

# Circular Bioeconomy Systems Institute

*Advancing Multidisciplinary Innovations for a Sustainable Bioeconomy*

*Presented at the*  
**Circular Bioeconomy Systems Workshops**  
March – June, 2024

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## Our inspiration

“I believe that the great Creator has put ores and oil on this Earth to give us a breathing spell... as we exhaust them, we must be prepared to fall back on our farms (*biological materials produced on land, in water, or elsewhere*) which are God’s true storehouse. We can learn to synthesize materials for every human need from things that grow.”

- George Washington Carver, Circa 1930

## Agri-Food Systems

- ❖ Driven by research & innovations in life sciences, engineering, biotechnology, computational & information sciences (NASEM, 2020)
  - Quadrupled supply of food and fiber since 1930
  - 22% of the US economy
  - Over 28% of the US workforce
  - Reduced world famine and poverty to the lowest recorded levels

## Challenges

- Increase productivity, food security, and resiliency...
- Develop economic opportunities ...
- Decarbonize economic activities, reduce GHG emissions...
- Regenerate natural systems, soil health, water resources...
- Eliminate or greatly reduce wastes and losses...
- Eliminate/significantly reduce environmental degradation...
- Replace fossil carbon sources with biomass carbon sources...

## Partial List of activities and partnering disciplines and stakeholders

### ACTIVITIES, 2019-2024

**2019 NASEM Board on Ag & Natural Resources**

**2020 ASABE Roundtable**

**2021 National Academy of Engineering (~1,000 attended)**

**2021 Multidisciplinary-Stakeholder Focus Group**

**2021-23 Circular Bioeconomy Systems Task Force**

**2021-23 Numerous webinars and presentations**

**2022 ASABE AIM Workshop (100 participants)**

**2023 ASABE - CBS Day Keynote & Concurrent Sessions**

**2023 - Circular Bioeconomy Systems Institute (CBSI)**

**2024 - CBSI Workshops, CBS Day and more**

### PROFESSIONAL SOCIETIES, AGENCIES AND FOUNDATIONS

Society of Food Engineers  
American Society of Dairy Science  
Institute of Biological Engineering  
American Society of Civil Engineers  
Soil and Water Conservation Society  
American Institute of Chemical Engineers  
American Society of Horticultural Sciences  
European Society of Agricultural Engineers  
American Society of Ecological Engineering  
Agricultural and Applied Economics Association  
Tri-Societies (Crop Science, Soil Science and Agronomy)  
American Society of Agricultural and Biological Engineers

