The Bioeconomy & Circular Economy in Southern Arizona: Profile, Economic Baseline, & Prospects

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MAP Talk: Arizona's Bioeconomy
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THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE & LIFE SCIENCES
Cooperative Extension

College of Agriculture, Life & Environmental Sciences

Collaborative Effort

- Department of Agricultural & Resource Economics
- Department of Biosystems Engineering
- Other Contributors throughout the UA College of Agriculture, Life & Environmental Sciences

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Southern Arizona Bioeconomy

- Agricultural industries (mostly in Yuma) directly accounted for
  - 80% of bioeconomy jobs
  - 75% of the value added
  - 60% of sales
- Including multiplier effects, total contribution
  - $6.5 billion in sales
  - 36,400 jobs

Southern Arizona Circular Economy

- Including multiplier effects, total contribution
  - $1.3 billion in sales
  - 12,600 jobs

- Circular economic activity concentrated in Pima County

Southern Arizona Circular Economy & Bioeconomy

- Total contribution of the bioeconomy and circular economy to Southern Arizona in 2019 was
- $7.9 billion in sales
- 49,000 jobs
- $3.8 billion of Southern Arizona Gross Regional Product

Questions

- What do *we* mean by "the bioeconomy?"
- What do *we* mean by "the circular economy?"
- What do *we* mean by "the circular bioeconomy?"

Circular Bioeconomy

- >50 countries have developed formal strategies to promote their bioeconomies
- No universally accepted definition or agreement about what economic activities to include
- >100 definitions of the circular economy

Defining the Bioeconomy

"A revolution in the life sciences will also go way beyond medicine into agriculture, chemical production, environmental sciences, micro-electronics. Biotechnology will be creating jobs that we don t even have names for yet. And they will be high-paying, high-demand jobs—and intellectually satisfying ones. New industries will emerge that will be a growing source of national economic strength and world leadership. Some have gone so far as to suggest that the twenty-first century will be based on a **bioeconomy** "

Dr. Bernadine Healy
Director of the National Institutes of Health (NIH)
1994 commencement address at Vassar College

Juan Enriquez, "Genomics and the World's Economy" *Science*, 1998

"The objective of the life science company is no longer to generate breakthroughs in a single area such as medicine, chemicals, or food but to become a dominant player in all of these."

NASEM *Safeguarding the Bioeconomy Report*

"The U.S. bioeconomy is economic activity that is driven by research innovation in the life sciences and biotechnology, that is enabled by technological advances in engineering and in computing information sciences."

