



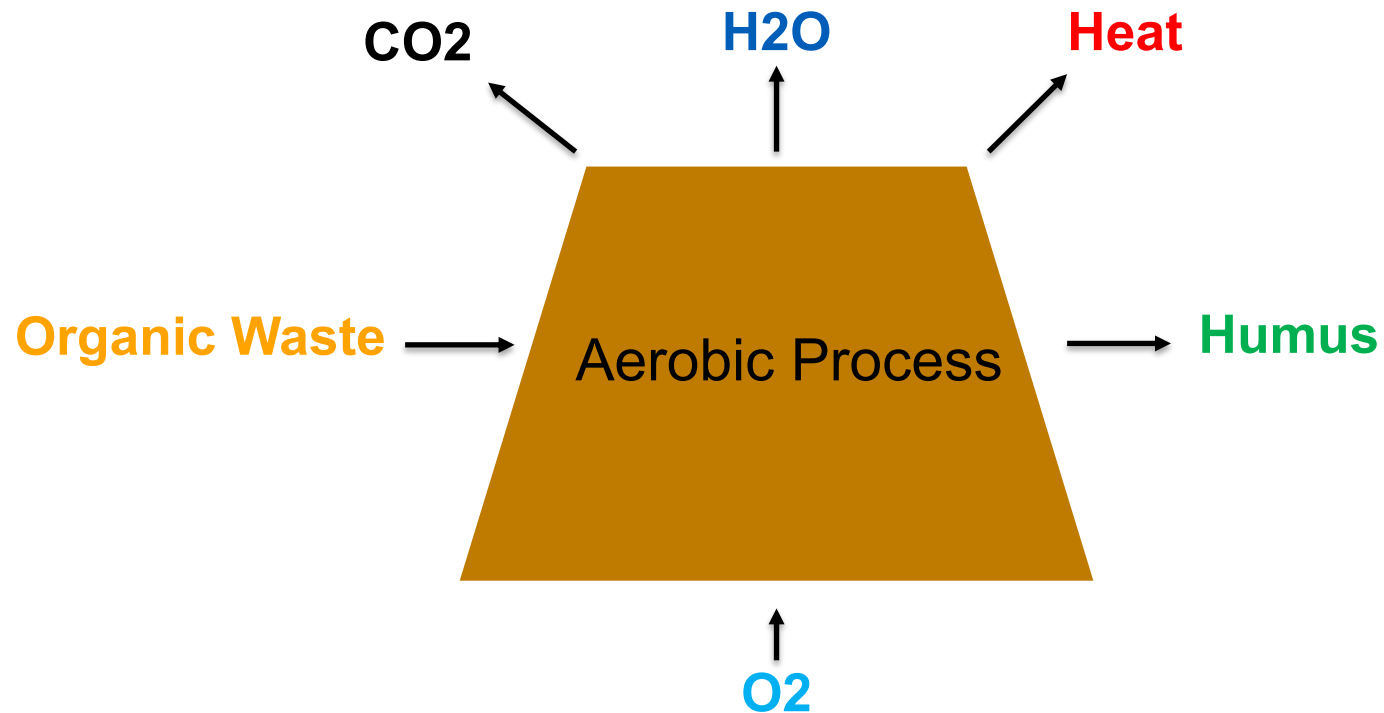
Aalto University
School of Engineering

Composting of Sludge and Organic Waste

WAT-E2180 - Biological Treatment of Water and Waste

Federico Varalta

Composting



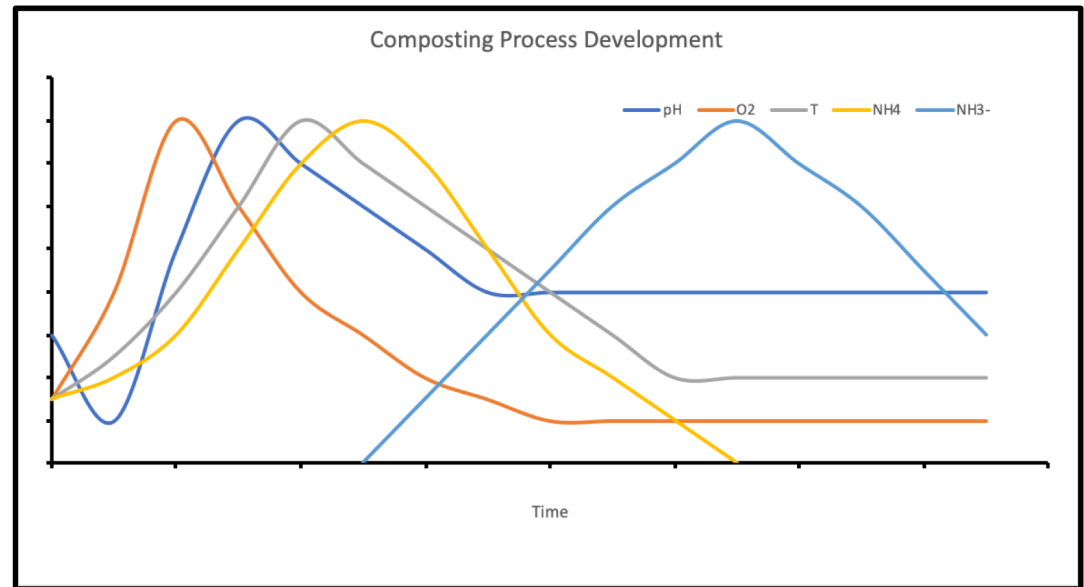
Composting Parameters

- **Feedstock characteristics**
- **Oxygen concentration**
- **C:N ratio (30:1)**
- **Temperature**
- **pH**
- **Moisture (70-80 %)**
- **Particle size**
- **Porosity**
- **Amendment, support material**



Composting Process Steps

1. Decomposition of easily degradable OM
