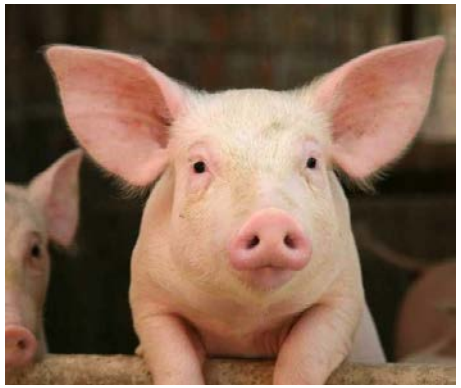
MAVITEC
Environmental




## Make revenue out of your manure and improve the environment

MAVITEC
Environmental

MAVITEC Environmental

MAVITEC Group

- Based in The Netherlands
- Sales and service offices worldwide
- Solutions for businesses with large quantities of animal by-products, biomass and other fuel sources
- Specialized in high quality recycling processes
- Expert in building, coordination and delivery of individual components

# References

| Location | Owner | Operating since/ completion date | Processing | Capacity (20% moisture) |
|---|---|---|---|---|
| **Wardensville, West Virginia** | Frye Poultry | 2011 | Turkey and poultry manure | 1.5 ton/hr |
| **South Charleston, Ohio** | Sexing Technologies | 2012 | Cow manure | 2.3 ton/hr |
| **Orleans, Indiana** | Riverview Farms | May 2017 | Poultry manure, turkey litter, swine manure, turkey and swine mortalities | 2.3 ton/hr |
| **Mead, Nebraska** | Greencycle Solutions | March 2018 | Wet distillery grain | 2.3 ton/hr |
| **Cordele, Georgia** | Synergy Solutions | August 2018 | Food waste, agricultural waste products | 2.3 ton/hr |
| **America, The Netherlands** | Willems Agro BV | 2018 | Pig manure | 2.3 ton/hr |
| **St. Petersburg, Russia** | Roskar | 2019 | Layer manure | 2.3 ton/hr |
| **Krasnobor, Russia** | Krasnobor | 2019 | Turkey based on woodchips | 2.3 ton/hr |
| **Riyadh, Saudi Arabia** | Almarai Company | 2020 | Poultry Litter | 4 x 23 ton/hr |

MAVITEC Environmental

## Gasification

- Gasification is a technical solution to convert organic streams into energy and charcoal
- Volume and mass are minimized significantly
- Helps provide a more complete solution to many of the issues facing (agricultural) companies.

MAVITEC Environmental

## Why Gasification

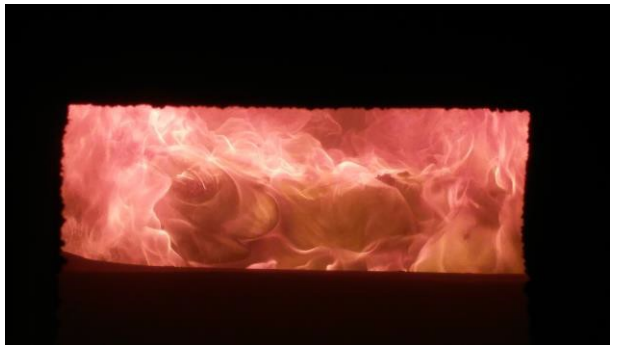
- The best, economic, ecologic, ergonomic way of handling your manure, litter and organic waste challenges
- Offers a complete solution to gasify organic streams into an energy source suitable for many applications, such as steam, electricity, hot water and hot air
- Ash and fixed carbon is converted into ash. Volatile matter is converted into heat.
- Produces a high quality EcoChar with many unique properties and uses

