Sustainable Cities, Sustainable Universities:

Re-engineering the campus of today for the world of tomorrow

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Abstract

On hundreds, if not thousands, of campuses across the world, courses, policies and infrastructure have been designed and revised in the pursuit of sustainability. A similar goal is pursued by as many cities. But, while there are many policies and many projects, how they fit together and contribute to the larger objective is not at all clear. In this paper, the shortcomings of most sustainability programs and projects in campuses and cities are addressed, and it points towards the need to develop a more-historical, holistic and dynamic "ecosystem" approach. This paper offers several models for working in this direction and a brief case study of "sustainable food" at UC Santa Cruz as a preliminary illustration.

Keywords: sustainability; campuses; cities; models; ecosystems; food

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I. Introduction

The vast majority of the world's university campuses that will be in existence at the end of the 21st century already exist today. Some have just opened; others are close to a thousand years old. University campuses can be conceptualized as "living labs" (Evans et al. 2015) or even as "living systems," near-biological entities with organically-connected elements (Broto, Allen & Rapoport 2012), rather than mere agglomerations of pieces and fragments. Moreover, university campuses resemble cities in microcosm, in design, landscape and infrastructural terms, and both are types of *spatial* institutions that operate according to similar bureaucratic and decision making principles. Inside, all sorts of processes take place to sustain functioning, although these are not "planned" in any real sense, and sometimes these processes do not work.

The extent to which campuses and cities are treated as integrated, even "ecological," systems in order to understand and analyze complex relationships, and the degree to which education is connected to the management and operation of the whole, is limited. Indeed, even a holistic, analytical and operational approach can fall victim to the managerial and bureaucratic fragmentation characteristic of large institutions. One office manages water, another energy, a third waste, and a fourth building maintenance. Each "sector" has its own department and interests to defend. Communication, much less develop integrated programs, is rare, and when one practice contradicts another--or renders the second impossible--there is little effort made to find a resolution. What is to be done?

University campuses can be laboratories for experimentation with holistic approaches, in terms of (re)design, landscape transformation, public participation and governance, and can provide important lessons and experience in larger projects. Transforming university campuses into sustainable entities, rather than merely institutions with sustainability projects, offers programmatic templates and practices that can be applied to the far

more complex and daunting project of urban sustainability. In such an effort, university students, staff and faculty play a critical role. Students are often strongly motivated and committed to sustainability, especially as it involves activism and experiential learning. Staff engages in everyday operational activities that must be transformed and linked to be sustainable. Faculty possesses the knowledge and authority necessary to see through a comprehensive sustainability strategy. This paper examines activities and examples of how a university campus offers a site for experimenting with technologies, practices and infrastructural reconfiguration, with implications for the much larger problem of urban sustainability. The goal of this paper is, therefore, to address this organization-institutional dilemma: how can integrated planning be reconciled with fragmented institutions?

This paper begins with a brief discussion of the literature on making universities sustainable, much of which focuses either on rating and rankings or incorporation of sustainability education and research into the curriculum. Comprehensive, long-term strategies across curriculum, facilities and management are rare. The consequent question then is: what might be involved in modeling the sustainable campus? Critical elements encompass not only the physical and material complications that always make campus reconfiguration difficult-- where to dig, what should go where, who will be disturbed, who will oppose, who will pay?--but also bureaucratic and regulatory requirements that must be met before a shovel ever hits the dirt. The paper then discusses sustainability in the food sector at UC Santa Cruz as an example of integrated planning and design. This case is not necessarily exceptional in the world of campus sustainability, but it provides historical and empirical data that illustrate the paper's arguments. Finally, the conclusion draws lessons from the project of making a university campus sustainable that could be applied to sustainable cities.

