



The Key to Sustainability: Profitability

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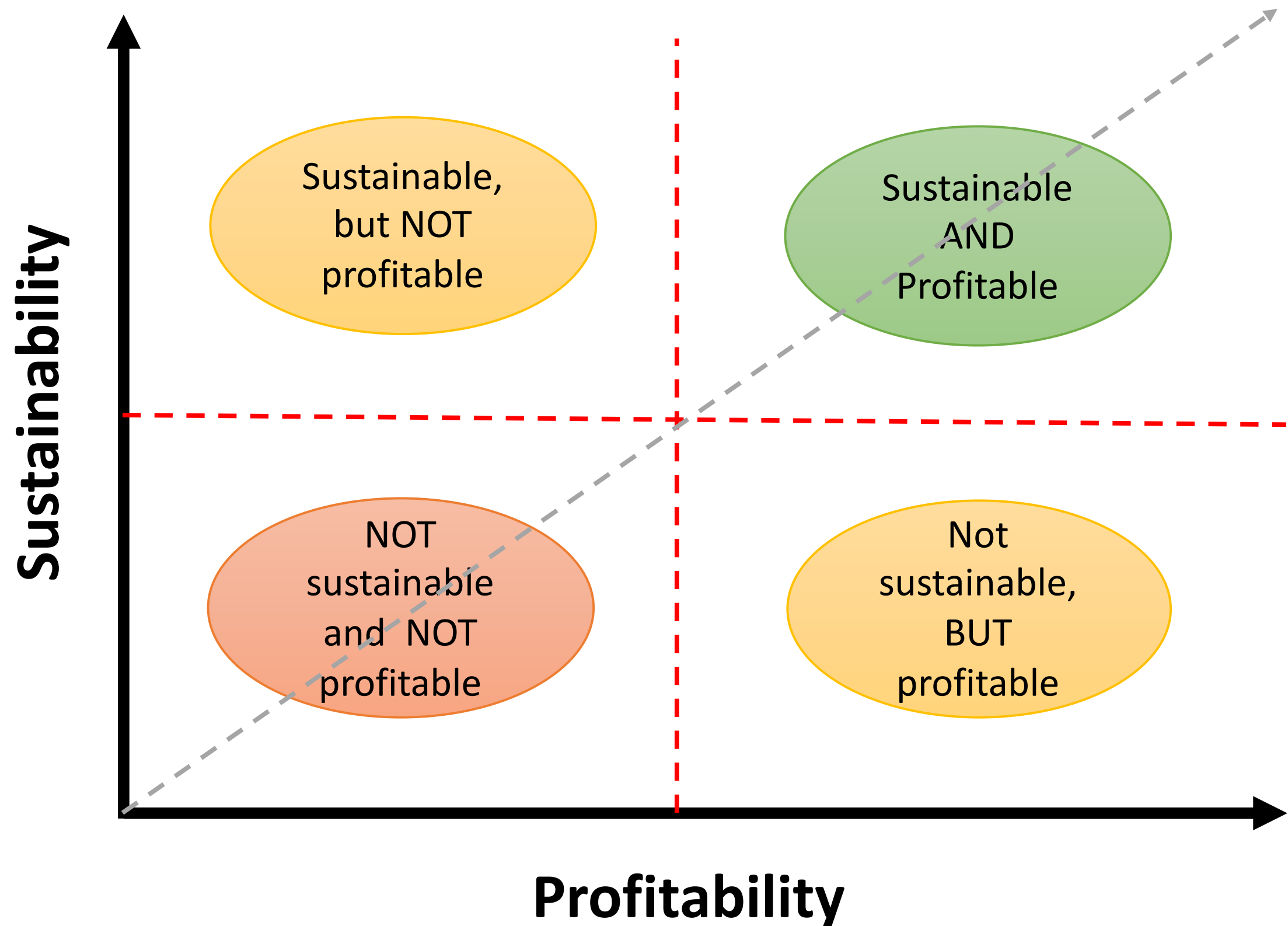
Meaning of AGATE

