measure its performance

CHECK Assess the measurements and report the results to decision makers

ACT Decide on changes needed to improve the process



Quality for the project

Quality Planning.

- Identifying which quality standards are relevant to the project, and determining how to satisfy them.

Quality Assurance (QA).

- The process of evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards.

Quality Control (QC).

- The process of monitoring specific project results to determine if they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory performance.

Managing the changes

Where do changes come from?

There are three categories of changes that can occur:

1. Changes that are necessary in order to meet the objectives of the project.

2. Changes that were not part of the original scope, but are approved along with the associated approved change in **schedule** and **budget**

Typically, these changes are in response to:

1. A change in the market
2. Additional knowledge forcing a modification in scope
3. A new technology or product that may not have been available earlier in the project life cycle, but would significantly improve the probability of project success

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Managing the changes

Change Control

- Change control is a methodology used to manage any change requests that impact the baseline of your project.

- It’s a way to capture that change from the point where it’s been identified through every step of the project cycle.

- That includes evaluating the request and then approving, rejecting or deferring it.

Managing the changes

How do I prioritize them?

The selection and prioritization of changes comes from the work performed by the CCB (change review board).

Changes should be quantified, analyzed and prioritized using some form of a ranking system.

Having a pre-defined ranking system will facilitate decision-making by making the decision an objective choice, eliminating emotional reactions.

Keeping decisions as objective as possible will minimize unnecessary work affecting the overall success of the project.

Managing the changes

How to Manage Changes On Projects

1. Accept That Change Happens.
2. The Change Management Process.
3. Receive Request/Demand for Change in Process on Project.
4. Carry Out Change Assessment.
5. Prepare and Present Recommendations.
6. The Decision.
7. Change Management Tools.
8. Developing a Project Change Request Form

The success through the team: building the team.

What do you mean by team building?

Team building is the process of turning a group of individual contributing employees into a cohesive team—a group of people organized to work together to meet the needs of their customers by accomplishing their purpose and goals

What makes team building successful?

For a team to be truly effective, its members must **unite with the same vision** and be **motivated to bring that vision to life.** They must share clear, measurable goals, and be committed to each play their part in the overall success of the group.

The success through the team: building the team.

Leader of the successful team

A successful team is usually led by an individual who is **trusted and respected by its members.** Such leaders unify members toward the same direction by providing focus and guidance. They also offer encouragement and motivation to keep the team morale high, even in the midst of challenges.

How can leaders can help their teams?

1. Open honest communication.
2. Create collaborative goals.
3. Celebrate their success.
4. Allow team members to problem solve.
5. Provide adequate resources and training.
6. Keep your eye on the big picture.
7. Show some empathy.

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Lecture 6, Information management, project quality

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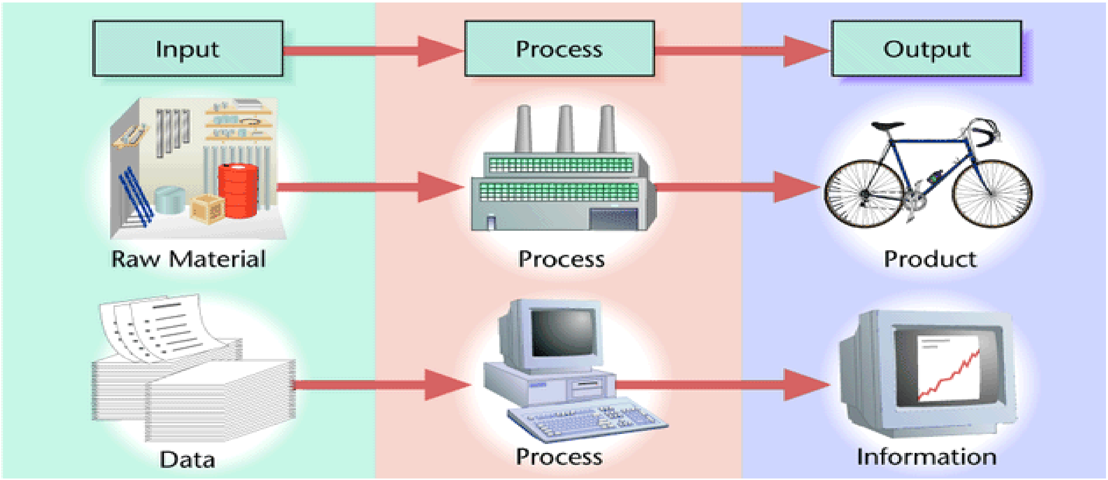

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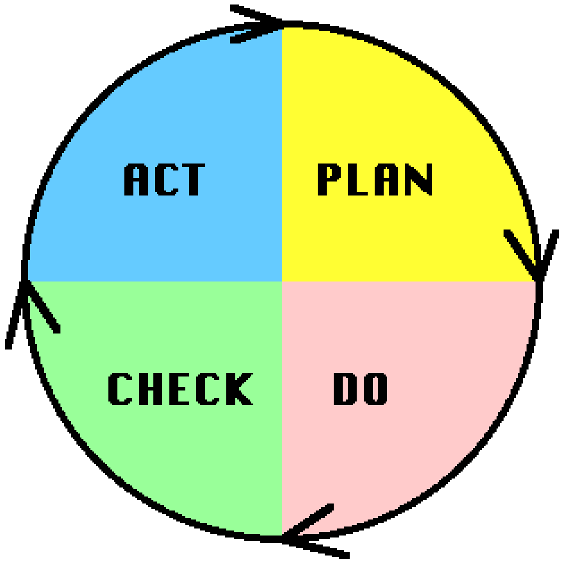

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Lecture 7, The supply chain & Managing Conflict.

