

Understanding Smart Energy Transitions as a New Source of Distrust:

The Perspectives of Hong Kong Citizens on the Risks of Regional Intercity Energy Collaboration in the Guangdong-Hong Kong-Macao Greater Bay Area (GBA)

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| I DARREN MAN-WAI CHEUNG | is Research Fellow, Asian Energy Studies Centre; Department of Geography, Hong Kong Baptist University, Room 1202, 12/F, Academic and Administration Building, 15 Baptist University Road, Kowloon Tong, Hong Kong SAR (dmcheung@hkbu.edu.hk). |
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| I DAPHNE NGAR-YIN MAH | is Director, Asian Energy Studies Centre; Associate Professor, Department of Geography, Hong Kong Baptist University, Room 1202, 12/F, Academic and Administration Building, 15 Baptist University Road, Kowloon Tong, Hong Kong SAR (daphnemah@hkbu.edu.hk). |
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| I ALICE SIU | is Associate Director, Deliberative Democracy Lab, Stanford University, 450 Jane Stanford Way, Building 120, Stanford University, Stanford, CA 94305-2050, United States (asiu@stanford.edu). |
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| I BENJAMIN C. McLELLAN | is Professor, Graduate School of Energy Science, Kyoto University, Yoshida Campus, Yoshidahommachi, Sakyo-ku, Kyoto 606-8501, Japan (b-mclellan@energy.kyoto-u.ac.jp). |
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| I SHINYA WAKAO | is Professor, College of the Mainland, Room A215, Learning Resource, Building #8, 1200 Amburn Road, Texas City, TX 77591, United States (swakao@com.edu). |
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| I VICTOR WAI YIN LAM | is MA student, Institute for Resources, Environment and Sustainability, Faculty of Science, University of British Columbia, Vancouver Campus, AERL Building, 429-2202 Main Mall, Vancouver, BC Canada V6T 1Z4 (victorwaiyinlam@gmail.com). |
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| I GLENN HIN-FAN LEE | is Research Assistant, Asian Energy Studies Centre; Department of Geography, Hong Kong Baptist University, Room 1202, 12/F, Academic and Administration Building, 15 Baptist University Road, Kowloon Tong, Hong Kong (glennlee@hkbu.edu.hk). |
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ABSTRACT: Hong Kong has an ambitious carbon neutral goal to meet by 2050. Achieving this goal requires a departure from a traditional city-scale centralised, fossil fuel-based energy infrastructure to a more decentralised, locally-generated renewable energy (RE) while expanding the regional intercity smart grid system to accommodate RE import in the Guangdong-Hong Kong-Macao Greater Bay Area (GBA). Such energy transitions inevitably bring new social challenges, but how Hong Kong citizens perceive such transitions in the GBA context is not well studied. This study draws on quantitative and qualitative data derived from an online deliberative poll (DP) (N = 174) on smart energy transitions. We have four key findings. Firstly, citizens showed a low level of trust in the national, provincial, and city governments whilst a high level of trust towards the incumbent electricity companies. Secondly, citizens showed distrust to the governments, suspecting that the genuine motives of the governments were to prioritise regional RE import over local RE production. Thirdly, citizens raised concerns over five types of risks (price volatility risks, energy reliability risks, cost overrun risks, data privacy risks, and environmental risks) that contributed to new sources of public distrust in governments' competence. Fourthly, the public distrust toward multilevel governments was found to be underpinned by demographic factors (age group and family size) and a sociopolitical context of recent social movements against government policies. Our findings suggest that policymakers in the GBA need to give sufficient attention to enhancing public trust, and thereby the policy legitimacy of regional smart energy transitions.

KEYWORDS: smart energy transitions, intercity energy collaboration, public distrust, public perception of risks, Guangdong-Hong Kong-Macao Greater Bay Area (GBA).

Introduction

Achieving carbon neutrality by 2050 is a shared target for major cities in the world. However, such decarbonisation goals were only able to limit global warming at about 2.4°C above preindustrial levels, in contrast to below 1.5°C as recommended by the Intergovernmental Panel on Climate Change (IPCC) special report in 2018 (Mah et al. 2022b). These findings have prompted major cities to pursue more ambitious decarbonisation policies to deal with climate impacts.

Smart energy transitions have created new opportunities for realising ambitious carbon neutrality goals. Through integrating information and communication technologies (ICT) into conventional grid systems, energy transitions can utilise smart grid technologies (including smart meters, distributed energy storage systems, and renewable energy – RE – sources) to better control real-time supply-side and demand-side energy management and enhance energy efficiency and energy security (Mah et al. 2022b). Smart energy transitions also open up transition options on geographical scales – enabling a higher level of integration of diversified local RE generation and intercity energy collaboration through regional infrastructure. In other words, the smart grid facilitates the connection of cities into smart energy clusters to explore a full range of benefits of energy-saving, demand response and RE on local, city, intercity, and national scales.

Global trends suggest that smart grid technology coupled with intercity collaboration has become a key national strategy to enhance global competitiveness whilst meeting carbon neutrality goals. The three major global bay areas (Tokyo Bay, San Francisco Bay, and New York Bay Areas) are some examples of regional intercity collaboration, while the European Supergrid, and the ASEAN power grid in Southeast Asia are some instances of possible regional energy collaboration in the power sector.

The Guangdong-Hong Kong-Macao Greater Bay Area (GBA) is a latest remarkable regional intercity collaboration example. First announced by China in 2017 to foster regional economic collaboration, the GBA comprises nine Guangdong provincial cities (Guangzhou, Foshan, Zhaoqing, Zhuhai, Zhongshan, Jiangmen, Shenzhen, Dongguan, and Huizhou) and two Special Administrative Regions (Hong Kong and Macao). Developing smart, green low-carbon energy and improving electricity transmission and distribution networks are areas highlighted in the Outline Development Plan for the Guangdong-Hong Kong-Macao Greater Bay Area (Mah et al. 2022b).

