Understanding undergraduate students’ perceptions of dynamic pricing policies: An exploratory study of two pilot deliberative pollings (DPs) in Guangzhou, China and Kyoto, Japan

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Abstract

Smart grids (SGs) are being deployed as a transformational technology in energy transitions. However, negative consumer responses to both smart meters and new pricing systems indicate that building public acceptance of these transitions is critically important. Deliberative Pollings (DPs) offer the potential to effectively integrate public perceptions into energy transition decision-making. Most deliberative governance studies focus on western countries and very few examine the Asian context. This paper presents an exploratory study of undergraduate students’ perceptions of dynamic pricing options in two pilot DPs conducted in the cities of Guangzhou and Kyoto. The study indicates that deliberative processes yield mixed outcomes in changing participants’ choice of pricing options. While many welcomed new pricing options, a significant number supported status quo options. Second, the normative mechanisms and outcomes of deliberative participation seem to apply in the Asian context. DP appears to enhance participants’ acceptance of complex and sophisticated pricing options. Dialogic processes enhanced the participants’ ability to understand complex issues and weigh up trade-offs when comparing options. Third, national level contextual differences associated with public distrust and familiarity with market logic may explain the differences in responses between Chinese and Japanese participants. We argue that complex and controversial energy decision-making needs to be supported by deliberative participatory processes to enable citizens to make informed and considered choices.

1. Introduction

Climate change concerns, rising energy costs, and the risks associated with nuclear power have heightened the urgency of a transition to a low-carbon future. By applying advanced information technology to modernise existing electricity networks, smart grids (SGs) are seen as an enabling technology to realise energy transitions through extending the choice of energy options on both the supply-side (e.g. major uptake of renewable energy sources) and demand-side (e.g., demand-side management (DSM)). They are increasingly being adopted and implemented in both developed and developing economies (e.g. the US, South Korea, Japan, and China). These trends have become even more pronounced in recent years since the Fukushima nuclear accident in 2011.

In this context the role of residential electricity consumers has become increasingly significant. In the literature on energy transitions, dynamic pricing systems are attracting growing attention as mechanisms to realise the vast untapped potential of DSM (Barton et al., 2013). In contrast to traditional flat-rate systems, in dynamic pricing systems electricity prices vary across time. Dynamic pricing may therefore induce consumers to reschedule their

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consumption of electricity and reduce consumption, and thereby contribute to load shifting and load reduction (Barton et al., 2013).

The introduction of more sophisticated and potentially more efficient pricing systems may, however, provoke public controversies or even public distrust (see, for example, Mah et al., 2012a; b). Deliberative approaches — innovative forms of public participation that emphasise the empowerment of a more informed citizenry to discuss, debate, and reflect on energy issues — have the potential to improve energy literacy and facilitate the governance of controversial energy technologies (CDD, 2012; DeWaters and Powers, 2013; Hankyoreh, 2017). These governing approaches are being increasingly adopted worldwide (including in the US, Germany, Japan, and South Korea). However, informed analysis of these approaches focuses almost exclusively on western countries.

This study analyses the influence of deliberative processes on energy decisions among undergraduate students in two Asian cities. This study focuses on undergraduate students for two main reasons. First, in recent years, the young population, including university undergraduate students, has increasingly become a focus in studies on youth-led social change as well as student-led campus sustainability initiatives (DeWaters and Powers, 2011; Helferty and Clarke, 2009; Ho et al., 2015; Trencher et al., 2013; Yarnes and Tanaka, 2012). Second, previous studies suggest that university students are a group of future decision-makers, leaders, and entrepreneurs who may be possible agents of change towards sustainability and possibly act as a benchmark for other social groups to follow (Vicente-Molina et al., 2013). University students therefore warrant study as a key stakeholder group in regard to sustainable futures (Lozano et al., 2013; Vicente-Molina et al., 2013).

This study has a geographical focus in Asia. Asian countries have played a pivotal role in the impacts of and responses to global climate change. These countries are diverse and differ from each other and Western countries in terms of their institutions, regulations, energy profiles, stakeholder landscapes, and public controversies. A better understanding of how and to what extent Asian countries might introduce participative and deliberative practices for energy policymaking is therefore of scholarly value and policy significance.

China and Japan are used as case study countries for this research. Both have been pioneering green-technology, including the deployment of SGs. They also possess shared characteristics in their energy regimes, which include the presence of partial electricity users such as industrial end-users have been the main participants in DSM in both developed (see, for example, in the U.S. (Eto, 1996)) and developing economies (see, for example, in China (Zhang et al., 2017)); residential electricity consumers, either as decision-makers for household electricity consumption or policy stakeholders through their votes, can become active agents in energy transitions driven by SG technologies (Fox-Penner, 2010; IEA, 2016; Ogunjuyigbe et al., 2015).