Supply Chain

Supply-chain management is the integration of the activities that procure materials and services, transform them into intermediate goods and the final product, and deliver them to customers

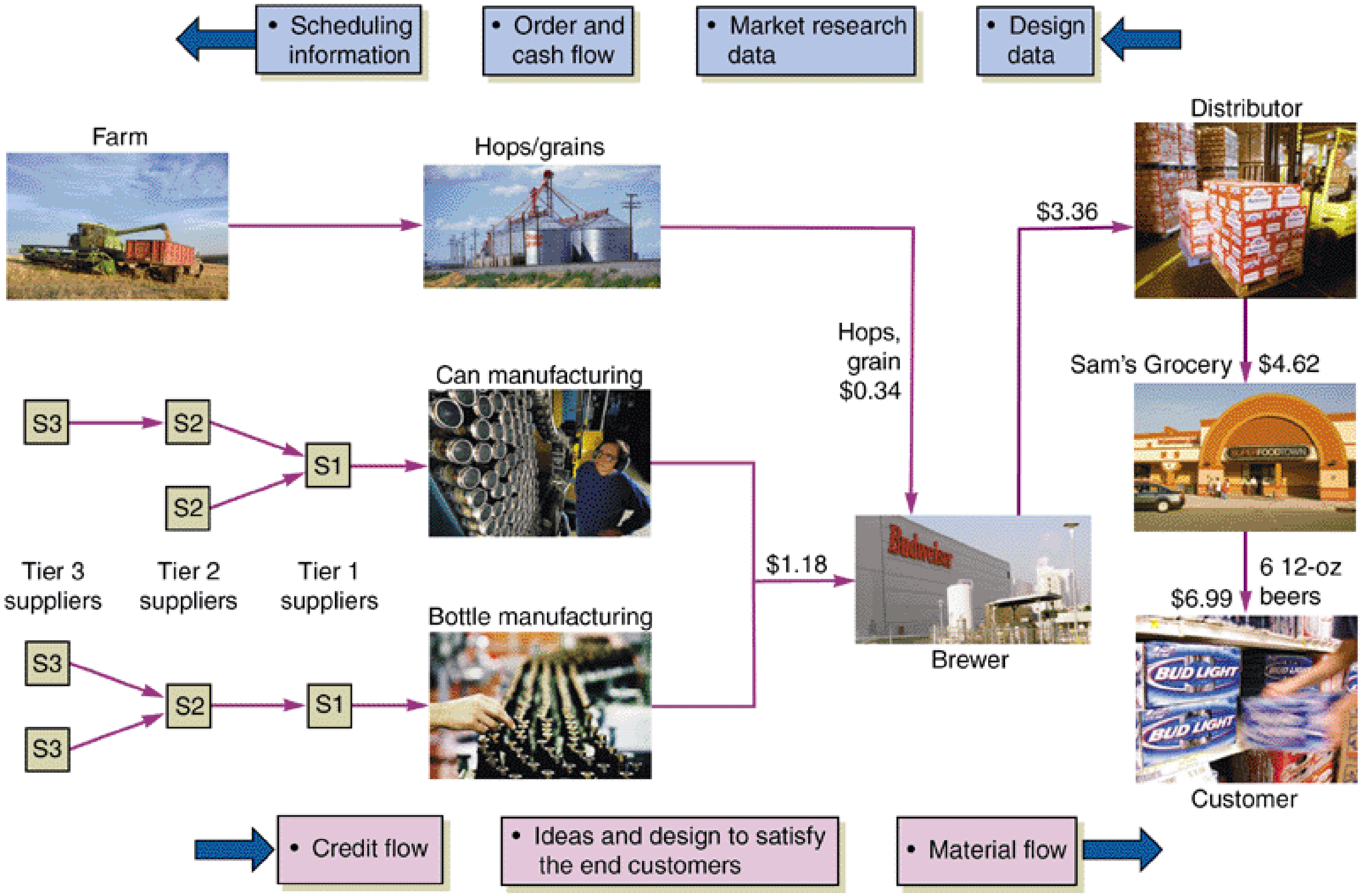
SCM vs Traditional Purchasing

- Traditional purchasing focuses on initial cost; SCM focuses on total cost of ownership

- Traditional purchasing tries to negotiate the price that is best for the purchaser; SCM focuses on negotiating a price that is best for the entire supply chain.

Example

Supply chain management



Supply Chain Focus

Traditional purchasing focuses on the flow of goods and information from the immediate supplier and immediate customer; SCM focuses on the flow of goods and information from initial supplier to ultimate customer.

