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Understanding public perception of smart grid deployment:

A comparative analysis of two pilot Deliberative Pollings (DPs) on dynamic pricing policies in Guangzhou, China and Kyoto, Japan

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Abstract

Worldwide, electricity consumers have become increasingly proactive as a change agent in energy transitions. This global trend has been reinforced by the accelerating deployment of smart grid (SG) technologies which has the potential to broaden energy choices not only on supply-side but also on demand-side management. Consumer backlashes amongst smart meter installation and new electricity tariff systems however suggest that public acceptance of energy transitions is critically important but has remained seriously under-researched. Deliberative Polling (DP), as one innovative approach of deliberative participation, offers potential to effectively bring the public values and perceptions into energy transition decision-making. But the effectiveness and mechanisms of this participatory approach have been addressed almost exclusively in western democratic-country settings.

This research is among the first multi-method studies comparing public perception of dynamic pricing options across Asian cities. We show how undergraduate students in Guangzhou and Kyoto became informed about potential benefits and trade-offs associated with different pricing options, and how they made considered decisions on and changed their perception of this complex energy issue after they participated in deliberative processes. We conducted two pilot DPs, each with 47 undergraduate participants sampled from a local university. Based on our quantitative questionnaire data and qualitative workshop data, this research has four major findings. First, while participants were given the opportunities to choose, a majority of participants chose to remain at status quo while many also welcomed new dynamic tariff options. Second, participants in both pilots showed an increase in acceptance to more sophisticated pricing options including time-of-use and critical peak pricing after deliberation. Third, the dialogic and learning processes appeared to enable participants to become informed, enhance their ability to understand complex issues, and weigh tradeoffs when they compared options. Fourth, cultural differences associated public distrust and electricity market reforms may explain differences in responses between Chinese and Japanese participants.

1. Introduction

Climate change concerns, rising energy costs, and the risks of nuclear power have heightened the urgency of a transition to a low-carbon future. Smart grids (SGs) represent one of the most revolutionary developments in energy management systems. They are increasingly being adopted and implemented in developed and developing economies (e.g. the US, South Korea, Japan, and China). These trends have become even more noticeable in recent years after the Fukushima nuclear accident in 2011. By applying advanced information technology to modernise existing electricity networks, smart grids have been regarded as an enabling technology to realise energy transitions through broadening choices of energy options on both supply-side (e.g. major uptake of renewable energy sources) and demand-side management (DSM) (e.g. demand responses).

It is in this energy transition context that the roles of residential electricity consumers in realising energy transitions have increasing attracted scholarly and policy attention. Citizens or “prosumers” generally assume a more proactive role in energy choices and decisions as SG technologies continue to develop. DSM is not a new concept. It began to emerge as a new approach for utility management in the 1970s, mainly in the US. The recent technological breakthroughs in SGs have however accelerated the interests in DSM activities. Such enabling technologies, including automated digital smart meters, home energy management systems (HEMSs), and home battery storage systems have allowed the introduction of more sophisticated ways of DSM activities in the household sector. Traditionally, large electricity users such as industrial end-users have been the main participants in such DSMs in both the developed (see, for example the U.S. (Eto (1996))) and developing countries (see, for example, China). A rapidly growing body of studies has suggested that SG can enable price-sensitive and well-informed household electricity consumers to reduce or reschedule consumption at times of high demand to times of low demand (see, for example, Brown and Zhou (2013) and World Energy Council (2012)).

This paper presents a cross-national comparative analysis of two pilot Deliberative Polls (DPs) on dynamic pricing and demand-side-management (DSM) in Guangzhou, China and Kyoto, Japan, held in 2016 and 2017 respectively. This study focuses on young people’s perception. 47 undergraduate students participated in each pilot DP.

Deliberative approaches – innovative forms of public participation that emphasize the empowerment of a more informed citizenry to discuss, debate, and reflect on energy issues – have the potential to facilitate the processes of SETs. These governing approaches are being increasingly adopted worldwide (including in the US, Germany, Japan, and South Korea) in order to engage the public in policymaking and to better address complex energy issues, particularly following the 2011 Fukushima nuclear accident. Among the key questions that need to be answered regarding deliberative in this study are: (i) whether and to what extent western normative consequences of deliberative participation can travel across, and be realized in Asian contexts?; and (ii) under what conditions, and how, could deliberative participation lead to improvements in energy governance?

Asian countries have played a pivotal role in global climate change impacts and responses. In addition, Asian countries differ notably across the region and with the West in their institutions, regulations, energy profiles, stakeholder landscapes, and public controversies. A better understanding of how and the extent to which Asian countries introduce participative and deliberative practices for energy policymaking is therefore of great scholarly value and policy significance.

China and Japan are significant case countries for this study. Japan and China have been pioneering the green-technology movement, including SGs deployment, as an alternative approach to low-carbon growth. The shared characteristics of the two countries' energy regimes, including the presence of partial electricity reforms, a dominant state, and incumbent utilities provide common ground for the cross-case comparison. However, Japan's community-oriented approach and China's vision for super-grids show that these countries are experiencing different development pathways for smart grids. The results from this study are valuable for the future smart grid development in Asia given its high population density.

Our analysis focused on quantitative data that we collected from pre- and post-DP questionnaires. We also considered qualitative data from transcription of small group discussions and expert panel sessions. Since much can be said about the processes of learning and dialogue among participants and with experts, detailed analysis that is based on qualitative data is beyond the purview of this paper. Our focus rather is a quantitative analysis that can track if there were changes of attitudes of participants before and after deliberation and how the younger generation in different national and socio-economic contexts responded to difficult "trade-off" decisions after going through intensive learning and deliberative processes. Qualitative data are used to supplement and enrich our primary quantitative analysis.

This paper is structured as follows: Section 2 discusses some key theoretical concepts relating to consumer engagement, SG driven energy transitions, and deliberative participation. Section 3 then introduces the methodological approaches adopted by this study. Section 4 discusses the contexts of this study. Section 5 presents a detailed discussion of our major findings. The final section discusses the conclusions and policy implications derived from our findings.

2. Theoretical perspectives

2.1. The roles of electricity consumers in energy transitions\

Electricity consumers have traditionally been overlooked in energy management systems while overriding attention has been given by policymakers to nuclear power and other supply-side measures (IEA, 2010). However, a growing body of literature has suggested that residential electricity consumers, either as decision-makers of household electricity consumption or policy stakeholders through their votes, can become active agents in energy transitions which are driven by SG technologies (Fox-Penner, 2010).

In smart grid systems, consumers, rather than being passive purchasers, are informed, price-responsive, and empowered to proactively manage their consumption through automated DSM. They may make substantial contribution to energy saving and a reduction up to 30% of peak load through the use of smart meters and real-time electricity information that can be linked to dynamic pricing systems (Faruqui *et al.*, 2010; IEA, 2010). An International Energy Agency (IEA) study found that as much as 50% of the means for decarbonising by 2030 will have to come from energy efficiency measures (IEA, 2010). DSM could bring consumer, utility, and societal benefits by lowering electricity bills, helping utilities operate more efficiently, and reducing greenhouse gases emissions (Strbac, 2008).

Besides DSM, consumers can also play an important role in the supply-side of energy management. Residential consumers can make a proactive choice of electricity provider and power options, and can become "prosumers" – consumers who can also produce electricity at household and community levels (IEA, 2010; Mah *et al.*, 2012).

2.2. Public perception and consumer engagement as a governance challenge of energy transitions

A number of emerging themes from the literature offer a better understanding of the social aspects of sustainable energy transitions. A growing body of the literature sheds light on the importance of public perception and consumer engagement in the context of energy transitions. The notion of public perception has been discussed in a broader context of public engagement, as well as governance systems. Work by Devine-Wright (2007) and Sovacool and Ratan (2012) for example, argue that public perception is a determining factor in energy transitions, and public acceptance is a pre-requisite of realising such transitions. The literature empahsises that public acceptance is a multi-dimensional concept operates at sociopolitical, market, and community levels (Sovacool and Ratan, 2012). Public acceptance can be affected by personal (e.g. age, social class), psychological (e.g. level of trust, knowledge, and direct experience), and contextual factors (e.g. technology type and scale, institutional structure) (Devine-Wright, 2007).

The literature also argues that engaging consumers, and the public at large, in energy transitions depends not only on people's awareness, but also their participation and persistence (e.g. to continue participating or not) (EPRI, 2014). Consumer engagement has to rely on the availability of technologies, as well as markets, and institutions, including the effective introduction of dynamic pricing, through which technology is applied and adopted by households (Bell *et al.*, 1996; Brown and Zhou, 2013).

In the SG literature, consumer acceptance has been identified as a key factor that may influence the deployment of SGs. A growing body of empirical evidence suggests that smart meter installation and the introduction of dynamic pricing systems, for example, often attract consumer backlash (Mah *et al.*, 2012; Broman *et al.*, 2014; Park *et al.*, 2014)

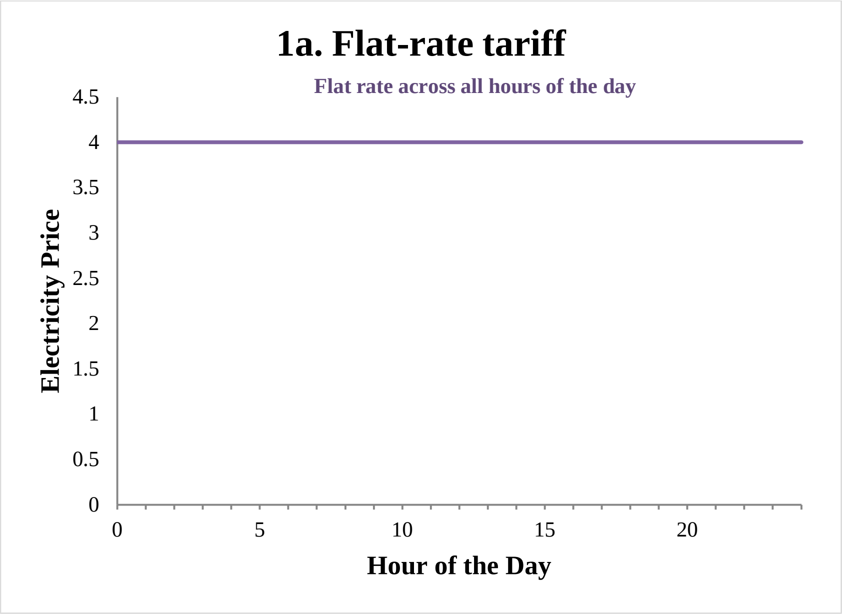
However, in the smart grid-related energy literature, *public acceptance* to more sophisticated tariff systems has been found to be generally low, resulting in low customer response to dynamic pricing, and limited impacts on energy saving and load shifting (Guo *et al.*, 2017). One of the greatest challenges for smart grid diffusion is therefore to have a good understanding of how ordinary citizens perceive the potential benefits, costs, and risks associated with moving away from simple, flat-rate systems to more sophisticated, dynamic systems.

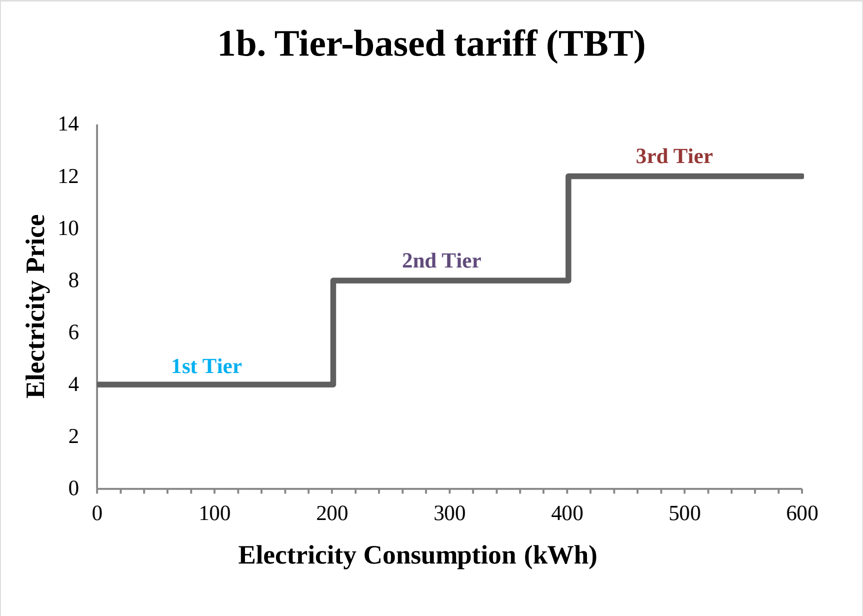
2.3. Trade-off decisions and public perception associated with dynamic pricing

A growing body of the literature on dynamic pricing policies discusses the potential applications, benefits, as well as trade-offs involved in various types of tariff systems (pricing structures) (see, for example, Brown and Zhou (2013); Silva and Santiago (2017)). Dynamic pricing systems, in contrast to traditionally flat-rate systems, have been widely recognised as an essential approach to realise the vastly untapped potential of DSM (Barton *et al.*, 2013). Such tariff systems, such as time-of-use, by varying electricity prices across time, could help to induce desirable behaviour in consumer consumption, particularly through load shifting and load reduction (which includes energy efficiency and conservation).

There are three main types of tariff systems: *flat rate tariff, tiered-based tariff, and time-based tariff*. There are three sub-types of time-based tariff systems: *time-of-use, critical peak pricing, and real-time tarif*fs discussed extensively elsewhere (see, for example, Brown and Zhou (2013)). As shown in *Figure 1*, these tariff systems have distinctive features, and each of them has their own functions and mechanisms, and creates opportunities for residential consumers to reduce electricity bills in various ways.