### Reduce CO2, save the planet

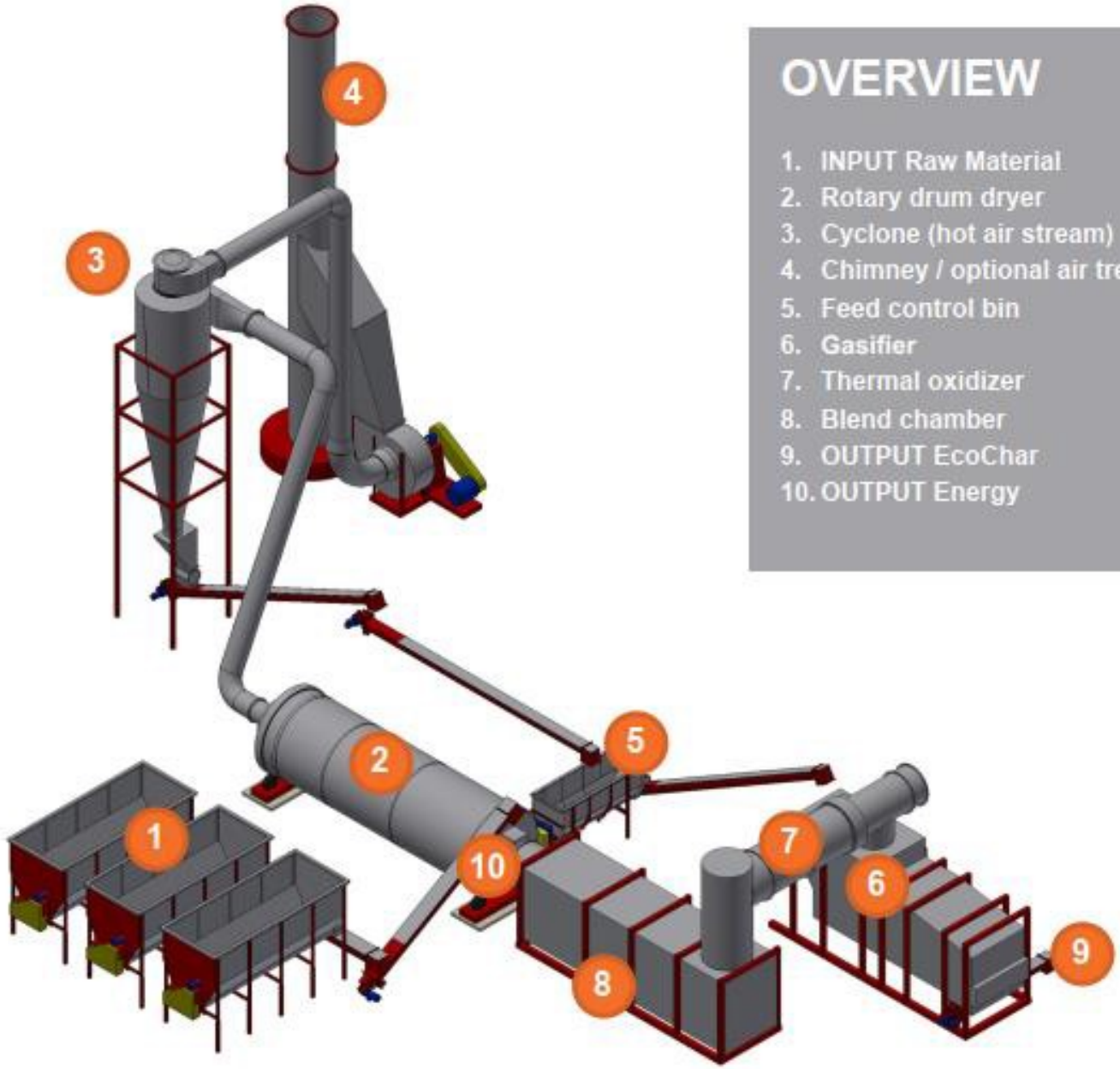
- Volume reduction up to 85%
- Valuable EcoChar
- Renewable energy
- Reduction $CO_2$

MAVITEC Environmental

## Gasification



- Chemical reaction caused by heating material in an oxygen-starved environment, resulting in incomplete combustion that drives off carbon-rich gasses
- Patented design engineered to support a variety of fuels, including manures and other biomass
- Gasification and oxidising are separate processes so they can be optimized individually. This reduces emmission and makes the installation more efficient.
- The low-pressure system allows for gasification with no or minimal carryover of particulate matter from most fuels



