



Engineering
Change Lab
USA

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2022 Engineering Ideas Institute

The Regenerative / Circular
Economy Opportunity and the
Future of Engineering

Boulder, CO, Sept. 26–28





The Regenerative / Circular Economy Opportunity and the Future of Engineering

Sustainability is not enough.

Escalating climate, infrastructure and social crises are outpacing efforts to address them with sustainable practices. The engineering community has the tools and strategies to take us beyond sustainability – both to address dire challenges and to restore living systems. Circular economy and regenerative approaches are principal means for achieving these ends.

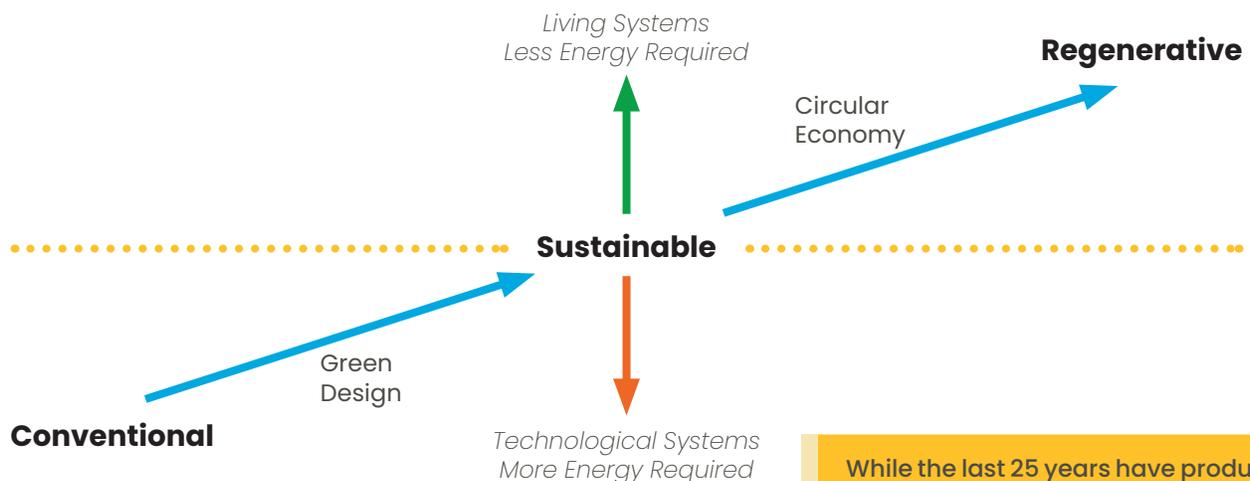
Engineers and their allied fields must have the commitment and courage to step up and engage in the hard work of leading change to benefit society.

These propositions were at the heart of the 2022 Engineering Ideas Institute convened by Engineering Change Lab – USA (ECL) in Boulder, Colorado. This summit drew on provocations, exercises, nature walks and dialogues to shift minds and prompt participants to think differently about the future of engineering. This year’s Institute focused on circular economy and regenerative strategies to push society toward a healthy, resilient future.



Championed by the Ellen MacArthur Foundation, a circular economy “...decouples economic activity from consumption” and replaces linear production with circular models designed to eliminate waste and pollution, optimize recycling, reduce the use of fossil fuels, and regenerate natural systems.

