POSITIONING ENGINEERS FOR URBAN SUSTAINABILITY INFRASTRUCTURE TRANSITIONS

Mikhail V. Chester, Assistant Professor *Arizona State University*

INTRODUCTION

I have been developing a course at Arizona State University (ASU) that is designed to connect engineering students with planning and social science students as well as local policy and decision makers to explore innovative solutions for improving the sustainability of infrastructure. There are two main dimensions to the course: 1) lectures that cover how infrastructure systems work and how they enable activities in cities that are generally considered unsustainable, and 2) a semester-long project that the class completes as a group, where they identify an infrastructure challenge and work with local policy and decision makers to design solutions.

OBJECTIVES

The overarching objectives are to teach engineers how to critically think about the future of infrastructure systems, interact with non-engineering players in the systems, and position them to be part of a dialogue about how the next generation of infrastructure should be designed and managed. This includes:

► Expose students to how infrastructure systems (i.e., transportation, buildings, water, wastewater, electricity, fuels, information and communication technologies, etc.) function, where engineers design, operate, and mange components, and where non-engineers operate and manage the system;

► Teach students how urban infrastructure enables emergent behaviors (use of energy, economic activity, waste generation, water consumption, etc.), and why emergent behaviors in many cities are considered to be unsustainable;

► Facilitate a class-wide project where students work with a local policy and decision maker to assess a local infrastructure system and design a long-run change that improves the sustainability of the city;

► Teach students techniques for balancing efficiencies in the system with costs, environmental outcomes, and social outcomes, and expose them to cases where one outcome may constrain another.

DEVELOPMENT HISTORY

The course has now been taught twice and will be taught yearly going forward. The first year I taught the course the class assessed the water-energy nexus in the Phoenix and how to meet future water needs in the desert city without increasing energy impacts. Last year they assessed how neighborhoods can be designed around the city's light rail (see sample project below).

LEARNING ACTIVITIES and MATERIALS

So far I have developed two sets of lectures: one on how infrastructure systems work and one on the major sustainability challenges facing each infrastructure system. I have also developed a database of literature on the Phoenix area related to the course concepts. In the coming year I will be adapting the lecture material to online modules for faculty at other schools. I will be developing a series of 2 to 4 lecture modules (with slides and recorded video) of particular infrastructure challenges.

EXECUTION

I have so far run the course using a traditional semester-long class model, however, in the future I am eager to explore collaborative opportunities with faculty at other universities. I think it would interesting to explore the possibility of running the course across two or more universities at the same time and facilitating more interaction between the students. I also think it would be interesting to explore opportunities for interdisciplinary collaboration. The course that I've offered at ASU has attracted planners and social scientists, in addition to engineers. And this year I will be connecting it to a construction cost estimation course. In the long run it could be valuable to connect engineers with policy, ecology, or environmental management programs, to name a few.

I have focused the course on the use of interdisciplinary teams assess components of the larger problem. Engineering graduate and undergraduate students are mixed (and the graduate students are encouraged to mentor the undergraduates in research) with planning, social scientists, and sustainability scientists. The teams are generally focused around non-technical (e.g., transitions, social equity) and technical challenges.

ISSUES TO RESOLVE

► I would like to add more interaction for the students and the infrastructure systems they are assessing. If one semester they are studying urban heat island and neighborhood design I would like to have them survey different parts of the cities and collect temperature readings. Or if they are studying transportation systems then I could have them develop a stated preference survey. I believe that exercises like these would be valuable and would provide the students with a stronger perspective of the technical and non-technical challenges they must overcome when designing sustainable solutions. I believe that stakeholder engagement is a critical and necessary component for transitions and must be incorporated into student's learning.

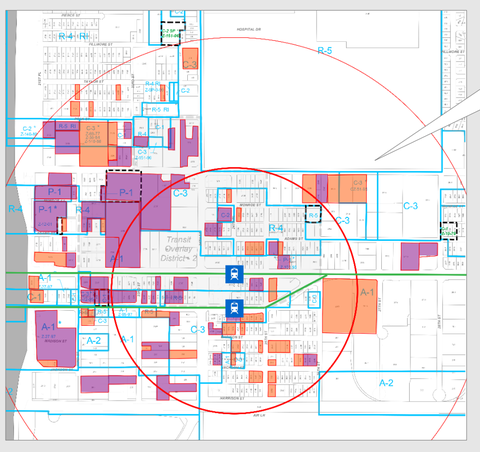
► The transition strategies that students identify should be grounded with the realities of their costs. I will be experimenting with the joining of a construction cost estimation course where the construction students act as consultants to my class to add a strong economic/fiscal dimension. So far, the students have been able to design infrastructure solutions without thinking about costs. The costing element will also allow them to see the benefit-cost tradeoffs of their solutions.

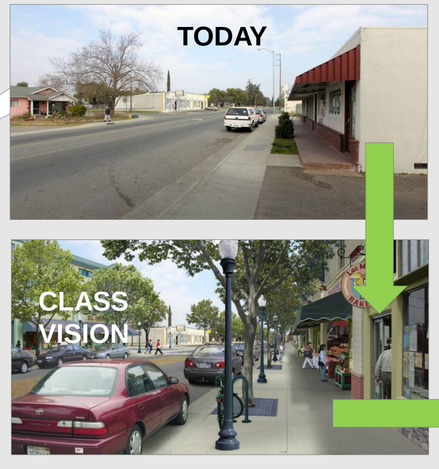
► I would like to improve the balancing of learning objectives across the interdisciplinary students.

DISCUSSION

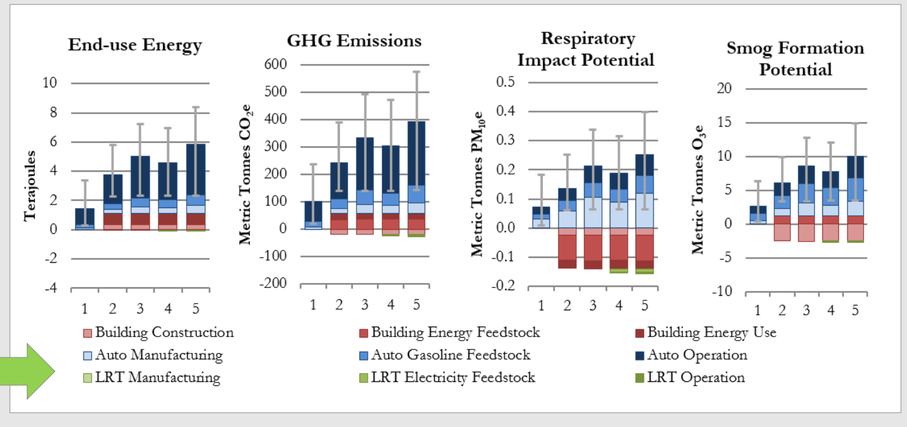
The primary objective of this project is to advance engineering education such that our students are positioned to become leaders in the creation of strategies to transition our cities. To do this, I am focusing on showing engineers how they can be part of the visioning and solution development processes, and can even be the voice for setting transitions in motion.

I anticipate that the project will provide me, my ASU colleagues, and (hopefully in the long-term) teachers at other universities with knowledge about how to rethink undergraduate capstone and graduate infrastructure-related courses to more effectively position engineers to be the catalysts of change.





Fall 2013: Phoenix Light Rail Land Use Densification



This project is supported by the National Science Foundation's Transforming Undergraduate Education in STEM grant number 1245205 (Mikhail Chester and Kristen Parrish).

2013 Frontiers of Engineering Education

Irvine, California

October 27-30

The National Academy of Engineering and

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