Agriculture
New Beginnings
Prosperity



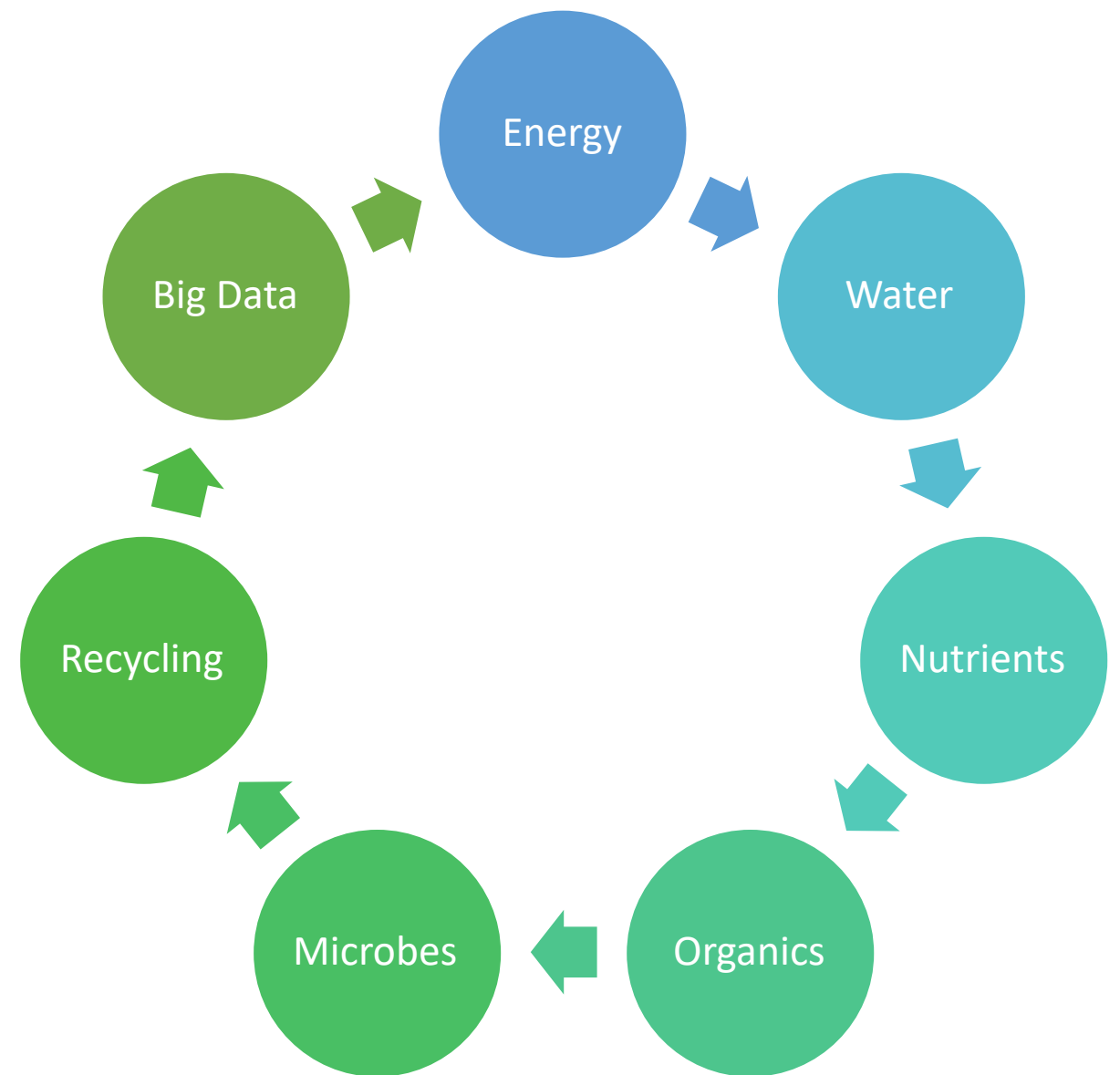
AGATE
Biosciences



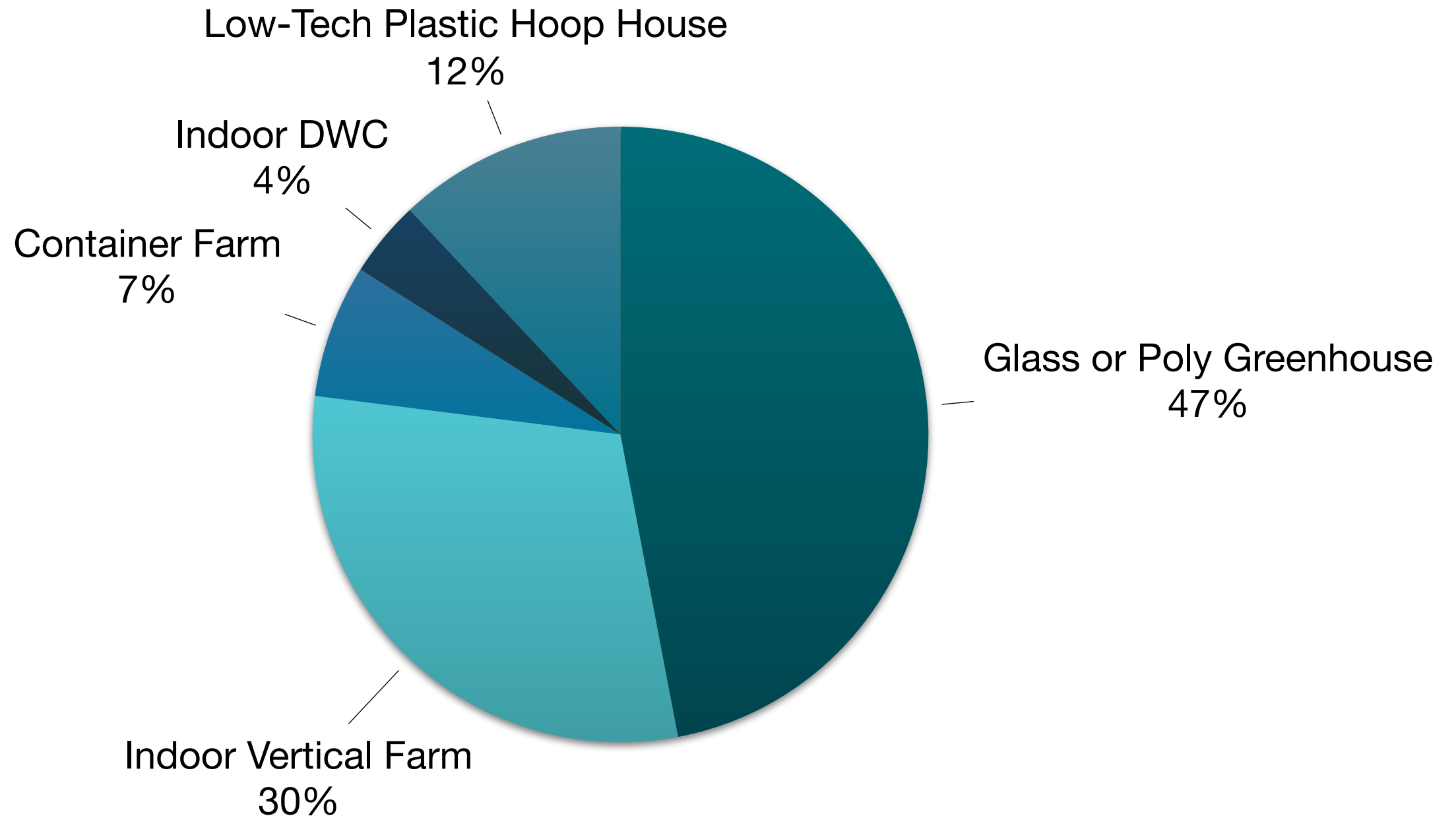


7 Sustainable Steps to Profitability

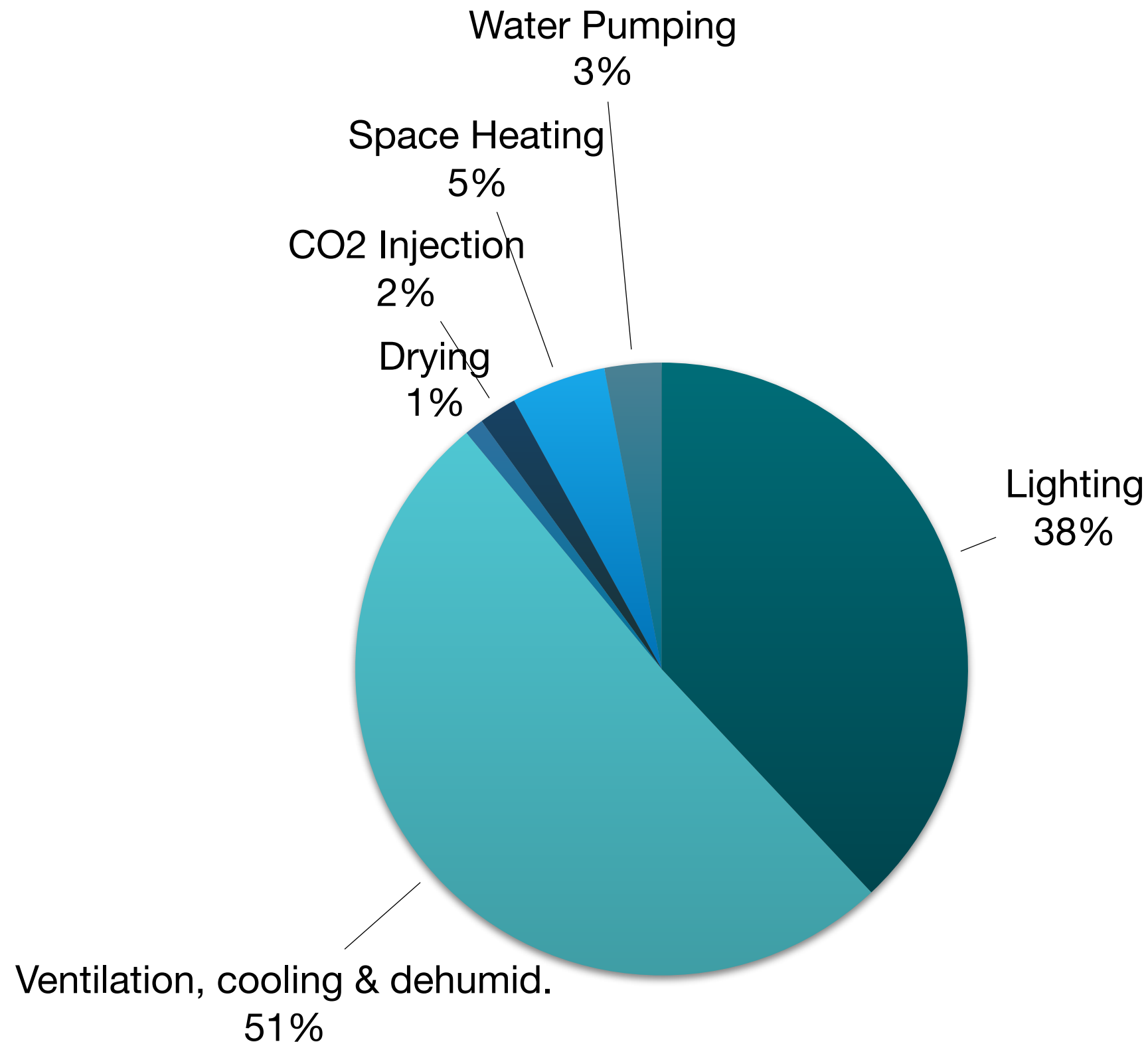
1. Energy use reduction
2. Water use reduction
3. Reduction of nutrient costs
4. “Organics” to improve yield and quality
5. Microbiology to improve yield and quality
6. Waste recycling to cut costs
7. Big Data, the future of Controlled Environment Agriculture (CEA).



