

# Research Methodology

## Chapter 6

### Report Writing

**Wondwossen Bogale (PhD)**

**Assistant Professor, Addis Ababa Institute of Technology, AAU**

**wondwossenboge@gmail.com**

# 6. REPORT WRITING

## What is Report writing ?

- A report is a *clearly structured document* in which the researcher identifies and examines issues, events, or findings of a research.
- As a matter of fact even the *most brilliant hypothesis, highly well designed and conducted research study*, and *the most striking generalizations and findings* are of little value *unless they are effectively communicated to others*.
- Writing of report is the last step in your research study.
- It requires *a separate set of skills* to write reports.
- *May seek the assistance and guidance of experts* for the purpose.
- Written reports give scope for future references

## 6. REPORT WRITING

1. It is essential *to share the results of our findings*. Research costs money and those who supply the money must get something of value in return.
2. *It is through research that the totality of the human body of knowledge increases.*
3. Human knowledge belongs to all humanity, *it must be shared and made available publicly.*
4. Knowledge is the only commodity in the world that actually increases in value and extent only when shared. *The researcher's duty is to increase knowledge.*
5. *We must share our experiences* with our colleagues to assist them in their quests.

# 6. REPORT WRITING

6. We must expose our work to critique by those who can evaluate our work in terms of *value*, *interest* and *accuracy*.

7. We must publish so that *we can give credit to those whose work has been instrumental* in us arriving at our findings.

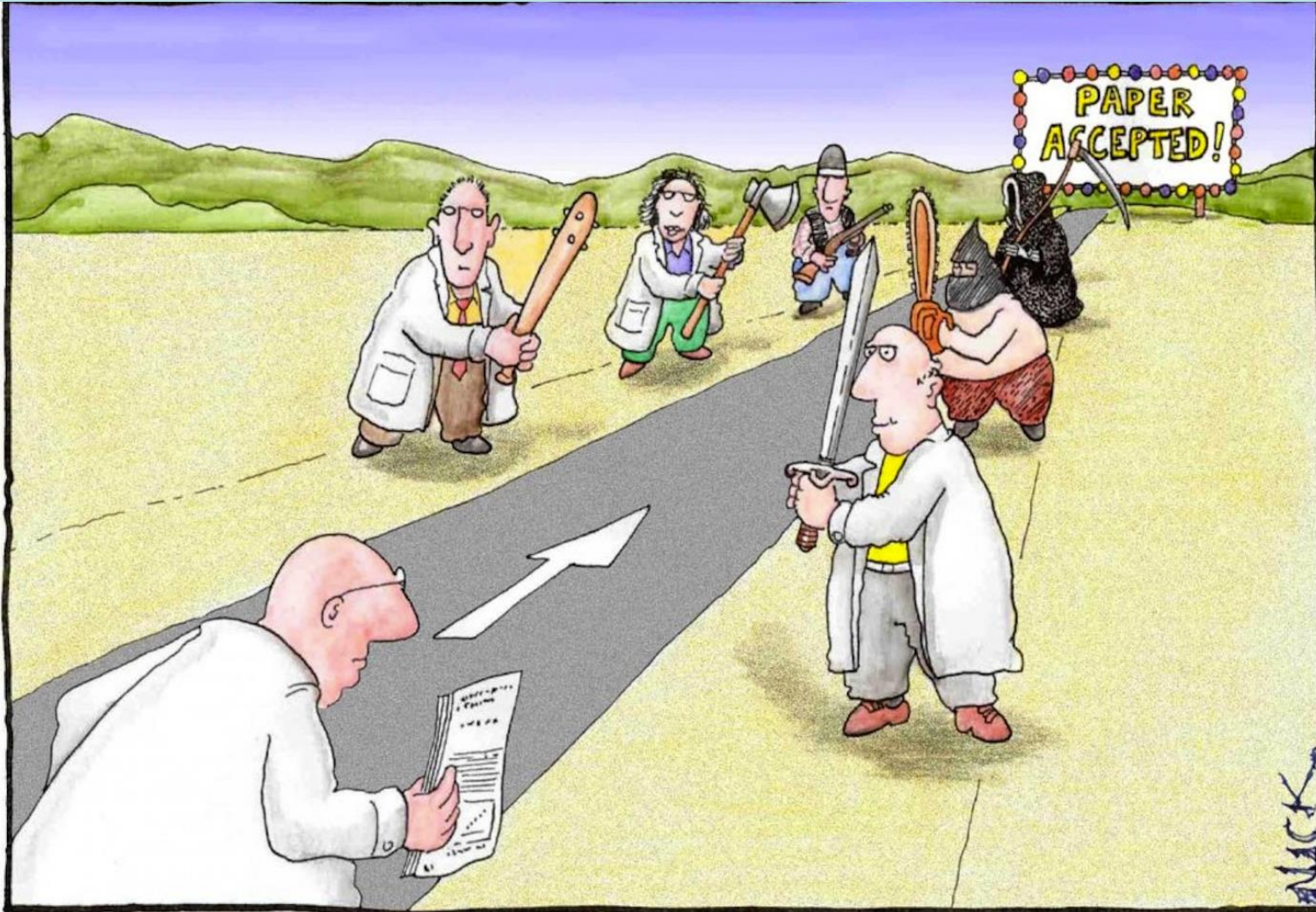
8. We must publish so as researchers' professional value can only be evaluated in terms of *their output*.

Types of research Articles :

Research results may be published in many ways. These are some of the more traditional ones:

1. *A journal article*
2. *A conference paper*
3. *An article in a trade or scholarly periodical*
4. *A thesis*
5. *A research report*

## 6. REPORT WRITING



## 6. REPORT WRITING

*IT IS USUALLY A LOT EASIER TO  
WRITE THESIS OR RESEARCH REPORTS  
THAN TO WRITE JOURNAL OR  
CONFERENCE PAPERS*

## 6. REPORT WRITING

1. ***Begin writing up the report as soon as you can.*** Do not leave it until you have finished your thesis.
2. ***Write down ideas as soon as you get them,*** rather than leaving them to the writing-up stage. Keep a research diary where you can safely note any ideas. Do not imagine that you will be able to remember these ideas at a later date.
3. ***Be aware of the nature of the report and the intended audience.***
4. If you are writing for a journal, ensure that your research ***fits within the scope of that journal's objectives*** as well as its editorial requirements.
5. You will not be able to write the final report out first time. You will need to ***rewrite*** it a number of times before it reaches completion.

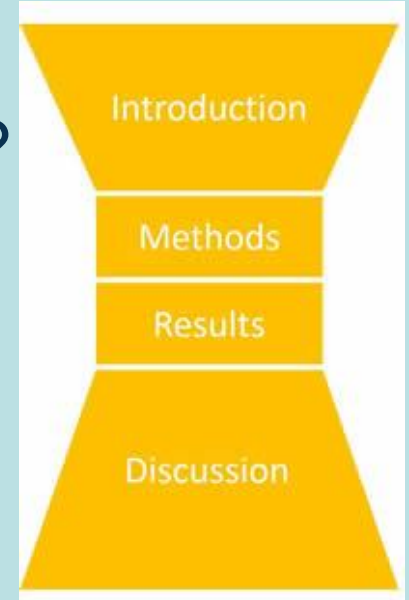
# SIGNIFICANCE OF REPORT WRITING

- Research report is considered a major component of the research study for the research task remains incomplete till the report has been presented and/or written.
- The purpose of research is not well served unless the findings are made known to others.
- The task of report writing must be accomplished by the researcher with utmost care and he may seek the assistance and guidance of the experts.

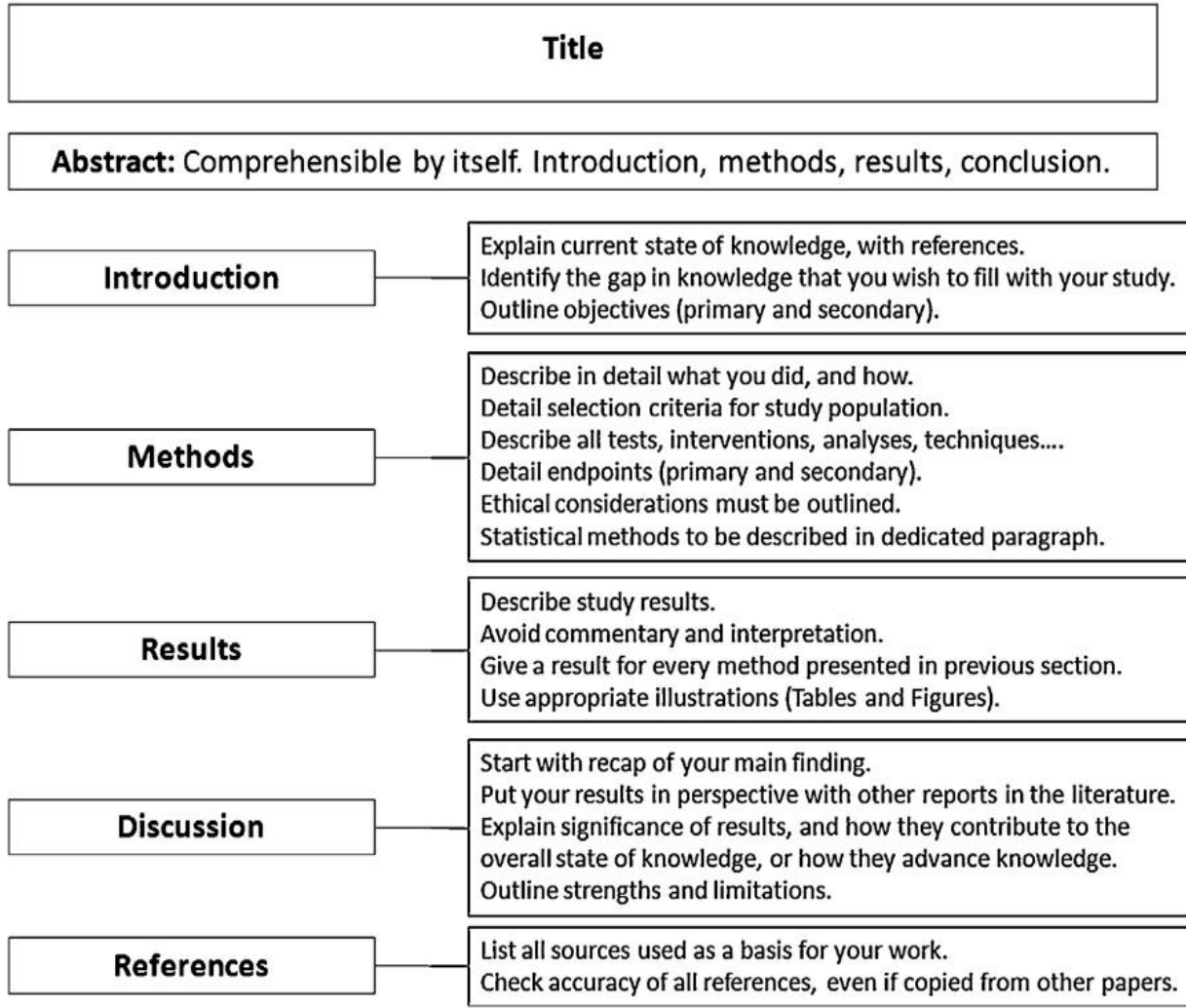


# THE IMRAD FORMAT

- IMRAD is an acronym that stands for the common sections of a scientific research or lab report : Introduction, Method and Result Discussion
- Introduction : What was the question ?
- Methods : How did you try to answer it ?
- Results : What did you find?
- Discussion : What does it mean?