It is also important to note that these tariff options may involve different sets of trade-offs decisions (see, for example, Fell *et al.* (2015) and Silva and Santiago (2017)). Different tariff options may differ in their potential benefits, costs, and risks. *Table 1* highlights the five key dimensions *(economic, environmental, technological, social and regulatory)* of comparing different tariff options.





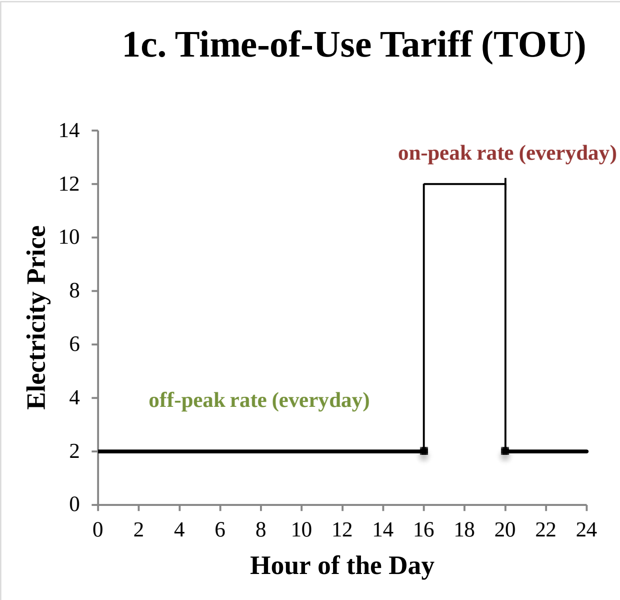
Flat-rate Tariff applies the same rate per unit of electricity consumption across all hours of the day.

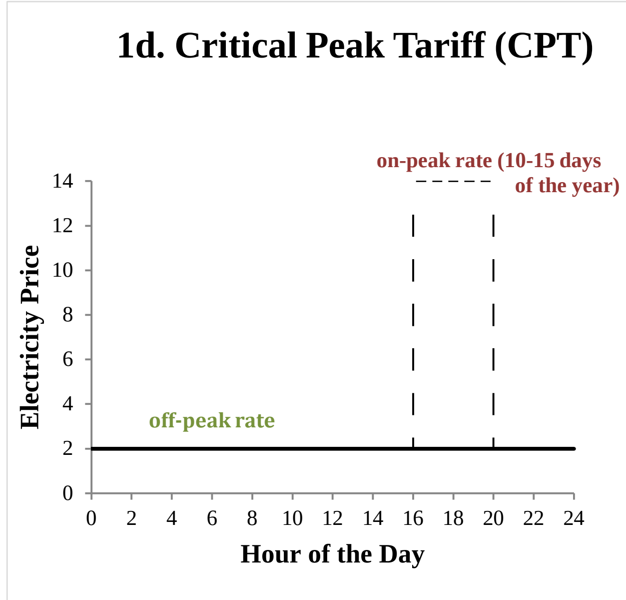
Opportunities for Consumers: customers' only opportunity to save money is to reduce usage.

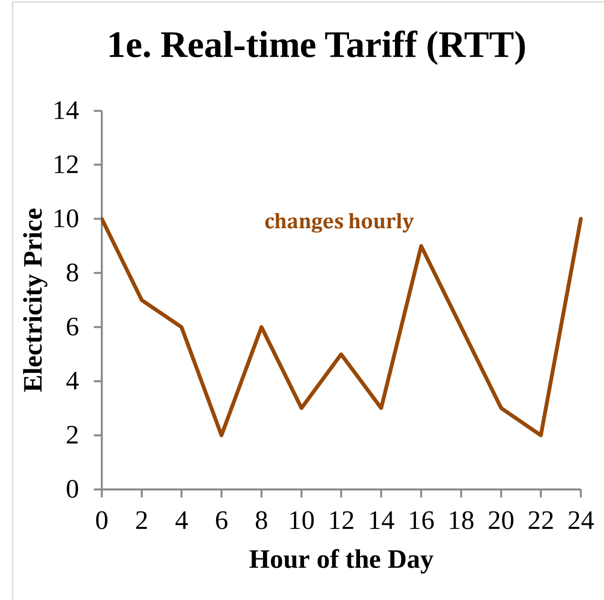
Tier-based Tariff (TBT) applies a low rate for an initial consumption tier, and a higher rate as consumers increase consumption beyond that or those tier(s).

Opportunities for Consumers: customers can save money by conserving electricity, but are deprived of accurate information regarding the actual cost of their electricity consumption.

Figure 1. Main types of electricity tariffs (to be continued on the following page).







Time-of-Use Tariff (TOU) divides rates into varying rates for different time periods or seasons. This tariff would be higher during the peak period, and lower during mid or off-peak periods. The tariff during the off-peak period is typically lower per kilowatt-hour than in flat-rate tariff.

Opportunities for Consumers: Customers have an opportunity to save money by shifting their electricity usage from "peak" to "off-peak" times where possible.

Critical Peak Tariff (CPT) is a special rate, where customers pay a higher tariff during peak periods (eg. 10 to 15 days of a year) encouraging customers to reduce peak loads during a constrained event.

Opportunities for Consumers: customers have the opportunity to save money by shifting their electricity use to off-peak periods during those days of the year.

Real-time Tariff (CPT) that better reflects market conditions by allowing utility companies to charge customers the near actual or actual costs of production. Such programs can notify customers an hour in advance or a day ahead and provide the most accurate cost of producing electricity at each hour.

Opportunities for Consumers: customers have the opportunity to save money by shifting their electricity use during the periods of low electricity prices throughout the varying prices of the day.

Figure 1. Main types of electricity tariffs (continued).

Table 1. Five key dimensions of comparing the benefits, costs, and risks associated with different tariff systems.

	Benefits Whether a specific tariff option can bring these benefits...	**Costs** Whether a specific tariff option may bring these impacts…	**Risks** Whether a specific tariff option may be associated with these risks…
Economic	• Reduce economic losses from power shortages • Enhance economic competitiveness • Reduce peak demand and thus reduce the need for building new generators • Lower electricity prices • Enhance reliability of electricity supply • Strength energy security • Reduce the burden on the hospital system due to air pollution-related illnesses	• Cost of installation of smart meters and advanced metering infrastructure (AMI) may push up electricity prices	• Risks of higher bills
Environmental	• Reduce CO_2 emissions and mitigate climate change impacts • Improve air quality	• Economic costs may incur	• Dynamic pricing may not be effective in reducing CO2 emission which is a multi-factor problem
Technological	• Smart meters and the associated communication networks and data management systems can enable consumers to participate in demand response programs. • Technological developments of AMI and smart meters	• Research and development can be costly	• Rapid technological obsolescence • Unreliability of new technologies
Social	• Raise public awareness on energy efficiency and demand-side management • Hi-tech industries and green jobs	• Personal inconvenience of becoming more aware of usage	• Loss of privacy • Loss of control • Injustice because of cross-subsidization and marginalization of poor and elderly people • Cyberattacks • Increased health risks (e.g. electromagnetic radiation associate with smart meters) • Alleged reports of meter reading inaccuracy • Poor information sharing with the public • Public may be indifferent to new pricing options because new pricing models are perceived to be too complex
Regulatory	• Privacy regulations can be passed toward the prevention of misusing data and cybercrimes (e.g. hacking the smart electricity system) • Privacy regulations alongside other new regulations associated with SG deployment can generally help to strengthen regulatory systems	• Regulatory costs are high	• Privacy regulations can be ineffective in terms of implementation and enforcement

Sources compiled by authors, from Charles River Associates (2005); Faruqui *et al.* (2012); Faruqui and Palmer (2011); Galvin Electricity Initiative (2011); Hu, Moskovitz, and Zhao (2005; IEA (2006); Jegen and Philion (2017); Mah *et al.* (2014); Stern (2015); Wang *et al.* (2012); Yang (2006); Z. Zhang (2014); Zheng *et al.* (2014).

2.4. Deliberative governance as a mechanism for enhancing public engagement

Around the world, growing concerns over public distrust and a lack of legitimacy have exposed the limited ability of conventional forms of top-down, expert-led, technocratic energy policymaking in engaging the public (including households) (Lee *et al.*, 2014; Lehtonen and Kern, 2009). Such approaches face a difficulty in understanding public values, dealing with vested interests, and motivating members of the public to participate in policymaking and to offer support to energy policies (Lee *et al.*, 2014; Lehtonen and Kern, 2009).

Deliberative participation is an innovative form of public engagement that emphasizes the empowerment of a more informed citizenry to discuss, debate, and reflect on energy issues (Petts, 2004). This participatory approach has been increasingly recognised as an important governance mechanism for facilitating the processes of sustainable energy transitions (Pidgeon *et al.*, 2014). Rooted in two major disciplines, democracy studies and participatory governance (Bull *et al.*, 2008; Meadowcroft, 2004), deliberative participation has several important normative characteristics: stakeholder dialogue, debate, reflexivity, and has the potential to improve decision quality, enhance policy legitimacy, and build trust in institutions (Bull *et al.*, 2008; Petts, 2004). Such deliberative practices can take various forms, including DPs, citizens' juries, and consensus conferences, and scenario development (Lehtonen & Kern, 2009; van de Kerkhof, 2006).

DPs are expected to overcome the limitations of traditional public opinion polling by integrating deliberative processes. Traditional polls have the limitation of being static, revealing only snapshots of public opinion while respondents are generally ill-informed. In contrast, quantitative analysis of the pre- and post-deliberation questionnaires of DPs can provide public opinion that is not only representative, but also more accurately reflect the considered and informed opinion of the public (Fishkin *et al.*, 2010).

Many countries, including Germany, France, and the Netherlands, have engaged in deliberative participation in the search for energy transitions (Kern and Smith, 2008; Schneider, 2013; Schweizer *et al.*, 2014). Such practices are emerging but have remained limited in Asia (Lee *et al.*, 2014).

2.5.Knowledge gaps

There are several knowledge gaps in the energy transition literature and in the Asian context that need attention. First, there is a lack of a firm understanding of the social aspects of energy transitions, particularly from the specific perspectives of consumer engagement and public acceptance. The theoretical linkages between consumer engagement and deliberative governance in the context of energy transitions have not be well developed. Second, the use of DPs is an innovative technique of public engagement in complex energy policy issues needed to be tested in context beyond the democratic-country settings in the West. The literature on energy transition and deliberative participation is mainly rooted in the West (e.g. from international and European perspectives (see for example, Kern and Smith (2008), Lehtonen and Kern (2009) and Petts (2008)). This has resulted in major knowledge gaps concerning Asian countries, which differ from their Western counterparts in their institutions, regulations, energy profile and issues, as well as public controversies (Berman *et al.*, 2010; Mah *et al.*, 2013). Third, there is a lack of systematic cross-national studies on energy transitions and deliberative governance. Fourth, there is a gap in the Asian context. Fifth, the significance of multimethod approaches for research have been increasingly acknowledged, but research combining quantitative and qualitative methods is still lacking (Winskel *et al.*, 2015). Our analysis combines quantitative data with qualitative data and could potentially add significant value in the field of sustainable energy transitions.

3. Methodology

3.1. A comparative analysis of two pilot DPs

This paper presents a comparative analysis of two pilot DPs on dynamic pricing and DSM conducted in Guangzhou, China and Kyoto, Japan *(Figure 2)*. When compared with a single case study approach, this comparative-cases approach can enhance both internal and external validity of the observed phenomenon of deliberative processes and outcomes across the two selected Asian cities (Chesbrough and Burgelman, 2001). Our comparative perspective is also of scholarly importance because cross-national comparisons have been lacking in the fields of energy-related innovation systems and deliberative governance (Lin *et al.*, 2013).

By comparing participants’ responses in these two pilots, we attempted to answer the following questions:

a) What were young people's (most) preferred tariff options? Did they change in their support after deliberation (i.e. after evaluating strengths, limitations, and risks of different tariff options)? Did they prefer not to change even after deliberation?
b) Why were young people supportive to particular tariff option(s)? What were their concerns over various tariff options?
c) Can differences in national and socio-economic contexts explain some of the observed phenomenon?

3.2.Pilot in nature with a focus on undergraduate students

Our two pilot DPs were conducted in the formats of a one-day deliberative workshop. The Guangzhou DP took place in Sun Yat-sen University in Guangzhou (GZ) in March 2016 while the Kyoto DP took place in Kyoto University in Kyoto (KY) in January 2017, each with 47 undergraduate participants (Figure 2).

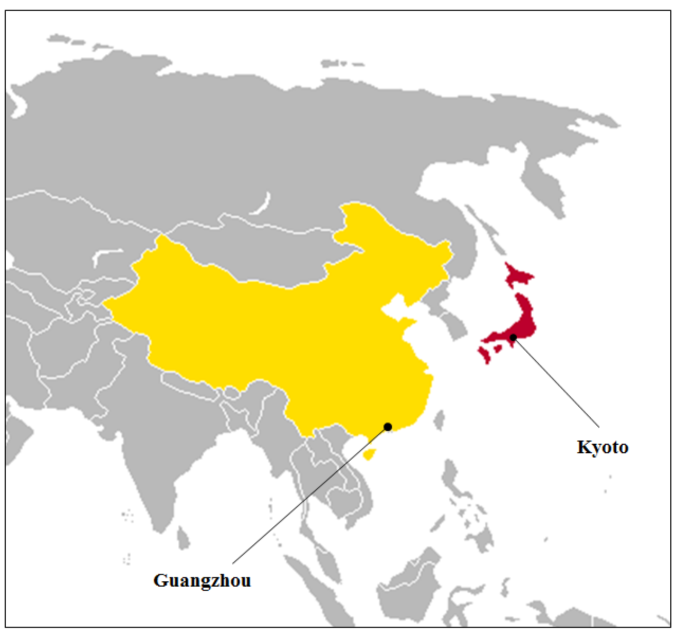


Figure 2. Geographical locations of Guangzhou and Kyoto.

