



# Algae as a potential source of bio-diesel in Ghana

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# Introduction

The global economy and for that matter the Ghanaian economy is largely dependent on energy.

An increasing global population to the current reported 7 billion people in October 2011, added to the desire for greater economic growth has culminated in an ever increasing demand for energy worldwide.

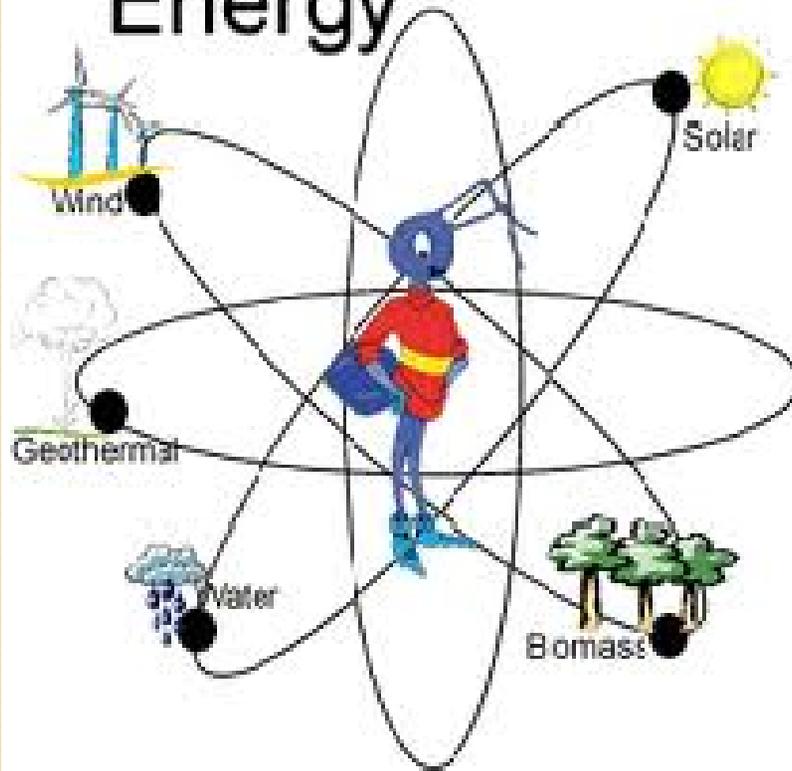


## Energy

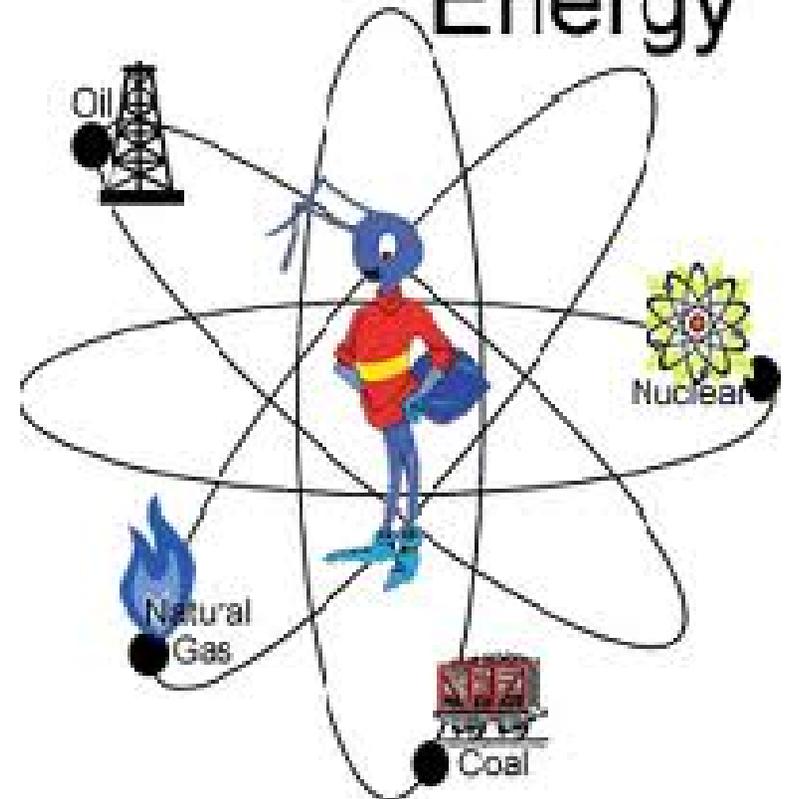
According to one estimate, with current trends and demands, globally 60% more energy will be required in 2030 than today