II. Conceptualizing the "sustainable university" & student learning

As concepts, "sustainability" and "sustainable development" are now several decades old; the term can be found in books, articles and agendas dating from the 1970s (Lipschutz 1991, 2012). Even so, clear definitions are difficult to come by: sustainability remains an essentially-contested concept (Gallie 1955). Progress towards sustainability goals has been slow and even controversial, as many campuses and cities (C&C) have come to experience (Velazquez, Munguia, Platt & Taddei 2006). Few cities and campuses have developed in a careful way; more often, change is the

product of ad hoc decisions made at many different times, in many different places, without much if any

consideration of the whole. Infrastructures are substantially fixed; practices and populations are not (Ramaswami et

al. 2012). It is often easier and less costly to tear down the old (or let it decay) and build anew, especially if new

projects and developments are designed and built with care and foresight--although from the perspective of

embedded resources, such replacement may be a foolish thing to do. Notwithstanding haphazard design, there are

substantial sunk and opportunity costs associated with the way things are. The way things have always been done

frequently trumps the way they ought to be (and ought to have been) done.

Given the complex histories of such institutions what, exactly, is a "sustainable university campus?"

According to Alshuwaikhat and Abubakar (2008: 1778),

> universities [like 'small cities']... have several activities and complex operations with potentially significant
> environmental impacts that, until recently, have been largely overlooked in terms of social and
> environmental responsibility… There is a common understanding in the literature that a sustainable
> university campus implies a better balance between economic, social and environmental goals in policy
> formulation as well as a long-term perspective about the consequences of today's campus activities."

Velazquez & colleagues (2006: 812) write that a "sustainable university" is

> A higher educational institution, as a whole or as a part, that addresses, involves and promotes, on a
> regional or a global level, the minimization of negative environmental, economic, societal, and health
> effects generated in the use of their resources in order to fulfill its functions of teaching, research, outreach
> and partnership, and stewardship in ways to help society make the transition to sustainable lifestyles.

Sustainable campuses begin to sound very much like sustainable cities:

> Figuring out how to make urban settlements more sustainable requires knowledge of how a local economy
> works, of how transportation systems are connected to land use and urban density, to economic activities,
> to housing supply [and] to other public infrastructures and services… The way urban systems work or fail
> to work together is a large part of the sustainability of an urban settlement (Blanco & Mazmanian 2014:7).

While sustainable cities and campuses are indisputably distinct entities, transitions to sustainability and efforts to

help citizens and students (and the larger community) transition to sustainable lifestyles, need not be disjointed

attempts. A growing body of literature examines collaboration between campuses and cities. Trencher and

colleagues (2014) show that cross-sector partnerships for urban sustainability are flourishing across the world,

bridging the gap between a sustainable university and a sustainable city. Other scholars have noted that such

collaborations consist of a "process of mutual learning, through which researchers, government authorities and

citizens exploit social innovation at the local scale to spur wider societal transitions by sharing experiences across

trans-border networks" (De Kraker et al 2013:49; see also Valkering et al 2013, cited in Trencher et al 2014: 154).

Sustainability education in the campus environment, both as classroom instruction and hands-on

experience, is the subject of extensive study. Among the most promising approach is the "living lab" which features,

according to Evans and his colleagues, three "core characteristics...: they comprise a geographically or

institutionally bounded space, they conduct intentional experiments that make social and/or material alterations [to

the space], and they incorporate an explicit element of iterative learning" (Evans et al 2015:2). Moreover,

> Living labs have the potential to strategically frame coproduction processes in two ways. First, consulting
> users and stakeholders allows complementary sets of projects to be strategically planned that offer holistic
> solutions to sustainability challenges. Second, by emphasising the iterative process of experimenting and
> learning from year to year they provide a more coherent basis for action over time. Both of these elements
> are valuable in a university setting, joining up the institutional response to sustainability challenges and
> engaging students in focused and applied projects that clearly contribute to a longer term, bigger picture of
> sustainability (Evans et al 2015:2).