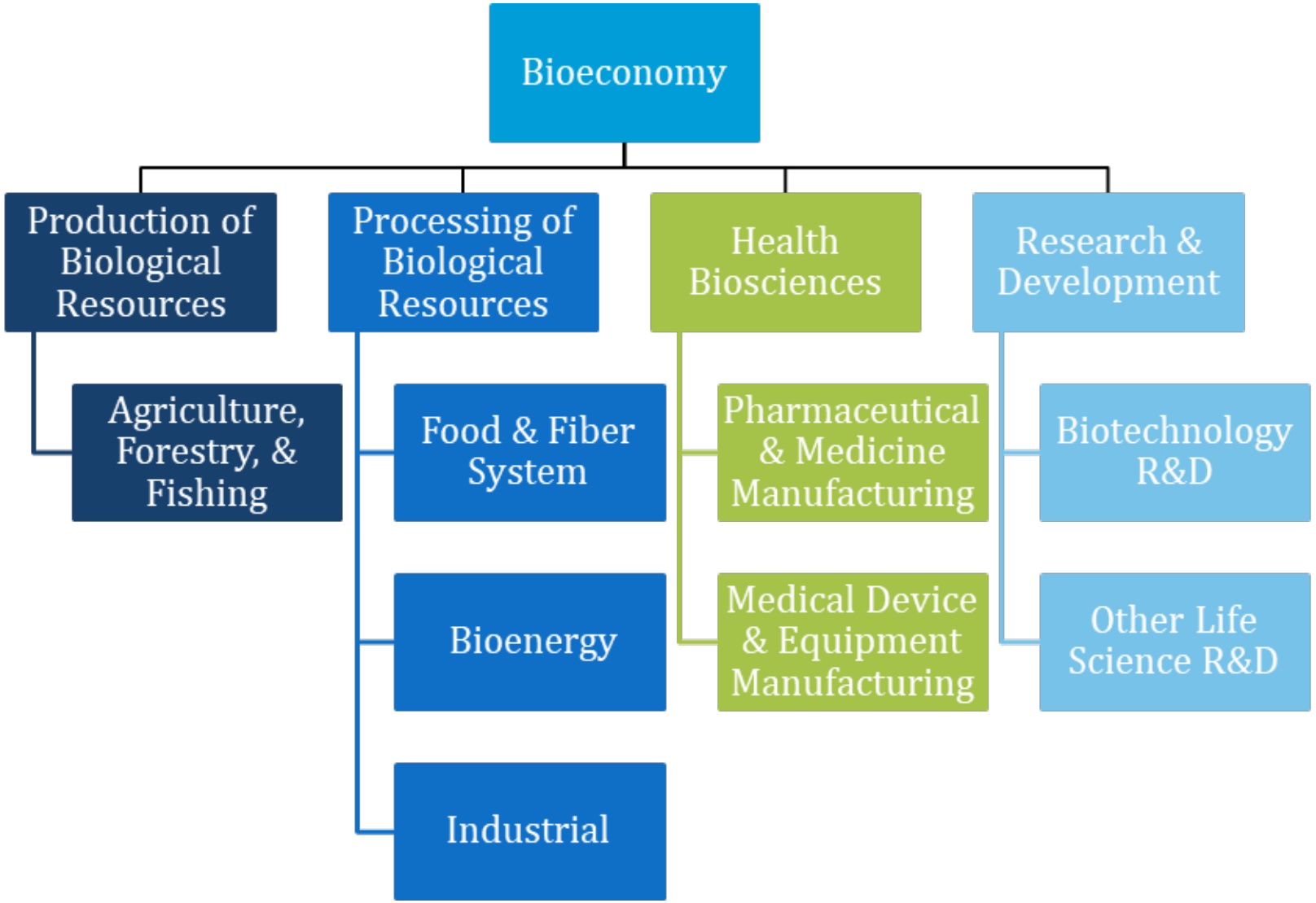
Different approaches to defining the bioeconomy landscape

North America (narrow)

- Biotechnology focus
- Medical / pharmaceutical applications
- Bio-cybersecurity & medical / genetic databases
- Narrower ag focus on biofuels & GM crops
- NASEM report includes intangible assets

EU (broad)

- Includes all agriculture, forestry, fisheries
- Includes non-energy biobased production (food processing, wood & paper products)
- Less emphasis on medical applications, GM crops
- De-emphasis of biotech R&D


Bioeconomy
Production of Biological Resources
Processing of Biological Resources
Health Biosciences
Research & Development
Agriculture, Forestry, & Fishing
Food & Fiber System
Bioenergy
Industrial
Pharmaceutical & Medicine Manufacturing
Medical Device & Equipment Manufacturing
Biotechnology R&D
Other Life Science R&D

