



Are low carbon cities attractive to cleantech firms? Empirical evidence from a survey



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ARTICLE INFO

Keywords:

Low carbon cities
Cleantech firms
Location preferences

ABSTRACT

This paper explores the business attractiveness of low carbon cities using a survey on cleantech firms. The results show that cleantech firms indicate neutral interest in developing physical presence in low carbon cities, even though they perceive positive effects of low carbon urban features on resident productivity and health. Business conditions that affect operating costs tend to have greater influences than market access factors, which are associated with the supply and demand of factors of production, on firms' decisions to relocate to low carbon cities. Conventional policies such as intellectual property rights protection and the development of intellectual clusters remain critical in incentivizing research and development in low carbon technology in low carbon cities. In summary, the low carbon features of a city do not appear to have major advantages in attracting cleantech companies. The diffusion of low carbon cities is likely to be driven by public environmental policies rather than corporate demand in the near future.

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1. Introduction

The development of low carbon cities is an important component of the solutions required to mitigate climate change. Despite the environmental benefits, financial feasibility remains a key concern in the development of low carbon cities. This paper analyzes the business attractiveness of cities with low carbon features through a survey that investigates the perceptions of cleantech firms about developing physical presence in low carbon cities. We identify the factors that contribute to the attractiveness of low carbon cities as business locations, and the policies that may induce research and development (R&D), a low carbon activity in low carbon cities. The results of the analysis will help formulate feasible strategies toward the development of low carbon cities.

Cities are major sources of greenhouse gas (GHG) emissions. The International Energy Agency estimates that urban areas account for 71% of energy-related global GHG emissions, and the figure is expected to rise to 76% by 2030 (International Energy Agency, 2008). To avoid the adverse effects of climate change, immediate actions are needed to reduce GHG emissions from cities. While policymakers are urged to decide on "... major decisions today about building low-carbon cities with compact urban designs, good public transport, efficient buildings and clean vehicles" (World Bank,

2010), the private sector must be incentivized to develop business activities in low carbon cities to secure economic and environmental sustainability of the climate change mitigation effort.

There is no universally agreed definition of the "low carbon city" in the literature. Baeumler, Ijjasz-Vasquez, and Mehndiratta (2012) suggest that "definitions of a low-carbon city should above all focus on how cities change their carbon emission trajectories independent of their initial carbon endowments, but in ways that do not compromise economic development and livability." Tang (2011) suggests that low carbon cities are cities that deploy advanced environmental and resource management in order to enhance energy efficiency and reduce fossil fuel consumption. Although the definition of "low carbon city" is obscure, the benefits of low carbon cities have been examined in several studies. For instance, Frumkin, Frank, and Jackson (2004) show that low carbon cities tend to have better air quality, which positively affects human health as it lowers the risks of respiratory illnesses, impaired cardiovascular functions, and cancer. Green buildings deployed in low carbon cities may reduce energy and water consumption and improve resident productivity and health. For instance, a building certified as a Platinum building by the Leadership in Energy and Environmental Design (LEED) program has been shown to be able to reduce energy consumption by 42% and water use by 34% during its first year of operation (Lockwood, 2006). Meanwhile, productivity and health may increase by 1% in Certified and Silver-level buildings and by 1.5% in Gold- and Platinum-level buildings due to better working conditions as measured by indoor air quality, thermal comfort, and lighting (Kats, 2003). Low carbon transport has been shown to

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produce economic, social, and environmental benefits (Litman, 2010). Economic benefits can be generated through decreases in traffic congestion, commuting costs, and traffic accidents; social benefits may come from better equity, human health, social cohesion, and social livability. Meanwhile, decreased air, noise, and water pollution, as well as reduced habitat loss improve the environment. Walkability promoted in low carbon cities stimulates not only social networking and interactions, but also improves health and productivity. This improved productivity can be measured by decreases in absenteeism, impairment of daily activities, and disruptions of social work or family life (Hertz, Unger, McDonald, Lustik, & Biddulph-Krentar, 2004; Pronk et al., 2004; Rodbard & Fox, 2009; Tucker & Friedman, 1998).

Despite potential environmental and socioeconomic value-added associated with a low carbon city, empirical knowledge on business development in a low carbon city remains limited (Gouldson et al., 2012). As a result, the development of effective strategies to overcome the socio-economic costs associated with a new low carbon city development or the transition of existing cities to low carbon cities remains a difficult task. This paper takes one of the first steps to fill this intellectual gap by investigating the perceived benefits, real interests, and decision factors for cleantech firms to develop business presence in low carbon cities. While low carbon cities can be ideal destinations for any low carbon components of industrial sectors, discussions with Masdar City of the UAE and Eco World Styria of Austria showed that these cities in particular, and other low carbon cities in general, are interested in attracting cleantech companies to operate in these cities. It is believed that a business-friendly environment in low carbon cities for cleantech firms will further mobilize the development and deployment of cost-efficient low carbon technologies for urban systems. Since the development of the cleantech sector has been characterized by a high level of dependency on regulatory drivers (as this industry is still in a rather immature stage), and also because of the large cost difference between conventional and new-energy technologies (driven by high levels of subsidization of conventional fuels), it is expected that policies may play a critical role in attracting cleantech firms to low carbon cities.