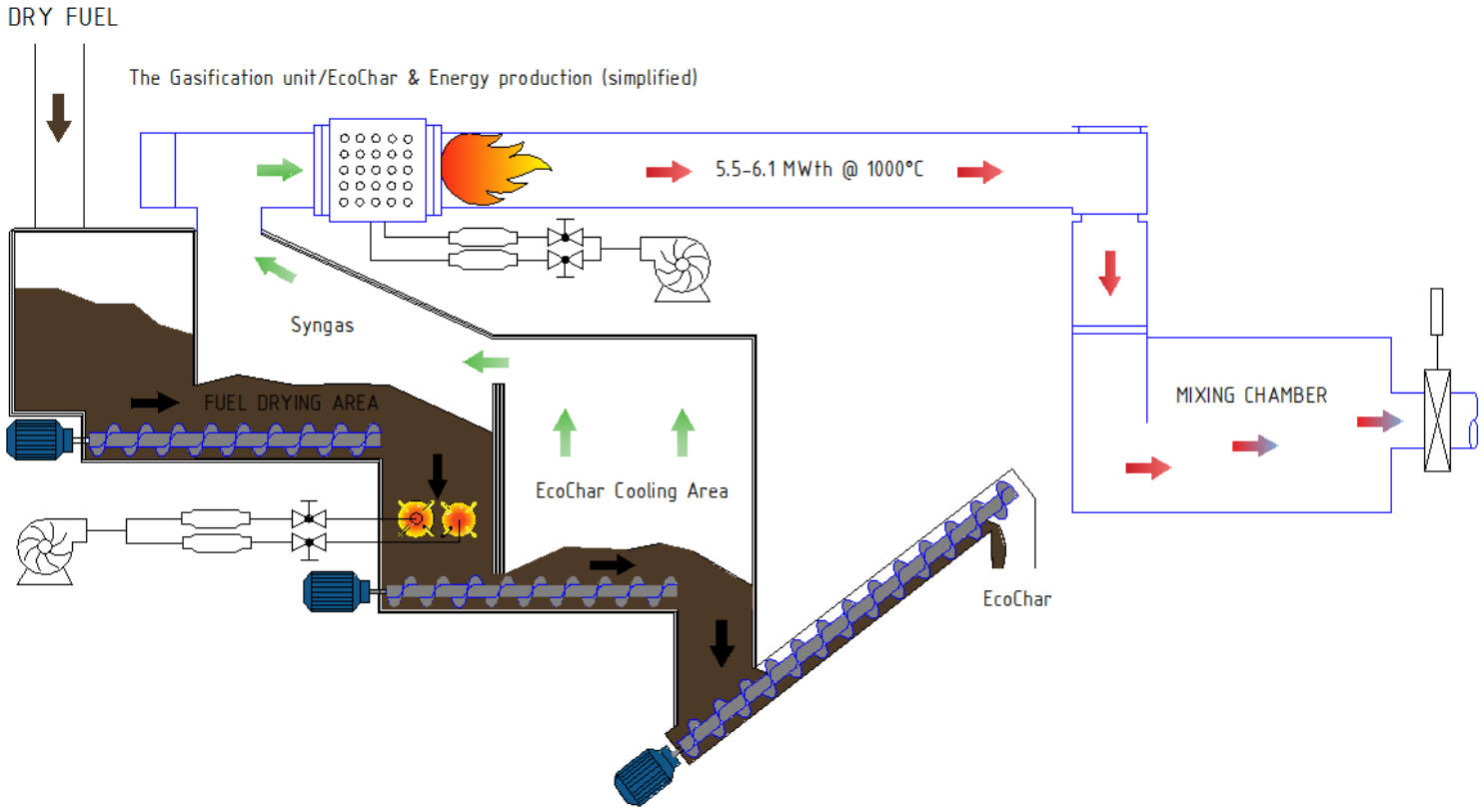

# OVERVIEW

1. INPUT Raw Material
2. Rotary drum dryer
3. Cyclone (hot air stream)
4. Chimney / optional air treatment
5. Feed control bin
6. Gasifier
7. Thermal oxidizer
8. Blend chamber
9. OUTPUT EcoChar
10. OUTPUT Energy