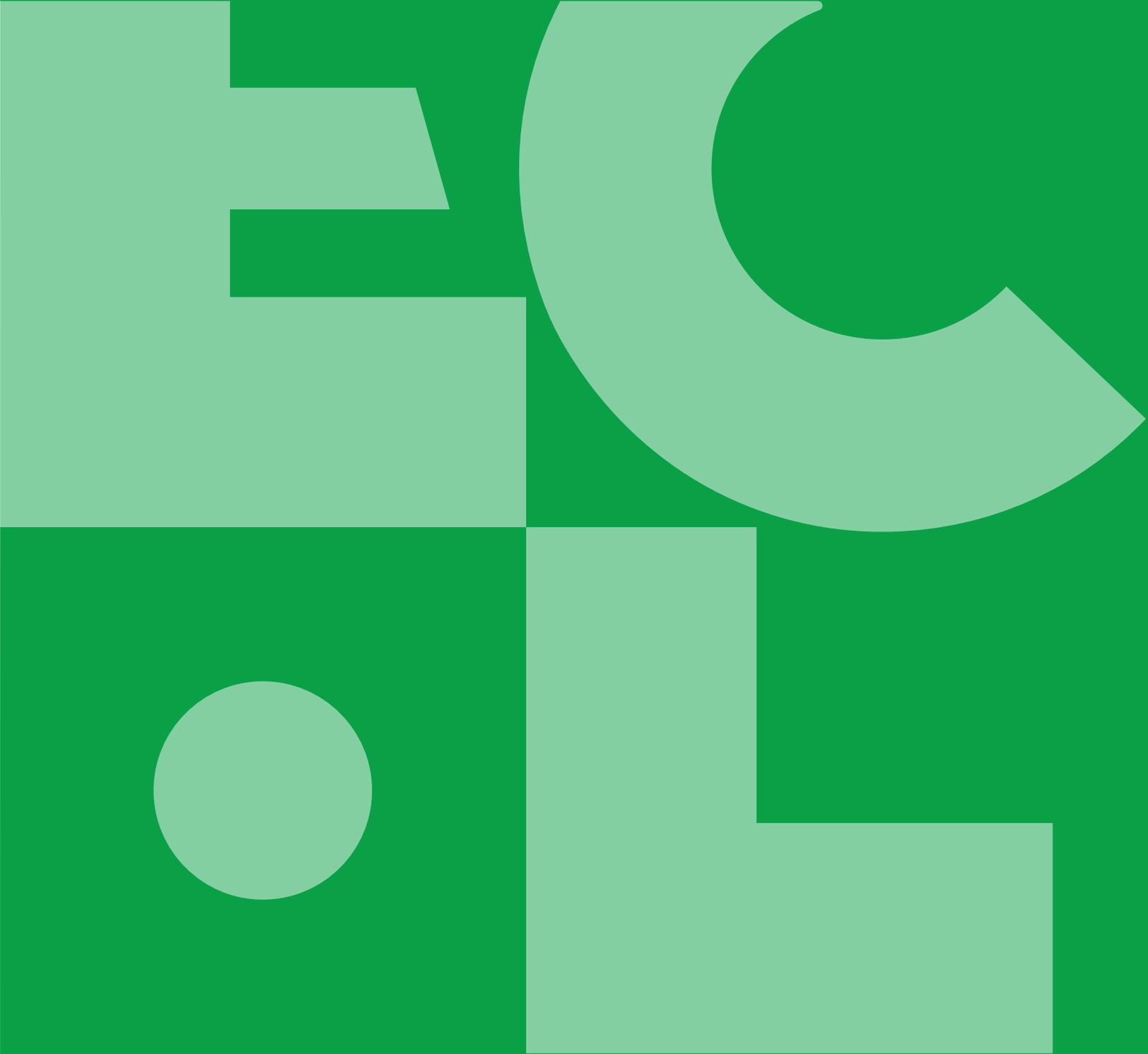
BEYOND SUSTAINABILITY TO REGENERATIVE PRACTICE & THE CIRCULAR ECONOMY



While the last 25 years have produced great progress from conventional to sustainable practices, the next 25 years must bring a transformation from sustainable to regenerative practices.

Adapted from Bill Reed, Regenesys Group





Provocation

Provocation – Transforming Food and Agriculture to Circular Systems



MAURY SALZ,
Past-President American Society of Agricultural and Biological Engineers

Maury Salz is retired as president of CLAAS Omaha, Inc. and is a Past President of the American Society of Agricultural and Biological Engineers (ASABE). He has more than 30 years of experience in the agricultural equipment industry in product development and the production of tractors, and grain and cotton harvesters. Today, he consults for small businesses and is an advocate for conservation in agriculture. Maury grew up on an Iowa family farm and still participates with farming operations. He has a BS degree from Iowa State University in Agricultural Engineering and has a MBA from St. Ambrose University.

Maury Salz, past president of the American Society of Agricultural and Biological Engineers (ASABE), described ASABE’s new initiative to move the bioeconomy (agriculture, forestry, and aquaculture) toward increased circularity (asabe.org/CBS).

Salz contrasted ASABE’s definition of a circular economy against traditional linear economic systems (see exhibit). ASABE’s position is that fossil fuels have a role in the circular economies of the future, but that their use should be minimized.