Controlled Environment Agriculture of Traditional Vegetable Crops



Energy Use Breakdown for a Typical Cannabis Grow

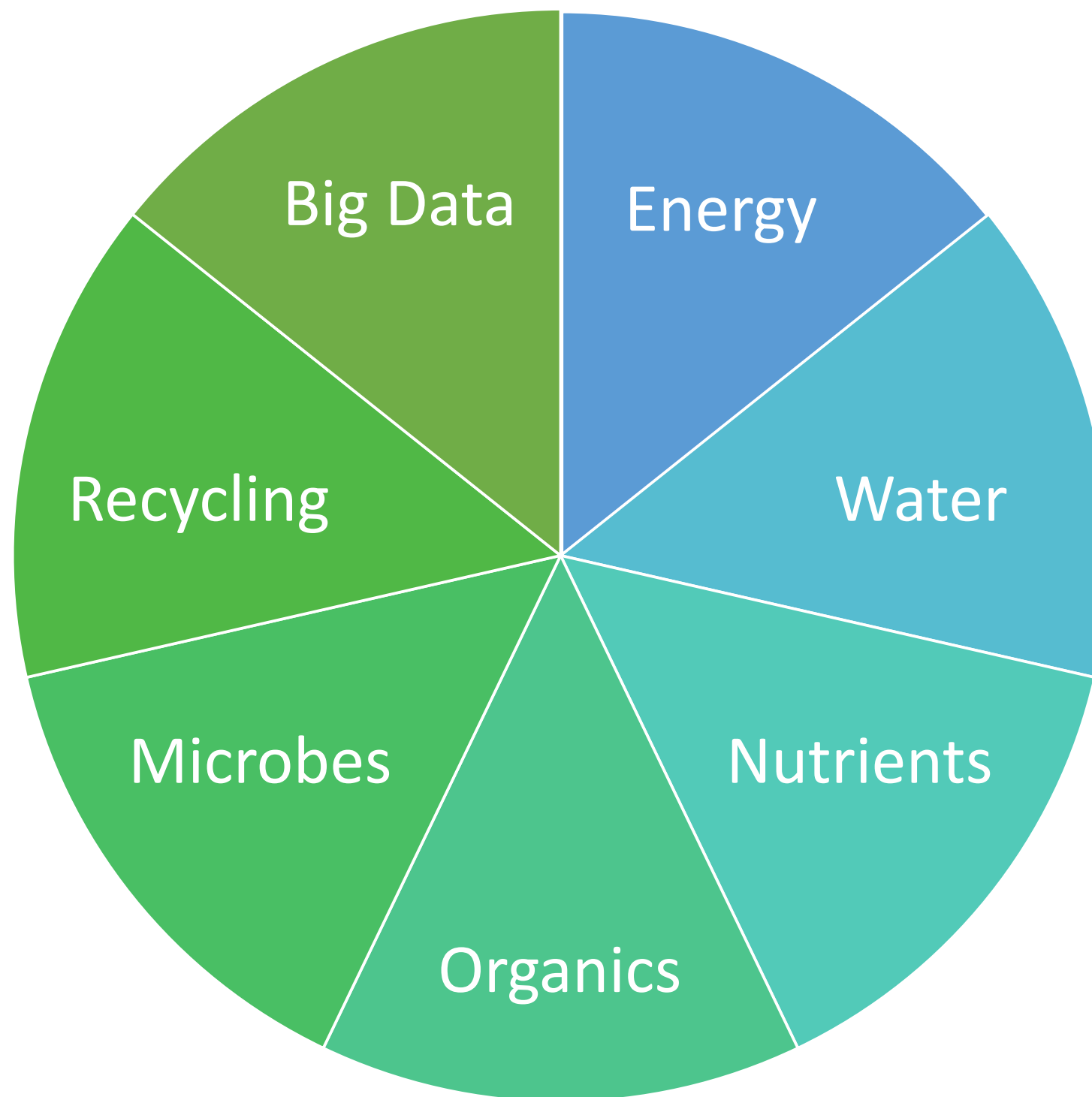


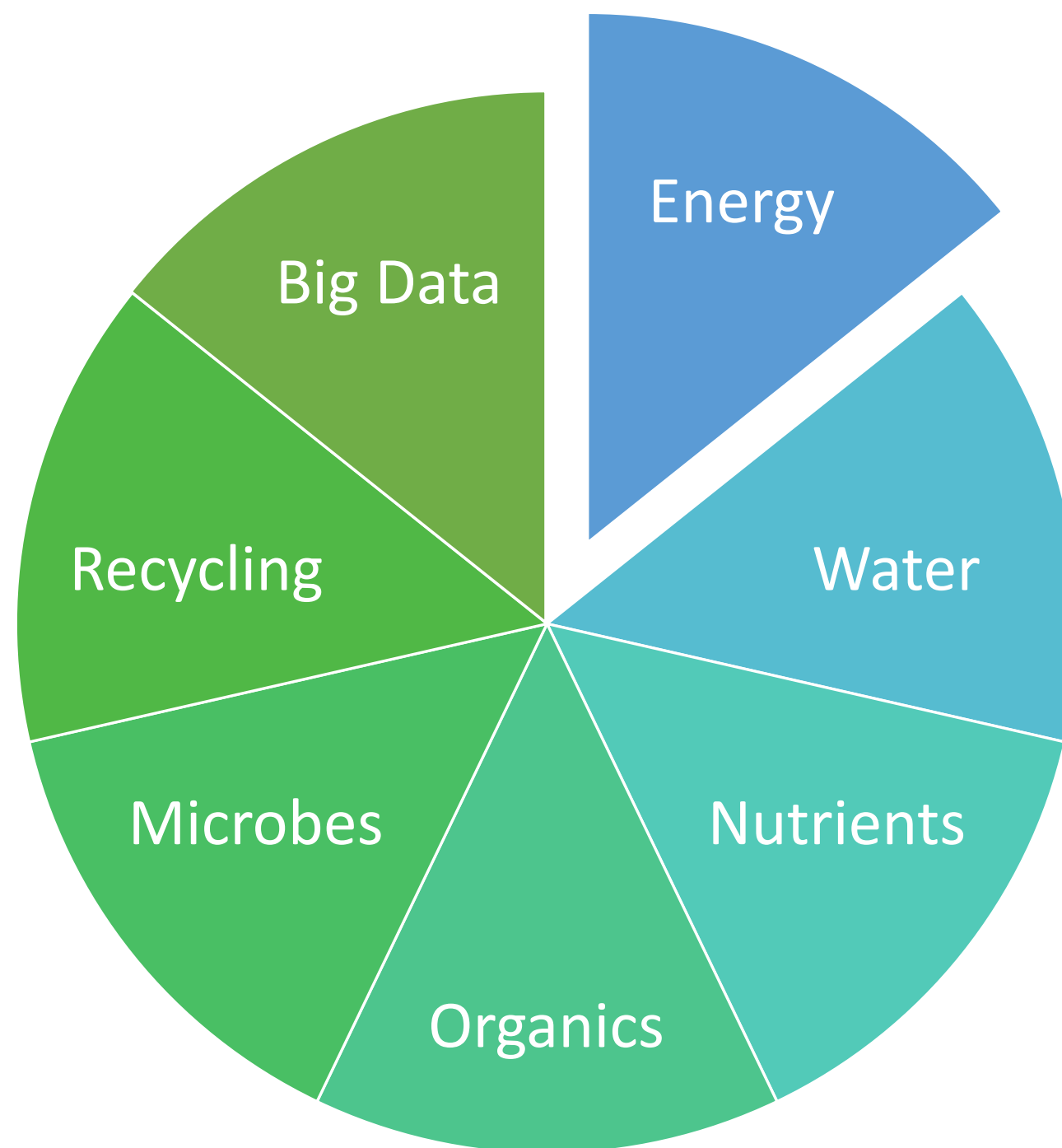
Indoor, Greenhouse, and Field Comparison Summary

- Indoor
 - 150 W/ft² of canopy
 - ✓ 60% of facilities
- Greenhouse
 - 60 W/ft² of canopy
 - 10% of facilities
- Field
 - ✓ <5 W/ft² of canopy
 - 30% of facilities
- How do we close the Sustainability Gap?