Ethics in the Supply Chain

- Avoid the intent and appearance of unethical or compromising practice in relationships, actions, and communications
- Demonstrate loyalty to the employer by diligently following the lawful instructions of the employer, using reasonable care and granted authority
- Avoid any personal business or professional activity that would create a conflict between personal interests and the interests of the employer

Ethics in the Supply Chain

- Avoid soliciting or accepting money, loans, credits, or preferential discounts, and the acceptance of gifts, entertainment, favors, or services from present or potential suppliers that might influence, or appear to influence, supply management decisions
- Handle confidential or proprietary information with due care and proper consideration of ethical and legal ramifications and government regulations
- Promote positive supplier relationships through courtesy and impartiality
- Avoid improper reciprocal agreements

Ethics in the Supply Chain

- Know and obey the letter and spirit of laws applicable to supply management
- Encourage support for small, disadvantaged, and minority-owned businesses
- Acquire and maintain professional competence
- Conduct supply management activities in accordance with national and international laws, customs, and practices, your organization’s policies, and these ethical principles and standards of conduct
- Enhance the stature of the supply management profession

Managing the Supply Chain

- ☑ Mutual agreement on goals
- ☑ Trust
- ☑ Compatible organizational cultures

Conflict!

What is Conflict?

"Conflict is a relationship between two or more parties (individuals or groups) who have, or think they have, incompatible goals and who act on the basis of those perceived incompatibilities",

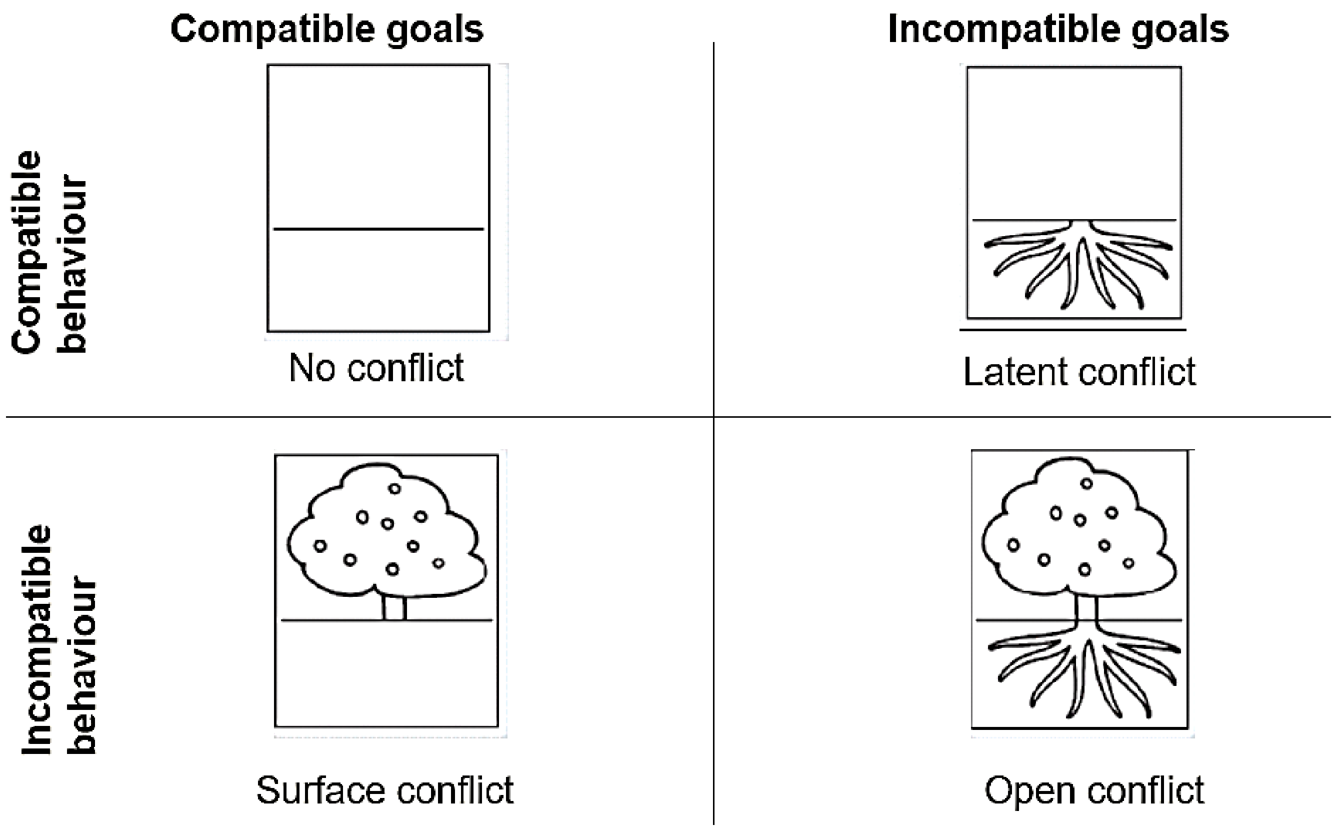
Schneider et al, 2016

What is Conflict?

- Conflict is not the same as violence – conflict is not always violent, or even immediately obvious

- Conflict often accompanies change; of course, this means it occurs around conservation interventions, especially where resource access or availability is impacted

Types of conflict



Causes of Conflict

- Poor communication – breeds mistrust
- Corruption and discrimination
- Inequitable distribution of costs and benefits of conservation
- Inadequate support (e.g. in dealing with human-wildlife conflict)
- Lack of monitoring of and reporting on activities
- Lack of presence on the ground

Identifying the source of conflict

What kind of conflict is it?

