

# INTRODUCTION

The cities in this volume represent important energy capitals in the fossil-fuel era. Indeed, in their own ways they have played, and some still do play, important roles in the production, processing, and transfer of hydrocarbon energy sources. In turn, fossil fuels have had significant impacts on them. The relationship between the coal and petroleum industries and these cities/regions not only represents an economic connection with a global reach, but major political, social, and environmental links as well.

*Energy Capitals: Local Influence, Global Impact* speaks to the intersection of fossil-fuel production and use and urbanization in specific locations around the world. The immediate results of this intersection, largely in the form of generating huge supplies of energy and large amounts of capital, often masks long-term local effects including the transformation of regional economies, fundamental changes in labor markets and educational institutions, high social costs in the areas of environmental quality and health, the shaping of regional infrastructure and the transformation of urban space, and changes in cultural attitudes. Studying the evolution of energy capitals reveals similarities and differences useful in understanding historical patterns of energy-led development where it takes place, with special emphasis on political, economic, technical, and social variables that influenced those patterns and shaped the environment in which energy industries emerged, grew, and in some cases, declined. A study of energy capitals can contribute a long-term perspective to current debates about the best ways to capture the benefits while managing the costs of such energy development.

This volume is the result of “Energy Capitals: Local Impact, Global Influence,” a workshop held at the University of Houston (UH) on May 21–22, 2010, and sponsored by the National Science Foundation and UH’s Center for Public History. With the exception of the essay on Pittsburgh, all of the remaining essays are versions of papers delivered at the workshop. The event was meant to bring together historians, social scientists, and other experts whose work on energy history and its intersection with urban and environmental history did not have a well-defined home in the current maze of academic associations. The subfield of energy history has remained rather dormant for several years since the end of the “energy crisis” in the 1970s, but has been reinvigorated recently because of the growing public

awareness of a wide array of energy issues. The speakers and commentators at the workshop utilized their presentations as a departure point to begin a conversation on the study of energy history and its place within a variety of societal contexts. A subsequent workshop titled “Energy Resources: Europe and Its Former Colonies,” was held in cooperation with the Rachel Carson Center for Environment and Society at the Ludwig-Maximilians-Universität in Munich, Germany, in October 2012. In all cases, the emphasis on energy history through the workshops has meant from the start to be global in scale.

## **Energy in the Fossil-Fuel Era**

On the most fundamental level, energy is “the available capacity of a body to do work.” Humans have unleashed energy by using the power of their own muscles or that of other animals. Humans also have exploited various forms of energy that nature stores in several forms such as gravitational potential (hydropower, tidal power), heat (geothermal), nuclear (fission, fusion), kinetic (windmills), waves, radiation (solar), and chemical (fossil fuels, wood, fuel cells).<sup>1</sup> All preindustrial societies relied on muscle power or energy sources that were relatively short-term transformations of solar radiation, such as flowing water or wind.<sup>2</sup> The Industrial Revolution, first in England and then elsewhere, swiftly began replacing muscle power with other forms of energy, sources that essentially were nonrenewable unlike those immediately derived from solar radiation. Since 1900, biomass [organic matter], coal, and oil supplied large quantities of energy, which at the time seemed endless and infinitely better at producing huge amounts of power.<sup>3</sup>

From the 1890s onward, fossil fuels overshadowed biomass as an industrial fuel even though the majority of the global population did not use them directly. In essence, fossil fuels effectively dominated worldwide energy production and use in the late nineteenth and twentieth centuries, resulting in a massive upsurge of total energy use.<sup>4</sup> Coal was the earliest modern fuel. Burning coal took place in ancient and medieval societies, but was never more than a minor source of heat or power in those years. In the seventeenth century, the Netherlands became the first country to shift to fossil fuels by burning peat, but England was the first to extensively utilize coal. Beginning as early as the 1540s (some two hundred years before the Industrial Revolution), the English began to mine all their major coalfields, shipping substantial quantities to London. By 1900 coal accounted for about 95 percent of the global primary energy supply, but slipped to about 23 percent in 2000. In the twentieth century, it was oil and not coal that captured broad scale energy use worldwide and it has been the dominant fossil fuel to this day.<sup>5</sup>

As historian John McNeill stated, “No other century—no millennium—in human history can compare with the twentieth for its growth in energy use. We have probably deployed more energy since 1900 than in all of human history before