# THE IMRAD FORMAT



# THE IMRAD FORMAT

Main points to keep in mind when writing the abstract.

Item	Notes
Background	A brief reminder of the context, and a brief statement of the main objective. Should be short and to the point. Two to three sentences are generally sufficient
Methods	Identify the gap in knowledge that you hope to fill <i>The main methods should be outlined:</i> The main inclusion criteria to define the population Define the study groups, if any Describe (very briefly) the main interventions or treatments State the primary endpoint You will not have room to explain all the methods in great detail, so stick to the overall defining criteria (e.g. adult patients [ $> 18$ years] with septic shock, defined as persistent hypotension despite adequate vascular filling)
Results	List the main results, with means, odds ratios, $p$ -values, etc for each group. List the result of the primary endpoint first, followed by secondary outcomes Ensure that you have given a result for every method you mentioned in the methods section There should be enough detail to back up your conclusion
Conclusion	A one-line conclusion summarizing your main finding is sufficient, with perhaps a short sentence with the implications for future research, if you have enough space The conclusion should be directly related to the main objective and endpoint
References	There should be no references in an abstract
Discussion	There should be no discussion, or no judgemental statements in the abstract (i.e. remarks such as “Surprisingly, we observed. . .”)
Figures	There should be no figures, tables or other illustrations in an abstract

# ELEMENTS OF A RESEARCH REPORT

- Title
- Abstract
- Introduction
- Literature review
- Problem statement
- Objectives
- Scope or Delimitations
- Methodology
- Results
- Discussion
- Conclusion
- Appendix

# TITLE

- The title of your research proposal should state your topic exactly in the smallest possible number of words.
- Good title :Concise title that gives reviewer a general sense of what you are investigating.
- Bad title : Too long and technical of a title will not gain the reviewer's attention or interest.

# ABSTRACT

- This information should be included in the abstract:
- *Introduction/background/problem statement*: Give a basic idea of what the scientific issue(s) are and what question(s) you are trying to answer
- *Methods*: Provide a very brief high-level sketch of what subjects or methods you used to investigate the research question
- *Results*: Give KEY results only; What is the “newspaper headline” or main finding(s) of the study?
- *Conclusion*: Describe the significance of your key findings, what they mean, and what their implication is on the field.

# ABSTRACT

- An abstract is *a shortened version* of a *research article, thesis, review paper, conference proceeding, or any in-depth analysis of a particular subject or discipline* and should contain all information necessary for the reader to determine:
  - (1) Background
  - (2) Motivation or problem Statement
  - (3) What the objectives of the study were
  - (2) How the study was done
  - (3) What results were obtained
  - (4) and the conclusion or significance of the results
- Its purpose is to provide a summary of the whole report or thesis
- Frequently, readers of a scientific journal will only read the abstract. Thus, it should be written carefully to have the greatest impact in as few words as possible.

## **What does a good abstract do?**

- Sparks interest in your project
- Provides a concise description of your research project
- States in a clear and simple way the main points of your project
- Stands alone

# EXAMPLE 1 : ABSTRACT

**By Wondwossen Bogale (Published on African Journal, 2010)**

**Background:** Wood charcoal has been the primary fuel for cooking in Ethiopia because it is cheap and easily available.

**Problem Statement:** However, using wood charcoal has consequences on health and pollution because of smoking.

**Objectives :** This study aims at providing a biomass as an alternative to wood charcoal using agricultural wastes (dry leaves, coffee husk, sugarcane trash, grass, etc) converted into charcoal briquettes to provide much needed source of cheap fuel that is cleaner in burning.

**Methods:** Simple extruder machine is used as die to make the briquette charcoal. Moreover, an effective carbonizes to change the agricultural waste into charcoal and an effective stove to burn and use the charcoal for cooking is used.

**Results:** The manual extruder machine has a capacity of pressing 30kg/hr and the carbonizer converts 15kg of input agricultural wastes into 5kg of burned charcoal with in 25 minutes. The stove is effective so that three meals are cooked at a time using 100g briquette charcoal.

**Conclusion:** As compared to wood charcoal the charcoal briquette produced from agricultural wastes are economical, environmentally friendly, healthy (no smoke at all) and reduce impact of deforestation.

**Key words:** Pollution, deforestation, extruder, carbonizer, wood charcoal, briquette charcoal, agricultural wastes, pyrolysis



## EXAMPLE 2

- A tri-generation system based on polymer electrolyte fuel cell and desiccant wheel – Part A: Fuel cell system modelling and partial load analysis
- Behzad Najafi, Stefano De Antonellis, Manuel Intini, Matteo Zago, Fabio Rinaldi, Andrea Casalegno
- Department of Energy, Politecnico di Milano, Via Lambruschini 4, 20156 Milano, Italy

## EXAMPLE 2

- **Background** : Polymer Electrolyte Membrane Fuel Cell (PEMFC) based systems have recently received increasing attention as a viable alternative for meeting the residential electrical and thermal demands.
- **Problem Statement** : However, as the intermittent demand profiles of a building can only be addressed by a tri-generative unit which can operate at partial loads, the variation of performance of the system at partial loads might affect its corresponding potential benefits significantly. Nonetheless, no previous study has been carried out on assessing the performance of this type of tri-generative systems in such conditions.

## EXAMPLE 2

- **Objectives** : The present paper is the first of a two part study dedicated to the investigation of the performance of a tri-generative system in which a PEMFC based system is coupled with a desiccant wheel unit. This study is focused on evaluating the performance of the PEMFC subsystem while operating at partial loads.
- **Methodology** : Accordingly, a detailed mathematical model of the fuel cell subsystem is first developed and validated using the experimental data obtained from the plant's and the fuel cell stack's manufacturer. Next, in order to increase the performance of the plant, two modifications have been proposed and the resulting performance at partial load have been determined.

## EXAMPLE 2

- **Result :** The obtained results demonstrate that applying both modifications results in increasing the electrical efficiency of the plant by 5.5%. It is also shown that, while operating at partial loads, the electrical efficiency of the plant does not significantly change; the fact which corresponds to the trade-off between the increment in the gross electrical efficiency and the lower slope of decrement in the auxiliary losses.
- **Conclusion:** The obtained results are suitable to be employed to assess the performance of the overall tri-generative system, conducted in the second part of the study, while meeting intermittent load profiles.
- **Keywords:** Tri-generation, Fuel cell, Proton exchange membrane, Fuel processor, Partial load analysis

# EXAMPLE 3 : ABSTRACT

## A Preliminary Comparative Performance Evaluation of Highly Efficient Waste-to-Energy Plants

Wondwossen Bogale <sup>a,b</sup>, Federico Viganò <sup>a,b</sup>

<sup>a</sup> Department of Energy, Politecnico di Milano, Via Lambruschini 4, 20156 Milan, Italy

<sup>b</sup> LEAP(Laboratorio Energia Ambiente Piacenza), Via Bixio 27/C, 29121, Piacenza, Italy

When looking for sustainable energy systems, Waste-to-Energy plants play a relevant role. **Therefore performance evaluation of these plants in order to increase their efficiency is of great relevance to the field of engineering.** In the present paper, highly efficient Waste-to-Energy plants are modeled and analyzed from the thermodynamic and technological points of view. Four existing plants constructed in Amsterdam/the Netherlands, Reo Nord/Denmark, Brescia/Italy and Germany were considered. The different methods aiming at increasing the efficiency adopted in these plants have been discussed and compared by using available data in the literature. The performance evaluation was carried out using a proprietary code developed at Politecnico di Milano. A sensitivity analysis was performed to investigate the effects of the plant size, condenser pressure, oxygen content and flue gas temperature at boiler exit on the efficiency of the plants. The results show that adopting a new configuration for steam cycle increases the efficiency of the plant, thus also reducing the corrosion of boiler tubes. It is also demonstrated that the proposed configuration leads to a net lower heating value efficiency of 33% .

Keywords : Efficiency, Combustion, Grate, Waste-to-Energy

# EXAMPLE 4 : ABSTRACT

## Estimation of wind energy potential in complex terrain using Computational Fluid Dynamics (CFD) - A case Study for the Province of Parma, Italy

Wondwossen Bogale

### Abstract

In this paper, Computational Fluid Dynamics model is used to assess the wind energy potential of the province of Parma, Italy. Due to the complexity of the terrain, wind energy assessment is a challenging task compared with flat terrain since several factors that affect wind flow like turbulence, flow separation, and high inflow angles result in a variable distribution of wind speed over a small distance. To get a better accuracy, Computational Fluid Dynamics model is used since it takes into account also the turbulence caused by mountains. Existing data collection, domain preparation, mesoscale simulations and detailed micro-siting considering legal and environmental restrictions have been employed to build the wind map of the province. The simulation result is also validated using available data in the literature. Based on the micro-siting and mesoscale simulation results, six locations are selected and the optimal positions for wind turbines are determined considering higher wind speed locations as well as the dominant wind directions. This study also shows that the total rated wind power and the expected total energy that can be harnessed from the six selected wind farms is 25.5MW and 70.78GWh/yr respectively.