Dynamic pricing as an approach to realise the untapped potential of DSM has gained increasing attention (Barton et al., 2013; Sioshansi, 2012). DSM is not a new concept. It emerged as an approach for utility management in the US in the 1970s. DSM may bring consumer, utility, and societal benefits by lowering electricity bills, helping utilities operate more efficiently, and reducing greenhouse gases emissions (Strbac, 2008). Traditionally, large electricity users such as industrial end-users have been the main participants in DSM in both developed (see, for example, in the U.S. (Eto, 1996)) and developing economies (see, for example, in China (Zhang et al., 2017)); residential end-users have played a much less significant role.

Recent technological breakthroughs in SGs have, however, led to greater interest in DSM activities in the domestic household sector. Through the use of smart meters, home energy management systems (HEMSs), and real-time electricity information linked to dynamic pricing systems, electricity consumers can become active players through reducing or rescheduling consumption (see, for example, Brown and Zhou (2013); World Energy Council (2012)). Studies suggest that consumers may substantially reduce overall energy consumption levels and reduce peak loads by up to 30% (Faruqui et al., 2010; IEA, 2010). The IEA also projects that as much as 50% of the decarbonising effort by 2030 will have to come from energy efficiency measures (IEA, 2010).

2. Theoretical perspectives

2.1. The role of electricity consumers in energy transitions

Electricity consumers have traditionally been overlooked in energy management systems. Policymakers in many countries have been preoccupied with nuclear power and other supply-side measures (IEA, 2010, 2016). A growing body of literature has suggested that residential electricity consumers, either as decision-makers for household electricity consumption or policy stakeholders through their votes, can become active agents in energy transitions driven by SG technologies (Fox-Penner, 2010; IEA, 2016; Ogunjuyigbe et al., 2015).

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2.2. Dynamic pricing: its typology and the associated trade-off decisions

Together with the increasing policy attention given to dynamic pricing and DSM, a growing body of literature explores typologies and mechanisms of pricing options. The literature suggests that there are three main types of pricing systems: flat rate tariffs, tiered-based (or block-based) tariffs, and dynamic pricing systems. Dynamic
pricing systems provide varying rates across time and can be further divided into three sub-types: *time-of-use, critical peak pricing, and real-time tariffs* (see, for example, Brown and Zhou, 2013). When compared with traditional flat-rate systems, dynamic pricing may induce price-sensitive consumers to reschedule consumption of electricity and reduce overall consumption through load shifting and load reduction (Barton et al., 2013; Brown and Zhou, 2013; Silva and Santiago, 2017).

As shown in Fig. 1 (in the Supplementary Information Section), different pricing systems have distinctive features: each of them has its own functions and mechanisms creating opportunities for residential consumers to reduce electricity bills in various ways (see, for example, Brown and Zhou, 2013). They also involve different sets of trade-off decisions (see, for example, Fell et al., 2015; Silva and Santiago, 2017) which are associated with different sets of benefits, costs, and risks. There are at least five key dimensions that need to be considered when comparing pricing options: economic, environmental, technological, social, and regulatory factors (Faruqui and Palmer, 2011; Mah et al., 2014; Wang et al., 2012) (Table 1 – in the Supplementary Information Section).

### 2.3. Managing public perceptions in energy transitions through deliberative governance

Despite the potential benefits offered by dynamic pricing, a growing body of empirical evidence suggests dynamic pricing may have limited impacts (Guo et al., 2017). In addition, smart meter installation and the introduction of dynamic pricing systems often attract a consumer backlash and provoke public distrust (Mah et al., 2012a, b; Park et al., 2014). The public can be highly skeptical of the motives of introducing dynamic pricing and may, for example, see it as simply a way to disguise a utility's intention to increase tariffs (Mah et al., 2012a, b).

There are various possible explanations for this. Work by Devine-Wright (2007) and Sovacool and Ratan (2012), for example, argue that public perception is a determining factor in energy transitions but it cannot be taken for granted. Sovacool and Ratan (2012) suggest that public acceptance is a multi-dimensional concept that operates at socio-political, market, and community levels. As such, engaging consumers in SG deployment may rely not only on the availability of technologies, but also on markets and institutions through which SG technology is applied and adopted by households (Bell et al., 1996; Brown and Zhou, 2013). The literature also suggests that public acceptance can be affected by personal (e.g. age, social class), psychological (e.g. level of trust, knowledge, and direct experience), technology type and scale, and contextual factors (e.g. institutional structure) (Devine-Wright, 2007).

Around the world, growing concern over public distrust and a lack of legitimacy have exposed the limitations of conventional forms of top-down, expert-led, technocratic energy policymaking (Lee et al., 2014; Lehtonen and Kern, 2009). Deliberative participation is a form of stakeholder involvement that emphasises the empowerment of a more informed citizenry to discuss, debate, and reflect on energy issues (Petts, 2004; Turcu et al., 2014). Such deliberative practices can take various forms, including DPs, citizens’ juries, consensus conferences, and scenario development (Einsiedel et al., 2001, 2001; Lehtonen and Kern, 2009; van de Kerkhof, 2006).

