

Electromechanical Engineering
Ingles II | 2022

Decarbonizing the Environment: Viability Analysis of Carbon Emission Reduction Processes in Large Power Plants

Students:

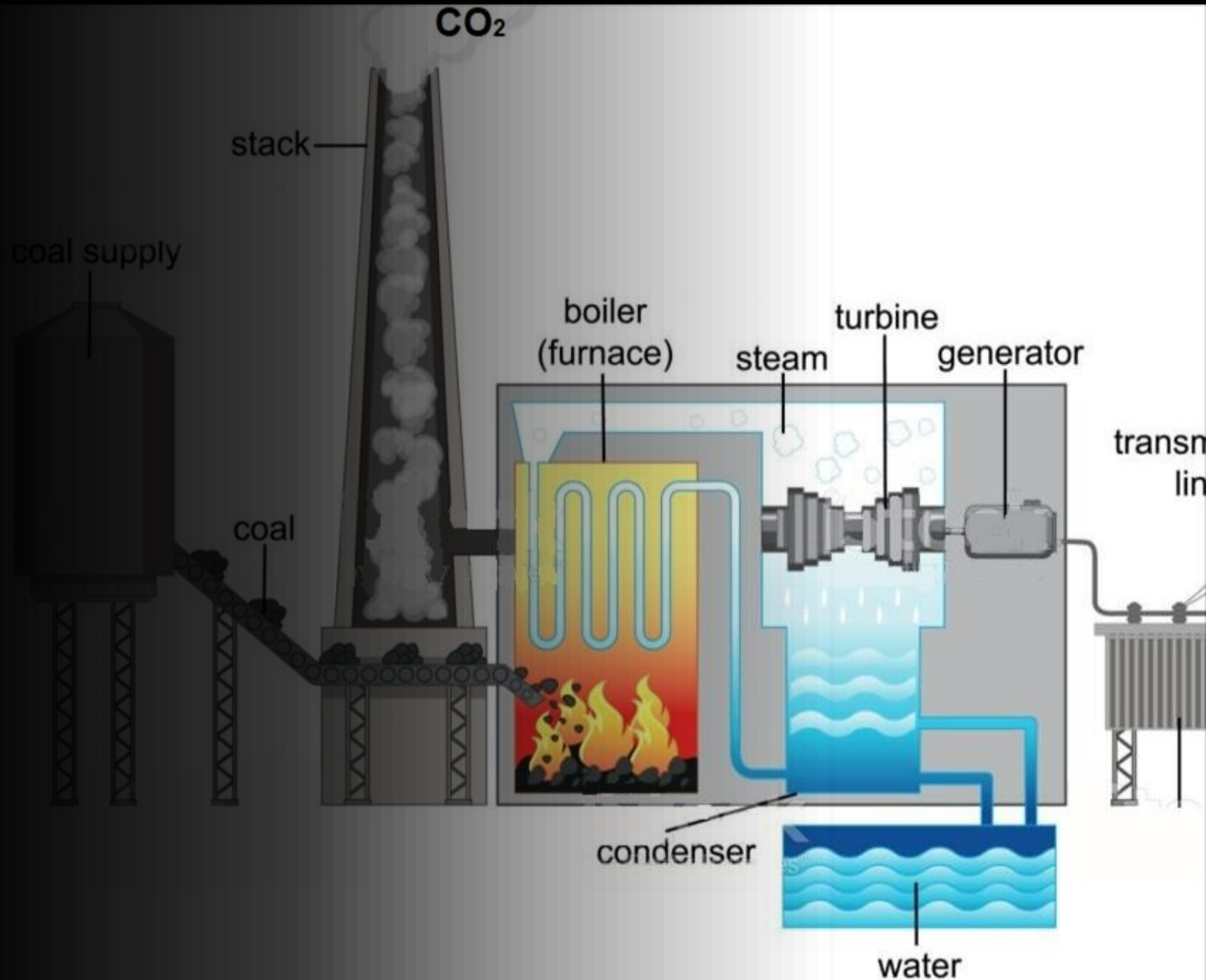
Kapp Diego

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I- INTRODUCTION

- Currently energy production is mostly dependent on thermal plants.
- The operation of these plants is based on burning fuel to generate steam.
- CO₂ reduction is one the main challenges for engineering today
- Different processes need to be implemented to reduce the amount of CO₂



