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SESSION 1

APPLICATION OF SUSTAINABLE ENGINEERING DESIGN FOR AGRO-MACHINERY TECHNOLOGY AND AGRO-WASTES VALUE ADDED-PRODUCTS

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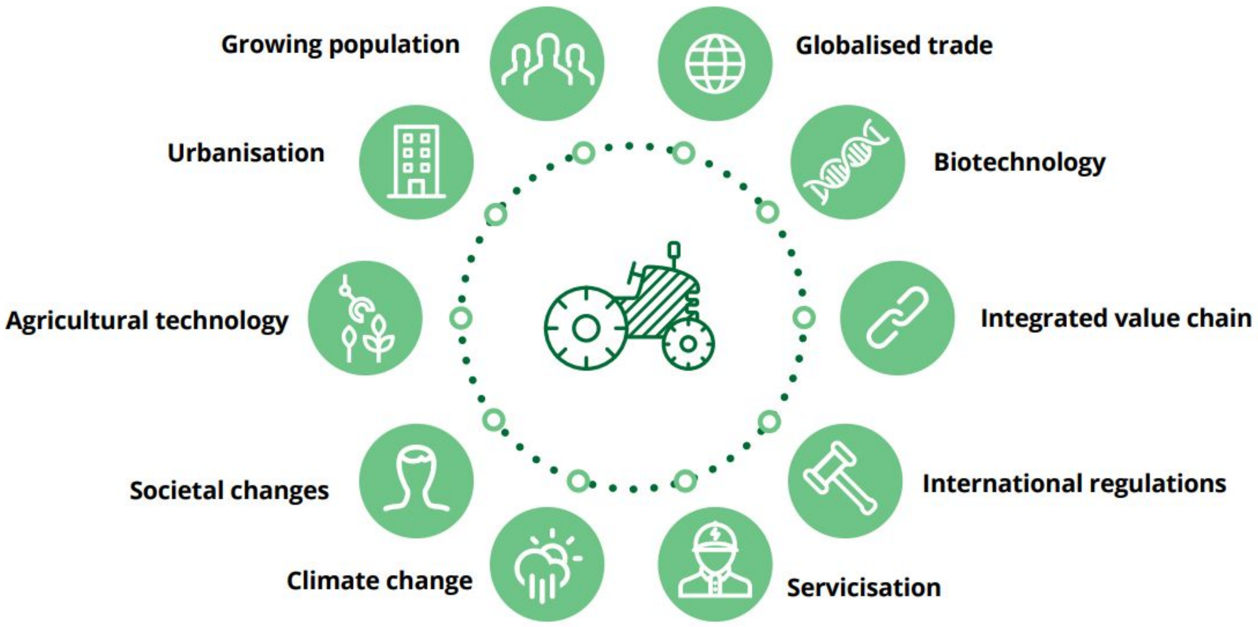
In 2020 alone, the global agriculture industry is **worth over USD9.6 trillion.**

Even with the pandemic, the industry is expected to increase with a compound annual growth rate of 6% in 2021. The pandemic has definitely impacted global food security, as a result of declining income, and subsequently putting food access at risk.

Source : Agriculture Global Market Report 2021: COVID 19 Impact and Recovery to 2030, (2021)

OVERVIEW OF AGRICULTURE MEGATRENDS

Trends are expected to have great influence on the agriculture industry and consumer behaviour



Source : Emerging Tech & Innovation in Malaysia's Agriculture Landscape What's Sprouting?. Dolomite, 2021

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GROWING POPULATION

The world's population is projected to reach 10 billion by 2050.

This is an increase of 28.2%. Global food production would have to expand by 70% to meet that demand.

BIOTECHNOLOGY

Genomics and genetic modification help improve existing varieties, resulting in increased yield and heightened resistance to pests and diseases.

This enables farmers to reduce the use of chemical pesticides and herbicides, while producing healthy and high-yield crops.

URBANISATION

50% of the world's population live in urban areas. By 2050, 70% of the world's population will live in urban areas. This means that with less people living in rural areas, will in turn affect the agricultural labour supply.

CLIMATE CHANGE

Changing weather conditions such as the increase in droughts and
floods will affect soil quality and decrease crop yield in general

AGRICULTURAL TECHNOLOGY

Modern farms and agricultural operations adopt cutting edge technologies such as robots, temperature and moisture sensors, aerial images, and GPS technology to trigger higher yield, greater efficiency, and lower costs, while remaining more environmentally friendly..

GLOBALISED TRADE

Crops are grown in the most suitable locations, then processed and sold internationally.

A small proportion of the communities are heavily reliant on imports of staple foods such as rice, meat and seafood products, causing local food to be price-sensitive to international events

WHAT IS THE ENGINEERING DESIGN?

ENGINEERING DESIGN

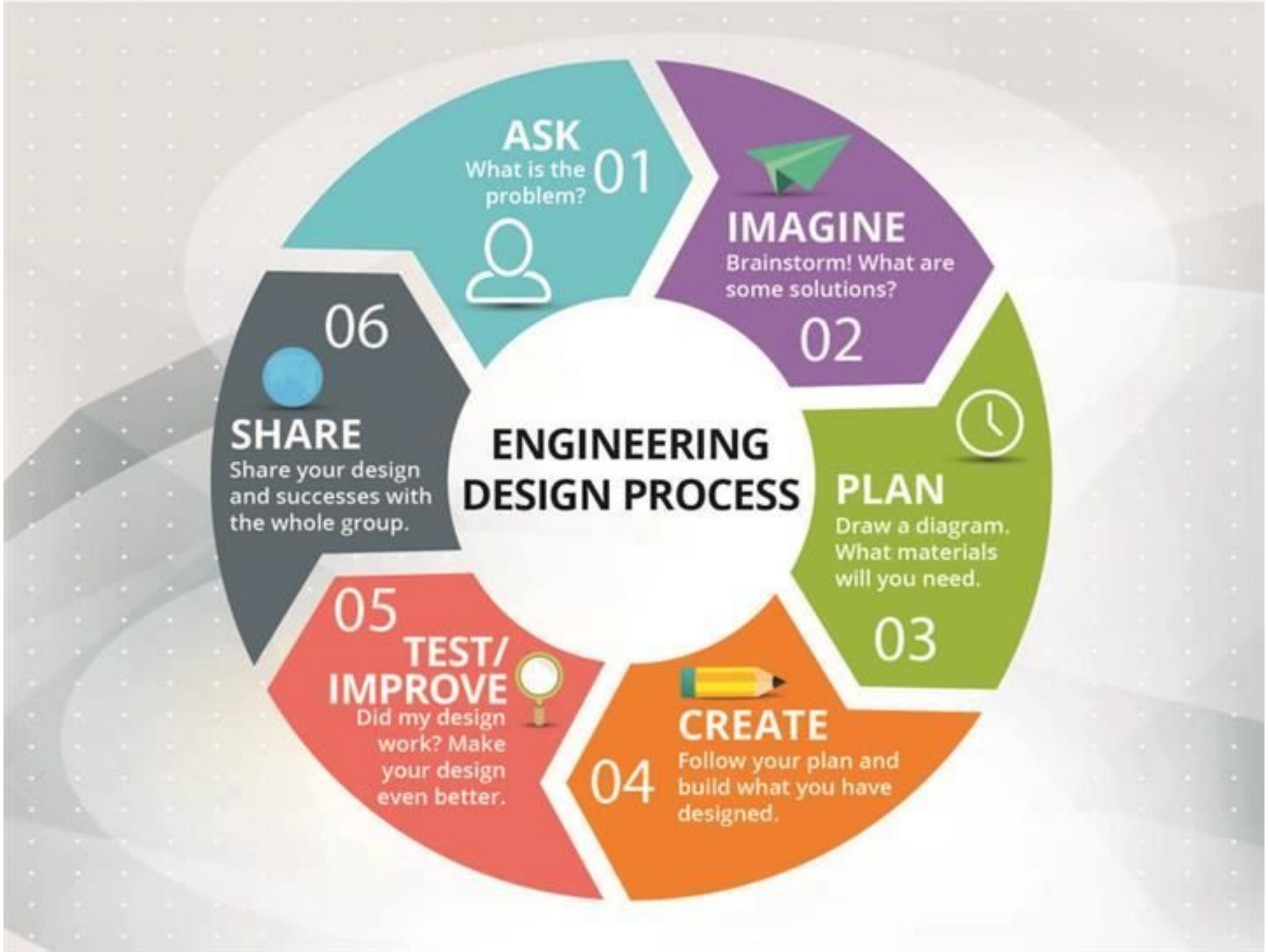
is the process of devising a system, component, or process to meet desired needs.