Deliberative participation has several important normative characteristics. It emphasises the need to dissolve the demarcation between science and the public, and to facilitate rational public debate as a means to achieve a socially viable consensus (Sundqvist, 2004). This approach has been increasingly recognised as an important governance mechanism for enhancing social learning, decision quality, policy legitimacy, and trust (Bull et al., 2008; Petts, 2004). In the context of energy transitions, such an approach is expected to enhance the overall efficiency of the processes of SETs (Pidgeon et al., 2014; Turcu et al., 2014), and facilitate the formation of more sustainable decisions (Turcu et al., 2014).

Deliberative approaches are, however, logistically challenging and are constrained by limits of time, cost and space (Epstein, 2000; Velasquez and Gonzalez, 2010).

DPs are a specific method of deliberative participation. Traditional polls have the limitation of being static, revealing only snapshots of public opinion. Respondents are generally ill-informed. DPs have the potential to overcome these constraints by integrating deliberative processes into more traditional public opinion polling methods (Fishkin et al., 2010a, b; Nabatchi, 2010; Shigetomi et al., 2009). DPs integrate small group discussions, expert Q&A sessions, and plenary discussion into deliberative events (CDD, 2017). Quantitative analysis of the pre- and post-deliberation questionnaires of DPs can therefore provide insights into public opinion that are not only representative, but also more accurately reflect the considered and informed opinion of the public (Fishkin et al., 2010a, b; Luşkin et al., 2002). The resulting changes in public opinion represent the conclusions the public would probably reach, if they are given opportunities to be informed and more engaged in the dialogue or public debate (CDD, 2017; Fishkin et al., 2010a, b).

Many countries, including Germany, France, and the Netherlands, have engaged in deliberative participation in the pursuit of energy transitions (Kern and Smith, 2008; Schneider, 2013; Schweizer et al., 2014). In Asia, recent initiatives include the national DPs on environment and energy options conducted in Japan in 2012 (CDD, 2012), and a nuclear deliberative opinion poll of sampled citizen jurors conducted in South Korea in 2017 (Hankyoreh, 2017).

### 2.4. Knowledge gaps

There are several knowledge gaps in the energy transition literature and specifically in the Asian context that need to be addressed. First, there is a lack of a firm understanding of the social aspects of energy transitions, particularly from the perspectives of consumer engagement and public acceptance. Theoretical linkages between consumer engagement and deliberative governance in the context of energy transitions are not well developed. Second, the use of DPs as an innovative technique of public engagement in complex energy policy issues requires further testing in contexts beyond the Western industrialised nations. The literature on energy transitions 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; Petts, 2008). There remain major knowledge gaps concerning Asian countries, which differ from their Western counterparts in terms of their institutions, regulations, energy profiles and issues, as well as the nature of energy-related public controversies (Berman et al., 2010; Mah et al., 2013). Third, there is a lack of comparative cross-national studies in the fields of energy-related innovation systems and deliberative governance (Lin et al., 2013). Finally, the significance of multi-method approaches for research has been increasingly acknowledged, but energy research combining quantitative and qualitative methods is still generally lacking in the Asian context (Winskel et al., 2015). Our analysis combines quantitative with qualitative data and could potentially add significant value in the field of SETs.
3. Material and methods

3.1. A comparative perspective of two pilot DPs

This study provides a comparative perspective of two pilot DPs on dynamic pricing and DSM conducted in Guangzhou, China and Kyoto, Japan (Fig. 2). When compared with a single case study approach, this comparative-case approach can enhance both internal and external validity of the observed phenomenon of deliberative processes and outcomes across the two selected Asian cities (Chesnourough and Burgelman, 2001).

By comparing participants’ responses in these two pilots, we address the following questions:

a) What were undergraduate students’ (most) preferred pricing options? Did they change their preferences after deliberation (i.e. after evaluating strengths, limitations, and risks of different pricing options)? Did they prefer not to change after deliberation?
b) Why were undergraduate students supportive of particular pricing option(s)? What were their concerns over various pricing options?
c) Can cultural differences in national and socio-economic contexts explain some of the observed phenomenon?
d) Can western normative processes and consequences of deliberative participation travel across, and be realised in the Asian context? And under what conditions, and how, can deliberative participation lead to improvements in energy governance?

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

Our two pilot DPs were conducted in the format of a one-day deliberative workshop. The first DP took place in Sun Yat-sen University in Guangzhou (GZ) in March 2016 and the second DP took place in Kyoto University in Kyoto (KY) in January 2017. Each DP had 47 undergraduate participants. Compared with full-scale DPs which typically involve at least 250 randomly sampled participants, our pilots are small in scale, focusing only on undergraduate participants. This study cannot claim statistical representativeness and has limits in generalising findings to the local population of GZ or KY. Our approach does however allow us to optimise the quality of the study given our budget constraints and various logistical challenges.

While these pilots are relatively small in scale, 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 dialogue in two one-and-a-half-hour small group sessions and two one-and-a-half-hour expert Q&A sessions which were all facilitated by trained moderators.

