

3 ACCA

THIRD AFRICA CONGRESS ON
CONSERVATION AGRICULTURE
5-8 June 2023 | Rabat, Morocco



Carbon footprint and cost of pumping water using photovoltaic and fossil energies within the context of irrigated conservation agriculture

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Theme:
Building a Resilient Future in Africa
through Conservation Agriculture and Sustainable
Mechanization



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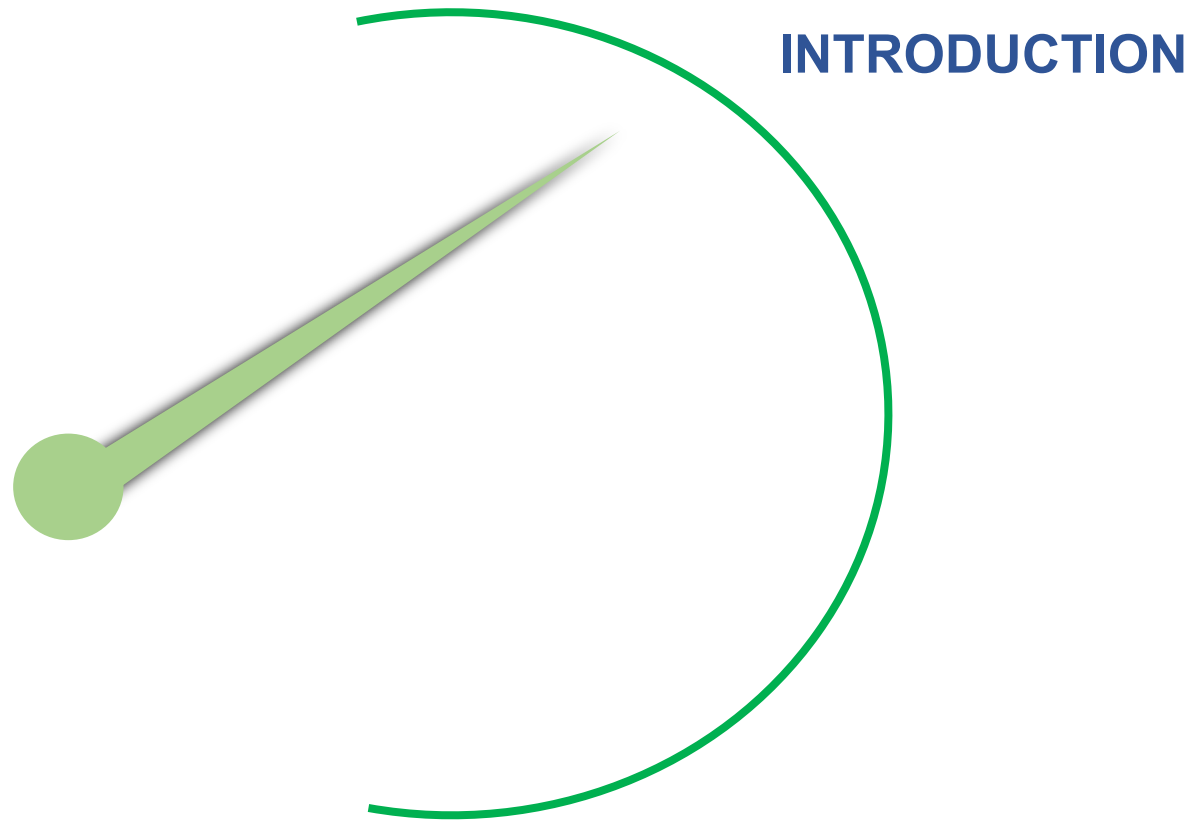