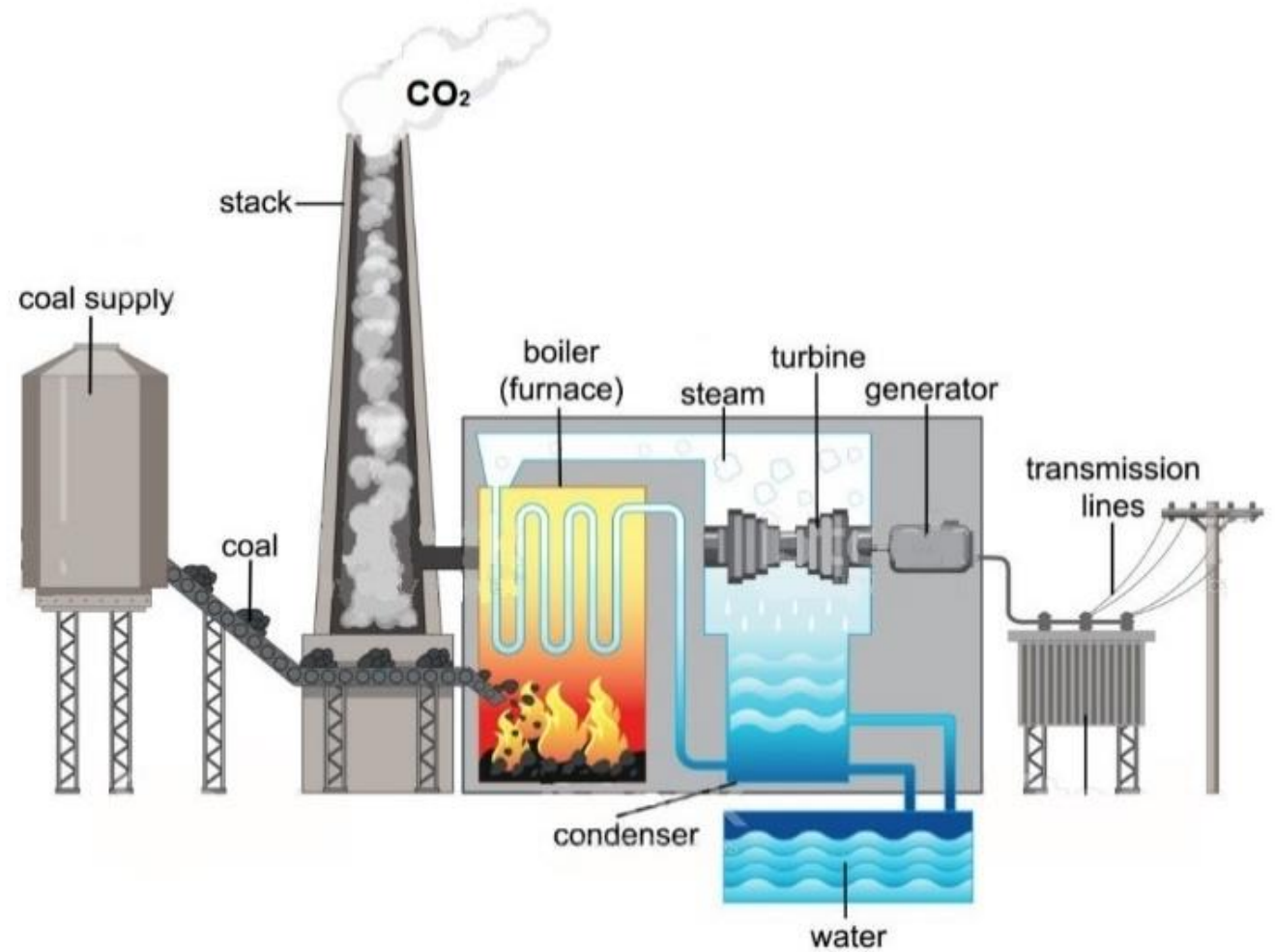
Map of the Presentation

- **Problem of CO₂ emissions caused by thermal electric energy production**
- **Consequences for our planet**
- **Methods to Reduce CO₂ Emissions**
 - **Pre- combustion**
 - **Post- combustion**
 - **Oxyfuel- combustion**
- **Viability Analysis of the different methods**