**Key words:** Wind energy, Complex terrain, CFD, mesoscale, micro-siting

# INTRODUCTION

- The main purpose of the introduction is to provide the necessary background or context for your research problem.
- How to frame the research problem is perhaps the biggest problem in proposal writing.
- The introduction typically begins with a general statement of the problem area, with a focus on a specific research problem, to be followed by justification of study.

The introduction generally covers the following elements :

- State the research problem
- Provide the context and set the stage for your research question in such a way as to show its necessity and importance.
- Clearly indicate why it is worth doing.
- Briefly describe the major issues and sub-problems to be addressed
- Identify the key independent and dependent variables of your research
- State your hypothesis or theory

# INTRODUCTION

## Outline of the main features of the Introduction section

---

### Feature

---

Background describing what is known on the subject

What is not known? What elements are still subject to controversy? What is the exact gap in the knowledge that your study hopes to fill? Cite any existing data, especially conflicting data that indicate uncertainty

Objective ( $\pm$  working hypothesis)

Cite the exact parameter you plan to measure

Cite the type of patient population or clinical context

Cite any secondary objectives

---



# INTRODUCTION

- The first section of the paper is the Introduction. Here is where you summarize what questions or hypotheses you are pursuing and why. What are the missing gaps in the scientific database that this work fills? This section also gives readers an opportunity to understand the major points of content background in the field. Typically, the introduction can be organized in the following way:
- Paragraph 1: Context—Explain why this research is important to public health, science, or technology; Tell the readers why this topic is an important one to study

# INTRODUCTION

- **Paragraph 2:** Gaps—Describe what gaps exist in the knowledge base that this research was designed to address; Explain the scientific “hole” in knowledge or controversy that this research is attempting to fill or solve
- **Paragraph 3:** Hypothesis being tested—Explain what you set out to do and why (what is the hypothesis to be tested?).

# *Methods to write Introduction*

- *Broad theme or topic of the study*
- *Narrowing the topic*
- *Make it specific*
- *Literature review*
- *Point out of the gap*
- *Reveal the research question*
- *Significance of solving this problem*
- *Objectives*

# INTRODUCTION - EXAMPLES

- When seeking sustainable energy systems, Waste-to-Energy plants play a great role. However, bringing long-term solutions in solid waste management that are highly efficient, environmentally safe, socially acceptable, extremely reliable and cost effective is a very challenging task.  
.....
- From the waste management perspective, Waste-to-Energy represents a very effective and easily manageable way to divert large amount of waste from landfills [1]. From energy perspective, energy recovery from waste can contribute up to 10 % of the energy needs of industrialized countries [2]. From an environmental perspective, modern WTE technologies can achieve levels of pollutant emissions among the lowest once imposed by the various legislations [3].
- However, the energy performance of these plants is highly affected by so many factors....Thus, performance evaluation of Waste-to-Energy plants in order to increase the efficiency, reduce the cost of investment without facing corrosion problems of boiler tubes in an environmental friendly way has a great engineering relevance. Thus, it is worth doing this..

## Example 2 : Introduction - Alternative organic fluid to enhance the performance of Aluto Langano geothermal power plant in Ethiopia

Samson Alemayehu, Wondwossen Bogale

- **Broad them or topic of the study :** The expected rapidly increasing energy demand of the globe and the unexpected rapid industrial and economic development of developing countries, like China and India, have resulted in a significant increase in energy demand and worldwide energy consumption. This ever increasing energy demand has led humankind on a quest for sufficient and efficient power sources. The desire to find sufficient energy by using power generation plants has led to overexploitation of resources. At the same time, power plant equipments have been improved more efficiently. However, these solutions have also resulted in resource depletion, environmental pollution, and excess carbon dioxide emission. Consequently, given all the present and future challenges of the planet, the World Commission on Environment and Development presented a conceptual report in 1987 entitled “Our Common Future” (WCED, 1987). The report focuses on global issues and addresses the problems from three different angles; economic growth, environmental protection and social equity and proposed “Sustainable Development” as the general solution to these problems. Since then, people, more specifically, scholars and environmentalists across the globe have shown their concern to the environment by fighting all devastating actions and proposing alternative ways to deal with these situations. Accordingly, hunting for cleaner, cheaper and more sustainable energy resources for replacing traditional fossil fuel dependent energy systems with sustainable energy systems has got worldwide attention in the past few decades [1]. Wind, solar, hydropower and geothermal energies are among the sustainable and/or renewable energy sources that could satisfy our energy demands while least affecting the balance of the ecosystem. While nuclear energy has been used as an alternative source of energy for over half a century, recently bio-fuels (such as ethanol, biodiesel, etc.) have also become widely accepted alternatives to fossil fuels [2].
- **Narrowing the topic:** Geothermal energy is one of the proven renewable energy sources for direct heat and reliable base load power generation. The earth’s geothermal energy was originally conceived from the formation of planets, and is replenished at approximately 80% by radioactive decay of minerals (i.e. uranium, thorium and potassium) at a rate of 30 TW [3], and 20% by residual heat from the earth’s interior such as volcanic activities and solar energy absorbed by earth surface [3,4]. Thus, the geothermal energy is the earth’s internal heat, naturally present in the earth’s core, mantle and crust, and flowing to the surface by conduction [5, 6].
- **Make it Specific:** Ethiopia, one of the few countries with geothermal potential in Africa, is endowed with a substantial amount of this energy system which is found scattered along the Ethiopian Rift Valley and the Danakil Depression. Since the late 1970’s, geo-scientific surveys mostly comprising geology, geochemistry, and geophysics, were carried out at, from

## Example 2 : Introduction - Alternative organic fluid to enhance the performance of Aluto Langano geothermal power plant in Ethiopia

### Samson Alemayehu, Wondwossen Bogale

- south to north, the Abaya, Corbetti, Aluto-Langano, Tulu Moye and Tendaho prospects [7]. In addition, a reconnaissance survey of ten sites in the central and southern Afar has been carried out, some of these being followed up by more detailed surface investigation. The geothermal potential of Ethiopia is approximated to be well over 1.0 GW [8]. Parsons Brinckerhoff (PB) has also carried out a project about development potential of geothermal in Ethiopia on the sites considered for development (2013) [9]. Even though Ethiopia has a huge geothermal potential, Aluto-Langano is the first geothermal power plant with a net capacity of 7.2 MW<sub>el</sub> that is installed power plant. This implies, Ethiopia is using only 0.002 % of its geothermal potential.
- **Literature review on Aluto-Langano:** Number of researches and studies has been made on the problems and current situation of Aluto-Langano geothermal power plant. Feasibility study for the expansion of the Aluto-Langano Geothermal power has been recently completed by Japanese researcher. The study indicated expansion of the Aluto Geothermal power plant to can give additional 35 MW<sub>el</sub> [10].
- **Point out the gap:** Even if, the cumulative results and findings of these studies and researches are the ground for making the plant operational, they focused on identifying and clearing out of the root cause problems of the existing system and hydrothermal properties of the geothermal fluid [12, 13].
- **Reveal the research question:** Even though, analysis of all and main problems related to the hydrothermal properties of the geothermal fluid and related technical problems of Aluto- Langano geothermal power plant has been discovered enough, it is very hard to find a detailed study of the plant performance, real thermodynamic causes of malfunctioning of the geothermal power plant and possibility of maximizing the energy performance of Aluto-Langano has not been studied.
- **Significance of solving this problem:** Therefore, understanding the real cause of the plant, knowing how the plant behaves at different operating conditions and the possibility of maximizing the plant performance will benefits the future intended geothermal projects in Ethiopia.
- **Objectives:** This study aims to contemplate on propose possible alternative solutions for non-revitalized hydrothermal properties of the production wells and their corollary problems related to the power production. The focus of this study is on thermodynamic analysis of the system for different working conditions and parameters (i.e. working fluid pressure and temperature, organic fluids, condenser pressure and insulations), by creating different simulation scenarios with different boundary conditions. The first objective is to design simulation layout and parameter fixing the factory design outcome as initial boundary condition. The second objective is to design alternative optimized parameters and technical renovations for reactivating Aluto -Langano geothermal power plant with feasibly acceptable and possible maximized output.

# OBJECTIVES

The objectives of a research project summarize what is to be achieved by the study.

- should be closely related to the statement of the problem
- General objectives states what is expected to be achieved by the study in general terms

## Specific objectives

- These are a breakdown of the general objectives
- Systematically address the various aspects of the problem

## SMART Objectives

- Specific
- Measurable
- Achievable/attainable
- Realistic
- Time bound

# DELIMITATIONS

- All research has limitations and thus certain work that will not be performed
- The work that will not be undertaken is described as the delimitations of the research

## Example :

- This research project was intended to find innovative grate combustor + steam cycle configuration based Waste-to-Energy plants with the objectives of increasing the efficiency of the plant, reducing the cost of electricity production without facing corrosion problems of boiler tubes in an environmentally friendly way. **Waste gasification and pyrolysis are not included in this research project.** However, a detailed comparison of each technology has been presented in the introduction section.