Compared with full-scale DPs which typically involve at least 250 random sampled participants, our study which is small in scale and focuses only on undergraduate participants cannot claim statistical representativeness and has limits in generalizing findings to the local population of GZ or KY. Our approaches are however adopted for two reasons. First, these approaches allow us to optimize the quality of the study under our budget constraints and logistical challenges. Undergraduates from these two universities were chosen because they were relatively accessible to the project's local collaborators.

Second, undergraduate students are a major sub-group of the public, and our study can contribute to the broader literature on stakeholder perception of energy transitions. The young population, including university undergraduate students and secondary students (see, for example, DeWaters and Powers (2011)) have increasingly attracted scholarly interests in energy studies. We studied undergraduate students for a number of reasons. Undergraduate students may become household decision-makers in a near future and would be in charge of energy-related and financial decisions in their households (Kalkbrenner and Roosen, 2016). Our findings may therefore contribute to the literature on prospective household decision-makers. In addition, this focus is particularly relevant to our understanding of the applicability of deliberative practices beyond the West. Research evidence suggests the younger population seems to possess a less complex, narrower set of energy policy expectations than older populations who tend to exhibit a broader array of expectations which reflect a more sophisticated understanding of the elements which influence energy policy (Valentine *et al.*, 2011). Our focus can therefore provide us an opportunity to understand how undergraduate students perceive different pricing options, and whether, how, and why their perception may change after deliberation. It is therefore important for this study to test the applicability of DPs as a governance practice that would shape young people's perspectives in ways that may foster energy transitions. Furthermore, the role of tertiary institutions in fostering sustainability transitions has attracted increasing attention (Trencher *et al.*, 2013; Yarime and Tanaka, 2012; Yarime *et al.*, 2012). Our study can therefore contribute to this emerging theme of literature by enriching our understanding of undergraduates' perceptions of an important energy policy.

3.3. Formats, sampling, and recruitment of the pilot DPs

While these pilots were relatively small in scale and cannot claim statistical representativeness, they comprise *all* key and essential elements of DPs. Participants received a briefing document and completed a pre-deliberation questionnaire approximately one week prior to the one-day DP. During the DP, participants had the opportunity to engage in dialogues in two one and a half hours small group sessions and two one and a half hours expert Q&A sessions where were all moderated by trained moderators.

In the first small group discussion, participants focused on comparing five electricity tariff options (which include flat-rate, tier-based, time-of-use, critical peak, and real-time tariffs) and weighing the strengths, weaknesses and risks of each tariff structure. Questions that arose from the first small group discussions were subsequently raised to experts during the expert Q&A session. Each small group was allowed to raise two questions shortlisted by their group members. In the second small group discussion, participants focused on discussing the future of the electricity tariff in GZ or KY. As such, participants had the opportunity to ask the expert panels questions on different tariff options, received feedback from expert panelists, and then reflected on his or her own opinions of tariff options. At the end of the DP, participants completed a post-deliberation questionnaire. An overview of the pilot DPs is provided in Figure 3.

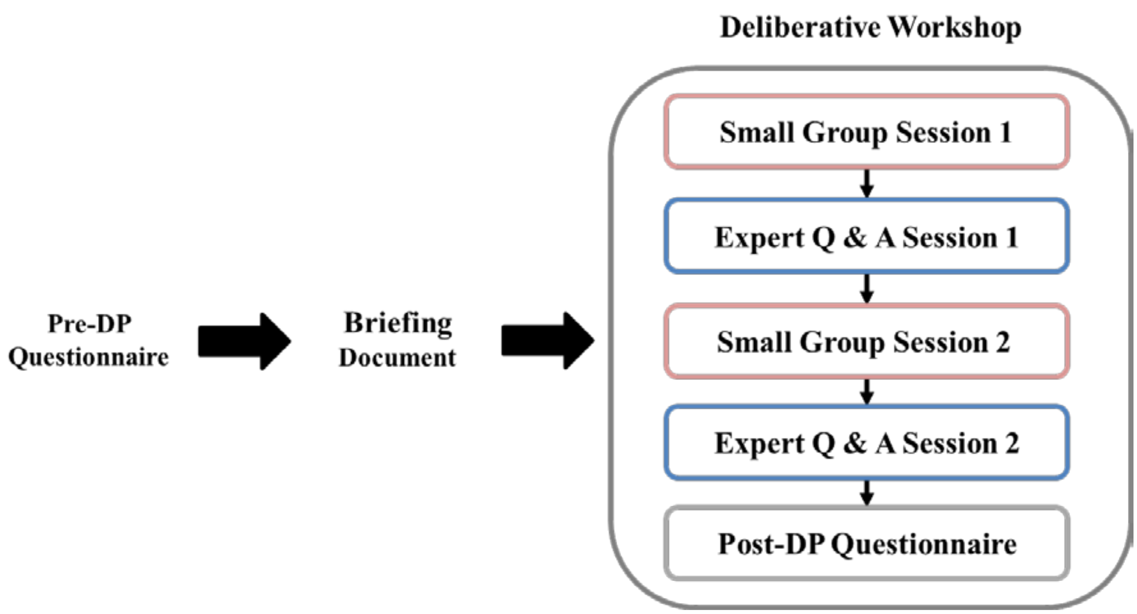


Figure 3. An Overview of the Format of the Project's Pilot DPs.

Pre- and post-deliberation questionnaires were designed to track participants' perceptions of (i) energy goals, (ii) approaches to solving energy problems, (iii) DSM as one of the solutions to reduce energy consumption; (iv) different dynamic pricing options, and (iv) different scenarios on pricing options prior to and after the workshop. Post-workshop questionnaires included an additional section for participants to reflect on the DP process.

DP normally requires the use of random sampling. But, as our pilot DPs were not full scale projects, other sampling methods were employed. However, to ensure methodological consistency between the two pilots, we adopted similar methodological approaches for sampling and recruitment (Tables 2, 3a and 3b): in each pilot, the project team and local research collaborators first conducted quota sampling to determine the proportional number of undergraduate students to be recruited in consideration of the distribution of students across major disciplines and gender ratio, and then recruit students in campuses of their respective university.

There were two relatively minor discrepancies associated with the sampling and recruitment methods in the DPs. First, the KY sample and recruited participants had a disproportional number of males over females which reflected the population makeup of the university (Kyoto University, 2017), and the number of recruited participants either surpassed or fell short of the targeted sample by faculty (Table 3b). Second, the recruitment process differed in some ways: the GZ sample was recruited by visiting school classrooms. The remaining participants were recruited by promoting the DP over social media outlets or by referral. The KY sample was recruited by a cluster method with the help of six recruiters who each recruited 5 to 20 students. Recruiters targeted students with diverse academic backgrounds and political views.

To sum up, the final number and composition of participants reflected an effort to gain a diversity of undergraduate views, set against the resources available to the project both to convene the DPs, generate quantitative questionnaire data and qualitative transcription data, and analyse the data in a timely but sufficiently detailed manner. Different recruitment methods were needed in order to address some logistically difficulties in recruitment in the local context. It is important to note that both GZ and KY samples generally reflect the demographics of the sampled university populations.

Table 2. An overview of the Guangzhou and Kyoto DP workshops.

	Guangzhou	**Kyoto**
Deliberation Date	19 March 2016	14 January 2017
Location	South Campus, Sun Yat-sen University	Yoshida Campus, Kyoto University
Campus Population	7,910[1]	13,374
Sampling Frame / **Participant Demographics (gender; school/faculty distribution)**	By proportional representation by size based on campus population (table 2a)	By proportional representation by size based on campus population with weighting given to females due to low numbers (Table 2b)
Recruitment Method	Campus recruitment in one day, 3 March, 2016	Cluster recruitment from 2 January-12 January, 2017
Participants	47	47
Number of Small Groups (participants per group)	5 (8-10 each)	4 (12-13 each)
Expert Panels	• Total of three experts • One senior executive from China Southern Power Grid), one senior executive from a local electricity distributor company; and one academic who has an expertise in energy policy in China	• Total of three experts • One local utility expert from Kansai Power Electric Company (KEPCO) and two academic, one in socio-environmental sciences and one in energy scenario development and analysis
Moderator Background	6 postgraduate students (5 moderated and 1 as backup and assistance)	3 postgraduate students and 1 university lecturer

[1]The total targeted sample of the Guangzhou pilot was reduced from originally 50 to 48. This was because after determining the initial sampling of 50 students, the local research collaborator found out that students from the Department of Psychology and School of Education did not have classes at South Campus; therefore, these students were excluded from the school target population and sample size.

Table 3a. The sample and recruitment at Sun Yat-sen University for the Guangzhou DP (*n* = 47).

Faculty/School	Sample (n)	Sex		Participants (n)	Sex	
		Male	Female		Male	Female
Liberal Arts	1	0	1	1	0	1
Humanities	3	1	2	3	1	2
Chemistry and Chemical Engineering	8	7	1	7	6	1
International Studies	1	1	0	1	1	0
Geography and Planning	4	3	1	4	3	1
Foreign Languages	2	1	1	2	1	1
Lingnan	4	3	1	4	3	1
Mathematics and Computational Science	7	2	5	7	2	5
Physics and Engineering	7	4	3	7	4	3
Life Sciences	6	1	5	6	1	5
Sociology and Anthropology	4	3	1	4	3	1
Medicine	1	0	1	1	0	1
Total	**48**	**26**	**22**	**47**	**25**	**22**

Table 3b. The sample and recruitment at Kyoto University for the Kyoto DP (*n* = 47).

Faculty/School	Sample (n)	Sex		Participants (n)	Sex	
		Male	Female		Male	Female
Integrated Human Studies	2	2	0	4	4	0
Letters	4	3	1	3	2	1
Education	1	1	0	2	2	0
Law	6	5	1	8	6	2
Economics	4	4	0	6	5	1
Science	5	5	0	6	5	1
Medicine	5	4	1	0	0	0
Pharmaceutical Sciences	2	1	1	0	0	0
Engineering	16	15	1	14	14	0
Agriculture	5	4	1	4	3	1
Total	**50**	**44**	**6**	**47**	**41**	**6**

3.4. Data collection and analysis

This study adopts a mixed-method approach, using both quantitative and qualitative methodologies. Our analysis focuses on quantitative data that we collected from pre- and post-DP questionnaires, complemented by qualitative data derived from transcriptions of small group discussions and expert panel sessions at the two pilot DPs. We use quantitative data from the questionnaires to track changes in participants' views on tariff options after deliberation. Qualitative data is used to understand participants' views, in particularly why and how they form their perceptions. This mixed-method approach has been perceived as a valuable and important way to derive combined insights into observed phenomena.

In relation to the qualitative data, small group discussions and expert panel discussions of the two pilot DPs were all audio-taped. Full (verbatim) transcription of the GZ DP was conducted and summary transcription was done for the KY DP. There has been an on-going debate whether it is necessary to transcribe all audio-recorded interview data verbatim, particularly in relation to mixed-method investigations (Halcomb and Davidson, 2006). Verbatim transcriptions, which refers to word-for-word written reproduction of the words spoken in the audio-recording, are regarded as critical in establishing the trustworthiness of the transcript (Halcomb and Davidson, 2006; Poland, 1995). They are however, often time-consuming and resource intensive, and are also subjected to transcriber errors such as misinterpretation of content and cultural differences (Halcomb and Davidson, 2006; Poland, 1995). In contrast, summary transcripts, as what we have conducted for the KY DP, which provide key words and points, may be sufficient for providing rich and detailed data for required levels of analysis of specific studies (Halcomb and Davidson, 2006; Poland, 1995).

In this study, qualitative data is used to supplement quantitative data in our analysis. We perceive that summary transcripts are sufficient for this level of analysis. In consideration of the relative merits of these two types of transcripts and our budget constraints, summary transcriptions instead of verbatim transcriptions were produced in KY DP (McLellan *et al.*, 2003).

In order to ensure the quality of the summary transcriptions, two measures were adopted. First, approximately one-fifth of the summary transcripts were spot checked by a fluent Japanese-English translator. The spot-check results suggest that generally as much as 80% of texts of those spot-checked sections were effectively summarized, and the summary transcriptions are thus sufficient for providing detailed enough data for our qualitative analysis. Second, the summary transcriptions were triangulated with direct observation of three authors of this paper who participated in the event to ensure that the summary transcription is sufficiently detailed for our analysis on particular elements of the observed phenomena.

4. Our case study contexts

4.1. Energy, social, and political contexts of China and Japan

China and Japan merit study because they share many of the challenges of ensuring public acceptance in energy transitions as found in other major economies such as the US, France, and Japan. These challenges include: i) nuclear choices (concerning, for example, new builds, project extension, as well as decommissioning) have to be made while public often react strongly against governments or project proponents or operators' decisions; ii) major uptake of renewable energy can be highly political sensitive because of rising electricity prices; iii) large potential of DSM is often under-realised due to the indifference of the public and a broad range of institutional and social barriers.

China and Japan are politically and socially distinct. While Chinese energy decision-making has been characterised as an authoritarian governance system (Lo, 2014), Japan has had a longer tradition of an inclusive and open energy decision-making systems (Mah *et al.*, 2013). It is however important to note that deliberative approaches to energy decision-making are being adopted in these two Asian countries, with their contextual features defining the opportunities of as well as constraints to the applicability of deliberative participation in the local contexts.