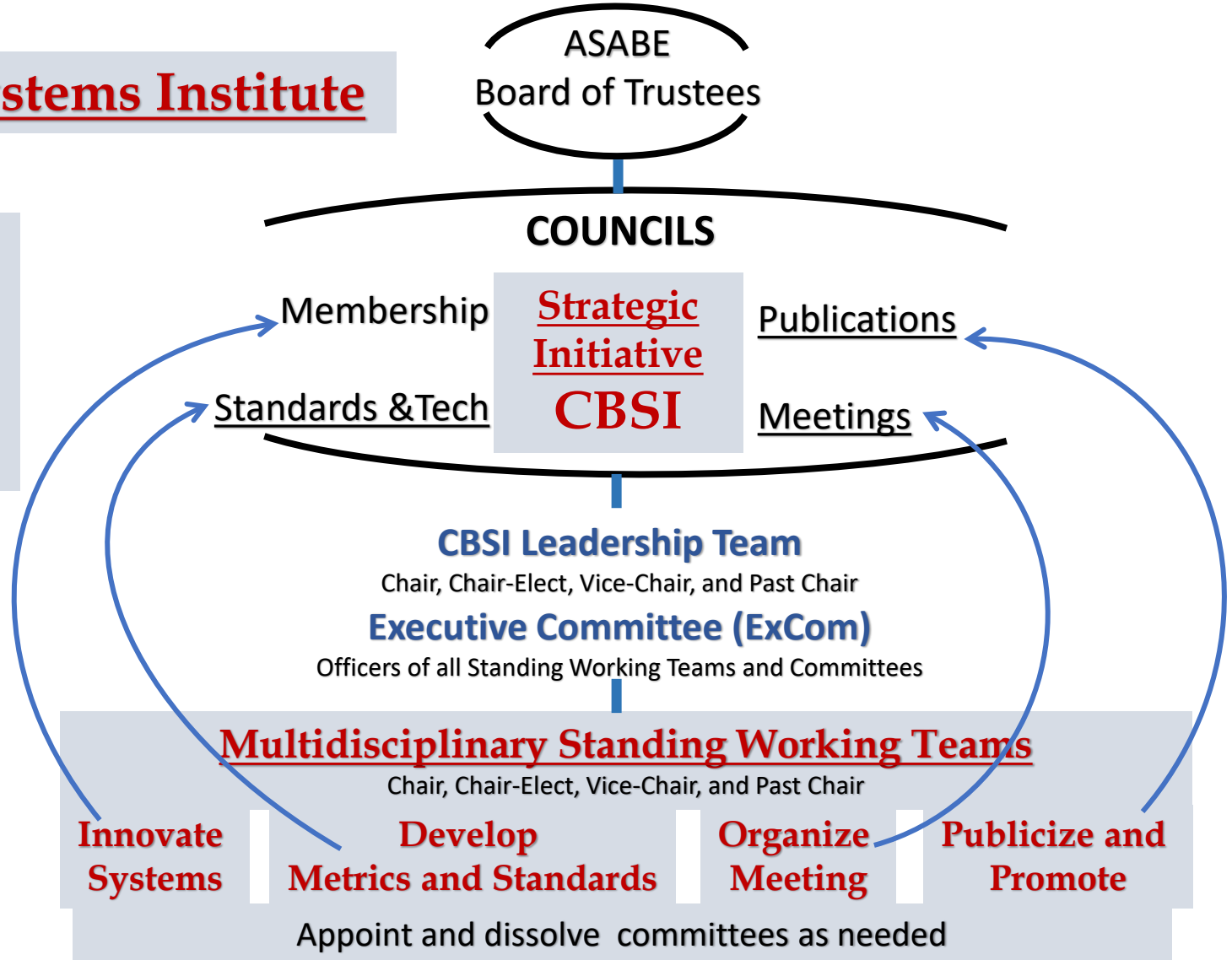
USDA-USAID  
NSF - National Science Foundation  
NAE - National Academy of Engineering Webinar  
NIST - National Institute of Standards and Technology  
BANR - Board of Agriculture and Natural Resources of the NASEM

Schmidt Futures  
ASABE Foundation  
World Wildlife Fund  
Solutions from the Land  
Field to Market Webinar  
Foundation for Food & Agriculture Research

# Circular Bioeconomy Systems Institute

- GOALS**
- Promote Innovations
  - Develop Multidisciplinary Culture
  - Communicate CBSI information
  - Grow ASABE-CBSI membership

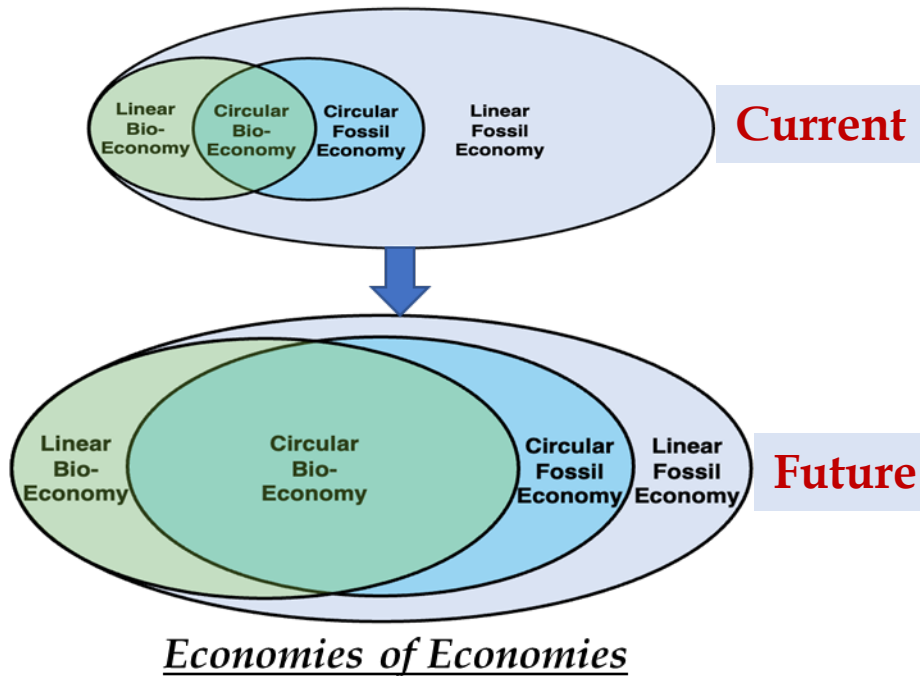
**CBSI Membership**  
ASABE Members  
**Affiliate Members**