Smart energy transitions through cross-city collaboration in the GBA comprise a major test case of exploring the full potential of smart technologies that can be driven by, scaled up, and sustained by urban dynamics. While smart energy transitions can be seen as a positive driver of decarbonisation, public acceptance is a critical factor in influencing the effectiveness of intercity smart energy collaboration in the GBA. The recent growing public distrust towards the Hong Kong Government poses new challenges to smart energy transitions in collaboration with the GBA, with a growing concern over new risks such as data privacy brought by the smart society.

The trust literature has proven the linkages between public perceptions of risk and trust (e.g., Das and Teng 2004), but the complex relationships between public perception of risk and trust in the context of regional intercity energy collaboration has not been well studied. This study seeks to contribute to the trust literature through studying intercity energy collaboration from the perspective of distrust, utilising Hong Kong as a case study and an online deliberative poll (DP) with Hong Kong citizens as the primary source of data. This study seeks to answer four research questions:

1. In what ways and to what extent do Hong Kong citizens perceive the national, provincial, and city-level governments and the electricity companies to be trustworthy?

2. Which aspects of trust matter to Hong Kong citizens when they explore possible energy futures?
3. What are the major types of risk perceived by Hong Kong citizens concerning public trust in the context of intercity energy collaboration?
4. Can contextual factors, in particular demographic and sociopolitical factors, explain the level of public trust towards the national, provincial, and city-level governments and the electricity companies?

The theoretical perspectives of smart energy transitions, regional intercity collaboration, and trust

Smart energy transition: The local and regional opportunities

The smart city concept has been widely adopted to address complex social problems ranging from the COVID-19 pandemic to migration and climate change (Mah et al. 2022b). There is a growing consensus that existing reduction targets under the Paris Agreement will not deliver the deep decarbonisation that is needed to avoid catastrophic climate impacts. Cities, as key sustainability transition arenas, urgently need to include smart grids as a core feature in increasingly interconnected, digitalised, and smarter grid systems to realise ambitious carbon-neutral goals (ibid.).

Policymakers have increasingly recognised the importance of smart grids as an enabling and transformative technology in realising energy transitions. With an aim of transiting from fossil fuel/nuclear-based centralised systems to low-carbon, more sustainable energy systems, “smart” energy transitions focus on utilising smart grids to drive, scale up, and realise the transitions. Through integrating ICT into existing electricity systems, smart grid technologies build an integrated energy system that can link a collection of complementary technologies (most notably smart meters, automated energy management systems, distributed energy storage systems, and RE technologies). Apart from hardware, smart grid developments require new pricing systems, most notably dynamic pricing such as time-of-use tariffs, that use pricing signals to induce electricity end-users to save energy or reschedule their electricity consumption to achieve load shifting and load reduction (ibid.). In essence, smart grid technologies have the potential to optimise both supply-side and demand-side energy management by integrating RE sources in distributed energy systems, scaling up energy-saving and shifting peak demand when supported by socio-institutional changes (ibid.).

Urban energy transition studies have shown that smart grid technologies have a major rescaling effect on energy transitions. Urban energy policies are generally implemented at national and city levels. Smart grids can shift the transition arenas downward to community levels, and upward to regional cross-city levels. This rescaling effect can redefine the places, processes, and politics of sociotechnical energy transitions (ibid.), thus making an important contribution to exploring alternative pathways of energy transitions.

A process of localisation of smart energy transitions has shifted the focus from city-level transitions down to sub-city, most notably

community levels, emphasising the importance of bottom-up innovative niches that foster transitions towards RE-based distributed systems and engage a large number of end-users (and prosumers) in distributed grid systems. This process helps creating social values that include empowerment, social cohesion, and an enhanced sense of moral obligation towards environmentally friendly behaviour (ibid.).

Smart grids also drive niche diffusions upward and outward movement of energy transitions to the regional intercity levels. Regionalisation is a major urban dynamic extensively studied in urban studies. Environment and sustainability research on regionalisation theory first grew rapidly during the 1980s and 1990s in the West, responding to air and water pollution associated public health risks (ibid.). In the energy domain, several concepts closely related to regionalisation have been used interchangeably in sustainability and energy studies over years. The evolution of these concepts from regional energy planning to cross-border energy governance to intercity energy collaboration under national technological innovation systems has coincided with the shift of discourse from the concept of sustainable development in the 1980s to climate change in the early 2000s, and to smart society in recent years. In the digital era, smart grid technologies have the potential to foster the interconnection of cities as clusters of smart energy cities/communities to explore the full benefits of energy-saving, demand response, and distributed RE on a regional scale. Smart grids, for example, can optimise the operation of a network of wind farms and solar farms in a region by smoothing the output variation as a result of geographical dispersion of RE sources (ibid.). Empirical developments indicate that these rescaling processes are critical to influencing transition outcomes but the complex mechanisms have yet to be well-studied.

Public perception of risks in smart energy transitions

Another strand of energy studies sheds light on the relevance of risk perception and trust in the context of energy transitions. The energy literature has shown evidence that public perception of risk is crucial to all kinds of energy policies, from energy planning to project implementation, and across all major energy areas ranging from climate, to RE, nuclear power, and to energy efficiency (Mah, Hills, and Tao 2014; Ryu, Kim, and Kim 2018).