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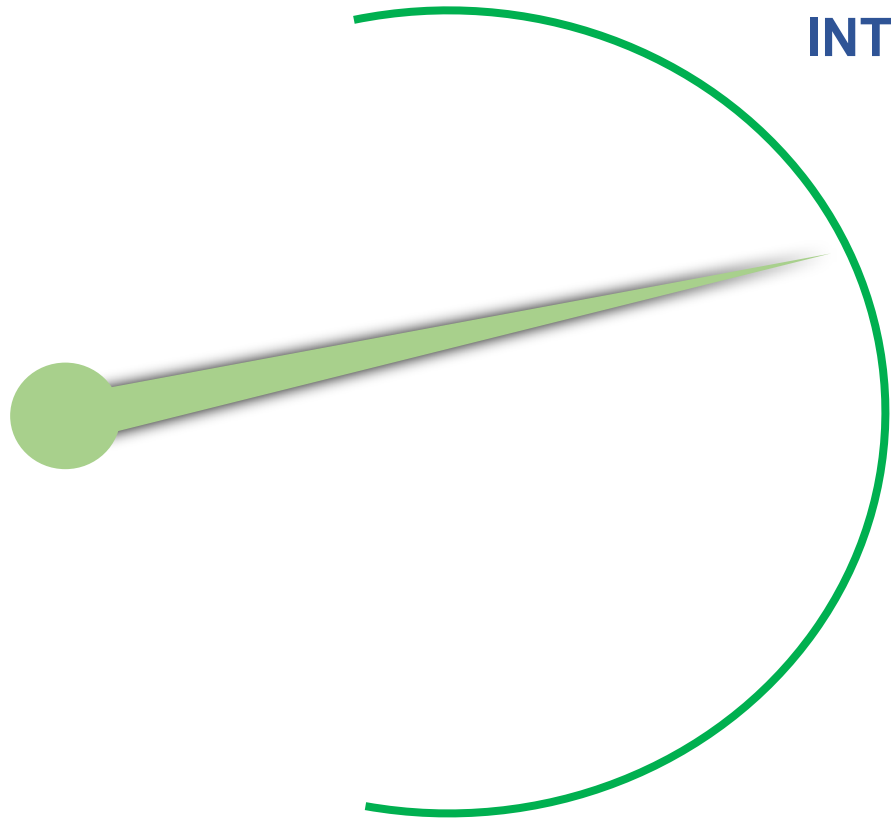
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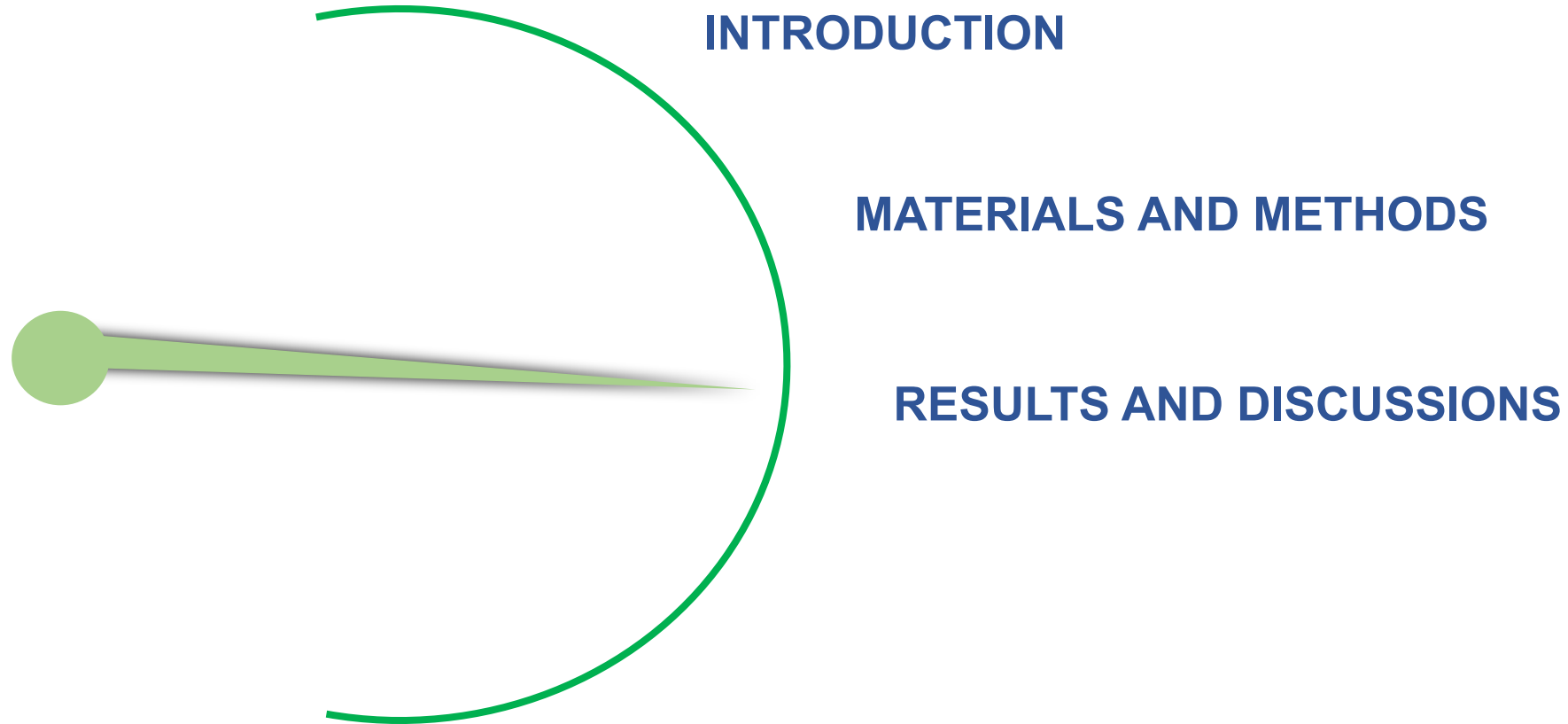
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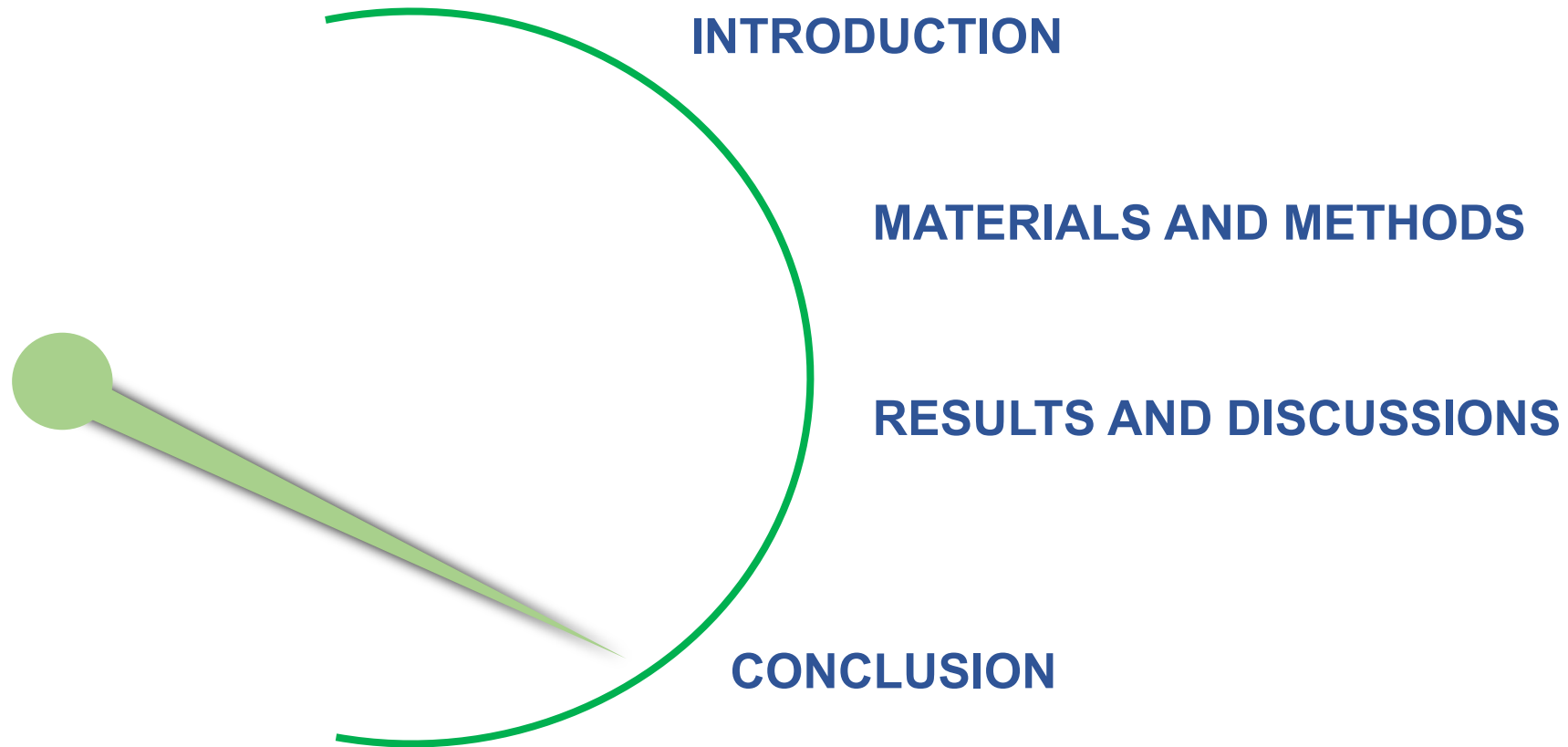
INTRODUCTION