2. Organic acids broken down, NH_4 release
3. Easy OM runs out, nitrification starts
4. Slowly degradable OM, diversification of species in the biomass



Design Criteria

Residence time



14 to 180 days

Hygienization



**According to EU
directive either 1
hour at 70 °C or
7 days at 60 °C**

Feedstock characteristics

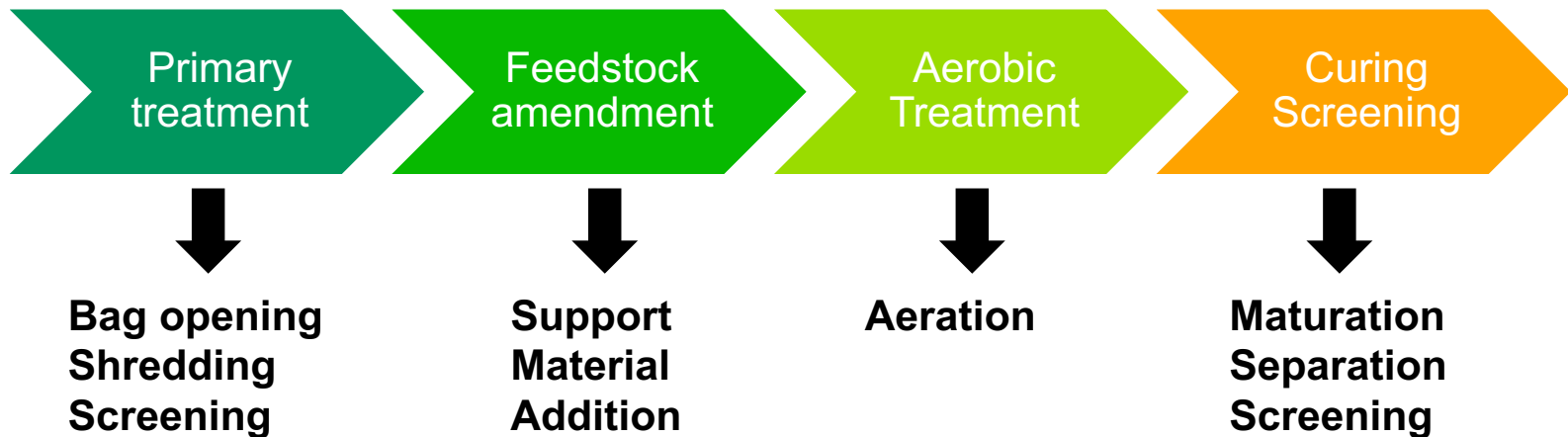
Nitrogen rich waste C:N ratio

- Liquid manure 2-3
- WWTP sludge 5
- Chicken dung 10
- Kitchen waste 13-23
- Cow/pig dung 20-25
- Feathers, hair 30
- Fruit 35