In the digital era, smart energy transitions are inevitably associated with risks. Smart energy transitions drive changes through a multitude of actors (electricity end-users, prosumers – end-users producing RE –, incumbent utilities, new energy companies, civil society, and government authorities) at different levels: from national, to regional cross-city, city, and down to community levels. Whilst these changes have created many new possibilities of alternative pathways of energy transitions, there exist major governance challenges in dealing with uncertainties. The variety of actors who are involved in the diffusion process entails a high degree of uncertainty about the direction of the transitions (Schot, Kanger, and Verbong 2016). Due to the complexity and indeterminacy of some transition processes in nature, imperfect scientific knowledge cannot explain and predict all mechanisms that can deliver energy transitions (Osazuwa-Peters et al. 2021), and many uncertainties and risks remain.

Energy transition studies suggest that risks associated with smart energy transitions are multifaceted: climate risks (such as extreme heat events), environmental risks, price volatility risks (as energy commodity markets continue to grow in scale, and expand in service areas), risks of job losses in the coal sector, and data privacy risks (ibid.).

A theme of the risk literature has shed light on the challenges of managing public perception of energy technological risks. Public perception has been found to be an important factor affecting public acceptance of energy technological risks, and thus the adoption of new green energy technologies. However, the literature also emphasises that public perception of risk is highly dynamic as it is socially, culturally, and historically constructed (Irwin 2000), and may change over time and space (ibid.; Mah, Hills, and Tao 2014). These sociocultural aspects of energy risk imply that managing risk perception requires more than technological solutions. However, how socio-institutional settings need to evolve in order to better manage the public perception of risk has remained understudied.

The role of trust in managing risk perception

In the global context of public distrust (Mah et al. 2021), recent developments in smart energy transitions have heightened public attention to the issues of trust. Trust, by definition, is a “psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviour of another” (Rousseau et al. 1998: 395). Trust is a prerequisite for effective risk management (Brecher and Flynn 2002), and crucial to enhancing policy legitimacy and improving policy efficacy (Braithwaite 1998; Mah et al. 2021). A growing body of the energy literature suggests that public trust/distrust is one of the most important factors in predicting the public acceptability of energy technologies (such as smart grids and wind power, Sonnberger and Ruddat 2017), and distrust can be a major adoption barrier (Perlaviciute et al. 2018). Given the importance of trust to effective energy transitions, five strands of the trust literature shed light on different aspects of this complex concept that helps understand the processes of energy transitions.

The first strand of the trust studies highlight the complex relationships between trust and public perception of risks. Public trust, and the associated public perception of risk, in government, experts, institutions, and markets is critical in the energy transition context because many decisions on energy choices must be made on the basis of incomplete information and a variety of risks (Loorbach and Verbong 2012). A relatively extensive body of the trust literature has found that high levels of trust can reduce perceived risk (Hunt, Frewer, and Shepherd 1999; He et al. 2014; Ryu, Kim, and Kim 2018). However, whether perceived risk, on the other hand, can be a determinant of public trust has been less studied. Recent empirical studies shed light on the widening of the trust gap during energy transitions – that the discrepancy between the trust needed by citizens and the trust possessed by governments and corporations can be widened because citizens perceive more risks and thus desire a greater demonstration of trust (Mah et al. 2021). While the trust literature suggests that public trust is an important factor in enhancing the acceptability of risky energy transition, whether public perception of risk may affect trust levels

has remained understudied.

The second strand of the trust studies show that some actors are more trusted while some are less trustworthy. Some studies have found that scientists and NGOs are more trustworthy while energy companies, nuclear safety authorities, and political parties are less trustworthy (EU 2007; OECD 2010). In a trust study in Hong Kong, Mah, Hills, and Tao (2014) found that there exists a multilevel perspective of trust in relation to central and local governments: respondents were found to have greatest distrust of the Central Government and Guangdong Provincial Government while finding the Hong Kong Government somewhat more trustworthy. This finding confirms studies elsewhere that also evidence variations in trust levels at different jurisdictional levels (OECD 2010).

The third strand of the trust literature distinguishes different dimensions of trust. Three key dimensions are identified as follows: (i) trust in *transparency* (Frewer et al. 1996; Hunt, Frewer, and Shepherd 1999) is associated with information disclosure; (ii) trust in *motives* is associated with openness (an opening up or closing down policymaking processes), integrity, and inclusiveness (Coleman 1990; Kim 2005; Stirling 2005); and (iii) trust in *competence* (Mayer, Davis, and Schoorman 1995) is associated with operational capabilities (Kim 2005) and capabilities in implementing alternative plans and managing energy-related risks (Walker et al. 2008).

The fourth strand of the trust literature explores the trust-building mechanisms through which trust can be built. The literature suggests that engaging the public in energy policymaking processes is a key trust-building mechanism, but the literature has also cautioned that a participatory approach to policymaking cannot guarantee that trust can be built. Public trust may deteriorate if people question the motives of such engagement exercises (Mah et al. 2021).

The fifth strand suggests that contextual factors, such as experiences (historical events might be included), knowledge level (Gölz and Wedderhoff 2018), demographics, and sociopolitical contexts are factors explaining trust (OECD 2017; Mah et al. 2021). On a regional scale, energy studies in Western Europe (Gölz and Wedderhoff 2018) and in the Middle East and North African (MENA) region (ibid.; Komendantova 2021) have found socio-institutional factors (Gölz and Wedderhoff 2018) such as a feeling of ownership of energy transition and other contextual factors to be critical in explaining regional differences in trust.

Public perception of policy issues and trust in China

In China studies, public perception on a wide range of policy issues has been examined. These issues range from social welfare and corruption to food safety and environmental risks. The literature suggests that public trust in the central and local governments, in particular regulators in China, is related to public perceptions of risk (Mah et al. 2022b). Regional factors, such as the level of economic development and traditional cultural, have been found to be critical in affecting local residents’ trust in the government (ibid.).