Linear vs. Circular Economy

A linear economy is the economic space where the value of products, materials, and resources is maintained in the economy for a short period of time with substantial generation of waste

A circular economy is the economic space where the value of products, materials and resources is maintained in the economy for as long as possible with minimal generation of waste



Adapted from Carcus & Dammer, Nova Institute, 2018

He highlighted ASABE’s goals for the Circular Bioeconomy Systems initiative.

ENGAGE
the ASABE community around the cross-cutting concepts and solutions of the circular bioeconomy.

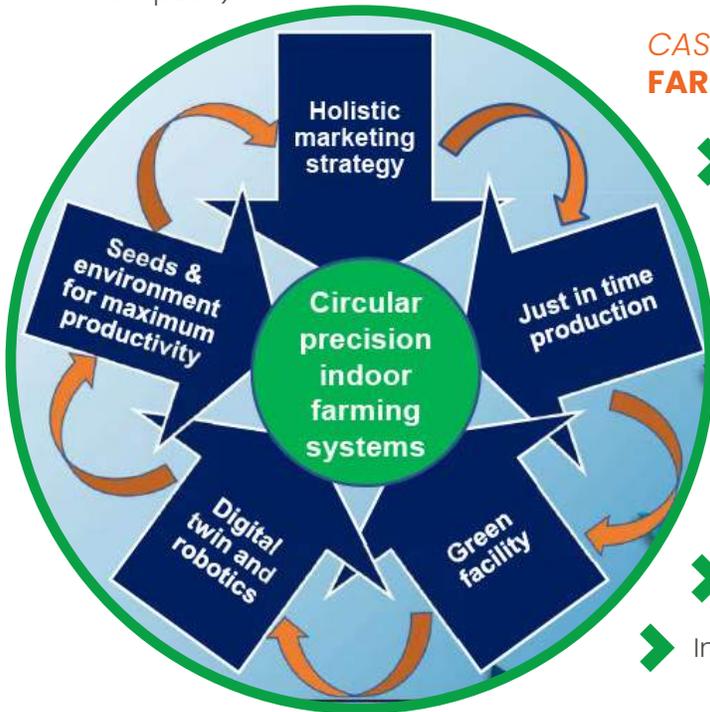
LEAD
stakeholders across the bioeconomy value chain to adopt and implement the principles of circularity.

CONNECT
to other societies and stakeholders for greater impact.

TRANSFORM
the bioeconomy, through new initiatives and projects in research and practice, toward increased circularity.

Provocation – Transforming Food and Agriculture to Circular Systems

Salz used the evolution from open-field farming to precision indoor farming systems to illustrate the potential benefits within the entire value chain (production, harvest/storage, processing/packaging, sales, and consumption).



CASE STUDY – CIRCULAR PRECISION INDOOR FARMING SYSTEMS

- Increase / maintain profitability.
- Create new biomass-based enterprises.
- Decrease use of non-renewable energy.
- Recover resources from wastes for economic uses.
- Increase resource productivity.
- Reduce greenhouse gas emissions.
- Develop a value chain systems perspective.
- Increase sustainability of systems.



Robotic harvesting of strawberries



Plants grown under LED

Salz concluded by describing ASABE’s action agenda to assess impacts and identify barriers to advancing their initiative. He emphasized that this transformation in the bioeconomy will require increased engagement of engineers with circular bioeconomy systems, as well as robust interdisciplinary alliances across the engineering community to develop an action agenda.

You can watch a brief video recording of Maury Salz discussing the ASABE initiative at this link.

Maury Salz, Past-President American Society of Agricultural and Biological Engineers

Group Exercise – Exploring Circular Economy Concepts

Given the examples of food and agricultural systems, participants explored three primary circular economy strategies offered by The Ellen MacArthur Foundation.

ELIMINATE

Eliminate material we do not need, including by design and replacement with more environmentally friendly material.

INNOVATE

Redesign products and technologies in a “reusing, recycling, or composting system” so materials do not end up as waste in the environment. Use renewable energy sources in making the products and technologies.

CIRCULATE

Circulate the materials, products, and technologies in the economy so that they never become waste or pollution.

Working in small groups, participants chose an engineering technology and brainstormed possible leverage points for increasing “circularity” related to that technology. The small groups then reflected on the potential for these leverage points to shift mindsets within the engineering community and the potential barriers to these mindset shifts. Highlights from the small group discussions are included below.