- Open?
- Latent?
- Surface?

What is the problem?

- Sources and triggers?
- Direct and underlying causes?

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Conflict Management

- It is based on the participation of the people who are involved in the conflict – the stakeholders. You need to know who *all* the stakeholders are in order to analyze and manage the conflict effectively

- **P.S.** Remember to look out for and involve weaker, less visible or marginalized stakeholders

Conflict Analysis Tools

Tool	Use to...
Impacts Matrix	Select priority conflict
Feasibility Matrix	Select priority conflict
Conflict Tree	Identify causes and effects of conflict
Conflict Mapping	Identify key conflict actors and the relationships between them
PINs Analysis Table	Reveal actors' interest and needs driving conflict

Impacts Matrix

Conservation Impacts	Human Impacts: High	Human Impacts: Medium	Human Impacts: Low	Human Impacts: None
High	Illegal resource extraction by armed groups in the park		Encroachment into the park for agriculture	
Medium		Village grievances over absence of revenue-sharing		
Low				
None				

High priority conflict: Carry through for further analysis

Medium priority conflict: Carry through for further analysis if extra resources are available

Low priority conflict: Consider for further analysis in future – no immediate need

Feasibility Matrix

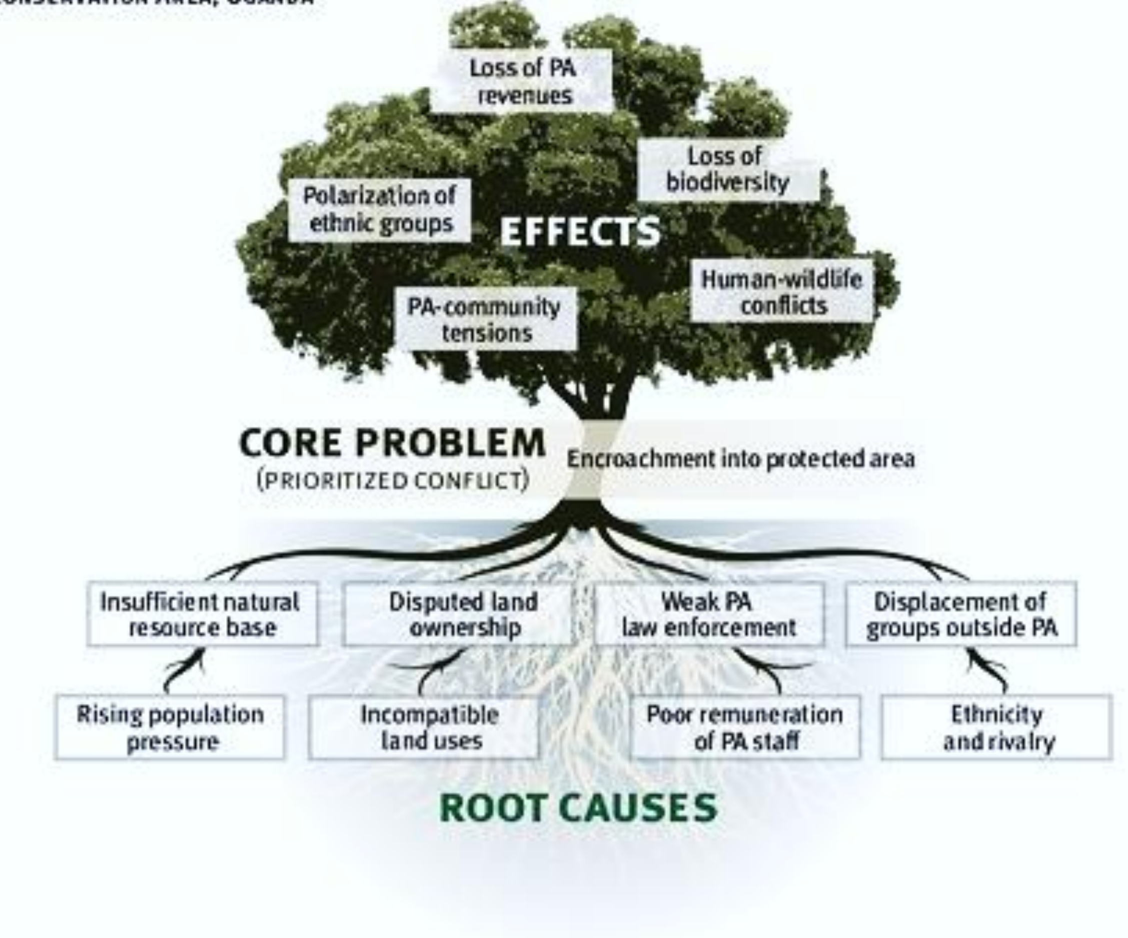
Summary of prioritized conflicts, potential impact and feasibility

Prioritized conflict	Impacts	Feasibility	Notes
Encroachment into the park for agriculture	Medium	High	Low risk to staff, within mandate, building on existing partnerships
Illegal resource extraction by armed groups in the park	High	Low	High risk to staff, requires too many resources, need more strategic partnerships (e.g. military, police)