# Available Energy Sources

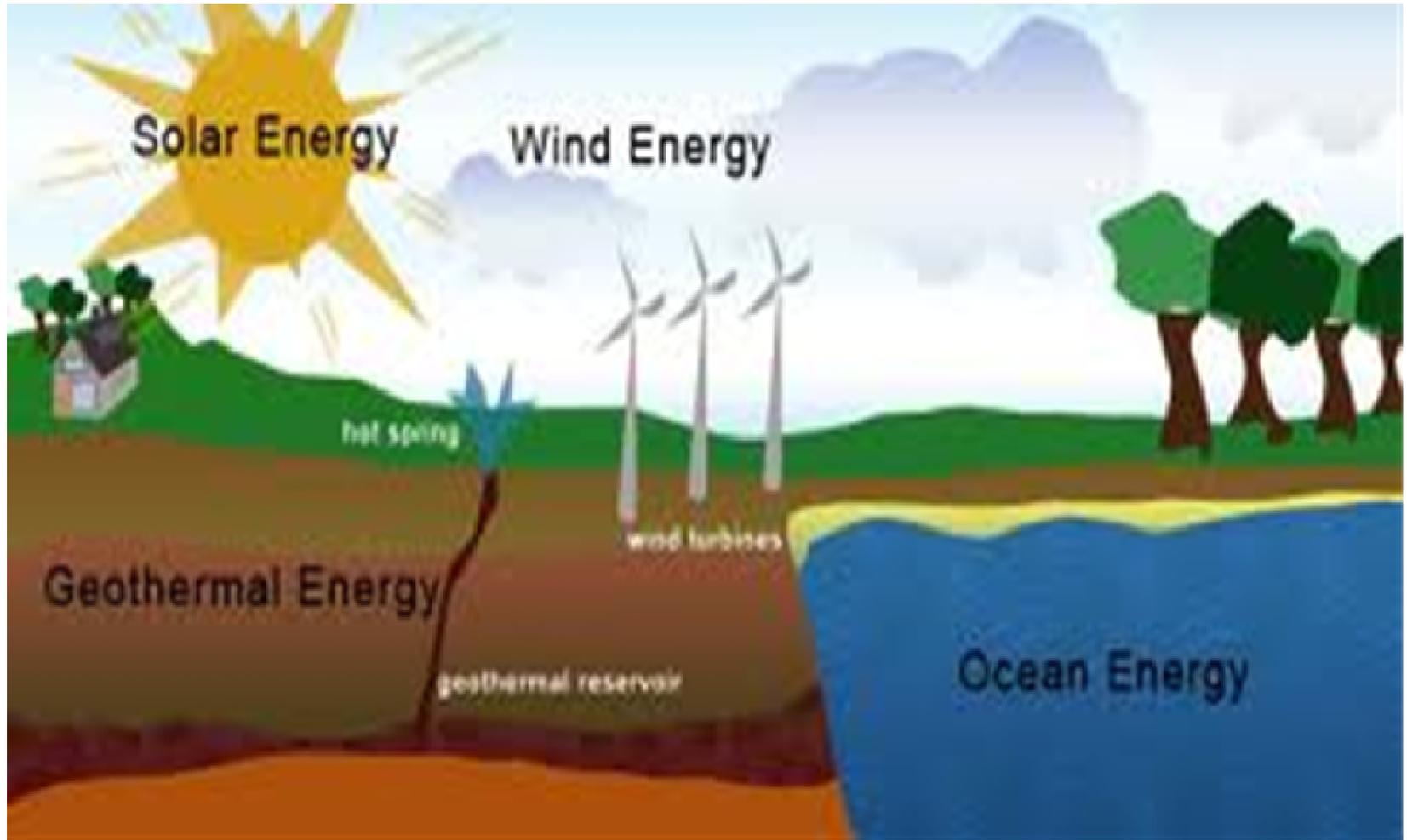
## Renewable Energy



## Non-Renewable Energy



# Renewable energy



# Hydro-power (Renewable)



Trabela Dam on Indus River, Pakistan

