**Local Climate Change Governance in China: An Analysis of Social Network and Cross-sector Collaboration in Capacity Development**

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**Abstract**

The pilot emission trading schemes in China have driven a new wave of local collaborations among state and non-state actors. Strong networks have been formed to support capacity development, potentially improving the quality of governance through inclusion and engagement. However, the currently poor knowledge about the structure of these networks poses a barrier to identifying who and what drive better climate change governance in China. This paper delineates a network of organizations involved in the development of the pilot emission trading scheme of Guangdong Province. It is based on a social network analysis using primary data from structured interviews with 45 local organizations. We identified key organizations who coordinated the network, and provided some explanations about the enabling conditions. Findings show that the network was oligopolistic. Connections were mediated by a handful of organizations with different degrees of public-private hybridity. Government agencies, civil society organizations, compliance enterprises, and management consultancies were not key network builders. Hybrid organizations and cross-sector initiatives have a high potential to become a transformative institutional innovation for improving governance in China. Further research into their contributions and impacts is warranted.

Keywords: climate change governance, emission trading, hybrid organization, social network analysis, China

**1. Introduction**

Environmental governance systems in the 21st century encompass various forms of collaborative partnership and network that involve public and private actors across scale (Bulkeley, 2005; Pattberg, 2010; Tosun and Schoenefeld, 2017). There are increasing tendencies for state actors to engage and collaborate with non-state actors, such as businesses, civil society organizations, universities, and independent think tanks. Such collaborations can improve governance by promoting the sharing of resources, increasing the frequency and quality of knowledge exchange, and increasing political legitimacy (Ansell and Gash, 2008; Emerson, Nabatchi, & Balogh, 2012; Innes and Booher, 2004; Parker, 2007). These benefits are particularly important for decision-makers governing highly complex and contested issues, such as climate change.

 Climate change decision-makers in China are aware of the value of public-private partnerships and networks for improving governance (Schröder, 2012). China currently accounts for 28% of the world’s carbon emissions (International Energy Agency, 2018). Although political authority in China rests upon the authoritarian state, an increasing number of non-state actors have been brought into the systems of climate change and energy governance established at difference levels (Francesch-Huidobro and Mai, 2012; Liu, Wang, & Wu, 2017; Lo, 2015; Schreurs, 2017; Schröder, 2012). Local-level collaborations in renewable energy development in Xinjiang and Guangdong Provinces are found to be effective in bringing together resources and skills from within and outside the state (Mah and Hills, 2012). Although Chen and Lees (2016) contend that the state continues to control the renewable energy sector through state-own entreprises (SOEs), non-state actors have increased their engagement in some areas, such as capacity development (Biedenkopf, Eynde, & Walker, 2017; Lo et al., 2018; Schröder, 2012).

 Capacity development is the process by which individuals and organizations acquire, improve, and retain the skills, knowledge, tools, and other resources needed to complete their tasks or achieve their goals (Eade, 1997). Market-based climate change policy instruments, such as emission trading schemes (ETSs), often have a complex policy design and the impacts tend to be less certain than their alternatives (e.g. mandatory emission reduction targets). The challenges to designing and implementing these policy instruments require greater efforts in raising the capacity of all parties involved for managing the changes in their area of responsibility. Earlier in China, international organizations were instrumental to building capacity both at local (Schröder, 2012) and national (Biendenkopf et al., 2017) levels. The role of local organizations is becoming more important as China has launched several sub-national ETSs as well as a national ETS, enabling participation by a wider range of local actors.

 This new wave of local collaborations in China driven by the ETSs is poorly understood. These ETSs are officially designated as *shi dian*, which literally means ‘trial points’, putting together a variety of institutional innovations to achieve emissions reduction targets (Shen and Wang, 2019; Zhang, 2015). Governance networks are an important example of institutional innovations. Initial evidence shows that non-state actors were able to partially substitute the state in the area of capacity development (Lo et al., 2018). However, the specific structure of these networks in the Chinese context has not been fully explored. Questions that remain unanswered are ‘how are the network constituents related to each other?’, ‘who coordinate the network? and ‘what enable them to enhance network connectivity?’. The research reported in this paper attempted to address these questions.

 This paper presents an analysis of a governance network involved in the implementation of an ETS in China. The findings make contributions to knowledge by identifying what make such a new and complex policy initiative successfully implemented, while demonstrating both top-down and bottom-up elements (Chen, Shen, Newell, & Wang, 2017). This will help us to understand the emerging mode of environmental governance in China, in which neither a predominantly centralized nor decentralized approach seems to exist (Lo, 2010, 2015, 2016), and potentially draw implications for other countries governed by an authoritarian or semi-authoritarian regime.

