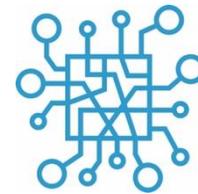
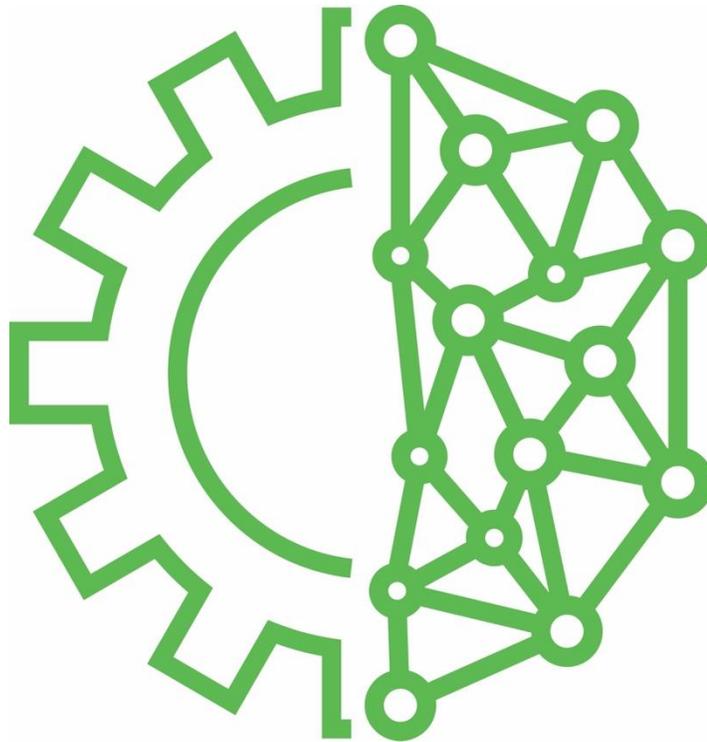


*PRINCIPLES OF ENVIRONMENTALLY RESPONSIBLE ENGINEERING:
Creating a Roadmap for Change*



**Snapshot of Recommended Resources
from Pre-Meeting Interviews**

The list below presents a cross-section of publications, texts, frameworks, tools, assets and organizations recommended by one or more roundtable participants as particularly helpful or informative. The list is preliminary and a starting point to seed our shared dialogue. We look forward to building upon and expanding this list during our time together in Washington, D.C., and beyond.

JANUARY – FEBRUARY 2019



Academy for Systems Change



VENTUREWELL™
idea to impact

FRAMEWORK/PRINCIPLES

Recommended by Marjan Eggermont

[Earth Democracy: Ten Principles of Justice, Sustainability, and Peace](#)

Vandana Shiva's Earth Democracy movement defines democracy through the lens that human beings and the rest of nature are intertwined and interdependent. The principles are: 1. Ecological Democracy - Democracy of all life. 2. Intrinsic worth of all Species and Peoples. 3. Diversity in Nature and Culture. 4. Natural Rights to Sustenance. 5. Earth Economy is based on Economic Democracy and Living Economy. 6. Living Economies are built on Local Economies. 7. Living Democracy. 8. Living Knowledge. 9. Balancing Rights with Responsibility. 10. Globalizing Peace, Care and Compassion.

Recommended by The Lemelson Foundation

[About Green Engineering](#)

Environmental Protection Agency's proposed 12 principles of green chemistry: 1. Prevent waste. 2. Maximize atom economy. 3. Design less hazardous chemical syntheses. 4. Design safer chemicals and products. 5. Use safer solvents and reaction conditions. 6. Increase energy efficiency. 7. Use renewable feedstocks. 8. Avoid chemical derivatives. 9. Use catalysts, not stoichiometric reagents. 10. Design chemicals and products to degrade after use. 11. Analyze in real time to prevent pollution. 12. Minimize the potential for accidents.

Recommended by Marjan Eggermont

[Sandestin Declaration: 9 Principles of Green Engineering](#)

The 2003 Sandestin Declaration represents the thinking of 65 chemists and engineers. Its nine principles of green engineering are: 1. Engineer processes and products holistically, use systems analysis, and integrate environmental impact assessment tools. 2. Conserve and improve natural ecosystems while protecting human health and well-being. 3. Use life-cycle thinking in all engineering activities. 4. Ensure that all material and energy inputs and outputs are as inherently safe and benign as possible. 5. Minimize depletion of natural resources. 6. Strive to prevent waste. 7. Develop and apply engineering solutions, while being cognizant of local geography, aspirations, and cultures. 8. Create engineering solutions beyond current or dominant technologies; improve, innovate, and invent (technologies) to achieve sustainability. 9. Actively engage communities and stakeholders in development of engineering solutions.