An emerging literature suggests that deliberative participation has already emerged in authoritarian China in various public policy areas (e.g. the price of water and even taxi strikes) at both national and local levels (Fishkin *et al.*, 2010; He and Warren, 2011). A recent example is a DP concerning local budget issues in Shanghai, conducted in 2015 (Han *et al.*, 2015). Japan is relevant to this study because it is a pioneer in Asia in exploring the possibility of using deliberation to enhance energy decision-making. In response to the energy challenges after the Fukushima nuclear accident, the Japanese government conducted its first national DP on energy and nuclear plan (which is the first of its kind in Asia) in August 2012 – seventeen months after the Fukushima accident took place – to collect public views on the country's energy future by 2030 (Aldrich, 2013; CDD, 2012).

4.2.Guangzhou and Kyoto contexts

Guangzhou and Kyoto are two major Asian cities which offer different economic, socio-political contexts for examining the youths' perception associated with dynamic pricing (Table 4). Guangzhou, located in the southeast of China, is a highly populated city with a GDP of about US$270 billion. Traditionally as a manufacturing hub, Guangzhou has emerged rapidly in recently years as China's southern business hub and industrial center (HKTDC, 2016). Kyoto, located in the Kansai Region, is a much less populated area but is one of political significance. Formerly the Imperial capital of Japan for more than one thousand years, this city has emerged as hubs of information technology, electronics, and tourism. Kyoto is home to the headquarters of Nintendo and Nissin Electric (Nintendo, 2017; Nissin Electric, 2017).

Although Guangzhou and Kyoto are distinctive in many aspects, these two cities and their situated province or region share similar energy challenges that rooted from their fossil fuel-based electricity sectors. Guangdong is the largest electricity consumer among all Chinese provinces with its electricity consumption reached 531 billion kWh in 2015 (NBS, 2016). Due to electricity shortage, Guangdong province historically endured blackouts, notably during two large power shortages in 2004 and 2011 in China (GZPS, 2015a, 2015b; Liang, 2006; SCMP, 2005). Guangdong has also remained as one of the most polluted areas in China with a serious problem of air pollution. Guangdong has also been the site of several controversial nuclear power plant projects and been protested on NIMBY grounds e.g. Jiangmen (Mah and Hills, 2014).

Similarly, the Kansai Region has been traditionally a major electricity consumer of Japan. Kansai is the second highest in electricity consumption (134.5 TWh) (FEPC, 2016) among the 10 major electricity supply regions in Japan, after the greater Tokyo area. In a broader national context, Japan has historically been dependent on fossil fuel imports, and particularly since the Fukushima nuclear accident in 2011, LNG and coal has had to compensate for the halted nuclear power production in order to satisfy electricity demand in recent years. As the most nuclearized region in Japan, Kansai had nuclear contributing to 45% of the then monopoly KEPCO's fuel mix prior to Fukushima accident, and it is particularly vulnerable to the issues associated with nuclear risks (Nakata *et al.*, 2015). Nuclear contributed to only 1% of the total electricity generated by KEPCO in 2016 (KEPCO, 2017).

Both Guangzhou and Kyoto have responded proactively to the energy challenges by introducing SG-related low-carbon policies. Guangzhou has committed to peak its carbon emissions by 2020 (C40 Cities, 2016). Guangzhou and some of its sister cities in the province are often first movers in SG-related initiatives. In 2012, Guangzhou launched the Pilot Low Carbon City Implementation Plan (C40 Cities, 2016). In 2012, Foshan, a neighboring city, was one of the four pilot cities in China experimenting demand response programmes (NDRC, 2015). Kyoto, on the other hand, has pioneered many of the country's low-carbon initiatives over the past decades. Kyoto was the site of the landmark signing of the Kyoto Protocol dating back to 1997 (Kyoto City Web, 2004). In more recent years, Keihanna Science City, one of the four sites selected for Japan's national smart grid pilot program, is situated within Kyoto Prefecture (PFKRI, 2016).

Table 4. An overview of the political, economic, and energy characteristics of Guangzhou and Kyoto.

	Guangzhou	**Kyoto**
Administrative Status	Sub-provincial city level	Capital city of Kyoto Prefecture
Province/Administrative Region	Guangdong Province	Kansai Region
Provincial/Regional Population (million in 2015)	108.5	21.7
City Population (million in 2015)	13.5	1.475
City Geographical Area (km^2)	7,434	828
Provincial/Regional GDP (2015) (US$ billion)	1,095	789
City GDP (US$ billion)[2]	271.51 (1,810.04 billion yuan (2015))	89.41 (9,825 billion yen (FY 2013))[3]
Provincial/ Regional Electricity Consumption (TWh)	523.5 (2014)	148.2 (FY2014)
Provincial/Regional Electricity Mix	Total installed capacity: 91.1GW (59% from coal, 16% from natural gas, 8% from nuclear, 7% from large hydro, 7% from small hydro, 2% from wind, and 1% from biomass and waste) (2014)	Total installed capacity: 36.0 GW (83% from thermal, 10% from hydro, 6% from nuclear, 1% from renewable) (FY 2014)

Sources compiled by authors from the following sources: Provincial/Regional Population: Kansai-METI (2016) and NBS (2016); City Population: GZBS (2016b) and Kyoto City Web (2016); City Geographical Area: GZBS (2016a) and Kyoto City Web (2008); Provincial/Regional GDP: MIPIM Japan (2016) and NBS (2016); City GDP: HKTDC (2016) and Statistics Japan (2015); Provincial/Regional Electricity Consumption: BNEF (2015) and NBS (2015); Provincial/Regional Electricity Mix: BNEF (2015); KEPCO (2014).

[2] At 1 yuan = $0.15 USD; 1 Yen = $0.0091 USD (7 June 2017)
[3] At the Prefectural level.

4.3. Dynamic pricing in China and Japan

Residential electricity tariff systems have been evolving in China and Japan over the past several decades. Traditional flat-rate systems in these two countries have been gradually modified with the introduction of dynamic-pricing elements. Three distinct phases of the evolution of the pricing systems can be specified in these two countries respectively; indicating that dynamic pricing systems have been evolving at their own pace and has resulted in the implementation of differing forms of dynamic pricing (Figure 4).

In China, Phase 1 refers to the period prior to July 2012 when flat-rate tariff was used. Phase 2 started in July 2012 when China introduced a nationwide three-tiered tier-based tariff (TBT) system for the residential sector in 29 provinces (except for Xinjiang and Tibet) (S. Zhang and Qin, 2015). China was motivated to introduce TBT as a pricing measure to reflect actual costs and external impacts of electricity more effectively. Phase 3 started in December 2013 when the Chinese government introduce a national policy on residential TOU on the basis of TBT (NDRC, 2011). In December 2013, the National Development and Reform Commission (NDRC) announced that residential TOU would be fully implemented nationwide, and local authorities whom have not rolled out such policies must do so by end 2015. Under this national policy framework, residents are expected to be encouraged to participate in shifting peak loads.

Since then, TBT has been generally the basis of the electricity tariff across Chinese households, while the TOU has been a voluntary opt-in electricity add-on tariff to the TBT. Householders can choose to use TBT in combination with TOU, but they must voluntary opt-in for TOU and already have an installed meter for their respective household (NDRC, 2013).

To sum up, TOU has been evolving in China over the last 30 years, and although it is still mainly voluntary for residential users, it is now at the point of being implemented nationwide at the local level. Although its reach is not as far as TBT systems, TOU systems has been applied to residential in small scale, and in a relatively larger scale in commercial and industrial sectors (T02).

Similarly, three distinct phases of tariff reforms can be specified in Japan (Figure 4). The first phase refers to the period prior to 2008 when a flat-rate tariff was adopted across household consumers in Japan. Phase 2 started in January 2008 and ended in April 2016. Similar to Phase 2 of tariffs in China, TBT remained as the basis of the electricity tariff across Japanese households but residential consumers can voluntary opt-in to TOU tariffs if such alternatives were made available by their electricity suppliers (which were geographical monopoly). Phase 3 started in April 2016 and was marked by the full liberalization of retail market in Japan. As a defining feature of this latest round of electricity market reforms in this country, retail electricity markets have been fully liberalised. While opt-in TOU with tier-based tariff prevails, residential consumers can now choose their own electricity suppliers. There has been an increasing, though still a small proportion, of residential consumers shifted to new electricity suppliers in Japan. While the national data is no accessible to this study, the experience in the Kansai region can be indicative. It was recorded that approximately 4% of residential consumers in Kansai shifted away from the once a geographically regional, monopolised Kansai Electric Power (KEPCO) to new electricity suppliers between April 2016 and January 2017 (T13).

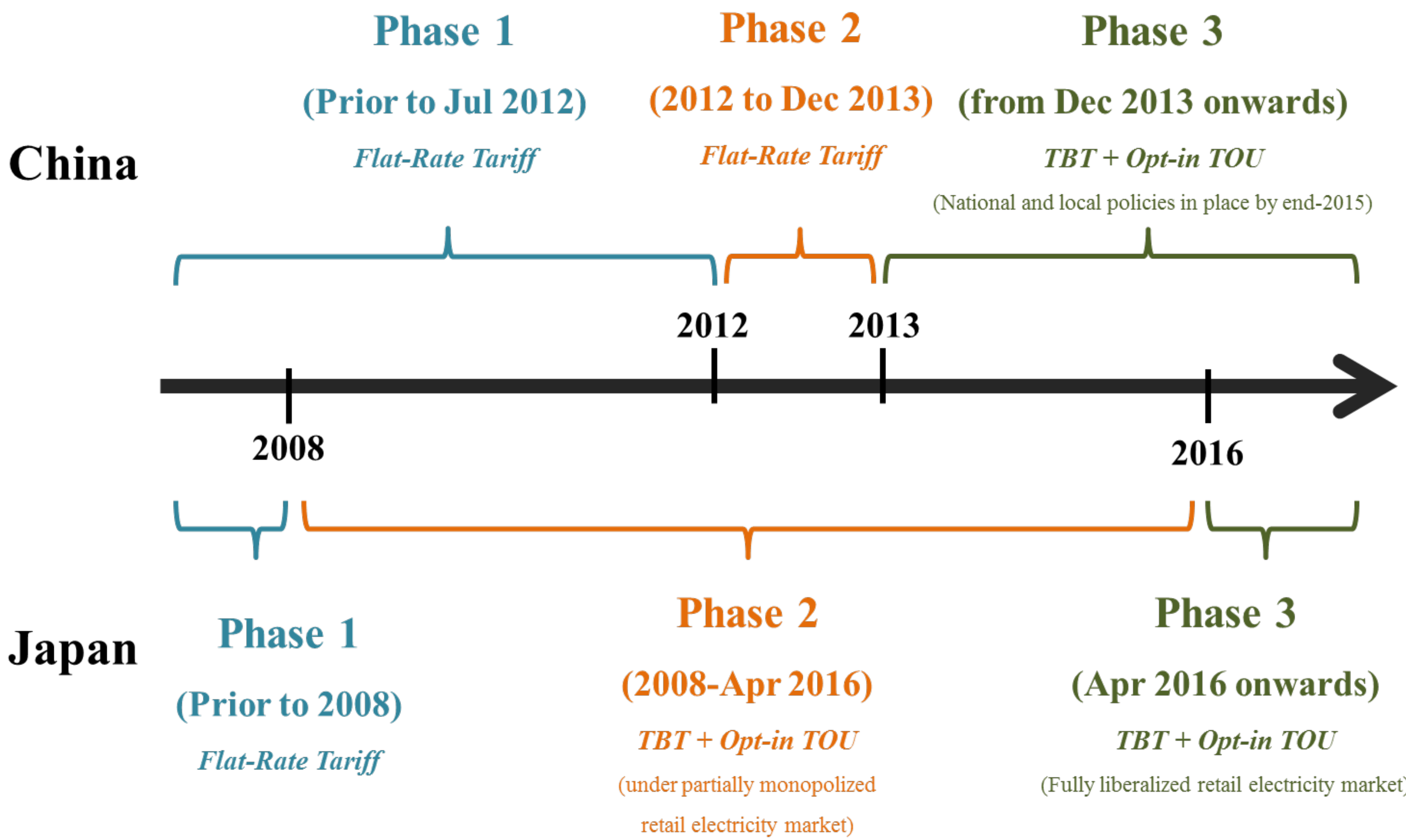


Figure 4. The evolution of electricity tariff systems in China and Japan.