It is a **decision-making process** (often iterative), in which the basic sciences,mathematics, and engineering sciences are applied to optimally convert resources to meet a stated objective.

THE ENGINEERING DESIGN PROCESS

A series of steps that engineers use to find a solution to a problem.

These steps include: defining the problem, brainstorming solutions, designing and building a prototype of the solution, testing the solution, and improving it.


ASK
What is the problem?
01
IMAGINE
Brainstorm! What are some solutions?
02
PLAN
Draw a diagram. What materials will you need.
03
CREATE
Follow your plan and build what you have designed.
04
05
TEST/ IMPROVE
Did my design work? Make your design even better.
06
SHARE
Share your design and successes with the whole group.
ENGINEERING DESIGN PROCESS

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THE ENGINEERING DESIGN COMPONENT FEATURES

The design must be low cost.

The design must be low and easy maintenance.

The design should be safe.

The design should not be detrimental to the environment.

The design should be aesthetically pleasing.

The design should be simple to operate, with minimum human effort.

Furthermore, it is essential to include a variety of realistic constraints, such as economic factors, safety, reliability, aesthetics, ethics, and social impact

ENGINEERING DESIGN PROCESS - GATHERING INFORMATION

1. Is the problem real and its statement accurate?
2. Is there really a need for a new solution or has the problem already been solved?
3. What are the existing solutions to the problem?
4. What is wrong with the way the problem is currently being solved?
5. What is right about the way the problem is currently being solved?
6. What companies manufacture the existing solution to the problem?
7. What are the economic factors governing the solution?
8. How much will people pay for a solution to the problem?
9. What other factors are important to the problem solution (such as safety, aesthetics and environmental issues)?

ANALYSIS OF DESIGN

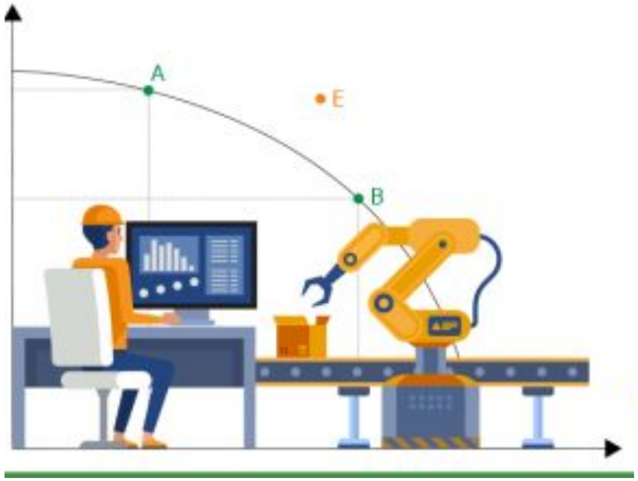
Analysis that may need to be considered; bear in mind that the importance of each varies depending on the nature of the problem and the solution.

1. Functional analysis
2. Industrial design/Ergonomics
3. Mechanical/Strength analysis
4. Electrical/Electromagnetic
5. Manufacturability/Testability
6. Product safety and liability
7. Economic and market analysis
8. Regulatory and Compliance

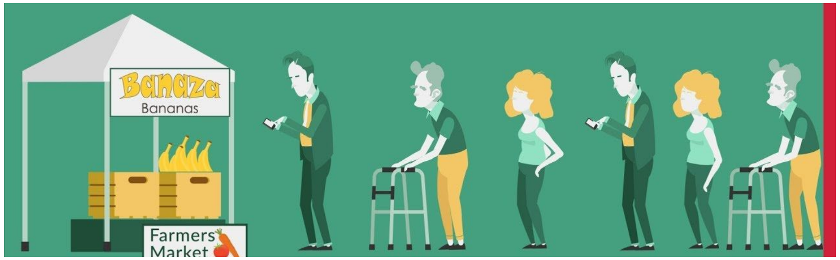
ENGINEERING DESIGN HAS GREAT POTENTIAL

To enhance the **global sustainability of agriculture in all fields of application**, from the development and correct use of innovative machinery to the latest application of farming solutions.

ENGINEERING DESIGN
GIVE INNOVATION SOLUTION



EFFICIENT PRODUCTION



SATISFY DEMAND

INVENTION VS INNOVATION

Invention

A device or process *originated* after study and experiment

→

Innovation

A new improvement to an *existing* device or process

Image taken from: http://www.novuslight.com/led-market-phasing-in_N239.html

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ENGINEERING DESIGN IN AGRICULTURE

plays an essential role in developing engineering-based methodologies and decision support tools for waste process and treatment

to reduce the greenhouse gas emission

to reduce and correctly apply pesticides and fertilizers

for better agriculture management and

protection of soil, water, and environmental resources

ENGINEERING DESIGN IN AGRICULTURE have potential exploitation for every actor involved in the agricultural system

- from **farmers** to **consumers**
- from **researchers** to **policy makers**
- from **service providers** to **technical resources** (machinery, chemicals, etc.) producers

APPLICATION OF SUSTAINABLE ENGINEERING DESIGN FOR

AGRO MACHINERY TECHNOLOGY

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AGRO MACHINERY TECHNOLOGY

Mechanization of field and farm operations plays a relevant role.

Fossil fuels consumed by self-propelled machines are recognized as one of the main factors responsible of environmental concerns related to agriculture (e.g., global warming and emissions of pollutants into the atmosphere).

An effective mechanization can increase yield, improve product quality and reduce the use of manpower and agrochemicals.

Labour challenges Ageing farmers, rural-urban migration and **3D (dirty, dangerous and demeaning)** association with agricultural jobs led to a labour shortage in the sector.

As a result, Malaysia has been relying on foreigners to work in the sector, taking the largest share of foreign workers in the country—27% in 2017, equivalent to 611,000 workers.

Source : Emerging Tech & Innovation in Malaysia's Agriculture Landscape What's Sprouting?. Dolomite, 2021

In order to overcome scarcity of labour in harvesting and planting seasons of paddy and wheat, rice transplanter, self-propelled reaper and medium size combine harvester have high demand among the farmers.

Studies identified that the number of husking rice mills are shrinking and the businesses are being shifted either to semi-automatic or to automatic rice mills.

These modern rice mills are using mechanical technologies, like pre-cleaning, parboiling, drying, milling, paddy separating, polishing, de-stoning, fine polishing (silking), colour sorting, aerating, bagging, weighing and sewing.

ENGINEERING DESIGN IN CEA (CONTROLLED ENVIRONMENT AGRICULTURE)

Innovations in greenhouse engineering are technical developments which help evolve the **CEA (Controlled Environment Agriculture)**

APPLICATION OF ENGINEERING DESIGN

AGRO MACHINERY TECHNOLOGY

CEA (CONTROLLED ENVIRONMENT AGRICULTURE)

PROBLEM

Extreme environments for agriculture

- Despite global shifts in attitudes toward sustainability and increasing awareness of human impact on the environment, projected population growth and climate change require technological adaptations to ensure food and resource security at a global scale.
- Although desert areas have long been proposed as ideal sites for solar electricity generation, nowadays the effort shifted toward development of specialized and regionally focused agriculture in these extreme environments.
- In coastal regions of the Middle East and North Africa (MENA), the most abundant resources are consistent intense sunlight and saline sea water.