Conflict Tree

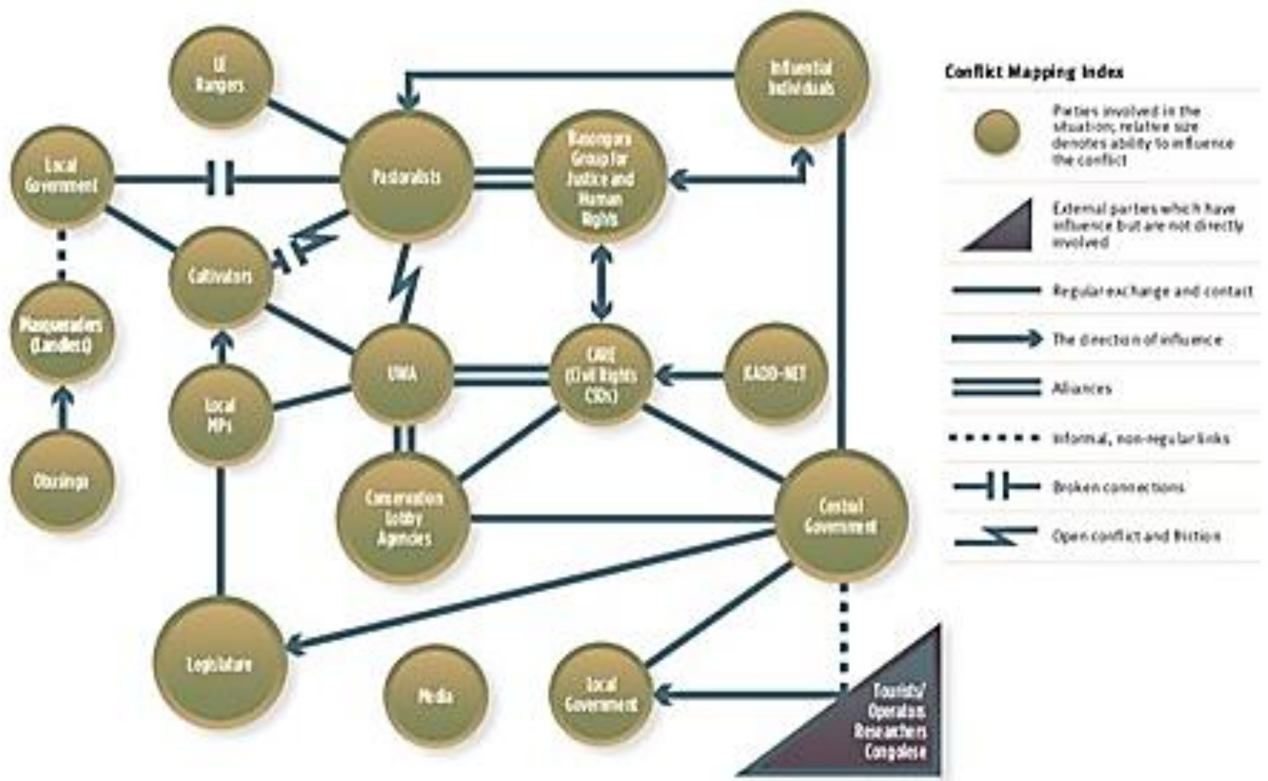
- Simple and effective way to separate out and visualise the causes and effects of the prioritised conflict

Figure 4: Simplified conflict tree for encroachment in Queen Elizabeth Conservation Area, Uganda

