Chapter 1
Green Energy:
Sustainable Energy Sources and Alternative Technologies

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ABSTRACT

Despite the general evolution and broadening of the scope of the concept of infrastructure in many other sectors, the energy sector has maintained the same narrow boundaries for over 80 years. Energy infrastructure is still generally restricted in meaning to the transmission and distribution networks of electricity and, to some extent, gas. This is especially true in context. This early 20th century system is struggling to meet community expectations that the industry itself created and fostered for many decades. The relentless growth in demand and changing political, economic and environmental challenges require a shift from the traditional 'predict and provide' approach to infrastructure which is no longer economically or environmentally viable. Market deregulation and a raft of demand and supply side management strategies have failed to curb society's addiction to the commodity of electricity. None of these responses has addressed the fundamental problem. This chapter presents an argument for the need for a new paradigm. Going beyond peripheral energy efficiency measures and the substitution of fossil fuels with renewables, it outlines a new approach to the provision of energy services in the context of 21st century urban environments.

INTRODUCTION

Contemporary responses to solving growing energy demand in the context of climate change and carbon constraints have typically focused on the two ends of our one-way linear energy infrastructure: reducing the greenhouse emissions of our electricity generators and reducing and controlling energy demand. Very little consideration has been given to re-defining our preconceived definitions and approaches to the delivery of energy to our urban communities. Achieving long term sustainability as well as social equality in the energy sector will require a focus on the energy services required in an

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urban context, and the planning and implementation of a 'living organism' network of independent 'energy cells'. This chapter discusses technologies and processes that can be integrated to address achieving long term social, ecological and economic sustainability in the energy sector.

Energy Infrastructure

Infrastructure is a military terminology that incorporates all buildings and permanent installations necessary for the support, deployment and operations of military forces ('Dictionary of Military and Associated Terms', 2001). The term was first used in a non-military sense in 1927 to refer collectively to the 'public works' (e.g. roads, bridges, rail lines, dams) that were required for an industrial economy. The birth of modern infrastructure was in the USA in the Great Depression, fuelled jointly by the political belief that the federal government should create jobs for the large number of unemployed according to Keynes' newly formulated macro-economic theory. Definitions of infrastructure have evolved over the century and now vary considerably, ranging from:

- a constrained economic viewpoint ('structural elements of an economy that facilitate the flow of goods and services between buyers and sellers') ('MacMillan Dictionary of Modern Economics', 1996)
- a broader social perspective (i.e. including social capital items such as housing, health and education facilities)
- a whole of society/whole of business view ('the fundamental structure or architecture of any system that determines how it functions and how flexible it is to meet future requirements') ('Computer Desktop Encyclopedia')

In summary, the definition of infrastructure has been 'evolutionary' and 'often ambiguous' and, in a practical sense, 'what is considered to be infrastructure depends heavily upon the context in which the term is used' (Moteff & Partomak, 2004, p. 2).

Despite the general evolution and broadening of the scope of the concept of infrastructure in many other sectors according to their individual contexts, the energy sector has maintained the same narrow boundaries for over 80 years. Energy infrastructure is still now, as in the early 20th century, generally restricted in meaning to the transmission and distribution networks of electricity (often termed 'the grid'), gas and oil, and sometimes electricity generation assets (power stations - i.e. energy conversion plants), gas and oil fields and oil refineries. In essence, energy infrastructure generally refers to the assets required to ensure the flow of energy commodities (e.g. electricity, gas, petroleum) to an end user in an industrial and economic paradigm.

Even within this generic acceptance of a definition of energy infrastructure, paradoxically, there can be quite marked differences of scope between different types of energy (e.g. electricity as opposed to gas or transport fuels), as evidenced in Table 1.

What has led to the generic societal understanding of the nature of energy infrastructure? A brief look into the growth of the electricity industry offers some clues. A thought-provoking history of the electricity sector's development from distributed generation, local networks to a monopolistic centralised generation and linear transmission and distribution system is revealed in *Power Play (Beder, 2003)*. In this book, Beder reveals that the idea of centralised power stations and large transmission/distribution networks did not arise as the most efficient and logical engineering and technological solution to provide electricity to communities across the USA. It came from Thomas Edison as a marketing construct for vertically integrated electricity monopolies in order to gain and keep consumers of electricity for life (Beder, 2003, p. 25). (A