Source : Emerging Technologies to Enable Sustainable Controlled Environment Agriculture in the Extreme Environments of Middle East-North Africa Coastal Regions
https://www.frontiersin.org/articles/10.3389/fpls.2020.00801/full

APPLICATION OF ENGINEERING DESIGN

AGRO MACHINERY TECHNOLOGY

CEA (CONTROLLED ENVIRONMENT AGRICULTURE)

The consistent solar radiation and strong daily winds of the MENA region can readily be used for **sustainable electricity generation** by traditional photovoltaics and wind turbines.

Traditional agriculture in MENA regions includes cultivation of date palms,recent developments have seen increased efforts toward aquaculture farming

APPLICATION OF ENGINEERING DESIGN

AGRO MACHINERY TECHNOLOGY

CEA (CONTROLLED ENVIRONMENT AGRICULTURE)

- In recent study mention two key technologies can enable low-energy greenhouses in hot coastal environments: these are **efficient organic transparent infrared solar panels** and **liquid desiccant-based cooling.**

- Newly reported advances in efficient infrared organic solar panels have shown key efficiency advances in the capture of latent heat energy to generate electricity

- This technology will allow the surfaces of greenhouses and windows to generate electricity, while simultaneously serving as a transparent enclosure to enable plant and algal growth

APPLICATION OF ENGINEERING DESIGN

AGRO MACHINERY TECHNOLOGY

CEA (CONTROLLED ENVIRONMENT AGRICULTURE)

- Future CEA greenhouses will combine infrared solar energy capture and desiccant cooling technologies to create stable contained environments in extreme desert coastal environments.

- Infrared harvesting transparent solar panels allow photosynthetic active radiation (visible spectrum) to penetrate transparent glass surfaces to enable photosynthesis while simultaneously reducing the heating effect

APPLICATION OF ENGINEERING DESIGN

AGRO MACHINERY TECHNOLOGY

CEA (CONTROLLED ENVIRONMENT AGRICULTURE)

Passive cooling can be achieved by passing hot external humid air through highly saline liquid **desiccant solutions** in porous matrices which adsorb air moisture, releasing dry, cooler air due to the vapor pressure difference.

APPLICATION OF ENGINEERING DESIGN

AGRO MACHINERY TECHNOLOGY

CEA (CONTROLLED ENVIRONMENT AGRICULTURE)

- Although greenhouses are not a new concept, emerging technologies now enable energy efficient and profitable implementation of CEA in extreme desert environments.

- Low-energy cooling and enhanced energy generation/temperature reduction by transparent infrared harvesting solar cells can be combined to create energy efficient greenhouses primed for future agriculture concepts.

APPLICATION OF ENGINEERING DESIGN

AGRO MACHINERY TECHNOLOGY

CEA (CONTROLLED ENVIRONMENT AGRICULTURE)

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APPLICATION OF ENGINEERING DESIGN

AGRO MACHINERY TECHNOLOGY

CEA (CONTROLLED ENVIRONMENT AGRICULTURE)

The increased efficiency of these greenhouses can improve agricultural efforts in the MENA region, while contributing to food security and encouraging development of the CCE.

It remains to be seen whether regulatory control and growing demand for locally sourced crops will enable MENA coastal regions to beco

APPLICATION OF ENGINEERING DESIGN

AGRO MACHINERY TECHNOLOGY

CROP DRYING EQUIPMENT

PROBLEM

A drying of medicinal, aromatic and green plant always a challenge for farmer to preserve **green colour in plant**

Current method for drying these plant is shade drying

APPLICATION OF ENGINEERING DESIGN

AGRO MACHINERY TECHNOLOGY

CROP DRYING EQUIPMENT

SOLUTION

1. The breakthrough made by developing special glass (intelligent nano-crystalline glass) cover for the collector.
2. The glass changes to dark colour when subjected to intense light and brighter at reduced sunlight.
3. This way, photosynthetic reaction of green vegetables can be limited to retain their dry green colour pigment
4. Therefore, overheating of solar dryer and subsequent denaturing of sensory and nutritional qualities can be prevented especially for medical plant that required low drying temperature than other.

APPLICATION OF ENGINEERING DESIGN

AGRO MACHINERY TECHNOLOGY

DEHAULING & SIZE REDUCTION OF CROP

PROBLEM

SAFETY CONCERNS on the processed agro materials due to oxidation of machinery surfaces

APPLICATION OF ENGINEERING DESIGN

AGRO MACHINERY TECHNOLOGY

DEHAULING & SIZE REDUCTION OF CROP

SOLUTION

1. **Engineered nanomaterial structures** can be used to coat the surface of machinery.
2. These materials can create additional strength and resistance of machine surface to environmental factors and corrosion.
3. Ceramic nanoparticles can enhance thermal stability of coated moving parts.
4. Mica and Talc have shown to reduce weight loss of equipment.

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APPLICATION OF SUSTAINABLE ENGINEERING DESIGN FOR

AGRO WASTES VALUE ADDED-PRODUCTS

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WHAT IS AGRO WASTE ?

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APPLICATION OF ENGINEERING DESIGN

AGRO WASTE VALUE ADDED PRODUCT

1. **Minimise the adverse impact** of agricultural wastes on the environment, groundwater and public health, and to make use of the agricultural waste as by-products, as raw materials for new products, or as bio-sources of energy production

2. The world is looking for an energy system that is accessible, sustainable and clean lesser carbon intensive for survival and welfare of living beings

APPLICATION OF ENGINEERING DESIGN

AGRO WASTE VALUE ADDED PRODUCT

3. Agricultural sector has inescapably drawn attention towards itself due to growing concern over population explosion, changing climate and depletion of resources.

4. Advancements in technology have caused rapid boost in farm productivity and hence huge production of agro-wastes.

APPLICATION OF ENGINEERING DESIGN

AGRO WASTE VALUE ADDED PRODUCT

5. There have been massive deteriorating impacts of agro-wastes on existing environmental conditions, creating wide scale environmental pollution as well as biodiversity loss.

6. Agro-wastes have huge potential in the form of energy and nutrient recovery (ENR), amalgamations of different technologies would promote sustainability.

7. ENR not only adjoins an added profitable product but also facilitates to close environmental nutrient cycles.

APPLICATION OF ENGINEERING DESIGN

AGRO WASTE VALUE ADDED PRODUCT

The Availability of Various Agricultural Waste

- Various types of agro-waste can be found in the environment, which depends upon the source and availability.
- They can be derived from many different sources such as municipal solid waste works, livestock excrements, lignocellulosic and agro-wastes, food crops, etc.
- Thus, such waste can be classified into four main generations based on their ability to produce different types of products

APPLICATION OF ENGINEERING DESIGN

AGRO WASTE VALUE ADDED PRODUCT

First-generation

1. This comprises various classes of food crops such as wheat, corn, rice, and sorghum.
2. The direct utilization of these crops as a primary feedstock of interest is often associated with energy generation and the production of various products.
3. However, one of the major challenges associated with this generation is the competition between its utilization in fuel and food production.
4. Fuel production is viewed to be of a higher return on investment than food production.

APPLICATION OF ENGINEERING DESIGN
AGRO WASTE VALUE ADDED PRODUCT

Second-generation

1. This generation generally consists of lignocellulosic wastes like sugarcane bagasse, wood chips, crop residues, and organic waste that can be employed to generate bioenergy using different waste beneficiation techniques.

2. This type of waste is associated with the overcoming of major limitations identified with the first-generation biomass.

APPLICATION OF ENGINEERING DESIGN
AGRO WASTE VALUE ADDED PRODUCT

Third generation

1. Microalgal biomass, which is used in engineered energy source production systems as a feedstock.

2. Hence, its cultivation can easily be achieved in lagoons and open ponds using a high nitrogenous compound containing agro-waste containing wastewater.

APPLICATION OF ENGINEERING DESIGN

AGRO WASTE VALUE ADDED PRODUCT

Fourth generation

1. This type of biomass is from metabolically engineered species such as bacteria, including algae generated from cleaner disposal, or emissions control processes such as CO_2 capture systems.

2. This increases the value of this generation as it can be used in high-value product production associated with higher polymeric hydrocarbon content requirements or any other bioenergy products.