In the context of energy issues, the China studies have indicated that public trust affects public acceptance of different energy technologies, such as nuclear power, RE projects, and carbon capture and storage (CCS) technologies (ibid.). China studies have consistently found that higher trust has led to higher public

acceptance of a project or a technology, while low trust in motive and competence led to low project acceptability (ibid.). Less clear, however, is the interaction between trust and public perception of risk in the context of smart energy transition in China.

Hong Kong and the Greater Bay Area (GBA) contexts

Located on the coastal area of South China, Hong Kong has a population of about 7.5 million and an area of 1,110 km². Hong Kong is governed under “one country, two systems” and enjoys a high degree of autonomy in executive, legislative, and judicial power under the authority of the Chinese Central Government. This political framework has determined the complex multilevel relationships between the Hong Kong, Chinese Central, and Guangdong Provincial Governments and intercity energy collaboration policies (ibid.).

Hong Kong has unique characteristics of an open market, high population density, and high GDP per capita yet low energy intensity in the GBA. As illustrated in Table 1 in Mah et al. (ibid.), the GBA cities have a high population density, and Hong Kong’s population density is about 4.7 times higher than the GBA. The services industry constituted some 92% of the Hong Kong economy in 2017, the second highest ratio after Macao. The GBA has an uneven distribution of GDP per capita, with Hong Kong ranked second highest. Hong Kong has a comparatively low energy intensity in the GBA and ranked third lowest among the 11 cities.

Hong Kong has a fossil fuel-based fuel mix for electricity generation and an ambition to phase-out coal by 2035 to achieve carbon neutrality by 2050. In 2017, coal contributed 46% of the electricity generation, followed by natural gas and nuclear, both at about 27%. In 2020, natural gas became the largest contributor to the fuel mix at 48% with coal reduced to 24%. RE represents a tiny proportion of the fuel mix over the years, at less than 0.01%. The government aims at increasing RE in the fuel mix to 7.5%-10% by 2035 (ibid.).

In contrast to the partially liberalised electricity market in China, Hong Kong has a geographically, vertically integrated, monopolistic electricity system. Two electricity companies, China Light & Power and Hongkong Electric, serve as the sole electricity generators, transmitters, and retailers in their respective regions. The financial and environmental performance of the electricity companies are governed by the Scheme of Control Agreements (SCA). The SCAs determined the annual permitted rates of return based on the value of fixed assets. Incentives of increasing the permitted rates are implemented for the electricity companies in reaching environmental performance targets such as promoting RE uptake and energy-saving (ibid.).

Hong Kong has experienced regional energy collaboration for about four decades. Liu et al. (2021) distinguish three stages of intercity energy collaboration in the GBA:

1. A market-driven collaboration between electricity companies from Hong Kong and China represented by three key power initiatives: (i) the interconnection of the Kowloon and Guangdong power grids in 1979; (ii) the Daya Bay Nuclear

Power Station in 1994; and (iii) the Guangdong Dapeng Liquefied Natural Gas (LNG) terminal in the early 2000s.

2. A local government-driven collaboration throughout the 2000s, focusing on intercity governmental agencies in formulating environmental protection initiatives.
3. A national government-driven collaboration. The Outline of the Plan for the Reform and Development of the Pearl River Delta (2008-2020) marked the beginning, followed by the recent intercity energy collaboration in RE particularly highlighted in the Outline Development Plan for the Guangdong-Hong Kong-Macao Greater Bay Area in 2019 (Table 2, ibid.).

Increasing opportunities for intercity energy collaboration underpinned by smart grid developments and carbon neutral targets are seen in recent years. The GBA and Hong Kong have rolled out different energy plans and policies to achieve carbon neutrality (Table 2, ibid.). To achieve the ambitious carbon neutrality targets by 2050, the Hong Kong Government recognises the necessity of regional energy collaboration given the limited potential for developing large-scale RE projects including limited land and high population density. Importing low-carbon and zero-carbon energy is highlighted as one of the options for regional energy collaboration.

The smart meter rollout plan is one of the major smart energy initiatives in Hong Kong. The two electricity companies plan to install smart meters for their residential customers by 2025 (ibid.). These smart meters enable digitalised real-time visualisation of household energy consumption with the aim of encouraging energy-saving and improving energy reliability.

Methodology

This study is a single case study utilising Hong Kong as the empirical case. Compared to a multiple case study, a single case study enables investigation of the complexities of case context arising from the unique history and influences specific to the case (Nock, Michel, and Photos 2007). This advantage allows us to analyse how the atypical sociopolitical context of Hong Kong affects citizens’ distrust of intercity energy collaboration in the GBA.

This study utilises primary research data collected from Hong Kong online deliberative polling (DP), drawing on four main sources of information: (i) quantitative data generated from three sets of questionnaires (T1: a preworkshop questionnaire completed about two days before the event day; T2: a preworkshop questionnaire completed on the event day; and T3: a postworkshop questionnaire) with the final valid sample of 174 (participants who successfully completed T1, T2, the DP, and T3 was 174); (ii) qualitative analysis of transcribed materials from small group discussions and two plenary sessions; and (iii) a qualitative analysis of news articles and reports for triangulation of data.

The online DP was conducted in July 2020, in the format of a half-day deliberative workshop with five components. These include: (i) pre-event questionnaire (T1); (ii) briefing materials; (iii) preworkshop questionnaire (T2), (iv) three small group discussions with two expert Q&A sessions in between the discussions; and (v) postworkshop questionnaire (T3). The questionnaires were utilised to track opinion changes throughout the deliberation. Participants

were randomly selected Hong Kong citizens from an opinion panel based on age group and gender. An initial sample of 225 was recruited in June 2020 to participate in the online deliberative workshops in July 2020.