In the first small group discussion, participants focused on comparing five electricity pricing options (flat-rate, tier-based, time-of-use, critical peak, and real-time tariffs) and assessing the strengths, weaknesses and risks of each tariff structure. Questions that arose from the first small group discussions were subsequently directed 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 discussed different scenarios on pricing options. Participants had the opportunity to ask questions on different scenarios, receive feedback from expert panelists, and then reflect on his or her opinions of pricing options. At the end of the DP, participants completed a post-deliberation questionnaire. An overview of the pilot DPs is provided in Fig. 3.

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 (v) 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 itself.

We adopted similar methodological approaches for sampling and recruitment in order to ensure methodological consistency between the two pilots (Table 2). DP normally requires the use of random sampling. As our pilot DPs were not full scale exercises, our pilots conducted quota sampling to determine the proportional number of undergraduate students to be recruited in consideration of the distribution of students across major disciplines, as well as the gender ratio. Students in campuses of their respective university were then recruited (Tables 3a and b, in Section of Supplementary Information).

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 disproportionate large number of males which reflected the population makeup of the university (Kyoto University, 2017), and the number of recruited participants either exceeded 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. Each of them recruited five to 20 students. Different recruitment methods were needed in order to address some logistical 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. The final number and composition of...
participants therefore reflected an effort to obtain a diversity of undergraduate views, set against the resources available to convene the DPs, generate quantitative questionnaire data and qualitative transcription data, and analyse the data in a timely but sufficiently detailed manner.

3.3. Data collection and analysis

This study adopts a mixed-method approach. Our analysis is based on quantitative data collected from pre- and post-DP questionnaires, and qualitative data derived from transcriptions of small group discussions and expert panel sessions at the two DPs. Quantitative data collected from the pre- and post-deliberation questionnaires is used to: (i) track changes in participants’ acceptance on four pricing options after deliberation; (ii) understand participants’ perceived usefulness of various aspects of the workshop. Qualitative data is used to understand participants’ views, 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 phenomenon.

In relation to the qualitative data, small group and expert panel discussions were all audio-taped. Full (verbatim) transcription was conducted for the GZ DP; 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 refer to word-for-word written reproduction of the words spoken in the audio-recording whereas summary transcripts provide key words and points. Both transcription strategies have strengths and limitations as summarised in Table 4. Verbatim transcriptions, for example, are useful in establishing the trustworthiness of the transcripts but are time-consuming and resource intensive. Summary transcription can save time but may be considered less trustworthy (Halcomb and Davidson, 2006; Poland, 1995).

In this study qualitative data is used to complement quantitative data. In our view summary transcripts can provide rich and detailed data which are sufficient for this level of analysis. In consideration of the relative merits of these two types of transcripts and our budget constraints, summary transcripts instead of verbatim transcripts were produced in the KY DP (McLellan et al., 2003).

To ensure the quality of the summary transcriptions, two measures were adopted. First, approximately one-fifth of the summary transcripts were spot checked by one of the co-authors who is fluent in Japanese. The spot-check results suggest that generally as much as 80% of texts were effectively summarised, and the
summary transcripts are thus sufficient to provide detailed enough data for our qualitative analysis. Second, the summary transcripts were triangulated with direct observation and notes taken by three of the paper’s authors who participated in the event.

We deployed two strategies to integrate data in this comparative study. First, across the two pilot DPs, we adopted similar approaches and formats for developing the briefing documents, pre- and post-deliberation questionnaires to ensure methodological consistency. Second, we utilised the multiple datasets to derive combined insights into the observed phenomena and underlying mechanisms, as well as explaining the differences in response between Chinese and Japanese participants.

4. Our case study contexts of China and Japan

National and local contexts often represent determining factors affecting energy technology and policy choices. This section provides an overview of the national and local energy, economic, and socio-political contexts of our two pilot DPs.

4.1. The national and local energy contexts

China and Japan are two of the most important economies in the Asia. China is a rapidly developing economy, and is expected to be the primary driver of global energy demand growth in the near future (IEA, 2016). In its 13th five-year plan, China has proposed the strategy of green energy development which seeks to improve energy efficiency and accelerate the development of renewable energy. As part of electricity market reforms, China started to introduce dynamic pricing in the early 2000s (WEC, 2016).

Japan is a highly developed nation. Historically a resource-poor country, Japan has long relied on importing energy to meet its demand (Vivoda, 2014). Japan’s energy supply is mainly from fossil fuels which provide approximately 67% of electricity generation. The 2011 Fukushima nuclear accident led to a review of nuclear energy policies and in a major reduction of nuclear power from 2011 to 2012 (Aldrich, 2013; CDD, 2012). That DP was the first of its kind in the energy field in Asia to the best of our knowledge. In China, deliberative participation has been introduced in various public policy areas (e.g. the price of water and even in relation to taxi strikes) at both national and local levels although not yet in the area of energy (Fishkin et al., 2006; Fishkin et al., 2010a; b; He, 2005; He and Warren, 2011; Jiang, 2010). A recent example is a DP conducted in 2015 concerning local budget issues in Shanghai (Han et al., 2015).

