Context matters to smart energy communities: Local features of Hong Kong, Seoul, Bristol and Nairobi

Daphne Ngar-yin Mah [a,b];
Aijia Wang [a];
Wing Kei Cheung [a,b]
[a] Department of Geography, Hong Kong Baptist University
[b] Asian Energy Studies Centre, Hong Kong Baptist University

The role of the city in undertaking smart energy transitions is critical, as these cities can develop city-based planning (Hodson & Marvin, 2010) and provide sites for smart energy transition activities (Mah, 2019). Besides, the community also plays a critical role in providing an arena for individual engagement in energy activities. This paper aims to introduce the specific city context of smart energy transitions from an Asian-European-African perspective, and four cities (i.e., Hong Kong, Seoul, Bristol, and Nairobi) are selected to represent the development of smart energy transitions.

Table 1. An overview of four case cities and their community

City (Country)	Hong Kong (China)	Seoul (South Korea)	Bristol (UK)	Nairobi (Kenya)
Population by city	7,472,600 (2022)	9,976,0000 (Q4 2022)	472,400 (Q2 2021)	53,330,978 (mid-2025)
City GDP (billion US$)	369.2 (2021)	358.83 (2021)	20.63 (2020)	29.36 (2023)
Global rank of GHG emission by country (2024)	1st	15th	24th	56th
Total GHG emissions by country (2024)	15536.10 MtCO2e	668.25 MtCO2e	386.70 MtCO2e	102.84 MtCO2e
Electricity mix by country	In 2023 Coal (61.3%) Hydro (13.5%) Wind (9.3%) Solar (6.1%) Nuclear (4.6%)	In 2024 Coal (32.6%); Natural Gas (24.9%); Nuclear (31.1%); Solar (5.5%); Oil (1.1%)	In 2024 Natural Gas (30.3%); Wind (29.5%); Nuclear (14.2%); Biofuels (12.2%); Solar (5.2%) Waste (3.7%) Coal (0.9%)	In 2024 Geothermal (43.2%); Hydro (28.3%); Wind (14%); Oil (8.8%); Solar (3.6%); Biofuels (2.1%)
Electricity market liberalisation status (●completely liberalised; ◖partially	○ (no liberalisation; vertical monopolised utilities)	◖ (generation liberalisation)	●	◖ (generation liberalisation)

liberalised; ○ null)				
Case communities	Fairview Park: 5,000 flats high income low-rise housing estate with rich solar resources Local contexts: the introduction of renewable feed-in tariff policy in 2018 has scaled up solar houses alongside the utilities' smart meter rollout plans to be completed by 2025	Sungdaegol: A new initiative on local P2P energy trading platform; active energy cooperatives promoting solar prosumption Local contexts: Grassroots prosumers' community in suburban Seoul supported by city government; WATTMALL, a community-based energy trading market (a social enterprise)	Easton: - Poor urban environment - an old neighbour that has aspired to develop solar as an approach to alleviating poverty	-

Sources: Bristol City Council. (2021, 2022); Bristol Energy Network. (2022); Census and Statistics Department HKSAR. (2022); International Energy Agency. (2020); Macrotrends. (2023a, 2023b); Office for National Statistics. (2022); Our World in Data. (2019); Statistics Korea. (2021); Trading Economics. (2022); BP (2022); Our World in Data (2023); International Energy Agency (2023);CCI (2023); Copenhagen Energy Centre on Energy Efficiency (2023); (European Commission, 2025); (IEA, 2025a); (KNBS, 2024)

1. Hong Kong

China was the world's largest emitter of GHG emissions, reaching 13,710,64 MtCO2e in 2021 (Our World in Data, 2023). China mainly relied on coal-based electricity generation, reaching a high proportion of 62.56% in the total electricity generation (BP, 2022). Meanwhile, China was also the major driver of development of renewable energy, accounting for 36% in solar and 40% in wind of the global capacity additions (BP, 2022).