Through a literature review and a series of preliminary discussions with representatives from cleantech firms, a survey was designed to investigate the interest of cleantech firms in developing physical presence in a low carbon city, and to identify effective policy initiatives to mobilize the development of this business sector in such locations. The survey starts by examining cleantech firms' perceptions regarding effects of low carbon city features on inhabitants' productivity and health and operating costs, as well as their interests in opening up new branches in a low carbon city. It then analyzes decision factors for cleantech firms contemplating such choices. Two groups of factors have been identified as the decision factors for branch development in low carbon cities: (1) market characteristics of the location as determined by the proximity or access to customers, suppliers, and factors and costs of production, and (2) business conditions, as reflected by governmental support such as tax exemption, as well as other incentive policies.

Finally, the survey identifies key decision factors for cleantech firms to move R&D activities to low carbon cities. As one of the first steps to identify major policy alternatives for decision makers to focus on, we consider factors such as intellectual property protection, cooperation with research institutions, close proximity to intellectual cluster and industrial park, and availability of consulting services in market research and product development. The paper is structured as follows. Section 2 provides a theoretical and empirical literature review of business location preference and cluster emergence. Section 3 describes the design of the survey and data characteristics. Section 4 analyzes the data. Section 5 concludes the analysis.

2. Literature review

The literature review focuses on the theories and empirical evidence on business relocation preferences and cluster development. While business relocation preference literature provides information on factors that affect a firm's business expansion strategy, cluster development literature sheds light on the firm's decision about location of R&D activities. The pertinent features of low carbon cities are presented to lay the foundation of the hypotheses for testing.

2.1. Location theory and empirics

Brower, Mariotti, and Ommeren (2004) defines two forms of business relocation: complete and partial relocation. While complete relocation refers to a movement of a company or business unit from one location to another, partial location is defined as an establishment of a new business unit in a new location without eliminating the pre-existing unit. The term "relocation" used in this paper refers to both forms of relocation. Rationales for business relocation are conventionally explained through the lenses of three key theoretical paradigms (Brower et al., 2004; Hayter, 1997). The *neoclassical theory* assumes that rational agents with perfect information relocate to maximize profits. Economic factors such as labor costs and market size are therefore key forces that affect the incentives of business relocation. In contrast, the *behavioral theory* presumes boundedly rational agents operating under imperfect information. Non-linear relocation costs due to path dependency may create disincentives for business relocation. Internal factors such as firm age and firm size are therefore critical in determining the attractiveness of business relocation. The *institutional theory* expands the neoclassical theory by incorporating factors related to economic relationships (customers, suppliers, rivals, unions, etc.). It assumes that cultural norms and social institutions play significant roles in shaping economic relationships. Locational preferences of the firms are the results of the relationships with suppliers, customers and other institutions (e.g., the government and the unions) that could affect the key production process of the firms. The institutional approach takes into account the environment in which the firm operates as well as the firm's own characteristics.

Empirical studies on business relocation highlight the importance of various factors pertinent to neoclassical, behavioral, and institutional theories, including internal (e.g., firm size, firm age, previous migration), external (e.g., market size, government aid) and origin-related factors (Artís, Ramos, & Suriñach, 2007; Brower et al., 2004; Dijk & Pellenbarg, 2000; Holl, 2004; Pennings & Sleuwaegen, 2000; Rasmussen, Jensen, & Servais, 2011). Most of the studies agree that one of the internal factors, firm size, has a negative effect on the willingness to relocate (Artís et al., 2007; Brower et al., 2004; Dijk & Pellenbarg, 2000). For instance, the study by Artís et al. (2007) of EU firms finds that the firms with less than 30 employees have higher willingness to relocate than bigger firms in the context of job destruction. A study by Brower et al. (2004) considering 21 countries finds that firms with more than 1500 employees have lower willingness to relocate than smaller firms due to the higher costs incurred by larger firms as a result of site relocations and employing larger numbers of new employees, compared to smaller firms. Dijk and Pellenbarg (2000) also find a negative effect of the firm size on firms' willingness to relocate based on the data for Dutch firms, due to the lower costs of moving and similar organizational problems for smaller firms.

Other internal factors such as firm age and previous relocation are negatively related to the likelihood to relocate (Brower et al., 2004; Pellenbarg, van Wissen, & van Dijk, 2002), as older firms tend to be more rooted in their spatial environment and previous relocation reduces the necessity to relocate again. In terms of

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