7 Sustainable Steps to Profitability





Energy Utilization

- Lighting
- HVAC
- Dehumidification

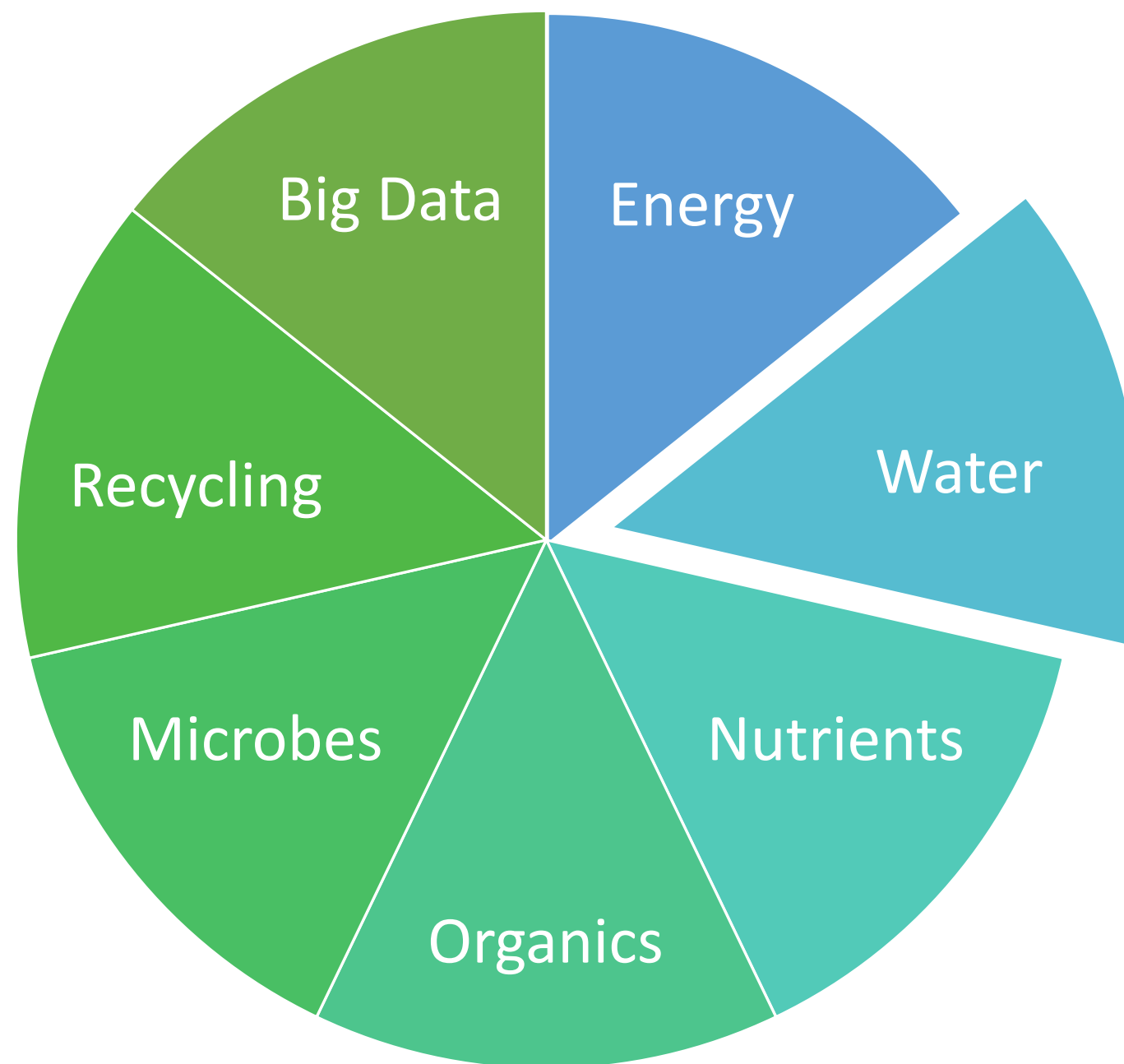


Selecting Energy Efficient Strains

Think Whole Plant

- High THC
- High CBD
- High secondary cannabinoids





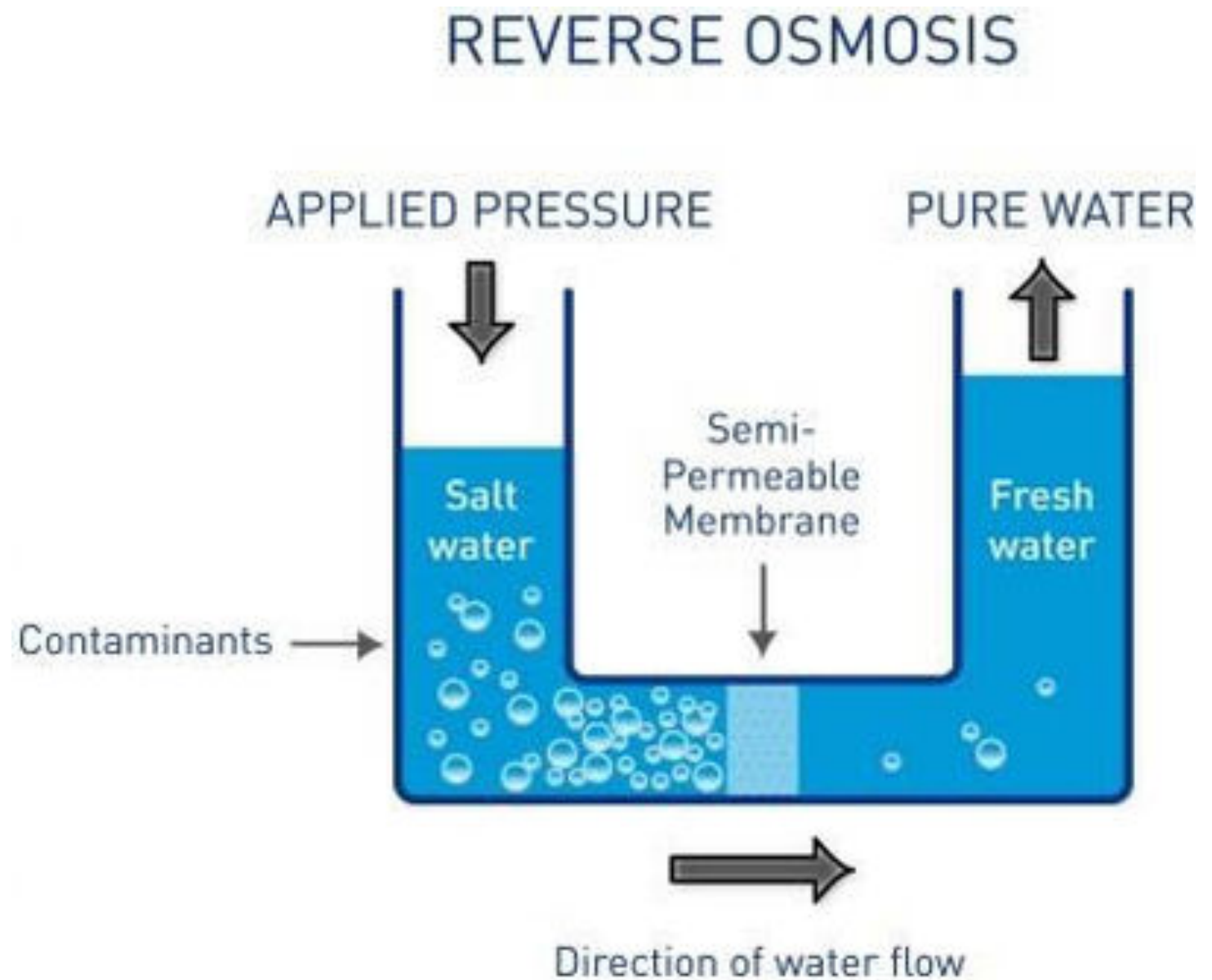
Water Utilization

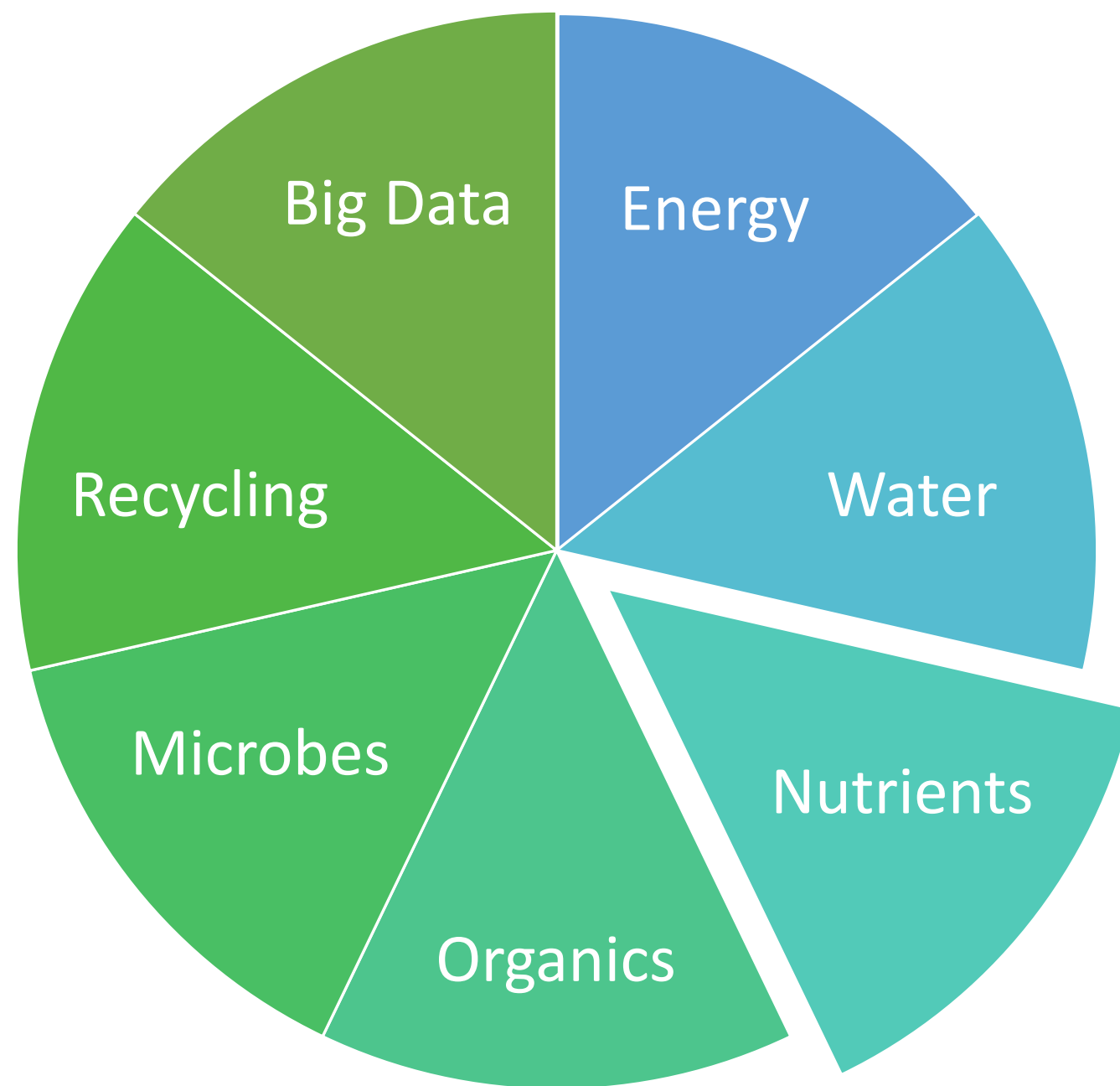
- Soil
- Hydroponics
- Aquaponics
- Aeroponics



Water Waste

- Generating RO water is wasteful
- Typically for every gallon produced 2 go down the drain
- Take advantage of the natural nutrients from your water source
- Design your dry fertilizer mix to match your water source
- There are exceptions if your water's mineral content is too high to support healthy plant growth