**Ghana: Akosombo Dam  
Bui Dam**



# Renewable energy (wind & solar)

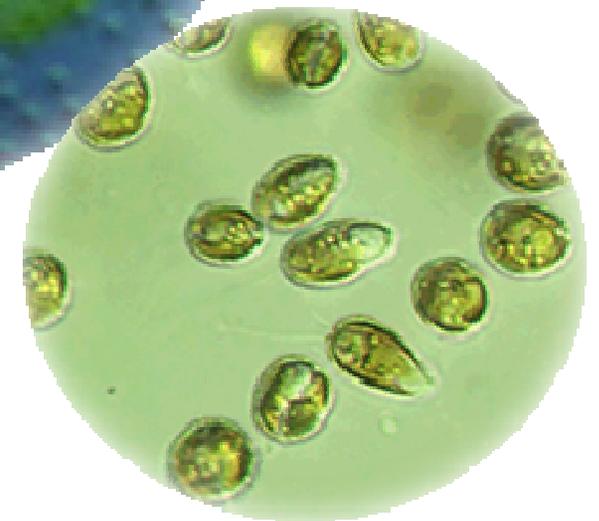
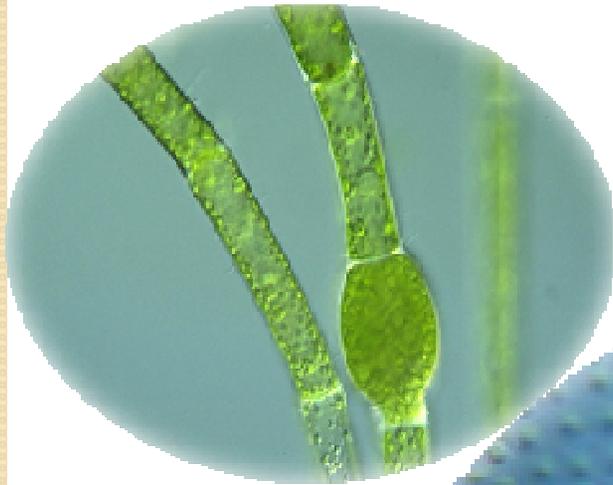