4. Findings

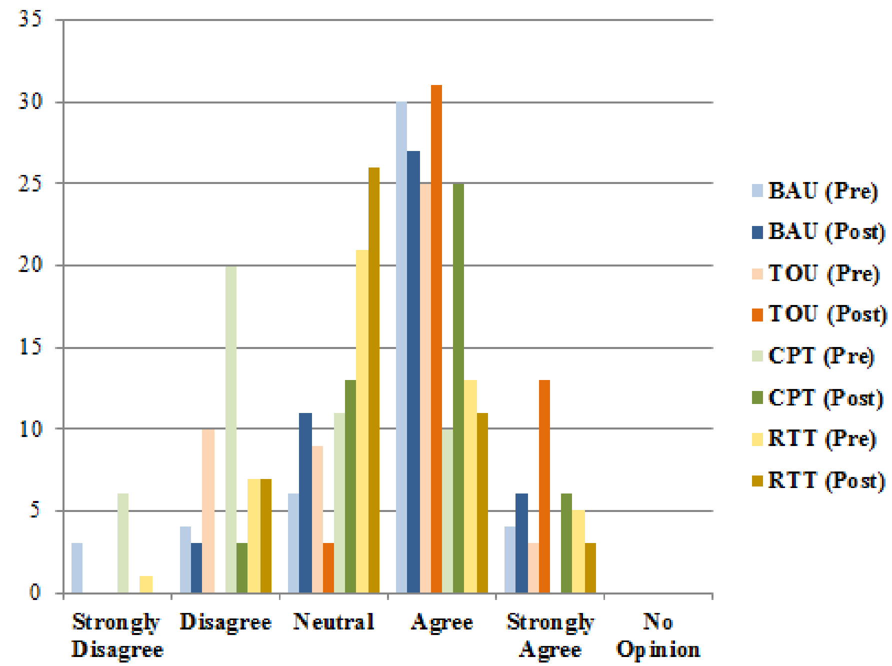
We have six major findings as follows:

4.1. Most participants were supportive to the status quo while many also welcomed new tariff plans.

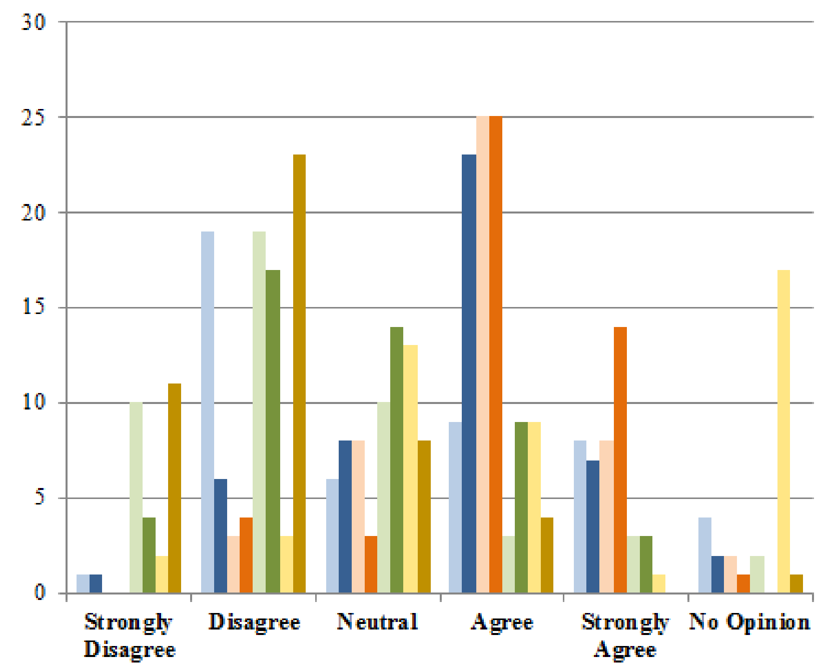
The first finding is that a large number of participants were supportive of the status quo tariff system. We asked participants their perception of different electricity pricing options *both before and after* the workshop through questionnaires. Responses have been consistent between GZ and KY participants, as well as before and after deliberation. Our finding shows that there were a large number of participants supportive to the status quo pricing system (Business-as-Usual) while many also welcomed new pricing options, most notably TOU systems (Figure 5).

Before deliberation, in GZ, the Business-As-Usual (BAU) scenario (i.e. a tier-based system with opt-in TOU) received the highest number of support (n = 34). In KY, BAU received the second highest number of support (n = 17). After deliberation, support for BAU remained steady in GZ (n = 33) and sharply increased in KY (n = 30).

Participants also welcomed new tariff plans even before deliberation: a majority of participants supported TOU (n = 28 in GZ and 33 in KY), and a moderate number of them supported RTT (n = 18 in GZ and 10 in KY) and CPT (n = 10 in GZ and 6 in KY). After deliberation, there was a noticeable increase of participants supported new tariff plans such as TOU (n = 44 in GZ and n = 39 in KY) followed by CPT (n = 31 in GZ and n = 12 in KY). Fewer participants supported RTT (n = 14 in GZ and n = 4 in KY). The change in attitude after deliberation is discussed in details in Finding 2.



(5A)



(5B)

Figure 5. GZ (5A) and KY (5B) participants' response to what extent they would want to make these tariff options available in GZ or KY before (pre) and after (post) deliberation.

4.2. Participants' acceptance of complex and sophisticated energy policy options increased after deliberation

We found that deliberative processes can increase participants' acceptance of complex and sophisticated energy policy options, i.e. the more sophisticated tariff options of TOU and CPT. We asked participants the extent to which they agreed to making the four tariff options available in their city. There was a discernable increase in support for TOU and CPT in both locations (Figures 5A and 5B). [4] Prior to deliberation, there was moderate support for TOU (n = 28 in GZ and 33 in KY) and low support for CPT (n = 10 in GZ and 6 in KY). After, deliberation, Guangzhou participants' support for TOU (n increased from 28 to 44) and CPT (n increased from 10 to 31) significantly increased while Kyoto participants' support for TOU (n increased from 33 to 39) and CPT (n increased from 6 to 12) modestly increased.

4.3 Mixed outcomes in participants' choices of pricing options reveal the complexity of public perception of dynamic pricing

Our DP results showed that deliberation yielded mixed outcomes in changing participants' choices of tariff options. While Finding 2 suggests that deliberation tended to increase participants' accept to more sophisticated tariff options, this finding has to be interpreted with caution.

When participants were given an opportunity to choose from different tariff plans, a majority of GZ and KY participants chose to remain with the status quo tariff option. After deliberation, GZ participants' support for business-as-usual (BAU) remained steady (n = 34 to 33). Meanwhile, there was a noticeable increase in KY participants' support for BAU (n = 17 to 30) (Figure 5).

Our findings suggest that participants in both DP were generally conservative about tariff options, and they tended to remain status quo. Our qualitative data from workshop transcriptions suggest that a broad range of concerns may discourage participants from adopting new tariff systems.

In GZ DP, some of these concerns related to implementation challenges of time-based tariffs. One GZ participant raised some equity concerns about the use and flexibility of electricity between the rich and the poor (e.g. the rich may be more adaptable and have higher capacity to pay for electricity use at time-based periods) and the conflict between peak-time charges and practical household needs (e.g. they need to prepare dinner at a specific time) (T06). In KY, one

[4] Numbers reported in this finding are expressed as aggregate numbers of 'strongly agree', 'agree', and 'disagree', 'strongly disagree' responses.

participant highlighted that because Kyoto has diverse groups of people (e.g. elders, parents, students, and tourists) and everyone has different energy patterns, it may be more reasonable to open electricity tariff options for everyone to choose as their liking, such that those who prefer time-based tariffs can choose the tariff that best suits them while those who do not can remain within the current tariff system (T17).

In addition, there were serious concerns over smart meter installation and application. Three of the GZ small groups were concerns about the installation costs of smart meters (T05, T07, and T09). Some GZ participants also raised issues over the risk of smart meter reading inaccuracies (T09), privacy and cyber security (T10, T12). While KY participants did not explicitly mention smart meter concerns, one participant did wonder about the popularity of smart meters (T13).

4.4. After deliberation, participants perceived themselves as better informed, being able to weigh trade-offs, and reflect on his or her own trade-off decisions

Our findings are consistent with the literature on deliberative participation that dialogic processes and deliberative formats appear to enable the participations to become informed, to be more competent in weighing tradeoffs, and subsequently allowed them to reflect on his or her own trade-off decisions.

We asked participants to complete a post-workshop questionnaire in which they reflected on the effectiveness of the DP. Participants also agreed that the dialogic design of these two DPs, notably the small group discussion and expert Q&A (plenary) sessions, useful (Figure 6). A majority of them found the small group discussion facilitated learning from different participants (n = 40 and 46 respectively).[5] A large number of GZ (*n* = 35) and KY (*n* = 36) participants found the expert Q&A session to be useful (Figure 7). Participants agreed that the expert Q&A sessions facilitated their own learning (*n* = 40 in GZ and *n* = 45 in KY) as well as the discussions in the small group (*n* = 40 in GZ and *n* = 39 in KY).

[5] Numbers reported in this finding are expressed as aggregate numbers of 'strongly agree', 'agree', and 'disagree', 'strongly disagree' responses.

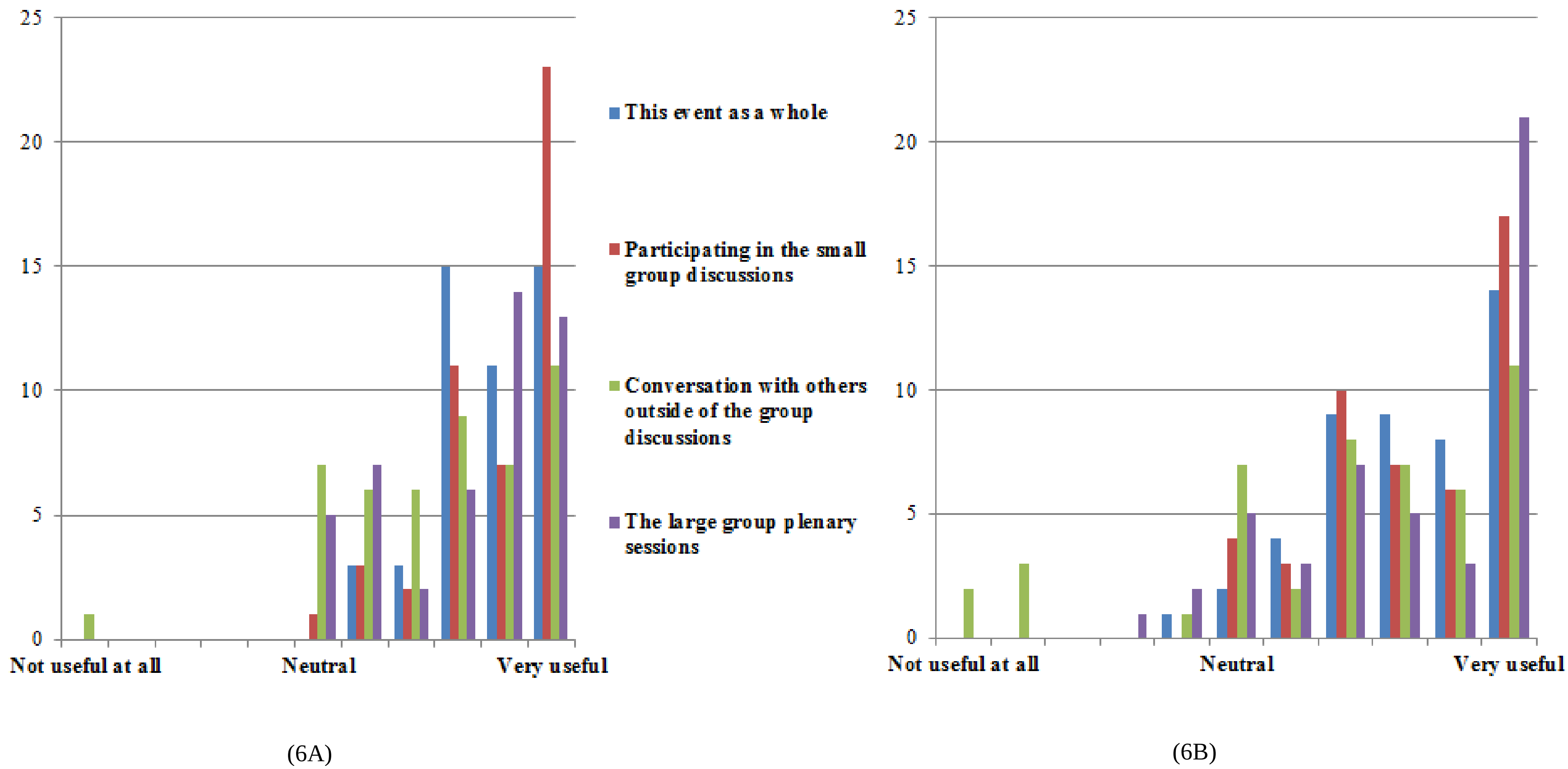
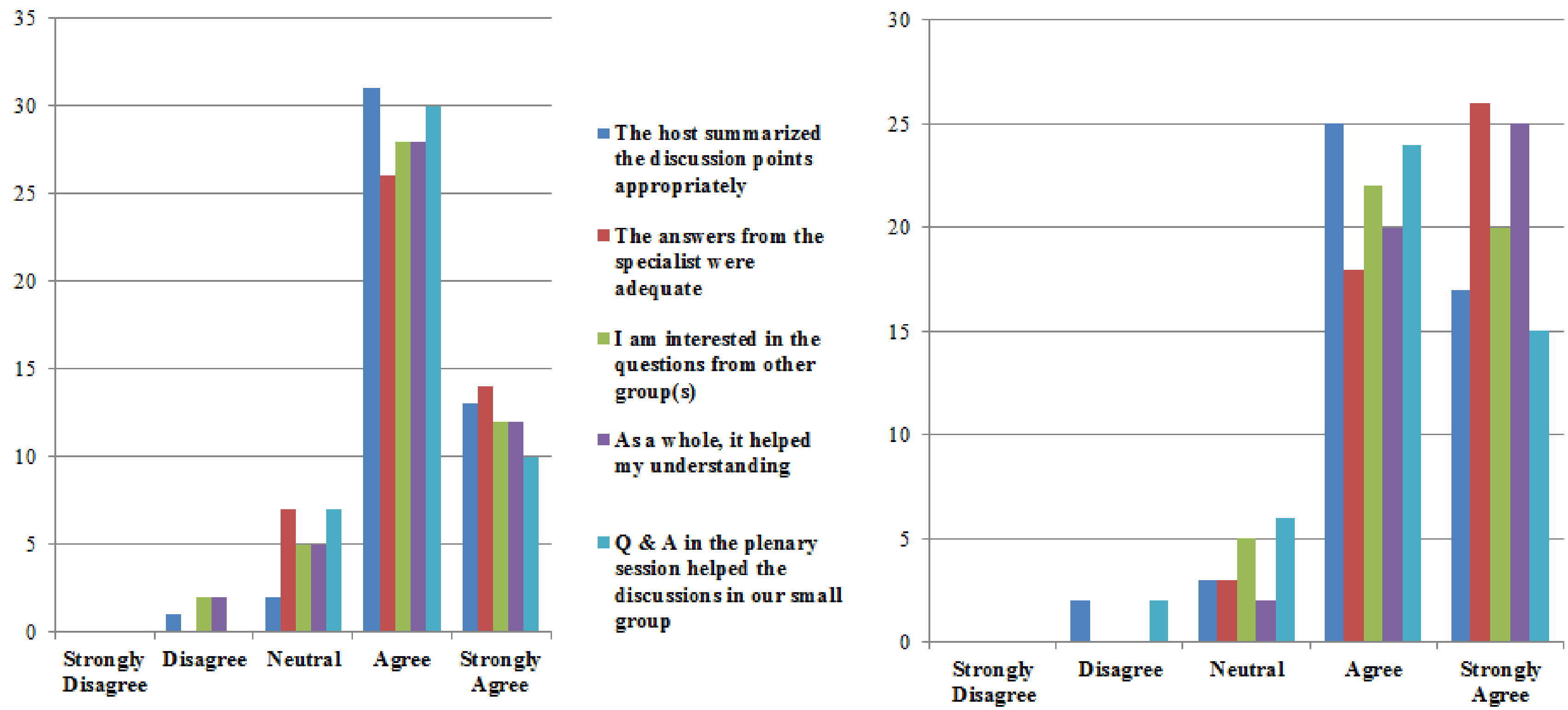


Figure 6. GZ (6A) and KY (6B) participants' response to the usefulness of the various aspects of the workshop.