# LITERATURE REVIEW

- *A literature review is both a summary and explanation of the complete and current state of knowledge on a limited topic as found in academic books and journal articles.*
- *It is an assessment of the literature and provides a summary, classification, comparison and evaluation.*

# *Purpose of the Literature Review*

- It gives readers easy access to research on a particular topic by selecting high quality articles or studies that are relevant, meaningful, important and valid and summarizing them into one complete report*
- It provides an excellent starting point for researchers beginning to do research in a new area by forcing them to summarize, evaluate, and compare original research in that specific area*
- It ensures that researchers do not duplicate work that has already been done.*

# *Purpose of the Literature Review*

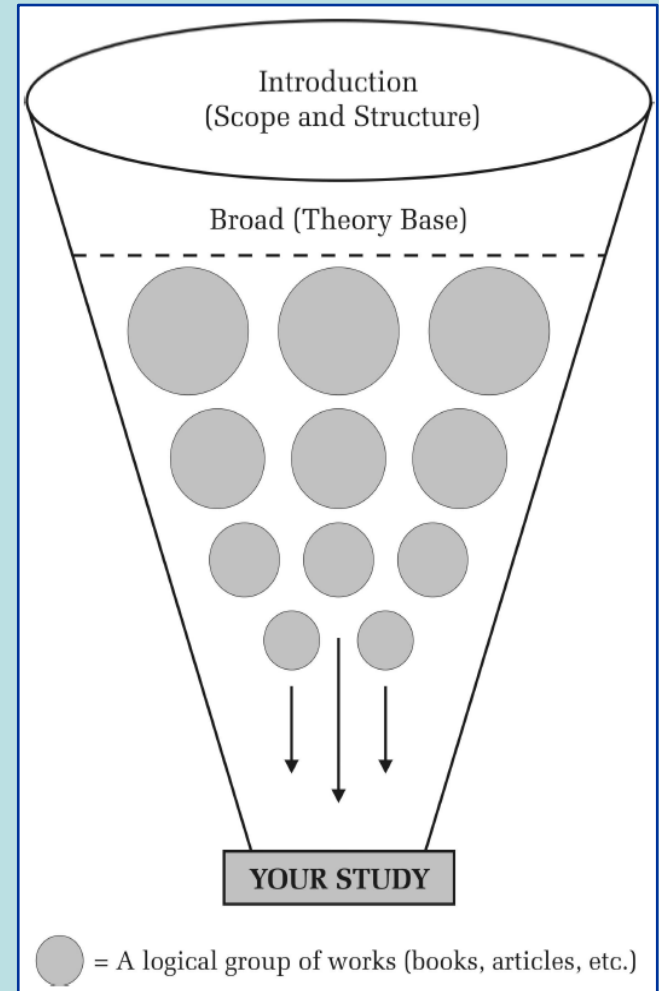
- *It can provide clues as to where future research is heading or recommend areas on which to focus*
- *It highlights key findings*
- *It identifies inconsistencies, gaps, contradictions in the literature*
- *It provides a constructive analysis of the methodologies and approaches of other researcher*

# Why do we write literature reviews?

- *Determine what has already been written on a topic*
- *Provide an overview of key concepts*
- *Identify major relationships or patterns*
- *Identify strengths and weaknesses*
- *Identify any gaps in the research*
- *Identify any conflicting evidence*
- *Provide a solid background to a research paper's investigation*

# LITERATURE REVIEW

- The balls in the top of the funnel are categories of works that are relevant to your investigation, but do not specifically address what you are doing.
- The next layer of works will be works that are closer to what you are doing, but still do not match directly.
- As you move down in your literature review funnel, the categories should get closer and closer to the research that you are going to undertake.
- Eventually you may find that a category contains only two or three, or possibly even one work.



# METHODS FOR ORGANIZING THE LITERATURE REVIEW

- By subject (if lit review covers more than one subject)
- Chronologically
- By theme, idea, trend, theory, or major research studies
- By author
- By argumentative stance

**Note :** In all methods, relationships between elements (e.g., subject, theme, author, etc.) must be shown.



# *A good literature review*

- *Demonstrates that the author is knowledgeable about the prior work on the relevant topic(s)*
- *Identifies research gaps*
- **Develop precisely stated research questions for their own further research**
- **Positions an empirical article or a thesis with respect to prior literature**
- **Develops theory.**

# Demonstrating knowledge

- *The literature review shows reviewers or examiners that the author is familiar with relevant prior and current relevant research. If at all possible, researchers **MUST** read the actual material they are citing. **If one merely includes a paper based on what someone else said about it, one runs the risk of reporting on, and/or using, or even citing that paper incorrectly.***
- *If I had then referenced either article incorrectly, knowledgeable readers could perceive that I was a lazy and careless author or even worse, that I was unethical in pretending to read what I had not. Reviewers of submitted work will be familiar with the papers in the area and once they detect an error in someone's work, they will doubt that author's overall credibility.*



# Identifying research gaps

- *A research gap might be viewed as something that has not been formally researched before.* When reviewing prior work it is good to check a “**call for future research**”. *This is when the author(s) note a limitation in their own work, or prior work on the topic as a whole and suggest that future research should be done, to fill this gap. These calls can give you (and other researchers who read your review) future research ideas.*

# Generating specific research questions

- *Most research is motivated by a general research purpose or observed practical problem that the researcher wants to address*
- *Literature reviews can provide justification for the importance of the overall research purpose.*
- *The research gaps noted in the review can be used to develop specific research questions*
- *Asking specific research questions that can be answered by the proposed research are important, because reviewers and examiners will judge the finished work partly on whether the researcher actually answered the questions they promised to answer.*

# *Positioning research*

- Reviewing the literature exposes the researcher to the various current problems and issues and more importantly, the ongoing debates in their area.
- This may then suggest to them which discussion(s) they want to join, and which journal(s) might be suitable outlets for their work (since those journals are currently interested in those discussions).
- To clearly establish which conversation is being joined and extended, *researchers need to know what has already been done, what is wrong with what has already been done, and how they are contributing to what has been done - this is called “positioning” one’s work with respect to prior literature.*

# Developing theory

- *A deep familiarity with the literature is essential when drawing out implications of the research in the discussion section and answering the all important question of how the new work informs, extends or even changes what is already known about the focal concept(s), relationships and/or issues.*
- *The knowledge the authors gain from doing their literature reviews will help researchers to develop the hypotheses that they intend to test.*

# THE LITERATURE REVIEW WRITING PROCESS

- **Step 1** : Choose a topic – Focus and Explore this topic
  - Topics you are familiar with and interested in
  - Topics your readers and other researchers interested in
- **Step 2** : Research – collect scholarly information and sources
- **Step 3** : Analyze the network of information and select works
  - Uses thought maps and charts to identify intersections of the research and outline important categories
  - Select the material most useful for your review
- **Step 4** : Describe and summarize each selected articles
  - Determine 2-3 important concepts or findings in each articles

# THE LITERATURE REVIEW WRITING PROCESS

- **Step 5** : Demonstrate – how concepts in the literature relate to results ; establish how the literature is connected
  - Identify the missing parts in previous studies that your study addresses
  - Highlight concepts that support your hypothesis, methods ,results and conclusions
  - Identify unaddressed issues in previous studies
- **Step 6** : Identify relationships in the literature and connect your own ideas to previous studies
  - Focus on the connections b/n the literature and the current study or guiding concept/argument

# Literature review Matrix

- The main point of the analysis
- Summarize the article you read
- Present in a table these important points

**1. Number**

**2. Reference**

**3. Study parameters**

**4. Focus**

**5. Research Gap**

**6. Findings**

No	Reference	Study Parameters	Focus	Research gap	Findings
1					
2					
3					
4					
5					
6					

## *TIPS FOR CREATING A STRONG LITERATURE REVIEW*

- Clearly define your topic and audience first
- Read many literature reviews and articles
- Focus more on current sources
- Take notes while reading literature



# LITERATURE REVIEW : BE ORIGINAL. FIND A GAP

- *Value of a research lies in its contribution to knowledge*
- *Should strive to show clearly how the previous research is lacking in some way*
- *This lack is called a “ gap ”*
- *Your research contributes to “fill” the gap.*
- *Ask yourself : What is the gap in that specific area ?*
- *Why is the gap you have identified so important?*
- *Why is it worth to investigate this particular gap?*
- *What is the benefit from studying that gap ?*

# LITERATURE REVIEW : BE ORIGINAL. FIND A GAP

## *Five Types of Gaps*

- *Knowledge-based* : Most common, occurs when we don't know (enough) about a phenomenon
- *Relationship - based* : occurs when we know about certain issues but are unsure about their relationship
- *Theory - based* : occurs when a theory or an aspect of a theory has not been investigated thoroughly, or not been tested in a particular way

# LITERATURE REVIEW : BE ORIGINAL. FIND A GAP

- *Methodological* : occurs when a research design or methodology has not been applied to a particular phenomenon
- *Analytical* : occurs when a phenomenon has not been investigated using a particular analytical approach i.e., qualitative vs. quantitative

# LITERATURE REVIEW

- ***Three key points***

1. ***What does what you are studying matter ?***

2. ***What has been done before ?***

3. ***What are you doing that is novel or interesting ?***

# *What does what you are studying matter ?*

- Why does what you are studying matter ?
  - Don't expect the reader to work this out
  - Examples :
    - Reduced fuel burn is good for the Environment
    - Improved hip joints will allow grannies to get to the shops
    - Building a flight simulator will result in better educated engineers
    - Provide references for your assertions

# Example

- *Improving turbine efficiency is very important as it saves fuel.*
- *Rose (1994) reported that a 0.1 % improvement in specific fuel consumption was worth around \$ 22,000 a year on a Boeing 747 airplane.*

Then in references list :

- Rose, M. (1994). Non axisymmetric endwall profiling in the hp nvgs of axial flow gas turbine. ASME paper 94-GT-249.

# What has been done before ?

- Probably the longest section
- Summarize the key points from previous work
- Be analytical :
  - **What is the advance ?**
  - **What were the authors not able to do ?**
- Aim is to convince the reader that you know what has been done in this field before you.

# EXAMPLE

Harrison (1989) describes a comprehensive investigation into the performance of leaned blades. He reported that simple lean reduces velocities at one endwall and increases them at the opposite wall. Compound lean reduces endwall losses but at the expense of increased midspan losses. This meant that compound lean in particular had no effect on overall loss coefficient but did substantially reduce the exit angle deviations as well as producing more uniform loss at the exit. This is likely to accrue benefits further downstream in real machines.

Then in the reference list:

Harrison, S. (1989). The Influence of Blade Stacking on Turbine Losses. PhD thesis, Department of Engineering, University of Cambridge.



# EXAMPLE

Barker and Gower (2010) examine the use of storytelling as a means of increasing effective communication in a diverse workplace. The authors present a model of storytelling as a complete organizational communication tool and discuss how to effectively apply storytelling in the diverse work environment. This approach may not be suitable for all organizations, but the information provided by the article can be used to help develop alternative strategies.

Frisoli (2010) uses a series of interviews he conducted over a five-month period with a West African man to study communication between two people of culturally diverse backgrounds. Frisoli found that the intended meaning of a communication on the Internet can be easily miscommunicated due to cross-cultural barriers, much more so than in face-to-face contact. Frisoli also found that people of diverse backgrounds often bring a different set of ethical attitudes toward technology that can further skew the communication. Moreover, Frisoli highlights the importance nonverbal cues in communication, as well as the differences in how those cues are read in different cultural settings.