For example, the "University Living Lab" initiative, launched at the University of Manchester in 2012, utilizes the

campus as an "amenable real world location in which to conduct applied research," allowing researchers, students,

external stakeholders and environmental consultants and university staff to co-produce knowledge about new

sustainability technologies and services in "real world" settings (Evans et al 2015: 2). However, a closer

examination of the specific program, as described in Evans et al. and on the University Living Lab website

(http://universitylivinglab.org/) suggests that, while there are "hundreds of academic and professional support staff

at the University who deal with sustainability… [and] over 100 organisations that relate to sustainability,"[1] the "lab"

is more of a cobbling together of many independent and autonomous projects that a coherent program.

Manchester is hardly unique in this. No one seems really to understand how the various parts of sustainability fit together or how students might learn about and experience an integrated system of sustainability-- and the same is generally true of cities. Students and faculty remain trapped in their disciplines; staff in their departments or offices; workers in their own sector. Even the highly-regarded Arizona State University School of Sustainability (https://schoolofsustainability.asu.edu/) maintains the "two cultures" separation of science and philosophy (Snow 1961), offering an undergraduate BA "best suited to students interested in social sciences, humanities, planning or related fields" and a BS "best suited to students inclined toward natural sciences, economics, engineering or related fields."[2] There are no "sustainable campuses" (or cities, for that matter); there are only campuses and cities that pursue sustainability in many forms and fashions.

Why? For the moment, many efforts to achieve sustainability on campuses and in cities are driven by concerns about climate change, prioritizing decarbonization strategies in the built environment rather than paying broader attention to the social systems and institutions driving carbon burning (Bulkeley & Castan Broto 2012; Trencher et al 210). Research by Trencher and colleagues (2014: 157) indicates that the built environment, energy, heating or cooling, and governance and planning are the three most commonly targeted urban systems by university sustainability partnerships--usually as distinct sectors. The sectoral approach to sustainability may miss many of the policy and decision points and the social practices that might be more critical for effective strategies. The problem thus remains: how is sustainability to be *implemented*?

III. Modeling the sustainable university for learning & research

To begin, differentiate a *commitment* to sustainability from *implementation* of sustainable systems and practices. Commitments are made by many universities and cities (McFarlane & Ogazon 2011). Implementation is much more difficult and is usually evident only as piecemeal projects (Koester, Eflin & Vann 2006). The need for holism is widely recognized even as there are few, if any, cases in which it is actually practiced. Most analyses, models and programs focus on material flows into and out of the physical institution--that which can be measured becomes the measure by which progress is assessed. Tracking how much water flows in, where it is used and how much flows out is relatively simple; what happens "inside the box" of systems, institutions and people is not.

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As Beringer and Adomßent (2008: 609) observe,

> the focus [of greening the campus] tends to be on operational transformation (i.e. resource conservation and efficiency improvements) and curriculum initiatives…. A systematic linking of academic--research and teaching--with facilities management and operations remains the exception. Furthermore, approaches which recognize the systemic nature of organizational change and which leverage campus sustainability via institutional drivers are as yet sporadic, and uncommon.

And, they (Beringer and Adomßent 2008: 609-10) continue,

> As in any system, the system is bigger than its component parts; synergies – for instance between administration and research; research and teaching; research, teaching, and community outreach; and so forth – arise which present unique leverage points for sustainability in higher education.

As important as flows and stocks are, *why* stuff is flowing into the institutions and how, within those institutions, decisions are made about what should flow in and out is at the core of the issue. This means *people*. And people do not consume resources directly; they do so with different intentions, goals, meanings and outcomes in mind. Materials are utilized in the course of pursuing not only subsistence goals but also social, cultural and normative ends. Motivations for consumption and associated patterns and practices by individuals, groups and structures, and the rules, regulations, norms, planning and management that steer stuff to specific places and services and direct the waste out, are all important in analyzing the institution and its people and designing and implementing sustainability. Yet, they are most often ignored.