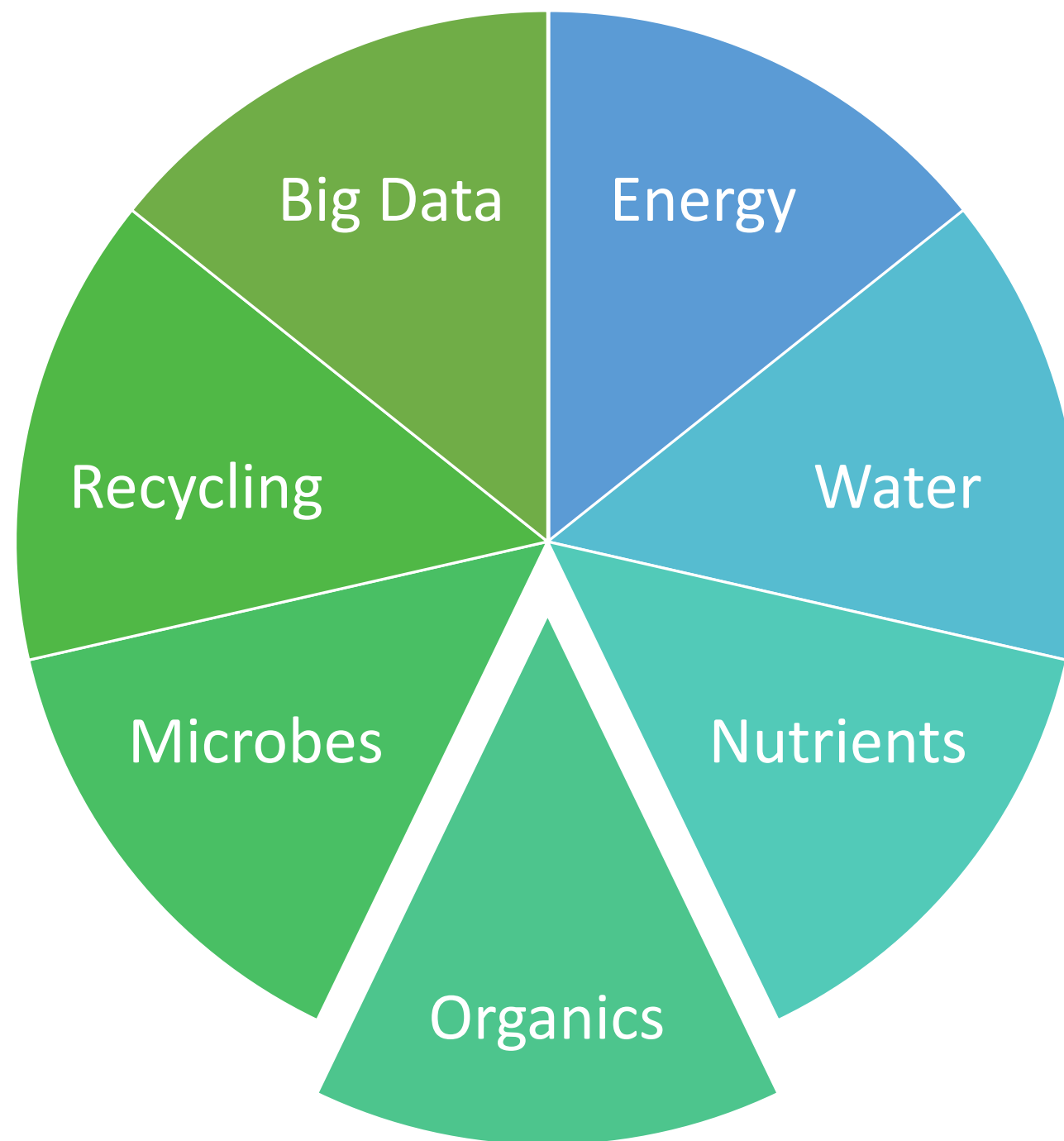




Nutrient Utilization

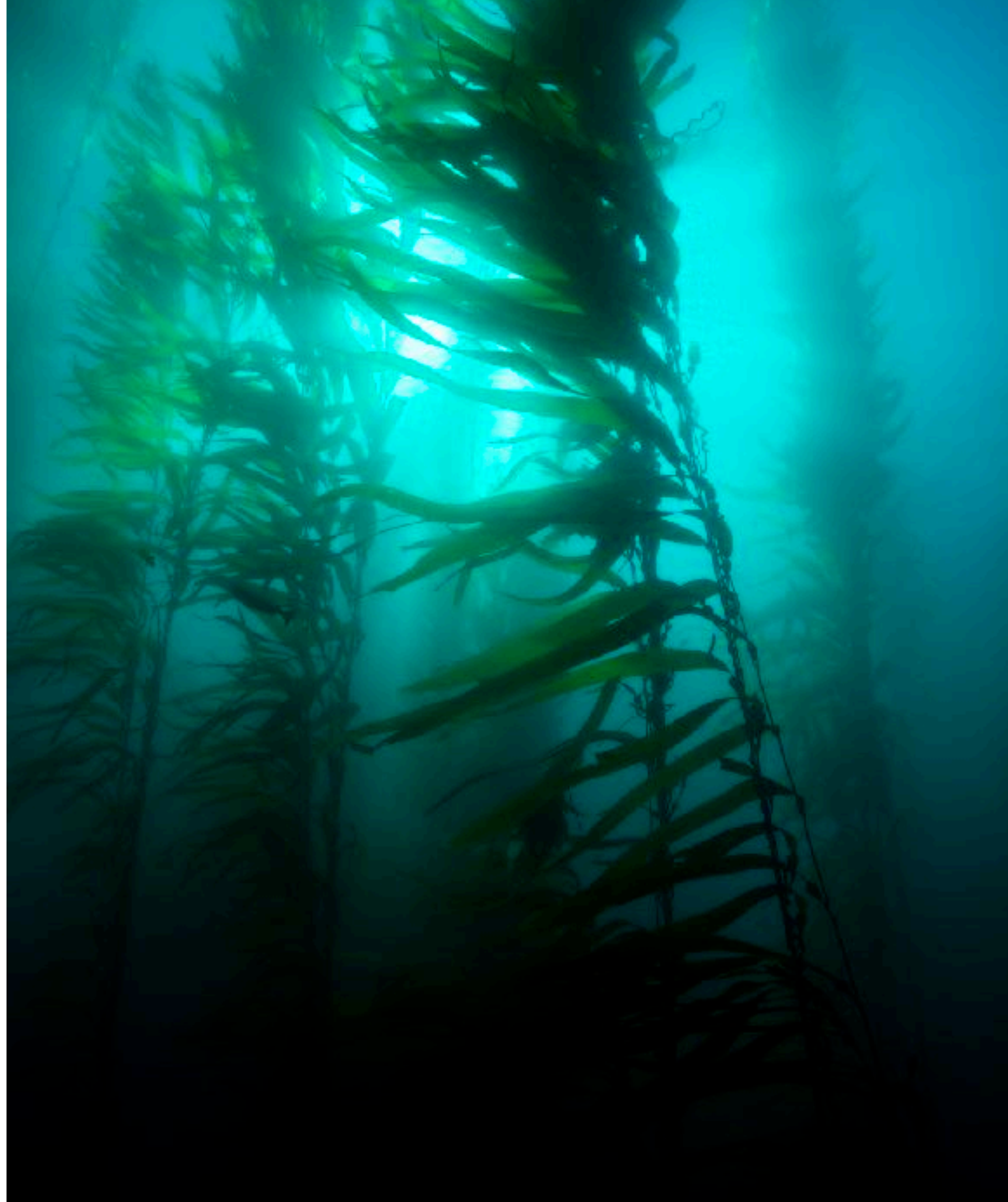
- Mineral Salts
 - Macro: N K Ca Mg P S
 - Micro: Cl Fe B Mn Zn Cu Mo Ni
- Don't waste money on nutrients
 - Farmers make their own!