In our briefing documents, three solar future scenarios highlighted four major areas of smart energy transitions: (i) public acceptance of various levels of regional energy collaboration in RE import from the GBA; (ii) prosumers'/consumers' choices in locally produced solar electricity; (iii) consumers' choices in the electricity market; and (iv) the level of prosumers' engagement in smart energy transitions. While contemporary scenario studies focus on the narrow scope of economic and technical implications in solar developments, our future solar scenarios focus on both social values of energy systems change and impacts to citizens and sociotechnical impacts. A narrative approach is adopted in the scenarios, summarising the pros and cons from a citizen's perspective in terms of smart homes, the impact on electricity prices, and changes in the electricity market. This approach aims to elicit citizens' attention to non-economic concerns and smart technological implications to view energy autonomy in a more comprehensive manner.

Findings

Smart energy transitions emphasise the use of smart meters, a home energy management system (HEMS), real-time energy data, and dynamic pricing to scale up energy-saving and RE within a household as well as on the community, district, city, or regional scales. As we reported in another paper (Mah et al. 2022a), results of the Hong Kong DP show that Hong Kong citizens generally welcomed smart energy developments, such as smart HEMS and dynamic pricing. In this paper, we enrich the understanding of public acceptance of smart energy developments with an analytical focus on trust. We found that public (dis)trust in government is a critical factor affecting public acceptance of smart energy developments. Our findings are discussed in details as follows:

Low level of trust among different levels of government

A defining feature of smart energy transitions is the use of smart meters to collect real-time electricity consumption data in order to formulate effective demand-side measures and change end-users' consumption behaviour. In our online DP, participants were asked to rate on a scale of 0 to 10 their perceptions of the trustworthiness of National Government, the Guangdong Provincial Government, the Hong Kong Government, and Hong Kong electricity companies if these parties collect their household energy information. 0 to 4 is classified as untrustworthy, 5 in the middle, and 6 to 10 as trustworthy. Three questionnaires (T1, T2, T3) were conducted to track the changes in the opinions of citizens throughout the deliberation of the Hong Kong online DP. Three questions concerning trust in information, trust in motives, and trust in competence were asked in these questionnaires. These three questions focused on asking their trust levels regarding: (i) the two major electricity companies in Hong Kong; (ii) the Chinese National Government; (iii) the Guangdong Provincial Government; and (iv) the Hong Kong Government. The results of these three questions are illustrated in Figures 1 to 3.

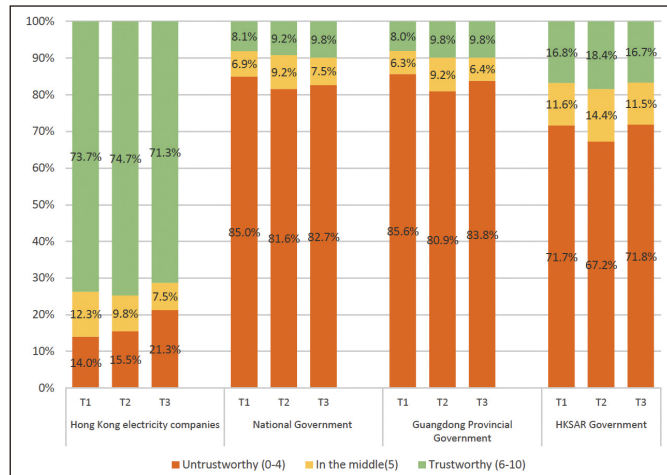
Findings from our DP show that Hong Kong citizens exhibited

an extremely low level of trust in the different levels of government, compared to a relatively high level of trust towards the electricity companies when they considered who could be trusted as a party to collect their personalised household electricity data. Several other major observations are summarised as follows:

1. There was a consistently extremely low level of trust towards the National Government: citizens showed extreme distrust towards the National Government. There was a minimal increase in all three trust dimensions for the National Government. Trust in information increased from 8.1% (T1) to 9.8% (T3); trust in motives from 6.9% (T1) to 8.1% (T3); and trust in competence from 7.5% (T1) to 9.8% (T3).
2. There was a consistently extremely low level of trust towards the Guangdong Provincial Government: citizens showed extreme distrust towards the Guangdong Government similar to the National Government. There was a minimal increase in all the three trust dimensions for the Guangdong Provincial Government after deliberation. Trust in information increased from 8.0% (T1) to 9.8% (T3); trust in motives from 6.9% (T1) to 8.0% (T3); and trust in competence from 8.1% (T1) to 9.8% (T3).
3. A consistently low level of trust towards the Hong Kong Government but comparatively higher than toward the National and Guangdong Governments: citizens showed extreme distrust towards the Hong Kong Government but regarded it as slightly more trustworthy than the National and Guangdong Governments. A minimal decrease in trust in information (from 16.8% in T1 to 16.7% in T3); a minimal increase in trust in motives (from 13.2% in T1 to 14.4% in T3); and a mild increase in trust in competence (from 13.3% in T1 to 19.0% in T3) was observed.
4. In contrast to the low trust in the governments, there was a consistently high level of trust towards incumbent electricity companies in Hong Kong in all three key aspects of trust. Trust in information (from 73.7% in T1 to 71.3% in T3) and trust in competence (from 64.2% in T1 to 63.2% in T3) only decrease minimally. Citizens showed the least trust in the motives of incumbent electricity companies. Trust in motives remained at slightly less than 50%, with a mild increase from 44.8% (T1) to 49.4% (T3).