Recommended by Marjan Eggermont

[12 Design Principles of Green Engineering](#)

As found on the American Chemical Society's website; from an article published in *Environmental Science & Technology* in 2003 by roundtable participant Paul Anastas and Julie Zimmerman. The 12 design principles of green engineering are: 1. Inherent Rather Than Circumstantial. 2. Prevention Instead of Treatment. 3. Design for Separation. 4. Maximize Efficiency. 5. Output-Pulled Versus Input-Pushed. 6. Conserve Complexity. 7. Durability Rather Than Immortality. 8. Meet Need, Minimize Excess. 9. Minimize Material Diversity. 10. Integrate Material and Energy Flows. 11. Design for Commercial "Afterlife". 12. Renewable Rather than Depleting.

Recommended by The Lemelson Foundation

[A guide to reducing the environmental impact of your product](#)

In 2018, Kickstarter and the Environmental Defense Fund compiled a guide focused on reducing the environmental impact of products. It focuses on five key areas, each with 5-7 additional sub-principles and accompanying resources, videos and worksheets. The focus areas are: 1. Long-lasting design. 2. Reusability and recyclability. 3. Sustainable materials. 4. Environmentally friendly factories. 5. Sustainable fulfillment and distribution.

TEACHING CONTENT

Recommended by Jon-Erik Dahlin

[Snowflake Education](#)

Snowflake Education, founded by roundtable participant Jon-Erik Dahlin, provides educational tools for sustainable development - board games, learning packages (which each consist of a preparatory assignment, classroom activity and follow-up assignment) and trainings. These tools offer “ready-to-use packages” in order to make the integration of sustainable development into any course easy and straightforward. Additional services include teacher training and consulting.

Recommended by Pali Singh

[Presidio Sustainability Enhancement to the Business Model](#)

Created by the Presidio Graduate School, The Business Sustainability Booster (BSB) helps entrepreneurs and business students integrate sustainable principles into an entire organization by providing a set of thought-provoking questions which help to identify social and environmental threats and opportunities. The BSB is intended to supplement the Business Model Canvas (BMC), and poses questions that entrepreneurs should consider as they design their business models to maximize their benefit to society and the environment.

Recommended by Multiple Participants

[Sustainable Minds](#)

Sustainable Minds is a cloud software and services company whose mission is to operationalize environmental performance into mainstream product development and manufacturing in an accessible, empowering and credible way. Sustainable Minds integrates its knowledge of product design, life cycle assessment and environmental systems design with expertise in Web-based business, software design and customer experience. Services include custom data creation, ecodesign, life cycle analysis and redesign. Its "SM in Education" feature includes webcasts from 14 higher education faculty with regard to integrating these topics into their respective curricula.

Recommended by Marjan Eggermont

[Materiom- Nature's recipe book](#)

Materiom is a non-profit organization working at the intersection of design, digital fabrication, ecology and material science. It uses open source data and technology to address materials challenges, lower barriers to entry in the biomaterials market and support the development of local supply networks that are regenerative by design. Materiom.org offers a comprehensive library of assets and an initial data sandbox of material property and performance data.

Recommended by Multiple Participants

[The Circular Design Guide](#)

This guide frames circular as “the next big thing in design”. Using a framework of “understand, define, make, release”, it offers 25+ assets including methods and strategies for circular innovations, such as regenerative thinking, circular business model, smart material choices and product redesign. Additional resources include stories, workshops (including full assets), worksheets, case studies and a glossary of relevant terms.

Recommended by David Sanchez

[Okala Ecological Design Guide](#)

The Okala project, authored by roundtable participant Philip White, began in the early 2000s to create a curriculum on ecodesign for undergraduate industrial design schools, and refocused in 2011 to also assist working designers, engineers and business planners. The 2014 Okala Practitioner guide provides practical assets, including methods for designing products, services and systems with low impacts to ecological health and human health. For example, Okala Impact Factors are a designer-friendly form of Life Cycle Assessment designed for quick decision-making, so that an understanding of ecological impacts can be factored into design decisions as early as the concept phase.

Recommended by The Lemelson Foundation

[NESST I2E Inventing Green Tool](#)

NESST’s I2E Inventing Green Tool is an online tool that simplifies the process of assessing and tracking environmental impact. The tool is designed for companies – including those operating in under-resourced countries – that have started early production and sales and are validating or preparing to scale.