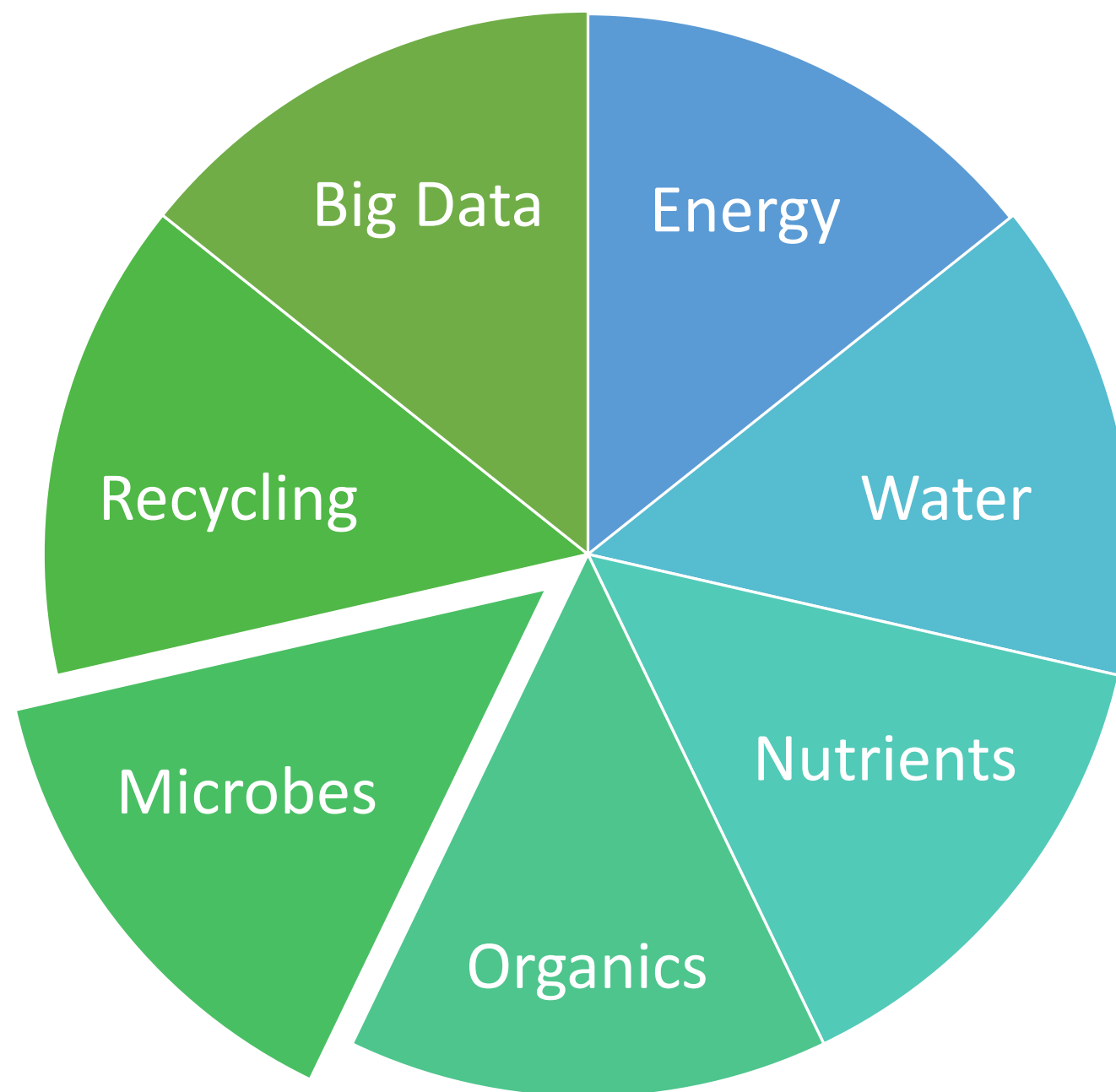




“Organic” Additives

- Kelp
- Humic Acid
- Fluvic Acid
- B Vitamins
- Carbohydrates



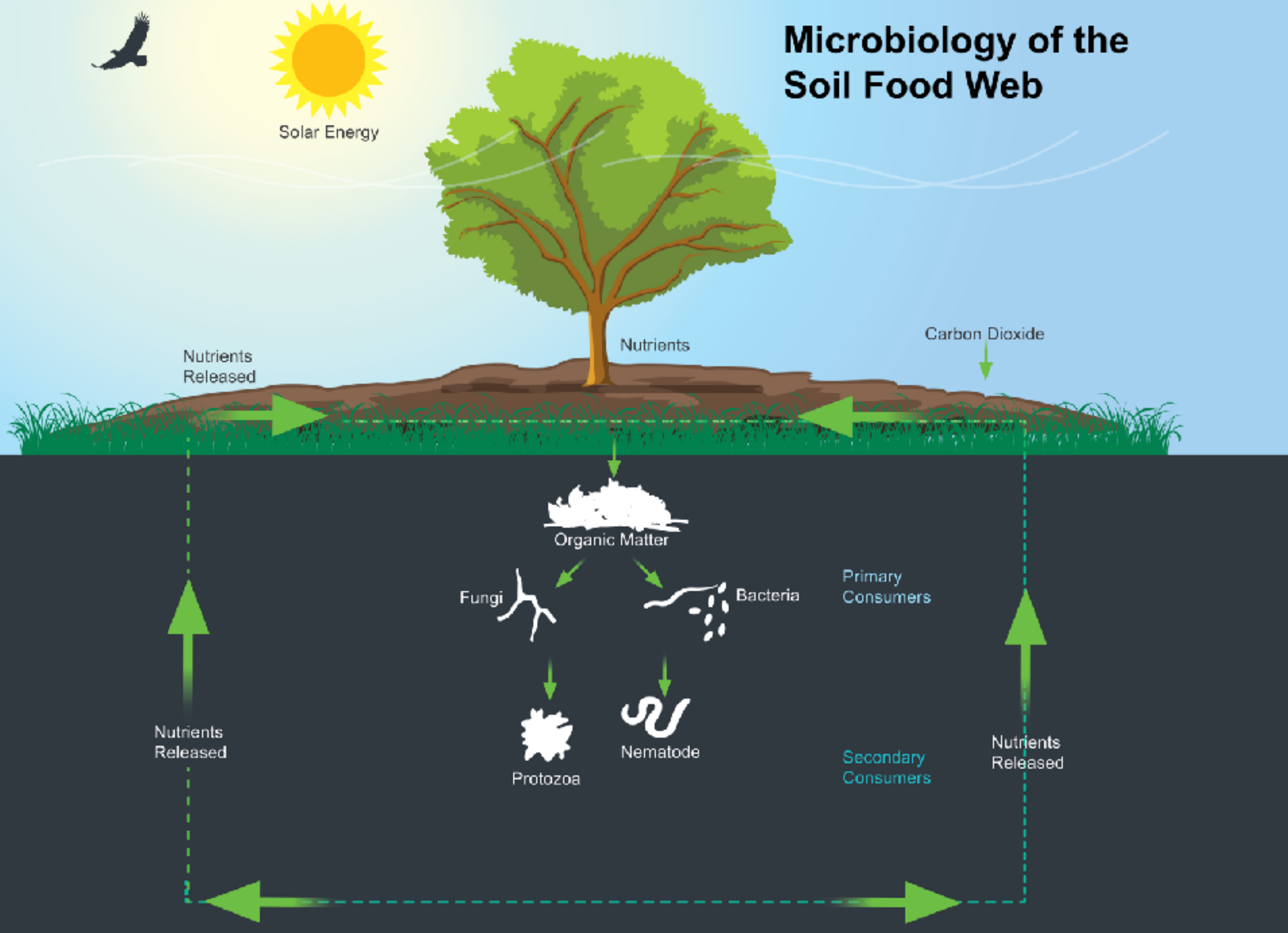


Microbes

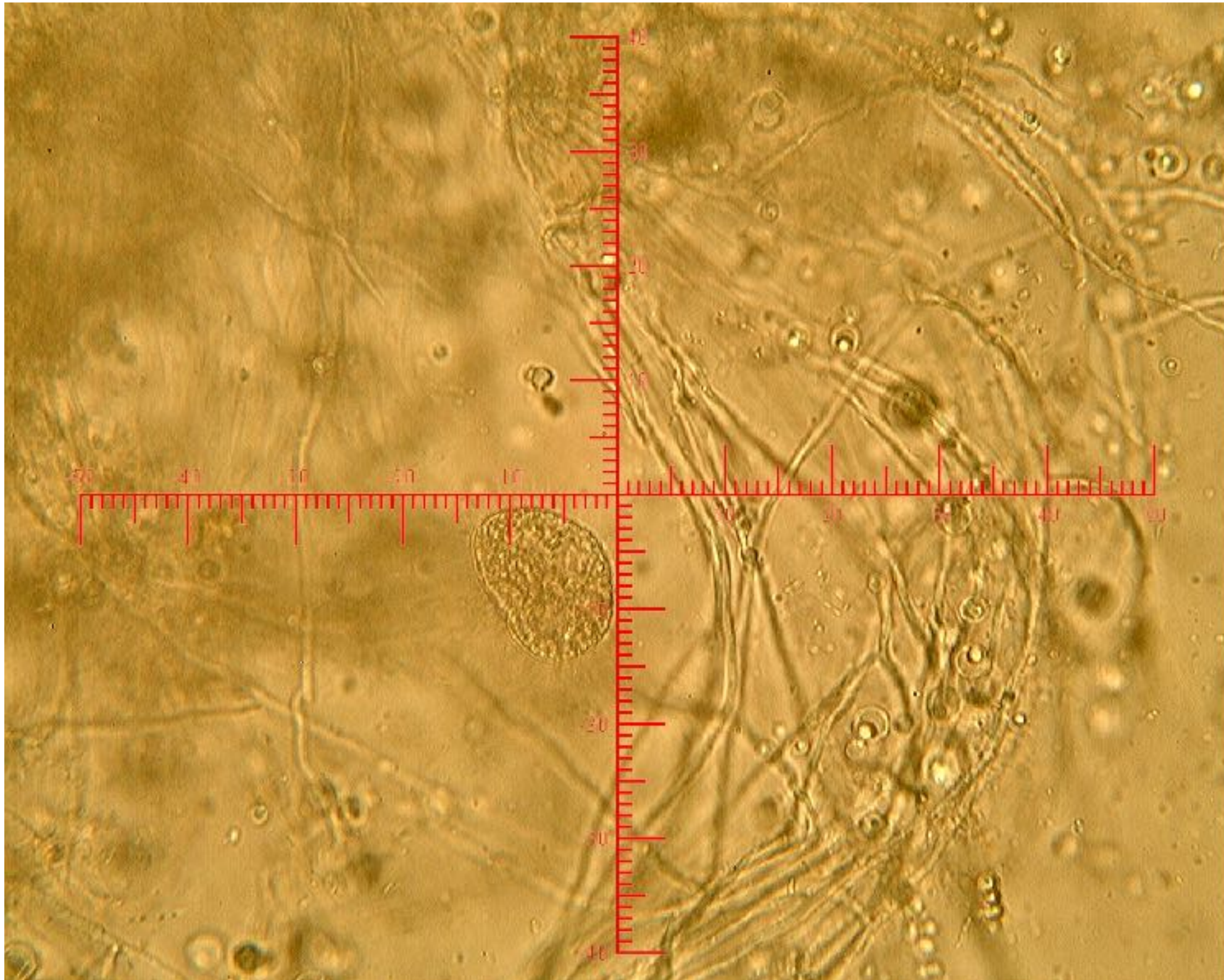
- Bacteria
- Fungi
- Protozoa
- Nematodes
- Read Teaming with Microbes
by Wayne Lewis and Jeff Lowenfels