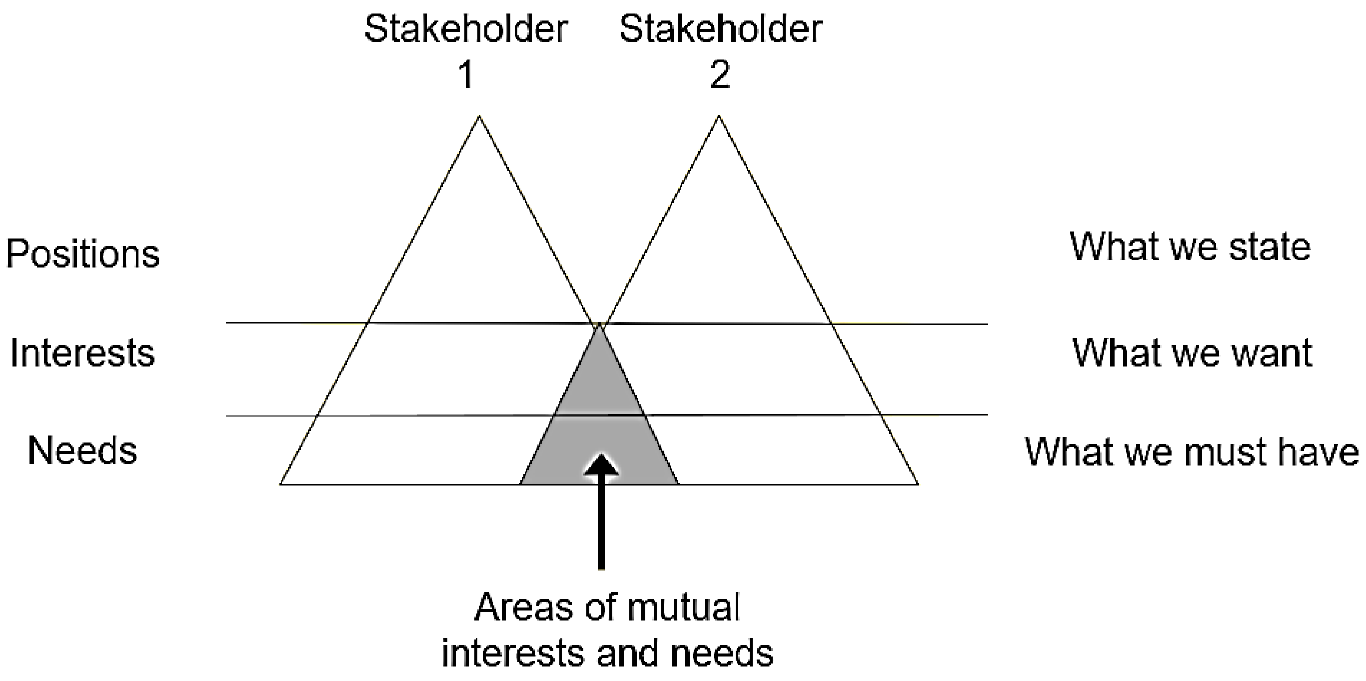


Conflict map

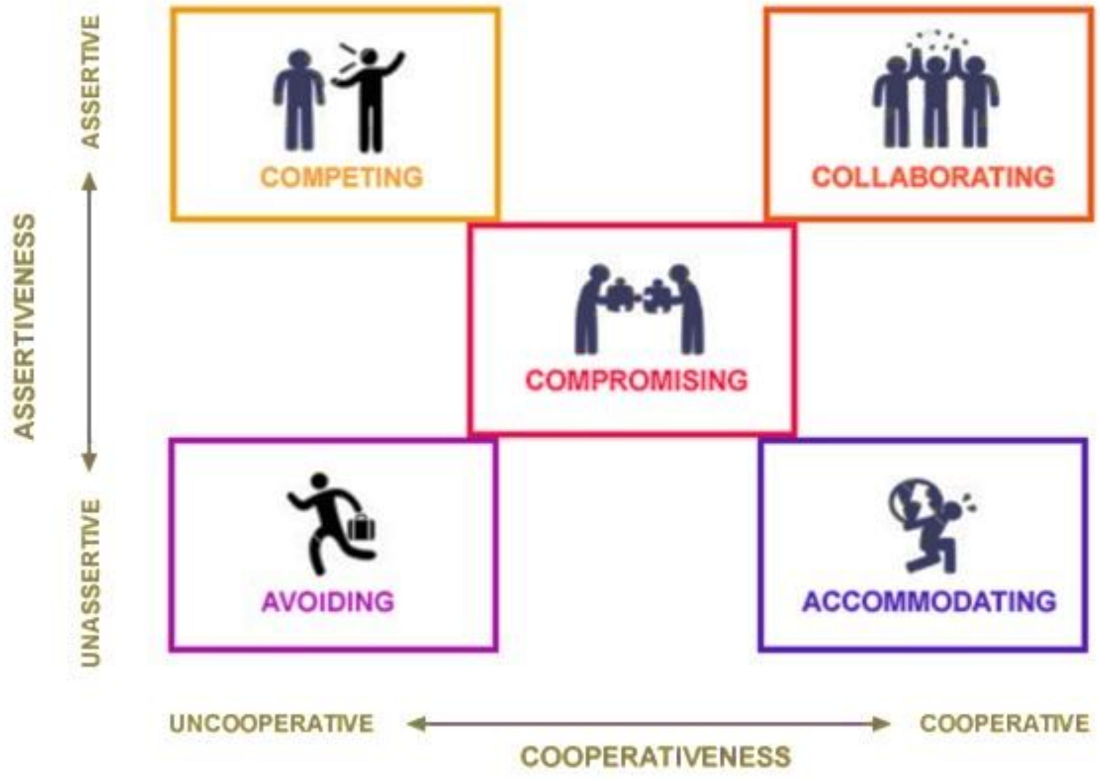
- Use a conflict map to visualise actor relations *after* you have identified your priority conflict and key stakeholders
- Include all key stakeholders as identified at the beginning
- Different lines show different kinds of relationships and directions of influence



Actor motivations: Positions, Interests, Needs (PINs)



Conflict management strategies



Checklist of basic steps

1. **Conflict analysis**
   - Problem and causes or sources of conflict
   - Stakeholder identification
   - Identification and understanding, PINS
2. **Identify solutions**; engage stakeholders, sensitization, awareness
   - Identify solutions both disputants can support
3. **Agreement**
4. **Execute agreement**

Identify solutions

- **Consultation** – decision-makers meet with interested stakeholder representatives to receive views on an issue
- **Dialogue** – stakeholders are supported in direct communication with each other to achieve better understanding of each others’ respective perspectives
- **Negotiation** – two or more parties have a structured dialogue about a conflict, to identify possible options for resolution together
- **Mediation** – Like negotiations, but with a dedicated third party acting as a mediator to help parties clarify the problem and identify potential resolutions

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Identify solutions

When identifying solutions remember these strategic considerations

1) Motivation

- Benefits/incentives
  1. Reduced costs
  2. Improved livelihoods
  3. Removal of negative impact
  4. New opportunities

2) Interests and needs (think about tools for conflict analysis)

Execute agreement

The agreement is where parties involved in the conflict will formalize their commitments to resolving the conflict