Barker, R., & Gower, K. (2010). Strategic application of storytelling in organizations: Toward effective communication in a diverse world. *Journal of Business Communication*, 47(3), 295-312. Business Source Complete, EBSCOhost. doi:10.1177/0021943610369782

Frisoli, P. (2010). Assumptions, emotions, and interpretations as ethical moments. Navigating a small-scale cross-cultural online interviewing study. *International Journal of Qualitative Studies in Education (QSE)*, 23(4), 393-405.

# EXAMPLE

## STRIP THE SUMMARIES

Barker, R., & Gower, K. (2010). Strategic application of storytelling in organizations: Toward effective communication in a diverse world. *Journal of Business Communication, 47*(3), 295-312. Business Source Complete, EBSCOhost. doi:10.1177/0021943610369782

Source Citation

Barker and Gower examine the use of storytelling as a means of increasing effective communication in a complete organizational context. Their model of storytelling as a complete organizational strategy to effectively apply storytelling in the workplace may not be suitable for all organizations, but the information provided by the article can be used to help develop alternative strategies.

Detailed Summary

Fine, M. G. (1996). Cultural diversity in the workplace: The state of the field. *International Journal of Business Communication, 33*(4), 485-502. doi: 10.1177/002194369603300408

Source Citation

Fine believes that the increasing cultural diversity of the US workforce is perhaps the most pressing challenge of our times. However, research into this issue has produced mainly general overviews. Missing are actual research studies of different voices in the workforce, especially those that have been marginalized. Doing so, the author asserts, provides academics an opportunity to demonstrate to the public the worth of their studies of cultural diversity and of multicultural discourses.

Detailed Summary

Frisoli, P. (2010). Assumptions, emotions, and interpretations as ethical moments: Navigating a small-scale cross-cultural online interviewing study. *International Journal of Qualitative Studies in Education (QSE), 23*(4), 393-405.

Source Citation

Frisoli uses a series of interviews he conducted over a five-month period with a West African man to study communication between two people of culturally diverse backgrounds. Frisoli found that the intended meaning of a communication on the Internet can be easily misinterpreted, much more so than in face-to-face contact. Frisoli's findings often bring a different set of ethical attitudes toward technology that can further skew the communication. Mr. Frisoli highlights the importance nonverbal cues in communication, as well as the differences in how those cues are read in different cultural settings.

Detailed Summary

Activate Windows  
Go to Settings to activate Windows.

# *What are you doing that is novel or interesting ?*

- Probably the most important section
- Justify your research
- Explain why what are you doing is an advance on what has been done before
  - *Pervious research have not explored the influence of trailing edge modeling*
  - *No one has carried out thus experiment before*
  - *This organization don't have a flight simulator and the research is to design and build one*

# Example

Although many authors have investigated secondary flows in turbines the detailed flow structure inside a cascade fitting with profiled endwalls has never before been measured. This is the topic of this research project.

Numerous other low cost flight simulators have been developed which enhance the learning experience. Such a simulation system could easily be developed for the department.

# CONTENT OF THE REVIEW

- *The literature review should have : An introduction, body and conclusion*
- *The length of each section depends on whether you are writing a brief literature review for a research paper or a whole chapter as part of a dissertation.*
- *The introduction should provide the reader with the scale and structure of your review. It serves as a kind of map.*

# *Content of the Review*

- *The body of the review depends on how you have organized your key points.*
- *The conclusion of the review needs to sum up the main findings of your research into the literature. The findings can be related to the aims of the study you are proposing to do. The reader is thus provided with a coherent background to the current study.*

# Example - Introduction

- *This section of the thesis reviews the various research activities that have been done before in order to increase the efficiency of Waste-to-Energy plants, highlights unsolved problems and/or the gap in this research area together with the recommended solutions by the authors. Not only the efficiency but also the economic and environmental analysis has been thoroughly reviewed. These plants operate over a large portion of their life span in off-design conditions, especially when they operate in combined heat and power mode. Therefore, each of the above-mentioned points shall be reviewed and presented in a chronological order by giving much more attention on what has already been done before, the gap in this research area with the objective of finding the ultimate performance of Waste-to-Energy plants as well as technical, economic and environmental implications of the proposed configurations.*

# Example - Body

- High temperature proton exchange membranes were first proposed for fuel cell applications in 1995 [Ref 1] and demonstrated in 1996 [Ref 2] with hydrogen as a fuel.The electrolyte membrane is made of phosphoric acid (PA) doped polybenzimidazole (PBI). .. In the last decade many efforts contributed in researching membrane physical-chemical properties [Ref 3], proton conductivity [Ref 4], water drag [Ref 5], degradation [Ref 6], resistance to carbon monoxide [Ref 7] and methanol oxidation [Ref 8].
- Fewer works are related to the study of anode polarization and pure hydrogen operation is widely employed on laboratory scale [Ref 9]. Unfortunately, in his work, the author tested PEFC with *high excess of reactants (>10)* and very high CO concentration in the feed (up to 30 %), with the intent of avoiding the presence of local effects. ***Unfortunately, in real systems, low stoichiometry is desired (from 1.2 to 1.3) and thus the onset of local effects is unavoidable and the resistance to fuel impurities becomes crucial.*** What's more, high temperature promotes the tolerance to fuel impurities, from 0.1% at 120°C to 3% at 200°C. Recent degradation studies [13] showed however that above 160°C operation is possible only for limited time. ***Thus in real system, poisoning of anode catalyst could become an issue if not properly addressed.***



# Example : Conclusion

- The importance of finding a new innovative Waste-to-Energy plant configuration that can increase the energy recovery potential from waste without facing corrosion problems of boiler tubes in an economical and environmentally friendly way benefits these facilities a lot. Increasing efficiency of conversion increases the amount of energy that can be extracted from solid waste fuel, generates as much sustainable energy as possible, counterbalances the huge investment cost of the plant by maximizing the economic income (more power and higher revenue) and reduces the CO<sub>2</sub> emissions. It is important to note that the current waste policies or legislatives forced the Waste-to-Energy facilities to increase their energetic efficiencies to tackle the challenges of global climate change and to secure a reliable energy supply. *In this perspective, this thesis aims to fill the research gap in these areas by finding new ways to increase the efficiency of the state-of-the-art and highly efficient Waste-to-Energy plants beyond 30 % (net electric efficiency on LHV basis) , which is the maximum efficiency achieved nowadays [23] by proposing a new configurations.*

# Most frequently used sentences in conclusion part of your literature review

- *However, to the best of our knowledge, it is very hard to find researches that focuses in four of the above mentioned points at the same time, i.e. : increasing efficiency beyond the state-of-the-art Waste-to-Energy plant ( > 30 % on LHV basis), finding cost effective configuration, reducing the CO<sub>2</sub> emissions and most importantly avoiding the serious problem of corrosion in boiler tubes. Thus, in this thesis different innovative and cost effective configuration has been proposed by focusing on the grate combustor, steam cycle and by contributing additional measures to further increase the efficiency and reduce the cost of the plant. This goal has been achieved by performing a detailed modeling and simulation of the plants.*

# Most frequently used sentences in conclusion part of your literature review

- *Even though several literatures can be found for biogas upgrading, it still needs special attention in reducing the operational cost of the upgrading system and disseminate the technologies for a wider use. Especially in Ethiopia, more than 82 % of the population is living in the rural areas and most of them are farmers. At the same time the rural electrification rate in Ethiopia is less than 10 % [Ref]. Thus, if we use the waste from cattle to produce biogas and upgrade it, it can be used for various applications: compressed gas, electricity generation, transportation etc. Thus, in this paper, a chemical absorption method is used to upgrade the biogas (Activated carbon to remove  $H_2S$ , Potassium hydroxide and Sodium hydroxide to remove  $CO_2$  and Silica gel to remove  $H_2O$ ). Detailed analysis of the food waste, raw Biogas and upgraded biogas were performed.*

# Most frequently used sentences in conclusion part of your literature review

- *Nevertheless, the systems developed in this regard have not been much successful. However, the use of devices to increase the mass flow rate through the rotor blades has been proven feasible through many researches. This study focuses on conducting a research on performance improvement of small wind turbine using computational fluids dynamics (CFD) and experimental analysis. It involves identifying the important parameters in diffuser designs and their relationship with velocity increase and, thus, augmentation in power. It focuses on the parametric relationships of a diffuser for a small, horizontal axis wind turbine. The output of the research result will range from being an input for commercial product development endeavors to an input for other researches on performance improvement of small wind turbine for rural electrification.*

# Literature review writing approaches

- There are three ways to combine an idea and its source with your own voice:
  - Direct quote
  - Paraphrase
  - Summary

# Literature review writing approaches

- **Direct quoting:** repeats exact wording and directly represents the author:
  - E.g. 'Rain is likely when the sky becomes overcast' (Smith, 1988)
- **Paraphrasing** is repeating an idea in your own words, with no loss of the author's intended meaning:
  - E.g. As Smith (1988) pointed out in the late eighties, rain may well be indicated by the presence of cloud in the sky.

# Literature review writing approaches

- *Summarizing* - shorten or crystallize a detailed piece of writing by restating the main points in your own words
  - E.g. Referring to the possible effects of cloudy weather, Smith (1988) predicted the likelihood of rain.
  - Smith (1988) claims that some degree of precipitation could be expected as the result of clouds in the sky, by clearly discounted findings of Jones (1986).