Microbiology of the Soil Food Web



Hydroponic Microbiology



“Organic” Hydroponic Microbe Study

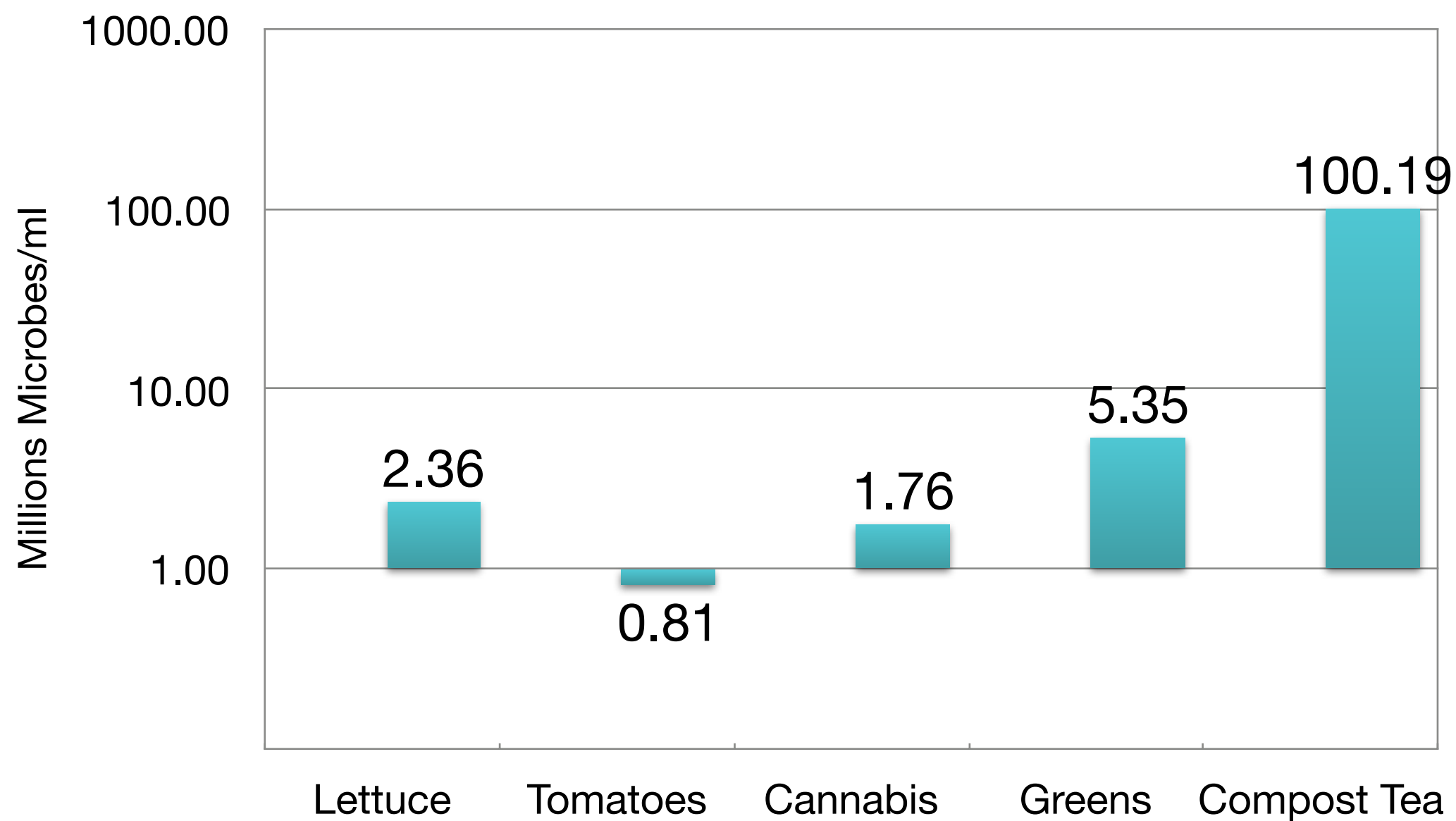
- Hydroponic Lettuce
- Hydroponic Tomatoes
- Aquaponic Lettuce
- Hydroponic Cannabis



Microbe Concentration in “Organic” Hydroponic Crops

Crop	Replications	Microbes/ml	% StDev
Lettuce	3	2.36×10^6	22
Tomatoes	3	0.812×10^6	27
Cannabis	6	1.76×10^6	54
Aquaponic Greens	3	5.35×10^6	14
Compost Tea	10	1.19×10^6	31

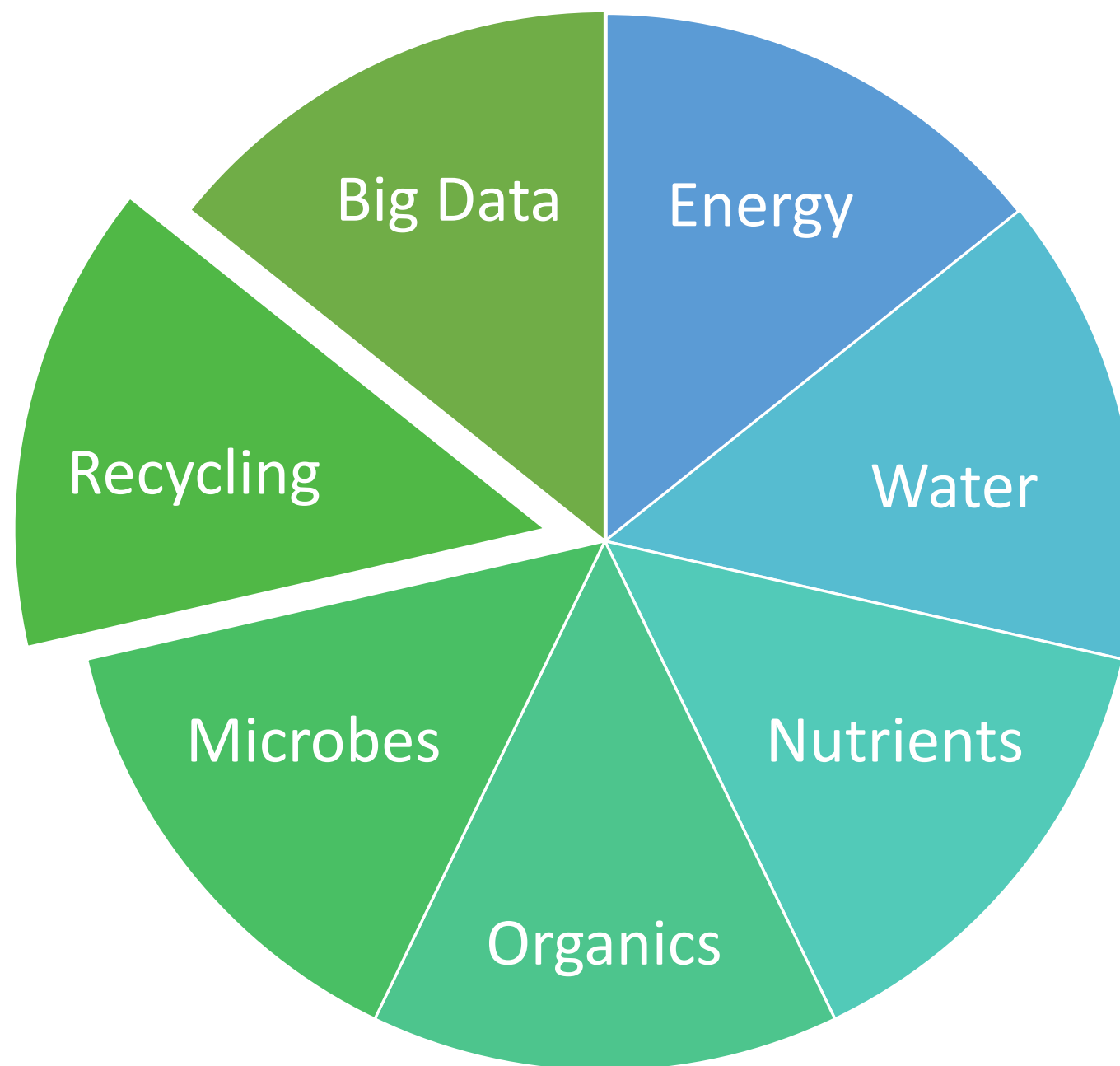
Microbe Concentration in “Organic” Hydroponic Crops



Microbes Summary

- Hydroponic systems have a large number of microbes in their root zone
- Similar numbers are found in all hydroponic systems in this study
- Microbial inoculants are claimed to produce 5-20% increase in yield in both vegetables and cannabis
- Microbial research on vegetable crops is relevant to cannabis production





Waste Recycling

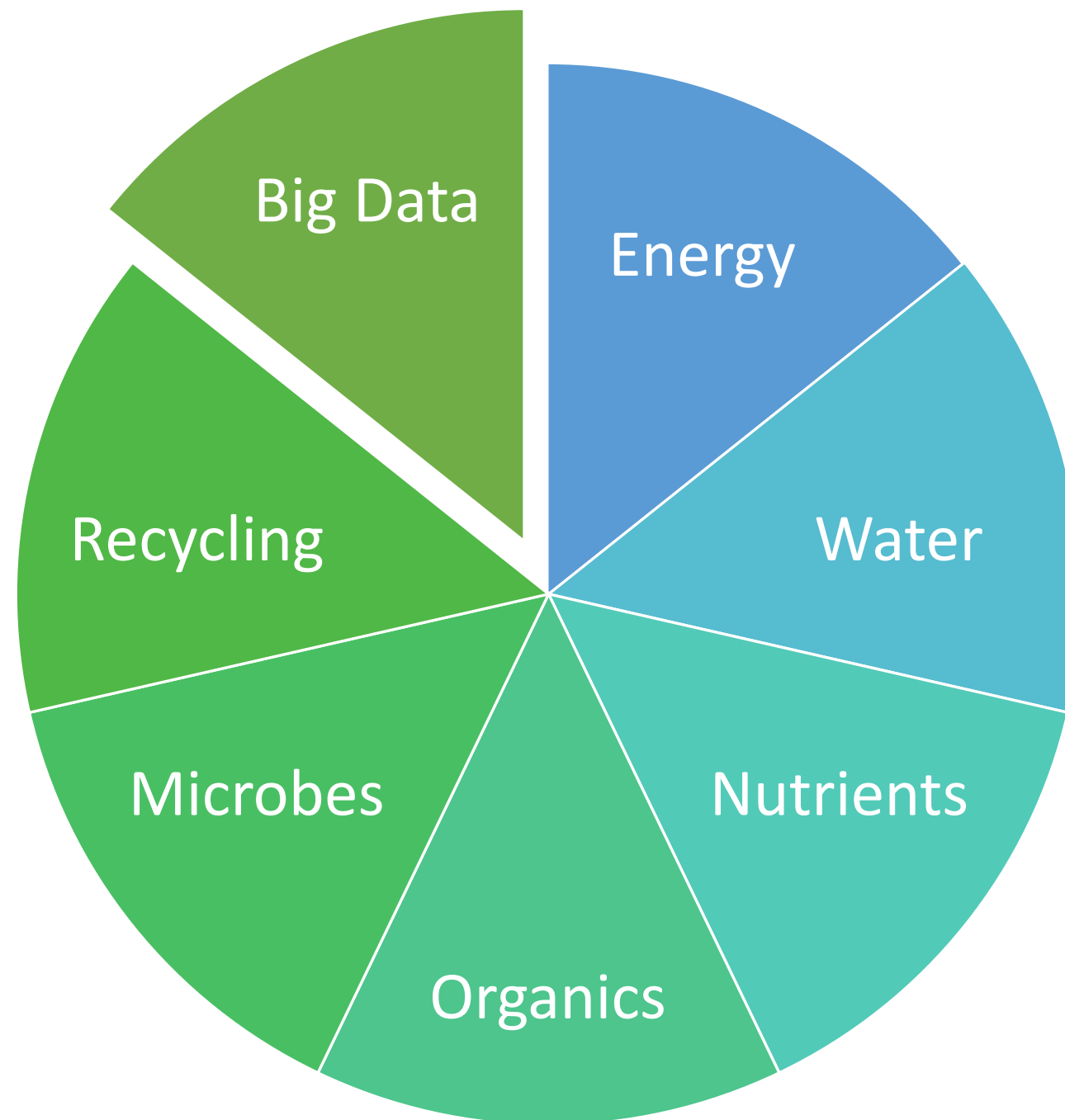
- Plant Material
 - Stems
 - Roots
- Growth Media
 - Soil
 - Coco Coir
 - Rockwool