At the local level, Guangzhou and Kyoto offer different economic and socio-political contexts for examining young peoples’ perception of pricing options (Table 5). Guangzhou is a highly populated city. Traditionally a manufacturing hub, the city has emerged rapidly in recent years as China’s southern business hub and industrial centre (HKTDC, 2016). Kyoto, located in the Kansai Region of Japan, is a much less populated area but is of great political significance. As the ancient capital of Japan for more than one thousand years, the city has emerged as a hub for information technology, electronics, and tourism. Kyoto is also 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 share similar energy challenges associated with their fossil fuel-based electricity sectors. Guangdong is the largest electricity consumer of all the Chinese provinces with electricity consumption reaching 531 TWh in 2015. Air pollution and power shortage have remained serious problems (NBS, 2016). Guangdong has experienced power blackouts, most notably in 2004 and 2011 (GZPS, 2015a, 2015b; Liang, 2006; SCMP, 2005).

Similarly, the Kansai Region where Kyoto is located has traditionally been a major electricity consumer. Kansai has been the second highest electricity consumer among the 10 major electricity supply regions in Japan (134.5 TWh) (FEPC, 2016), surpassed only by the Greater Tokyo area. Prior to the Fukushima accident, Kansai was once the most nuclear-intensive region in Japan with nuclear contributing to 45% of the then monopoly KEPCO’s fuel mix prior to the Fukushima accident. After the accident, nuclear contributed only 1% of the total electricity generated by KEPCO in 2016 (KEPCO, 2017). Kansai’s major energy challenges are to develop energy plans to compensate for the lost nuclear power production and to satisfy electricity demand (Nakata et al., 2015). Keihanna Science City, one of the four sites selected for Japan’s national smart grid pilot program, is situated within Kyoto Prefecture (PFKRI, 2016).

4.2. Dynamic pricing in China and Japan: major developments

In recent decades, residential electricity pricing systems have been evolving in China and Japan. Changes have been introduced into the traditional flat-rate systems and there has been a move towards pricing structures based on dynamic-pricing. We identify...
three distinct phases in the evolution of these pricing systems (Fig. 4).

In China, Phase 1 refers to the period prior to July 2012 when the flat-rate tariff was used. Phase 2 started in July 2012 when China effectively introduced a nationwide three tier-based tariff (TBT) system for the residential sector. Phase 3 started in December 2013 when the government introduced 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 implemented nationwide, and local authorities that had not rolled out such policies had to do so by the end of 2015. Under this national policy framework, residents are expected to be encouraged to participate in shifting peak loads.

At present, TBT has remained the basis of electricity tariffs for Chinese households, while TOU has been a voluntary opt-in electricity add-on to TBT. Initially as pilot projects, TOU is now at the point of being implemented nationwide at the local level. However, the adoption rate of TOU has been minimal in the domestic sector (Transcript T02).

Similarly, three distinct phases of tariff reform can be identified in Japan. Phase 1 covers the period prior to 2008. At that time a flat-rate tariff was adopted for household consumers in Japan. Phase 2 started in January 2008 and ended in April 2016. Like the tariffs in Phase 2 in China, TBT remained as the basis of the electricity tariff across Japan but residential consumers could voluntarily opt-in to TOU tariffs if such alternatives were made available by their traditional monopoly electricity suppliers. Phase 3 started in April 2016 and was marked by the full liberalisation of retail markets in Japan. While opt-in TOU with TBT prevails, residential consumers can now choose their own electricity suppliers. There has been an increasing, though still a small proportion of residential consumers who have shifted to new electricity suppliers. While the national data is not available to the present study, the experience in the Kansai region may be indicative. Between April 2016 and January 2017 approximately 4% of residential consumers in Kansai shifted away from the former regional monopoly Kansai Electric Power (KEPCO) to new electricity suppliers (Transcript T14).

Table 5
A comparison of Guangzhou and Kyoto.

<table>
<thead>
<tr>
<th>Administrative Status</th>
<th>Guangzhou</th>
<th>Kyoto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Province/Administrative Region</td>
<td>Sub-provincial city level</td>
<td>Capital city of Kyoto Prefecture</td>
</tr>
<tr>
<td>Provincial/Regional Population (million in 2015)</td>
<td>108.5</td>
<td>21.7</td>
</tr>
<tr>
<td>City Population (million in 2015)</td>
<td>13.5</td>
<td>1.475</td>
</tr>
<tr>
<td>City Geographical Area (km²)</td>
<td>7434</td>
<td>828</td>
</tr>
<tr>
<td>Provincial/Regional GDP (2015) (US$ billion)</td>
<td>1095</td>
<td>789</td>
</tr>
<tr>
<td>City GDP (US$ billion)²</td>
<td>271.51 (1810.04 billion yuan (2015))</td>
<td>89.41 (9825 billion yen (FY 2013))⁶</td>
</tr>
<tr>
<td>Provincial/Regional Electricity Consumption (TWh)</td>
<td>523.5 (2014)</td>
<td>148.2 (FY2014)</td>
</tr>
<tr>
<td>Provincial/Regional Electricity Mix</td>
<td>Total installed capacity: 91.1 GW (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)</td>
<td>Total installed capacity: 36.0 GW (83% from thermal, 10% from hydro, 6% from nuclear, 1% from renewable) (FY 2014)</td>
</tr>
</tbody>
</table>

