Landscape and Urban Planning 166 (2017) 85–89

Contents lists available at ScienceDirect

Landscape and Urban Planning

journal homepage: www.elsevier.com/locate/landurbplan

A revised approach to the energy-water nexus using place-work-folk and energy balance theories of Patrick Geddes

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ARTICLE INFO

Keywords:
Patrick Geddes
Place-work-folk
Energy-water nexus
Environmental planning
Sustainability
Energy balance sheet

ABSTRACT

The use of energy to transport, treat, pump, convey, cool, and heat water and the parallel use of water to extract, refine, and use energy is a relationship known as the energy-water nexus. Not only is this relationship growing in importance as population growth and increasing living standards strain both resources, but it also becomes more problematic as energy production moves towards more water intensive practices and water requires increasing more energy to use. Despite a growing awareness of this connection a lack of understanding exists across stakeholders in both fields and a significant need exists for better cross-coordination and planning.

Over a century ago urban planner, Sir Patrick Geddes, provided ideas about environmental and civic planning that if employed may improve the mutual constraints between energy and water. Specifically, Geddes' development of 1) the integrated concept of "place-work-folk" described below, and 2) his suggestion for ranking and promoting societal activities based on their dual importance to society and impact on nature, provide a balanced approach to the energy-water nexus. Representative of his holistic thinking, both ideas recognize the mutual dependence between people and their environment as a relationship necessary for life enhancement and survival of both. This analysis employs a historical review of Geddes' theories with logical argumentation to illustrate the modern applicability of his planning concepts to just one area of sustainable development with the intent that their potential utility to other domains will become more apparent.

1. Introduction

In this article I draw attention to the mutually supporting and constraining connection between energy and water resources in a relationship known by policy makers and academics as the energy-water nexus. On one side of the relationship requirements for water to be at the right temperature, physical state, salinity, location, and time of year require a significant amount of energy to achieve. New findings by researchers indicate, for example, that the United States public water supply alone uses 6.1% of national electricity consumption (Twomey and Webber, 2011). On the other side of the relationship employment of petroleum, natural gas, and coal as energy sources requires a parallel use of water in production, extraction, and generation. The average American household, for example, uses 29 kW of electricity requiring 10 gallons of water to produce each day (Mills, Gabriel, & Gabriel, 2012), and contributes to making thermoelectric power plants the single largest user of water in the United States.

This relationship is becoming progressively more important as 1) population growth, urbanization, increasing living standards, and changes in food consumption place increasing strains on both resources, 2) energy production moves towards more water intensive practices such as biofuels and shale gas, and 3) water requires increasingly more energy to be used. Thus as energy constraints become water constraints, water constraints become energy constraints (Webber, 2013a). Unfortunately the relationship between the two resources is not commonly recognized or understood. Not only does a lack of data prevent the clear articulation of water and energy consumed on both sides, but also existing institutions are set up to address one resource or the other under a prioritization schema driven by outdated precedents.

Despite these challenges it is important to recognize energy and water stakeholders, planners, and policy-makers can have a positive influence on this relationship. Researchers estimate, for example, that power plants could conserve more water than all of the U.S. water conservation methods combined if they modernized their cooling systems (Wilson, Leipzig, & Griffiths-Sattenspiel, 2012). Thus planners and policymakers have significant opportunities to make a difference in the unique relationship between energy and water. In response to calls for further study from the United States (U.S.) Congress (King et al., 2013King, Stillwell, Twomey, & Webber, 2013), in this paper I explore opportunities to manage these resources using environmental and civic planning theories developed by Scottish urban planner, Patrick Geddes, that are especially relevant to the challenges of the energy-water nexus.

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http://dx.doi.org/10.1016/j.landurbplan.2017.05.016
Received 22 July 2015; Received in revised form 3 April 2017; Accepted 19 May 2017
Available online 12 June 2017

The research methods I employ are primarily a historical review of Geddes' theories with logical argumentation of how they may apply to challenges in energy and water planning using state and national energy and water consumption and production data.

One of Geddes' key theories was inspired by the work of the French economist Frederic le Play who categorized sociology into the three elements: *Lieu, Travail, Famille*, or Place, Work, Folk. With an academic background rich in biological studies, Geddes quickly identified the counterpart of le Play's sociology elements in biology as: Environment, Function, Organism (Stalley, 1972). He then blended these two triads and applied them to social issues as a way to describe the mutual influence landscape (place) has on the occupations (work) and the society (folk) that develop in a region. Today the concept of place is often referred to as a sense of place but continues to include connotations of identity and character. Folk may be more usefully thought of as the cultivation of community and group identity, and work generally encompasses employment, career, manual and creative work.

Geddes also added to the value of the original triad by emphasizing the importance of their interrelationships and strongly encouraging their study as an organically related whole. Place-WORK, for example, represents work that develops in a specific place such as mining in mountainous terrain or fishing near the sea, and place-FOLK represents people influenced by their environment such as the Eskimo culture that develops in colder climates (Boardman, 1944). Examples of these interrelationships are illustrated in my recreation of one of his many Place-Folk-Work diagrams in Fig. 1.