1900.”<sup>6</sup> Historian Alfred Crosby added, “We lurched into the fossil fuel era some two to three hundred years ago with the invention of the steam engine.” This innovation allowed us, along with the internal combustion engine, “to tap the concentrated energies of ancient biomass which subterranean heat and pressure have transformed into coal, oil, and natural gas.”<sup>7</sup> Electrification from major increases in the use of coal and then oil boosted demand for industrial and residential power needs, and these same fossil-fuel sources dramatically transformed motive power as well: locomotives, steamboats, automobiles, trucks, and airplanes. Probably the most important characteristic of society based on fossil fuels is “the exponential increase in per capita energy consumption.”<sup>8</sup> Crosby concluded that “our technological civilization as it now exists would be impossible without the enormous consumption of these fossil fuels. Modern civilization is the product of an energy binge.”<sup>9</sup>

### **Cities and Fossil Fuels**

The most obvious and significant concentration of energy production and consumption occurred in and around cities. It makes good sense that coal, oil, and natural gas industries were attracted to cities as centers of production, processing, and transfer. Energy regimes in twentieth-century cities built upon arrangements whereby energy sources could be extracted near them, transported to them or close to them, stored, processed, and delivered to customers.<sup>10</sup> Beginning in the nineteenth century and extending into the twentieth, a combination of technological advances (such as extraction techniques and the steam engine) and sociopolitical processes (societal negotiations and choices made over energy systems) produced access to cheap and plentiful fossil fuels, which in turn stimulated economic growth and development. Urbanization was particularly influenced by the intense exploitation of fossil fuels, economically and environmentally.<sup>11</sup>

Before the Industrial Revolution, when biomass and muscle power fueled much of the world, the global urban population was around 3 percent, and the human, animal, and solar radiation sources that constituted much of the energy base limited the size of cities. Maybe somewhat exaggerated but with much truth, some experts stated that “[t]he high levels of contemporary urbanization owe their existence and continued growth entirely to fossil fuels,” which takes into account power for farmlands that provide food, transportation, construction, industrial systems, and various household necessities and amenities.<sup>12</sup>

Cities and their hinterlands as foci of fossil-fuel production and consumption, therefore, are central historical phenomena of the twentieth century. Urban development per se exerts great pressure on local environments and the surrounding regions, particularly exaggerated by fossil-fuel production, processing, and transfer, and fossil-fuel dependency for power generation and transportation.<sup>13</sup> Cities

also exhibit characteristics as flows of energy, whereby sources provide heat, light, power, and transport, and in so doing leave a large ecological footprint. Impacts include—within cities or related to urban needs—land for extraction, transportation, conversion of fuels, generation and transmission of electricity, and extensive use of water.<sup>14</sup>

Cities are major modifiers of the physical environment. “Their existence,” geographer Ronald J. Johnston noted, “can influence the course of basic physical processes, such as the hydraulic cycle.”<sup>15</sup> Urbanization removes much of the filtering capacity of soil and rapidly channels precipitation into available watercourses, thus encouraging flooding. Building cities affects the atmosphere by increasing airborne pollutants and also creating “heat islands” where temperatures are greater than the surrounding area. Various urban activities produce huge volumes of waste products that require complex disposal mechanisms. As geographers Thomas Detwyler and Melvin Marcus concluded, “Unfortunately, the urban ecosystem seldom treats air and water resources by riparian standards; that is, they are not returned to the ecosphere in the same condition in which they were received.”<sup>16</sup> As such, this footprint measures the quantity of land, water, and air utilized to sustain the human population, resources consumed, and the waste absorbed.<sup>17</sup>