APPLICATION OF ENGINEERING DESIGN

AGRO MACHINERY TECHNOLOGY

WHAT IS BIOMASS ?

Biomass is renewable organic material that comes from plants and animals.

APPLICATION OF ENGINEERING DESIGN

AGRO MACHINERY TECHNOLOGY

AGRO BIOMASS CONVERSION

PROBLEM

Disposal of large amount of agricultural raw materials and residues (biomass) generated either in the farm, poultry houses, livestock pens, or agro-processing industries

APPLICATION OF ENGINEERING DESIGN

AGRO MACHINERY TECHNOLOGY

Biomass sources for energy include:

1. Wood and wood processing wastes
    - firewood, wood pellets, and wood chips, lumber and furniture mill sawdust and waste, and black liquor from pulp and paper mills

2. Agricultural crops and waste materials
    - corn, soybeans, sugar cane, switchgrass, woody plants, and algae, and crop and food processing residues

3. Biogenic materials in municipal solid waste
    - paper, cotton, and wool products, and food, yard, and wood wastes

4. Animal manure and human sewage

AGRO BIOMASS CONVERSION

Converting biomass to energy

Biomass is converted to energy through various processes, including:

1. Direct combustion (burning) to produce heat
2. Thermochemical conversion to produce solid, gaseous, and liquid fuels
3. Chemical conversion to produce liquid fuels
4. Biological conversion to produce liquid and gaseous fuels

Direct combustion

is the most common method for converting biomass to useful energy. All biomass can be burned directly for heating buildings and water, for industrial process heat, and for generating electricity in steam turbines.

Thermochemical conversion

includes *pyrolysis* and *gasification*. Both are thermal decomposition processes in which biomass feedstock materials are heated in closed, pressurized vessels called *gasifiers* at high temperatures.

They mainly differ in the process temperatures and amount of oxygen present during the conversion process.

Pyrolysis

I. entails heating organic materials to 800–900^{o}F (400–500 ^{o}C) in the near complete absence of free oxygen.

II. Biomass pyrolysis produces fuels such as charcoal, bio-oil, renewable diesel, methane, and hydrogen.

Hydrotreating

I. is used to process bio-oil (produced by *fast pyrolysis*) with hydrogen under elevated temperatures and pressures in the presence of a catalyst to produce renewable diesel, renewable gasoline, and renewable jet fuel.

Gasification

I. entails heating organic materials to 1,400–1700^{o}F (800–900^{o}C) with injections of controlled amounts of free oxygen and/or steam into the vessel to produce a carbon monoxide and hydrogen rich gas called synthesis gas or *syngas*.

II. Syngas can be used as a fuel for diesel engines, for heating, and for generating electricity in gas turbines.

III. It can also be treated to separate the hydrogen from the gas, and the hydrogen can be burned or used in fuel cells. The syngas can be further processed to produce liquid fuels..

A chemical conversion process

known as *transesterification* is used for converting vegetable oils, animal fats, and greases into fatty acid methyl esters (FAME), which are used to produce biodiesel.

Biological conversion

I. includes fermentation to convert biomass into ethanol and anaerobic digestion to produce renewable natural gas.
II. Ethanol is used as a vehicle fuel. Renewable natural gas—also called *biogas* or *biomethane*—is produced in anaerobic digesters at sewage treatment plants and at dairy and livestock operations.
III. It also forms in and may be captured from solid waste landfills. Properly treated renewable natural gas has the same uses as fossil fuel natural gas.

GASIFICATION AN ECO-FRIENDLY AND EFFICIENT ROUTES FOR LIGNOCELLULOSIC BIOMASS CONVERSION

Direct combustion

I. Often used to meet the heat and steam needs of traditional industries.
II. However, it releases particulate and gaseous pollutants harmful to human health and the climate.
III. Mixing of various fuels, such as coal and torrefied biomass, can reduce gas emissions, but the ash problems remain

GASIFICATION AN ECO-FRIENDLY AND EFFICIENT ROUTES FOR LIGNOCELLULOSIC BIOMASS CONVERSION

Gasification and pyrolysis

I. are environmentally eco-friendly and efficient ways of converting lignocellulosic biomass to direct combustion
II. Both processes have certain advantages in terms of energy efficiency.
III. The products are more sustainable and suited to the bioenergy needs of traditional industries.
IV. Gasification is a process for the thermal conversion of carbon-based solids (coal, wood, straw.) into synthesis gas or syngas, which is composed of hydrogen (H_2), carbon monoxide (CO), carbon
V. dioxide (CO_2) and methane (CH_4) .
VI. Syngas is usually used to produce electricity, heat, or chemicals such as methanol and hydrogen.

GASIFICATION AN ECO-FRIENDLY AND EFFICIENT ROUTES FOR LIGNOCELLULOSIC BIOMASS CONVERSION

VII. Gasification can therefore be considered as optimization of pyrolysis aimed at increasing the yield of gas.
VIII. Replacing air with oxygen as a gasification agent eliminates nitrogen.
IX. This favors the production of high calorific value gases.
X. Heating rate, reactor design, and gas after-treatment are the main factors that control the production of clean,
XI. high-quality gas products from gasification.

Biomass Feedstock

– Trees
– Grasses
– Agricultural Crops
– Agricultural Residues
– Forest Residues
– Animal Wastes
– Municipal Solid Waste

Conversion Processes

- Enzymatic Fermentation
- Gas/liquid Fermentation
- Acid Hydrolysis/Fermentation
- Gasification
- Pyrolysis
- Combustion
- Co-firing

PRODUCTS

Fuels:
– Ethanol
– Renewable Diesel
– Renewable Gasoline
– Hydrogen

Power:
– Electricity
– Heat (co-generation)

Chemicals
– Plastics
– Solvents
– Chemical Intermediates
– Phenolics
– Adhesives
– Furfural
– Fatty acids
– Acetic Acid
– Carbon black
– Paints
– Dyes, Pigments, and Ink
– Detergents
– Etc.

Food, Feed and Fiber

BREAK

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SESSION 2

APPLICATION OF SUSTAINABLE ENGINEERING DESIGN FOR AGRO-MACHINERY TECHNOLOGY AND AGRO-WASTES VALUE ADDED-PRODUCTS

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THE GLOBAL AGRICULTURE LANDSCAPE

In response to the megatrend taking shape in the agriculture industry, innovative solutions and business models have been created with proven results.

Rerouting Value Chain Innovation
Skipping stages in the value chain through direct-to-consumer methods in order to reduce supply inefficiency

Crop Efficiency Technology Innovation
Technology offered by start-ups and cross-industry innovators to increase effective yield.

Bio-chemicals, bio-energy & bio-materials Innovation
Innovative production of bio-energy to reduce ecological footprint.

Contained Farming Innovation
Use of smart greenhouses and contained farming methods to value chain efficiency.

Food-tech & Artificial Meat Innovation
Creating lab-grown meats and eggs to harness "sustainable protein".

Digital tech enabled

Bio-tech enabled

INNOVATION DEVELOPMENT
OF

AGRO MACHINERY TECHNOLOGY

As **agriculture meets digital technologies**, a new frontier of innovation is emerging and creating multiple pathways to a smart farming future

PRECISION AGRICULTURE

What is the problems ?

Time-consuming to process massive amount of data
Increased production costs to grow crops

Utilization of cutting edge technologies such as autonomous drones and IoT for agriculture seedling, spraying, plant analysis mapping to grow more with less input and without human intervention

Drones gather huge data and shorten the time to process and value with the use of AI

Precision Terracing

Precision Tree Counting

Bagworm Infestation Mapping

Drone Spraying

ARTIFICIAL INTELLIGENCE IN AGRICULTURE

Nowadays considered as a high potential, improving practise for decision-making in agriculture.

It is quickly getting peoples' intention, and more visible in society and dynamically turning our social awareness and lifestyle.

The techniques provide several opportunities to monitor the plant growth and development from pre- to postharvest.