- The mediator should aim for parties to shake hands and agree to an alternative
- The mediator then writes up a contract in which necessary actions and agreed time frames are specified for the conflicting parties
- The contract could take the form of e.g. a set of resource use agreements, or water user committee rules

Execute agreement

Resources needed:

- Financial
- Human
- Logistics
- Knowledge of local context
- Interpersonal and communication skills

Monitoring

You should monitor any conflict management measures taken

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Monitoring

Impacts Matrix: High-, medium- and low-priority conflicts

Conservation Impacts \ Human Impacts	High	Medium	Low	None
High	Illegal resource extraction by armed groups in the park		Encroachment into the park for agriculture	
Medium		Village grievances over absence of revenue-sharing		
Low				
None				

High priority conflict: Carry through for further analysis

Medium priority conflict: Carry through for further analysis if extra resources are available

Low priority conflict: Consider for further analysis in future – no immediate need *"a good conflict resolution process is one in which stakeholders...have the opportunity to really understand each other's needs, develop a range of alternatives for how to address those needs, and reach a mutually agreeable solution. The emphasis is on communication" (Lewis 1996)*

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Project management, techno economic analysis and finances

Lecture 8, Basics of Risk Management

What is Risk?

"the possibility of loss or injury"

- involves understanding potential problems that might occur on the project and how they might impede project success.
- Risk management is like a form of insurance; it is an investment.

Stages of Risk Management

- Risk Identification
- Risk Analysis
- Response To Risk

Risk Identification

- Risk identification is the process of understanding what potential unsatisfactory outcomes are associated with a particular project

- Several risk identification tools include checklists, flowcharts, and interviews

Risk Analysis

- Risk analysis is the process of evaluating risks to assess the range of possible project outcomes
- Determine the risk's probability of occurrence and its impact on the project if the risk does occur
- Risk Analysis techniques include expected monetary value analysis, calculation of risk factors, PERT (Program Evaluation and Review Technique) estimations, simulations, and expert judgment

Response to Risk

- Risk avoidance: eliminating a specific threat or risk, usually by eliminating its causes
- Risk acceptance: accepting the consequences should a risk occur
- Risk mitigation: reducing the impact of a risk event by reducing the probability of its occurrence

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Co-funded by the Erasmus+ Programme of the European Union

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Steps of Risk Management

1. **Risk Management Planning**

    Developing a plan for risk management activities.

2. **Risk Identification**

    Finding those risks that might affect the project.

3. **Qualitative Risk Analysis**

    Evaluating the seriousness of the risk and the likelihood it will affect the project.

Stages of Risk Management

4. Quantitative Risk Analysis

Developing measures for the probability of the risk and its impact on the project.

5. Risk Response Planning

Finding ways of reducing negative impacts on the project as well as enhancing positive impacts.

6. Risk Monitoring and Control

Maintaining records of and evaluating the subprocesses above in order to improve risk management.

Potential Risk Areas

Knowledge Area	Risk Conditions
Integration	Inadequate planning; poor resource allocation; poor integration management; lack of post-project review
Scope	Poor definition of scope or work packages; incomplete definition of quality requirements; inadequate scope control
Time	Errors in estimating time or resource availability; poor allocation and management of float; early release of competitive products
Cost	Estimating errors; inadequate productivity, cost, change, or contingency control; poor maintenance, security, purchasing, etc.
Quality	Poor attitude toward quality; substandard design/materials/workmanship; inadequate quality assurance program
Human Resources	Poor conflict management; poor project organization and definition of responsibilities; absence of leadership

Risk types

- **Market risk:** Will the new product be useful to the organization or marketable to others? Will users accept and use the product or service?
- **Financial risk:** Can the organization afford to undertake the project? Is this project the best way to use the company's financial resources?
- **Technology risk:** Is the project technically feasible? Could the technology be obsolete before a useful product can be produced?

Risk Mitigation Strategies

Technical Risks	Cost Risks	Schedule Risks
Emphasize team support and avoid stand alone project structure	Increase the frequency of project monitoring	Increase the frequency of project monitoring
Increase project manager authority	Use WBS and PERT/CPM	Use WBS and PERT/CPM
Improve problem handling and communication	Improve communication, project goals understanding and team support	Select the most experienced project manager
Increase the frequency of project monitoring	Increase project manager authority	
Use WBS and PERT/CPM		

Good project risk management

- Unlike crisis management, good project risk management often goes unnoticed
- Well-run projects appear to be almost effortless, but a lot of work goes into running a project well
- Project managers should strive to make their jobs look easy to reflect the results of well-run projects

DEFINIG GEOTHERMAL PROJECT RISKS

1. TECHNICAL AND TECHNOLOGICAL RISKS
Impossibility of technological realization of a certain variant
Change of rate of production
Change of isothermal time of production
2. ECONOMIC RISKS
Changes in energy prices
Increase of concession fees
Changes of CAPEX
Changes of OPEX
3. ECOLOGICAL RISKS
Accident situations (discharge of produced geothermal water into the environment)
Risk of environmental accident
Risks after the exploitation
4. INSTITUTIONAL RISKS
Long process of obtaining concession approvals
Changes in partner interest in the project