Recommended by The Lemelson Foundation

[Inventing Green: A Toolkit for Sustainable Design](#)

VentureWell’s *Inventing Green: A Toolkit for Sustainable Design* helps early-stage inventors understand how the lifecycle of their products will affect the environment. The toolkit includes assets such as a video series and several other resources that can be used together, à la carte, or within short workshops, multi-day accelerators or as part of a university-level engineering or design course.

Recommended by Dave Allen

[AIChE Academy](#)

AIChE Academy provides education and training resources (courses, presentations and videos) to chemical engineering professionals and the companies they work for. Topics range from process safety to fundamentals, biomanufacturing and solids handling.

Recommended by The Lemelson Foundation

[Biomimicry: A Sustainable Design Methodology](#)

Free, four-week online course offered by the Minneapolis College of Art and Design (MCAD). The course serves as “a fun introduction to biomimicry” and provides readings, video, weekly assignments and discussions with fellow participants and instructors, including roundtable participant Cindy Gilbert.

Recommended by VentureWell

[Tools for Design and Sustainability](#)

VentureWell-hosted site for designers, inventors and startup founders who are curious about options and/or are seeking practical advice for taking action with regard to “green” design and sustainability. Created by roundtable participant Jeremy Faludi, it offers assets including content to read and/or watch, as well as exercises to apply lessons learned and examples for reference across the following areas: whole system mapping, measuring sustainability, greener materials, lightweighting, design for lifetime & sharing, energy effectiveness and changing lifestyles. Also contains specific curricular recommendations for educators of linked content and exercise for courses in three disciplines: engineering/physics, design and business.

Recommended by John Warner

[Beyond Benign: Green Chemistry Education](#)

Beyond Benign develops and disseminates green chemistry and sustainable science educational resources that empower educators, students and the community at large to practice sustainability through chemistry. It focuses on science education, sustainability, innovation and initiatives supporting human and environmental health to provide an educational continuum from K-12 to higher education with an important community engagement component. Other key action areas include professional development, a college student fellows program and the Green Chemistry Commitment - signed by over 50 higher ed institutions.

TOPICAL WEBSITE/RESOURCE

Recommended by Dave Allen

[Journal of American Chemical Society](#)

The Journal of the American Chemical Society (JACS) is the flagship academic journal of the American Chemical Society and the world’s preeminent journal in all of chemistry and interfacing areas of science. JACS is devoted to the publication of fundamental research papers and publishes approximately 19,000 pages annually.

Recommended by Nora Clinton

[Skills for a New Economy: A paradigm shift in education and learning to ensure future economic success](#)

UK-focused, academic report from the Aldersgate Group which focuses on describing the transformation that will be necessary in education and training systems to accompany and support the transition to a circular or “new” economy, defined as an economy in which top quality design, sustainable production and long-term resource efficiency are more important than high levels of consumption and short-term profits. With regard to education, the text highlights paradigms to be rebalanced for the 21st Century (i.e. shift from reductionism to whole system learning).

Recommended by Marjan Eggermont

[An Engineering-to-Biology Thesaurus for Engineering Design](#)

Academic publication which addresses the challenges around translation between disciplines; specifically, those that engineers can face “with utilizing the vast amount of biological information available from the natural world around them. Often it is because there is a knowledge gap or terminology is difficult, and the time needed to learn and understand the biology is not feasible.” The

paper presents an engineering-to-biology thesaurus, to provide engineers with “a tool for leveraging nature’s ingenuity during many steps of the design process...[and] increase the probability of designing biologically-inspired engineering solutions.”

Recommended by Dave Allen

[Sustainability in Engineering Education and Research at U.S. Universities](#)

Five years after Environmental Science & Technology published a special issue on Principles of Green Engineering, a team of academics from four U.S. universities (including roundtable participant Dave Allen) “benchmarked the extent to which sustainability concepts are being incorporated into the research and educational missions of colleges of engineering in the U.S.” In this subsequent Environmental Science & Technology article, published in 2009, results are based on extensive questionnaires from 400+ engineering departments and faculty. The report indicated that a “significant number of the next generation of American-trained engineers were being schooled in sustainable approaches and design.”

Recommended by Dave Allen

[ChemEs Get Schooled in Sustainability](#)

Published in 2012 in CEP Magazine (an AiChE publication) by Dave Allen and David Shonnard, this article frames that sustainable design will be required if the world is to support a growing population with increasingly higher living standards, and that chemical engineers will be charged, in part, with this responsibility. The article then discusses the knowledge and tools that will be required for sustainable engineering and describes how these can be incorporated into chemical engineering education for both students and practicing engineers.

