# Chapter 2
# Defining Energy-Based Economic Development

**Abstract** EBED is a direct extension of the energy planning and economic development disciplines. This chapter provides important foundational information to support the EBED framework and applications described in the remainder of the book. It defines EBED, describes the economic development and energy policy and planning disciplines, summarizes how these disciplines have converged, and discusses the goals inherent within EBED initiatives. This chapter also differentiates EBED from other disciplines. Distinguishing characteristics include EBED's focus on advanced, efficient, or low-emissions energy; its pursuit of joint energy and economic development goals; ability to build on the varying scale and distributed nature of some types of low-emissions energy; its alignment of development and energy goals into one unified approach; and the active role of governance, leadership, and stakeholder engagement.

## 2.1 Definition

EBED includes activities at the nexus of energy policy and planning and economic development disciplines, where practitioners seek to address the challenges and opportunities within the juncture of these two fields. This domain embraces initiatives, programs, or policies that share the goals of economic development and energy. Several important elements within this conceptualization of the EBED domain distinguish its practices from other efforts. In particular, EBED

- focuses on advanced, efficient, or low-emissions energy sources and technologies;
- advances joint energy and economic development goals;
- builds on the varying scale and distributed nature of low-emissions energy;
- provides a framework that aligns goals in a unified approach; and
- recognizes the role of governance, leadership, and stakeholder models in shaping outcomes.

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EBED focuses on energy sources that are advanced, efficient, or low-emissions[1] and that are driving new forms of economic development (Carley et al. 2011, 2012). Advanced means innovative technological improvements on conventional or alternative energy. Efficient technologies use less input energy to produce the same amount of output energy. A low-emissions technology produces limited amounts of emissions throughout its entire production cycle.

First, many researchers and practitioners highlight renewable energy and energy efficiency as promising solutions to our current global and local energy challenges. In this book, we highlight and discuss renewable energy and energy efficiency innovations and examples of how places around the world are adopting these innovations for diversification or decarbonization reasons. We recognize, however, that renewable energy and energy efficiency will comprise only a portion of our future energy scenario and are also more relevant in some regions than in others. Extractive industries such as coal, gas, oil, and rare elements, for example, are also relevant to these discussions if they are extracted in ways that are more advanced, produce less emissions, and are more efficient. For these reasons, researchers and practitioners working in a range of energy fields are important to the EBED discussion.

Second, EBED initiatives, by their definition, advance both economic development and energy goals. Economic development is a significant element in the adoption of energy solutions at national and subnational levels and is also important in the mitigation of energy-related problems, such as the quest for reducing GHG emissions. Energy is an important aspect of economic development because, as an industry, the energy sector is in a state of significant transformation with increased global demand and limited supply of natural resources. As an ever-present and required input for growth, energy creates an opportunity for innovation to meet the demand for new kinds of energy provision. When there is need for innovation there is typically opportunity for market-based growth, thus making the energy domain a hot bed for economic development potential. In short, energy has become a driver of economic development, not just an enabler of it.

Third, EBED is conducive to varying scales and distribution models that can be widely deployed. The assets on which EBED initiatives can build differ widely from location to location, but the more distributed nature of lower-carbon energy sources widens the potential for the kinds of markets, places, and households that can experience the economic benefits from EBED. We showcase in this book the diverse projects and places that are taking advantage of EBED by leveraging their unique energy and economic development asset base.

Fourth, EBED initiatives use a framework—presented in Chap. 3—that aligns goals, objectives, outcomes, and measurement to ensure project outcomes. This

[1] The original conceptualization of EBED focused on "low-carbon," rather than "low-emissions" energy solutions. In this book, we expand the definition from low carbon to low emissions to highlight the importance of technologies and other solutions that not only aim to reduce GHG emissions, but also seek low levels of other pollutants as well, including but not limited to $SO_2$, $NO_x$, and particulate matter.

alignment of the various components of the EBED process helps involve a wider set of champions to advance common causes. As one scholar articulates, "Starting with a green growth and development goal is far more than a rhetorical device in that it engages different political and economic actors, and can achieve more effective progress by aligning their plans, interests and leadership" (Zadek 2011, p. 1062).

Finally, and closely related to the last point, the EBED framework recognizes the role of governance, leadership, and stakeholder engagement in shaping desired outcomes. Incorporating the role of actors and institutions within the EBED process accounts for political context and human realities that are often difficult to quantify but can have significant effects for policy and program success. Späth and Rohracher (2010) underscore this point in their work on energy regions by stating:

> The participation of a specific variety of actors from different parts of society can be of paramount importance for the momentum that such an alliance can generate. Only an alliance including major businesses, NGOs and government authorities can assume enough authority for their joint objectives, agenda and standards because a more homogenous or incomplete constellation would not be trusted to produce socially robust and operational solutions…but rather partial interests (p. 454 and referencing Boström 2006).