PRECISION AGRICULTURE

IMPACT ACHIEVED

1. Improved crop yields by 67% with the use of drones and IoT
2. Decreased food production cost by 50% by reducing the level of traditional inputs needed to grow crops such as land, water and fertiliser
3. Shorten plant cycles and increase crop yield through AI driven platforms
4. Reduced water, land and fuel consumption by 95% compared to traditional outdoor farming
5. 100% efficacy of drone pesticide spraying
6. Reduction of labour of up to 50% through automated dosing
7. Increase yield of up to 20% through robotics and machine learning for dynamic grading

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URBAN FARMING VERTICAL HYDROPONIC FARMING

What is the problems ?

- **Huge water consumption** in traditional farming
- **Lack of space** for farming in city
- Increased **carbon emission**

Urban Farming is sustainable farming that grows food in the metropolitan to supply oneself or distribution and marketing the produces within the cores of metropolitan areas and at their edge

URBAN FARMING VERTICAL HYDROPONIC FARMING

Effective planting system with personalised and well designed SOP that enables every farm to run smoothly and effectively

The urban farming had adapt the online real-time apps with IoT readiness for data collection, analysis of management and evaluation information to manage the farm remotely

The importance of Urban Farming can be classified as follow

Ensure Food Security

When the city or metropolitan is well developed with Urban Farming activities, source of food and supply chain will be localized. The city or metropolitan will be resilient to any interruption on food supply chain due to unforeseen crisis such as pandemic lockdown etc.

Green The City

Urban Farming will be actively and continuously adding green plants to the concrete jungle once was fill with flora and fauna. The plants will help to clean the air and promote a healthy city.

Reduce Carbon Footprint

On average food that we consume travel 300 km to reach end consumer. Along the line, it needs further cooler room facilities to keep them fresh and durable which cause significant carbon footprint added every year. Urban Farming can reduce the food miles to 10km and eliminate cool room facilities to keep them fresh.

The importance of Urban Farming can be classified as follow

Employment Opportunities

Urban Farming can be designed to suit marginal society like disable people. That will create working opportunities for the disable to be independent and contribute to our society as any other ordinary person

Efficient Use of Empty Space

Urban Farming can make good use of empty space that is otherwise vacant or left with activities that has no economy output. For example, they can be built on roof top that is normally vacant and unutilized. Putting it into good economy use and help to cool down the tenent under the roof.

URBAN FARMING
VERTICAL HYDROPONIC FARMING

IMPACT ACHIEVED

1. Environmentally friendly, pollution free and saves 90% of water usage
2. efficient, effective, and non-toxic farming techniques as well as urban gardening solutions that emphasizes on space optimization
3.
4. Space efficient and increased profitability
5. Reduced 1900 kg of carbon footprint each year

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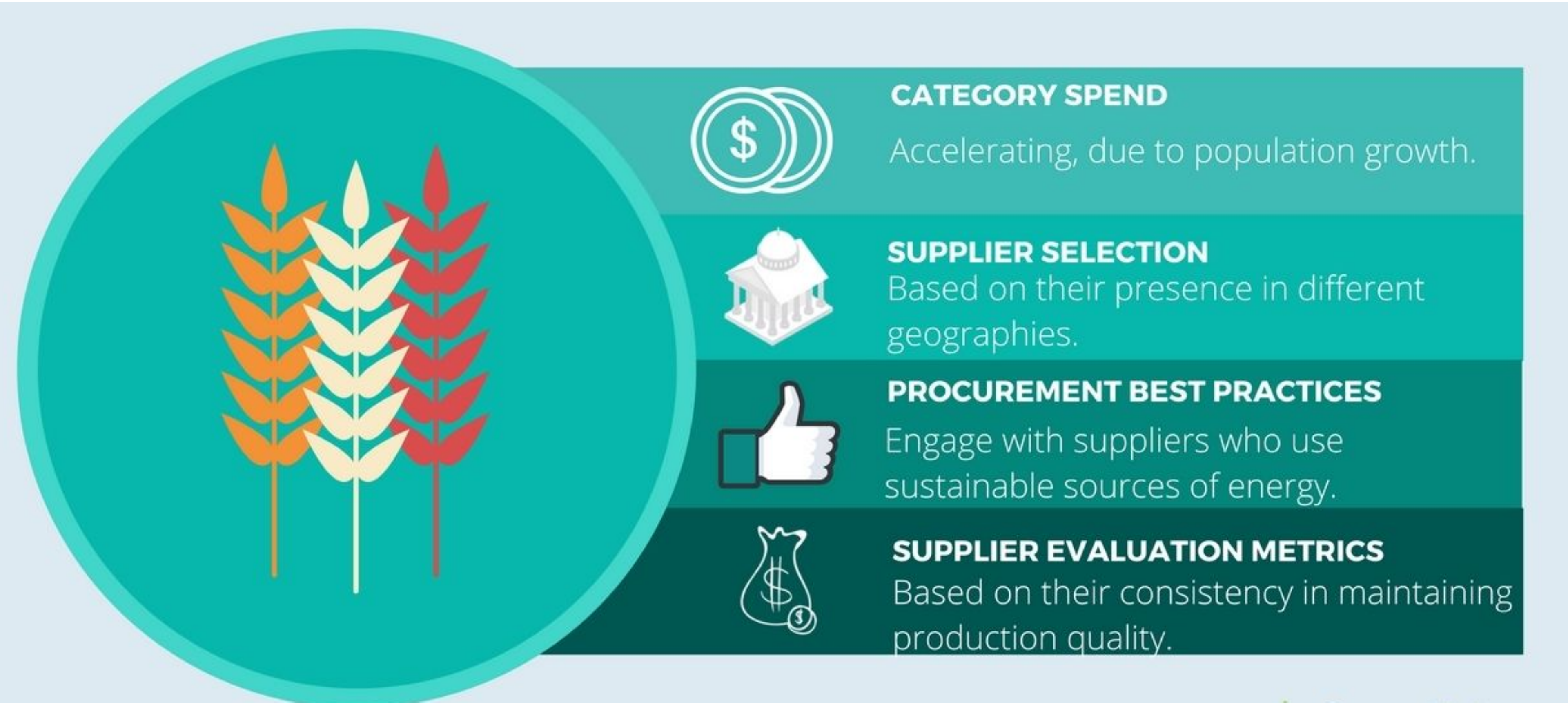
CLOUD BASED PROCUREMENT AND INVENTORY SYSTEM

What is the problems ?

- **Human error** during the procurement process
- Inefficiency in **inventory management**

Cloud-based procurement and inventory system that keep tracks of everything in one place

The system assists in forecasting raw ingredient purchases and recommended usage through analysis of weather reports and historical data using AI technology


CATEGORY SPEND
Accelerating, due to population growth.
SUPPLIER SELECTION
Based on their presence in different geographies.
PROCUREMENT BEST PRACTICES
Engage with suppliers who use sustainable sources of energy.
SUPPLIER EVALUATION METRICS
Based on their consistency in maintaining production quality.