Southern Arizona Bioeconomy Jobs

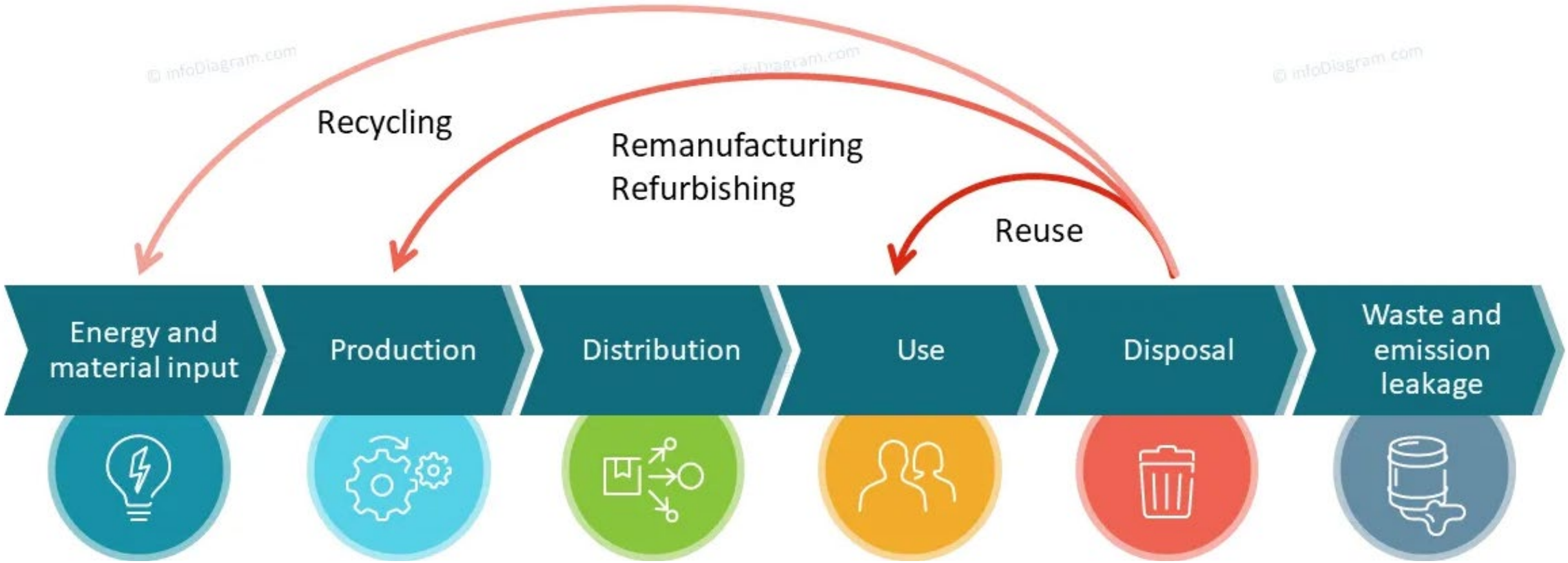
Activity	So. AZ	Cochise	Pima	Santa Cruz	Yuma
Production of Biomass (crops)	14,069	958	572	0	12,539
Food & Fiber System	2,136	104	1,437	50	545
Bioenergy	0	0	0	0	0
Industrial	0	0	0	0	0
Health Biosciences	235	0	235	0	0
Research & Development	1,093	39	1,001	0	53
Total	17,533	1,101	3,245	50	13,137