II- PROBLEM OF CO₂ EMISSIONS CAUSED BY THERMAL ELECTRIC ENERGY PRODUCTION

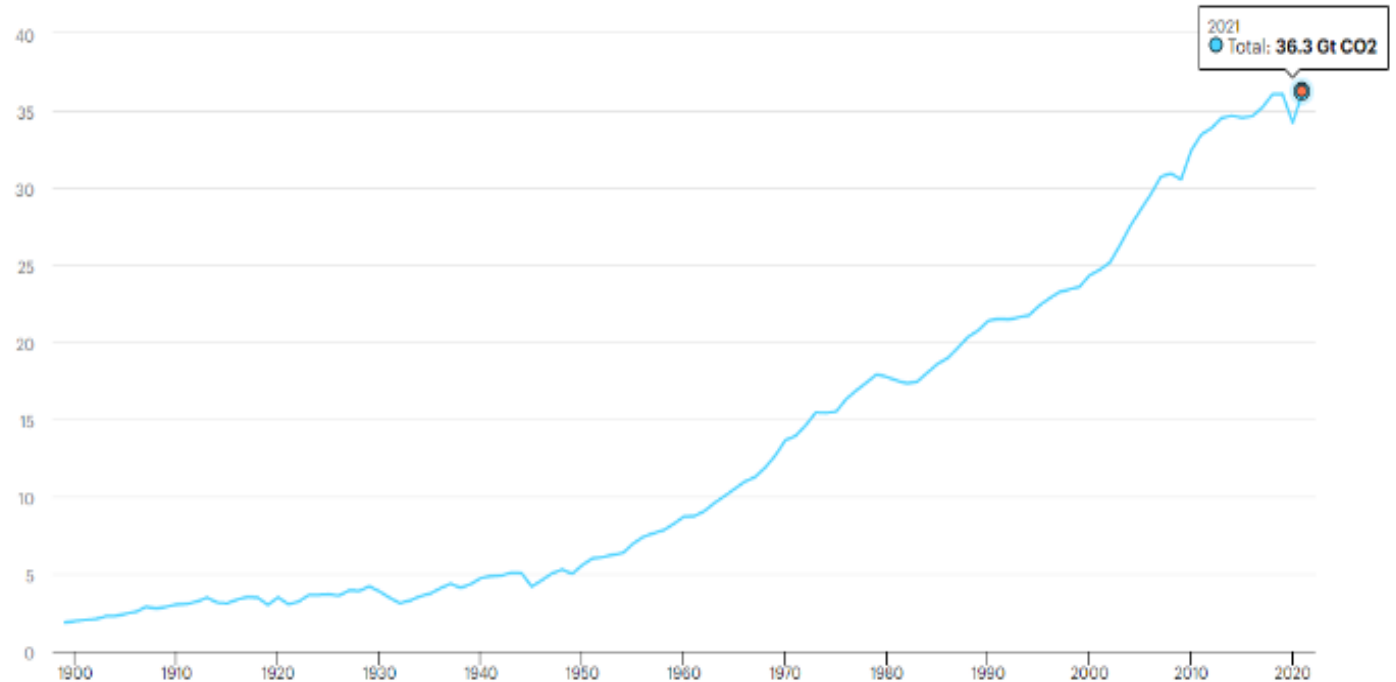
conventional thermal power plants



II- PROBLEM OF CO₂ EMISSIONS CAUSED BY THERMAL ELECTRIC ENERGY PRODUCTION

Global energy-related carbon dioxide emissions rose by 6% in 2021 to 36.3 billion tonnes

- Coal reaching an all-time high of 15.3 billion tons
- Natural Gas reaching a 7.5bn tons
- Oil reaching a 10.7bn tons