Electricity market-oriented reform has begun since 1980s in China, while the reform was incomplete as the two state-owned enterprises (i.e., State Grid Corporation of China and China Southern Power Grid) still represent the main market share. Hong Kong's electricity market is also dominated by two electricity companies, HK Electric and CLP.

Hong Kong government has been actively releasing a series of documents (e.g., Hong Kong's Climate Action Plan 2030+, Hong Kong's Climate Action Plan 2050) to combat climate change and achieve carbon neutrality. In 2018, the introduction of renewable feed-in tariff policy aimed to promote the use of solar and renewable energy at the residential sector. Community engagement was thus given more attention on practicing these energy initiatives. For example, Fairview Park in Yuen Long District, which is a low-density community with substantial solar resources, show great potential in driving energy transitions through engaging in solar generation and renewable energy system.

2. Seoul

The GHG emission in South Korea reached 659,40 MtCO2e in 2021, ranked 13rd globally (Our World in Data, 2023). South Korea's electricity generation was characterised by the dominance of fossil fuels (International Energy Agency, 2020). Its electricity market was partially liberalised, it liberalised in the generation and transmission while the retail was still monopolised by the Korea Electric Power Corporation (KEPCO).

Seoul, the capital of South Korea, recorded the population of 9,976,0000 as of 2022 and city GDP of USD$ 358.83 billion in 2021. Sungdaegol is a representative energy self-reliant community in Seoul, enabling energy cooperative for local peer-to-peer solar energy trading. The prosumer energy community program with engagement by grassroots was supported by the city government. WATTMALL, a community-based energy trading market, enabling citizens to develop and provide energy by their own (The Seoul Institute, 2018).

3. Bristol

Bristol is located in Southwest of the UK with a population of 472,400 in 2021 and a GDP of USD$ 20.63 billion in 2020. It ranked 23rd of the global GHG emission, and the electricity generation mainly replied on Natural Gas (40.08%) and Renewables (37.72%) (BP, 2022). Bristol has set a target of carbon neutrality by 2030, implemented Bristol's One City Plan and signed the UN-wide climate change mitigation commitment (Michalec et al., 2019).

The electricity market in Bristol is fully liberalised with engagement of diversity of stakeholders including local governments, energy supply companies, communities, and non-governmental organizations (Chitchyan & Bird, 2021). Easton, the east of Bristol city center, remains poor urban environment and fuel poverty challenges, showing great potentials on engaging community in solar initiatives to alleviate poverty.

4. Nairobi

Nairobi is the capital and largest city of Kenya. The city population of Nairobi was 53,330,978 by mid-2025, the City's GDP was USD 29.36 in 2023. Kenya was ranked for the 56th in the global rank of GHG emission in 2024 with 102.84 MtCO2e (European Commission, 2025). The major electricity mix in Kenya in 2024 relied on geothermal (43.2%), hydro (28.3%), wind (14%), oil (8.8%), solar (3.6%) and biofuels (2.1%) (IEA, 2025a).

Kenya seeks to achieve carbon neutrality by 2050 through a series of targets, including reducing emissions by 23% by 2025 and 66% by 2050 (Johnson, 2023). The electricity market in Kenya is partially liberalised in generation sector, with rapid increase of electricity access through the adoption of on and off-grid solar (Apergi et al., 2024). Kenya Power and Lighting Company (KPLC) is currently the sole purchaser of all produced electricity, and the sole distributor that operates the country's interconnected grid (International Trade Administration, 2024). Clean cooking is one of the key issues of energy transition in Kenya. To successfully transition households away from polluting fuels (e.g., firewood), the Government of Kenya has launched the Kenya National Cooking Transition Strategy (KNCTS) to achieve universal access to clean cooking with electricity by 2028 (IEA, 2025b).

References

Apergi, M., Eicke, L., Goldthau, A., Kurniawan, J., Schuch, E., & Weko, S. (2024). Pathways to a sustainable electricity sector in Kenya: Challenges and transformational factors. *Utilities Policy*, *91*, 101854.

BP. (2022). *BP Statistical Review of World Energy: 2022*.

