Universiti Teknologi MARA

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Economic Feasibility of Biomass Utilization for Power Generation

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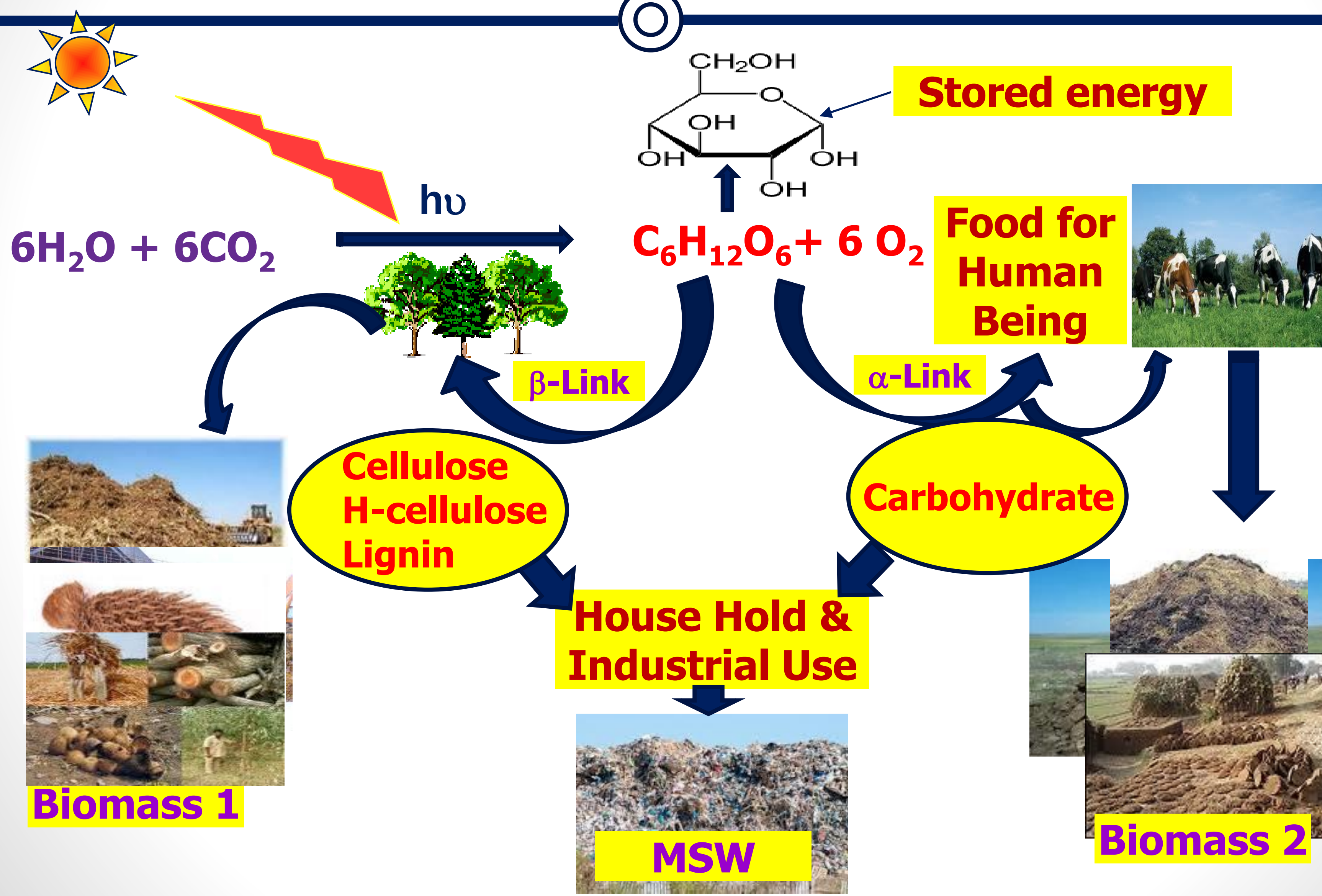
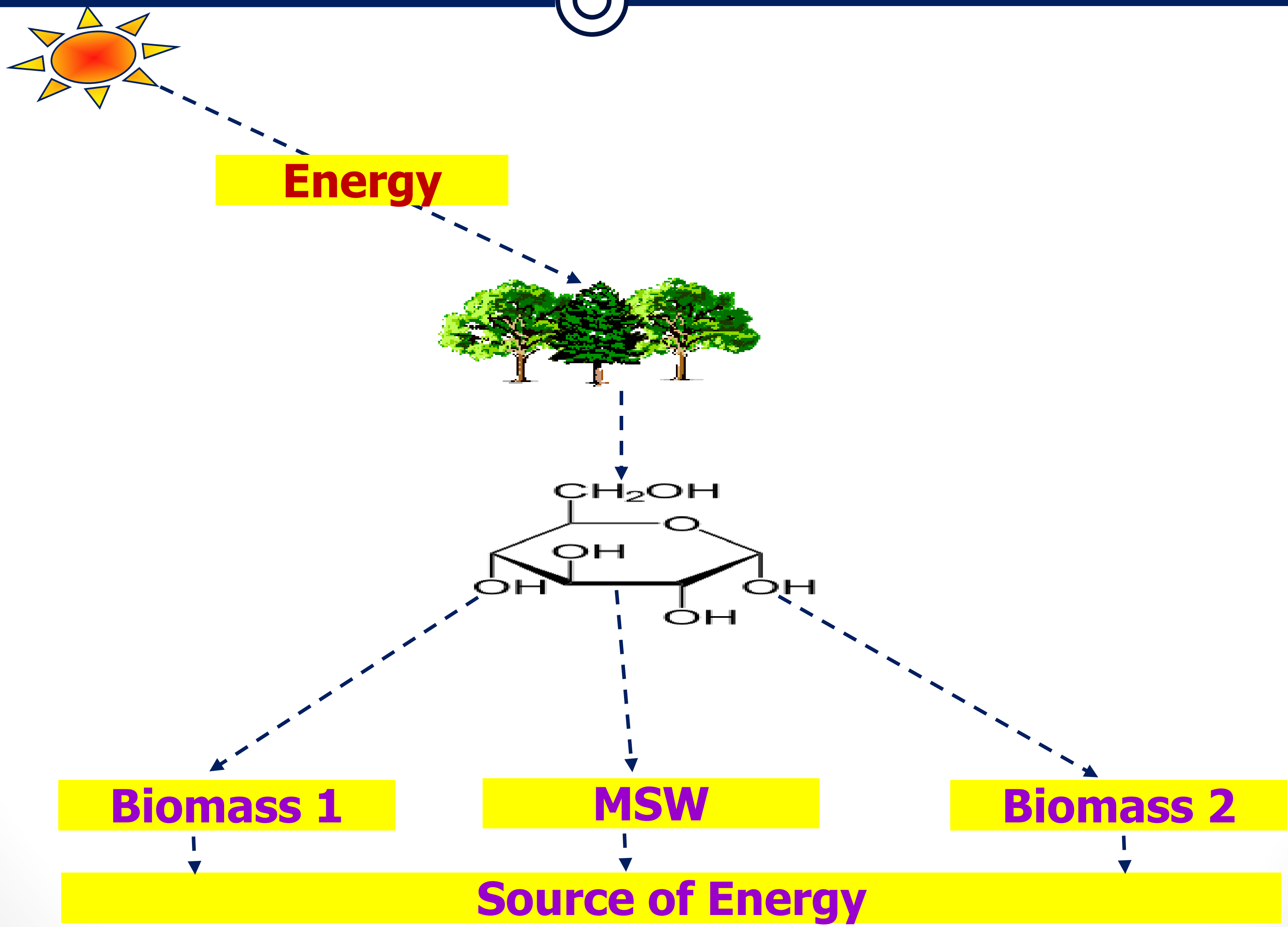
What is biomass and how is it formed?