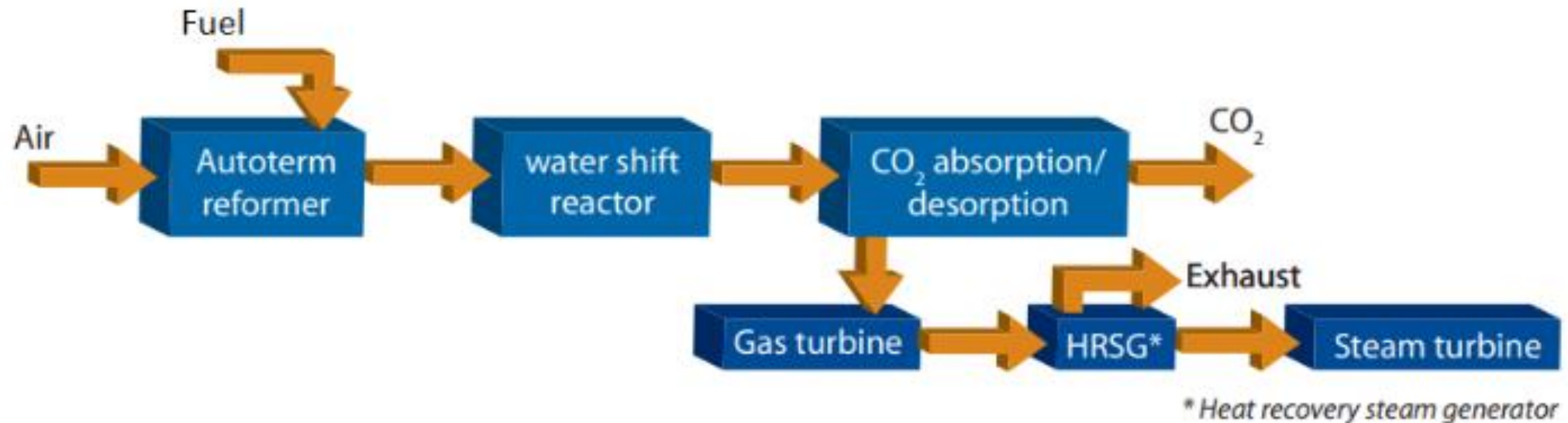


III. METHODS TO REDUCE CO₂ EMISSIONS

- Pre-combustion
- Post-combustion
- Oxyfuel- combustion

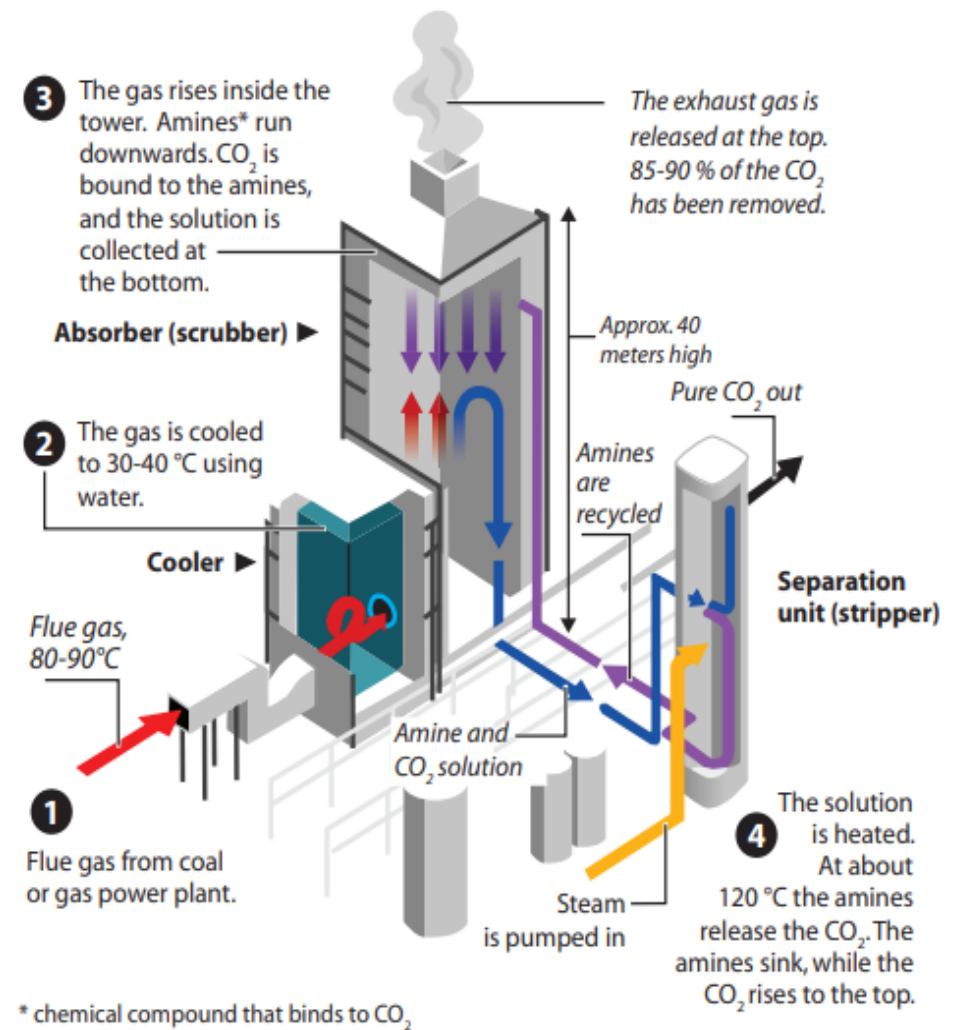
- Pre-Combustion

It consists in the transformation of a fuel into a gaseous stream to later separate the CO₂ from the hydrogen