One approach to holistic incorporation of human and institutional factors in sustainability design and implementation is through a "human ecosystem" analysis (Figure 1; Machlis, Force & Burch 1997; Force & Machlis, 1997). Machlis and his colleagues (Machlis, Force & Burch 1997: 352) propose that

> The social order (individually, collectively, and in relationship to social institutions and social cycles) provides high predictability in much of human behavior. Taken together, social institutions, social cycles, and the social order constitute the social system. Combined with the flow of critical resources, this creates the human ecosystem. Each of these elements substantially influences the others. For example, changes in the flow of energy (such as an embargo and resultant rationing) may alter hierarchies of power (those with fuel get more) and norms for behavior (such as informal sanctions against wasting fuel).

Force and Machlis (1997: 374-75. italics in original) further propose that the "social system" is composed of three parts:

> The first is a set of *social institutions*, defined as collective solutions to universal social challenges or needs….The second subsystem is a series of *social cycles*…. The third subsystem is the *social order*, which is a set of cultural patterns for organizing interaction among people and groups.

Figure 1: The Human Ecosystems Approach[3]
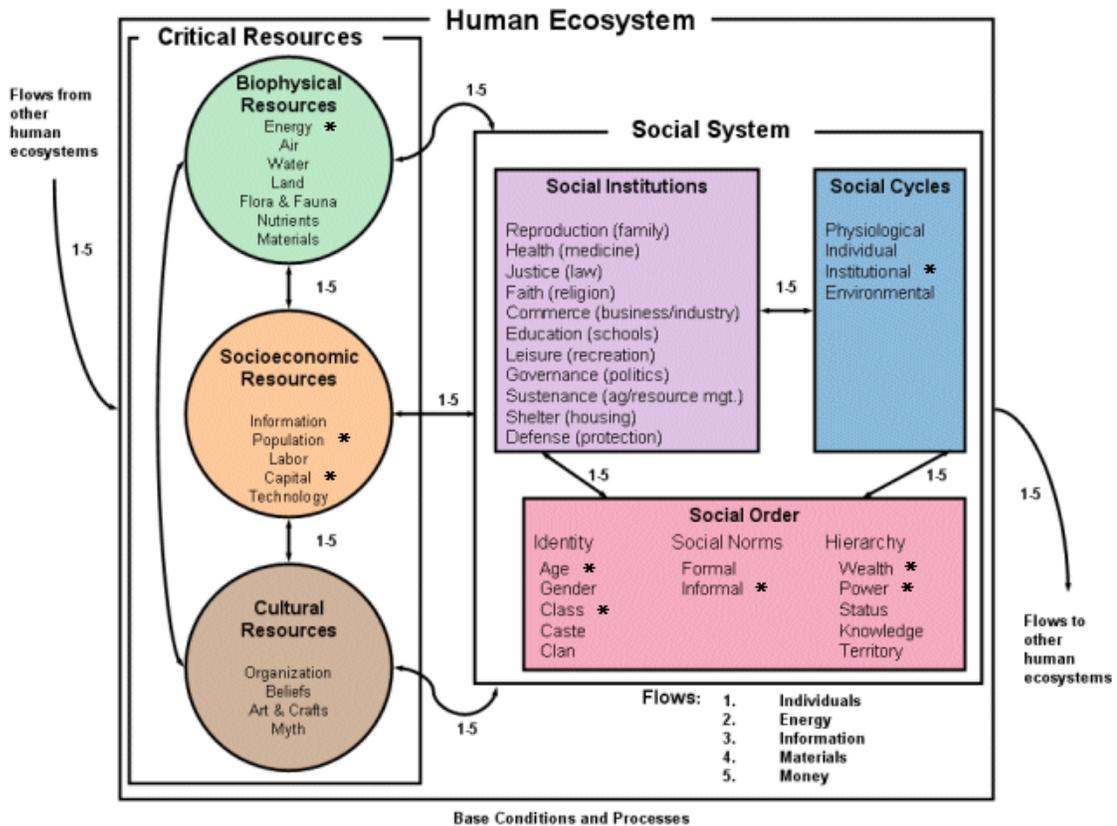
"Critical resources" constitute foundational flows into the human ecosystem, but it is social resources essential to the functioning and reproduction of the institution and the decisions, policies and actions that make the whole thing work. This framework is commonly used to examine human impacts on "natural" ecosystems, but there is no reason this framework cannot be applied as "institutional ecosystem" analysis by incorporating social factors and forces.