Engineering Technology	Circular Economy Strategies	Barriers
Single-Family Housing	<ul style="list-style-type: none"> • Down-sizing (lot, house, garage). • Modular construction. 	<ul style="list-style-type: none"> • Public perception.
Road and Highways	<ul style="list-style-type: none"> • Incorporating land use into transportation demand planning. • Road diets. • Capacity enhancements that take advantage of times when system is under-utilized. • Carbon sequestration in concrete. • Re-use of concrete and asphalt. • Use of road for re-charging EV's. • Life-cycle cost analyses. 	<ul style="list-style-type: none"> • Changes in public policy.
Urban Environment	<ul style="list-style-type: none"> • Better balance between green spaces and paved spaces. • Adaptive re-use of infrastructure, buildings, and spaces. • Electrification. • Address affordable housing through innovative allocation of financial resources. 	<ul style="list-style-type: none"> • Mindset shifts – waste to nutrients, cost to investment, short-term to generational. • Willingness to embrace inter-connectedness and expanded engagement with all stakeholders.
Airport Infrastructure	<ul style="list-style-type: none"> • Eliminate de-icing waste. • Reduce fuel usage during taxiing. • Use of automated vehicles to optimize fuel use. 	<ul style="list-style-type: none"> • Education of stakeholders. • Regulations. • Need for partnerships with new players.

KEY TAKEAWAYS FROM THE EXERCISE AS EXPRESSED BY PARTICIPANTS ARE CAPTURED BELOW.

How do we address our pipeline of people – recapturing people who should be part of the engineering community and attracting different types of people who will value this type of thinking?

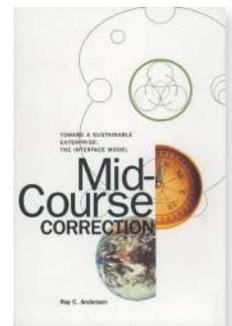
Current systems (procurement, funding, standards) are not conducive to circular economy thinking.

Circular economy strategies require recognition of the inter-disciplinary breadth of solutions.

Highways and the urban environment are examples of disconnects. Current systems do not account for true costs.

Mindset shifts are necessary – linear to circular – and moving from parts to seeing whole systems and from short-term thinking to consideration of full life cycles.

We need to respect and commit to health, safety, and welfare for all.



The book, Mid-course Correction, by Ray Anderson was cited as a notable example of circular thinking.

A final observation was that, on the traditional S curve of adoption of innovation, we are still near the bottom of the curve with respect to circular economy and regenerative practices.





Exercise

Exercise – Biomimicry, Being Inspired by Nature

One of the major sources of inspiration and creativity for moving beyond sustainability toward circularity and regeneration is the concept of biomimicry, learning from and emulating nature in design solutions. After viewing videos from biomimicry expert Janine Benyus participants were asked to identify a current problem or issue that they are currently encountering. Participants then spent time observing nature in the surroundings of the Colorado Chautauqua, collecting observations of natural phenomena and examining them for ways to transfer nature’s principles to their current issue. Several key takeaways from the group discussion of this individual exercise are captured below.



(Benyus Video 1)



(Benyus Video 2)



Nature works on a long-term scale and as a system.