INNOVATION DEVELOPMENT OF

AGRO MACHINERY TECHNOLOGY

POTENTIAL IMPACTS

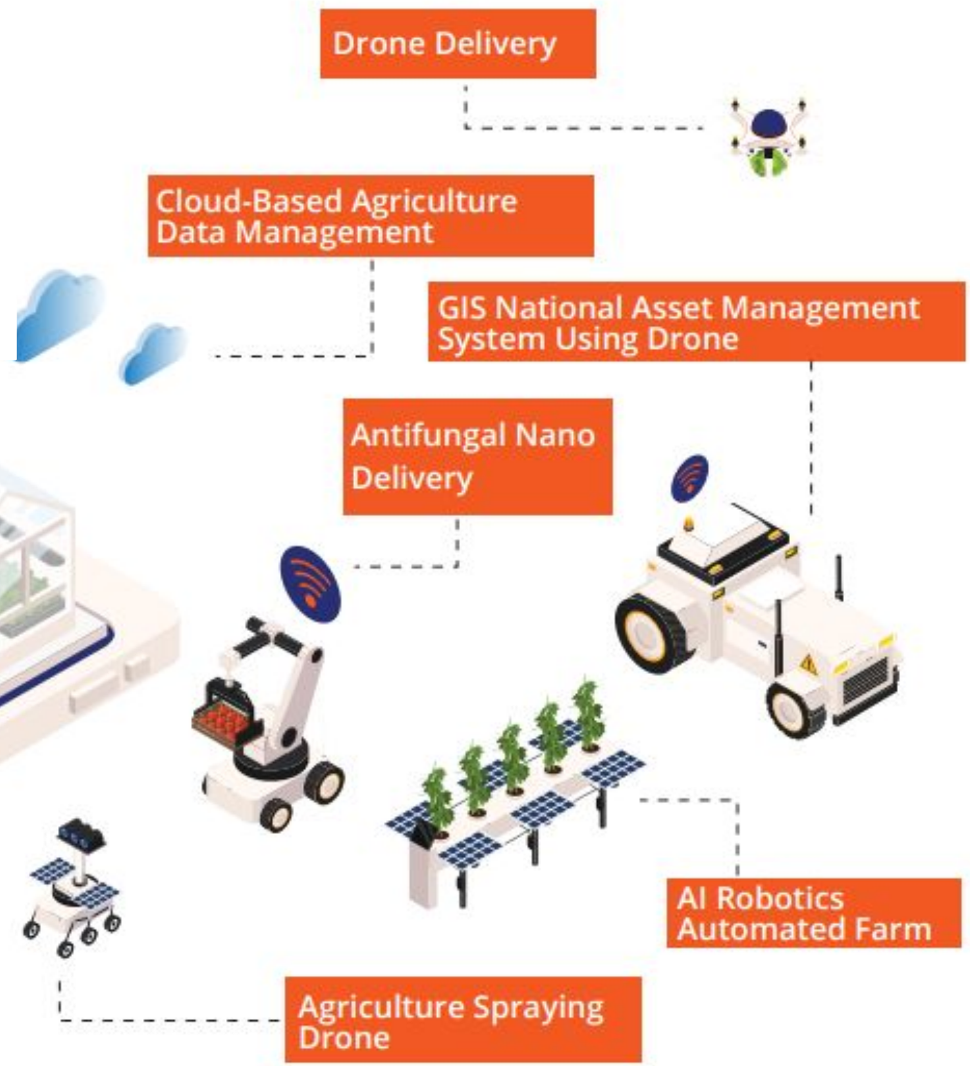
50%
Labour force reduction

30%
Productivity improvement

20%
Cost reduction

FOCUS

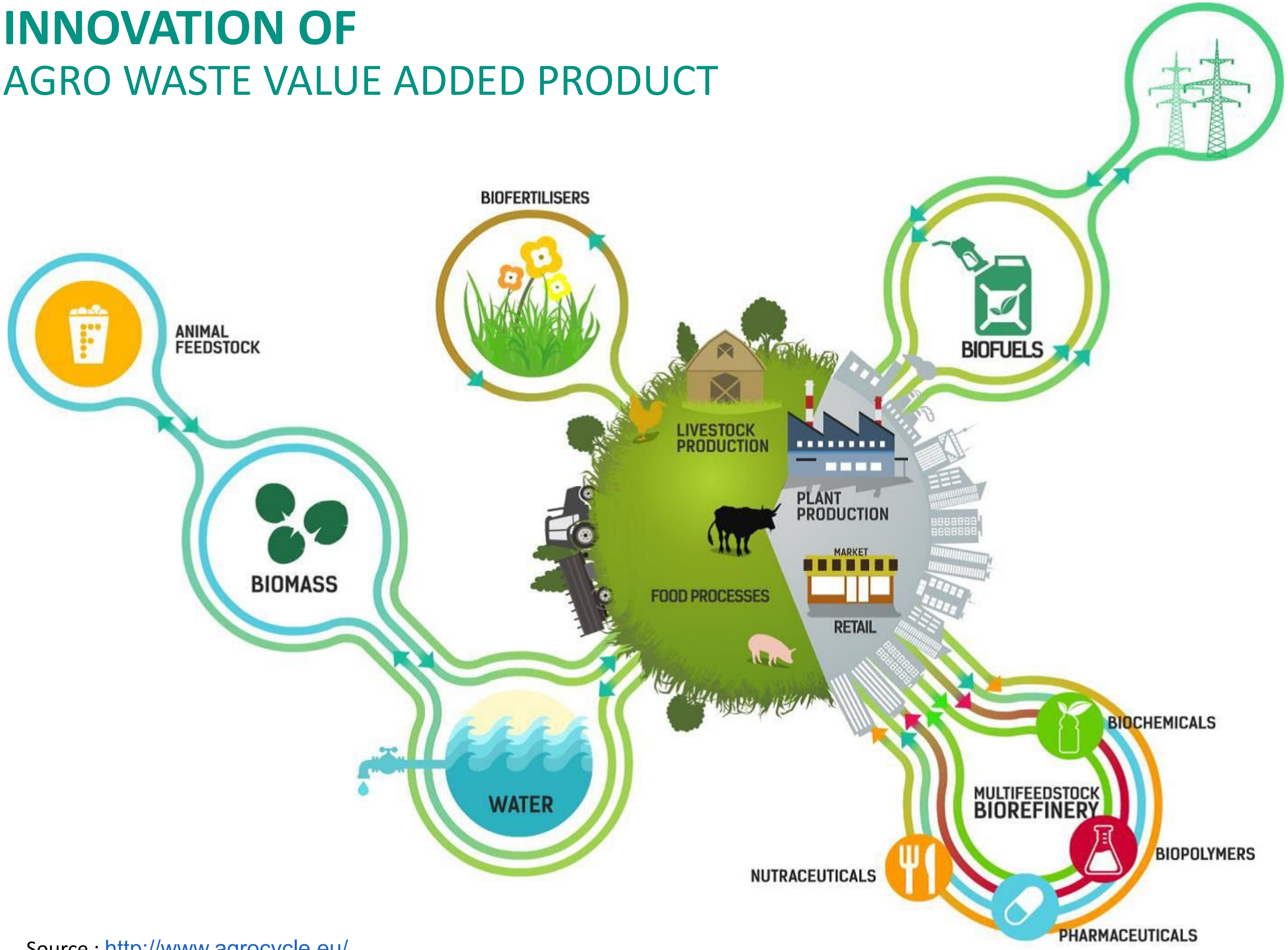
- Harvesting
- Maintenance
- Fertilisation



INNOVATION DEVELOPMENT
OF

AGRO WASTES VALUE ADDED-PRODUCTS

INNOVATION OF
AGRO WASTE VALUE ADDED PRODUCT



Source : http://www.agrocycle.eu/

INNOVATION OF AGRO WASTES VALUE ADDED-PRODUCTS

ENZYMES FROM AGRICULTURAL WASTES

"The industry involving the engineered enzymes global market has been predicted to rise from 4.5 billion USD (2016) to $6.2 billion USD (2021).

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WHY ENGINEERED ENZYME ?

INNOVATION OF AGRO WASTES VALUE ADDED-PRODUCTS

ENZYMES FROM AGRICULTURAL WASTES

1. Enzymes are **cost-intensive** which add additional cost to operational processes.

2. Analysis of economics of enzyme bioprocess states that **50% of the production cost is related to capital investment**, whereas raw material cost only one-third of the total cost.

3. Therefore, substitution of feed stocks with agricultural waste can substantially increase return on investment

(de Castro et al., 2014).

INNOVATION OF AGRO WASTES VALUE ADDED-PRODUCTS

ENZYMES FROM AGRICULTURAL WASTES

Examples of industrial enzymes produced from agricultural waste:

α-amylase

1. Alpha amylases belong to that class of enzymes that breakdown α-1, 4 bonds present between two glucose units in a polysaccharide chain.

2. The action of α-amylase result in the generation of α-limit dextrins and short chain oligomers.

3. α-amylases are widely used for various purposes in different industries brewery, baking, paper and pulp, detergent, pharmaceutical and textile industry.

Cellulase

1. Cellulases are a group of enzymes belonging to a family of enzymes known as of glycoside hydrolases and are of great importance not only to industries but to natural world as well.