Geddes understood comprehending each of these elements drove the necessity for extensive data collection, or survey. A regional survey in fact became one of Geddes' trademark contributions to the field of urban planning and as I show below, is a key element linking his planning theory to the energy-water nexus. Geddes emphasized the survey first method as a correction in the chronological order of existing town planning efforts. Specifically he noticed planning efforts in Great Britain were proceeding before adequately surveying the geographical, cultural, and historical factors that create a city (Boardman, 1944). Without this understanding Geddes considered the resulting town plans as passable, but missing the key opportunity to create the best possible plan. He therefore appealed for an end to 'the isolation of our present facts from past ones,' and to redirect these efforts encouraged consideration of the historical factors that profoundly modify the local situation and lead to different social fabrics (Geddes, 1915). This advice is especially useful to planners as they leverage lessons learned from previous planning efforts impacted by culture in unexpected ways.

Similarly Geddes saw the historical segregation of rural and urban planning as detrimental to their common interests. Instead he encouraged combining rural and urban data and analyzing it together in a regional report that relates a town not only to its immediate environment but also to the larger surrounding region (Geddes, 1915). As explained by one of Geddes key biographers, Paddy Kitchen, "By understanding the origin of city professions in the natural occupations of their rural ancestors, Geddes claimed that planners were better placed to undertake the re-creation of the city region," (Kitchen, 1975). The desire to understand professional origin and its' rural influence explains why Geddes' proposed such an extensive list of areas for study that range from geographical maps and social statistics, to historical means of communication and commerce.

PLACE (Geography)	place-WORK (or geographical ECONOMICS)	place-FOLK (or geographical ANTHROPOLOGY)
WORK-place (economic GEOGRAPHY)	WORK (Economics)	work-FOLK (economic ANTHROPOLOGY)
folk-PLACE (anthropological GEOGRAPHY)	folk-WORK (anthropological ECONOMICS)	FOLK (Anthropology)

Fig. 1. Place-Work-Folk Diagram of Respective Sciences (Recreated from Geddes in Boardman, 1944).

A second key aspect of the Place-Work-Folk relationship is that the paradigm may be reversed as Folk → Work → Place. To illustrate consider primitive societies in which the surroundings influenced the occupations that developed depending on the environment, such as hunting that is predominantly found in heavily forested areas. In more modern times people began to have greater social mobility and thus greater choice in their occupations. Kitchen describes, "people were not necessarily mechanistically determined by environment in the Darwinian sense, but could exercise their own will," (Kitchen, 1975). For Geddes it follows that, "Having chosen their work, they can fashion the place; they can mould the environment in harmony with their ideals," (Geddes in Kitchen, 1975). I suggest it is this concept of making occupational and cultural choices based on ideals that is especially important in applying Geddesian planning to the energy-water nexus in order to make tough decisions between competing priorities for these resources.

In the following sections my application of Geddes' notions of Place-Work-Folk begins with Place-Work. I show how understanding the place by conducting a regional survey of energy and water resources aligns the work by integrating the individual institutions for their joint benefit. In the second section I explore Work-Folk using modernization of the electric grid and reprioritizing and committing to revised water laws as opportunities to improve both the occupational and cultural utility of water and energy resources. In the final section I complete the linkage with Folk-Place using the examples of development near sand dunes and drought disaster resilience and mitigation to emphasize how the environment is impacted by an energy-water culture − defined here as the values, principles, and beliefs that accompany energy and water consumption and related technological development. I also explore how the energy and water character of the environment influence the culture of the region in this section.

2. Place-work

One of the relationships Geddes explores in the place-work-folk triad is Place-WORK. This combination signifies, "natural advantages which determine work of each kind at the right place for it," (Geddes in Kitchen, 1975) and is also labeled as geographical economics in Fig. 1. In this relationship understanding the geography or natural advantages of a place conditions the type of work, thus the need for geographic and social surveys are especially important to identify not only the occupational alternatives that have already been acknowledged but also the possibility of new ones.

With respect to energy I suggest this could mean, for instance, initiating a renewable energy industry in a region in which it did not inherently develop on its own. Wind power technology, for example, has been adopted in European countries since around 1000 CE. (U.S. DOE, 2013). In the United States on the other hand, despite a history of using wind technology and significant wind capacity, wind energy as an industry did not take off until the early 21st century (U.S. DOE, GWEC in Webber, 2013b). Many factors have contributed to this delay, however, following Geddes' guidance to survey then plan to the natural advantages of a region I believe may have supported an earlier development of this industry in the appropriate locations.

With respect to the energy-water nexus, data collection and analysis grew in the early 2000's (King et al., 2013). To date key areas of published energy-water nexus research are provided in the following Table 1.

Together these efforts have brought attention to the energy-water nexus and provided empirical data to understand the relationship in which energy constraints become water constraints and water constraints become energy constraints. A significant source of data for much of this research has come from existing databases, such as the energy database provided by the Energy Information Agency (EIA).