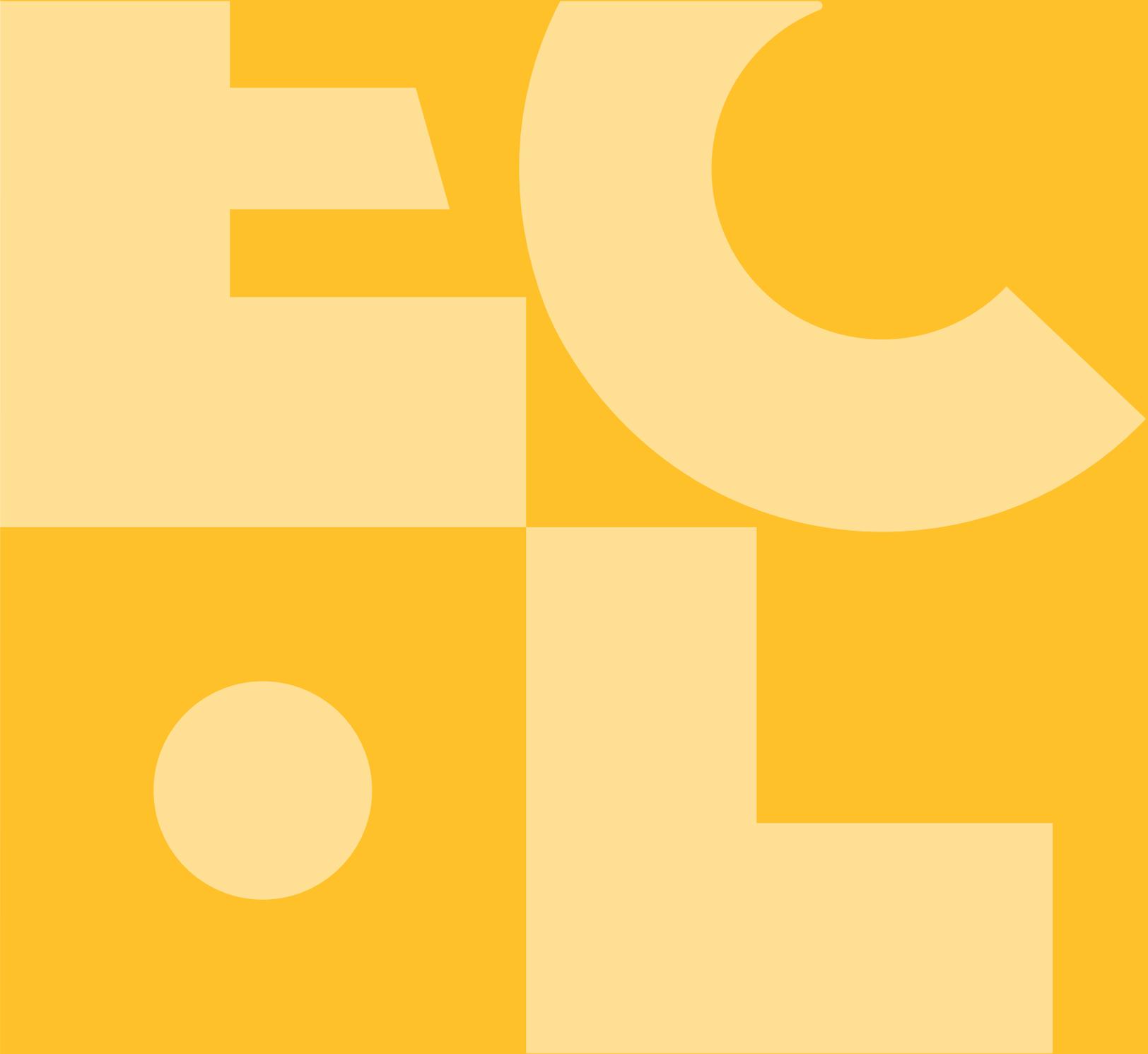


Storms, however, produce sudden, unpredictable, large-scale change. How do we take advantage of other types of disruption or “storms” that impact our work?



Taking time for reflection can be a valuable part of engineering practice. Biomimicry requires curiosity, close observation (careful study and research), and creative leaps. And, it’s OK to be playful.





Provocation

Provocation – Regenerative Practice



DANIEL LAWSE,
Verdis Group

As Verdis Group’s Chief Century Thinker, Daniel Lawse combines his passion for regenerative solutions with living systems design to catalyze systems change across teams, organizations, and industries. He challenges us to shift how we think and act with a long-term view – a simple shift to create thriving organizations and communities for generations to come. Daniel is also a co-facilitator of the Regenerative Leadership Community, where he creates spaces to explore and advance effective regenerative system solutions with peers.

According to author Paul Hawken, the goal of regenerative approaches is to restore and breathe life into the living systems within which our technologies, businesses and economies are nested. Daniel Lawse, principal of the Verdis Group, emphasized that engineers need to do more than simply learn new practices to achieve regenerative outcomes – they must adopt a “new way of thinking, seeing and being in the world” to lead society toward a regenerative future.

According to Lawse, this new way of thinking includes recognizing that our work extends beyond the boundaries of our projects, inviting new people to the table to ensure that we are solving the right problem, recognizing the importance of interconnections that can alter decisions, and ensuring that we are asking the right questions.



“Our thinking affects our speaking which affects our actions; words create worlds.”
– Daniel Lawse



Provocation – Regenerative Practice

Lawse highlighted four critical shifts that are key to this new way of thinking.

Separate to Connected. A quote from the famous naturalist John Muir illustrated this concept, *“When we try to pick out anything by itself, we find it hitched to everything else in the universe.”* The challenge for the engineering community is to move beyond our standard practice of breaking projects into tasks to also including reflection on the sum of the parts as an element of our work.