# Biomass (plants) [Renewable]



# Jatropha

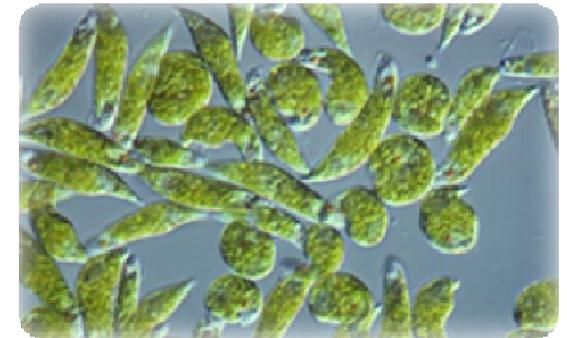
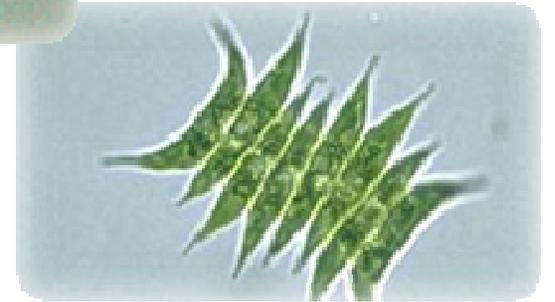
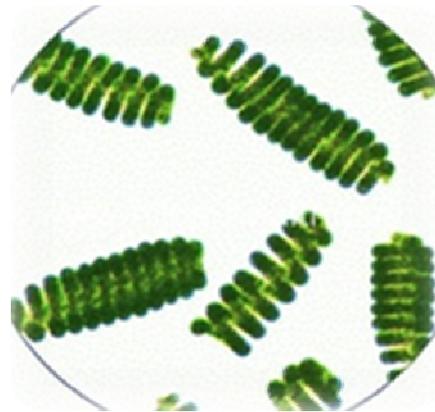
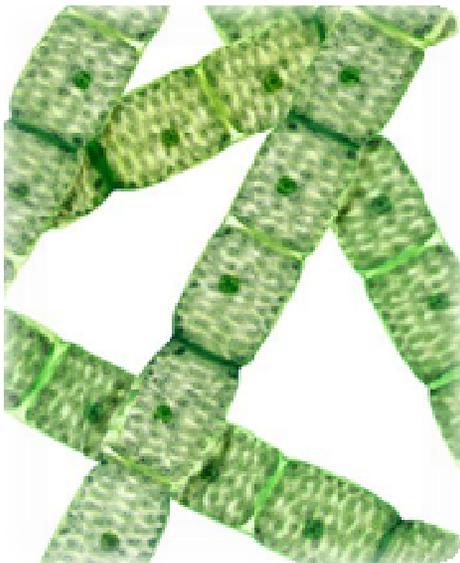
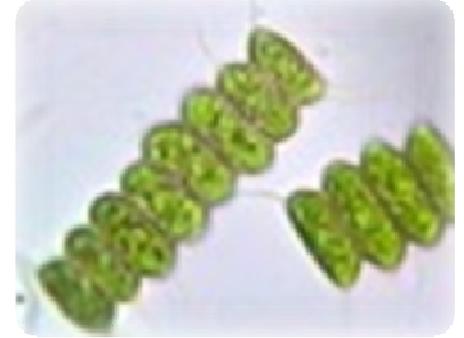
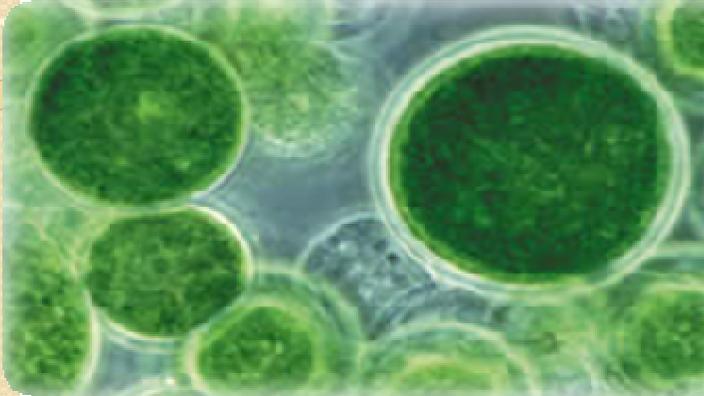