Linear vs. Circular Economy

Linear Economy – take-make-use-dispose

Circular Economy – 4Rs: reduce, reuse, repair, recycle

Linear vs. Circular Economy



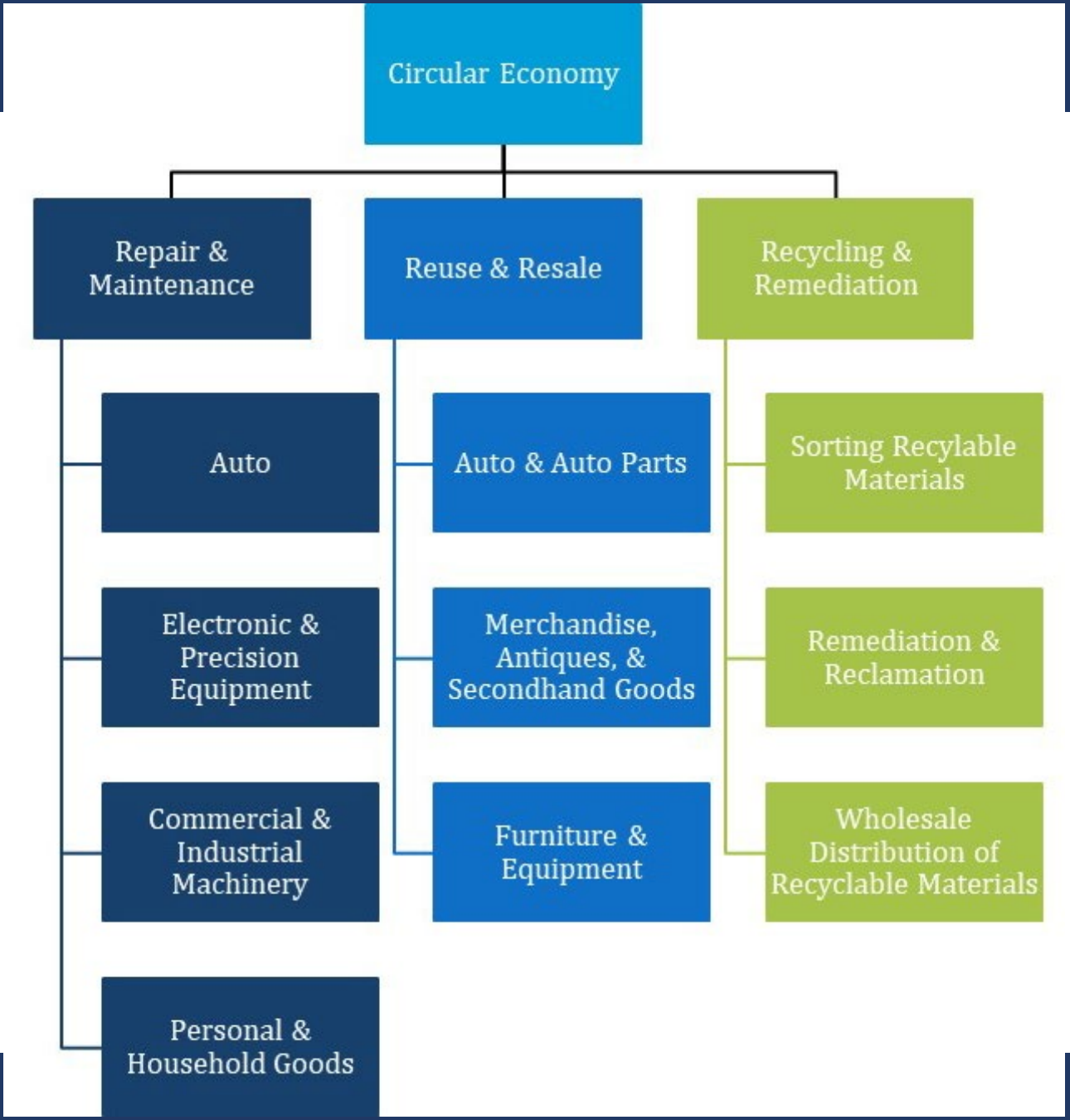
Waste Management Hierarchy