MATERIALS AND METHODS

PLAN

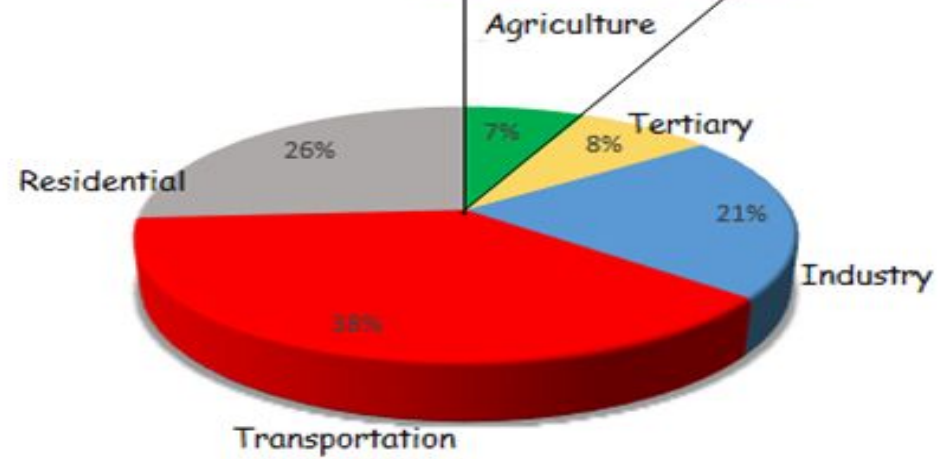


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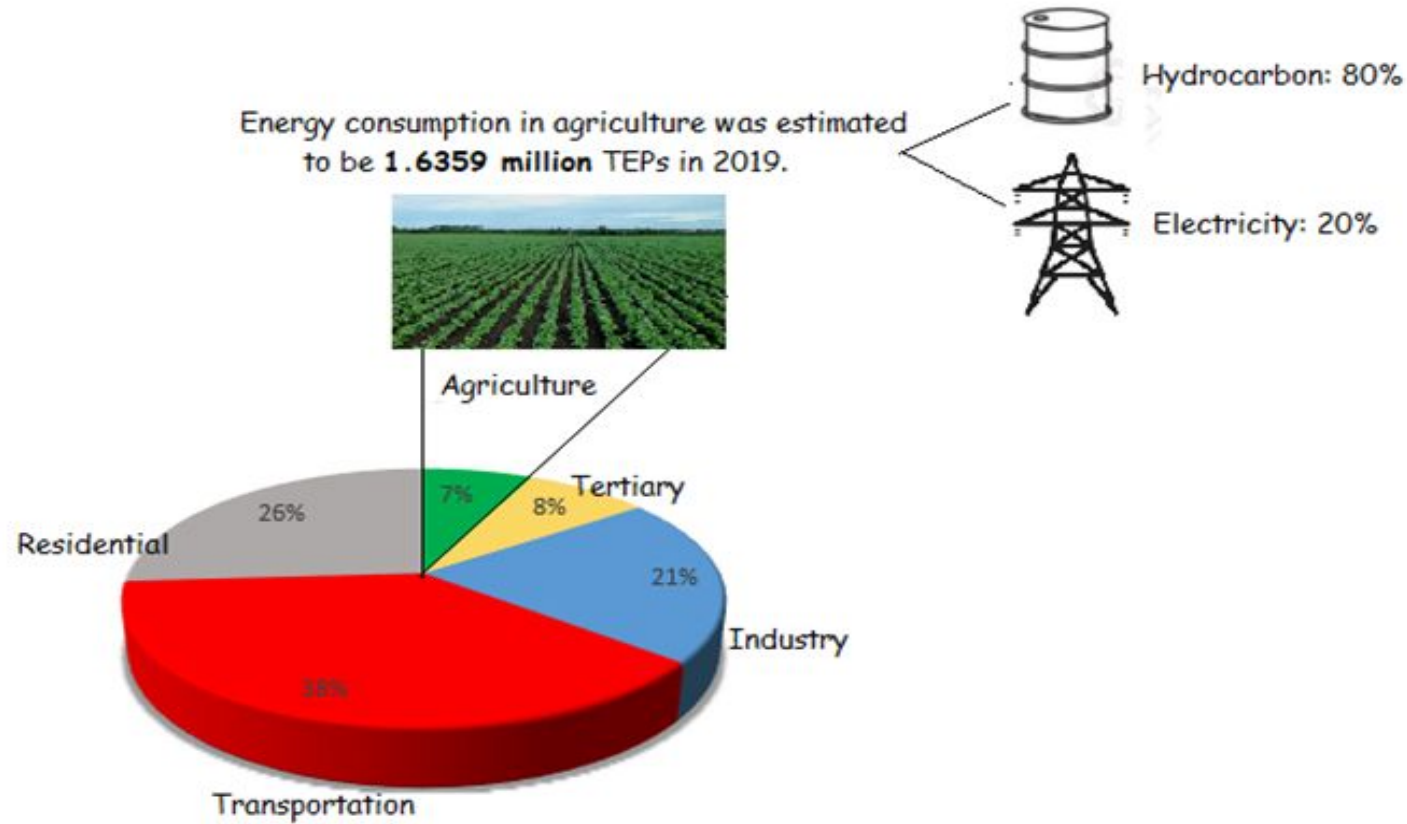


