There Is Only One Existential Threat. Let's Talk About It.
Frank W. Gayle

Our politicians are ready to take on climate change. Are our engineering schools?[1]

The threat of global climate change has loomed over us for decades, and Americans have largely blamed our collective inaction on a lack of political will. Now, the tide has turned, and the Administration and Congress are poised to enact sweeping climate reform.

Scientists and engineers must be ready to rise to the occasion with innovative technical solutions. But do our engineering schools prepare students to design for a sustainable future?

What engineering schools currently teach: designing for profit

Design for cost, performance, and manufacturability: these criteria dominated curricula in the 20th century, an era blinded by the fallacies of endless growth and endless resource availability. Our schools groom engineers to be hired by corporations whose missions are to churn out short-term profits for shareholders. The result: products with low cost, high performance, and high manufacturability, with societal cost and environmental impact largely ignored.

University students take a course or two on sustainability. But an informal survey of senior design projects from a dozen leading US schools indicates that *none* require any aspect of sustainability as part of all senior design projects. No low-carbon design. No environmental impact assessment. No supply chain risk analysis. No recyclability, repairability, durability, or any other metric designed to lighten the devastating ecological burden of endless production and consumption.

What engineering schools need to teach: designing for circularity

Circularity, also known as the circular economy, is based on reusing products and components over and over again and designing out waste by recovering embedded energy and spent materials.[2] Step one of this necessary paradigm shift is to reward circularity thinking and design in *every class*, culminating in the Senior Design Project. This will instill an instinct for sustainability, the ability to think circularly, with tools for sustainable design, and – hopefully – passion that will last a lifetime.

This is not an empty dream. Kyoto University developed the world's first wooden satellite with the aim of reducing space waste.[3] One Starbucks outlet broke free of the company's cheap single-use plastic "splash stoppers" and employed a small disk of waxed cardboard instead. These innovations must become the norm rather than the exception for our world – and it starts with our schools.

Can it be done? Any one of the following is truly a Blue Sky stretch goal, yet all are needed:

1. Rewards for professors who institute these concepts (see footnote[4] for timeline)
2. Rewards for students who prioritize broad ecological and societal benefits
3. Tools for teaching circularity, for solving local to global scale problems
4. Tools encompassing circularity for engineers to use in real-world design challenges
5. Methods for teaching creative thinking in the context of circularity
6. Changes in ABET accreditation standards to make sustainability a priority
7. Changes in corporate culture to prioritize design for sustainability

Two key questions for engineering schools

1. Will our graduates contribute to the welfare of humanity and reduce climate change and environmental impacts, now and in the future?
2. Can professors and policy makers show the necessary leadership to give the next generation of engineers the tools to design for climate, ecological, and societal resilience?

The future is theirs. The choice is ours. With Blue Sky thinking, we can change this story.

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[1] Title adapted from Farhad Manjoo. https://www.nytimes.com/2020/10/28/opinion/climate-change-election.html
[2] https://www.ellenmacarthurfoundation.org/circular-economy/what-is-the-circular-economy
[3] 1/5/2021 https://www.dezeen.com/2021/01/05/wooden-satellite-lignosat-kyoto-university-sumitomo-forestry/
[4] The first step is to reward professors who institute these concepts for all their senior design projects. Our timeline sets a fall 2021 goal of six professors. NSF is to send a Dear Colleague Letter in the summer of 2021, with grants by fall 2021. By fall 2022, a dozen leading universities will adapt these concepts for all senior design projects. NSF will encourage such behavior via grants, and will fund a study to determine effectiveness of the initiative on engineering education and post baccalaureate engineering design in the real world. Timeline for the entire program to be presented orally.