2011

Transitional Curricula in Leading Research and Land Grant Universities

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By James Crowley

Transitional curricula are courses designed to promote student awareness of major scientific and technical challenges that will characterize life in the twenty-first century. Foremost among these are the problems of climate change and resource exhaustion, with primary concern for the depletion of fossil fuels. Climate change science and policy is widely discussed, following the approaches of the Intergovernmental Panel on Climate Change (IPCC 2007), which issues major technical reports approximately every five years. These assessments focus on basic science, vulnerabilities of natural and human ecosystems, and various means of adaptation or amelioration. Less formally chronicled, world reserves of oil, natural gas, coal, and other forms of mineralized fossil fuels are also monitored as they are produced.

Burning of fossil fuels couples human energy production to climate change. Current trajectories have been estimated with reasonable confidence. Annual increases in global greenhouse gases are, for example, well known through monitoring efforts such as the Mauna Loa climate station in Hawaii, which has tracked global carbon dioxide levels since 1958; currently, CO_2 concentrations are increasing at approximately 2 parts per million per year, and at current rates would pass a "dangerous" level of 450-550 ppm by mid century, threatening major climate changes including destructive patterns of drought and flood, and sea-level rise of at least several inches. Current production of oil, natural gas, and coal will peak within the first quarter of the century and be followed by rapid declines in production rates, reaching approximately 50% of peak production by mid-century. World population growth is slowing, but the current population (to reach 7 billion by October 2011) is projected to be between 8 and 9 billion by mid-century. The clash of population, energy, and climate suggest the need for major technological changes in order to safeguard planetary ecology and to protect food, water, and resources to meet human needs.

American higher education needs to play a crucial role not only in addressing scientific and technical issues, but also in the production of an educated populace capable of long-term societal changes that will accompany a decline in fossil fuels and a rational response to climate threats. Using the notion of "transitional" communities (Hopkins, 2009), we are undertaking a scan of curricula and academic structures in the nation's top research universities (using the "old" Carnegie Foundation Research I and II classification system). Our intent was to create an accessible database of web-based information that characterizes the current state of these leading edge academies, and to begin to draw an assessment of characteristics of the degree of involvement and intensity of curricular developments at these institutions.

Our search involved a survey of academic departments and courses, using a broad image of what we considered to be relevant to "transition." Some of what we captured (i.e., entering a course or a department into our database) was indicative of traditional academic approaches to describing sciences of natural history or of human behavior (e.g, economics, political science, philosophy) such as may be of use in building awareness of problem states. For example, we were directly interested in courses and academic centers focused on global climate change, including efforts to explain atmospheric physics, greenhouse gases, climate responses, or the geographic consequences of climate change. Similarly, courses with "sustainable" themes in such areas as economics or water, forestry, fisheries, or mineral management were also sampled. As we began to find examples, we became more aware of degrees of forward-thinking. Many courses reflect an engineering or science approach that is descriptive, with course orientation not visibly changed from what it may have been for the last 3-4 decades (e.g., hydrological science or engineering). Other courses were more conscious of the implications of future change—an emphasis on problem definition—such as courses on water management in western states experiencing significant draw-downs from fossil water or surface river systems. Beyond focus on problem definitions, we also became more conscious of courses oriented toward novel solutions, often under a mantel of "sustainability," and featuring technologies—an emphasis on technical solution—for resource conservation through efficiencies or recycling, for example. Finally, we also began to see (or perhaps to want to see) the emergence of a still deeper appreciation for broader social and infrastructural change—coping with a "fundamental predicament of humankind"—involving changes in human settlement patterns (clustered urban centers replacing suburban sprawl) and transportation (the end of the automobile age as we have known it) and consumerism.

From this awareness, we sense four patterns of response within the leading universities:

0. "Life in the rear-view mirror." Academic departments and traditions tend to conserve past best-practices and standard approaches to technology and science. Informative, future-oriented courses are largely nonexistent and courses in engineering and the applied sciences are taught much as they have been for decades, without consideration for the unique problems of design, construction and energy in the twenty-first century.

1. “Houston, there is a problem.” Global awareness of climate, energy, and ecology are increasing interest among academic faculty and students in the nature of problems, mostly of anthropogenic origin. Most universities offer courses intended to familiarize students with the causes and potential consequences of climate change and resource limitations. Courses may be of high quality and quantity, but generally do not deal with changes in technology and policy needed to address these issues. Here the focus is on “what will happen if….”
2. “We can solve that.” A tradition of technology-based success in human industry, accelerated by the Industrial Age and the Fossil Fuel Era (mid 1800s), has been centered on university communities, with particular success in the land-grant institutions with tri-part missions of research, education, and technical outreach. Here the emphasis is on solving problems of a global scope through technical approaches (e.g., carbon-sequestration for coal-fired power plants). The universities in this tier largely treat transitional issues as problems that can be solved or changes to which we can adapt. Technological fixes are sought for transitional problems and courses in engineering and the applied sciences incorporate sustainability into the core education students receive.
3. “We are in a predicament.” We also believe that mere reliance on technology—while a necessary condition to ameliorate climate change and to develop alternative infrastructure for agriculture and housing—may not suffice, and that awareness must also lead to social movements to alter human consumption patterns, affecting global economics and social equity. This classification is reserved for universities that go beyond finding solutions to transitional problems

and prepare students to pragmatically attempt implementation of necessary technologies and policies to support major changes in human interactions with the planet. Courses deal with effective communication as well as political and economic barriers to effective action. An early expression of such a social movement is Hopkins' Transitional Community.

While we hesitate to draw quantitative conclusions from the current preliminary survey, it appears that today's leading edge universities are largely characterized by categories 1 and 2. That is, the focus is traditional or problem focused. That we still lack the large-scale systems to cope with the future can largely explain relatively weak progress in category 3. We are simply not ready to train a generation of scientists or engineers to redesign suburban infrastructure, to create the solar and wind-augmented smart power grid of 2050, or to start turning out the vast quantities of energy conserving or sun-capturing systems that we will soon need. We have been disappointed, thus far and at this preliminary stage, to not see much greater evidence of futuristic thinking within the visible curricula of this group of universities.

Both Mr. Crowley and Dr. Logan are committed to continuing this effort until a large sampling is completed, hopefully by the end of 2011. A statement of findings at that time will be submitted to the *Chronicle of Higher Education*, in an effort to foment a larger national discussion.