How can this be applied to the sustainable campus (and city)? Careful and detailed modeling of a campus's (sub)systems, institutional operation and social norms and practices can facilitate planning for sustainability, especially insofar as it identifies critical decision making and action sites and individuals that might not otherwise be recognized. Models are not the real world, of course, but they can be very helpful in terms of identifying feedbacks, synergies and unexpected outcomes, in understanding how subsystems and the overall campus operates and in posing and answering questions not only about what opportunities may exist for intervening in and modifying policies and actions relevant to campus sustainability. Given the sophistication of such models, it is possible to incorporate human and institutional behaviors that vary input behaviors to see results from contrasting decisions, policies and actions.

Thus, a *sustainable* campus approach, first, analyzes the functioning of its various services and the activities of its people as interconnected elements of a complex system of education *and* operation and, second, intervenes at those points and offices which result in the greatest gains relative to some baseline. This approach maps out the complex relationships and how they affect each other, and plans and acts with full cognizance of both those relationships and their effects, now and in the future. In this mapping process, the history of the institution is critically important, because current configurations and practices are products of the past and continue to shape the present and future in both material and social terms.

IV. Completing the sustainability puzzle

As noted earlier, there is no shortage of sustainable education or sustainable management being practiced on university campuses (and in cities). What is absent from the literature (and, it would seem, from actual practice and policy) is the integrated approach to creating a sustainable campus described above. Both UC Santa Cruz (UCSC Sustainability Office, nd) and Aalborg University[4] (Christensen, et al 2009) are making slow progress toward this analytical and applied goal, but they remain far from any optimum. If practicing integrated sustainability on campus is the puzzle, not all of the pieces are, as yet, on the table. Identifying which pieces are there and which are missing, to extend the metaphor to its breaking point, may make it possible to determine how to complete the puzzle.

Offered here is a modification of the Human Ecosystem approach that centers social and institutional factors as a means of completing the sustainability puzzle. What emerges from this exercise is a very rough model in which institutional procedures in campus sustainability are central: as previously observed, material facilities may be fixed once concrete is poured, but little else remains constant. Figure 2, roughly sketches out a "campus ecosystem," with three primary elements: (1) the "product chain," that is, the movement of a resource, good or service into, through and out of conceptual campus boundaries; (2) the material infrastructure that facilitates this movement, such as the buildings, tables, chairs, pipes, HVAC that "process" the good or service on its trip through the campus; and (3) the institutional arena, where policies and decisions are made regarding that movement, tastes and cultural preferences are expressed, markets are made and laws and regulations are enforced. Note that all three of these elements are significant "social" (rather than biological or geophysical) in that they focus on roles, rules, behaviors and practices.