Post-Combustion

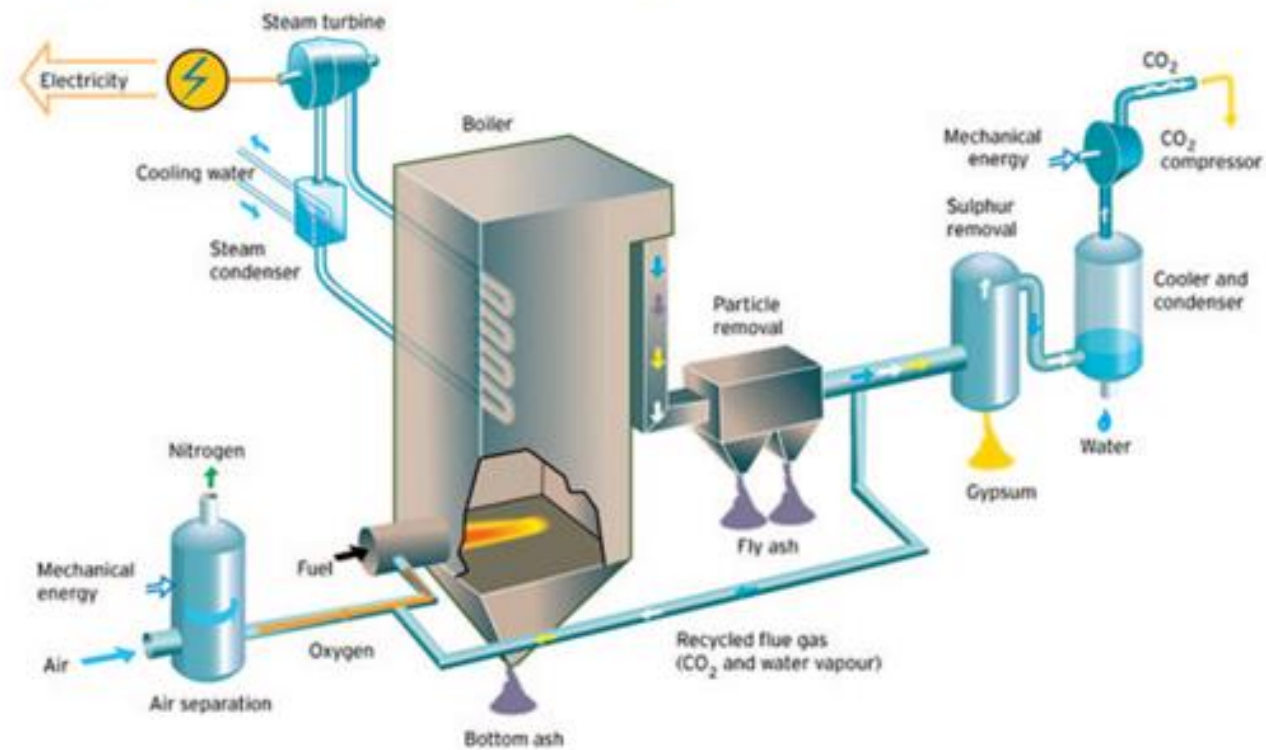
CO₂ is captured in the exhaust gases when combustion ends.



OxyFuel-Combustion

The combustion takes place using pure oxygen rather than air.

Oxyfuel (O_2/CO_2 recycle) combustion capture



IV.