# Circular Bioeconomy Systems

**Vision:** A healthy planet driven by vibrant, sustainable circular bioeconomy systems producing plentiful food, feed, forest products, and renewable resources

## Grow Circular Bioeconomy



## Principles of Circularity

*Increase use efficiency*

**ASABE**

*Design out waste and pollution*

*Keep products and materials in use*

**Ellen MacArthur F.**

*Regenerate natural systems*

*Provide economic benefits*

**ASABE**

**A circular bioeconomy** is one in which the values of bioproducts, materials and resources are maintained in the economy for as long as possible by cascading use of biomass from biological resources and producing minimal wastes using a systems approach for economic development.

**Moving from a Fossil-based Industrial Age toward a Bioeconomy-based Sustainable age.**

**From  
Linear**  
to  
Circular



*Animation provided  
by  
Prof. Sauleh Siddiqui,  
American University;  
PI of NSF project  
RECIPES*

**Multiscale RECIPES  
for Sustainable Food  
Systems**  
NSF Grant 2115405

*Animation by Liz Sisk Illustration*

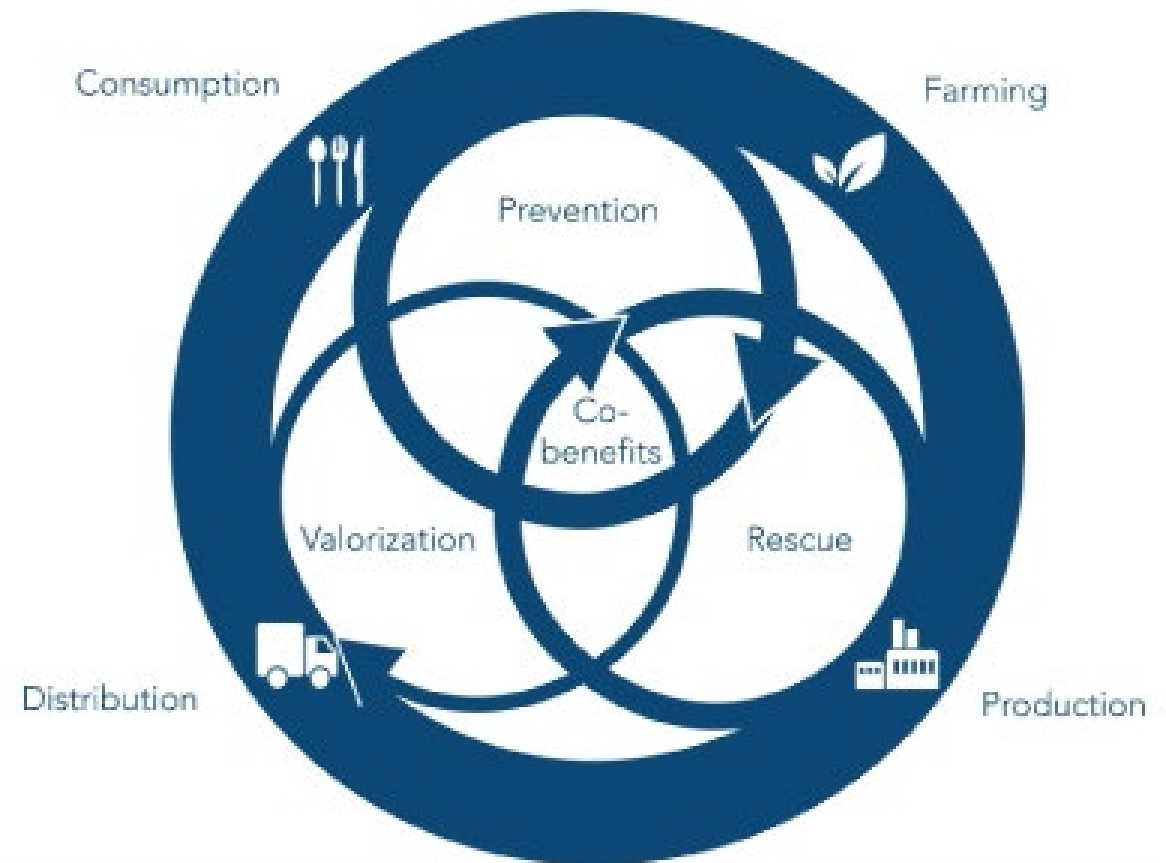
# From Linear to Circular

Animation provided  
by  
Prof. Sauleh Siddiqui,  
American University;  
PI of NSF project  
RECIPES