Cities for a variety of purposes also consume vast amounts of energy. According to one expert, “Collectively, buildings are either the largest or second largest consumers of energy (behind industrial conversions) in all rich societies.” In the United States in 2000, buildings consumed 40 percent of all fuels and 75 percent of electricity.<sup>18</sup> In the first half of the twentieth century, consumption of fuel oil grew rapidly, not only because of industrialization but also because of home heating needs in cities. These two sources represented the greatest growth area for fuel oil use.<sup>19</sup> The production and consumption of energy by cities emphatically resulted in substantial environmental challenges—pollution, changes in land use, more infrastructure, and population concentration. Fossil-fuel cultures have left a very large environmental footprint in the form of land claim by extraction, transportation, and in the generation and transmission of electricity. Through combustion, fossil fuels oxidize carbon and heat their surroundings, produced most recently by automobiles and power plants in the case of air emissions or in extensive removal of land cover.<sup>20</sup> Cities require vast inflows of raw materials and structural components (such as concrete, metals, and wood products). Material inputs required to maintain high-energy societies are far greater than what preceded them. In general, fossil-fuel-supplied cities play a major role in key biochemical cycles by producing air and water pollution and significantly contributing to climate change on a regional and even global level.<sup>21</sup> Along with the exchange of energy by the oceans and atmosphere and solar energy, fossil-fuel emissions are a basic cause of climate change.<sup>22</sup> As environmental expert Vaclav Smil stated, “A century of fossil-

fueled industrialization, urbanization, and subsidized farming changed both the extent and the rates of environmental intervention. . . . By the 1960s, when environmental concerns emerged as a major preoccupation of industrial civilization, there was no doubt that energy industries and energy use were the leading causes of environmental degradation and pollution.”<sup>23</sup>

## **Energy Capitals**

We define energy capitals as cities/regions with strong ties to energy industries and with strong roles in energy production, energy distribution, and/or energy technology. They also play a vital role in resource development and the provision of attendant services. When we think about energy capitals we normally think about them as centers for financial capital accumulation (profit centers) generating wealth for corporate entities or governments that draw that wealth from the production and sale of energy and then distribute it beyond the community where it was generated. This perspective is too narrow. Energy-led development (in this case during the fossil-fuel era) has shaped the evolution of many cities and regions, influencing metropolitan growth while changing patterns of energy consumption and concentrating the environmental impacts of energy production locally as well as in areas of consumption far removed from production facilities.

Cities such as Houston, Texas; Los Angeles, California; Baton Rouge/New Orleans, Louisiana; Tampico, Mexico; Calgary, Canada; Stavanger, Norway; Perth, Australia; and Port Gentil, Gabon (also Oklahoma City/Tulsa, Oklahoma, and Aberdeen, Scotland, neither of which are included in this volume), are representative of contemporary cities which deserve the moniker of energy capital. In the past, the production, transportation, and intensive use of energy also strongly influenced the development of such cities as Pittsburgh, Pennsylvania—a coal and oil center. At some point in their development, these cities or their surrounding regions became important parts of the complex of economic activities needed to produce and distribute energy to broader markets. The idea of energy capitals is not time specific or limited to regions that remain dominated by energy production. In the past, for example, oil strongly affected such cities as Los Angeles and Tampico, Mexico, in one phase of their development before waning in influence. Indeed, the most temporary form of an energy capital—the boom community, produced by the frenzied development of large newly discovered oil fields (such as Oil Creek, Pennsylvania, or Spindletop, Texas)—has attracted some attention by scholars, but not much beyond their role as catalysts for such booms.

The strong and complex connections at the intersection of energy-led development, urban growth, energy use, and environmental impacts in energy capitals are intuitively obvious. Yet they are largely missing from the existing historical literature. Perhaps the connections are simply too deeply embedded to be easily ana-

lyzed. Also, the study of energy history has not yet developed as fully as the vibrant fields of the history of technology, urban history, and environmental history. One way to begin to examine more fully these related issues, therefore, is to focus on extreme cases which show most dramatically the relationship between energy, environment, and urbanization. These extreme cases are the energy capitals.

Of course, it is not accurate to limit energy capitals to oil centers only. Other forms of energy have greatly influenced the development of cities over the centuries such as Pittsburgh or Manchester, England (coal); Oak Ridge, Tennessee (nuclear power); or hydropower in a variety of locations, including the Tennessee Valley and the Pacific Northwest in the United States, Austria, and throughout Scandinavia. For coherence, however, *Energy Capitals* focuses on fossil fuels in a very significant period of human history.