Source: compiled by authors from the following sources: Provincial/Regional Population: (Kansai-METI, 2016; NBS, 2015); City Population: (GZBS, 2016b; Kyoto City Web, 2016); City Geographical Area: (GZBS, 2016a; Kyoto City Web, 2008); Provincial/Regional GDP: (MIPIM Japan, 2016; NBS, 2016); City GDP: (HKTDC, 2016; Statistics Japan, 2015); Provincial/Regional Electricity Consumption: (BNEF, 2015; 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).
⁶ At the Prefectural level.
5. Results and discussion

5.1. Mixed outcomes in participants’ choices of pricing options revealed the complexity of trade-off decisions

Deliberative processes have the potential of facilitating informed decisions and subsequently the substantive quality of decisions that are made (Petts, 2004; Turcanu et al., 2014). An important question for this study is whether deliberation changed participants’ acceptance of different pricing options. In our two DPs, we asked participants their perceptions of different electricity pricing options both before and after the workshop. The DP results showed that deliberation yielded mixed outcomes in changing participants’ choices of pricing options. There are three important observations:

(a) Most participants of the two DPs consistently showed their support for new pricing options both before and after deliberation. As shown in Fig. 5, 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); although few supported CPT ($n = 10$ in GZ and $6$ in KY). After deliberation, most participants supported new tariff plans, including TOU ($n = 44$ in GZ and $39$ in KY), with a moderate number supporting CPT ($n = 31$ in GZ and $12$ in KY) while fewer supported RTT ($n = 14$ in GZ and $4$ in KY).

(b) Participants’ acceptance of complex and sophisticated energy policy options noticeably increased after deliberation. We found that deliberative processes can increase participants’ acceptance of complex and sophisticated energy policy options, i.e. the more sophisticated pricing options of TOU and CPT. We asked participants the extent to which they agreed to make the four pricing options available in their city. There was an increase in 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 $31$) increased while in Kyoto participants’ support for TOU ($n$ increased from $33$ to $39$) and CPT ($n$ increased from $6$ to $12$) also increased.

(c) While many participants welcome new pricing options, a considerable number of participants were supportive of the status quo. Before deliberation, in GZ, the Business-As-Usual (BAU) scenario (i.e. a tier-based system with opt-in TOU) received the greatest support ($n = 34$). In KY, BAU received the second highest level of support ($n = 17$). After deliberation, support for BAU remained steady in GZ ($n$ changed from $34$ to $33$). However, there was a noticeable increase in KY participants’ support for BAU ($n$ increased from $17$ to $30$). These data suggest that participants in both DPs were generally conservative about pricing options, and the KY participants preferred the no-change option even more after deliberation.

The mixed findings of the DP results are inconclusive and need to be interpreted with caution. It is important to note that a majority of GZ and KY participants chose the status quo pricing option, and some KY participants even more so after deliberation. These findings raise an important question: why did some participants not favour change even though they were given the opportunity to do so?

Our findings seem to shed light on the centrality of understanding benefits, costs, and risks in making trade-off decisions. Our qualitative data suggest that participants obtained a relatively sophisticated understanding of alternative pricing options. On the one hand, they seemed to recognise the potential benefits of new pricing options, most notably raising public awareness of energy efficiency, reducing electricity consumption, and improving the efficiency of energy systems (see, for example, T03, T15). On the other hand, they did raise concerns over a broad range of issues associated with the costs and risks of new pricing options. A sense of uncertainty may result in a more conservative view among participants. They particularly welcomed the existing pricing arrangements for their simplicity and convenience (see, for example,
T07, T15).

We summarised and categorised the key questions raised by GZ and KY participants during expert Q&A sessions for comparison (as presented in Table 6 in Supplementary Information Section). It is evident that the GZ and KY participants shared concerns over new tariff systems in many areas. These concerns include peak shifting, electricity tariffs, electricity generation, electricity consumption, electricity markets, and information accuracy. In addition, both GZ and KY participants were keen to seek clarification on the purposes of potential applications and benefits of peak shifting if new pricing options are adopted. They showed considerable interest in learning experiences from previous demonstration projects and industries that have implemented demand response programmes.

Participants were also able to develop a more sophisticated understanding of the subject matter during the DPs. They raised questions that went beyond costs and technologies. In the GZ DP, one participant raised equity concerns about the use and flexibility of electricity between the rich and the poor (e.g. the rich may be more flexible in rescheduling daily routines and have a higher capacity to pay for electricity use at time-based periods) (Transcript T06). In the KY DP, one participant suggested that because Kyoto has diverse groups of people (e.g. elders, parents, students, and tourists) with different energy needs and consumption patterns, it may be more reasonable to open electricity pricing options for everyone to choose so that those who are less adaptable to new tariff systems can choose to stay in the current one (Transcript T22).