MAVITEC
Environmental

MAVITEC Environmental

# Gasifying process



MAVITEC Environmental

## Advantages of gasification

- Solves litter/manure/organic waste and litter/sludge challenges
- Reduces volumes up to 85%
- Reduced emission compared to the alternative which is burning
- up to 50 tonnes of litter/manure per single unit per day (10-20% moisture)
- Generates 5.0-5.5 MWth @ 1000°C as hot air flow depending on caloric value input material
- High energy content of the hot air can be used for various purposes; steam, hot water, hot air, electricity
- Possibility of high capacity steam generation (7 tonnes steam @ 10 bar)
- Possibility of electricity generation (up to 1 MW)
- Produces 350-600 kg/hr high quality EcoChar as end product

## Economics

- 3 sources of income:
  - input material – sludge, manure, digestate
  - energy – heat, steam, hot water, electricity
  - EcoChar
- Costs
  - labor, packing material, energy, maintenance
- Payback depends on the above

MAVITEC Environmental

## Fuels

- The input of the gasifier is a fuel with a maximum moisture content of 20%

  *If the input has a higher moisture content a pre-drying step has to be taken. If necessary this pre-drying step will be included in our gasification solution*

- Poultry litter/manure
- Cattle manure
- Porcine manure
- Sludge or digestate
- Biosolids

## Processing syngas

- Main product of gasification: carbon monoxide (CO), hydrogen and methane gasses (syngas)

  *The syngas composition is fuel dependent, with temperature typically ranging between 800-850 °C*

- As soon as the syngas leaves the gasifier and flows into the thermal oxidizer, ambient temperature air is introduced to oxidize the syngas, with the CO being converted to carbon dioxide ($CO_2$)

- Retention time in the oxidizer is 1.2/2 sec.

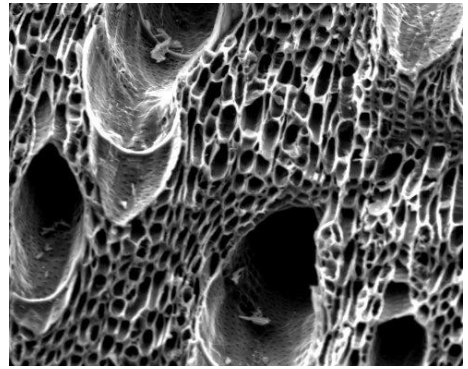
  *A hot air stream is produced of about 1000 °C (energy content between 5.5-6.1 MWth)*

  The ability to use the thermal energy product as direct heat, steam or electricity is a simple matter of adding equipment

## Solid output: EcoChar

- Temperature and retention time are critical in the quality of EcoChar
  - May vary depending on its application
  - Retention time of the gasifier can easily be controlled to ensure optimal output

