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Regional Graphic

# The geography of green technology licensing in China

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## ABSTRACT

Heatmap techniques are used to visualize the geography of green technology license agreements in China. The map is based on unique patent and licensing data, linking regional technology development (licensors) to regional technology adoption (licensees), thus allowing the study of diffusion patterns of green technologies. It highlights the fact that most green technology license agreements are concluded within the same region, which is often neglected when studying diffusion processes from a network perspective. Heatmaps allow a better interpretation of network data, in particular for networks with many loops when compared with classical network visualizations.

KEYWORDS:

green technology | eco-innovation | sustainability transitions | China | heatmap

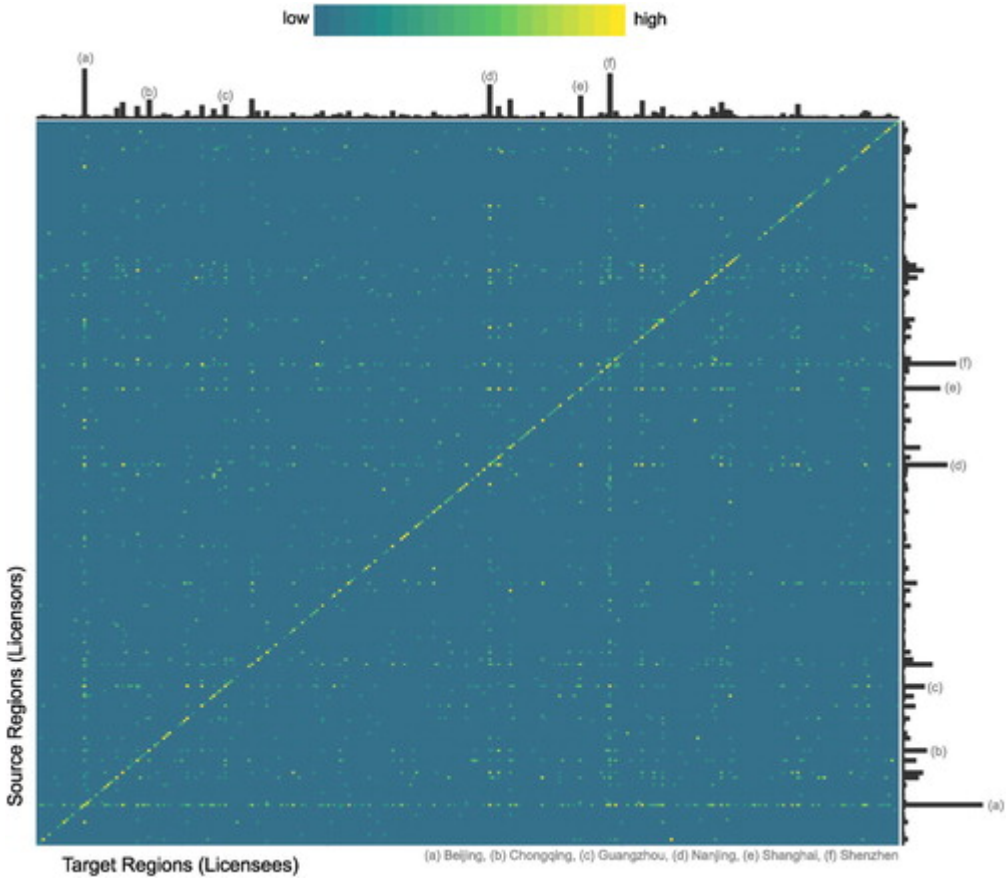
JEL CLASSIFICATIONS:

O33 O34 R11 R12

The adoption of green technologies is crucial for tackling climate change and offering solutions to resource depletion and further environmental challenges. While there is a growing body of literature on the geography of green technology development (Barbieri et al., 2020), research on adoption and diffusion is scarce. This regional graphic provides information on the geography of license agreements for green technology patents in China, highlighting the importance of intra-regional diffusion processes.

A license agreement is a contract between a licensor (patent owner) and a licensee who is authorized to make use of the technology. Licenses thus allow the measurement of both innovation development and innovation adoption. The data underlying this graphic was retrieved from IncoPat, a Chinese patent database listing license agreements. Green technology patents were identified using the ENV-TECH classification (Haščič & Migotto, 2015). A geocoding process was then employed to regionalize the licensor and licensee addresses to the prefectural level, resulting in a data set of 9396 license agreements for 8565 patents. To be specific, licensor addresses from the patent documents were geocoded using the open-source GeoNames database, while licensee names (e.g. firms, universities) were used to obtain locations via Google Maps and Baidu Maps API queries. In a final step, licensors and licensees were aggregated to 294 prefecture-level regions. Based on the regional information for licensor–licensee linkages, a directed asymmetric adjacency matrix A with the dimensions $294 \times 294$ was constructed, with cells $a_{ij}$ indicating the number of licensed patents from source region (licensors) i to target region j (licensees). This data representation allows a detailed study to be made of the diffusion of technologies, which is usually done in network visualizations (Gui et al., 2019). However, this often leads to neglecting the importance of intra-regional licensing. In fact, about 57% of all license agreements for green technologies are concluded intra-regionally, leading to a relatively sparse network of diffusion. The share of intra-regional licensing, however, differs between regions (e.g. Guangzhou, 43%; Shanghai, 49%; Nanjing, 54%; Beijing, 51%; Shenzhen, 70%; and Chongqing, 82%) (Figure 1).

Figure 1. Heatmap of the region-to-region adjacency matrix for green technology patent license agreements. Note: A high number of license agreements is indicated by a lighter colour (log scale). Bars indicate the number of licensors (right) and licensees (top) per region. Licensing data was retrieved from IncoPat (www.incopat.com); the graphic was created in R using the superheat package (Barter & Yu, 2018). Licenses with commencement dates ranging from 2008 to 2019 were used; design patents were excluded.

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Heatmap visualization techniques help to analyze network loops in that respect, while (spatial) network visualizations often lead to an overestimation of the value of interregional linkages (e.g. Gui et al., 2019). This regional graphic adds to the literature by arguing that knowledge diffusion via license agreements relies on geographical proximity and established local collaborations (Bidault & Fischer, 1994; Seo & Sonn, 2019). Moreover, the findings support arguments for regional specificities of sustainability transitions, as the development and adoption of green technologies often seems to occur within close geographical boundaries (Hansen & Coenen, 2015).

## DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author.

## Additional information

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