Circular industries vs. circular activities

Most industries are engaged in circular **activities** (e.g. recycling, reusing)

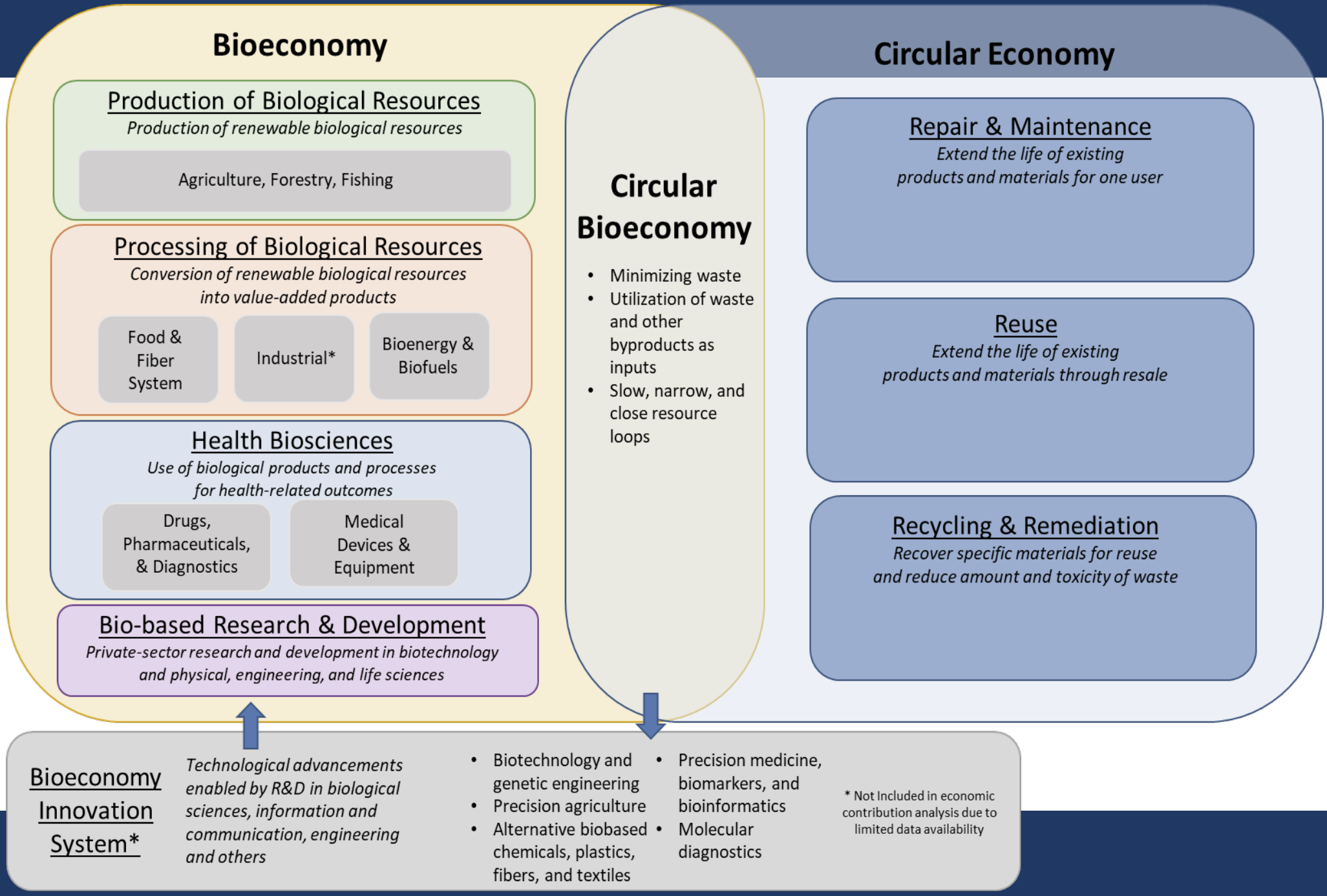
Our study only measured **industries** specializing in circular activities