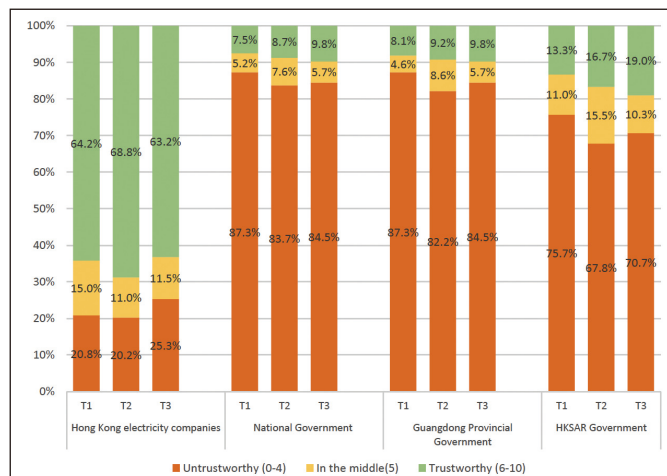
These results imply that any future proposals of intercity energy collaboration will be perceived with a high degree of scepticism by the citizens, echoing the findings from Wang et al. (2021). In a low trust environment towards the governments, citizens will question the different aspects of proposed intercity energy collaboration projects. In terms of information, citizens are likely to question whether the information is transparent, comprehensive, objective, and reliable. In terms of motives, citizens are likely to question if the governments are open to accepting alternative options, have the integrity to honour agreements, willingness to listen to different opinions, and credibility in their commitments to the project, and if the perceived project impacts are accurate. In terms of competence, citizens will challenge whether the governments have the capacity to implement alternatives and manage risk. As shown in the later sections, citizens raised and explained these concerns during the online DP.

Figure 1. Trust in Information



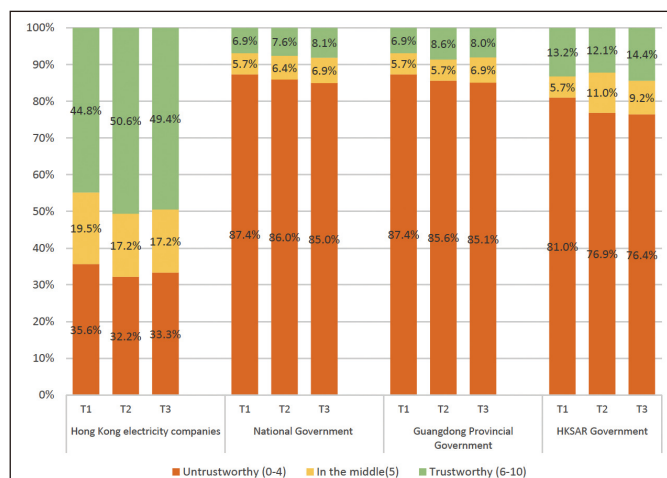
On a 0 to 10 scale, where 0 is extremely untrustworthy, 10 is extremely trustworthy, and 5 is in the middle, how trustworthy would you say are the following parties if they collect your household energy information? Source: authors.

Figure 2. Trust in Motives



On a 0 to 10 scale, where 0 is extremely untrustworthy, 10 is extremely trustworthy, and 5 is in the middle, how trustworthy would you say are the following parties in protecting public interest? Source: authors.

Figure 3. Trust in Competence



On a 0 to 10 scale, where 0 is extremely untrustworthy, 10 is extremely trustworthy, and 5 is in the middle, how trustworthy would you say are the following parties in providing reliable services? Source: authors.

Distrust in governments' motives in prioritising local RE production over regional RE import

Citizens doubted the Hong Kong Government's commitment to looking for alternatives such as local RE before looking for regional RE import. During the discussion about future options for regional RE collaboration, citizens went into some serious discussions on local solutions. First, citizens thought that vacant land was available for local solar development, and developing local solar should be a priority option over RE import from the GBA. For instance:

Many government lands are vacant, so I think it can start on these lands first. Rather than leaving them vacant, it's better to use to develop solar energy. It is unnecessary to rely on the GBA for everything... (Small group discussion 1f)

As revealed in the quote, a value judgement of whether "local" was a priority alternative energy source and "cross-border" underpinned the core discussion of local RE development. The term "energy autonomy" was repeatedly highlighted among the opinions on local RE, whereas the word "rely" was mentioned the most among the opinions on regional RE import. In essence, the citizens were of the view that Hong Kong has not yet made full efforts or utilised full capacity in developing RE locally; Hong Kong "should" try its best to solve the problem by ourselves, rather than relying on help from across the border (i.e., the GBA). While citizens were concerned about "energy autonomy," they questioned if the government had a motive of "relying" on RE import and reducing the degree of local "energy autonomy." This concern contributed to citizens' distrust in the government's motives.

Second, citizens did not trust that the government was able to maintain a high level of energy reliability with more RE import from the GBA. Citizens' concern about regional RE import came from sufficiency and stability. On the one hand, citizens preferred a diversity of energy supply and did not believe that the GBA had sufficient RE supply even for their own region. For instance:

They [the experts of the plenary sessions] point out that Mainland China is facing a shortage of resources as well, particularly Guangzhou. Why are we still heavily depending on the Mainland? Keep in mind that at the beginning of this pandemic, not only Hong Kong but the whole world panicked due to the shortage of masks. This is exactly the result when we are too reliant on one country. That is why I disagree the most with this proposal. (Small group discussion 2k)

On the other hand, citizens were uncertain whether RE import from the GBA would be stable: "As far as I know, China sometimes faces a lack of stability in power supply. Therefore, we need to consider the stability if we import RE from the GBA..." (small group discussion 1g).

A core concern was whether the current stable electricity supply would have to be sacrificed under cross-border power grid integration. Hong Kong has attained a high level of energy supply reliability at 99.999%, which is higher than that in Guangzhou and Shenzhen at 99.989%. While Hong Kong maintained an annual average power outage of 0.92 minute per household, cities in Southern China had an annual average power outage of 4.22 hours

per household (Mah et al. 2022b). These figures supported citizens' perceptions of the unstable electricity supply in the GBA. Citizens showed their distrust in the government in suggesting regional RE import because this proposal could not respond to citizens' visions of maintaining a high level of energy reliability.