2. Cellulases disintegrate the complex and crystalline cellulose fibres present in the lignocellulosic biomass (LCB) to release simpler sugars.

3. From industrial perspective, they find a range of applications biorefinery, brewing, baking, detergents, textile, paper and pulp industry.

4. Cellulases are mostly produced from *Trichoderma reesei* or its improved strains for industrial use.

Xylanase

Plant polysaccharides contain xylans as complex integral heteropolymers which are degraded through the action of enzymes xylanases.

Due to heteropolymeric structure, xylan requires a group of enzymes for its hydrolysis such as p-coumaric acid esterase, endo xylanases, ferulic acid esterase, β-xylosidases, α-glucuronidase and acetylxylan esterase.

Among these, most of the research has been carried out on β-xylosidases and endoxylanases.

Xylanases are used in industries like biomedical, bioethanol, animal feed and food industry amid which they are majorly used in biorefinery where they are required to disintegrate the xylan present in LCB so as to further process the biomass for production of biofuels or other value-added products.

INNOVATION OF AGRO WASTES VALUE ADDED-PRODUCTS

BIOFUEL TECHNOLOGY

- Biofuels can be produced from agricultural, commercial, domestic, and industrial wastes (if the relative waste has a biological origin).
- If the biomass used in the production of biofuel can regrow quickly, the fuel is generally considered to be a form of renewable energy.
- Wood and residues from wood, for instance, spruce, birch, eucalyptus, willow, oil palm, remains the largest biomass energy source today.
- It is used directly as a fuels or processed into pellet fuel or other forms.
- Biomass also includes plant or animal matter that can convert into fuel, fibers, or industrial chemicals.

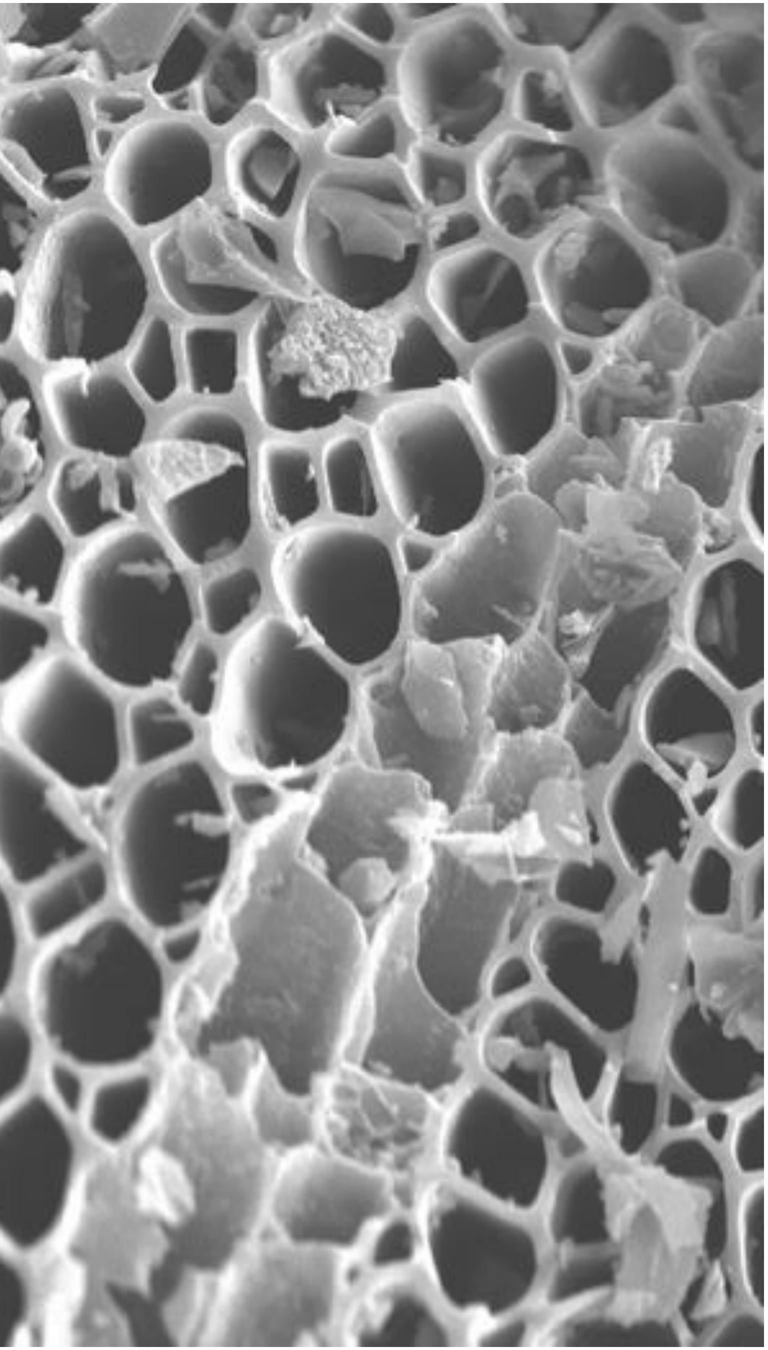
INNOVATION OF AGRO WASTES VALUE ADDED-PRODUCTS

BIO FERTILIZER FROM AGRICULTURAL WASTES

Biofertilizer is commonly referred to as the fertilizer that contains living microorganisms and it is expected that their activities will influence the soil ecosystem and produce supplementary substance for the plants

INNOVATION OF AGRO WASTES
VALUE ADDED-PRODUCTS

BIO FERTILIZER FROM AGRICULTURAL WASTES



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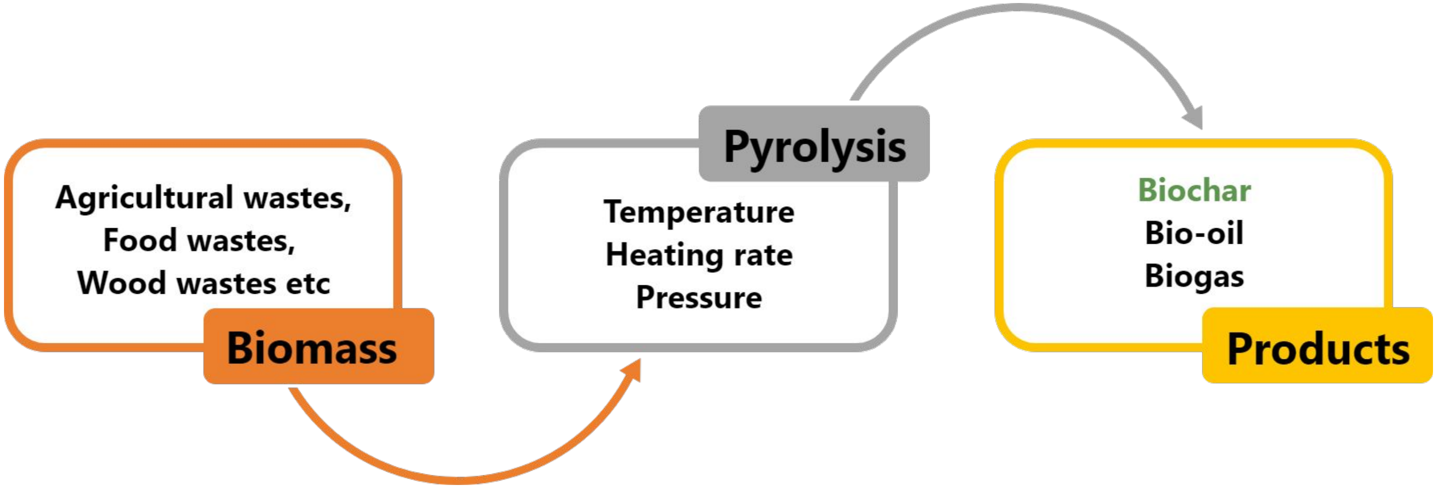
INNOVATIONS IN BIOCHAR ENHANCED HIGH PERFORMANCE BUILDING MATERIAL

Biochar is a solid residue formed by pyrolysis or gasification of waste biomass including agricultural waste, forest waste, food waste etc.