Introduction

Energy consumption in agriculture was estimated to be **1.6359 million TEPs** in 2019.



Introduction

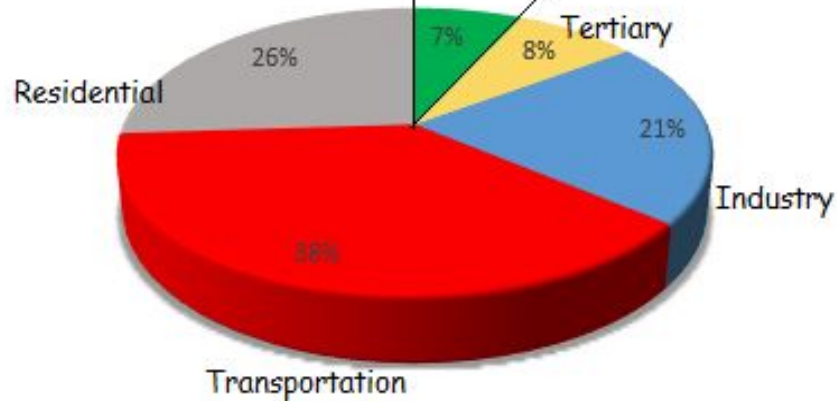


Introduction

Energy consumption in agriculture was estimated to be **1.6359 million** TEPs in 2019.



Agriculture



Hydrocarbon: 80%



Electricity: 20%



Hydrocarbon: 80%

GPL: 32%

Diesel: 68%

Burning of Fossil Fuels
=
More Carbon emissions



Introduction

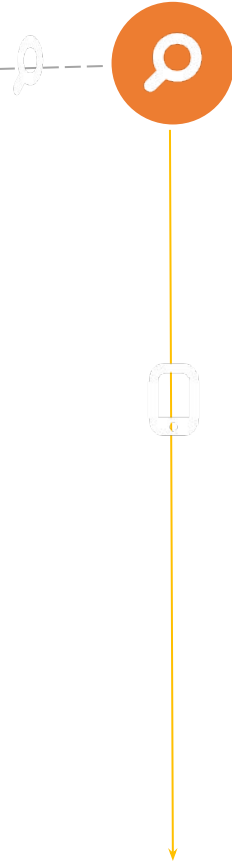
- Equipping small farmers by photovoltaic water pumping system to improve energy and water use efficiencies .
- No official use of Butane Gas for water pumping



Materials And Methods

Farmer Survey Information on :

- ☐ The exploitation;
- ☐ Irrigation system;
- ☐ Pumping Station;



Materials And Methods

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- The exploitation;
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Economic Study:

- Annual Energy Consumption;
- Annual Total Cost;
- Annual Volume Pumped;
- Cost of Water Cubic Meter;



Materials And Methods

Farmer Survey Information on :

- The exploitation;
- Irrigation system;
- Pumping Station;



Economic Study:

- Annual Energy Consumption;
- Annual Total Cost;
- Annual Volume Pumped;
- Cost of Water Cubic Meter;

Environmental Study:

- PV Pumping System;
- Diesel Pumping System;
- Gas Pumping System;



Materials And Methods

Located in El Brouj occupying a total area of 30 ha, which is dedicated to the production of Olives. The farm is equipped with a drip irrigation system.