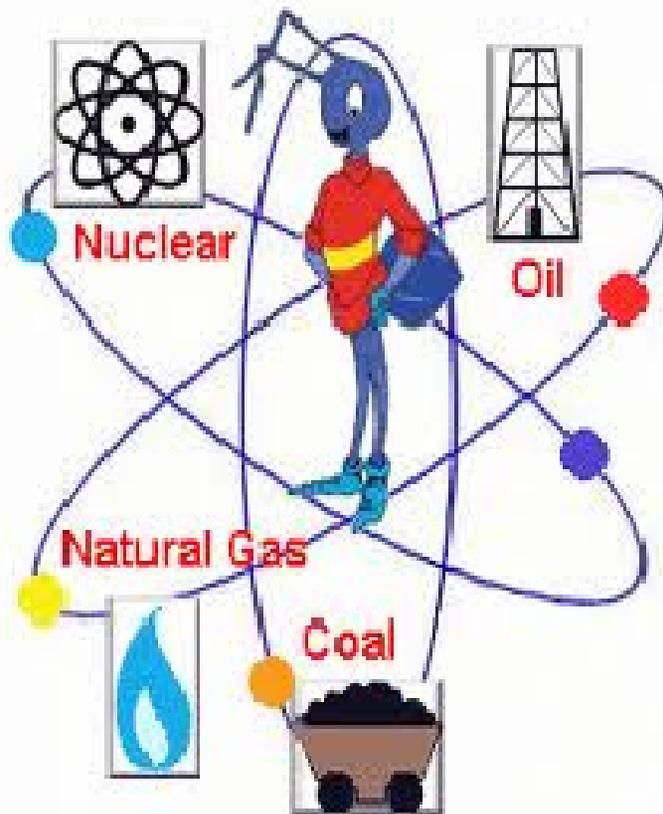
**BIOMASS FROM  
MICRO-ALGAE**

МИКРО-АЛГАЕ

# Biomass from micro-algae



# Non-Renewable Energy



# Non-Renewable Energy (Coal)





## Ghana situation

- Increase in population
- Expansion of the economy

Increase in demand for  
energy

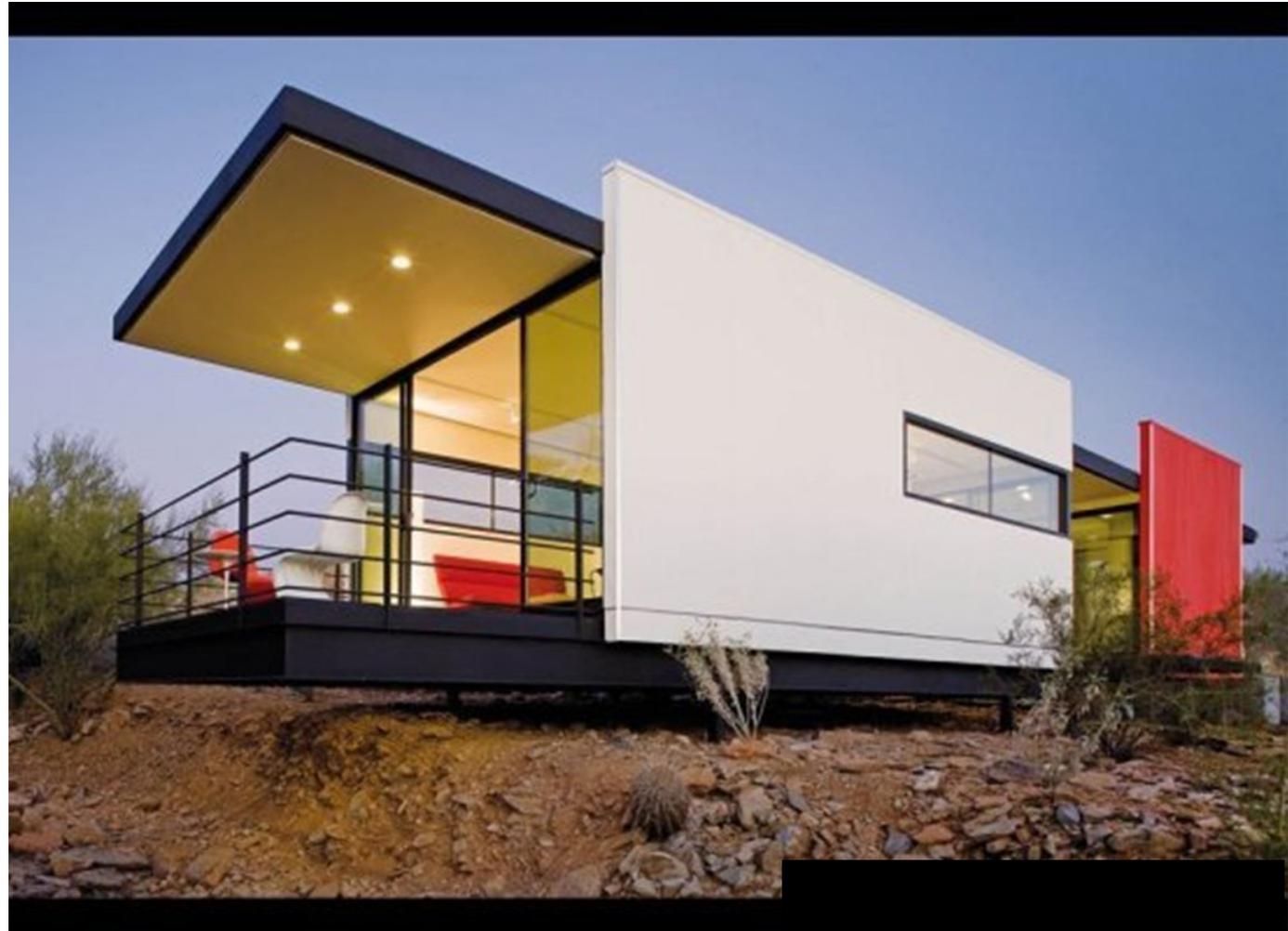
# Transportation



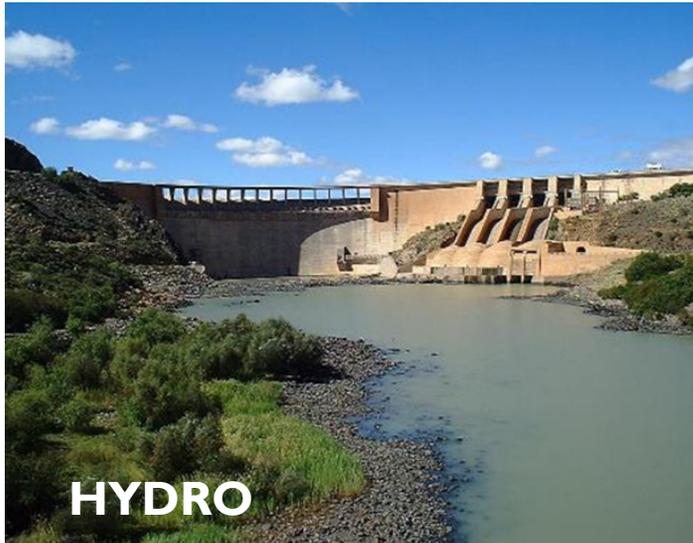
# Industry, particularly mining



# Domestic Use



# Energy Sources Available to Ghana





## Energy

Fortunately, Ghana has started producing crude oil (fossil fuel) in commercial quantities since October 2011. The production of crude oil and hence petroleum diesel is expected to meet the future energy needs of all sectors of the economy.



# Energy

The continued use of fossil fuels is not sustainable, simply because, they are finite resources. Furthermore the combustion of fossil fuels results in **pollution of the environment.**



# Energy

Combustion of fossil fuels leads to emissions of green house gases such as carbon dioxide ( $\text{CO}_2$ ), sulphur dioxide ( $\text{SO}_2$ ), and nitrogen oxides ( $\text{NO}_2$ ,  $\text{NO}_3$ ).