(7A) (7B)

Figure 7. GZ (7A) and KY (7B) participants' response to their opinions on the content and process of expert Q&A sessions.

Small group sessions and expert Q&A sessions of the DPs were carefully structured and moderated in order to facilitate participants to discuss not only the potential benefits, but also costs and risks associated with various tariff options. Our findings suggest that these deliberative processes enabled our participants, at least to a certain extent, weigh trade-offs and then reflected on his/her own views on tariff options (Figure 8). Most participants in both GZ and KY DPs agreed that they could understand complicated issues (*n* = 42 for GZ; *n* = 38 for KY). Almost all GZ and KY participants' agreed that their opinions became clearer (*n* = 44 for both GZ and KY). In addition, qualitative data derived from direct observations of the project team and workshop transcriptions is consistent with this observation. In various sessions, GZ and KY participants raised a number of questions regarding each pricing option's key features, strengths, weaknesses, risks, and applicability in other countries as well as their own.

In GZ workshop, one participant asked, *"how do we manage the conflict between electricity consumers using RTT and investment that the utility has made? Can you please provide some examples? It looks like developed countries have not widely implemented them, or have not implemented them at all."* (T01).

Another GZ participant asked, "*For RTT, aside from the installation of smart meters, what are the other costs?*" (T02).

In the KY DP, one participant asked in the afternoon Expert Q&A session, "*I think that the response of electricity consumers is generally important, especially when it comes to freely choose our electricity supplier, and whether the use of renewable energy gets priority. Some might think Option 1 (BAU) is unfair, so how would they would feel about the unfairness in Option 2 (TOU) and Option 3(CPT)*?" (T13)

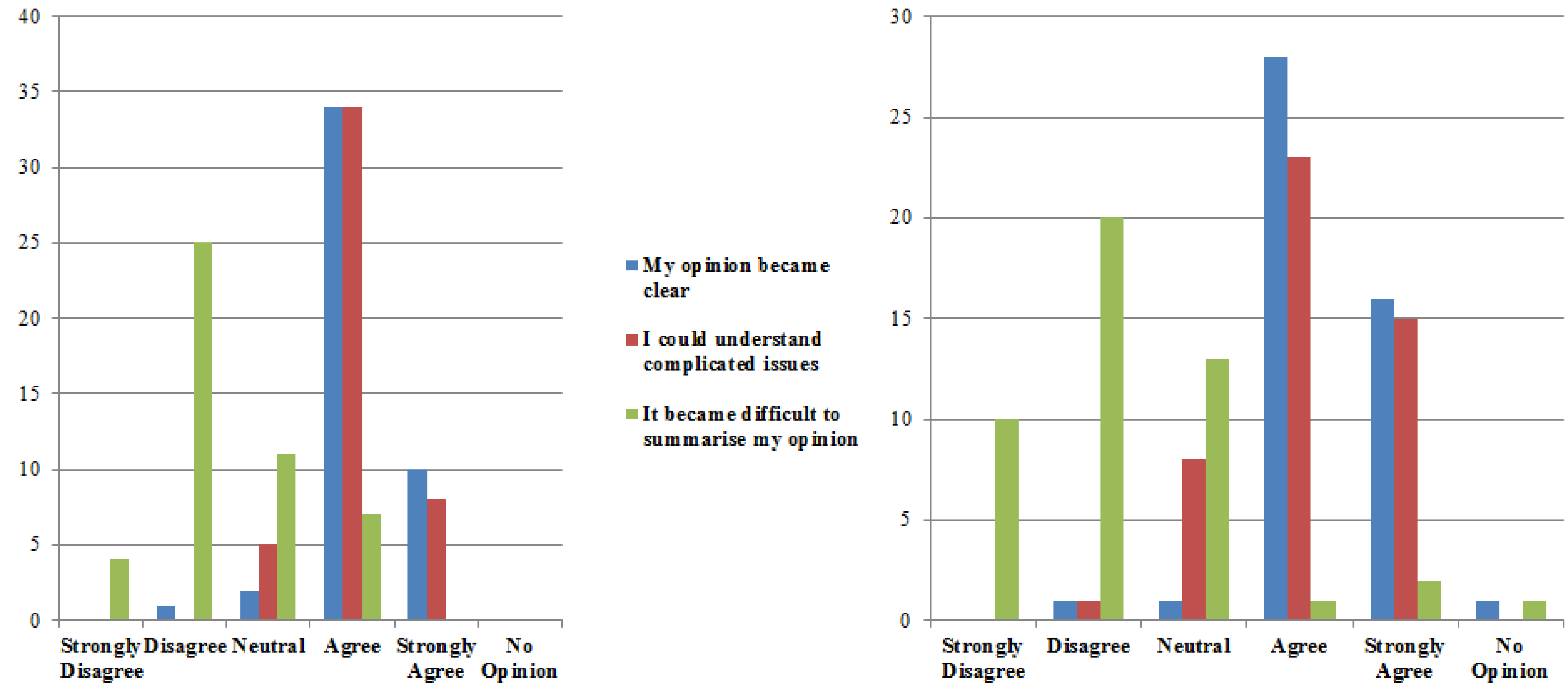
Generally, in response to questions asked during the expert Q&A sessions, experts in both pilot DPs were able to provide clarifications and elaborations on issues raised by participants, and shared their own views on how tariff options may be applied in the respective electricity sectors.

Qualitative analysis from our transcripts suggests that some participants were able to develop reasoning for his or her views by drawing on the comments by some experts. For example, one GZ participant developed his arguments against TOU. Based on how experts stated that a noticeable difference between the tariff at peak and off-peak periods in TOU must be evident. This is an illustrative example that shows that the deliberative processes enabled participants to formulate questions which were derived from reasonable concerns, and thus contributed to rational debates on controversial matters.

In summarizing their discussions, a GZ participant stated, *"…we think that the price difference between peak and off-peak periods for TOU must be high…but for example, if the peak period is* *during noontime, I also have to prepare food for some people, wouldn't this higher electricity price make it unfair for some groups such as the residents*?".

The expert then responded, *"…I believe that setting the right price difference between peak and off-peak periods is the best way to modulate electricity consumption. For residents, this may mean postponing cooking and using electric appliances by about an hour. If there is only a one-time difference between peak-time and off-peak periods, then you might not care about it. But if there is a 5- times difference between peak and mid-peak periods, they may choose to use electricity during the mid-peak period…"* (T01).

This finding can have important implications on energy policy-making because they show how a group of the engaged public may change their energy decisions on a complex subject matter after undergoing intensive learning and deliberative processes.



(8A) (8B)

Figure 8. GZ (8A) and KY (8B) participants' views on the effectiveness the DP events.

4.5. Key questions raised by DP participants showed young people were able to raise a broad range of concerns and asked well-formulated questions

We summarized and categorized compared the key questions raised by GZ and KY participants during expert Q&A sessions (as presented in Table 4). By identifying similarities and differences of questions and concerns raised by GZ and KY participants, we have several observations:

First, the areas of common concerns raised by the GZ and KY participants are many. These concerns include peak shifting, electricity tariffs, electricity generation, electricity consumption, electricity market, and information accuracy issues.

Second, participants in both DP showed serious concerns about the feasibility and effectiveness of TOU. In GZ and KY small groups, one of the re-occurring concerns was the effectiveness of dynamic pricing options such as TOU in shifting peak load, noting that industries, rather than households, are the main drivers of electricity demand in both Guangdong and Kansai.

Third, they were concerned about the implementation challenges as well as effectiveness in realizing peak shaving. They shared deep concerns about the effectiveness of new pricing options. In GZ and KY small groups, one of the re-occurring concerns was the effectiveness of dynamic pricing options such as TOU in shifting peak load, noting that industries are the main drivers of electricity demand in both Guangdong and Kansai. Both GZ and KY participants raised questions on the purposes of, potential applications, and potential benefits of peak shift if new pricing options are adopted. They were also keen to learn experiences from previous demonstration projects and industries which have implemented demand response programmes.

In relation to the nature of the questions raised, it is important to note that participants in both pilots were able to formulate questions concerning complex matters. For example, they raised questions about information accuracy, the progresses and limitations (or even failures) of electricity market reforms.

These questions are categorized and presented in *Table 5*.

Table 5. Main questions raised during Expert Q&A Sessions by categories.

Peak Shift/DSM	
GZ	How can DSM disperse, shift, or minimise electricity? What are the ways (e.g. storage technologies, energy-saving appliances)
KY	What is the outcome of peak shift? Why is there a need to shift or shave the peak?
Electricity Tariffs	
(Specifying details and elaboration)	
GZ	How does the cost of producing electricity under RTT change according to the “real-time” cost, and why does it keep on fluctuating?
KY	When users sign on to a plan, who will explain to them the electricity tariff structures? Is it someone from KEPCO, or a third-party services person?
(Compare and contrast)	
GZ	What are the experiences of consumers using TOU and TBT?
KY	Which electricity tariff option is the cheapest?
(Implementation challenges and effectiveness)	
GZ	What is the effectiveness of implementing TOU, and its effectiveness of households?
KY	Is it predicted that society will be opposed to these tariff options, and how?
Electricity Generation	
GZ	What is the difference in the costs of generation and environmental pollution in peak/additional plants and conventional plants?
KY	What are some real examples of different types of electricity generation?
Electricity Consumption	
GZ	Is the primary cause of peak load due to household or industrial electricity consumption? What kind of electricity tariff structure can be implemented for households, industries and services?
KY	What are some real examples of different types of electricity generation?
Electricity Market	
KY	Has electricity market liberation been successful? Are there cases of failure in electricity tariff structure reform?
Information accuracy	
GZ	Where did the data from peak electricity use come from? What are the criteria used to determine that?
KY	In Options 2 and 3 indicated on pages 20-21, Option 2 states that “Peak reduction and shifting effects are clear” but why is it clearly indicated in Option 3?

4.6. National level cultural differences may explain heterogeneity of concerns and responses among young people in these two cities

There are two noticeable differences between the responses from the GZ and KY participants. First, our qualitative workshop data show that KY participants appeared to be more sensitive to a fair distribution of potential benefits from energy savings between utilities and residential end-users. GZ participants, in contrast, did not raise questions of this nature.

A KY participant asked the following question at the Expert Q&A session: "*How would the benefits from cost saving through DSM be shared? Would utilities get the most money? Or residential end-users*?".

Secondly, cultural differences in KY participants appeared to be more receptive to more radical changes in tariff options. TOU, followed by BAU, was supported by most KY participants as a preferred pricing option (Figures 5A and 5B), followed by BAU, both before and after the deliberative workshop. The data suggests that KY participants strongly supported a more radical progression from BAU (i.e. the current TBT system with opt-in TOU) to a complete TOU system. In contrast, GZ participants chose to remain at the status quo with TOU playing a relative minor role.

Cultural differences that associate with public trust and electricity market liberalisations across these two countries may explain differences in GZ and KY participants' responses. Public distrust in the market regulators and operators of the power sector in Japan has been well documented, and is particularly so after the Fukushima nuclear accident (Fam *et al.*, 2014; Kingston, 2013). On the other hand, the relatively rapid progressions of electricity market reforms may create an environment in which Japanese are familiar with market mechanisms, including the use of pricing systems to incentive DSM. The recent completion of the retail market electricity may send a strong signal to Japanese public that more sophistical tariff options are a prominent energy policy in this nation.

These plausible explanations are consistent with the literature which highlights the importance of national level cultural differences in shaping energy transition pathways. Our finding in particularly sheds light on the role of electricity market reforms, enriching the literature which has identified a range of cultural factors, including individualism, public distrust, and familiarity with market mechanisms (Fam *et al.*, 2014; Mallett *et al.*, 2017)

In addition, the data relates to GZ participants seems to be consistent with the literature that suggests where the young population possess a less complex, narrower set of energy policy expectations, they tend to exhibit a narrower array of expectations on energy policies (Valentine *et al.*, 2011).[6] In China, domestic electricity consumers still have no choice of their suppliers as retail market liberalization is limited. Chinese participants may have therefore less receptive to alternative tariff options which are underpinned by market mechanisms.