Carbon rich waste C:N ratio

- Leaves 40-60
- Shrub trimmings 40-50
- Straw/hay 60-70
- Corn/rice stalks 80-100
- Sawdust 100-500
- Paper/cardboard 200-500

Composting process set-up



Windrow Composting

- + Simple operation
- + Low investment
- + High capacity



- Odour problems
- Contamination risk
- Low efficiency
- Inhomogeneous process
- Long residence time

Tunnel Composting



- + Simple operation
- + Low investment/capacity
- + Monitoring

- Contamination risk
- Low process control
- Poor mixing
- Long residence time



Cell composting

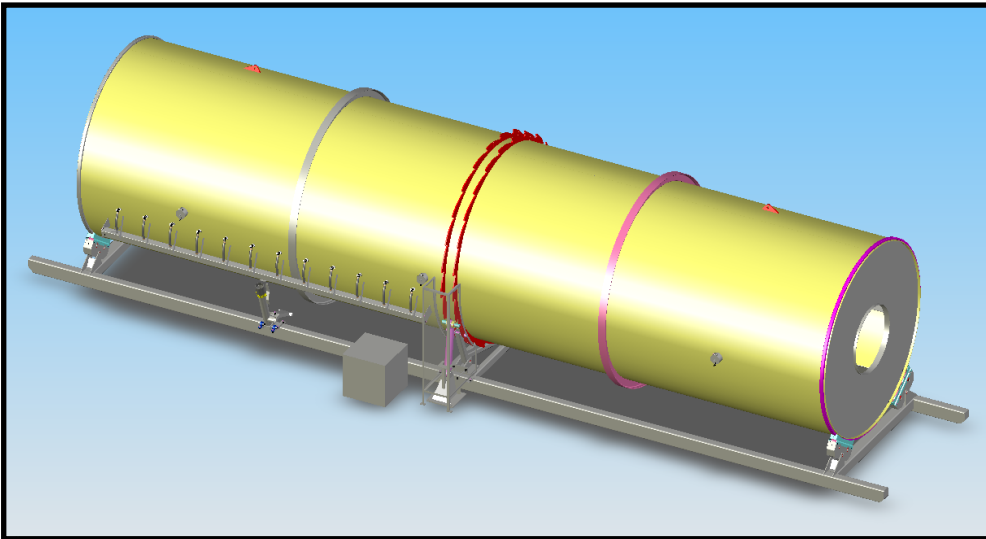
- + Odour control
- + No contamination
- + Reliable Monitoring
- + Short residence time
- + Uniform aeration



- High investment costs
- Labour intensive
- Poor mixing
- Unreliable process control



Drum Composting



- + Full process control
- + No contamination
- + Uniform aeration
- + Homogeneous mixing
- + Short residence time

- High investment costs
- Labour intensive
- Odour control required



Landscaping

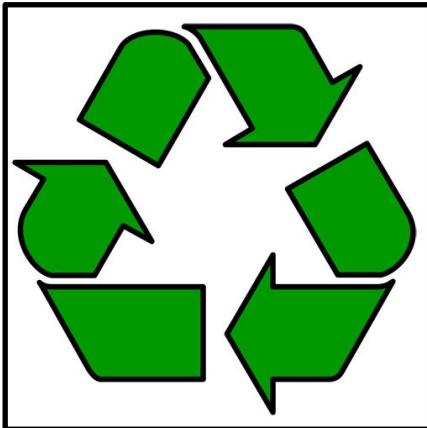


Urban farming



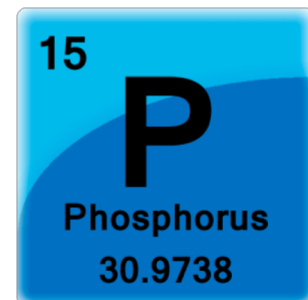
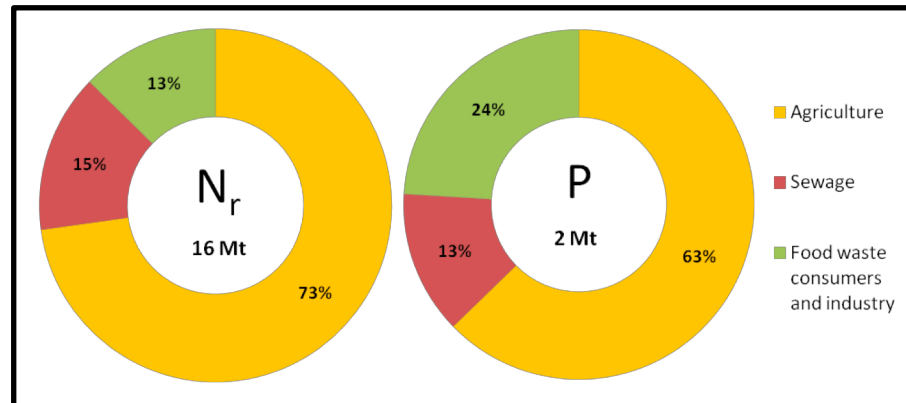
New winds