# Method

- *If you consider a research study as a delicate dish of knowledge, a paper's methods section would be like a recipe that lists all the necessary ingredients of the study and how they need to be combined during cooking.*
- *Ideally, it allows the dish to be prepared again with the same result.*
- *The methods section ties the introduction to the results section to create a clear story line; it should present the obvious approach to answer the research question and define the structure in which the results will be presented later.*



# Method Section

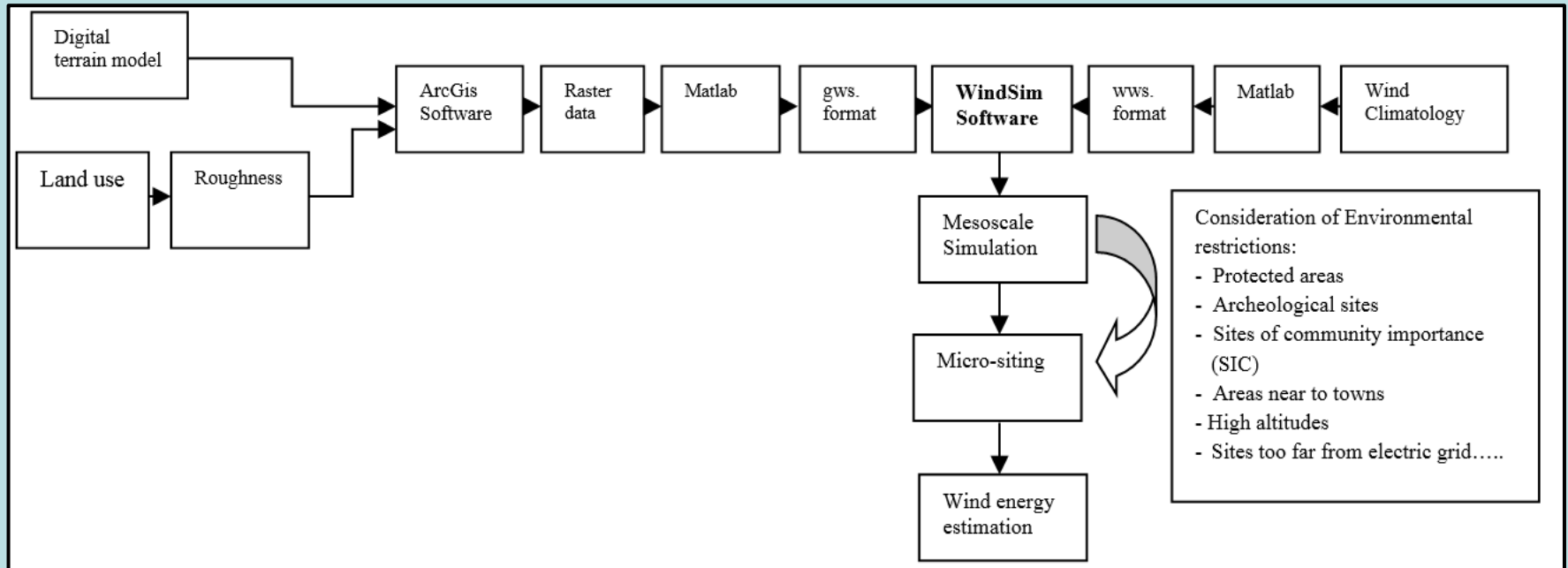
- *The methods section of a paper presenting original research from a quantitative study has four basic elements:*
  - *Study design*
  - *Selection of participants - selection criteria/ selection methods*
  - *Data collection*
  - *Data analysis*
- *It is quite common to use such subheadings to structure the section (the target journal may offer specific guidance).*
- *After you have drafted the methods section, ask yourself, “Would a researcher be able to reproduce our study with the information I provide in this paper?”*

# Method Section

## Checklist for the methods section

- Include basic information *on study design, setting and subjects, data collection, data analysis, and ethical approval*
- Refer to previous publications from the same large research project, such as a study protocol, for additional information (if applicable)
- Consider providing detailed information on the methods as supplementary materials
- **Ask yourself, “Would a researcher be able to reproduce the study with the information I provide in this paper?”**
- *Note : To master the writing of the methods section it is important to look at many other examples of methods sections in articles with similar scopes and aims as ours*

# EXAMPLE 1 - WIND ENERGY ASSESSMENT



# Example 2 : Method - Alternative organic fluid to enhance the performance of Aluto Langano geothermal power plant in Ethiopia

Samson Alemayehu, Wondwossen Bogale

- Description of the plant**

- Mathematical model**

2.2.1. Heat exchangers

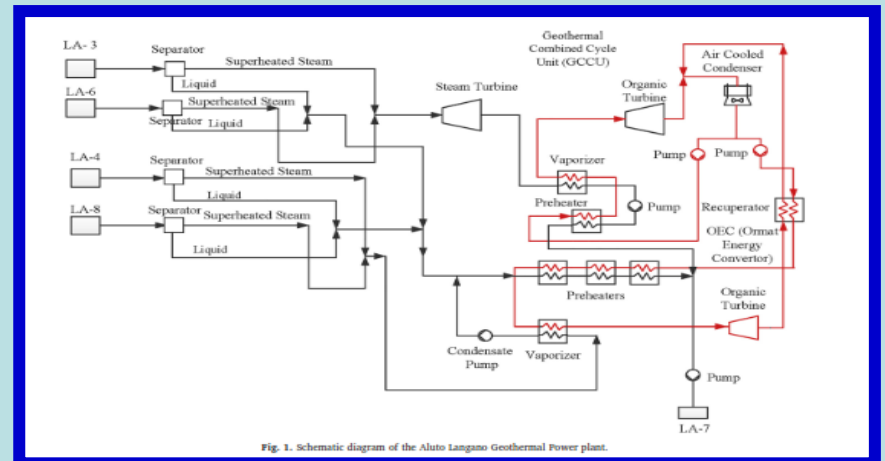
$$\dot{Q} = U \times A \times LMTD$$

2.2.2. Steam turbine

$$A = \frac{Cm\sqrt{(v_i/P_i)}}{\sqrt{1 - (P_e/P_i)^2}}$$

2.2.3. Feed pump

$$\dot{w}_{pump} = \frac{\dot{m}_w \times \Delta P}{\rho_w \times \eta_{pump}}$$



Initial design state parameters and specifications.

No.	Parameters	Value
1	Steam Turbine Inlet Pressure	12 bar
2	Air Cooled Condenser Pressure	1.12 bar
3	Organic Turbine Working Fluid	Isopentane
4	Steam Turbine Inlet Temperature	188 °C
5	Gross Output Power	8.52 MW <sub>el</sub>
6	Net Output Power	7.28 MW <sub>el</sub>

- Modeling and simulation : Matlab**

- Initial design state parameters and specifications.**

# Result Section

- *The results section of an article presents a clear, concise, and objective description of the findings from a particular study and is mostly written in the past tense.*
- *The findings are presented without interpretation, as this should occur in the discussion section only.*
- *You may think of the results section as mirroring the methods section: For every method (what you did), there should be a corresponding result (what you found) and vice versa.*

# Result Section

- *Keep the story line of your paper in mind: Findings in the results section should match and answer the research questions from the introduction, using the procedures explained in the methods section.*
- Retaining this focus will help you to be more concise, that is, to decide which findings to present and which to leave out.

# Result Section

## Checklist for the results section

- *Write the results section in the past tense.*
- *Structure it by highlighting your key findings*
- *Match the results section with the methods section.*
- *Present findings without interpretation.*
- *Highlight findings from tables and figures in the text.*
- *Present estimates with 95% confidence intervals.*
- *Consider providing additional results in tables and figures as supplementary material.*

# RESULT SECTION

- *What did you find out from the method you had employed ?*
- *The core of the research work*
- *Often includes tables, figures, or both*
- *Should present results but not comment on them*

*To write effective result section :*

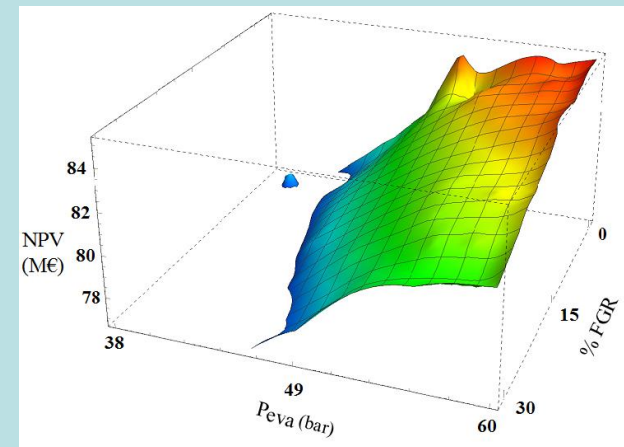
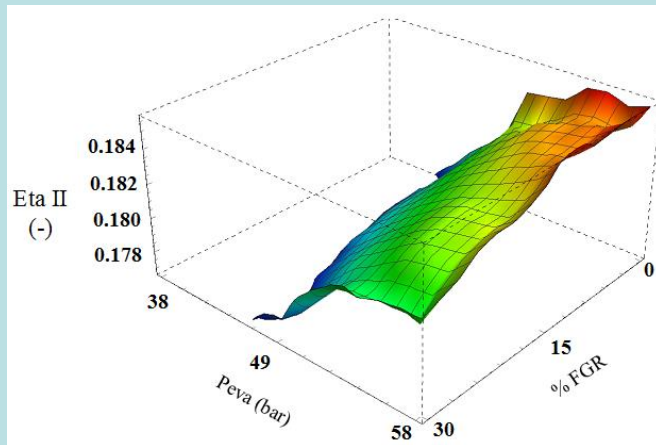
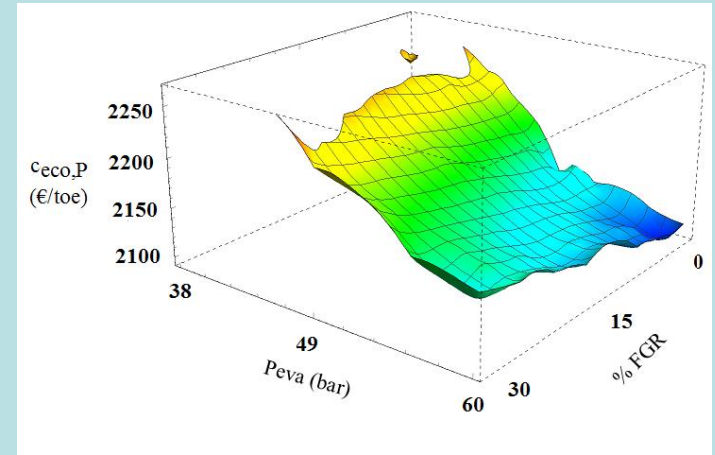
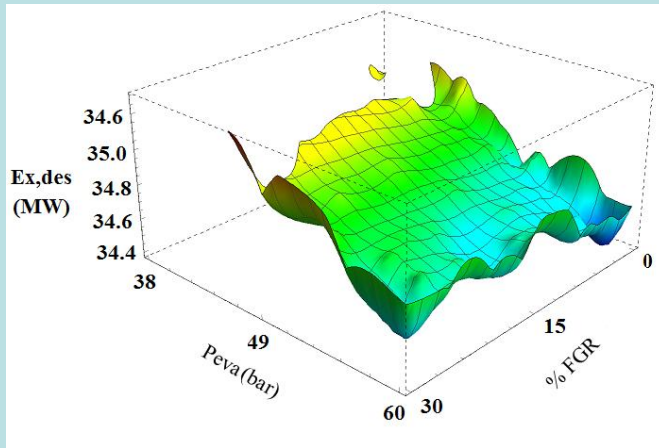
1. *Determine which results to present by deciding which are relevant to the question(s) presented in the Introduction*
2. *Organize the data in the Results section in either chronological order according to the Methods or in order of most to least important.*
3. *Determine whether the data are best presented in the form of text, figures, graphs, or tables.*
4. *Summarize your findings and point the reader to the relevant data in the text, figures and/or tables.*
5. *Describe the results and data of the controls and include observations not presented in a formal figure or table, if appropriate.*