TECHNICAL CONCEPTS

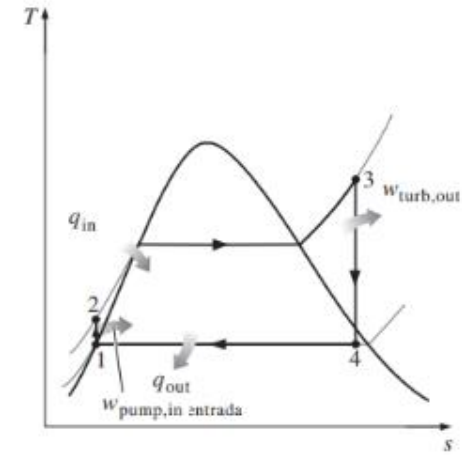
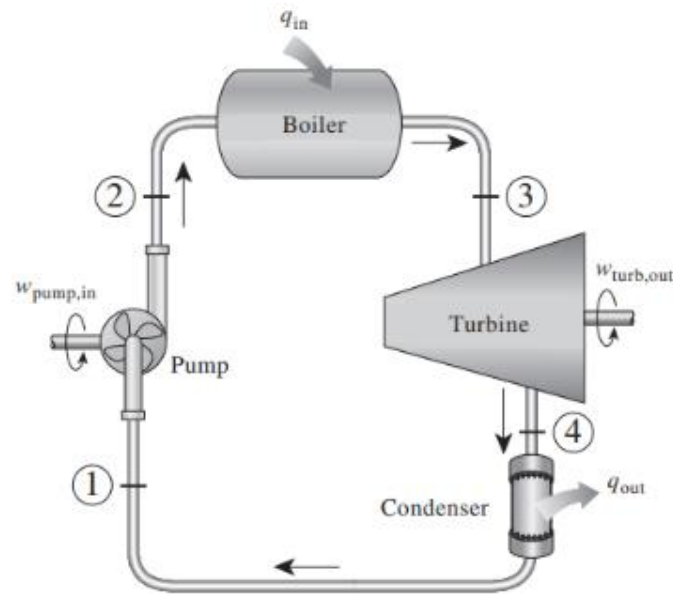
A. Thermal Efficiency:

It is a coefficient that shows the percentage of supplied energy is converted into produced energy. This is the ratio between input energy and output energy.

$$\eta_{ter} = \frac{E_{produced}}{E_{supplied}} = \frac{E_{output}}{E_{input}} \quad (3)$$

B. Rankine cycle:

- It is the water pumped into the boiler transforming it into steam.
- The water vapor is used to move the turbine that is connected to the electrical generator.
- The steam condenses and is pumped back to start the cycle.



$$E_{input} = E_{output} \quad (4)$$

$$q_{input} = W_{turbine} + q_{output} \quad (5)$$

$$W_{turbine} = q_{input} - q_{output} \quad (6)$$

V- VIABILITY ANALYSIS OF METHODS:

A. PRE-COMBUSTION

- It needs to use energy to separate CO_2 and H_2 .
- This energy loss can be reduced.
- There is a decrease in thermal efficiency from 38.7% to 31.2%

Advantage

- The energy loss can be reduced if the hydrogen obtained in the separation is used as fuel.

disadvantage

- It is a system that requires a large initial cost.
- It needs to use energy for its reactions.
- The price of electric energy could increase.

V- VIABILITY ANALYSIS OF METHODS:

B. Post- combustion

- The energy consumption is lower.
- Thermal efficiency is lower, at around 7% .
- It depends on the level of CO₂ in the exhaust gases.

Advantage

- It is versatile to be applied in most part of thermoelectric power plant

disadvantage

- The CO₂ capture capacity is much lower when compared to other methods

C. Oxyfuel- combustion

- The overall loss of energy efficiency is around 12%
- The efficiency of energy generation is between 43-48 %

Advantage

- *It provides a simple way to capture most of the CO₂ without emissions.*
- *This technology can be used in any thermal plant.*

disadvantage

- It has a large requirement for O₂ production.



Conclusion

- The application of these methods depends on the type of power plant:
 - It size
 - It production
 - The fuel used
- It is only justified to apply these methods in countries where the emission of CO₂ is relevant to the world.
- Thermoelectric plants are currently used as base production plants because they can produce energy on a large scale.

Thanks for your attention.

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