Integrating Energy Technology and Policy
an interdisciplinary course for STEM and Policy graduate students

Kristin L. Field, Mark Alan Hughes, Russell J. Composto
University of Pennsylvania
NSF Research Traineeship (NRT) on Soft Materials, Autonomous Experimentation and Energy Policy

Goals of the National Science Foundation Research Traineeship

• To train graduate students in the skills, knowledge, and competencies needed to pursue a range of STEM careers.

• To train STEM graduate students in high priority interdisciplinary or convergent research areas.

• Details: https://new.nsf.gov/funding/opportunities/national-science-foundation-research-traineeship

This NRT is focused on

**Soft Materials – Autonomous Experimentation – Science Policy**

(aka the “Soft AE Program”)
Climate change creates societal grand challenges (interdisciplinary solutions needed)

Course focus
The energy sector’s relationship to and impact on greenhouse gas emissions, specifically at the interface between technology & policy

Goals
• Examine how science & technology interact with policy
• Use case studies from the energy transition to identify best practices for solving complex, systemic problems
• Prototype interdisciplinary collaboration using real-world, timely, complex, societal scenarios
Tech & policy challenges related to the energy transition in 3 course sections

Logistics
Graduate Level, cross-listed in Penn Engineering & Weitzman School of Design

Sections and Activities
Part 1: Basics - policy, tech, climate change; Focus - tech and policy intersections
Part 2: Case Studies from the energy transition
Part 3: Grand Challenge Team Projects

Typical class structure for Parts 1 and 2.
• Pre-lecture reading and written assignments
• Lectures by instructors building upon the reading
• Small group in-class activities & presentations
Course materials span a range of sources.
Part 2 Case Studies change each year and focus on intersections of tech & policy

- Building, Appliance & Efficiency Standards
- Solar
- Hydrogen
- Carbon Dioxide Removal
- Solar Geoengineering
- Aviation & Maritime

Examples from a range of mature to emerging tools & approaches
Part 3 Students choose grand challenges
team projects
Outcomes support increased student comfort & background with policy and tech

Pre-post survey

N=29, rank options range from 0 – 5 (highest comfort); combined 2023 & 2024

For **science policy**, 22 students increased rank, while 6 indicated no change

For **tech** (science & engineering), 5 students increased rank, while 21 indicated no change

1 student (policy) and 3 students (tech) decreased ranks – *indication of new awareness of complexity of grand challenges?*
Students felt there were opportunities to learn from others with different expertise

Final Survey
N=15, rank options range from 1 – 5 (highest agreement); 2023 (2024 forthcoming)

10 students gave opportunities for **peer-to-peer** learning 4 or 5

14 students gave opportunities for **learning from instructors** with different expertise 4 or 5
Students felt skills gained were useful for their next academic or professional steps.

Final Survey

N=15, rank options range from 1 – 5 (broadly useful); 2023 (2024 forthcoming)

12 students gave **usefulness of skills** 4 or 5

2 students ranked usefulness at 3
1 student ranked usefulness at 2
Selection of responses to “Did this class affect your career plans?”

No, I still want to do academia BUT I do feel confident in interfacing more with policy and using my expertise in science to influence policies in ways I never thought about prior to this class.

Yes. This course really sparked my interest in energy policy and made me want to include it more in my research moving forward.

I realized there were other paths where I can help with communication between scientists and policy makers: ex NGOs, congress, start ups. I don't /have/ to go into industry!

No, but it will help me in my pursuit of them! I came into the class knowing I wanted to go into energy law, and I feel better equipped to tackle difficult questions of technology and policy.

I would say yes. It's given me connections and insights to national government which I could never understand otherwise. It helped me way better understand infrastructure and its importance.
This course is dynamic and unique

Collaboration across disciplines, academic cultural norms

- **Energy & effort**: “discipline-typical” materials, assignments, expectations → more intention for integration, syllabus to summaries
- **Guidelines & guardrails**: conflict of interest, team plans, explicit expectations for projects, iterative feedback (peer & instructor)
- **Reinforcing benefits of backgrounds/perspectives**: intersection of policy & technology, in-class activities
- **Cultivating collaboration & pro-social culture**: incentivizing grading structure

Reflection & Feedback

**Institutional support** for interdisciplinary courses

**Programming/infrastructure support** (NRT Soft AE, KCEP)

Larger community with complementary activities
Thank you!

NRT program - National Science Foundation (Award 2152205)

Co-instructors: Shuchi Talati (2023), Oscar Serpell (2023, 2024)

KCEP Staff: Bill Cohen, Angela Pachon