5. Conclusions

This research is among the first multi-method studies comparing public perception of dynamic pricing options across Asian cities. We show how undergraduate students in Guangzhou (GZ) and Kyoto (KY) became informed about potential benefits and trade-offs associated with different tariff options, and how they made considered decisions on this complex energy issue after participated in deliberative processes.

This study examined public engagement and public perception of dynamic pricing by conducting a comparative analysis of two pilot Deliberative Pollings (DPs) in GZ and KY. We have made several important contributions to the literature on governance for energy transition. First, by examining public engagement from the perspective of deliberative governance, we built the theoretical linkages between the challenges of managing public perception and deliberative governance as a mechanism for engaging the public in the context of energy transitions. Second, we tested the applicability of DPs which originated and has been more commonly adopted in Western than in the Asian contexts. We found that the normative mechanisms of DP can be applied beyond the West to the Asian context, at least to a certain extent. Deliberative processes in our two pilot DPs appeared to increase participants' acceptance of complex and sophisticated energy policy options after they became more informed about and weighed the associated trade-offs of different tariff options. Third, we enriched the literature by bringing the Asian perspectives on energy transitions with a focus on dynamic pricing policy and deliberative participation. Although this study involved pilots with undergraduate participants in two Asian cities only, our findings provided insights into possible cross-national socio-economic and political factors that may influence energy transition trajectories in these two distinct countries. Electricity market reforms and public distrust are two factors that appear to explain the cross-national differences of participant responses in our two case cities.

Our study also made empirical contributions in the field of energy transitions from stakeholder perspectives. Undergraduates are an important sub-group of the young population, as well as the broader policy stakeholder groups. Our findings enrich the growing body of the literature

[6] Numbers reported in this finding are expressed as aggregate numbers of 'strongly agree', 'agree', and 'disagree', 'strongly disagree' responses.

focusing on young people (see, for example, , Fell *et al.* (2015)), and shed light on how this group of young people perceived different tariff options, their concerns, as well as how and why their perception may change after deliberation.

Our findings have two policy implications. The first policy implication is that our findings shed light on the complexity of public perception on tariff options. One of our most interesting findings is that even when participants were given the opportunities to choose, many of them in both pilots chose to remain with the status quo tariff option even though they seemed to be informed of the limits of Business-as-Usual (no change) as well as the potential benefits of alternative tariff options such as TOU. The KY DP is particularly useful in highlighting the complexity that may occur in weighing the benefits and costs of the tariff options. Although more participants accepted TOU after deliberation, there was a sharp increase of participants supported BAU. Their deep concerns about effectiveness of TOU as well as other concerns were many. These findings suggest that policy makers and other policy stakeholders including utilities need to give sufficient attention to public acceptance while exploring new tariff policies or options.

The second policy implication relates to the importance of deliberative participation in energy decision-making. Our findings shed light on the applicability, potential benefits, as well as challenges of introducing this higher form of participation in improving energy decision-making and enhancing energy governance. The extent to which when, in which areas, and how such participatory approaches could be introduced in desirable ways in the specific national, local, and policy contexts would require sufficient attention.

This study has several limitations which suggest future research directions. First, detailed qualitative analysis of workshop transcripts has yet to conclude. In-depth understanding of several emerging themes from this study, especially new utility-consumer relationships, the role of market regulatory reforms in energy technological transitions, and trust dimensions of energy transition could be further developed with such detailed qualitative analysis in order to enrich the literature in these fields (see, for example, Mitchell and Woodman (2010), Shen *et al.* (2014), and Stephens *et al.* (2017)).

Appendix 1. List of Transcripts and Codes

Guangzhou	
T01	Morning Expert Q&A Session
T02	Afternoon Expert Q&A Session
T03	Small Group A Morning Discussion
T04	Small Group A Afternoon Discussion
T05	Small Group B Morning Discussion
T06	Small Group B Afternoon Discussion
T07	Small Group C Morning Discussion
T08	Small Group C Afternoon Discussion
T09	Small Group D Morning Discussion
T10	Small Group D Afternoon Discussion
T11	Small Group E Morning Discussion
T12	Small Group E Afternoon Discussion
Kyoto	
T13	Afternoon Expert Q&A Session
T14	Small Group A Morning Discussion
T15	Small Group A Afternoon Discussion
T16	Small Group C Morning Discussion
T17	Small Group D Afternoon Discussion

(*some transcripts of KY DP are not yet completed)

References

Aldrich, D. P. (2013). Rethinking Civil Society–State Relations in Japan after the Fukushima Accident. *The journal of the Northeastern Political Science Association*, *45*(2), 249-264.

Barton, J., Huang, S., Infield, D., Leach, M., Ogunkunle, D., Torriti, J., & Thomson, M. (2013). The evolution of electricity demand and the role for demand side participation, in buildings and transport. *Energy Policy*, *52*, 85-102. doi:http://dx.doi.org/10.1016/j.enpol.2012.08.040

Bell, M., Lowe, R., & Roberts, P. (1996). *Energy Efficiency in Housing*. Aldershot, Hants, England : Brookfield, Vt.: Avebury.

Berman, E., Moon, M., & Choi, H., (Ed.). (2010). *Public administration in East Asia: Mainland China, Japan, South Korea, and Taiwan*. Boca Raton, FL CRC Press.

BNEF. (2015). *Guangdong*. New York City: Bloomberg New Energy Finance. http://global-climatescope.org/en/download/reports/countries/climatescope-2015-cn-44-en.pdf.

Broman Toft, M., Schuitema, G., & Thøgersen, J. (2014). The importance of framing for consumer acceptance of the Smart Grid: A comparative study of Denmark, Norway and Switzerland. *Energy Research & Social Science*, *3*, 113-123. doi:http://dx.doi.org/10.1016/j.erss.2014.07.010

Brown, M., & Zhou, S. (2013). Smart-grid policies: an international review. *WIREs Energy Environ*, *2*, 121-130. doi: 110.1002/wene.1053.

Bull, R., Petts, J., & Evans, J. (2008). Social learning from public engagement: dreaming the impossible? *Journal of Environmental Planning and Management*, *51*(5), 701-716. doi:10.1080/09640560802208140

C40 Cities. (2016). Cities100: Guangzhou - Low-Carbon Megacity Encourages Green Growth. Retrieved from http://www.c40.org/case_studies/cities100-guangzhou-low-carbon-megacity-encourages-green-growth

CDD. (2012). *Results of Deliberative Polling® Energy and Environmental Policy Options in Japan*. Stanford: Center for Deliberative Democracy, Stanford University. http://cdd.stanford.edu/2012/results-of-deliberative-polling-energy-and-environmental-policy-options-in-japan/.

Charles River Associates. (2005). *Applications of Dynamic Pricing in Developing and Developed Countries*. Oakland, USA: World Bank. http://siteresources.worldbank.org/INTENERGY/Resources/ApplicationsofDynamicPricing.pdf.

Chesbrough, H., & Burgelman, R. (2001). Introduction to comparative studies in technological evolution. In R. Burgelman & H. Chesbrough (Eds.), *Research on Technological Innovation, Management and Policy (Volume 7): Comparative Studies of Technological Evolution* (pp. ix-xvi). Amsterdam; London; New York; Oxford; Paris; Shannon; Tokyo: JAI - Elsevier Science.

Devine-Wright, P. (2007). *Reconsidering Public Attitudes and Public Acceptance of Renewable Energy Technologies: A critical Review*. Manchester: School of Environment and Development, University of Manchester. http://www.sed.manchester.ac.uk/research/beyond_nimbyism/.

DeWaters, J. E., & Powers, S. E. (2011). Energy literacy of secondary students in New York State (USA): A measure of knowledge, affect, and behavior. *Energy Policy, 39*(3), 1699-1710. doi:http://dx.doi.org/10.1016/j.enpol.2010.12.049

EPRI. (2014). *Understanding Electric Utility Customers - 2014 Update: Review of Recent Studies*. California: Electric Power Research Institute. http://www.sgiclearinghouse.org/Technologies?voc_27=1086&submit=Apply.

Fam, S. D., Xiong, J., Xiong, G., Yong, D. L., & Ng, D. (2014). Post-Fukushima Japan: The continuing nuclear controversy. *Energy Policy, 68*, 199-205. doi:http://dx.doi.org/10.1016/j.enpol.2014.01.014

Faruqui, A., Harris, D., & Hledik, R. (2010). Unlocking the €53 billion savings from smart meters in the EU: How inceasing the adoption of dynamic tariffs could make or break the EU's smart grid investment. *Energy Policy, 38*(10), 6222-6231.

Faruqui, A., Hledik, R., & Palmer, J. (2012). *Time-varying and Dynamic Rate Design*. Montpelier, USA: RAP. http://www.google.com.hk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CCAQFjAAahUKEwjfpL3NssvHAhXTno4KHdTZA4Q&url=http%3A%2F%2Fwww.raponline.org%2Fdocument%2Fdownload%2Fid%2F5131&ei=nSDgVZ_iLtO9ugTUs4-gCA&usg=AFQjCNFmTRDmCXAKUiCTKK2-hkIMqAIr-Q.

Faruqui, A., & Palmer, J. (2011). Dynamic Pricing and its Discontents. *Regulation, 34*(3), 16-32. doi:http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1956020

Fell, M., Shipworth, D., Huebner, G., & A. Elwell, C. (2015). *Public acceptability of domestic demand-side response in Great Britain: The role of automation and direct load control* (Vol. 9).

Fell, M. J., Shipworth, D., Huebner, G. M., & Elwell, C. A. (2015). Public acceptability of domestic demand-side response in Great Britain: The role of automation and direct load control. *Energy Research & Social Science, 9*, 72-84. doi:http://dx.doi.org/10.1016/j.erss.2015.08.023

FEPC. (2016). History of Japan's Electricity Power Industry. Retrieved from http://www.fepc.or.jp/english/energy_electricity/history/

Fox-Penner, P. (2010). *Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities* Washington, DC: Island Press.

Galvin Electricity Initiative. (2011). *Maximizing Consumer Value Through Dynamic Pricing: A Suggested Approach for Regulators*. N/A: Galvin Electricity Initiative. http://www.galvinpower.org/sites/default/files/DynamicPricing_0110.pdf.

Guo, P., Li, V. O. K., & Lam, J. C. K. (2017). Smart demand response in China: Challenges and drivers. *Energy Policy, 107*, 1-10. doi:https://doi.org/10.1016/j.enpol.2017.04.019

GZBS. (2016a). *Administrative Divisions Area and Population Density (2015) (行政区域面积和人口密度(2015 年))*. Guangzhou, China: Guangzhou Bureau of Statistics. http://210.72.4.52/gzStat1/chaxun/njsj.jsp.

GZBS. (2016b). *Population Structure and Distribution in Guangzhou in 2015 (2015 年广州市人口规模及分布情况)*. Guangzhou: Guangzhou Bureau of Statistics. http://www.gzstats.gov.cn/tjyw/201604/t20160412_39495.htm (In Chinese).

GZPS. (2015a). *Corporate Social Responsibility Action Report 2014*. Guangzhou, China: Guangzhou Power Supply Bureau. https://www.guangzhou.csg.cn/shzr/zrbg/201508/P020150806384524482177.pdf (In Chinese).

GZPS. (2015b). Some Districts in Guangzhou May Not Have Enough Power This Summer. Retrieved from https://www.guangzhou.csg.cn/ydb/xwzx/gsxw/201507/t20150714_1847.html (In Chinese)

Halcomb, E. J., & Davidson, P. M. (2006). Is verbatim transcription of interview data always necessary? *Applied Nursing Research, 19*(1), 38-42. doi:http://dx.doi.org/10.1016/j.apnr.2005.06.001

HKTDC. (2016). Guangzhou (Guangdong) City Information. Retrieved from http://china-trade-research.hktdc.com/business-news/article/Facts-and-Figures/Guangzhou-Guangdong-City-Information/ff/en/1/1X000000/1X09VTH4.htm

Hu, Z., Moskovitz, D., & Zhao, J. (2005). *Demand-Side Management in China's Restructured Power Industry : How Regulation and Policy Can Deliver Demand-Side Management Benefits to a Growing Economy and a Changing Power System*. Washington, D.C.: World Bank Group. https://openknowledge.worldbank.org/bitstream/handle/10986/18000/ESM3140PAPER0051ChinaDSM01PUBLIC1.pdf?sequence=1.

IEA. (2006). *China's Power Sector Reforms: Where to Next?* Paris: OECD Publishing. https://www.iea.org/publications/freepublications/publication/chinapower.pdf.

IEA. (2010). *Energy Efficiency Governance: Handbook*. Paris: International Energy Agency. http://www.iea.org/publications/freepublications/publication/gov_handbook-1.pdf.

Jegen, M., & Philion, X. D. (2017). Smart grid development in Quebec: A review and policy approach. *Renewable and Sustainable Energy Reviews*. doi:http://dx.doi.org/10.1016/j.rser.2017.06.019

Kalkbrenner, B. J., & Roosen, J. (2016). Citizens' willingness to participate in local renewable energy projects: The role of community and trust in Germany. *Energy Research & Social Science, 13*, 60-70. doi:http://dx.doi.org/10.1016/j.erss.2015.12.006

Kansai-METI. (2016). *Welcome to Kansai*. Osaka: Kansai-METI. http://www.kansai.meti.go.jp/3-1toukou/_INVEST_support_eng/2016welcome-eng/Welcome2016_E_all.pdf.