This point is important because EBED is driven by a diverse set of actors. The framework EBED provides helps these actors and the institutions they represent work from a common understanding that incorporates local context. Energy policy and planning decisions are typically made solely by utility companies, regulators, and policymakers. The EBED realm incorporates actors such as economic developers, government officials, civil servants, the community, community development practitioners, donors, industry and business leaders, and representatives of the nonprofit realm. This integration of diverse actors in EBED activities builds a more robust network for cross-fertilizing activities. As a result, there is greater potential for more innovative and prolific resolution of EBED issues.

### *2.1.1 Other Definitions of the Energy–Development Nexus*

Others have used several working definitions to describe the juncture of energy and economic development. Terms such as "green economy" and "green jobs" are sometimes used, but these definitions can be easily applied for advocacy and political purposes and thus obfuscate the intent of the terms and make it more challenging for different audiences to find a common understanding. For example, "green" can mean a variety of things to different people or organizations (Fitzgerald 2010; Peters et al. 2010). We seek to be more explicit in the definition of EBED to enhance communication among practitioners from a variety of backgrounds. Clearly defined terms facilitate the development of cohesive objectives and performance metrics and make it easier to design, evaluate, and scale successful programs.

Other definitions are more specific. Nissing and von Blottnitz (2010) use a term "sustainable energisation," for example, to describe this nexus of energy and economic development. This definition is constructive because it focuses on different levels of energy development, as defined according to primary and secondary energy service needs. Primary energy service needs are defined as entirely consumptive in nature. They do not make significant contributions to financial or economic development but enable short-term poverty alleviation and improved quality of life. Conversely, secondary energy service needs contribute to productive output, such as income growth, skills development, and infrastructure development, which in turn leads to medium- to long-term economic development (Nissing and von Blottnitz 2010). Sustainable energisation is defined as the following:

> The transitional process of progressively meeting primary and early secondary energy service needs of a poor economic subgroup (second economy) through the delivery of an enhanced quantity, quality and/or variety of accessible and affordable energy services, enabling the sustainable development of the considered subgroup based on poverty alleviation and economic development, as well as the optimization of the energy service supply network from a lifecycle perspective. (Nissing and von Blottnitz 2010, p. 2186)

The distinction that Nissing and von Blottnitz make between primary and secondary energy service needs is important. "Energisation" can be applied to alleviate poverty by supplying energy services and in ways that boost growth or development. The core concept of "energisation," however, is the transition from energy supply (i.e., primary needs) to growth and development (i.e., secondary needs) in a developing-country context. Nissing and von Blottnitz highlight three important sustainable energisation targets in their work:

- poverty alleviation
- transformative strategies that provide a bridge between poverty alleviation and economic growth
- efforts directed toward boosting economic growth and development.

Although we believe "energisation" provides a constructive overview of activities in the energy and development nexus, it excludes a range of EBED activities. EBED is broader than sustainable energisation in that it includes efforts to improve access to and availability of energy (i.e., primary) and ways to supply energy to promote long-term development (i.e., secondary). EBED, for example, can include research and development (R&D) efforts to create a new technology in support of energy-efficient lighting or workforce training programs that teach energy retrofitting skills in construction. These examples do not promote access or long-term economic development; rather, encourage employment, affordable energy use, and efficient energy use.

Later in this chapter, we expand on these points by presenting the spectrum of energy and economic development goals EBED advances. First, we delve more deeply into the foundation of the energy and economic development disciplines to describe the underpinnings of the EBED framework.

## 2.2 Foundations

Understanding the basis for the convergence of energy planning and economic development advances knowledge about the EBED domain and its evolution. This overview of the founding disciplines is intended to help the student, researcher, and practitioner better recognize the strategic use of elements from one or the other discipline to improve EBED outcomes.

### *2.2.1 Economic Development*

Economic development is a dynamic field that is defined in many different ways, depending on one's vantage point. We define it simply as "a process of creating wealth for regions and improving the economic opportunities for the people that live and work within them. Desired results from this process include improved standards of living and reduced levels of poverty" (Carley et al. 2011, p. 283). We offer additional definitions to highlight different perspectives. Malizia (1994) defines economic development as

> The ongoing process of creating wealth in which producers deploy scarce human, financial, capital, physical and natural resources to produce goods and services that consumers want and are willing to pay for. The economic developer's role is to participate in the process of national wealth creation for the benefit of local consumers and producers by facilitating either the expansion of job opportunities and tax base or the efficient redeployment of local resources (pp. 83–84).

This definition underscores the importance of wealth creation, production systems, and the role of the developer in facilitating the development process for the benefit of those who live and work in the location where the development occurs. Bolton (1991) emphasizes economic distress in his definition, and Eisinger (1998) extends this perspective to specify that the ultimate intent of economic development is to "enhance the collective well-being" of communities (p. 6). Amsden sees economic development as a process from moving from an economy based on primary products that uses unskilled labor to an economic asset base of knowledge that requires skilled labor (2001, p. 2).