Energy capitals, in addition, have not emerged in a historical void. Their study has much to draw upon as well as contribute to the study of urban development in general and case studies of regions that have been shaped by different common economic influences, such as a variety of industrial products or even finance. Regional development driven by energy shares several important attributes with modern urban development in general. The most obvious is the movement of large numbers of migrants from rural areas to industrial jobs in and around cities. Equally important in the process of change is the connection of city and hinterland. As William Cronon, Kathleen Brosnan, and others have demonstrated, we understand the urbanization process to entail regional impacts which extend the influence of urban development beyond politically constructed borders, while creating interdependence between built and natural features.<sup>24</sup>

The production and transportation of large quantities of fossil fuels has greatly affected many parts of the world, a process often accompanied by the introduction of advanced technologies from large companies based outside the respective region. The long-term impacts have included the transformation of regional economies, population growth fueled by mass migration to the opportunities presented by growth, fundamental changes in labor markets and educational infrastructure, high social costs in the areas of environmental quality and health, the shaping of infrastructure and the transformation of urban space, and changes in cultural attitudes.<sup>25</sup>

## **Impacts of Energy Capitals**

By their very nature, all cities are energy intensive. A high concentration of people in a limited space demands energy use for heating and cooling, for transportation, for work—for almost any activity one could imagine. However, energy capitals, in particular, are historically significant because of the roles they play and have played in both production *and* consumption of energy. Concentration of human

and material resources for purposes of survival, construction of infrastructure, and the production and consumption of goods and services are essential characteristics of communal living. Energy-led development has shaped the evolution of many cities and regions, influencing metropolitan growth while changing patterns of energy consumption and concentrating the environmental impacts of fossil-fuel production locally as well as in areas of consumption far removed from production facilities.

Recent scholarship on global cities, especially in sociology, appears to provide some insight.<sup>26</sup> As sociologist Saskia Sassen noted, “Economic globalization, accompanied by the emergence of a global culture, has profoundly altered the social, economic, and political reality of nation-states, cross-national regions, and . . . cities.”<sup>27</sup> While useful, the focus on transnational networks of cities and “transnational spaces for economic activity” in this study and elsewhere primarily focuses on the global economy, which is not the primary concern of *Energy Capitals*. Studies dealing with “the resource curse” or “the oil curse” also provide an additional basis for analysis by emphasizing the difficulties of emerging oil-producing nations as they seek to develop by exporting oil produced primarily by foreign companies.<sup>28</sup> But even here, the question of “the oil curse” is not relevant to all of the cities we study, nor does it give primary attention to the intersection between fossil-fuel production and use and urban growth. Nevertheless, more comparative work on energy-led development over time and place is welcome no matter what the specific emphases.

*Energy Capitals* attempts to help fill the gap in the historical literature especially with respect to the energy/city nexus. Cities and regions that reap the long-term economic benefits of energy production are often physically transformed (or at least modified) by the burgeoning energy industries and, at times, pay high social and physical costs. Demands for water, wastewater systems and solid-waste disposal systems, communication, transportation networks and facilities, and external sources of power (particularly electricity) put pressure on cities to expand their infrastructure, and in some cases, energy industries compete directly with municipal infrastructure needs. The historical impact of fossil fuels reaches beyond the conversion of resources to stationary and motive power, such as the illumination of streets and interiors; the movement of trains, cars, buses, and trucks; and the generation of heat and refrigerated air. Broadly understood, energy encompasses all processes of production and consumption that allow people to function in the physical world. One general impact is clear: changes in energy supply and demand in the past have greatly affected the economic and physical contexts within which cities and regions have grown.

New technologies using new sources of energy have shaped the transportation and communication revolutions that transformed the world economy in the last

two centuries. To restate a main theme of the book: The impact of new sources of energy on the American economy has been particularly pronounced in the years since the mid-nineteenth century, when the widespread use of fossil fuel and urbanization accelerated. Fossil fuels helped transform the modern city worldwide (which is especially obvious in energy capitals), altering the physical environment in new and significant ways. The most obvious impact was a fundamental change in land-use patterns in and around cities, which reached out and absorbed the once rural land surrounding the sprawling urban centers. The concentrated use of fossil fuels in the production of goods brought a new scale of industrial pollution to cities; growing energy use for transporting people and goods added another layer of pollution to the mix, particular in cities that grew rapidly only after the advent of the automobile. In these and many other ways, as the lure of jobs and better opportunities from urban industrial growth attracted ever larger populations, the environmental impacts of increasing energy use also grew dramatically.