Source : https://biochar-innovations.com/technology.html

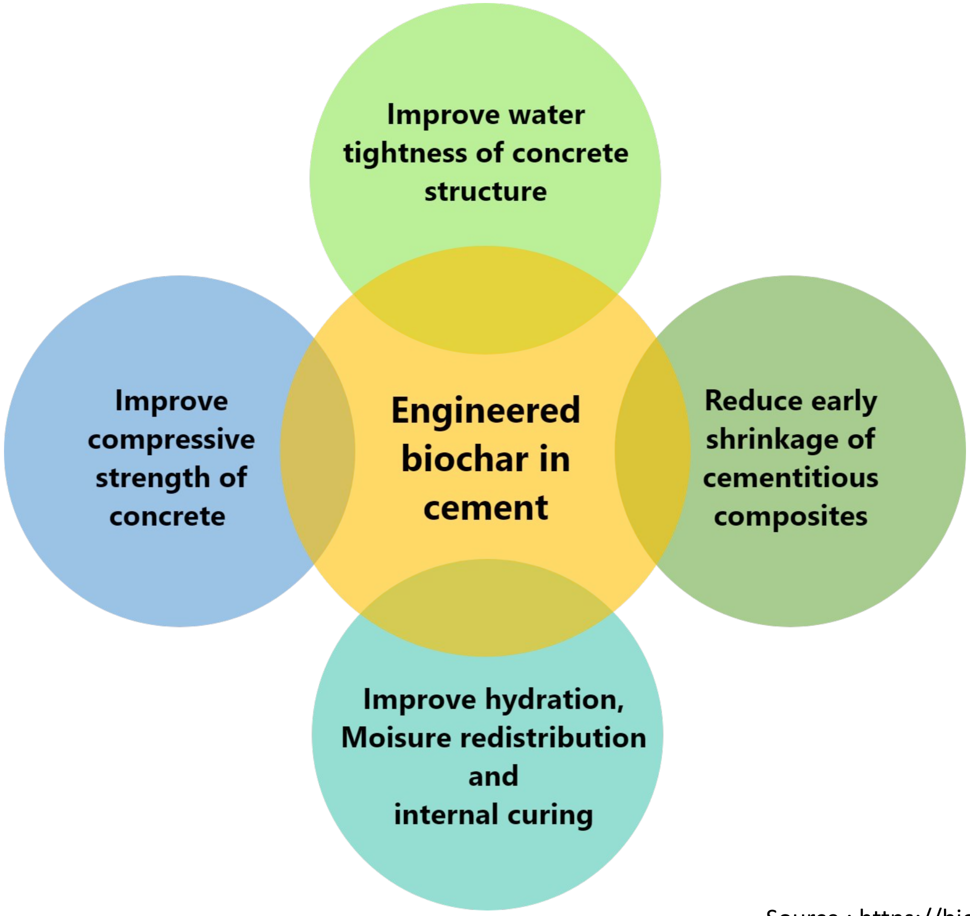
BIOCHAR ENHANCED BUILDING MATERIAL TECHNOLOGY

Enhance building durability and indoor air quality by applying engineered biochar as cementitious admixture and air-filtration material, respectively.

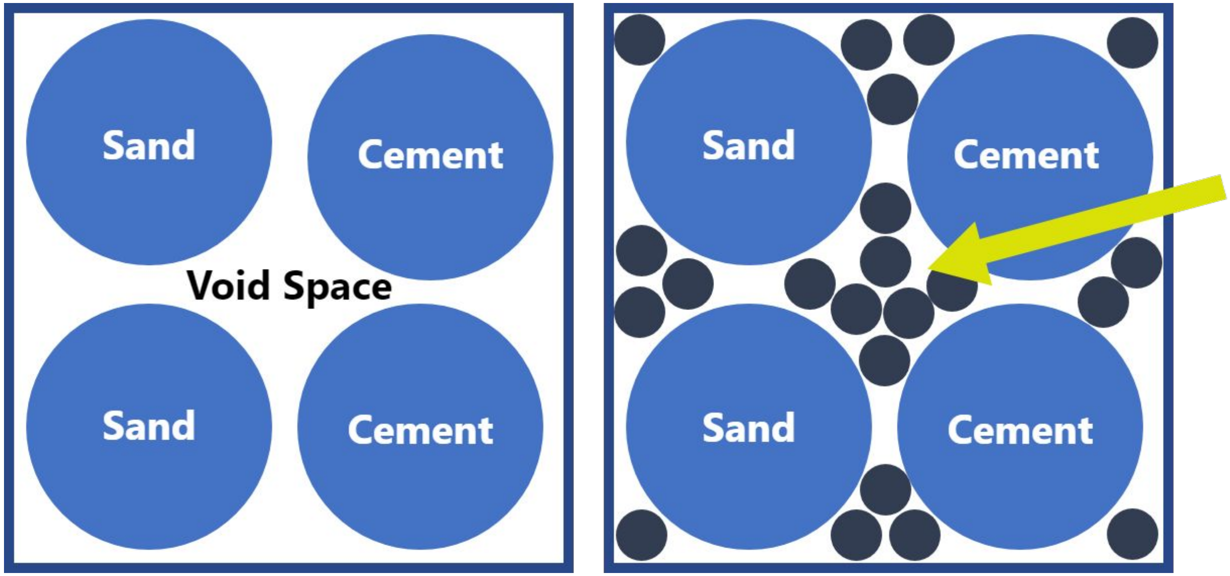


Source : https://biochar-innovations.com/technology.html

BIOCHAR ENHANCED BUILDING MATERIAL TECHNOLOGY



Source : https://biochar-innovations.com/technology.html



Biochar particles packing space and pores between solid particles

Source : https://biochar-innovations.com/technology.html

INNOVATIVE USE OF TECHNOLOGY ALONG THE AGRICULTURE VALUE CHAIN

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Supply and Production → **Processing** → **Distribution** → **Retailing** → **Consumption**

- Agricultural technology is applied mainly in the farm, for **improving and maximising yield and optimising farm management and operations.**
- Drones can collect **highly detailed images of crop and field characteristics, indicating crop health across the field.** Collected images show differences in the amount of reflected light that can then be related to plant health or soil type.
- Accurately prediction of conditions on a global scale can determine **farm insurance, investment on protection and mitigation of destructive events.**

- Several companies have begun to apply **logistics technology** to make food distribution more efficient
- Logistics technologies enable **food traceability** thus enhancing transparency and obtaining full control of information flow within the supply chain.
- **Predictive capabilities** are escalated when AI in logistics is implemented. Having a tool for accurate demand forecasting and capacity planning allows farmers to be more proactive and save costs.

- According to reports and studies, precision agriculture reduces **fertilizer use by 40% whereby 68% of consumers are willing to pay more** for food without unhealthy / artificial ingredients.
- **Circular Economy** facilitates the shift from traditional "Take, Make, Waste" to "Make, Use, Return". Product disposal is replaced by product reuse to be environmentally friendly.

CHALLENGE IN AGRICULTURE

Technology
- Slow adoption
- Lack of talents
- Insufficient investment

Funding
- Lack of access
- Funding on hold

Investments
- Long period to achieve return on investment

Players
- Investors and startups have difficulty in identifying and connecting with each other

Farmers
- Heavy reliance on middle-man
- Income inequality

Market
- Accessibility issue
- Connecting with buyers

Talent
- Low interest amongst local talent and high reliance on foreign workers

Mechanisation
- Need for more R&D
- No incentives for adoption
- Low commodity margin

Cost
- High cost for input and logistics

Startups
- Lack of incentives
- Insufficient talent

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SUSTAINABLE ENGINEERING DESIGN → COMMERCIALIZATION

use creativity and imagination to find new solutions while working within various limitations,includes the laws of nature, the desires of clients and consumers, available materials, and public safety.

DEMAND / GLOBAL ISSUE

SUSTAINABLE ENGINEERING DESIGN → **RESEARCH VALUE**

COMMERCIALIZATION

INVENTOR

UNIVERSITY

TECHNOLOGY EXPERT

INVESTOR

THANK YOU

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