Regardless of the vantage point from which economic developers approach their work, ultimately they try to create economic opportunities for businesses (e.g., increasing profitability) and workers (e.g., higher skilled and higher paid jobs) and to spur growth and development for specific locations. Some examples of interventions that may be tailored to specific locales include industrial growth strategies, industry recruitment and retention, export promotion, business investment, microenterprise development, special economic zones, entrepreneurship training, and worker training.

Two features of economic development are particularly important in the context of EBED. First, the increased importance of innovation and knowledge as a driver

of economic development and the transformation of economies has elevated the role of education, R&D, and entrepreneurship in development. Colleges, universities, and R&D centers tend to have more prominent and active roles in economic development than they did in decades past. For example, countries are now designing universities to focus heavily on commercialization, not just education. King Abdullah University of Science and Technology in Saudi Arabia is one such example: it focuses on creating a "knowledge-based economy" through research, product development and transfer, entrepreneurship, industry collaboration, and policy (King Abdullah University of Science and Technology 2013).

Second, sustainability and the "triple bottom line" of coordinated economic, environmental, and social development are increasingly demanded in economic development efforts (Stimson et al. 2006). For decades, environmental consequences of growth remained tangential to economic development because mitigating against them was commonly viewed as an inhibitor to growth. In fact, proponents of sustainability and economic development were often at odds with each other. This is becoming less prevalent because of a steadily growing awareness about the value of a clean environment to economic development and the direct costs of heavy pollution. For example, rapid industrialization in China since the late 1970s has resulted in economic growth that is "nothing short of spectacular" and contributing "considerable poverty reduction in its wake" (Hausmann et al. 2008, p. 356 cited in Serra and Stiglitz 2008). One of the main costs of this growth is ambient air pollution and the significant impact of this air pollution on public health (Kan et al. 2012). Ambient air pollution, as of 2010, was in the top four mortality risk factors for China and in the top seven worldwide. In China, air pollution contributed to approximately 3.2 million deaths in 2010 (Wong 2013). In response, the Chinese government has established targets to limit air pollution in Bejing, Tianjin, and Hebei, cities with the most extreme smog (China Daily USA 2013). The growing recognition that there are real costs to human health and worker productivity is forcing sustainability into the economic development discipline more than ever.

### *2.2.2 Energy Policy and Planning*

The field of energy policy and planning includes actions taken by government, not-for-profits, or private organizations to plan energy resource use, develop energy technologies, and develop policy instruments and regulations to shape direct energy (i.e., heat) or secondary energy (i.e., electricity) production and consumption. These efforts encompass the full fuel cycle of all energy resources—location, extraction, transportation, refinement, processing, distribution, combustion or other use, and waste disposal. It also includes the supply-side resources and technologies used to produce energy, factors and approaches related to energy consumption such as energy efficiency and load control, and information or knowledge about energy resource management.

The coalescence of some of the issues described in Chap. 1, including the increasing recognition of climate change and its negative effects, volatile energy prices, and an increasing focus on energy security and energy access, has raised awareness of the importance of energy policy and planning to preserve economic stability. The potential for massive blackouts (such as those occurring in Northern India in 2012 and California, USA, in 2000 to 2001) due to unreliable infrastructure and the risks that these electrical malfunctions pose to businesses reaffirm the significant connection, if not reciprocal relationship, between energy development and economic growth. Energy policy and planning is also becoming increasingly common not merely as a response to environmental, social, or economic problems, but as an opportunistic market-based approach because energy technologies have significant potential for future marketability.

Like economic development, the shape and form of energy policy and planning depend on the country context. For example, Germany embraced a progressive energy policy platform beginning in the 1970s to improve its energy security, though this evolved into an environmental platform in the 1990s, as well as a later goal of replacing nuclear generation (Runci 2005; IEA 2013a). In contrast, in countries like the United States that have less prominent national leadership on energy and climate policy, besides electricity and natural gas market oversight and alternative energy tax incentives, many state and local entities—both governmental and nongovernmental—have stepped into leadership roles. These entities have initiated efforts to increase diversification of energy sources, increase energy self-sufficiency, or both. Instead of focusing on carbon mitigation policies, many of this energy policy and planning is motivated by economic development objectives in pursuit of "home-grown" energy or as a means of diversification of state or regional economies to improve competitiveness (Rabe 2004, 2008). Many recent state and local energy strategies attempt to gain an early alternative energy market share and profit from future energy developments.

Also similar to economic development, energy policy and planning efforts have become increasingly focused on energy technology innovation, which is defined by Gallagher and her colleagues (2006) as

> The set of processes by which improvements in energy technology, which may take the form of refinements of previously existing technologies or their replacement by substantially different ones, are conceived; studied; built, demonstrated, and refined in environments from the laboratory to the commercial marketplace; and propagated into widespread use (p. 195).