Inert to Living. We tend to view our organizations as things rather than as dynamic living systems. A living systems views imparts value to people and results in grace or compassion for people even when they make a mistake. As leaders, we must recognize the adage that change happens at the speed of trust and along the lines of relationships.

Short-term to Long-term. Our work is generational in nature. What if we adopted the Native American Seven Generations philosophy, that the decisions we make today should result in a sustainable world seven generations into the future?

Closed Systems to Open Systems. We often think in terms of closed systems, where variables are known, and systems are discrete. Regenerative approaches require a shift to thinking of our work as being part of open systems that are dynamic, with expanding and changing variables.



In his concluding thoughts, Lawse echoed that we are early in the transition to regenerative design, figuring out new ways to co-create a regenerative world. He expressed his hope that young leaders will have a voice in this transition.

You can watch a brief video recording of Daniel Lawse discussing regenerative practice at this link.



Group Dialogue on Regenerative Practice

In an extended group dialogue, participants reflected on this question.

What do we think we know about the role of engineers and the engineering community in helping the evolution of the living systems within which they are nested?



KEY POINTS FROM THE DIALOGUE ARE NOTED BELOW.

- We have a professional and ethical responsibility to create a regenerative and resilient world.
- We are important but not as important as we think we are – we need to engage.
- The American value of individualism is contrary to the concept of living systems. What does this mean to the engineering community?
- Engineers do not embrace change like we should.
- We think of ourselves as problem solvers. We think our role is to enlighten and not to learn.
- The inputs we consider are not complete. Do the problems we solve address the real need?
- Nature does not do problem solving. What if we shifted our mindset away from problem solving?
- If power is upstream, we should challenge the way we test PE's. More emphasis on seven generations thinking.
- We look at environmental regulations as obstacles to progress. We need deeper thinking.
- We need greater empathy toward other living things.
- What if we looked at the land we are working with as having already been constructed by master engineers?
- Do we know who we are impacting? We need to hear from diverse voices.
- There is an over-reliance on the traditional view of leaders. Change needs to come from all levels.
- Engineering has been disconnected from living systems. Are we training engineers to think differently?
- Nature's corrective mechanisms may not favor human life. We are not recognizing that these changes are part of natural systems – something new emerges.
- Tribalism in society works against achieving acceptance of natural systems. What is our role in the engineering community in overcoming this?
- Our inclination is not thinking long-term.
- Mentorship is vital to empowering new leaders.
- Learning from non-technical sources outside of traditional engineering needs to be embraced.



Group Dialogue on Regenerative Practice

- There is a need for humility, recognizing that we do not have all the solutions.
- We are not experts in living systems.
- The Industrial Revolution has resulted in an embedded view of the role of engineering that is no longer valid. We have work to do in changing the culture of engineering.
- The engineering community is a living system whose essence needs to change.
- How do we change or broaden the motivations for business?
- Our challenge is to continue to improve quality of life but with different constraints than in the past. We will be challenged by those who disregard living systems impacts.
- Will society accept new types of solutions/strategies from engineering? We cannot let this constrain us.
- A shift to a mindset of adaptation as opposed to problem-solving is needed.
- Can we move beyond our culture of individualism and consumption?
- Is it our job as an engineering community to model different ways of thinking? How can we help society (or the engineering community) discover its essence?
- Optimism can be found in the next generation.



Wrapping up the discussion, ECL-USA Creative Director and Lead Facilitator Kyle Davy reminded participants that history show that it only takes 20 percent of a community to drive change. The changes we seek may take decades, but they are possible.

Complete provocateur presentations from the 2022 Engineering Ideas Institute are available at the link below.

[2022 Engineering Ideas Institute Provocateur Presentations](#)



Regenerative Practice: Dialogue

Guidelines for Listening in Dialogue:

- Suspend your views (assumptions & certainties)
 - Articulate them (don't advocate)
 - Inquire into them
- Listen to your listening
 - Be aware of your thoughts
 - Maintain peripheral attention
- Be patient with a slow pace and take advantage of silence

Guidelines for Speaking in Dialogue:

- Speak truthfully and only for yourself
- Build on what others have said
- Seek to expand the inquiry
- Speak to the center of the circle of individuals
- Avoid extended "power-lit"