Bokashi Composting

- An Anaerobic Fermentation
 - Performed in the absence of oxygen
 - Results in lactic acid production
 - Prevents growth of pathogens due to low pH

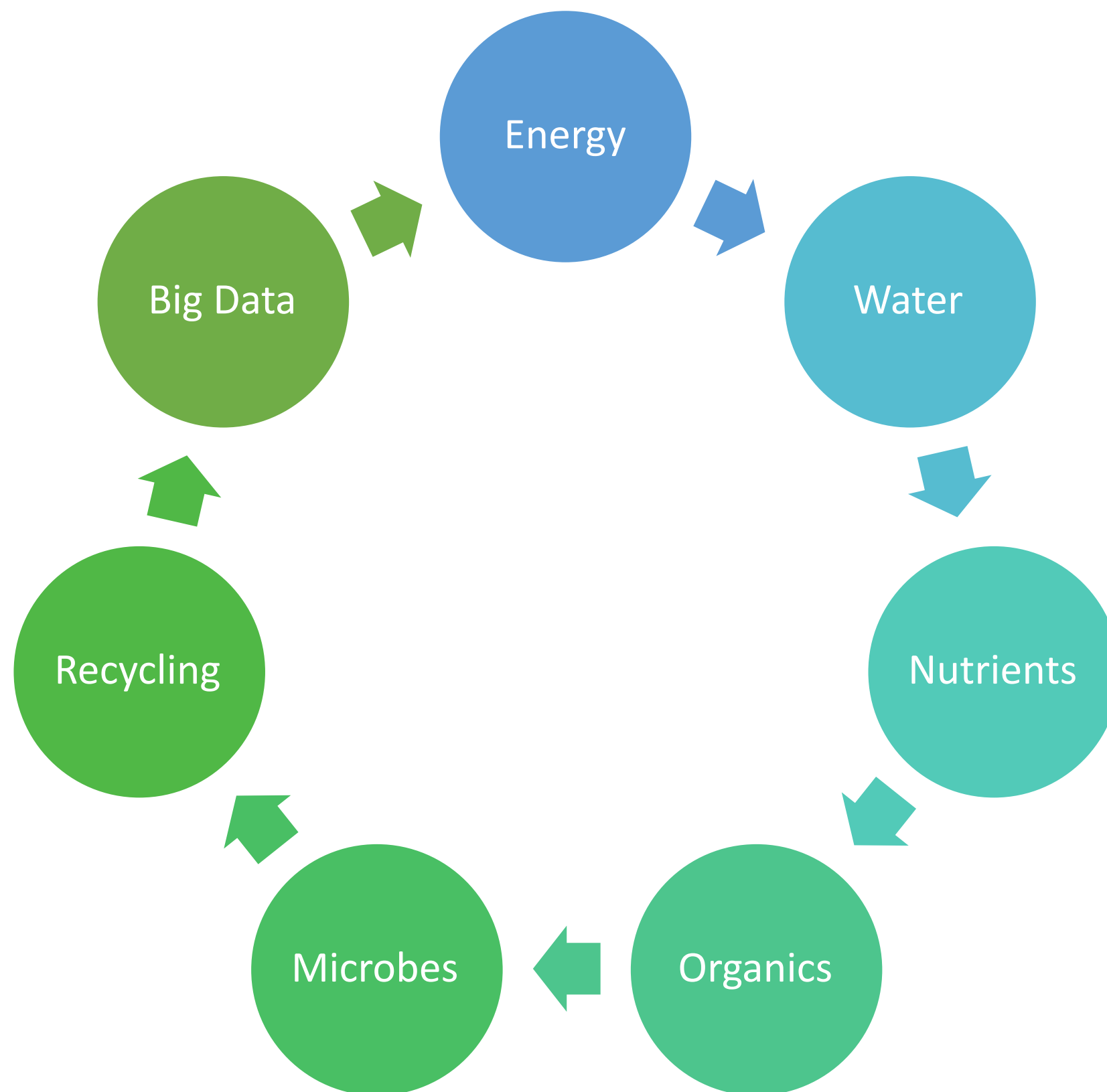


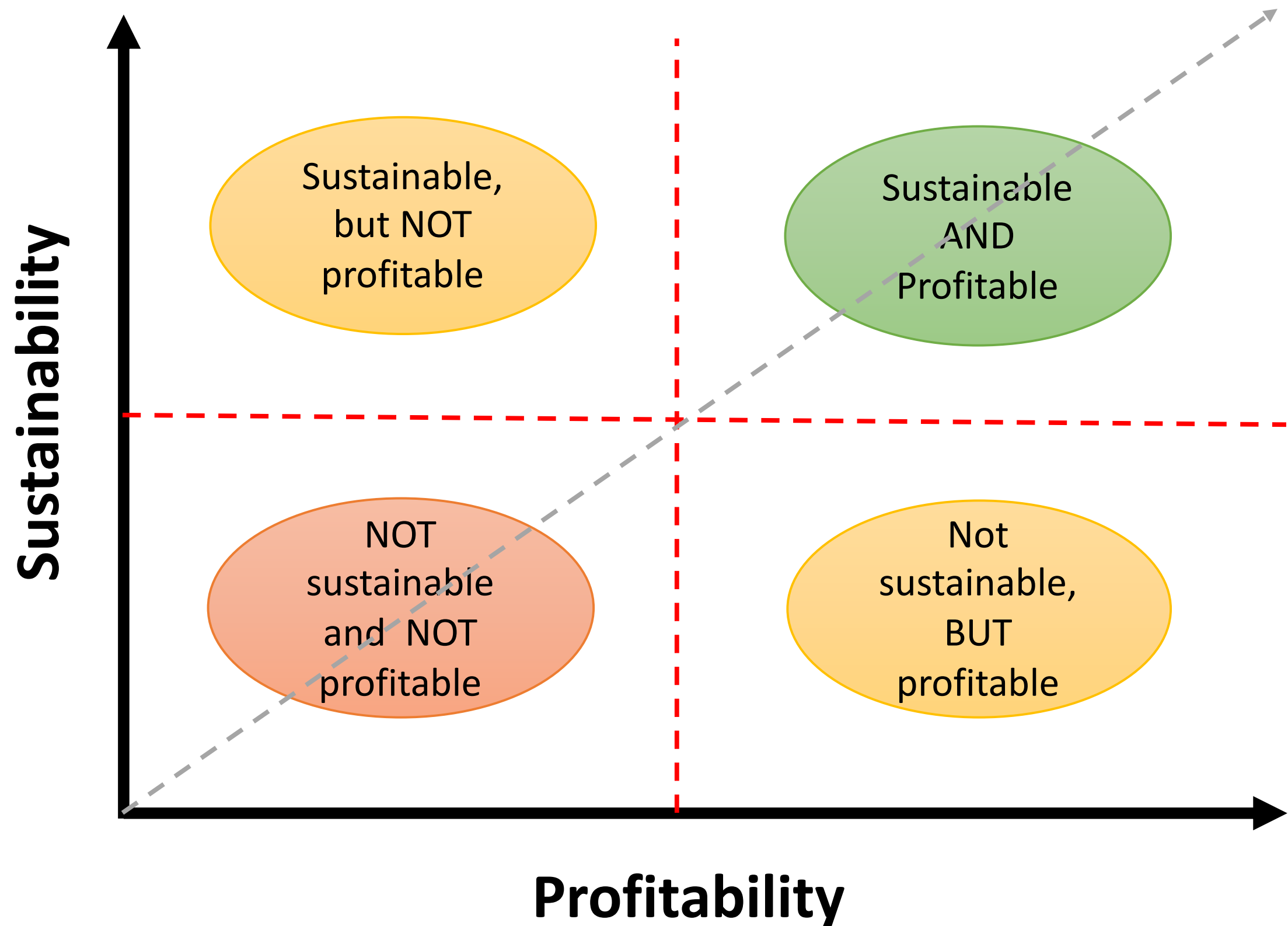


Big Data

- Identifying best practices
- More efficient operation
- Providing data to the community for benchmarking







Key Take-home Messages

1. **Energy:** Use energy efficient methods wherever possible
2. **Water:** Select your growing methodology to reduce water use
3. **Nutrients:** Make your own nutrients
4. **Organics:** Take advantage of nature's complexity
5. **Microbes:** Foster healthy plants with a beneficial root microbiome
6. **Recycling:** Recycle grow media and plant waste material
7. **Big Data:** Share your data to assist the development of new capabilities for sustainable practices

“Be a citizen scientist. Record your grow conditions and results in terms of yield and quality. If you are disciplined and do this, you will know where you stand as a cultivator and gain insights you otherwise wouldn’t have had.”

–Roger Kern

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8/29/2018

Cannabis Science Conference