Energy technology innovation focuses on development and deployment of efficient, reliable, advanced, and low- to no-carbon energy technologies, including demand- and supply-side technologies. These technologies are intended to serve one of two roles: (1) replace or enhance conventional energy sources or (2) bypass technologies based on conventional sources to advance technological solutions beyond what is in existence.

Some regions have emerged as "first movers" in terms of energy innovation by testing energy policies and programs that thrust the emerging research and

development into new and highly anticipated growing markets. For example, China has invested significant resources since the early 2000s into their solar technology market, in an effort to develop manufacturers of solar technologies—such as solar photovoltaic panels—that are leaders in global markets. Over the past several years, China has invested more in the renewable energy industry than any other country (Frankfurt School—UNEP Collaborating Centre for Climate & Sustainable Energy Finance 2012). These investments, particularly in the solar industry, have led China to hold a dominant market position, relative to others, in solar panel, wind turbine, and other energy technology markets (Bradsher 2010).

### 2.2.3 Convergence

As these fields continue to evolve, their convergence is becoming more prevalent because of the shift of energy from functioning merely as an enabler to functioning as a driver of economic development. The two disciplines, of course, have shared fundamental connections since the beginning of human and economic development. These linkages are best described through the lens of an "energy ladder" (Barnes and Floor 1996). Toman and Jemelkova (2003) summarize this concept in the following passage:

> … linkages among energy, other inputs and economic activity clearly change significantly as an economy moves through different stages of development … at the lowest levels of income and social development, energy tends to come from harvested or scavenged biological sources (wood, dung, sunshine for drying) and human effort (also biologically powered). More processed biofuels (charcoal), animal power, and some commercial fossil energy become more prominent in the intermediate stages. Commercial fossil fuels and ultimately electricity become predominant in the most advanced stages of industrialization and development … energy resources of different levels of development may be used concurrently at any given stage of economic development: electric lighting may be used concurrently with biomass cooking fires. Changes in relative opportunity costs as well as incomes can move households and other energy users up and down the ladder for different energy-related services (p. 3).

The most basic connection point between energy access, human development, and economic well-being is that energy is a fundamental enabler of basic human needs, such as food, shelter, clean water, transportation, healthcare, and education. Although this the relationship has always existed, in the last two decades the global understanding of the importance of energy as it relates to basic human needs has increased. Accordingly, international donors have intensified their investments at the connection points between energy and human development (UNDP 2005; Nissing and Blottnitz 2010; World Bank 1996).

Energy is also a primary factor of production and a crucial component of every business and economy. Our modern economy rests on the availability of energy—energy for electricity, transportation, production processes, and a variety of other economic needs.

Economic development and energy policy and planning are accelerating with new emphasis because the need for solutions to interrelated social, economic, and environmental problems is becoming more pronounced. It is now becoming common to see economic development initiatives that comprise energy strategies or vice versa. The evolution and current trends in each field demonstrate synergies that support the development and progress in the other and, thus, a greater integration of the two.

In addition to parallels in how the fields have emerged, the goals of each discipline frequently complement those of the other. Energy policy and planning seeks to improve energy self-sufficiency, which can result in the creation of businesses that are unlikely to relocate outside a given region, and increase energy diversification, which can result in the creation of new technologies, businesses, and jobs. Economic development initiatives may seek to catalyze growth through innovation, which can result in increases in energy efficiency or the creation of new technologies that diversify a given region's energy sources.

## 2.3 EBED Goals

EBED activities are driven by simultaneous pursuits of energy and economic goals. We identify ten EBED goals in Table 2.1 and discuss each in turn in the sections that follow. Five goals are under the realm of energy policy and planning and the other five goals under the realm of economic development. Aligning a set of goals from each realm under one framework helps one shape programs, track progress, and report successes and failures. We also reiterate here that what distinguishes EBED from other activities is that EBED efforts always involve the combination of some subset of energy and economic goals.

### *2.3.1 Energy Goals*

#### 2.3.1.1 Energy Diversification

Energy diversification refers to the mix of energy sources that comprises a region's energy portfolio. The concept generally implies a transition away from heavy reliance on one type of energy toward a blend that includes a variety of energy resources. Although it is not always the case that a greater diversity of energy sources is better, it is often the case that exclusive reliance on one energy type is risky. Exclusive or nearly exclusive reliance makes a region particularly vulnerable to price volatility, security threats, weather abnormalities, and other supply disruptions. For example, diversification efforts may target centralized power applications, an increase in the number of and reliance on natural gas power plants, wind turbines, or concentrated

**Table 2.1** EBED goals by discipline

| Energy policy and planning | Economic development |
|---|---|
| Diversify energy sources | Drive industry growth |
| Reduce greenhouse gas emissions and related environmental impacts | Increase innovation and entrepreneurship |
| Increase energy efficiency | Increase regional income |
| Increase energy security | Decrease poverty |
| Reduce energy poverty | Create jobs |

solar thermal facilities. Alternatively, diversification efforts may focus on decentralized power applications, for which a diverse energy mix may include distributed generation units such as solar photovoltaic panels, nuclear modules, natural gas micro-turbines, or combined heat and power systems.