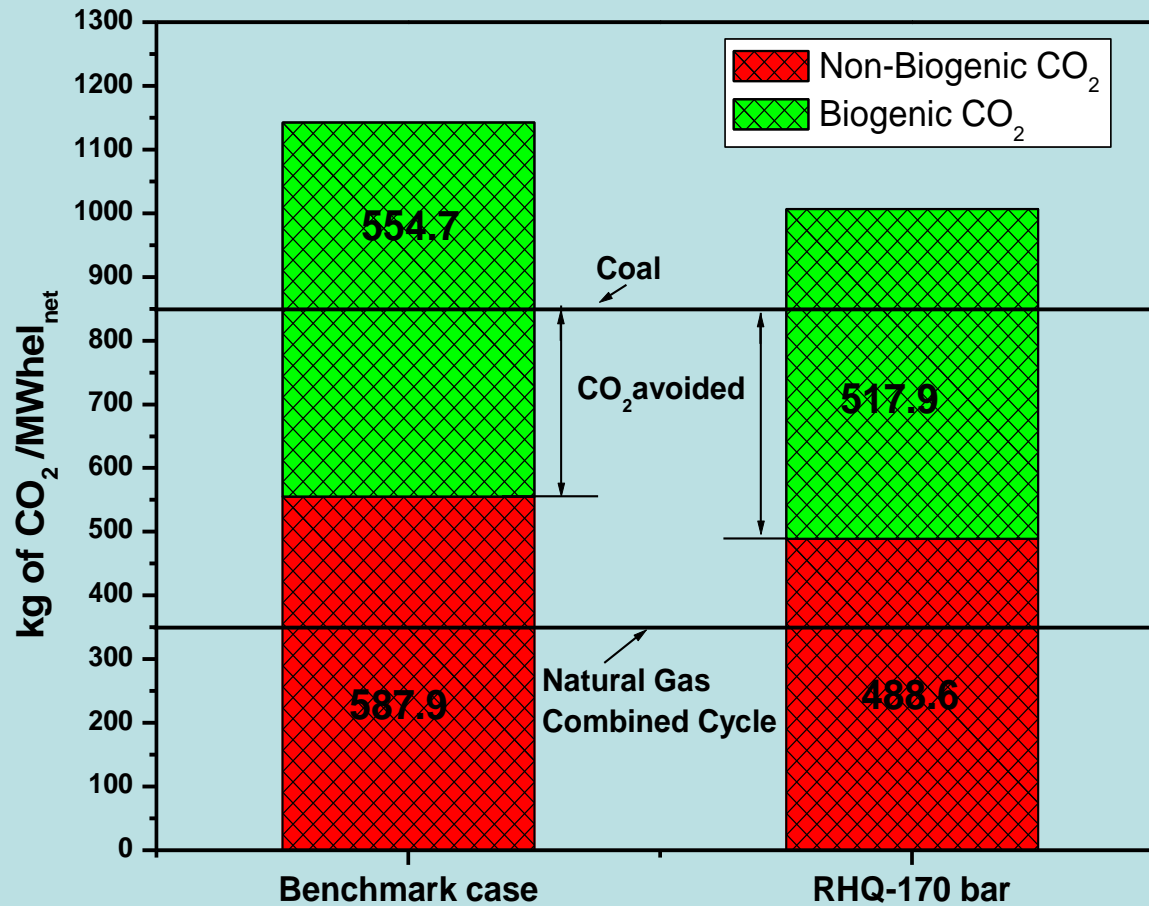
# RESULT- EXAMPLES

Description	Unit	Design point	Optimal point
Msw mass flow rate	kg/s	4.45	4.45
Electrical net power	kW	10,037.3	10,568.5
<b>Exergy destruction, total</b>	<b>kW</b>	<b>35,149.5</b>	<b>34,617.9</b>
Steam mass flow rate	kg/s	16.17	16.08
First law efficiency	%	21.7153	22.8646
Second law efficiency	%	17.5803	18.5108
R1 Index	-	0.6500	0.6783
Product exergetic cost	toe/h	4.91	4.75
Product spec exergetic cost	-	5.69	5.40
Product economic cost	€/h	1,937.8	1,932.5
Product spec economic cost	€/toe	2,245.4	2,126.7
Per hour revenues	€/h	2,775.4	2,850.1
Specific investment costs	€/kW,lhv	1,366.2	1,360.9
Specific o&m costs	€/kW,lhv	167.5	167.2
<b>Net present value</b>	<b>M€</b>	<b>77.3</b>	<b>83.9</b>
<b>Payback time</b>	<b>y</b>	<b>7</b>	<b>6</b>
Deareator pressure	bar	2.79	2.79
Turbine inlet steam temperature	°C	390.0	415.0
CO <sub>2</sub> production	kg of CO <sub>2</sub> /MWh <sub>net</sub>	1,609.6	1,528.6
of which non renewable CO <sub>2</sub>	kg of CO <sub>2</sub> /MWh <sub>net</sub>	805.1	764.6

# RESULT- EXAMPLES



# RESULT- EXAMPLES



# Crucial point to be incorporated while writing result section

1. Background information
2. Reporting results
3. Summarizing results
4. Commenting on results
  - *Step 1: Interpreting results*
  - *Step 2: Comparing results with the literature*
  - *Step 3: Accounting for results*
  - *Step 4: Evaluating results*
5. Summarizing the study
6. Evaluating the study
  - *Step 1: Indicating limitations*
  - *Step 2: Indicating significance/advantage*
  - *Step 3: Evaluating methodology*
7. Deductions from the research
  - *Step 1: Making suggestions*
  - *Step 2: Recommending further research*
  - *Step 3: Drawing pedagogic implication*

# Result and discussion section

- **Background information**

- *It is used by authors to prepare readers for the report or discussion of the results that follow. It therefore contained some important statements such as research questions, the aims and purposes of a study, the theoretical background or established knowledge, and the study's research methodology.*

- *Example 1. This paper reports the results of the detail study of continuous pyrolysis system for biochar production.*

- **Reporting results (Obligatory)**

- *This is to announce the main research finding to the readers. It is considered to be one of the most important parts in the writing of research articles.*

- *Example 2. Regarding the exante design characteristics, we find a nonlinear, inverted U-shaped relationship between..*

# Result and discussion section

- ***Summarizing reports***
- ***Commenting on results (Obligatory)***
  - ***The purpose of this section is to establish the meaning and significance of the research results in relation to the relevant field and it was realized by four different choices***
    - ***Interpreting results***
    - ***Comparing results with the literature***
    - ***Accounting for results***
    - ***Evaluating results***
- Comparing results with the literature was the most important step used while writing research articles.

# Result and discussion section

- *Summarizing the study*
- *Evaluating the study (obligatory)*
  - Indicating limitations
    - *Example 9. Like every study, our study is subject to a number of limitations that offer opportunities for future research. First, due to the relatively small sample size of our study, we were only able to investigate the direct effects of target achievement and subjectivity emphasis on fairness perceptions.*
  - Indicating significance/advantage
    - *This means the authors tried to claim that to some extent their research findings were of importance or contributory to the field. This means that authors tended to state that their research findings were noteworthy to the field for a number of reasons.*
    - *Example 10. Our findings may help redirect the discussion surrounding the risk associated with auditors' lack of...*

# Result and discussion section

- Recommending further research
  - The authors tried to encourage other researchers to further investigate or study closely particular areas.
  - *Example 11: Future research might investigate potential interactions between the two variables as well as interactions with the organization's internal policies or external environmental characteristics.*



# Result and discussion section

- ***Deductions from the research***
  - Making suggestions
    - ***It is was used to draw inferences about the results by suggesting what can be done to solve the problems identified by the research.***
      - ***Example 5. Our findings suggest that if management wants to attract high achievers, next to adequate contract design including performance incentives, management should regard control aspects.***
  - Recommending further research
    - ***Pointing out the line of further study***
      - ***Example 6. Future research might illuminate whether MA practice is in need of improvement of control systems or..***

# Result and discussion section

- Drawing future implication

- *Drawing future implication*

- *Example 7. The implication of our study is that when determining bonus payouts, supervisors who care about*

# Result and discussion section

- *The purpose of the discussion section is :*
  - *To give the reader a summary of the main findings*
  - *To put them into context by comparing with literatures*
  - *To discuss future implications*
  - *To state any shortcomings of the research design.*
- *Although the structure of the introduction can be visualized as a funnel, the discussion can be visualized as an inverted funnel.*
- *Thus, the introduction and discussion together form an hourglass shape.*
- *The discussion starts with the narrowest part by answering the research question in the summary of*

# Result and discussion section

- *main findings, and it then gradually widens out to comparisons with other studies and the interpretation of the study findings in the wider context of the study topic.*
- Although the results section merely presents data, the discussion section offers an interpretation of the data, and should never present new results.
- A typical discussion section consists of:
  - ***Main findings***
  - ***Comparison of findings with literatures***
  - ***Strengths and limitations***
  - ***Implications of the research.***

# Result and discussion section

- *Start by presenting the main findings, by answering the research question in exactly the same way as you stated it in the introduction section (see “Introduction”).*
- *If you cannot present the main findings in three sentences, it may mean that you have forgotten the storyline of the paper.*
- *Do not waste words by repeating results in detail, and only use numbers or percentages if they are really necessary for your message.*
- *Do not ignore or cover up inconvenient results.*

# Result and discussion section

- *Reviewers will pick them up anyway, and it weakens your paper if you try to hide them.*
- *Also, do mention unexpected findings by explicitly stating that they were unexpected and did not relate to a prior hypothesis; such honesty will strengthen your paper.*
- *Include a separate subsection about the strengths and weaknesses of the study.*
- *Every study has its limitations, and you should make sure to mention them.*
- *Sometimes it is possible to counterbalance a limitation with a specific strength.*

# Result and discussion section

## *Checklist for the discussion*

- Check if the discussion has a clear inverted funnel shape with distinct sections providing:
  - *A summary of main findings (What did we find?);*
  - *Comparisons with other studies (What is known?, What is new? and How does this fit in?)*
    - When comparing with other studies, discuss the reasons for differences and similarities with your results and do mention the limitations of those studies, but be respectful and objective.
  - *Strengths and limitations (Are the findings true?)*
  - *Implications (Are the findings important? What can we do with them?).*
- Answer the research question in the first paragraph and check if this is in line with the research question posed in the introduction.
- Check if the discussion section does not present new results.
- Be frank about acknowledging limitations.