## Multiscale RECIPES for Sustainable Food Systems

NSF Grant 2115405

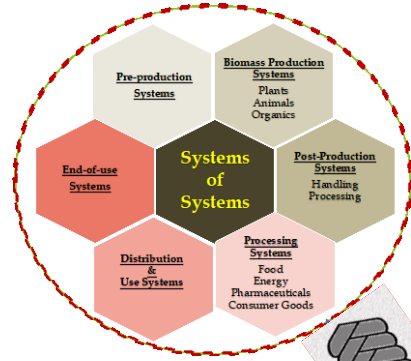
Animation by Liz Sisk Illustration





# Complex Systems of Systems

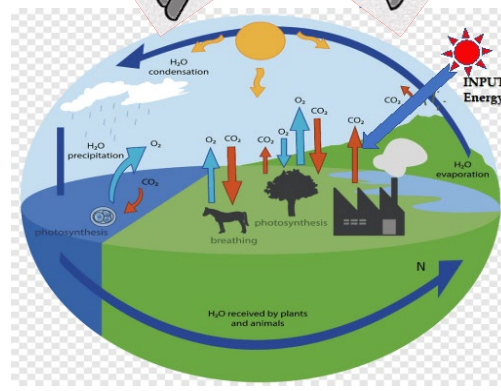
## Food and Agriculture Value-chains



## Socio-Economic Systems



## Interwoven



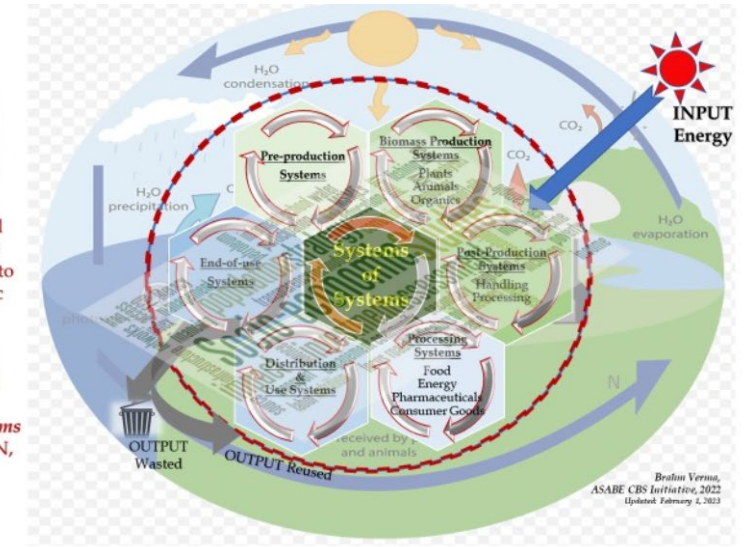
Nature's Ecosystems

COMPLEX  
SYSTEM OF SYSTEMS  
TRADEOFFS  
INTERDEPENDENCIES

### Systems of Systems

The Earth's biogeochemical cycles provide input resources to Socio-economic and Food and Agriculture Value-chains that are *Systems of Systems* (cycling H<sub>2</sub>O, N, P, ...)

## Layered



Nature's ecosystems and human's food-agriculture and socio-economic systems are **interwoven and layered together to create complex systems of systems** in which resources interact spatially and temporally and continuously cycle.

**We need multidisciplinary systems approaches, and create an alliance of professional societies!**

**TRANSITION**  
from  
Linear to Circular  
will require a  
**transition**  
of mindsets and habits  
inculcated from  
education  
and  
lived experiences;  
these are the  
fountains of  
innovations

<b>LINEAR</b>	<b>CIRCULAR</b>
A System	Systems of Systems
Connected	Interwoven
Complicated	Complex
Disciplinary	Transdisciplinary
Control	Collaborative/ Adaptive
Singular	Integrated
Ecology <b>OR</b> Commerce	Ecology <b>AND</b> Commerce
Take	Reciprocate
Waste	Byproducts
<b>Tyranny of the OR</b>	<b>Creativity of AND</b>
<b>End</b>	<b>Endless</b>

## Why CBS Workshop?

*A step to build multidisciplinary-stakeholder partnerships toward forming a professional society alliance*