Denmark offers an example of a country that set clear goals to diversify its energy base after the oil shocks of the 1970s. At that time, Danish policymakers and citizens realized that the country was heavily reliant on outside sources for energy and was, therefore, highly vulnerable to fuel shocks. The Danish were also becoming increasingly worried about the GHG emissions associated with their heavy dependence on foreign fossil fuels. As a result, the Danish government set a goal to operate entirely off renewable sources by 2050. It expects to be one-third of the way there by 2020 (Moss 2012). The Danish have diversified their energy mix through an increase in large-scale wind energy and biomass plants, coupled with energy efficiency measures, behavior measures, and a push for electric vehicles in the transportation sector.

#### 2.3.1.2 Reduce GHG Emissions and Related Environmental Impacts

As discussed in Chap. 1, GHG emissions from energy use are a major contributor to the average warming of the climate system and a major contributor to other emissions to air and water pollution. Reducing emissions from electricity, industry, transportation, and household use in both developed and developing countries is a critical goal for energy policymakers and planners. Increasingly, the implications of warming global temperatures are being examined across disciplines such as health, economics, and governance so that planning efforts can accommodate anticipated changes resulting from climate change. For example, as air quality diminishes, especially in urban areas, efforts to mitigate and adapt to the pollution are becoming standard local government functions.

Cities and countries alike are embracing EBED policies and programs that aim to reduce emissions, particularly GHG emissions but also including other forms such as sulfur dioxide, nitrogen oxides, particulate matter, and mercury. Examples include the national government in South Africa through its SARi and the European Union's commitment to reduce its GHG emissions by 20 % of 1990 levels by 2020 through an emissions trading scheme, renewable energy standards, energy

efficiency measures, carbon capture, and reduced emissions from vehicles (European Commission 2013). As yet another example, Jakarta built a bus rapid transport system that relies on a combination of diesel and compressed natural gas (CNG) to service an estimated 39 million riders (C40 Cities n.d.). This transport system has the potential to increase mass transit and reduce $CO_2$ emissions by replacing petroleum with CNG.

#### 2.3.1.3 Energy Efficiency

The goal of energy efficiency is to use less energy to achieve the same purpose. Energy efficiency efforts generally encourage energy consumers (i.e., households, businesses, and governments) to use less energy to receive the same level of energy output. Energy efficiency, which fits under the umbrella of demand-side management more generally, involves lighting, heating, and cooling. Efficiency efforts may also focus on energy-generating technologies, where the technology is improved to use less fuel inputs to generate energy outputs, or transmission technologies, where less power is lost through the electrical transmission and distribution process. Finally, efficiency is possible in the transport sector through refinements to the internal combustion engine or the introduction of other innovations such as electric vehicles.

Efficiency improvements offer several benefits. First, assuming that the cost of improving the efficiency of some good is less than the savings associated with reduced energy use, efficiency efforts save money, which can then be applied toward other goods, services, or development opportunities. Second, a reduction in energy consumption directly translates into a reduction of GHG emissions and other environmental pollutants, although the amount of decrease depends on the energy resource that powers the good. Third, improved electricity efficiency can reduce grid congestion and thereby save money on grid management and new energy construction.

The improvement of energy use or technological efficiency supports other energy-related goals as well. For example, if a country or individual uses less energy, assuming no rebound effect,[2] the result will be reduced GHG emissions and potentially enhanced energy security and less pressure to diversify its energy base.

A variety of energy efficiency programs are being deployed across the world, in both the public and private realms and at both national and local levels. These activities include the incorporation of energy efficient materials and products in standard building operations (e.g., light-emitting diode [LED] light bulbs, double-insulation window panes, or recycled stone, metals, industrial materials, and other

[2] A rebound effect is when someone uses more energy as a result of consuming a more efficient product. For example, if one buys a conventional hybrid vehicle with a much higher miles-per-gallon rating than his or her previous vehicles, then the amount spent on gasoline may decline. As a result of paying less to fill the tank, he or she may actually drive more miles than before.

"green building products") or methods such as smart-controls or targeted maintenance. These types of energy efficiency activities have the potential to reduce energy use and costs to businesses and residents for heating, cooling, and power. As a more concrete example, the rapidly growing city of Abu Dhabi is pushing the limit of water and electricity use as it continues to develop. The government understands that it must focus on conservation as it considers new production capacity and, as a result, is working to evaluate the country's demand for water and electricity and eliminate inefficient uses of these resources to save money and extend power and water supplies (RTI International 2013).