Figure 2: Model of a campus ecosystem
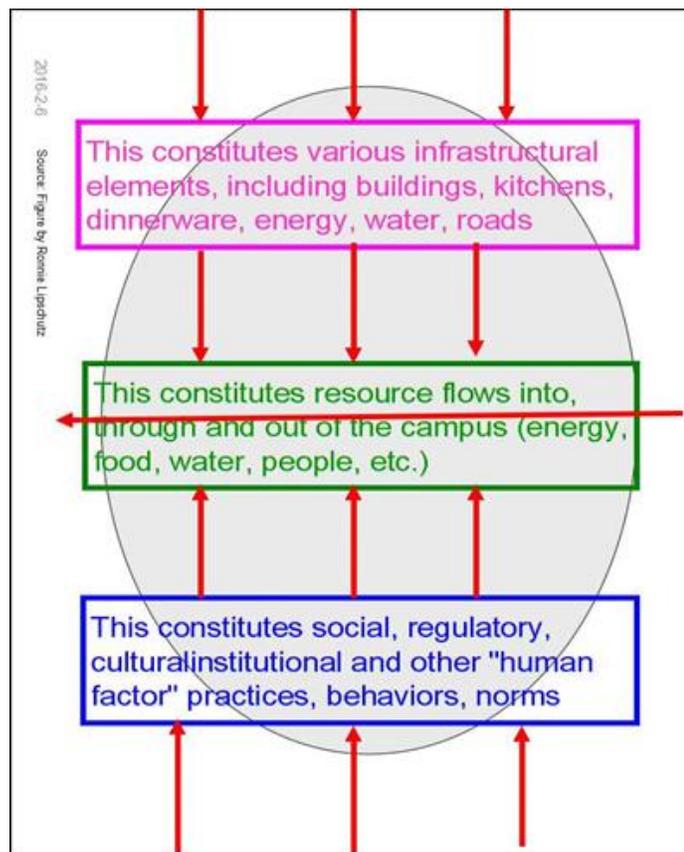
Food provision on campus offers an illustration of this institutional "ecosystem." Virtually all universities provide a range of dining and food access services. Most, if not all, of the food that enters a campus comes from external sources (a few campuses grow some of their own food). In turn, most of the waste products--paper, plastics, compostables, wastewater and sewage--are shipped off campus. Within the campus, there are food preferences, food planning and food preparation--and, of course, dining. In addition to food, other material inputs into the food system include dining halls, energy, water, dining utensils, refrigerators, freezers, stoves, ovens, tables, chairs, waste transport and disposal space, among many other parts. The required quantity of material things is a function of numbers of diners and their individual and aggregated food preferences and eating habits. Someone must devise meal plans and menus, matching purchases to demand, ensure workers are available to cook, distribute and clean up, maintain facilities and health standards and remove waste (and sewage). Students can learn, at home, from peers, in class and while eating, about what tastes good and what does not, how to choose more carefully and waste less, and what they might do to reduce food waste. Someone must mobilize the means of bringing in food and carrying wastes out; water must be provided in the required quantities and at mandated temperatures; the dining space and storage facilities must be heated and cooled. this does not exhaust the elements of the campus food ecosystem (Figure 3).