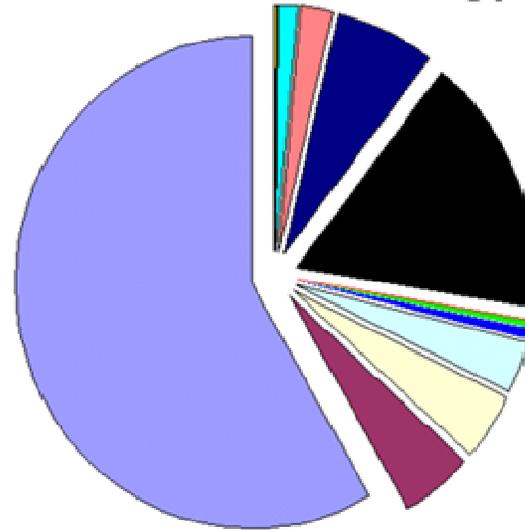


## Biofuel

**Energy** to meet national and global needs and to reduce environmental problems must come from other sources such as solar, wind, hydrogen, and **BIOFUELS**.

# Renewable Energy

World Renewable Energy 2005



Large hydro 58.23%	Small hydro 5.12%	Wind power 4.58%	Biomass elec 3.42%
Geothermal elec 0.72%	Photovoltaic 0.42%	Other elec** 0.05%	Biomass heat* 17.08%
Solar heat 6.83%	Geothermal heat 2.17%	Biodiesel fuel 1.21%	Bioethanol fuel 0.16%



# BIOFUEL

Biofuel is generally defined as gas, liquid, or solid fuel made up of, or derived from **BIOMASS**



## BIODIESEL

Biodiesel fuel can be obtained from a variety of sources including waste cooking oil, rice barn, corn oil, fish oil, and **algae**



## ALGAE

According to Shay (1993), macro- and micro-algae generally have a higher photosynthetic efficiency than other biomass and are thus considered as one of the best sources of biodiesel. Indeed the algae can produce 250 times the amount of oil per acre as soybeans.