Southern Arizona Circular Economy Components

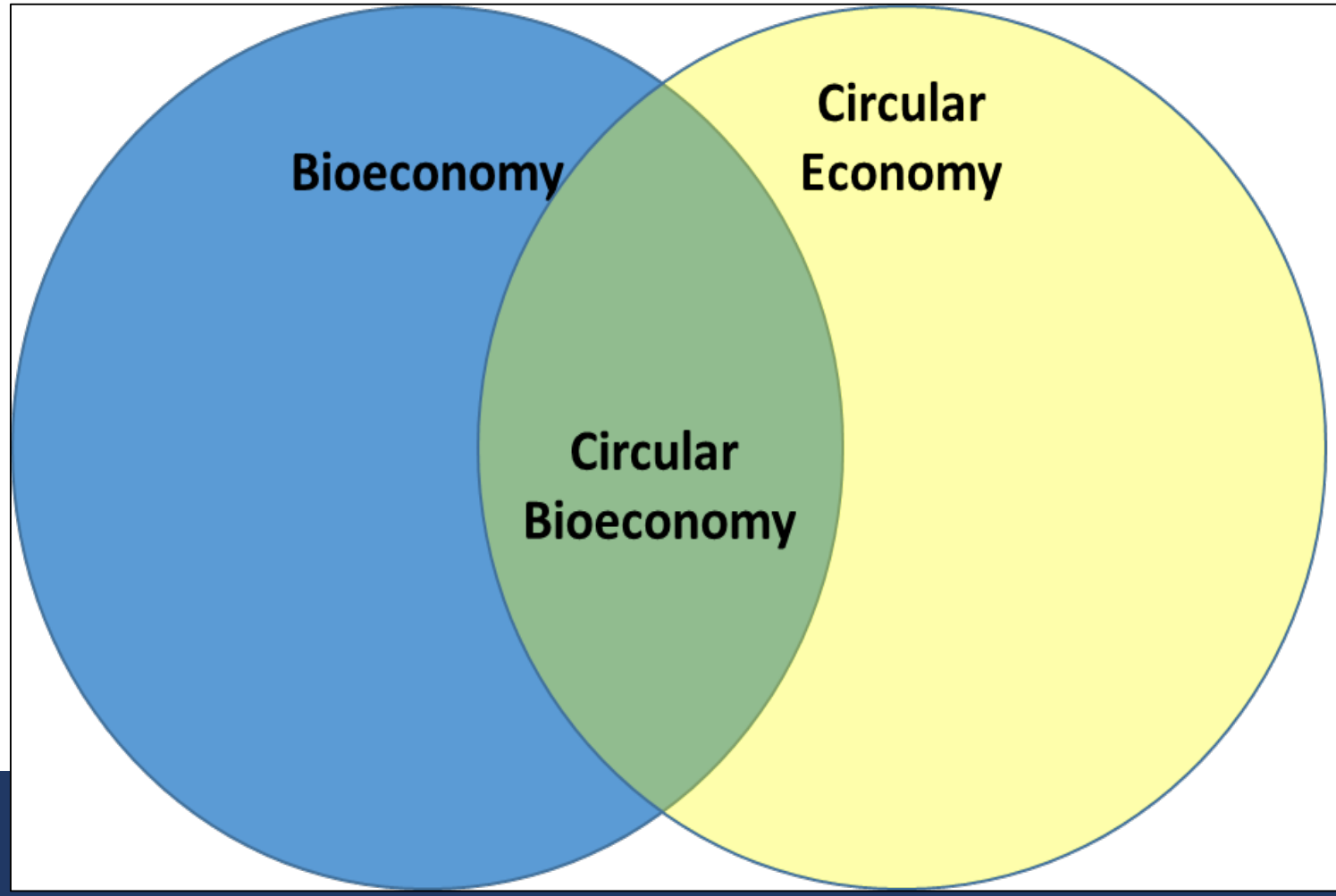


Southern Arizona Circular Economy Jobs

Industry	So. AZ	Cochise	Pima	Santa Cruz	Yuma
Repair and Maintenance	3,995	191	3,096	57	651
Reuse	2,028	141	1,798	0	89
Recycling and Remediation	152	0	152	0	0
Total	6,175	332	5,046	57	740


Bioeconomy
Production of Biological Resources
Production of renewable biological resources
Agriculture, Forestry, Fishing
Processing of Biological Resources
Conversion of renewable biological resources into value-added products
Food & Fiber System
Industrial*
Bioenergy & Biofuels
Health Biosciences
Use of biological products and processes for health-related outcomes
Drugs, Pharmaceuticals, & Diagnostics
Medical Devices & Equipment
Bio-based Research & Development
Private-sector research and development in biotechnology and physical, engineering, and life sciences
Circular Bioeconomy
Minimizing waste
Utilization of waste and other byproducts as inputs
Slow, narrow, and close resource loops
Circular Economy
Repair & Maintenance
Extend the life of existing products and materials for one user
Reuse
Extend the life of existing products and materials through resale
Recycling & Remediation
Recover specific materials for reuse and reduce amount and toxicity of waste
Bioeconomy Innovation System*
Technological advancements enabled by R&D in biological sciences, information and communication, engineering and others
Biotechnology and genetic engineering
Precision agriculture
Alternative biobased chemicals, plastics, fibers, and textiles
Precision medicine, biomarkers, and bioinformatics
Molecular diagnostics
* Not Included in economic contribution analysis due to limited data availability

CIRCULAR ECONOMY AS THE INTERSECTION OF BIOECONOMY & CIRCULAR ACTIVITIES



Circular bioeconomy includes

- Bio-based products
- Share, reuse, remanufacture, recycling
- Cascading use
- Utilization of organic waste streams
- Resource-efficient value chains
- Organic recycling, nutrient cycling

Circular Bioeconomy Case Studies

- Reviving Guayule in Southern Arizona
- Biochar for Irrigated Desert Croplands
- Urban and Peri-Urban Vertical Farming
- Leafy greens and mushroom production integrated CEA system
- The Circular Bioeconomy of Decoupled Aquaponics

Circular Bioeconomy Case Studies

- Underground Vertical Farming in Southern Arizona as Inspired by Underground Vertical Farming on the Moon and Mars
- Bioregenerative Life Support for Space Habitats and Earth Applications of Controlled Environment Agriculture
- Microalgae for High-Value Bioproducts
- Phyto-mediated Wastewater Treatment for Removing Contaminants from Wastewater Effluent
- Yuma "Growing Our Own" Initiative

The University of Arizona Links Tucson & Yuma: The 2 Hubs of the Southern Arizona Circular Bioeconomy

New Policy Developments

- 2022 Executive Order on Advancing Biotechnology and Biomanufacturing Innovation for a Sustainable, Safe, and Secure American Bioeconomy
- Department of Commerce developing satellite accounts for the bioeconomy
- States introduce right-to-repair legislation
- 2021 Executive Order on Promoting Competition in the American Economy encourages FTC chair to, "exercise … statutory rulemaking authority … in areas such as … restrictions on third-party repair or self-repair of items
- American Farm Bureau and John Deere Sign Memorandum of Understanding Addressing Right to Repair

Future Research

- Opportunities to shift purchases from out-of-region suppliers to local Southern Arizona suppliers; more dollars could stay in Southern Arizona
- Multipliers for local (circular) services vs. imported manufactured goods
- Role of the U of A in the bioeconomy innovation ecosystem
  - Interactions with private sector
  - Injection of federal R&D funding into local economy
- Role of state and local public sectors in the circular economy