Bristol City Council. (2021). *The population of Bristol*. https://www.bristol.gov.uk/council-and-mayor/statistics-census-information/population-of-bristol

Bristol City Council. (2022). *Bristol Key Facts*. https://www.bristol.gov.uk/files/documents/1840-bristol-key-facts-2022/file

Bristol Energy Network. (2022). *About Us*. https://bristolenergynetwork.org/aboutus/about-ben/

CCI. (2023). *CHIFFRES CLÉS--Rhône et Métropole de Lyon*.

Census and Statistics Department HKSAR. (2022). *Population by Sex and Age Group*. https://www.censtatd.gov.hk/en/web_table.html?id=1A

Chitchyan, R., & Bird, C. (2021). Bristol as a smart local energy system of systems: skills case study. *Available at SSRN 3966236*.

Copenhagen Energy Centre on Energy Efficiency. (2023). *Lyon Smart Community*. Retrieved 09 November from

European Commission. (2025). *GHG emissions of all world countries (2025 report)*. https://edgar.jrc.ec.europa.eu/report_2025.

Hodson, M., & Marvin, S. (2010). Can cities shape socio-technical transitions and how would we know if they were? *Research Policy*, *39*(4), 477-485.

IEA. (2025a). *Countries and regions*. https://www.iea.org/countries.

IEA. (2025b). *Kenya's energy sector is making strides toward universal electricity access, clean cooking solutions and renewable energy development*. https://www.iea.org/news/kenyas-energy-sector-is-making-strides-toward-universal-electricity-access-clean-cooking-solutions-and-renewable-energy-development

International Energy Agency. (2020). *Korea 2020 Energy Policy Review*.

International Energy Agency. (2023). *Electricity generation by source, France 1990-2021*. Retrieved 07 November from https://www.iea.org/countries/france

International Energy Agency. (2020). *Korea Electricity Mix*. https://www.iea.org/countries/korea

International Trade Administration. (2024). *Energy-Electrical Power Systems*. https://www.trade.gov/country-commercial-guides/kenya-energy-electrical-power-systems

Johnson, S. (2023). *Climate change: How Nairobi is building framework for good, green jobs*. Mayors Migration Council. Retrieved 25th November from https://mayorsmigrationcouncil.org/news/oped-nairobi/

KNBS. (2024). *Gross County Product – 2024*. K. N. B. o. Statistics.

Macrotrends. (2023a). *Bristol, UK metro area population 1950-2023*. https://www.macrotrends.net/cities/22840/bristol/population

Macrotrends. (2023b). *Seoul, South Korea metro area population 1950-2023*. https://www.macrotrends.net/cities/21758/seoul/population

Mah, D. N.-y. (2019). Community solar energy initiatives in urban energy transitions: A comparative study of Foshan, China and Seoul, South Korea. *Energy research & social science*, *50*, 129-142.

Michalec, A. O., Hayes, E., & Longhurst, J. (2019). Building smart cities, the just way. A critical review of "smart" and "just" initiatives in Bristol, UK. *Sustainable cities and society*, *47*, 101510.

Office for National Statistics. (2022). *Regional gross domestic product: City-regions Office for national*

statistics. https://www.ons.gov.uk/economy/grossdomesticproductgdp/datasets/regionalgrossdomesticproductcityregions

Our World in Data. (2023). *Greenhouse gas emissions, 2021*. Retrieved 02 November from https://ourworldindata.org/greenhouse-gas-emissions

Our World in Data. (2019). *Total greenhouse gas emissions*. https://ourworldindata.org/grapher/total-ghg-emissions?tab=table&country=~CHN

Statistics Korea. (2021). *(Regional Income)*. https://kostat.go.kr/portal/korea/kor_nw/1/13/2/index.board?bmode=read&bSeq=&aSeq=422615&pageNo=1&rowNum=10&navCount=10&currPg=&searchInfo=&sTarget=title&sTxt=

The Seoul Institute. (2018). *International Conference for Transition city, Seoul 2018*.

Trading Economics. (2022). Hong Kong GDP - 2022 data. https://tradingeconomics.com/hong-kong/gdp