In addition, there were serious concerns over uncertainties associated with smart meter installation and applications. Three of the five GZ small groups were concerned about the installation costs of smart meters (Transcripts T05, T07, and T09). One GZ participant asked: “For RTT, apart from the installation of smart meters, what are the other costs?” (Transcript T02). Some GZ participants also raised issues over the risk of smart meter reading inaccuracies (Transcript T09), privacy and cyber security (Transcripts T10, T12). While KY participants did not explicitly mention concerns over smart meter rollout, one participant did query the public acceptance of smart meters (Transcript T14).

5.2. The normative mechanisms and outcomes of deliberative participation seem to apply in the Asian context

Our findings seem to be consistent with the literature on deliberative participation that dialogic processes and deliberative formats may attain some normative outcomes of deliberation. We found that after deliberation, participants perceived themselves as better informed, competent in weighing trade-offs, and being able 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 DPs. Most participants agreed that the dialogic DPs, particularly the small group discussion and expert Q&A sessions, were useful (Fig. 6). A majority of them found the small group discussion facilitated learning from different participants (n = 40 and 46 respectively).² In relation to the effectiveness of the expert Q&A sessions, a large number of GZ (n = 35) and KY (n = 36) participants found the sessions to be useful (Fig. 7). Participants agreed that the expert Q&A sessions facilitated not only their own learning (n = 40 in GZ and n = 45 in KY), but also facilitated the small group discussions (n = 40 in GZ and n = 39 in KY)(Fig. 7).

What, then, are the reasons for the positive comments from participants? Our quantitative questionnaire and qualitative workshop data suggest that these deliberative processes enabled our participants to weigh trade-offs and then reflect on his/her own views on pricing options. In our two pilot DPs, small group sessions and expert Q&A sessions were structured and moderated in order to facilitate participants to discuss not only the potential benefits, but also the costs and risks associated with various pricing options. As Fig. 8 shows, 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).

Qualitative data derived from direct observations of the project team and workshop transcriptions are consistent with the findings. 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.

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 experts. Generally, experts in both pilot DPs were able to provide clarification and elaborations on issues raised by participants.

For instance, one GZ participant developed his arguments against TOU based on the comments from experts that a noticeable difference between the tariff at peak and off-peak periods in TOU must be evident.

In summarising their discussions, that 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 further 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 ...” (Transcript T01).

5.3. 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. A KY participant asked the following question in the Expert Q&A session: “How would the benefits from cost saving through DSM be shared? Would utilities or residential end-users get most of the money?” GZ participants, in contrast, appeared to be more subtle when raising questions of this nature.

Another noticeable difference in participants’ responses in the two DPs is that KY participants appeared to be more receptive to market-based pricing options. TOU, followed by BAU (i.e. the current TBT system with opt-in TOU), was supported by most KY participants as a preferred pricing option (Fig. 5A and B) both before and after the deliberative workshop. In contrast, GZ participants chose to support the status quo with TOU playing a relatively minor role.

Cultural differences associated with public trust and familiarity with market logic across these two countries may explain the differences in KY and GZ participants’ responses. Public distrust of the market regulators and operators of the power sector in Japan has

² Numbers reported in this finding are expressed as aggregate numbers of ‘strongly agree’, ‘agree’, and ‘disagree’, ‘strongly disagree’ responses.
been well documented, particularly after the Fukushima nuclear accident (Fam et al., 2014; Kingston, 2013). In contrast, it has been documented that Chinese electricity consumers are generally less skeptical about state-owned grid companies (Mah et al., 2017). It was found that the trust relationships between grid companies and household end-users in China can at least partly explain the relatively rapid deployment of smart meters in the country.

On the other hand, the relatively rapid progression of electricity market reforms may have created an environment in which the Japanese are familiar with market mechanisms, including the use of pricing systems to incentivise DSM. The recent completion of retail market electricity reforms may send a strong signal to the Japanese public that more sophisticated tariff options are prominent components of energy policy. In China, domestic electricity consumers still do not have the choice of their suppliers because retail market liberalisation has remained minimal. Chinese participants may therefore be less receptive to alternative pricing options that are underpinned by market mechanisms.

6. Conclusions

This study advances the energy transition literature by bringing the deliberative perspective on participation in the Asian context. We examined how dynamic pricing options were perceived by undergraduate students in Guangzhou and Kyoto. This exploratory study conducted through two pilot DPs is not intended to generalise the findings to the population. It has however derived three main findings which contribute to theory building in transition studies as follows:

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

Fig. 7. GZ (7A) and KY (7B) participants’ response to their opinions on the content and process of expert Q&A sessions.
i. Deliberation tended to increase participants’ acceptance of more sophisticated energy options and our finding sheds light on the complexity of the deliberative outcomes. While deliberation tended to increase participants’ acceptance of more sophisticated energy options, the data also suggest that support for no-change (i.e. the BAU option) was considerable. KY participants who preferred the BAU option actually increased noticeably after deliberation. This finding provides a better understanding of how the public may react to trade-offs in electricity system transition. Dynamic pricing is a typical example of the use of market instruments to replace government intervention in energy governance. Our participants however expressed deep concerns about the effectiveness of dynamic pricing, as well as equity issues. The concerns expressed by our participants enrich the literature on the importance of understanding the complexity of trade-off decisions as government intervention and market mechanisms interact (see, for example, da Silva and Santiago, 2017; Einsiedel et al., 2013; Trutnevyte et al., 2015).