### Goals

1. Envision transdisciplinary system-level solutions to modify the current constituent system for making a more circular system of systems, and
2. Identify knowledge, techniques and skills needed, and the importance of multidisciplinary partnerships and systems approaches to innovate the needed solutions

### To address the following challenges

- Decarbonize economic activities, reduce GHG...
- Regenerate natural systems, soil health, and water resources...
- Produce near zero waste...
- Eliminate/significantly reduce environmental degradation...
- Replace fossil carbon sources with biomass...
- Increase food security and reliance...
- Increase productivity and economic benefits

*“as much as 60 percent of the physical inputs to the global economy could, in principle, be produced biologically.”*

## Workshop Dates and Locations\*\*

<u>Constituent System Boundaries</u>	<u>Dates</u>	<u>Place</u>
Natural Res. & the Environ. Systems	27-29 March	Chicago
Farm Production Systems	1-2 April	Chicago
Socio-Economic System across Value-chains	4-6 April	Chicago
Controlled Environmental Agri Systems	17-19 April	Biosphere II, AZ
Food Processing Systems	23-24 April	Chicago
Animal & Dairy Systems	23-24 April	Chicago
Urban Agricultural Systems	8-10 May	Sarasota, FL
Young Professionals, Edu, and Training	14 & 16 May	Via Zoom
Capstone Workshop	17-18 June	Minneapolis
<i>Report outcomes at professional Meetings</i>	<i>Summer/Fall</i>	<i>TBD</i>
<i>Planning a CBS Summit</i>	<i>Fall</i>	<i>TBD</i>
<i>CBS Summit for Building an Alliance</i>	<i>Spring-Fall 2025</i>	<i>TBD</i>

**\*\* Dr. P.V. Vara Prasad, Distinguished Professor and Director of the Feed the Future Innovation Lab on Sustainable Intensification Innovation Lab (SIIL) at Kansas State University has provided \$500,000 to fund the workshops.**

## Workshop Objectives and Outcomes

- **Objectives:** To envision and develop an action plan for applying principles of circularity to transition constituent systems for advancing sustainable circular bioeconomy systems.
- **Impacts:** Assess the degree to which circularity would be achieved in the envisioned constituent systems. That is, provide an estimate of achieved increased resource use efficiencies, reduced waste and pollution, increased regeneration of natural systems, and increased socio-economic benefits, tradeoffs, and well-being.
- **Barriers:** Assess ecological, technical, economical and social barriers to be overcome for achieving the objectives.
- **Outcomes:** Recommend actions needed to achieve the envisioned circularity. Analyze need for new knowledge and innovations to identify multidisciplinary stakeholders

## Workshop Outcomes - A List of Actions

- A. Identify **major societal challenge(s)** toward achieving circularity
- B. Identify **knowledge, techniques and skills needed** for system-level innovations
- C. Identify **connections** to:
  - i. Young Professionals & Education
  - ii. Metrics, Methods and Standards
  - iii. Developing countries/regions
- D. Provide recommendations for **building a professional society alliance**
- E. Provide **rationale for a CBS Summit** organized by multiple professional societies.
- F. Outline content for **publications and messaging documents**

# CBS Day 2024 Afternoon Session

## Anaheim, CA (July 28, 2024)

### GOALS and OUTCOMES of the CBS WORKSHOPS (10 min. each)

1. **Farm Production Systems** – P.V. Vara Prasad, Ignacio A. Ciampitti, Bruno Basso, Charlie Messina
2. **Animal and Dairy Systems** – Lara Moody
3. **Natural Resources and Environmental Systems** – Ximing Cai, Adel Shirmohammadi and Gretchen Sassenrath
4. **Controlled Environmental Agricultural Systems** – K.C. Ting and Adel Shirmohammadi
5. **Food Processing Systems** – Ziyneet Boz, Juming Tang and R. Paul Singh
6. **Urban Agricultural Systems** – Charlie Messina, Stephanie ...
7. **Socio-Economic Systems** – Gal Hochman, Madhu Khanna, and David Zilberman
8. **Young Professionals** – David Jones and Sharvari Raut

## Our inspiration

“I believe that the great Creator has put ores and oil on this Earth to give us a breathing spell... as we exhaust them, we must be prepared to fall back on our farms (*biological materials produced on land, in water, or elsewhere*) which are God’s true storehouse. We can learn to synthesize materials for every human need from things that grow.”

- George Washington Carver, Circa 1930



# Thank you!

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