# Result and discussion section

- This discussion is where you interpret and explain the significance of your results, and how they fit into the wider picture of what has already been observed and reported on the same topic.
- The discussion should start with a brief recap of the main findings of your study.
- This can be followed by the interpretation of your results. Pay attention when interpreting not to simply repeat the results, or at the other end of the scale, not to over-interpret.
- You should present your findings factually; after all, this is a scientific article, not a prose novel.



# Result and discussion section

- **Paragraph One** : Summarize the key findings in the first paragraph, but take care not to repeat what was already included in the previous sections of the paper. Relate these key findings to the a priori hypothesis that was stated in the Introduction section.
- **Paragraph Two** : After you summarize your key findings, use the second paragraph to state your case: explain your interpretation of the results and how it relates to what is already known or more importantly not known in the literature. Use this section to refer to other reviews and published papers, but sparingly cite your own work in this field when relevant to avoid excessive self-referencing. Clarify what your study adds to the knowledge

# Result and discussion section

- ***Paragraph Three and Four*** : Use paragraphs three and four to discuss the possible mechanisms that explain the results these are key paragraphs of the paper.
- ***Paragraph Five and Six : Strengths/limitations and Implications***

# Conclusions

- *What are the larger implications of your work?*
- *What is the bigger picture?*
- *Work on incorporating these implications into your very last sentence*

# *Components of conclusion*

- *Context of the study*
- *Stating the main findings*
- *Compare your result/Validate*
- *State importance of your findings*
- *Limitation*
- *Future work*

## *Example 1: Conclusion*

- **Context of the study:** In this study a detailed experimental analysis to upgrade raw Biogas has been performed in order to increase the calorific value and remove unwanted components from the raw biogas.
- **Stating the main findings:** Based on the experimental result shows these innovative technologies reduce the acidic content ( $\text{H}_2\text{S}$ ) by 99 % and removes the  $\text{CO}_2$  by 82 %. Thus, the Methane content has been increased from 56.7 % to 85 %. The  $\text{CO}_2$  content reduces from 36 % to 10 %.

## *Example 1: Conclusion*

- **Compare your result/Validate:** The experimental has been validated by using data coming from literatures.
- **State importance of your findings:**
- **Limitation:** It is highly recommended to do economic analysis to prove that the additional cost to upgrade biogas can be returned back by selling the upgrade Biogas.
- **Future work:** Future works can be performed by using different Biogas upgrading technologies to better select the right technologies that are efficient, economical and environmental friendly.

Example 2 : Conclusion - Alternative organic fluid to enhance the performance of Aluto - Langanu geothermal power plant in Ethiopia  
Samson Alemayehu, Wondwossen Bogale

- **Context of the study:** In this study a detailed alternative solution to reactivate and maximize the energy potential of the Aluto-Langanu power plant was suggested by performing thermodynamic analysis of the system for different working conditions and parameters.
- **Stating the main findings:** Based on the result, changing working fluid, Isobutane instead of Isopentane gives the system better efficiency and net electric power. Besides, decreasing condenser pressure up to some acceptable (below the atmospheric pressure of the location) also improves the efficiency of the power plant to some measurable units.
- **Compare your result/Validate:** The model has been validated by using data coming from the plant operators. The results show that approximately 0.1 % variations exist between the model and the real plant net electric power output.

Example 2 : Conclusion - Alternative organic fluid to enhance the performance of Aluto - Langano geothermal power plant in Ethiopia  
Samson Alemayehu, Wondwossen Bogale

- **State importance of your findings:** The method presented in this article can be applied for modeling of geothermal power plants, to understand the real cause of the geothermal power plants, to know how the plant behaves at different operating conditions and to find possibilities that maximize the energy performance of the plant.
- **Limitation:** It is highly recommended to do economic and environmental analysis to know cost of electricity and avoided CO<sub>2</sub> emissions while maximizing the energy perfume of geothermal power plant.
- **Future work:** Future works can be performed to solve the mechanical problems of the plant, part load performance analysis and a detailed assessment of temperature and pressure drop locations on the pipe network of the power plant.



# REFERENCES

- Each reference must include the names of all authors (in the same sequence in which they appear in the research proposal or thesis), the article and journal title, book title, volume number, page numbers, and year of publication.
- The exact format for depicting references within the body of the text and as well as the end of the research proposal varies from one discipline to another
- The information you give in the reference list must be enough for readers to find the books and papers in the library or a database.

# REFERENCES

- *Science moves forward by building on the research work of others, so it is important to appropriately cite previous work **to acknowledge your sources, underpin your hypothesis, show that you are familiar with the relevant field, and give credit to the work of others, as well as avoid being charged with plagiarism.***
- *Correct citations will allow readers to get an overview of the main work done previously within the field (the web).*

# REFERENCES

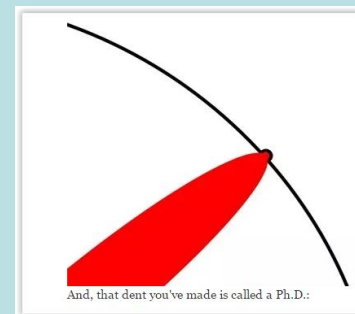
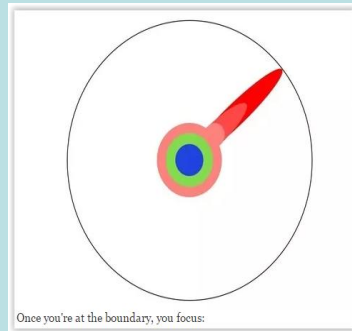
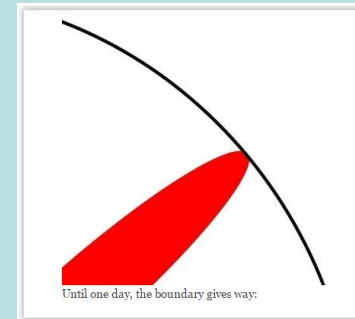
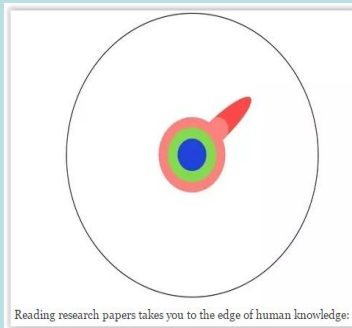
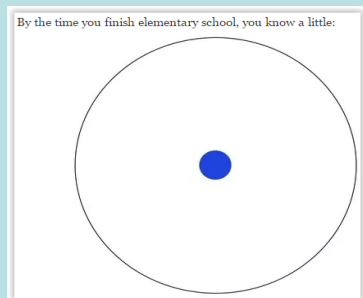
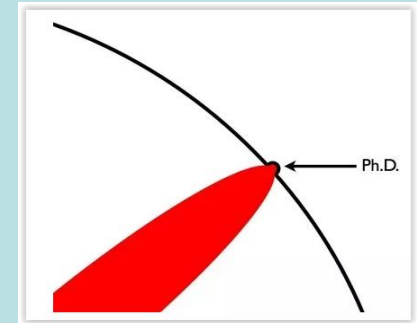
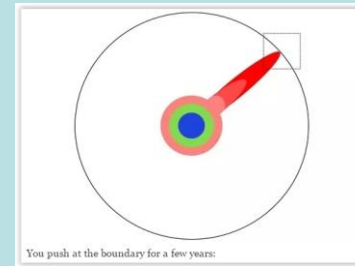
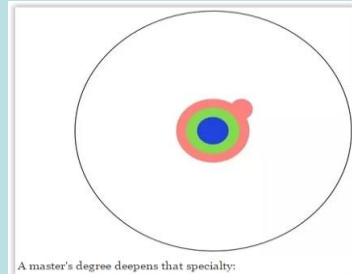
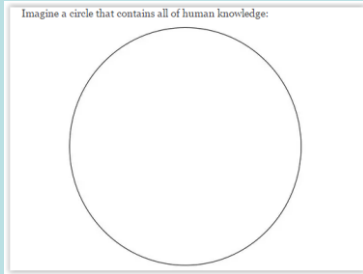
- If you have several references that back up a specific statement, choose the one you think is most appropriate. Consider choosing the reference which
  1. Provides the highest level of evidence,
  2. Is open-access available,
  3. Has been most recently published, or
  4. Has been published in the journal to which you are submitting your manuscript.
- The latter will demonstrate to editors that you know and read their journal (which you should anyway, if you want to successfully publish with them).

# REFERENCES

## Checklist for citing and references

- *Use reference management software at all times.*
- *Find the requested output style in the author instructions of the target journal and adhere to it 100%.*
- *Always cite the original source behind a statement.*
- *Use your own words to describe facts derived from references, never copy paste sentences.*
- *If you need to choose among several references, select one by considering the level of evidence, open-access, year of publication, and published in the target journal.*
- *Check the final reference list for errors.*

# REMARKS : CONTRIBUTION



THE END