Five major risks as new sources of public distrust in governments' competence

Although smart energy transitions create opportunities for intercity energy collaboration, new sources of risk emerge and become new sources of distrust in the governments. Five main types of risk were pointed out by citizens during the deliberation in the Hong Kong online DP: price volatility risk, energy reliability risk, cost overrun risk, data privacy risk, and environmental risk (see Table 3, *ibid.*).

The first risk was about price volatility in electricity prices. Citizens perceived that the government was unable to stabilise electricity prices. Citizens were particularly concerned about the potential cost implications if dynamic pricing systems are introduced in Hong Kong. One participating citizen noted his/her reservation about the ambitious solar scenario: "If we opt for the ambitious solar scenario, we will then have to adopt a time-of-use pricing system in which there will be a differentiation of peak time and non-peak time for electricity charges. We may need to pay more" (Small group discussion 1o).

It is important to note that the regional context of the GBA has heightened citizens' concerns about the risks of higher electricity prices. Some participating citizens pointed out that once Hong Kong entered into a contractual agreement with the GBA to import RE, Hong Kong had minimal negotiation power over the prices. The costs of RE import will then be transferred to local citizens. As a citizen pointed out: "In addition, in the case of electricity supply in the Mainland, the problem is that their cost might be HKD 1, but they might sell to us for HKD 5 or HKD 10. To illustrate, Dongjiang water is a perfect example" (small group discussion 1n). Dongjiang water was an instance of freshwater supply imported by Hong Kong from the GBA. At about USD 0.04/m³, Hong Kong has an obligation to purchase water supply for at least 615 million m³ of water annually from 2012 to 2023 (Mah et al. 2022b). In addition, citizens were concerned that Hong Kong had to engage in price competition with other regions of China in purchasing RE. As one citizen highlighted:

It mentioned that we have to compete with buyers in other regions for buying the certificates to supply electricity. So it will be affected by market fluctuations, this is what the public cares about the most. It is because they don't want to see the price fluctuate day by day, or in short, it affects the costs when they use it... (Small group discussion 1a)

The second risk was energy reliability and concerns about power outages under extreme weather. Citizens perceived that the government was incapable of minimising the risks of power outages from RE import. Under extreme weather conditions such as typhoons, overreliance on power supply from the GBA would be more likely to lead to power outages:

We can compare it with Macao. Most of their electricity comes from Southern Power Grid. Last time, when the typhoon came,

they suffered a long time of power outage. We should be cautious. (Small group discussion 1d)

The perception of governments' incompetence in minimising the risks from overreliance on RE import contributed to a new source of distrust in governments' competence. To the citizens, the power outage in Macao caused by typhoon Hato in 2017 was a clear instance of overreliance on energy import. Due to damage in the transmission infrastructure, Macao suffered a power outage for about 31.5 hours, and Hato caused ten deaths and 244 injuries. With the vivid experience of the Macao power outage, citizens questioned whether the government could deal with such a power outage given that Macao imported 94.9% of its energy from the GBA.

The third risk related to infrastructural costs overruns. Citizens perceived that the government was incapable of managing infrastructural costs. Investment in upgrading transmission infrastructure was necessary to import larger amounts of RE from the GBA. Citizens questioned whether it was cost-efficient to import RE rather than developing RE locally:

Because the cost of transmission can be high as well. So we have to examine if the cost of developing locally is really more expensive than importing from the Mainland; around the same or just slightly more expensive. I think we should develop solar in Hong Kong... (Small group discussion 1b)

Why would you need to purchase more electricity from the Mainland, China? There would be a great amount of energy loss during transmission, so it is much better to produce and consume locally. (Small group discussion 1k)

Previous experiences of cost overruns in government projects also contributed to citizens' distrust in governments' competence. For instance, the Hong Kong-Zhuhai-Macao Bridge overran by about USD 1.6 billion, and the Shatin to Central Link, an extension of the Mass Transit Railway, overran by more than USD 2.6 billion (Mah et al. 2022b). The previous performance in managing costs contributed to another concern of the citizens.

The fourth risk concerned data privacy. Discussing solar development regardless of local or intercity energy collaboration, participants' distrust was multifaceted. First, participants distrusted the electricity companies to willingly open electricity data in a transparent manner. They perceived that the electricity companies would open the data only when they had no choice (i.e. in the case of opening up the grid).

Second, participants distrusted the truth of electricity information provided, even if open data for public access was welcome. They perceived that it was hard to avoid fake data or maliciously falsified information from any party. Third, participants questioned whether a credible monitoring agency would be in place for handling open electricity data. One participant summarised the multiple dimensions of distrust in this manner:

[On solar development in general] I think when it is time to open the electricity use data, it will involve privacy, and I believe the electricity companies will then link it to the issue of opening up the grid. It is through opening up the grid that electricity companies can have a reason or an excuse to open

the data. If there is something like apps or measures to monitor the solar systems, it is good. However, it is also hard to avoid a party falsifying the data in the absence of a highly credible monitoring agency. (Small group discussion 2f)

Moreover, participants were distrustful over government monitoring of their electricity data. Since personal and family data were given to the utilities or electricity companies when using their services, participants perceived that privacy was always an issue, and it was impossible for them to protect their privacy:

In fact, if we talk about privacy, the issue is always present. It is because all the personal and family data have already been stored in the utilities or electricity companies. If a certain agency wants to hack the database, it can do so now anyway. Thus, there is no way to stop the government from monitoring, and probably the government would make great effort in monitoring the data... (Small group discussion 2f)

The perception of unwilling or falsified information disclosure contributed to a new source of distrust in information and motives. Citizens perceived that government bodies lacked the credibility to protect privacy, as well as the capacity to monitor the transparency, openness, and accuracy of electricity data. More importantly, citizens perceived that governments were the parties that had a high chance of infringing data privacy. These perceptions suggested that citizens distrusted information and motives when they discussed cross-border RE import.