The photovoltaic pumping system comprises:

- 78 panels; max power = 270Wp
- Maximum Power = 17kW



Materials And Methods

Economic Study

➤ Annual Energy Consumption :

$$C_e = \epsilon \cdot d \cdot N_{bj}$$

➤ Annual Total Cost (Dhs):

$$C_e \times \text{Unit Price}$$

➤ Annual Pumped Volume (m³) :

$$V = Q \cdot d \cdot N$$

➤ Cost of Water Cubic Meter (Dhs):

$$\text{Annual Cost} / V$$

Environmental Study

- ❑ Fossil fuels emit greenhouse gases during electricity production;
- ❑ Photovoltaic panels produce electricity without any emissions.

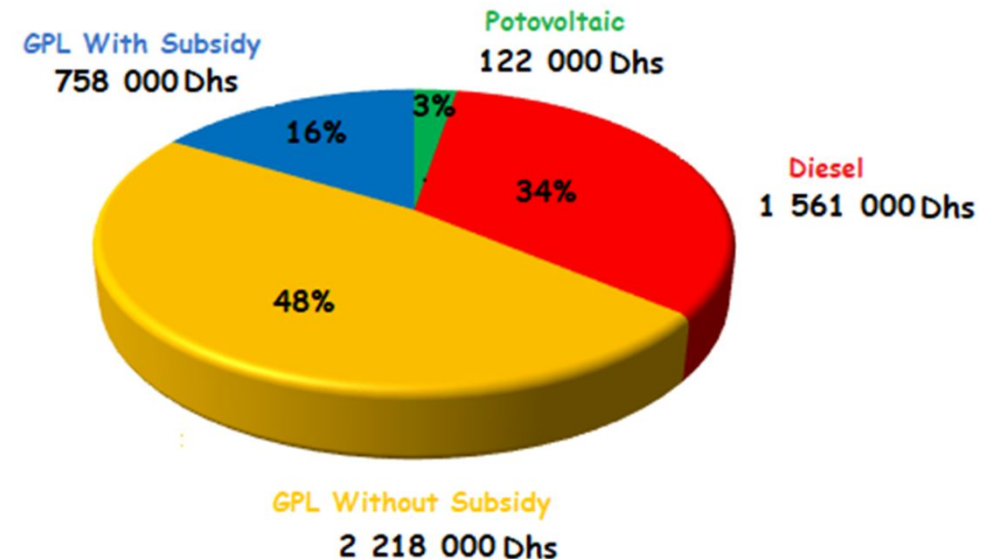
However, the production, transportation, and recycling of these panels still result in emissions.

Results and discussions

Economic Study: Total Expenditure for 10 years of Energy Exploitation (17 kW)

- Photovoltaic investment cost is the most affordable at 122,000 Dhs.
- Other options (2,218,000 Dhs and 1,561,000 Dhs for the GPL and Diesel engine).