Thus, the most visible social and physical cost of energy industry development is the concentration of environmental and health risks from the production of fossil fuels. In this sense, energy capitals often have been forced to absorb substantial local costs for producing energy sold in national and international markets, becoming sacrifice zones of sorts. The response to such costs of energy-led industrialization often has been indifference or neglect. This is the case, in part at least, because technologies of energy production have been the historical focus of coal, oil, and natural gas industries, while investment has lagged substantially in technologies of pollution control. The political and legal processes for negotiating societal solutions to such problems also shaped regional responses to social and physical costs, and such processes have differed sharply across time and place.

The following questions provide a departure point for a comparative analysis of energy capitals. As a group, the chapters in this book address many of these issues in whole or in part. The authors, however, were free to explore the historical questions they believed were most pertinent or most relevant to their expertise.

- What economic benefits have accrued to the region over time because of fossil-fuel production?
- How have the needs of the energy industry shaped urban infrastructure, particularly industrial and municipal demand for water supply and wastewater systems, transportation and communication networks, disposal facilities, and scientific and technical educational systems?
- What have been the most obvious social costs? In particular, what have been the primary environmental impacts on the region of the specialized technology used in fossil-fuel production and processing? In the broadest sense, have energy capitals been

treated like “sacrifice zones” that carry the environmental burden of a product used far away from the point of production?<sup>29</sup>

- What about the broad implications of energy consumption, particularly questions related to availability of cheap energy close to the source and its impact on urban growth and development?
- What has been the impact of energy-related growth on political systems as they sought to make public policy about the costs and benefits of energy-led development?
- What has been the impact of the interaction between urbanization and energy development on culture, including labor, education, race and ethnicity, gender, and a variety of other social concerns?
- How has migration of workers to the jobs in energy-related manufacturing altered the demographics and spatial organization of the region, expanding the influence of the urban center out into its hinterland?

The current chapters do not give substantial attention to questions of specific technology and science related to energy development in the cities discussed, but future studies should consider these issues more fully. Most energy capitals share the common formative experience of rapid growth after the introduction of advanced technologies increased the regional production of supplies of fossil fuels destined for national and international markets. At times a cycle of boom and bust ensued, leaving a region vulnerable to changes in energy supply and demand beyond its control. In some cases, regions have been successful in absorbing new technologies and building economies capable of diversifying in the face of fundamental changes in the energy. Consider the following questions:

- What is the relationship between specific production technologies and environmental pollution?
- What are the specialized technologies that have grown out of these fossil-fuel industries? For example, such discussions can include refinery technologies of fuel production and petrochemicals, and various heating and cooling equipment.
- What has been the role of science in energy production and how does the application of various scientific processes affect demand for resources and potential impacts on urban life? This includes everything from chemical recycling to waste disposal.

Each of the queries stated above generates a large subset of related questions for analysis; together they offer potential opportunities for viewing energy capitals well beyond the passing attention they have received in the existing literature. Indeed, the same set of questions might be profitably used to compare urban development among a wide variety of major cities.

## **Energy Capitals and the Future**

Many energy capitals share a life cycle of rapid growth, maturity, and decline. Differences may occur, of course, depending on when a resource is discovered and developed. If a region succeeds in absorbing the economic growth generated by fossil-fuel development, it will often enjoy an extended period of maturity in which the growth of demand for its products encourages economic expansion. Sooner or later, this era gives way to a time of decreased demands for its energy-related products, leading to a period of economic decline unless the region finds the will and the resources to diversify its economy. During this cycle of boom and bust, a region is vulnerable to changes in energy supply and demand beyond its control. In some cases, regions have been successful in absorbing new technologies and building economies capable of diversifying in the face of fundamental changes in the energy industries. We need to know more fully why some regions have been able to absorb the technologically advanced processes needed for energy production and some have not. We also need to understand the environmental implications of the production/consumption cycles.

The presumption of a post-petroleum world—or even more broadly a post-fossil-fuel world—confronting us sooner than later, can benefit from a deeper understanding of how energy capitals emerged and evolved throughout the world. Such studies can help us to understand how certain energy sources become essential to economic growth, but also how they shaped their physical surroundings in such a way as to develop mutual dependencies between industries and urban areas. Such interdependencies, in many ways, shape (and also constrain) transitions to new energy eras. Such matter-of-fact notions as “a post-petroleum era” are not something that will occur outside of their historical context. For us to understand the rise, growth, and fall of energy capitals is to better understand the role energy plays in society at large—not simply as a source of power, but as an engine of change.