ii. Dialogic and learning processes enabled participants to become more informed and competent in weighing trade-offs associated with complex energy decisions. Our findings suggested that the normative mechanisms and outcomes of deliberative participation such as stakeholder dialogue and social learning can travel across, and be realised in the Asian context (Bull et al., 2008; Turcanu et al., 2014). Our findings are consistent with the literature that deliberation is conducive to nurturing an informed, energy-literate public that is better equipped to make thoughtful, considered, and responsible energy-related decisions and choices (Callan and Thomas, 1996; DeWaters and Powers, 2011).

iii. National level contextual differences are important factors in shaping young people’s energy decisions. We found that contextual differences associated with public distrust and familiarity with market mechanisms may explain the differences in responses between Chinese and Japanese participants. Our findings are consistent with the literature in which a range of cultural factors, including individualism, public distrust, and familiarity with market mechanisms, may affect energy decisions (Einsiedel et al., 2013; Fam et al., 2014; Mallett et al., 2017). Although this study only involved pilots with undergraduate participants, our findings provided insights on the possible cross-national socio-economic and political factors that may influence energy transition trajectories in these two distinct countries.

Our study also makes empirical contributions in the field of energy transitions from the stakeholder perspective, and in the context of Asia. This research is among the first multi-method studies comparing public perceptions of dynamic pricing options across Asian cities. Undergraduates are an important sub-group of the young population, as well as a broader policy stakeholder group. Our findings also enrich the growing body of the literature focusing on young people (see, for example, Fell et al., 2015; Lozano et al., 2013; Vicente-Molina et al., 2013), and shed light on how this particular group perceive different pricing options, express their concerns, as well as how and why their perceptions might change after deliberation.

Our findings have policy implications for effective engagement in the context of energy transitions. The first policy implication relates to the importance of deliberative participation for energy transitions. There are studies that suggest university students are a key stakeholder group in regard to sustainable futures (Lozano et al., 2013; Vicente-Molina et al., 2013). Our findings show that undergraduate students in two Asian cities changed their energy decisions on complex subject matters after undergoing intensive learning and deliberative processes. In this sense, we argue that this group of future decision-makers, leaders, and entrepreneurs can be better equipped to make thoughtful and responsible energy decisions through participating in intensive and deliberative processes. It is therefore essential to introduce higher forms of participatory approach in order to ensure society progresses towards sustainable energy futures.

The second policy implication relates to possible measures to address barriers to engaging stakeholders in dynamic pricing and other energy policies. Our findings shed light on the complexity of public perceptions on pricing options. We found that participants’ perceptions of different pricing options were influenced by...
tradeoffs between alternatives, perceptions of the distribution of costs and benefits between utilities and electricity consumers, and a number of other contextual factors. These findings suggest that policy makers and other policy stakeholders, including utilities, need to give sufficient attention to the wide range issues that the public may be concerned about when engaging them on new pricing options.

Clearly, there are some limitations of this study. First, it has limitations in generalising the findings beyond the pilots. A comparative study between the youth in a number of western and Asian cities could enhance the generalisability of findings. Second, detailed qualitative analysis of workshop transcripts has yet to be conducted. 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 transitions, could be further developed with detailed qualitative analysis in order to enrich the literature in these fields (see, for example, Mitchell and Woodman, 2010; Shen et al., 2014; Stephens et al., 2017).

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Appendix 1. List of Transcripts and Codes

| Guangzhou DP |
| 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 |
| T13 Morning Expert Q&A Session (status: missing transcription; two versions of audio-recordings — from two recorders) |
| T14 Afternoon Expert Q&A Session |
| T15 Small Group A Morning Discussion |
| T16 Small Group A Afternoon Discussion |
| T17 Small Group B Morning Discussion (status: done) |
| T18 Small Group B Afternoon Discussion (status: done) |
| T19 Small Group C Morning Discussion |
| T20 Small Group C Afternoon Discussion (status: transcription missing) |
| T21 Small Group D Morning Discussion (Status: transcript done) |
| T22 Small Group D Afternoon Discussion |

| Tokyo DP |
| T23 Morning Expert Q&A Session (status: missing transcription; two versions of audio-recordings — from two recorders) |
| T24 Afternoon Expert Q&A Session |
| T25 Small Group A Morning Discussion |
| T26 Small Group A Afternoon Discussion |
| T27 Small Group B Morning Discussion (status: done) |
| T28 Small Group B Afternoon Discussion (status: done) |
| T29 Small Group C Morning Discussion |
| T30 Small Group C Afternoon Discussion (status: transcription missing) |
| T31 Small Group D Morning Discussion (Status: transcript done) |
| T32 Small Group D Afternoon Discussion |

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jclepro.2018.07.255.