Recommended by Pali Singh

[Engineering for Change](#)

E4C’s mission is to prepare, educate and activate the international engineering workforce to improve the quality of life of underserved communities around the world. E4C provides resources and platforms that accelerate the development of impactful solutions and ensure public health and safety around the globe. Products include the dissemination of news and insights, field analysis, trends and professional developments across eight content areas: agriculture, energy, habitat, health, info/communication technologies, sanitation, transport and water.

Recommended by Marissa Jablonski

[The Brown Agenda](#)

Book by Richard Fuller, founder and president of Pure Earth and a leading expert on toxic issues. The Brown Agenda’s mission is to identify and clean up the poorest communities throughout the developing world where high concentrations of toxins have devastating health effects. In the book, Fuller recounts his travels to the earth’s most toxic locations, introduces readers to the plight of the “poisoned poor,” and suggests specific ways people everywhere can help combat pollution worldwide.

Recommended by Marissa Jablonski

[Urban Ecology: A Natural Way to Transform Kids, Parks, Cities, and the World*](#)

Book by Ken Leinbach, a nationally recognized science educator and leader in community-based environmental education, with a foreword by Peter Senge, founding chair of the Society for

Organizational Learning. The text focuses on the Urban Ecology movement - the idea that nature is everywhere - through telling the story of a group of educational entrepreneurs and their transformative work at the Urban Ecology Center in Milwaukee, WI.

Recommended by Marissa Jablonski

[Biomimicry Institute](#)

The Biomimicry Institute, based in Missoula, MT, empowers people to create nature-inspired solutions for a healthy planet via global, regional and professional networks; resources for educators, organizations and individuals; a curated online library, an annual design challenge, access to expert speakers and news and events.

Recommended by Multiple Participants

[Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming](#)

Project Drawdown is a nonprofit organization and coalition of scholars, scientists, entrepreneurs and advocates from across the globe that is mapping, measuring, modeling and communicating about a collective array of substantive solutions to global warming, with the goal of “reaching drawdown.” In its next phase, Project Drawdown will continue to serve as a clearing house for solutions and intends to take on and disseminate research related directly to the goals of economic and ecological regeneration, make its data and tools freely available online, develop tools/training/curricula for K-12 learning and build coalitions and communities of practice.

Recommended by David Sanchez

[International Living Future Institute](#)

The International Living Future Institute (ILFI) is a nonprofit working to build an ecologically-minded, restorative world for all people. Using principles of social and environmental justice, ILFI seeks to counter climate change by pushing for an urban environment free of fossil fuels. ILFI runs the Living Building Challenge, the world’s most rigorous green building standard, the Living Product Challenge, the Living Community Challenge, and the “Reveal,” “Declare” and “Just” transparency labels. Together, these programs develop a green framework for living in a 21st-century world. ILFI also offers a virtual and in-person learning experiences and research/publications.

Recommended by John Warner

[Club of Rome](#)

The Club of Rome, founded in the late 1960s, pursues a mission to promote understanding of the global challenges facing humanity and to propose solutions through scientific analysis, communication and advocacy. The Club focuses on the interconnectedness of today’s global challenges and takes a perspective that is holistic, systemic and long-term. It is an international organization whose current co-presidents hail from South Africa and Belgium. The Club of Rome has ~100 full members, including roundtable participant John Warner, and produces reports, holds events and takes on complex projects.

Recommended by Jon-Erik Dahlin

[Association of the Advancement of Sustainability in Higher Education \(AASHE\)](#)

A membership organization for institutions, it is committed to modeling sustainability across all operations and activities. AASHE defines sustainability as encompassing human and ecological health, social justice, secure livelihoods and a better world for all generations. One of its 2020 goals is to

“accelerate higher education’s contributions to global sustainability through increased outreach, communications and advocacy.” AASHE offers services including STARS (self-reporting framework for measuring sustainability performance), and a campus sustainability hub of toolkits and resources about sustainability in higher ed, from academics to operations to governance.

Recommended by Curt McNamara

[American Society for Engineering Education](#)

A membership organization for engineering educators, including professionals inside and outside of academia, and students. Offers professional development opportunities, publications and conferences. Among its current objectives are to “strengthen our technological and programmatic infrastructure to advance innovation and excellence in teaching, scholarship, research and service.”

Recommended by Heidrun Mumper-Drumm

[Cumulus Association](#)

Founded in 1990, Cumulus is the only global association to serve art and design education and research. It is a forum for partnership and transfer of knowledge and best practices. Cumulus currently consists of over 280 members from 56 countries. Cumulus was a pioneer in developing jointly organized MA-programs, intensive workshops, projects and biannual conferences. It also holds competitions, summer schools and exhibitions, and presents the international Cumulus Green award for “cultivating and leading global cultures, societies and industries towards more ecological and responsible solutions.”