## ALGAE

There is enough evidence to indicate that algae are the most promising source of alternative energy source



## ALGAE

The use of algae as a source of fuel is not new. Rudolph Diesel was probably the first to demonstrate the use of biodiesel from a variety of crops in 1900.

- Kapdan & Kargr, 2006;
- Chisti, 1980-1981.



# BIODIESEL

There has been a revival in the use of biodiesel worldwide in recent years largely because of the escalating price of petroleum, and more importantly the realisation that global warming is associated with the burning of fossil fuel.



# Biodiesel from algae in Ghana

- In Ghana, the use of algae for biofuel production started in our lab in 2012
- Professor Gabriel Ameka  
Department of Botany
- Dr Louis Doamekpor  
Department of Chemistry

# BIODIESEL

Received considerable attention in recent years:

- biodegradable,
- Renewable, and
- non-toxic fuel
- It contributes no net carbon dioxide or sulphur to the atmosphere and emits less gaseous pollutants than normal diesel

Lang *et al.*, 2001; Antolin *et al.*, 2002; Vicente *et al.*, 2004.



# Microalgae

Microalgae have been suggested as very good candidates for fuel production because of their advantages of:

- higher photosynthetic efficiency
- higher biomass production and
- faster growth compared to other energy crops

Milne *et al.*, 1990; Ginzburg, 1993; Dote *et al.*, 1994; Minowa *et al.*, 1995



## Biodiesel

Use

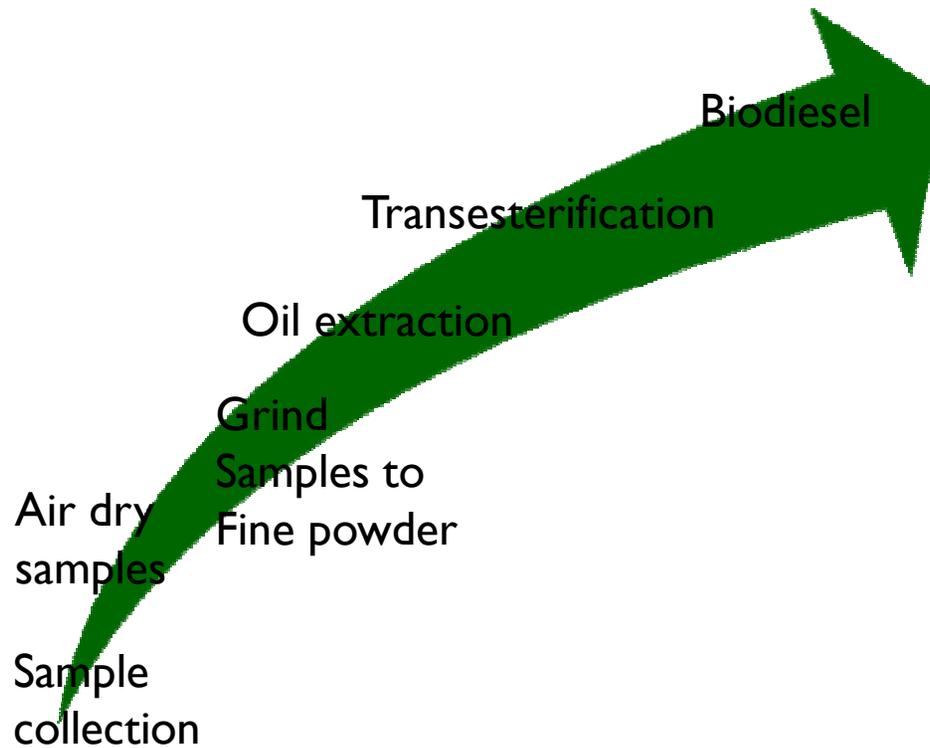
Macro-algae (marine)

Micro-algae (freshwater)