RISK MATRIX

POSSIBILITY	IMPACT				
	1- not relevant	2-small impact	3-moderate impact	4-critical impact	5-catastrophic impact
Very unlikely (0-10% possiblity)	Low	Low	Low	Low	Moderate
Unlikely (10-33% possiblity)	Low	Low	Moderate	Moderate	High
Not unlikely/not likely (33-66% possiblity)	Low	Moderate	Moderate	High	High
Likely (66-90% possiblity)	Low	Moderate	High	Very high	Very high
Very likely (90-100% possiblity)	Moderate	High	Very high	Very high	Very high

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	RISK	P	I	P×I	DESCRIPTION AND MITIGATION MEASURES
1. Technological risks	Impossibility of technological realization of a certain variant	50%	4	high	The impossibility of technological realization of variant is possible, but it is possible to anticipate it in the preparatory phase of the project and therefore direct the project to another least economically sensitive variant of the selected technological solution.
	Change of rate of production	90%	5	very high	The risk of changes in energy production is possible and very high, and the consequences of this risk could have a significant impact on the project implementation and the results of the project itself. This risk can be reduced by preliminary workover and well testing of.
	Change in isothermal production time	90%	1	low	The change in isothermal production time may also be possible since the behavior of aquifers is not defined, but the calculated isothermal production time is extremely long in the selected technological variant (over 490 years) so it is expected that this will be more than enough for the project under consideration of 25 years.

2. Economic risks	Change of investment as well as change in annual operating costs	90%	5	very high	A change of an investment, as well as a change of annual operating costs, is very likely to occur. It is impossible to estimate all the financial inputs that should affect investment and operating costs without knowing the capacity of the reservoir, the technological solution that will be applied and the design of the power plant. On the other hand, the investor, in cooperation with the local community as a user for public use, can apply as an entity qualified to apply for various projects within the state and the EU to withdraw funds for increasing the share of renewable energy sources. Some investment costs related to the workover of the existing well and the construction and completion of new wells for geothermal energy will be more accurately estimated after the initial testing of the reservoir. It will also be possible to estimate the operating costs after selecting the exact technological solution for the construction of a geothermal power plant, although they will still be extremely sensitive to changes in energy prices and project revenues.

3.	Environmental risks	Risk of accidents and environmental accidents	30%	2	low	In the case of an accident (discharge of produced geothermal water into the environment), there will be heat exchange with the external atmosphere and the release of gases present in geothermal water. In this case, it is necessary to carry out technical interventions and remediate the problem and prevent water leakage into the environment. However, adverse environmental impacts need to be analyzed taking into account water composition and quality. It is necessary to analyze the penetration of water into the soil and/or surface due to corrosion of transport pipelines, taking into account the mineral composition to define the level of risk, ie whether water poses a danger to any component of the environment. Given that certain amounts of gas are dissolved in the water, it is necessary to analyze whether the gas in geothermal water can be the cause of an environmental accident in the event of uncontrolled leakage of geothermal water. As in the case of geothermal production, it is the production of non-combustible fluid, so for wells no fire and explosion hazard zones are determined, while it is common practice to prescribe fire and explosion hazard zones for gas and oil wells. In the geothermal production and use substances that could be the cause of fire or explosion will not be used. As accidents are rare and have not been recorded so far in recent years of geothermal water exploitation in existing locations in Croatia, it is not expected that increasing geothermal production could significantly disrupt the state of environmental components in the observed area. With regular control and maintenance of the system of exploitation and injection of geothermal water, there is no risk of environmental accidents.

	RISK	P	I	P×I	DESCRIPTION AND MITIGATION MEASURES
3. Environmental risks	Risk of pollution after the project	10%	2	low	After the end of the geothermal project, there is no danger of harmful impact on the environment. Wells must be completed or decommissioned to ensure the tightness of the system. After the end of the project, surface facilities will be removed. Noise and dust may increase during these operations. These impacts will be limited in time and space and without a lasting impact on the environment. The well-decommissioning procedure will be carried out according to the standard procedures. For the sites to be restored to their original condition, the wells must be decommissioned safely, ie cement barriers must be installed to separate the layers at appropriate depths, the well must be dismantled, protective pipes cut at least 1.5 meters below the surface and welded and covered. After that, it is necessary to bring the soil to its original condition by agro-technical measures.

	RISK	P	I	P×I	DESCRIPTION AND MITIGATION MEASURES
4. Institutional risks	Documentation risks	90%	4	very high	The long process of obtaining approval for the exploitation of geothermal potential is a real risk if we take into account the complex situation regarding the ownership of infrastructure and legislation on obtaining the right to use geothermal aquifers. Due to the complexity of obtaining legal documents related to the exploitation of geothermal water, which otherwise requires lengthy procedures to obtain all necessary documentation (exploitation decision, mining projects, EIA, location and construction and use permit for wells and facilities), there may be a risk of extending the duration of the project. This needs to be minimized through clear project management. The risk of such impacts on project implementation should be minimized by defining the ways and forms of cooperation and by defining the goals of individual participants in the project as well as defining mandatory steps and consequences of not taking them by investors in the project.
	Change in energy prices and subsidies	90%	4	very high	A change in the subsidized price has a very high impact and probability. It is important to note that the law on renewable energy sources, as well all other regulations must regulate the incentive price for electricity production from geothermal power plants. This risk can be eliminated, but it needs to be taken into account.