Last but not least, the fifth risk concerned environmental damage. Participants were distrustful of possible damage to the environment caused by the cross-border electricity infrastructure required from intercity energy collaboration. The perception of environmental damage caused by electricity infrastructure contributed to a new source of distrust in governments' competence in protecting the environment. As a participant stated: "I strongly oppose buying electricity from the GBA. Because, first, their infrastructure may destroy the ecology..." (small group discussion 1j).

Demographic and sociopolitical contextual factors underpinned the public distrust

Why, then, did the trust level remain low across the three levels of governments? Our results showed that citizens' demographic factors had mild influence on the levels of trust towards the electricity companies and the governments. Pearson correlation analysis was conducted before and after the online DP (T1, T2, T3) to assess if there were significant relationships between citizens' demographic factors (including age, number of family members, number of children, educational level, income level, and the highest monthly electricity expenses) and the trust levels towards electricity companies and the governments.

Our results showed that age group, number of family members, and number of children have weak relationships with the trust levels toward different levels of government (Appendices 1-3, Mah et al. 2022b). The T3 results suggested that:

1. Citizens from elder age groups tended to support the Hong Kong Government in trust in information.

2. Citizens having more family members tended to support the China National and Guangdong Provincial Governments in terms of information, motives, and competence.
3. Citizens having more children tended to support the China National and Guangdong Provincial Governments in terms of information and motives.

With respect to the sociopolitical context, recent poor perceptions of water import from and energy management in the GBA added to mistrust toward the governments. An agreement to import Dongjiang River water from the GBA has operated for decades. While the unit price of water purchase increased every year in principle, the water quality has gradually degraded over the years due to development around the Pearl River Delta area (ibid.). This negative experience of collaboration with the GBA made citizens distrust the governments in proposing new RE collaboration projects. As stated by a citizen: "Actually, we could cooperate with the Mainland, but not many people trust them. Shall we first settle the Dongjiang water problem, and move towards other cooperation projects one by one?" (small group discussion 3n).

It is important to note that citizens' trust was eroded by a series of social events that occurred in recent years and right before the Hong Kong online DP in July 2020. These events included the social movement caused by the Extradition Law Amendment Bill in 2019-2020 and subsequent sanctions under the National Security Law in June 2020. Distrust and political discontent towards the governments were central to the social unrest. Distrust in the Central Government was highlighted as one of the "fuels" of the protests (Shek 2020). Such distrust also affected trust in intercity energy collaboration with the GBA, as a citizen stated:

About introducing RE from Greater Bay Area, I totally disagree with it, especially under the atmosphere in Hong Kong now. I believe that at least half of the people may disagree with this idea. It is just like the Dongjiang water case that we didn't know how it is calculated. (Small group discussion 1i)

Conclusions

Smart technologies coupled with urban dynamics have the potential to enhance global competitiveness and realise the climate-neutrality goals of cities. Our GBA case study explored the potential developments of smart grid in the context of regional intercity collaboration with a focus on exploring public perception of risks as a new source of distrust. Based on small group discussions and questionnaire data from an online DP (N = 174), we found that five types of perceived risk in smart energy transitions appeared to have become new sources of public distrust in government's competence, in a wider extremely low trust toward the national, provincial, and city governments.

Our results confirm the trust literature showing that public perception of risk is related to public trust, and this theoretical linkage is evident in the specific context of regional smart energy transitions in the GBA. We found that public distrust in all three key aspects of transparency, motives, and competence mattered when citizens participated in the deliberative discussion on smart energy futures.

Our study advances the trust literature in smart energy transitions in

two important ways. Firstly, by specifying the five types of perceived risk that appeared to be new sources of public distrust, our finding makes important contributions to the debate over two alternative pathways of smart energy transition – a critical choice between the localisation and regionalisation of smart energy transitions. In contrast to the localised transition pathway that emphasises locally produced energy saving and solar initiatives and thus energy autonomy within Hong Kong, the regional cross-city energy collaboration does provide some new opportunities for Hong Kong to scale up energy transitions in cost-effective ways. However, our finding on the five types of perceived risk in regional cross-city energy transitions sheds light on the complexity of public perception of risk. We showed that these new opportunities for the use of new smart energy technologies alongside new developments of regional energy collaboration may undermine public distrust in government competence. Our conceptualisation of the five risks thus provides a better understanding of the counteracting forces for change from the perspective of trust.

Secondly, our findings drew attention to the importance of sociopolitical context in shaping public distrust in smart energy transitions. Our findings suggest that public trust was socially and politically embedded and constrained. Smart energy transition is not solely an economic, environmental or technological issue but can be social and political. Our findings thus contribute to smart energy transition literature by shedding light on the importance of pre-existing public distrust as an underpinning foundation for smart energy transitions in the context of regionalisation.

Our findings yield significant policy implications. Our understanding of the five types of perceived risk is useful in guiding the design of effective trust-building strategies. Policymakers in the Hong Kong, Provincial, and National governments, need to pay sufficient attention to new sources of risk that could further undermine public distrust. Failure to manage effectively these new

risks may further undermine public distrust, which is already at very low levels across all these three levels of government. Given the nature of Hong Kong's polity and politics, the political tension associated with the complex interplay between central-local relationships and cross-city competition would likely remain an issue difficult to address for years to come. Efforts should be made to resolve social and political tensions.

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