Figure 3: A campus food ecosystem

Source: Figure by Ronnie Lipschutz
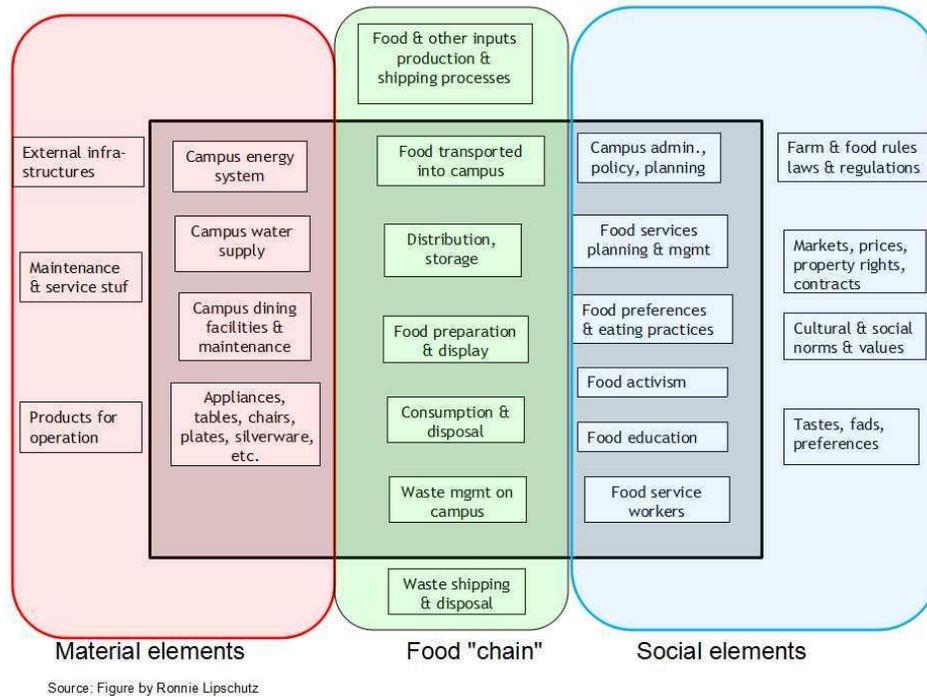
Who are these "someones?" Students play a central role in shaping the food ecosystem through their upbringings, choices and preferences; they can also be an important constituency in forcing an institution to change its practices, in monitoring the efficacy of new practices, in conducting research. University officials in charge of dining and housing make decisions about what is to be offered, when meals will be available, from whom to purchase goods, and with whom to contract for operating the dining halls. Dining hall operators are important in terms of the foods and services they offer, the mix of both, and the quantities made available; garbage truck drivers are critical to make certain the waste does not pile up. And, as the saying goes, "many others."
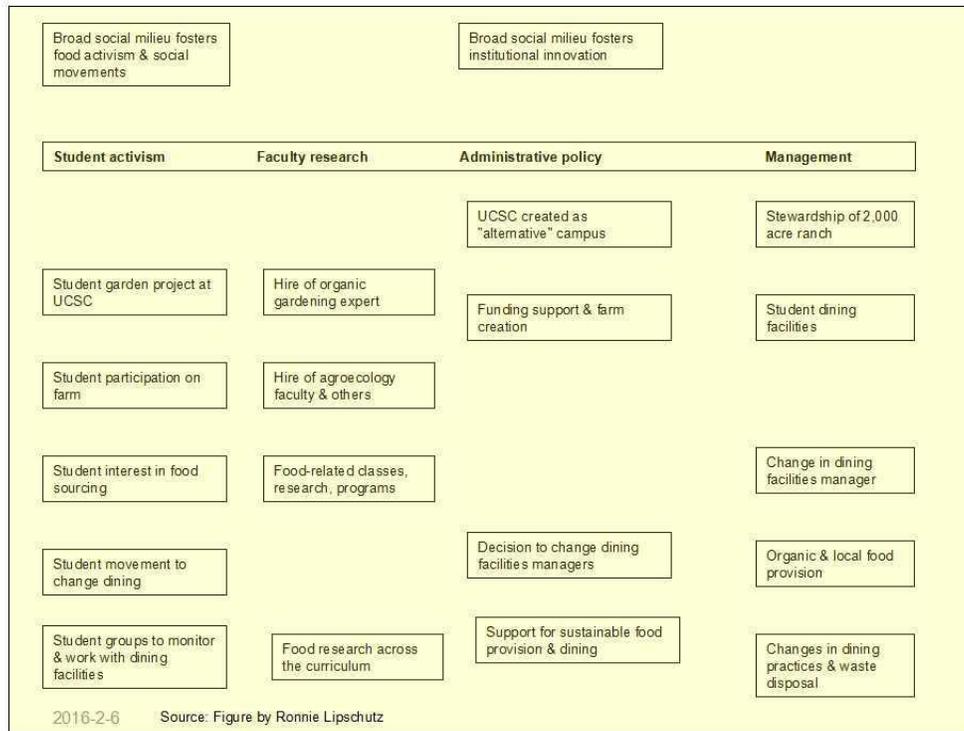
The half-century history of the food ecosystem at UC Santa Cruz offers an illuminating example of how sustainability becomes integrated into the campus food system. This has not been a planned or designed trajectory even though it has resulted in an approximation of what might result from strategic planning. This history is too long to repeat here (UCSC Regional Oral History Collection 2003, 2008, 2010; Center for Agroecology & Sustainable Food Systems nd; UCSC Regional History Project nd), but the interaction of student activism, faculty research, administrative policymaking and managerial action--the social--have played central roles. The dynamic looks something like this:

1. Movements of the 1960s foster activism around food origin and quality which becomes the basis for student activism;
2. Expert faculty member is recruited to develop and manage a Student Garden Project;
3. Administration approves hire and garden site, and subsequently approves project expansion; and
4. Additional faculty conduct research on food production and food systems, which
5. Stimulates further student activism with campus support for food-related research.