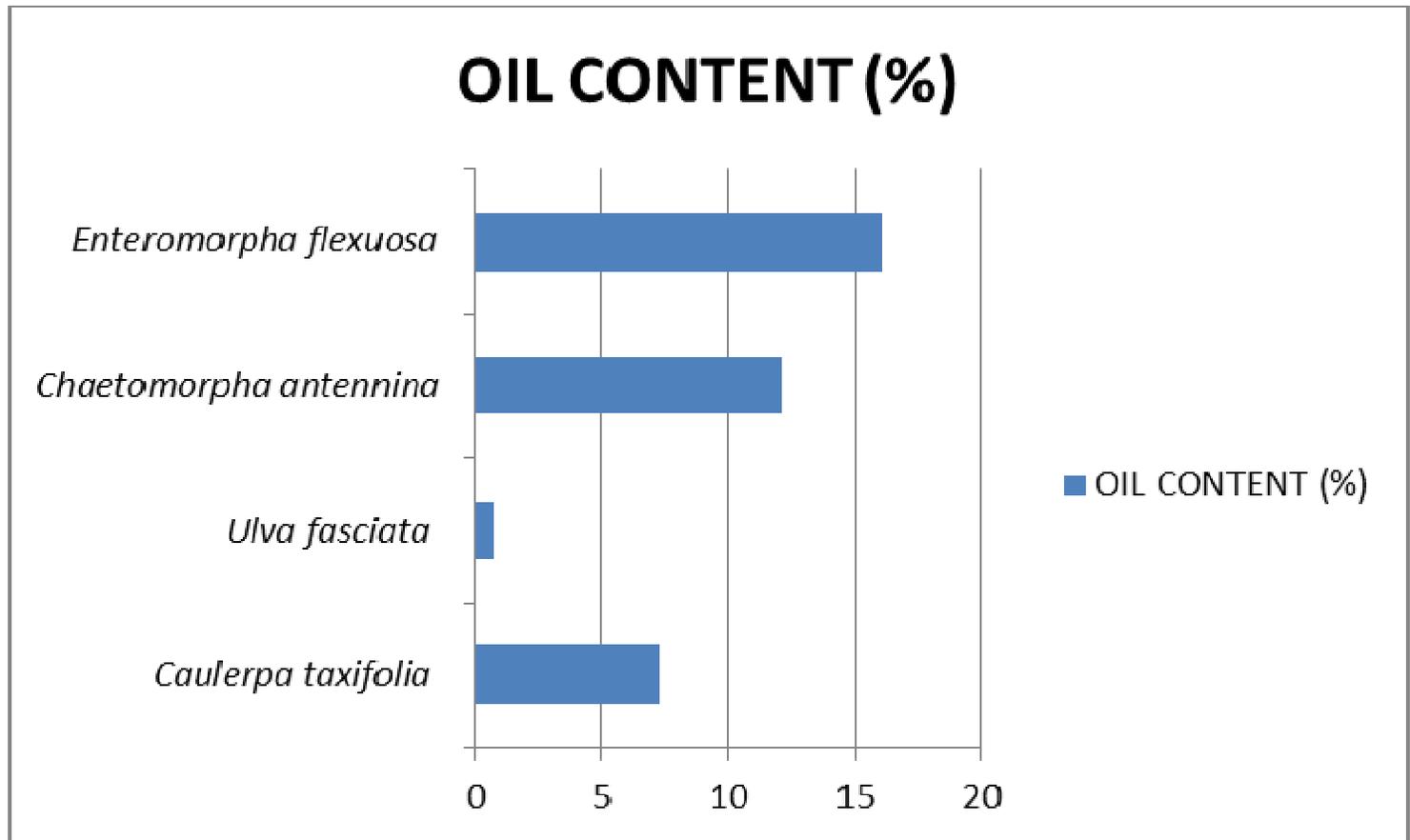
# Marine algae



# Methods



# Results





## Current studies

Currently

- (i) Refine /improve biodiesel from macro-algae
- (ii) Collect micro-algae from the wild and grow in the lab for extraction of oil and biofuel production
- (iii) **Seek collaborators**



Some  
natural  
habitats  
of algae



# Future studies

How to grow micro-algae on commercial scale for biofuel production