#### 2.3.1.4 Energy Security

Energy security is defined as the ability to access reliable, affordable, and diverse energy (UNDP 2004), and it generally is conveyed in a strategic context at the national level. The IEA defines it as "the uninterrupted availability of energy sources at an affordable price" (IEA 2013b). The concept of energy security is far-reaching and includes aspects that are difficult to price or quantify such as reliability, affordability, and national safety. Energy security refers to geopolitical circumstances that do not compromise the integrity or safety of a nation, the quality delivery of energy services, and the use of diverse energy resources. Those countries that seek energy security aim to have a healthy energy mix and avoid overreliance on either any particular resource or nation.

It is difficult to predict the potential benefits associated with improving energy security, but these benefits are positive in that they give countries more autonomy and independence from other national governments, assuming that it does not come at the expense of reduced economic activity in global markets. Improving the reliability of national infrastructure or access to basic modern energy or reducing the vulnerability of a nation to foreign policy threats, for example, is indubitably important to all nations.

Denmark's bold goal of 100 % renewable energy by 2050 is an example of a country embarking on long-term plan for energy security. Denmark is making significant investments to shift its infrastructure and incentivize renewable energy industry development. The country is investing significantly, for example, in energy storage, distributed grid systems, and electric vehicles. Some countries are also pursuing energy security goals through natural gas extraction within their borders. For example, Russia stopped supplying natural gas to the European pipeline in the Ukraine in January 2009, one of the coldest times of the year in Europe. As a result, 20 countries in Europe had significant shortages of natural gas (MSNBC cited in Rao 2012). To respond to energy security issues such as this, Poland, for example, is developing regulations to promote the extraction of 70 years' worth of natural gas that could theoretically lower dependence on Russian gas (Moss 2012; Speak 2013).

#### 2.3.1.5 Energy Poverty

Increasing access to energy is a means to reduce energy poverty. As discussed in Chap. 1, energy access is crucial for households and individuals and also for entire industries and businesses. Energy access allows school children more time in a day to study and write, members of a household time and resources to cook, and those within the medical profession the resources to provide quality medical care. Thus, energy poverty has deep implications for social development. Businesses, including industrial businesses, also need reliable, readily available, and affordable energy to run their operations. Some industries need to locate near affordable energy sources. For example, industries that run large computer server operations, such as Google, tend to locate these functions in temperate locations with readily available and affordable energy access (Bruns 2012). Electricity interruptions for these businesses are detrimental to their core services. Schools, households, hospitals, and manufacturers also need access to energy.

Energy access is so fundamentally important to basic human development and the development of nations that many countries have set national goals to achieve universal energy access. China and India, for example, both have universal energy access goals (Wang 2009; Ministry of Power, Government of India 2005). These goals can be reached through the provision of modern electricity access, either via the electrical grid or small-scale distributed applications that provide localized electric loads. Other ways to reduce energy poverty include cookstove programs that use energy efficient and cleaner sources of fuel for household cooking, rather than simple biomass, dung, crop residues, or charcoal. Woody biomass and these other resources tend to increase indoor air pollution, deplete local forests of trees, and consume a disproportionate share of women's time in the household for wood collection (Ezzati and Kammen 2002). Low-cost solar lanterns distributed to households and schools are another example of how low-emissions energy sources are being used to increase energy access.

### *2.3.2 Economic Development Goals*

#### 2.3.2.1 Increase Industry Growth

Regions, localities, and countries typically seek ways to expand their existing industry base and transition it into an emerging, globally competitive industry of the future. Diversifying a place's economic base reduces the overreliance on one or a few sectors and, in turn, reduces susceptibility to economic cycles or massive closures within those sectors. Industry growth is important to economic developers because the benefits from it spill over into other economic development goals. As industries grow, typically jobs and income to households and government jurisdictions also expand and generate more wealth for an area, which can fuel a positive cycle of growth and expansion. Industry growth goals in economic

development are closely intertwined with goals to increase income and jobs, other economic development goals described later in this section. The rise of national economies in Southeast Asia is often cited by development economists as examples of countries that have launched themselves through industry growth into globally competitive markets and reaped the subsequent economic benefits (Amsden 2001; Wade 1990).

Industry growth efforts aim to reduce costs and improve information exchange and coordination between businesses within an industry and between business and government, respectively. The North Carolina Biotechnology Center, located in North Carolina, USA, is an organization established to lead an industry growth strategy. This initiative is supported by state government and houses an industry library, provides grants and loans to companies, and serves as a liaison office to government officials to strengthen understanding of the industry and its needs for growth by state leaders. Taiwan offers an example of an industry strategy that set out to reduce cost barriers for an emerging industry. Taiwanese officials sought to diversify its agriculture industry from sugar to orchid production. The government invested $65 million in supportive infrastructure such as a genetics laboratory, shipping and packing facilities, roads, quarantine facilities, water and electricity hook-ups, and low interest credit to farmers (Rodrik 2007, p. 104 citing Bradsher 2004, p. A1).