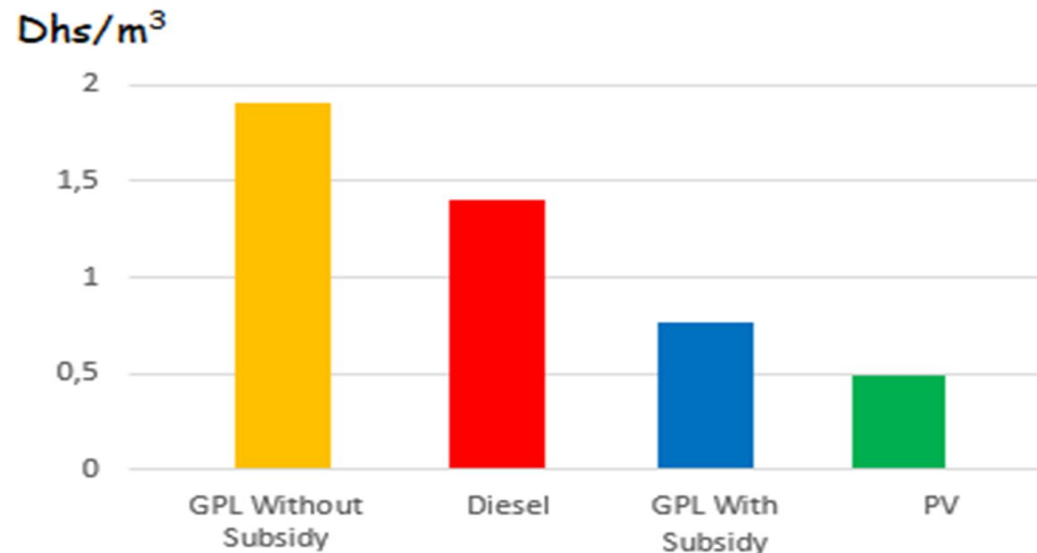
Expenses for 10 years



Results and discussions

Economic Study: Cost of Water Cubic Meter

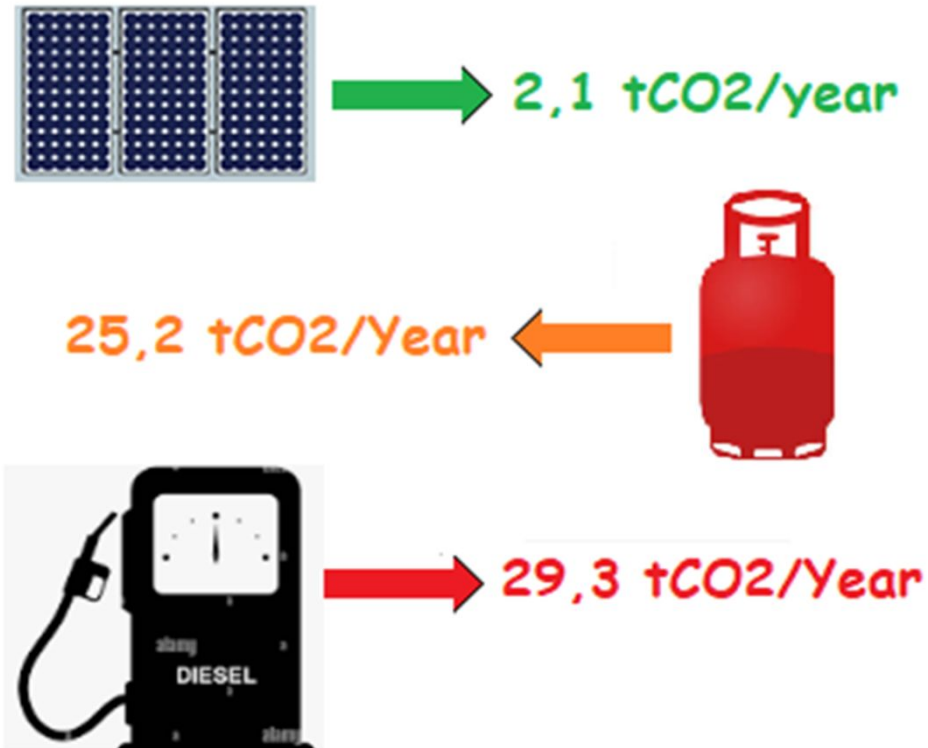
Cost of Water Cubic Meter



- PV System : 0.48 Dhs/m3.
- GPL With Subsidy : 0.70 Dhs/m3
- Diesel System : 1.48 Dhs/m3.
- GPL Without Subsidy : 1.80 Dhs/m3

Results and discussions

Environmental Study: Emissions of CO₂



- Photovoltaic pumping system emits a negligible amount of CO₂ emissions (2.1tCO₂/year).
- GPL System emits around 25.2tCO₂/year
- Diesel ranks highest at 29.3tCO₂/year.

Conclusion:

- **PV: High initial cost for 1-year; but more competitive** compared to other systems over its **10-years** operational period.
- **PV: the cost of each cubic meter of water pumped is lower** than that of a **thermal pumping system**, with a difference rate of **49%**.
- **PV: It emits fewer CO2 emissions** compared to **other energy sources**.
- **Efficient water application using PV energy** can significantly enhance the **sustainability of mechanized irrigation** and serve as a **crucial component of Conservation Agriculture**.



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