- Development of bioeconomy
- Precision farming
- Proper nutrients management
- Carbon sequestration
- Demand for organic fertilizers

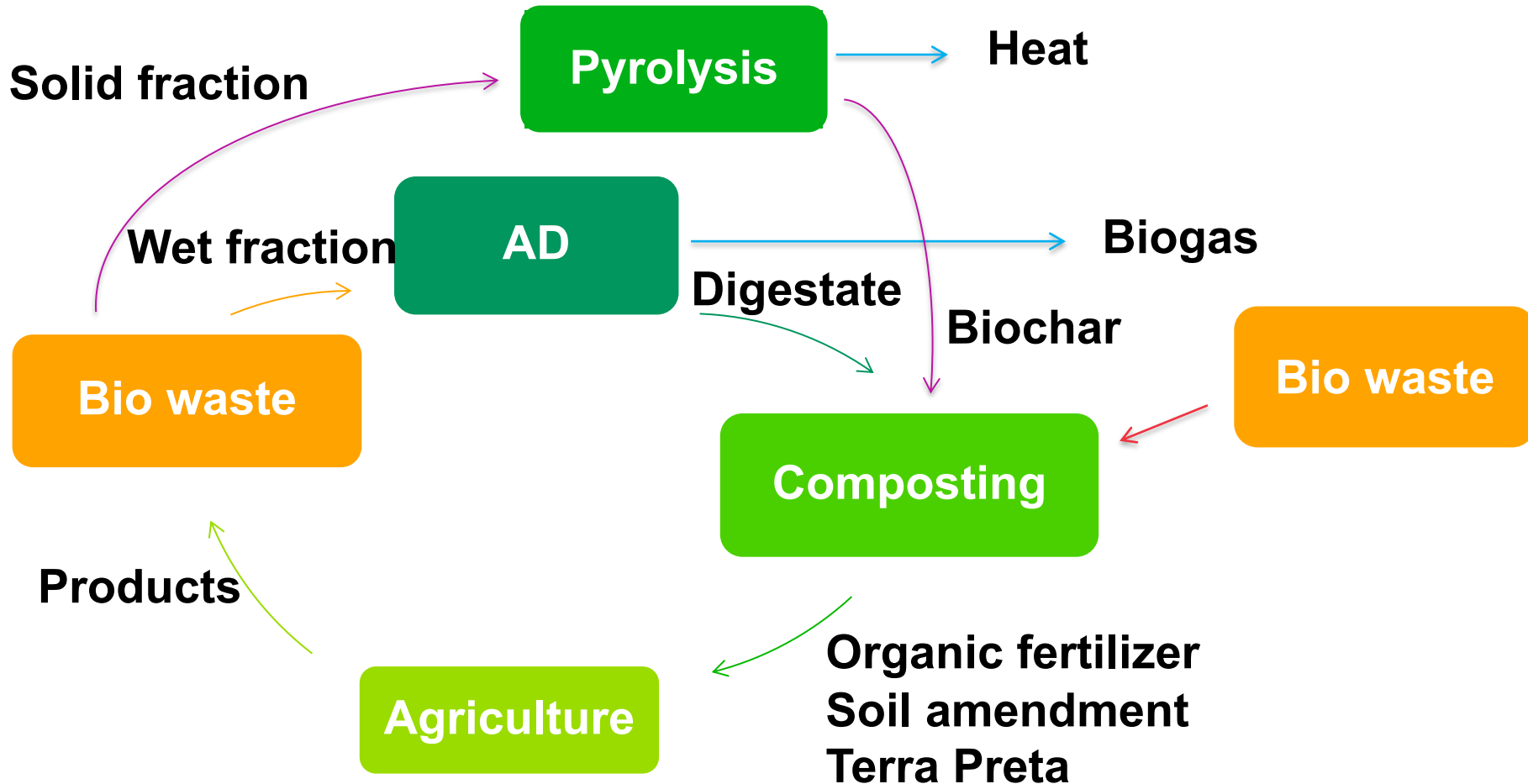


Composting & Nutrients Recycle

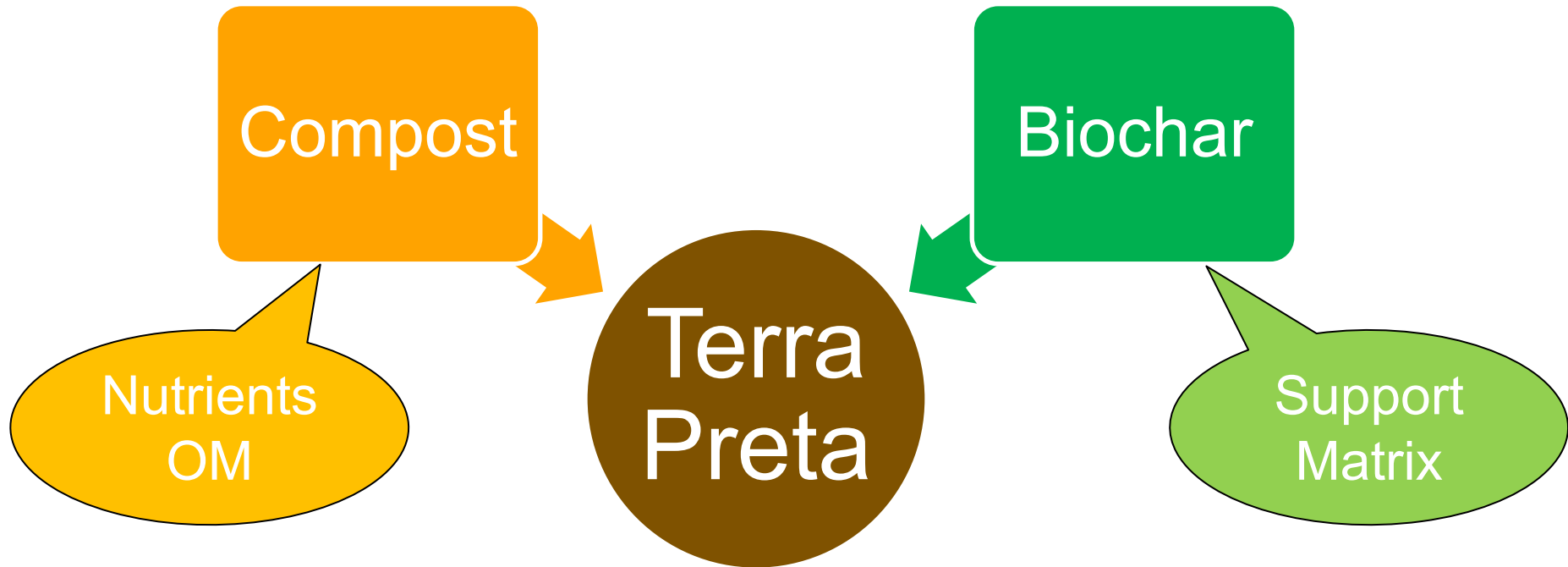
- Nutrients are present in the raw material
- Stabilization of organic matter
- Nutrients in a stabilized form
- Slow nutrients release



Composting within the bioeconomy



Composting & Terra Preta



Effects of Biochar on Composting

- **Increased process temperature**
- **Shorten maturation time**
- **Improved moisture retention**
- **Improved ion exchange capacity**
- **Increase the pH both during process and in the end-product**
- **Increase stability of the organic matter**
- **Increase nutrients content in the compost**
- **Improve nutrients availability in the soil**
- **Adsorb organic pollutants and heavy metals**
- **Effective carbon sequestration process**

Uncertainties over Biochar/Composting

- **Biochar quality**
- **Interactions of biochar and nutrients during composting**
- **Biochar/Compost ratio**
- **Interaction with different type of soils**
- **Capacity to remove POPs**
- **Effect on crop's growth**
- **Effect of biochar ageing on pollutants release**
- **Sustainability as carbon sequestration procedure**