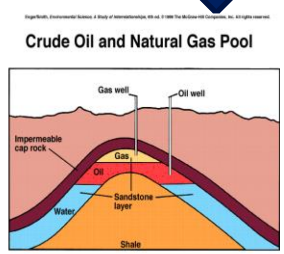
Energy transformation

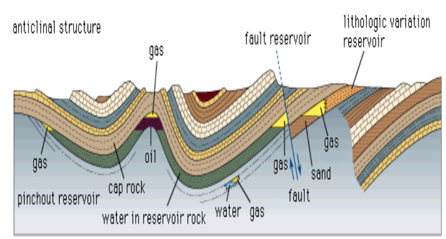


Biomass is the Source of Fuels, Chemicals, Materials & Power

Millions of years

1. **Biogenesis**
2. **Metagenesis**
3. **Catagenesis**



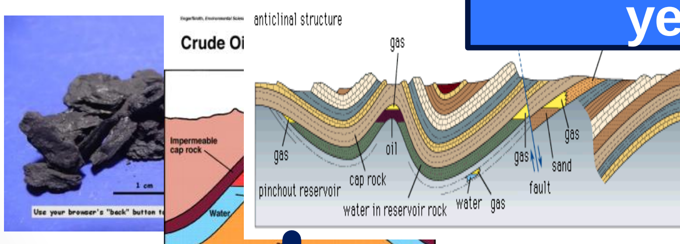


Fuels **Chemicals** **Materials** **Power**

Objective

Millions of years

Overall objective is to reduce millions of years to zero year.



Fuels

Chemicals

Materials

Power

0 year

Modern technology

Fuels

Chemicals

Materials

Power

Barriers of Biomass Utilization for Power Generation

Problem with Collection, transportation and storage

Characteristics	Problems	Pretreatment
1. Flappy	1. Collection	1. Drying
2. Low density	2. Transportation	2. Pelletizing
3. Too moist	3. Storage	Additional cost