Efforts to boost R&D, innovation, and entrepreneurship in emerging sectors are also strategies that support industry growth. The city of Pittsburgh's Alpha Lab is a business incubator that fosters entrepreneurship and business growth in software applications. It coordinates entrepreneurs and investors in this sector and provides low-cost space and grants to promising start-up companies, and it aims to lay the foundation for a globally competitive software industry of the future.

#### 2.3.2.2 Increase Income

Increasing income is closely related to industry growth. Investments to boost industry expansion include attracting foreign direct investment (FDI) and increasing exports to generate more income for a country or a locality. Strategies to increase GDP, FDI, or a local tax base are all examples of ways to increase a place's revenues. More income allows for greater investment in infrastructure, education and training, public health, and quality of life, all factors that propel further economic development. For example, Taiwan and South Korea became "export platforms" in the 1960s, as Wade (1990) describes as "importing capital and intermediate goods, adding further processing with cheap labor, then exporting" and have become "highly integrated economies, moving speedily into high-wage, high-technology activities" (p. 42).

Countries often use a suite of policies and regulations to increase income, ranging from export incentives, marketing and recruitment, import controls, tariffs, industry protection, foreign exchange and exchange rates to export processing zones. Somewhat related, but on a smaller scale, localities use different techniques

to attract income to their region. Business and industry recruitment strategies are approaches used by officials to site a company outside of their region to their jurisdiction. Tax and finance schemes such as enterprise zones or tax increment financing are techniques local economic developers employ to revitalize or incentivize investments to targeted areas. Reduced taxes or favorable financing mechanisms are used to reduce overall costs to an individual company to attract several of them to colocate, thus generating an increase in overall income to a jurisdiction (Eisinger 1998). We discuss some of these financial mechanisms in more detail within the industry policy discussion in Chap. 4.

#### 2.3.2.3 Increase Innovation and Entrepreneurship

Innovation and entrepreneurship are increasingly used as ways to transform economies from low-cost and low-wage to higher value-added types of production or distribution of products. Innovation rests on businesses pushing new technologies, products, or processes to markets. Innovation involves scientific or other discoveries that companies can use to expand a business line or start an entirely new line of business. Innovation can also lead to modifications of the business model itself. In recent years, this approach to innovation has expanded to a focus on economic development on innovation ecosystems, which includes interactions between actors and institutions as part of the innovation growth process.

In advanced economies, innovation tends to be closely linked to sophisticated technology development, but it has broader connotations in less developed economies. The World Bank stresses that innovation is not just linked to technology; it is something new that can readily be diffused to a region or country in which it appears that can create jobs and wealth or improve welfare (World Bank 2010, pp. 10–11 and p. 54). Innovation is "technologies or practices that are new to a given society … not necessarily new in absolute terms" (2010, p. 4).

A mobile payment system based in Kenya, M-PESA, is an example of a successful innovation adopted at a large scale. This software application, which literally translates to "mobile money," allows people to transfer money by text message on their cell phones. This technology has revolutionized how Kenyans conduct their business and personal finances. According to *Bloomberg Businessweek* magazine, over 14 million Kenyans, or approximately 70 % of the country's adult population, have an M-PESA account (Greeley and Ombok 2011). M-PESA has increased access to finance, increased financial security, and enhanced benefits of business-to-business transactions by improving communication of market information and timeliness of payments between businesses. In addition, this service has allowed Kenyans to send or spend money for other purposes as well, such as for shopping, utility bills, taxi rides, or distant relatives (Graham 2010).

Innovation and entrepreneurship are linked: as new ideas are turned into innovations, these innovations need a business model and enterprise to help launch them into markets so that they can be widely disseminated. Somewhat distinct from innovation, entrepreneurship is also often viewed as a means for countries

and localities to create their own employment opportunities and generate local income by "growing their own" market needs with local businesses and enterprises.

China's rural township and village enterprises (TVEs) offer a unique example of entrepreneurship strategies that played a key role in helping a country modernize. Throughout rural China, TVEs are small enterprises, either collectively owned by local residents or the government, that have significant local autonomy and strict budget constraints. These enterprises are credited as playing a significant role in Chinese economic development since the late 1970s, accounting for up to 19 % of average annual real growth rates from the late 1980s to 1990s; in 2000, estimates are that these enterprises accounted for as much as 47 % of total industrial output for that year (Fu and Balasubramanyam 2003, p. 27).

Another example of an entrepreneurship support organization is Techstars, which is one of the world's largest business accelerators. This program pools venture and angel investors to support entrepreneurs in their quest to take innovations to market. With an investment from Techstars of approximately $118,000 in start-up capital and business mentoring for each start-up, these companies then average $1.6 million in outside venture capital, raised after they exit the entrepreneurship support program (Techstars n.d.).