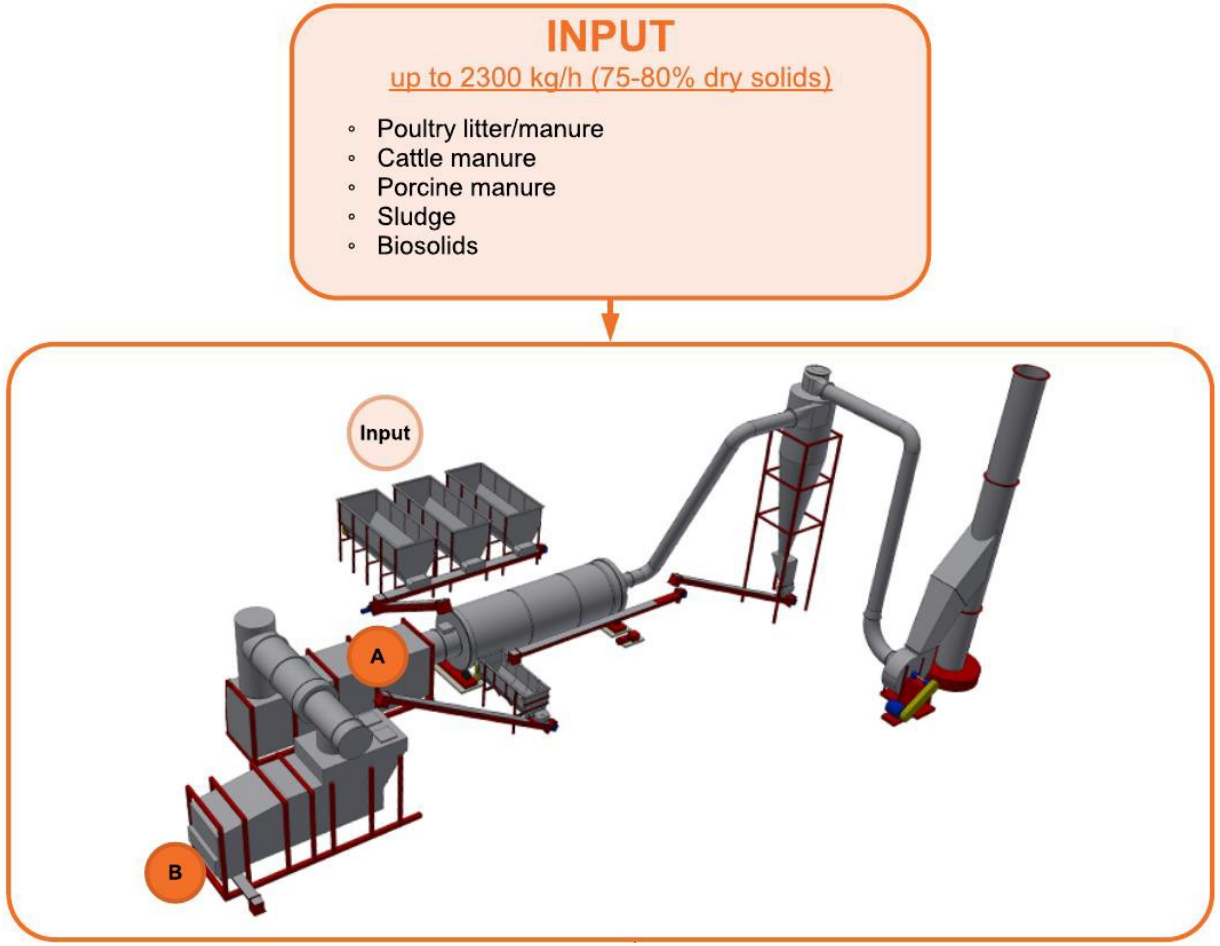
- EcoChar still contains the mineral ash and fixed carbon which offers great environmental advantages and economic value