Barriers ……..Cont…

Problem with conventional technology

Combustion steam cycle

1. Efficiency <20%
2. Investment - High
3. Electricity price – Low
4. Land space - Large

Gasification engine cycle

1. Efficiency > 35%
2. Efficiency > 60% (CHP)
3. Investment – Moderate
4. Land space-Less than 50%

Gasification steam cycle

1. Efficiency <20%
2. Investment – High
3. Land space - Large

Barriers ……..Cont…

Problem with Governmental policies

Example - Malaysia

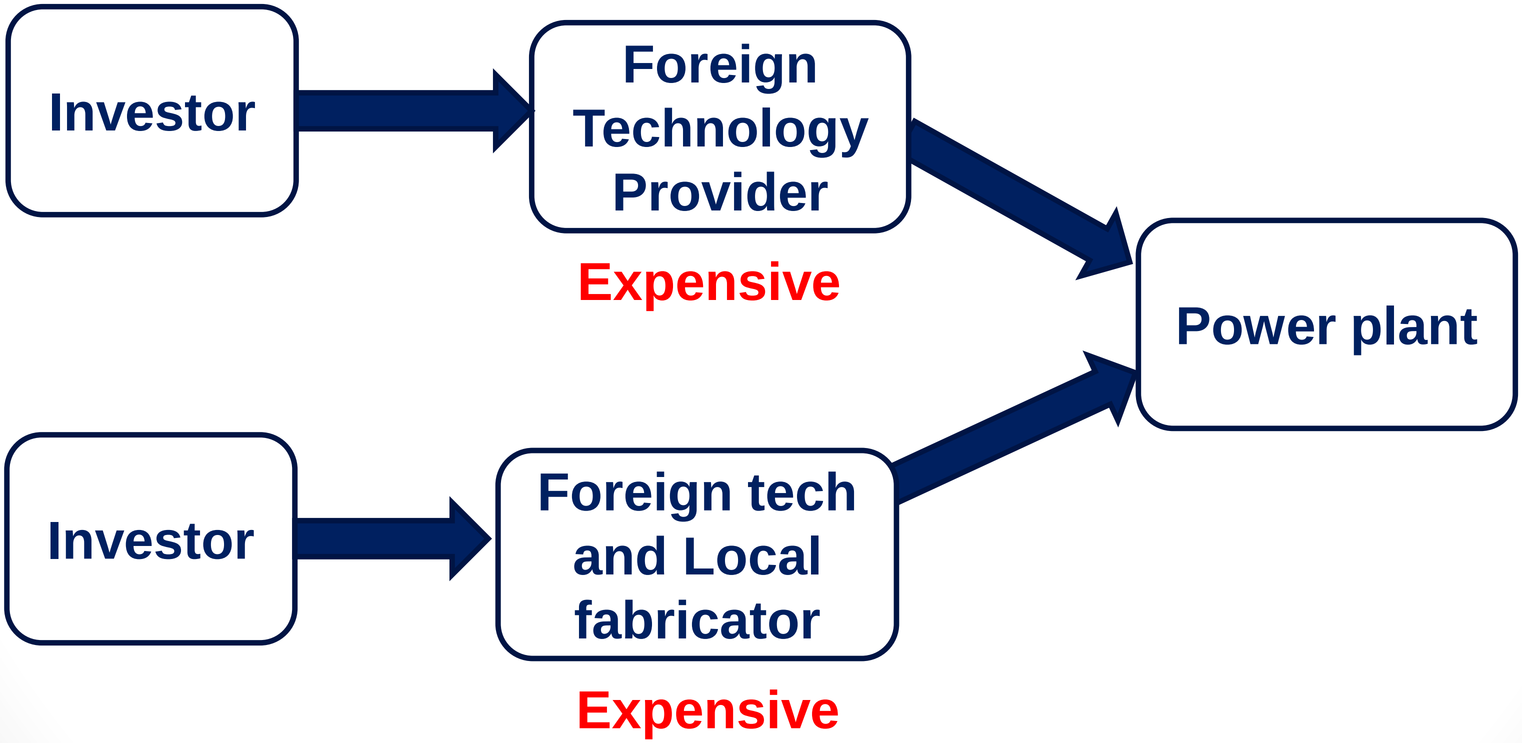
- **Malaysian has policy to utilize biomass for power generation; however, it is slow process and is not friendly to private investor.**

- **Exporting huge oil palm biomass as pellet but not giving support to utilize it by private sectors for power generation.**

Barriers ……..Cont…

Problem with Capital Investment

Example - Malaysia



How to make biomass power technology economically feasible?

- Double the overall efficiency half is the total requirement and costing.
- Investor friendly governmental policy.
- Investor must have expert human capital.
- Investor must have own fabrication facilities.
- Investor friendly financing policy.

How to multiply the efficiency?

Downdraft gasifier with catalytic hot gas cleaning → Clean gas → Gas engine

Efficiency, 40%

Efficiency, 90%

Overall η_{el}, 35%

Heat recovery, 30%

Total efficiency for CHP = 65%

Investor friendly governmental policy

- **Government must give incentive to the investor and buy the privately produced electricity with reasonable price.**
- **Government must give national grid facilities to supply electricity.**
- **Malaysia has both of the facilities.**

Cost down by the expert human capital and self-fabrication facilities

- **If an investor can develop expert human capital and equipment fabrication facilities, the capital cost would be less than half for setting up a power plant.**

- **The investor should jointly work with University expert team to jointly develop the technology.**

An example to show how the biomass power production is feasible.

Example: Malaysian palm oil mill

Total FFB process Ton /day	CPO, Ton/day	EFB, Ton/day	Meso-carp, Ton/day	PKS, Ton/day
1000	200 (20%)	220 wet (22% of FFB)	140 wet (14% of FFB)	60 wet (6% of FFB)
		66 dry (30% of wet)	84 dry (60% of wet)	51 dry (85% of wet)

An example …cont.