And so on. Figure 5 crudely illustrates this dynamic in a roughly chronological fashion. Absent one of the four

"forces," the current degree of food sustainability would not have been achieved.

A similar historical, analytical and subsequent planning exercise could be undertaken for other components of a sustainable campus or city and, if possible, integrated into a single project. What elements must be mobilized, created or fostered in order to achieve objectives? Do these already exist? Where are the critical decision-making and action points and sites that might not otherwise be visible to causal analysis, observation and even influence? This approach offers ample opportunity for students across disciplines to identify the components of a campus (or city) resource ecosystem, to gather data from various sources and interviews, to ask people in key locations what they do and how they do it, to work with policymakers and managers and staff of the ecosystem "components," to develop and implement plans for increasing sustainability, and to coordinate among similar team engaged in similar projects elsewhere on campus or in the city.

Figure 5: The Sustainable food dynamic at UCSC

Broad social milieu fosters food activism & social movements

Broad social milieu fosters institutional innovation

Student activism	Faculty research	Administrative policy	Management
		UCSC created as "alternative" campus	Stewardship of 2,000 acre ranch
Student garden project at UCSC	Hire of organic gardening expert	Funding support & farm creation	Student dining facilities
Student participation on farm	Hire of agroecology faculty & others		
Student interest in food sourcing	Food-related classes, research, programs		Change in dining facilities manager
Student movement to change dining		Decision to change dining facilities managers	Organic & local food provision
Student groups to monitor & work with dining facilities	Food research across the curriculum	Support for sustainable food provision & dining	Changes in dining practices & waste disposal

2016-2-6   Source: Figure by Ronnie Lipschutz

V. Sustainable campuses, sustainable cities

The world and its social system, as well as its universities and cities, are far from achieving sustainability. What can be done to further this goal? This paper has argued that cities and campuses share many structural, infrastructural and institutional features, and that that which can be applied to one may also be applied to the other. But this paper has also argued that most efforts to become more sustainable are piecemeal ones focused on specific resource flows--food, energy, water, roads--without incorporation of the larger contexts and social activities that make these resources available. If analyses and actions begin with knowledge of those contexts and activities, and specify the role specific resources play in them, more significant, positive changes may be achieved than when goods are merely sourced more sustainably.

University campuses have been in the forefront of efforts to understand, design and act more sustainably, but there is much more that can be done than to build new buildings, create new degree programs and tout how much more sustainable a campus is this year than last. What is necessary is institutional transformation--not only new ways of doing things but new things to be done--in which the "inhabitants" are more than passive consumers and observers. Universities can reorganize their curricula, management and policymaking, and student activists and faculty supporters can become partners in such a process. This is possible only if institutional ecosystems are thoroughly mapped and their histories of development fully documented. In future work, the authors intend to further develop this approach to campus and city sustainability.

End Notes

1. "People," at: http://universitylivinglab.org/people; "Groupings," at: http://universitylivinglab.org/organisations (last accessed on Jan. 20, 2016).
2. "Choosing a Sustainability Undergraduate Degree," Arizona State University School of Sustainability, at: https://schoolofsustainability.asu.edu/degrees/undergraduate/ (last accessed Jan. 20, 2016).
3. Source: Frederick Area Watersheds Association, "The Human Ecosystems Approach," at: http://nbwatersheds.ca/fawa/the-human-ecosystem-framework (last accessed Jan. 21, 2016), adapted from Machlis, Force & Burch 1997: 352). Reprinted by permission.

4. There does not appear to be any central sustainability website at Aalborg University.

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