MAVITEC Environmental

## Gasification: Input

- Manure
- Sludge
- Biosolids



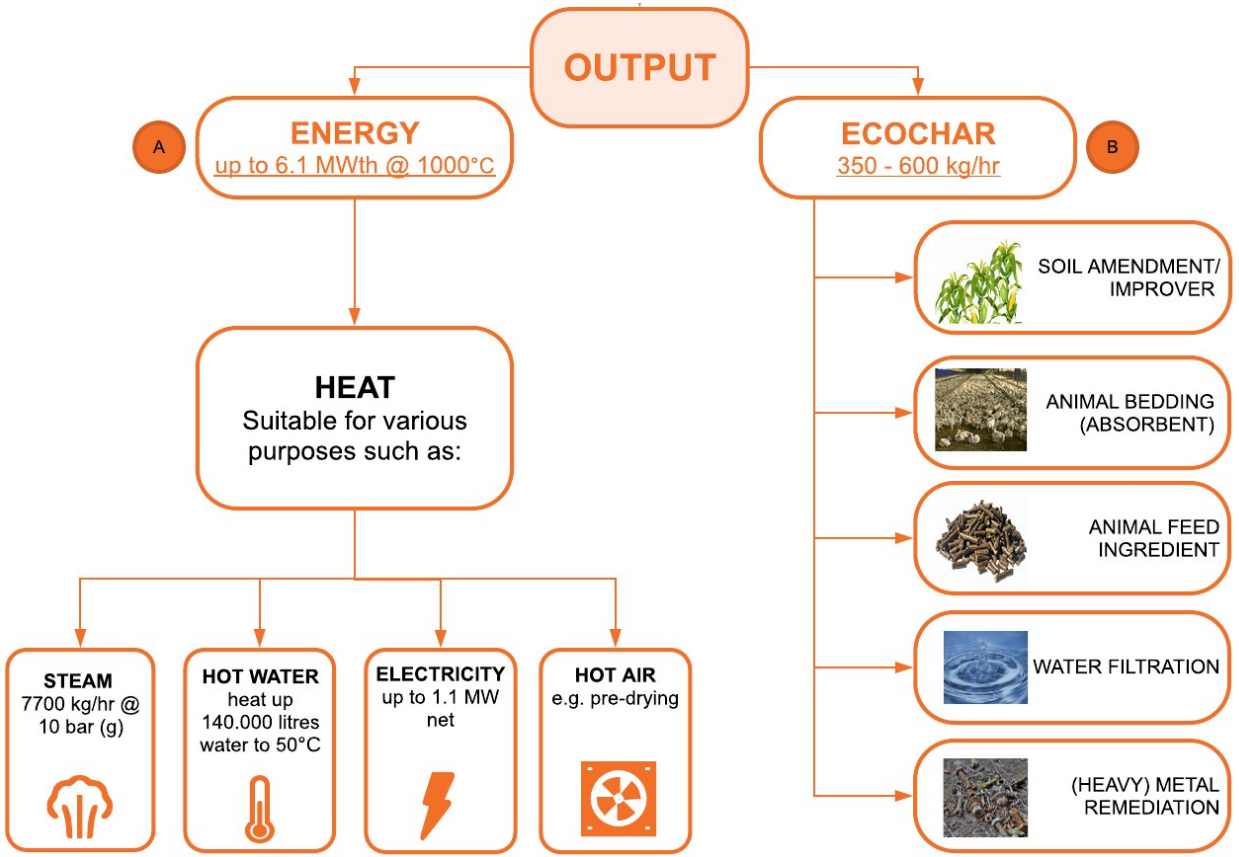
# Gasification: Output

**Energy (heat)**

- Steam
- Hot water
- Electricity
- Hot air

**EcoChar**

- Soil amendment
- Animal bedding
- Animal feed
- Water filtration
- (Heavy) metal remediation



# Advantages of EcoChar

- Valuable and carbon-rich: high P, K, Ca and Mg values
- Free from pathogens, E-coli, growth hormones and residues from medication (burned in gasifier)
- It can hold up to 1.5 times its own value in water
- Increases plant growth and improves the performance over time
- Increases the water retention properties of soil, so less water is needed to keep the soil moisturized
- Releases the amount of nutrients gradually and hereby lowers the amount of fertilizer and nutrients needed
- Commercial value between €100-800,- per ton, depending on composition and end-use purpose
- Surface (BET): up to 260 m2/gram

*Values differ depending on type of input used*

# Main uses of EcoChar

## 1. Fertilizer

- In addition to essential nutrients, EcoChar also contains other supporting substances like carbon and sulphur
- EcoChar is able to absorb water
  - It retains the water until the plant needs it; it acts like a buffer
  - It is able to provide the plant with water for the short term

## 2. Bedding

- EcoChar can be used to counteract odour
- EcoChar reduces the ammonia-levels, which is harmful for (young) animals

## 3. Water filtration

- Biochar is already used for water filtration, EcoChar can be used with the same functions

## 4. Replacement of peat moss for potting soil

- EcoChar is cheaper than peat moss
- EcoChar is more sustainable than peat moss

## 5. Soil remediation

- EcoChar can immobilize the presence of contaminants (e.g. copper) in the soil through fixation

## 6. Compost

- EcoChar has great potential for reducing greenhouse gases and NH3 emissions when composing wet, nutrient-rich material

## Economic value of EcoChar

- EcoChar still contains the mineral ash and fixed carbon which offers great environmental advantages and economic value
- EcoChar is valuable for improving stability in soil as it is retained in the soil over many hundred of years, unlike fertilisers which typically require annual application
- It potentially qualifies for carbon credits

MAVITEC
Environmental