#### 2.3.2.4 Job Creation

Job growth is often considered the ultimate endgame for economic developers. Employed workers that earn fair wages tend to make for more stable societies. Politicians, policymakers, advocates, and civic leaders of all backgrounds tend to seek ways to create jobs so that their populations benefit from greater stability. This goal is perhaps the most cross-cutting in that it is often the result when other goals are met. Job creation becomes a top priority among economic development goals in places with significant unemployment, experiences in sharp economic downturns, or mass lay-offs within a critical industry base.

Job creation strategies generally focus on immediate or medium-term ways to create employment opportunities so that individuals have the means to earn income gainfully to support themselves and their families. Job creation efforts are divided into two camps: those that generate employment and those that increase the employability of workers (Karnani 2009).

In times of economic crisis, governments often invest in large public infrastructure projects as a means to create immediate and large numbers of jobs to have a noticeable and significant impact. In the recent global recession, many countries used this tactic within their self-prescribed stimulus packages or applications to development banks. For example, in late 2008 Armenia requested funds from the World Bank to help the country weather the economic shocks from the global financial crisis. Sharp declines in GDP, FDI, and employment coupled with increases in poverty forced the country to apply for emergency funds to immediately begin a road improvement project of over 100 km. The resulting project

was estimated to create 7,600 person-months of temporary jobs (Ishiria and Bennett 2010, pp. 1–2). Although not a long-term fix, these kinds of solutions help keep incomes and families afloat until the economy recovers. As a different example, during the recent recession in the United States many government-sponsored energy efficiency buildings programs were as much an effort to employ laid-off construction workers in rural and urban areas as an effort to increase energy efficiency.

A second type of job creation strategy is workforce training or mechanisms to enhance employability of the unemployed or underemployed. Education that helps workers retool their skillsets for jobs in newly competitive industries occurs in places where mid- or late-career workers are caught in an economic adjustment, where the techniques used are not in line with competitive industry practice. Youth employment is also an area of focus for job creation strategies. As of 2013, 290 million or a quarter of the world's youth—defined as 15- to 24-year-olds—are neither employed, in school, or in a formal training program (*The Economist* 2013). Efforts to address this epidemic typically focus on bridging the skills gap between what is taught in school and what business and industry need. Vocational and technical schools and industry-based training programs typically are used to help boost skills training in unmet demands. Examples range from South Korea's government-sponsored vocational "meister" schools for machine operators and plumbers to IBM's training school established in New York. A newly planned community outside of Ramallah in the West Bank aims to address this skills gap through virtual employment of its workers in its information technology hub, with international companies serving as a sort of "on-the-job training" for the well-educated but underskilled workforce there (Lawrence et al. 2009).

#### 2.3.2.5 Reduce Poverty

Similar to job creation, poverty alleviation is often an underlying goal for most economic development strategies and of course closely tied to job creation and income generation goals. Efforts to boost incomes either for companies, governmental jurisdictions, households, or workers all ultimately aim to generate wealth. Greater wealth in the form of income and assets improves a locale's ability to invest in physical infrastructure (e.g., roads, ports, water, broadband Internet, and education and training) and a household's or individual's ability to pursue personal investments (e.g., healthcare, education, safe environment, and transportation). In regions marked by impoverished conditions, more resources to make infrastructural and personal investments help facilitate an environment that allows individuals to succeed and create economic opportunities and thus break the cycle of poverty.

A significant number of policies and programs aim to reduce poverty, many of which are deeply researched and highly debated in terms of their effectiveness. These policies and programs range from childhood malnutrition and maternal and child health programs, basic road construction, water and sewage infrastructure to

microcredit programs that help families access affordable credit to generate income through entrepreneurial activities. Given that antipoverty efforts are so sweeping in nature, for the purposes of this book, we focus on efforts targeted more specifically at increasing income and wealth for households or individuals.

Employment and training programs for disadvantaged youth in urban slums are an example of a poverty reduction program. Funding support to help reduce the opportunity costs of young girls going to school and free or reduced-cost health-care clinics are other examples of antipoverty programs.

## 2.4 Conclusion

EBED has several distinguishing features, the most prominent of which is its focus on advanced, efficient, and low-emissions energy. EBED is different from related disciplines in that it pursues joint energy and economic development goals, as outlined in the chapter above. It involves a more comprehensive and diverse set of actors, champions, and beneficiaries as a result of the more dispersed nature of the energy resources EBED supports. EBED also offers researchers and practitioners an integrated framework to align what are often considered disparate goals into a unified approach. Finally, EBED recognizes the role of governance, leadership, and stakeholder models in shaping its success.

EBED is a direct extension of the energy planning and economic development disciplines. As both founding disciplines have evolved through the years, a number of synergies in practice and objectives have emerged that mark the nexus of the EBED domain.

In the following chapter, we describe the process of designing, implementing, and evaluating an EBED program.

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