Example: Energy to be converted to electricity

Total Biomass produced in a mill Ton /day	Total energy content MJ	Heat transfer to gas (90% eff)	Heat transfer to electricity with 35% gas engine efficiency, MJ	Power plant can be built with 35% eff, MW
201	3.5×10^6	3.1×10^6	1.1×10^6	12.7

Example: Heat recovery for steam and power production

Total exhaust gas to be produced, Ton/d	Exhaust gas temperature, ºC	Heat recovery MJ	Steam power, MW	Heat recovery in steam for mill, MJ
1335	500	534000	3	7.9×10^5
Total power production MW	**Gross Annual revenue, RM, Million**	**Gross annual revenue from CPO RM, Million**	**15 MW Power plant CAPEX RM, Million**	**Payback period Year**
15.7	64.5	140	80-90	2.3

Picture of Complete Gasifier

Model of Commercial Power Generation from Biomass

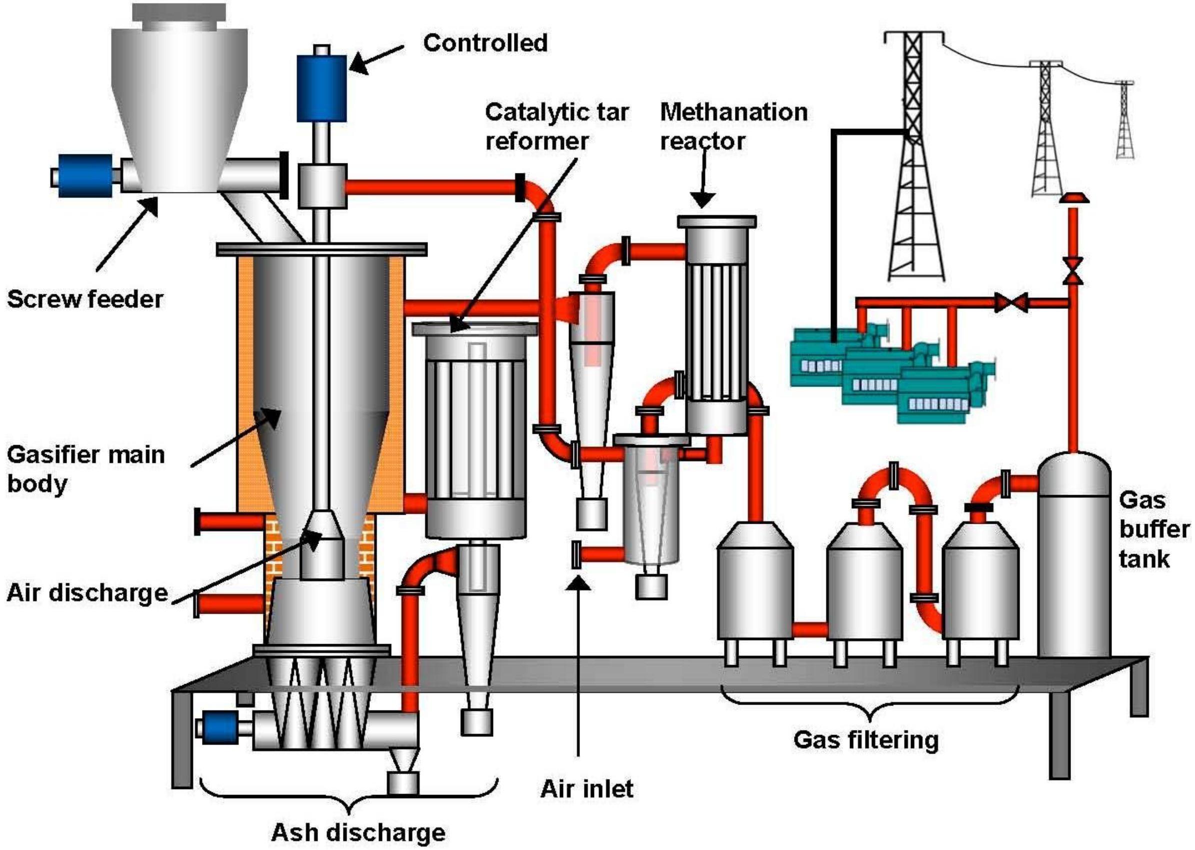
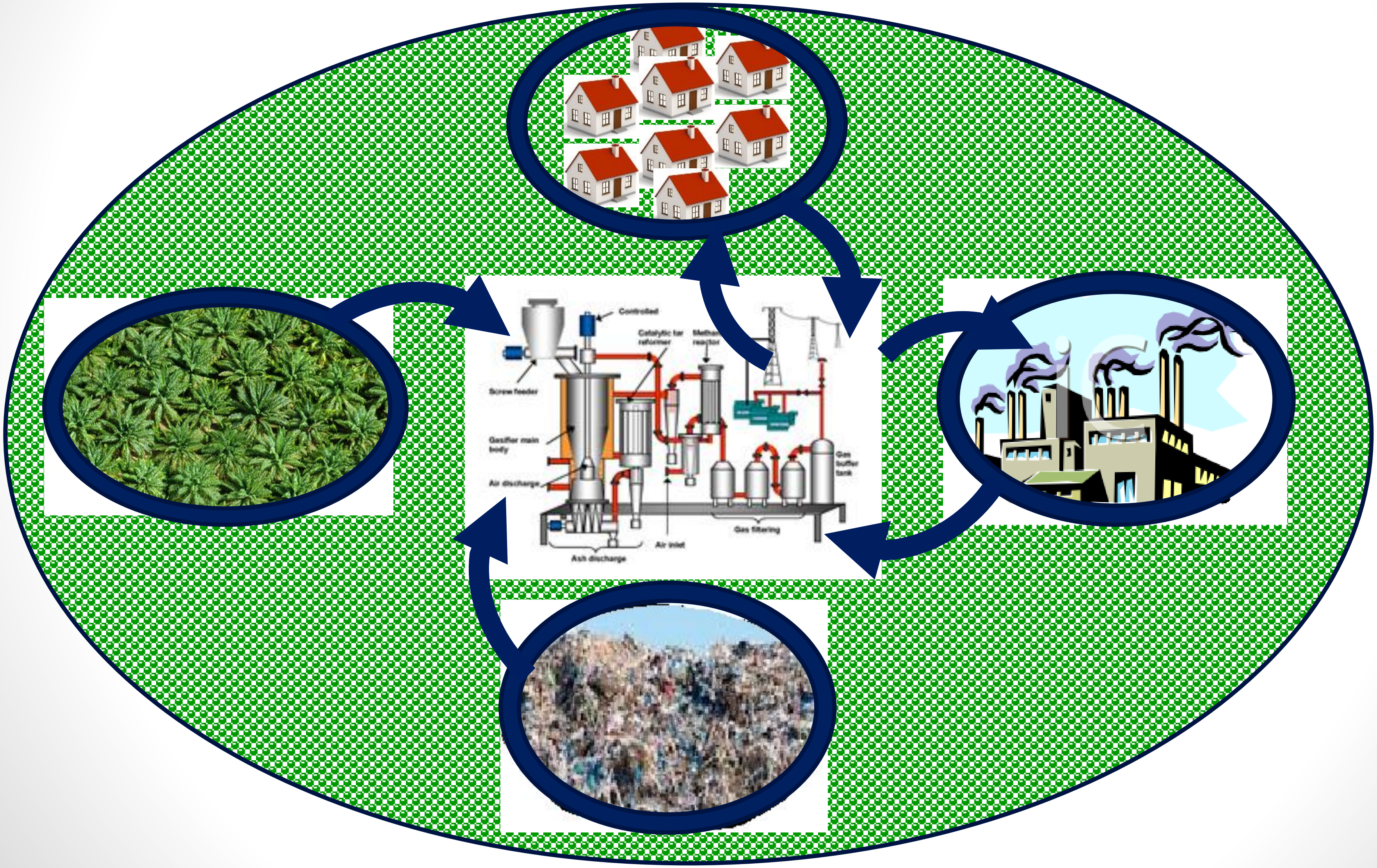


Figure 1. A schematic diagram of the prototype gas cleanning and conversion process for electricity generation.

Model of Biomass Power for Island of Maldives



Conclusion

- Biomass based power generation faces a number of challenges.
- The challenges can be overcome by combined effort of expert groups, investor and government.
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Thank You