KEPCO. (2014). *Kansai Electric Power Group Report 2014: CSR & Financial Report*. Osaka, Japan: Kansai Electric Power Group. http://www.kepco.co.jp/english/corporate/list/report/pdf/e2014.pdf.

KEPCO. (2017). *Power Book 2016: the Kansai Electric Power Co., Inc. Company Profile*. Kyoto: KEPCO. http://www.kepco.co.jp/english/corporate/list/document/pdf/2016_en.pdf.

Kern, F., & Smith, A. (2008). Restructuring energy systems for sustainability? Energy transition policy in the Netherlands. *Energy Policy, 36*(11), 4093-4103. doi:http://dx.doi.org/10.1016/j.enpol.2008.06.018

Kingston, J. (2013). After 3.11: Imposting nuclear energy on a skeptical Japanese public. *The Asia-Pacific Journal*, *11*(23 (4)), 1-20. http://apjjf.org/site/make_pdf/4129.

Kyoto City Web. (2004). Kyoto Unveiled Its New Aspect of a City Hosting International Meetings in 1966. Retrieved from http://www2.city.kyoto.lg.jp/koho/eng/historical/first/09.html

Kyoto City Web. (2008). Geography of Kyoto City. Retrieved from https://www2.city.kyoto.lg.jp/koho/eng/databox/geography.html

Kyoto City Web. (2016). *Topics of City Government: October 2016*. Kyoto, Japan: City of Kyoto. https://www2.city.kyoto.lg.jp/koho/eng/topics/2016_10/index.html.

Kyoto University. (2017). Facts and figures covering our 110-year history. Retrieved from http://www.kyoto-u.ac.jp/explore/en/data/

Lee, T., Lee, T., & Le, Y. (2014). An experiment for urban energy autonomy in Seoul: The One 'Less' Nuclear Power Plant policy. *Energy Policy*, *74*, 311-318.

Lee, T., Lee, T., & Lee, Y. (2014). An experiment for urban energy autonomy in Seoul: The One 'Less' Nuclear Power Plant policy. *Energy Policy*, *74*, 311-318. doi:10.1016/j.enpol.2014.08.023

Lehtonen, M., & Kern, F. (2009). Deliberative Socio-Technical Transitions. In I. Scrase & G. MacKerron (Eds.), *Energy for the Future: A New Agenda* (pp. 103-122). London: Palgrave Macmillan UK.

Liang, Q. (2006). Heat wave causes power shortage in Guangzhou. Retrieved from http://www.chinadaily.com.cn/cndy/2006-07/15/content_641412.htm

Lin, C.-C., Yang, C.-H., & Shyua, J. Z. (2013). A comparison of innovation policy in the smart grid industry across the pacific: China and the USA. *Energy Policy*, *57*, 119-132. doi:http://dx.doi.org/10.1016/j.enpol.2012.12.028

Lo, K. (2014). A critical review of China's rapidly developing renewable energy and energy efficiency policies. *Renewable and Sustainable Energy Reviews*, *29*, 508-516. doi:http://dx.doi.org/10.1016/j.rser.2013.09.006

Mah, D., & Hills, P. (2014). *Nuclear decision-making in Hong Kong: A background paper*. Hong Kong: Asian Energy Studies Centre. http://aesc.hkbu.edu.hk/wp-content/uploads/2014/10/AESC_Working_Paper_12.pdf.

Mah, D., Leung, K. P. Y., & Hills, P. (2014). Smart grids: The regulatory challenges. In D. Mah, P. Hills, V. Li, & R. Balme (Eds.), *Smart Grid Applications and Developments* (pp. 115-140). London; Heidelberg; New York; Dordrecht: Springer.

Mah, D., van der Vleuten, J., Hills, P., & Tao, J. (2012). Consumer perceptions of smart grid development: Results of a Hong Kong survey and policy implications. *Energy Policy*, *49*(0), 204-216. doi:http://dx.doi.org/10.1016/j.enpol.2012.05.055

Mah, D. N.-y., van der Vleuten, J. M., Hills, P., & Tao, J. (2012). Consumer perceptions of smart grid development: Results of a Hong Kong survey and policy implications. *Energy Policy*, *49*, 204-216.

Mah, D. N.-y., Wu, Y.-Y., Ip, J. C.-m., & Hills, P. R. (2013). The role of the state in sustainable energy transitions: A case study of large smart grid demonstration projects in Japan. *Energy Policy*, *63*, 726-737.

Mallett, A., Stephens, J. C., Wilson, E. J., Langheim, R., Reiber, R., & Peterson, T. R. (2017). Electric (dis) connections: Comparative review of smart grid news coverage in the United States and Canada. *Renewable and Sustainable Energy Reviews*. doi:http://dx.doi.org/10.1016/j.rser.2017.06.017

McLellan, E., MacQueen, K. M., & Neidig, J. L. (2003). Beyond the Qualitative Interview: Data Preparation and Transcription. *Field Methods, 15*(1), 63-84. doi:doi:10.1177/1525822X02239573

Meadowcroft, J. (2004). Deliberative Democracy. In Robert F. Durant, Daniel J. Fiorino, & Rosemary O'Leary (Eds.), *Environmental governance reconsidered : challenges, choices, and opportunities* (pp. 183-218). Cambridge, Massachusetts: MIT Press.

MIPIM Japan. (2016). *Invest 2015 - Economic Profile of Osaka*. Osaka, Japan: MIPIM Japan. http://www.mipimjapan.com/RM/RM_MIPIMJapan-en/2016/documents/mipimjapan-2016-invest-osaka.pdf?v=636072106092796346.

Mitchell, C., & Woodman, B. (2010). Towards trust in regulation—moving to a public value regulation. *Energy Policy, 38*(6), 2644-2651. doi:http://dx.doi.org/10.1016/j.enpol.2009.05.040

Nakata, M., Sano, I., & Mukai, S. (2015). Air pollutants in Osaka (Japan). *Frontiers in Environmental Science*, *3*(18). doi:10.3389/fenvs.2015.00018

NBS. (2015). *Electricity Consumption by Region (分区总消费量)*. Beijing: National Bureau of Statistics. http://www.stats.gov.cn/tjsj/ndsj/2015/indexch.htm (In Chinese).

NBS. (2016). *China Statistical Yearbook*. Beijing: China Statistics Press. http://www.stats.gov.cn/tjsj/ndsj/2016/indexeh.htm.

NDRC. (2011). *Guidelines Regarding Pilot Demonstration of Tier-Based Electricity Pricing on Residential Users (关于居民生活用电试行阶梯电价的指导意见)*. Beijing: National Development and Reform Commission. http://www.sdpc.gov.cn/fzgggz/jggl/zcfg/201111/t20111130_448436.html (In Chinese).

NDRC. (2013). *Notice Related to Optmising the Tier-Based Electricity Pricing System(关于完善居民阶梯电价制度的通知)*. Beijing: National Development and Reform Commission. http://jgs.ndrc.gov.cn/zcfg/201401/t20140102_574319.html (In Chinese).

Nintendo. (2017). Principal Offices and Facilities. Retrieved from https://www.nintendo.co.jp/corporate/en/offices/map_kyoto.html

Nissin Electric. (2017). Company Outline. Retrieved from http://nissin.jp/e/about/company.html

Park, C.-K., Kim, H.-J., & Kim, Y.-S. (2014). A study of factors enhancing smart grid consumer engagement. *Energy Policy, 72*, 211-218. doi:http://dx.doi.org/10.1016/j.enpol.2014.03.017

Petts, J. (2004). Barriers to participation and deliberation in risk decisions: evidence from waste management. *Journal of Risk Research, 7*(2), 115-133. doi:10.1080/1366987042000158695

Petts, J. (2008). Public engagement to build trust: false hopes? *Journal of Risk Research, 11*(6), 821-835. doi:10.1080/13669870701715592

PFKRI. (2016). *Kansai Science City: Keihanna Science City*. Kyoto, Japan: Public Foundation of Kansai Research Institute. https://www.kri.or.jp/news-event/img/outline_2016_E.pdf.

Pidgeon, N., Demski, C., Butler, C., Parkhill, K., & Spence, A. (2014). Creating a national citizen engagement process for energy policy. *Proceedings of the National Academy of Sciences, 111*(Supplement 4), 13606-13613. doi:10.1073/pnas.1317512111

Poland, B. D. (1995). Transcription Quality as an Aspect of Rigor in Qualitative Research. *Qualitative Inquiry, 1*(3), 290-310. doi:doi:10.1177/107780049500100302

Schneider, M. (2013). France's great energy debate. *Bulletin of the Atomic Scientists, 69*(1), 27-35. doi:10.1177/0096340212471284

Schweizer, P.-J., Renn, O., Köck, W., Bovet, J., ,, Benighaus, C., Scheel, O., & Schröter, R. (2014). Public participation for infrastructure planning in the context of the German "Energiewende". *Utilities Policy*, http://dx.doi.org/10.1016/j.jup.2014.1007.1005.

SCMP. (2005). Guangzhou pays price for power shortages. Retrieved from http://www.scmp.com/article/496712/guangzhou-pays-price-power-shortages

Shen, B., Ghatikar, G., Lei, Z., Li, J., Wikler, G., & Martin, P. (2014). The role of regulatory reforms, market changes, and technology development to make demand response a viable resource in meeting energy challenges. *Applied Energy, 130*, 814-823. doi:http://dx.doi.org/10.1016/j.apenergy.2013.12.069

Silva, H. B. d., & Santiago, L. P. (2017). On the trade-off between real-time pricing and the social acceptability costs of demand response. *Renewable and Sustainable Energy Reviews*. doi:http://dx.doi.org/10.1016/j.rser.2017.05.219

Statistics Japan. (2015). Chapter 3 National Accounts. Retrieved from http://www.stat.go.jp/english/data/nenkan/66nenkan/1431-03.htm

Stephens, J. C., Kopin, D. J., Wilson, E. J., & Peterson, T. R. (2017). Framing of customer engagement opportunities and renewable energy integration by electric utility representatives. *Utilities Policy, 47*, 69-74. doi:http://dx.doi.org/10.1016/j.jup.2017.05.005

Stern, F. (2015). *Demand Resposne in China: The Market & Strategic Positioning of Active Players*. Beijing: Azure International. http://www.azure-international.com/images/stories/azure/publications/pdf/DEMAND-RESPONSE-IN-CHINA_The-Market-Strategic-Positioning-of-Active-Players_2015_Azure-International_FS.pdf.

Strbac, G. (2008). Demand side management: benefits and challenges. *Energy Policy, 36*(12), 4419-4426.

Trencher, G. P., Yarime, M., & Kharrazi, A. (2013). Co-creating sustainability: cross-sector university collaborations for driving sustainable urban transformations. *Journal of Cleaner Production, 50,* 40-55. doi:http://dx.doi.org/10.1016/j.jclepro.2012.11.047

Valentine, S., Sovacool, B. K., & Matsuura, M. (2011). Empowered? Evaluating Japan's national energy strategy under the DPJ administration. *Energy Policy, 39*(3), 1865-1876. doi:http://dx.doi.org/10.1016/j.enpol.2011.01.029

van de Kerkhof, M. (2006). Making a difference: On the constraints of consensus building and the relevance of deliberation in stakeholder dialogues. *Policy Sciences, 39*(3), 279-299. doi:10.1007/s11077-006-9024-5

Wang, Z., Zhang, B., & Zhang, Y. (2012). Determinants of public acceptance of tiered electricity price reform in China: Evidence from four urban cities. *Applied Energy, 91*(1), 235-244. doi:http://dx.doi.org/10.1016/j.apenergy.2011.09.002

Winskel, M., Ketsopoulou, I., & Churchouse, T. (2015). *UKERC Interdisciplinary Review: Research Report*. London: UK Energy Research Centre. http://www.ukerc.ac.uk/publications/ukerc-interdisciplinary-review-research-report.html.

World Energy Council. (2012). *Smart Grids: Best Practice Fundamentals for a Modern Energy System*. London: World Energy Council. http://www.worldenergy.org/documents/20121006_smart_grids_best_practice_fundamentals_for_a_modern_energy_system.pdf.

Yang, H. (2006). *Overview of the Chinese Electricity Industry and its Current Uses*. Cambridge, UK: Electricity Policy Research Group, University of Cambridge. http://www.cambridgeeprg.com/wp-content/uploads/2008/11/eprg0517.pdf.

Yarime, M., & Tanaka, Y. (2012). The Issues and Methodologies in Sustainability Assessment Tools for Higher Education Institutions. *Journal of Education for Sustainable Development*, *6*(1), 63-77. doi:10.1177/097340821100600113

Yarime, M., Trencher, G., Mino, T., Scholz, R. W., Olsson, L., Ness, B., . . . Rotmans, J. (2012). Establishing sustainability science in higher education institutions: towards an integration of academic development, institutionalization, and stakeholder collaborations. *Sustainability Science*, *7*(1), 101-113. doi:10.1007/s11625-012-0157-5

Zhang, S., & Qin, X. (2015). *Lessons Learned from China's Residential Tiered Electricity Pricing Reform*. Geneva, Switzerland: The International Institute for Sustainable Development. https://www.iisd.org/gsi/sites/default/files/ffsr_china_lessons_learned_may_2015.pdf.

Zhang, Z. (2014). *Energy Prices, Subsidies and Resource Tax Reform in China*. Milan, Italy: Fondazione Eni Enrico Mattei. http://www.feem.it/userfiles/attach/20148261036444NDL2014-072.pdf.

Zheng, X., Wei, C., Qin, P., Guo, J., Yu, Y., Song, F., & Chen, Z. (2014). Characteristics of residential energy consumption in China: Findings from a household survey. *Energy Policy*, *75*, 126-135. doi:http://dx.doi.org/10.1016/j.enpol.2014.07.016