The research reported in this paper is based on Social Network Analysis (SNA), which can quantitatively show the structure and quality of relationships among the actors concerned. Our analysis identified a few ‘bridging organizations’ who coordinated the network, and played critical roles in the collaborative climate governance in China, especially in the area of capacity development. We further elaborate these concepts in the next section, which is followed by a description of the methods used. We then introduce our case study, which focused on the network of actors involved the governance of the largest pilot ETS in China.

**2. Governance networks and bridging organizations**

Collaborative governance is ‘a governing arrangement where one or more public agencies directly engage nonstate stakeholders in a collective decision-making process that is formal, consensus-oriented, and deliberative and that aims to make or implement public policy or manage public programs or assets’ (Ansell and Gash, 2008, p. 544). The collaboration may benefit from a strong and productive network comprising state and non-state actors, which is conductive to networked governance (Backstrand, 2008; Howes et al., 2015; Parker, 2007). Networks enable collective climate action by encouraging individuals to participate in group-level activities (Tosun and Schoenefeld, 2017). Parker (2007) suggests that one of the critical features is that networks order action such that the behaviour of participants is different from that which they would otherwise engage in as individual actors. The shift in action involves formal and informal processes of empowerment, legitimization, and sharing of resources and knowledge. Not all individual actors have direct access to these opportunities, which are often provided or mediated by ‘bridging organizations’.

Bridging organizations bring together actors who are diverse on many dimensions but share some interest in solving problems (Brown, 1991). Their activities mediate connection between actors who would otherwise have not been connected (Berkes, 2009) and facilitate communication, collaboration and coproduction among these actors (Cash et al., 2003; Crona and Parker, 2012). Common examples are non-governmental organizations (NGOs), universities, and multi-stakeholder initiatives that have access to governments or supranational institutions (Berdej and Armitage, 2016; Brown, 1991; Crona and Parker, 2012; Gupta, Pistorius, & Vijge, 2016; Nguyen, Bush, & Mol, 2016; Rathwell and Peterson, 2012). Bridging organizations significantly contribute to the structure and functioning of networks for robust environmental management and governance. Therefore, their strong presence and impacts are evidence for a functioning governance network and are often the main focus of network analyses.

The structure of networks and the networking role of bridging organizations are poorly described in most studies of climate or renewable energy governance in China. Some of these studies focus on the structure and dynamic of power (Chen and Lees, 2016; Lo, 2015; Miao and Li, 2017; Qi and Wu, 2013; Schreurs, 2017; Tsang and Kolk, 2010). A smaller but growing body of literature has demonstrated the presence and impacts of key organizations that coordinate and steer policy-making processes and are able to connect the authoritarian state and other actors in meaningful ways (Francesch-Huidobro and Mai, 2012; Liu, et al., 2017; Mah and Hills, 2012; Schröder, 2012; Shen, 2017). These organizations include a mix of public, private, and hybrid actors, such as public universities (Mah and Hills, 2012), governmental-organized NGOs (GONGOs) (Francesch-Huidobro and Mai, 2012), public-private capacity-building centers (Schröder, 2012), and private renewable energy producers (Shen, 2017). The analytical focus of these studies has been organizations, collaborations, partnerships, and outcomes of a policy or a course of action, rather than the networks of actors. Biedenkopf et al. (2017) is one of the few studies outlining such a network, but their analysis is limited to international organizations, which are not key players in local climate governance.

This suggests that there has been limited knowledge about the structure of networks and how bridging organizations are embedded into these networks. This creates barriers to understanding the forms of collaborative governance existing or emerging in China that can navigate between the top-down-bottom-up dichotomy. The research described below systematically delineates an extensive network of actors and identifies bridging organizations to see how this network contributes to a key function of climate governance, i.e. capacity development (Andonova, Betsill, & Bulkeley, 2009).

In analyzing this network, we make reference to the concept of *Tertius iungens*, which is based on the Latin verb "*iungo*" which means to join, unite, or connect. This concept recognizes that individuals and organizations in a connecting or “arbiter” role can benefit from the social or organizational network. However, rather than being “the third who benefits” (the *tertius gaudens*), they can be “the third to benefit” (the *tertius iungens*) by uniting unconnected network members (Obstfeld, 2005). *Tertius iungens* is a strategic behavioral orientation toward connecting people in one's social network by either introducing disconnected individuals or facilitating new coordination between connected individuals (Obstfeld, 2005, p.102). Such an orientation and the presence of dense organizational networks are conductive to organizational and institutional innovations.

**3. Methods**

*3.1 Social Network Analysis (SNA)*

Evidence was sought from a SNA and semi-structured interviews. SNA is used to systematically describe the relationships amongst individuals or organizations and the patterns of these relations (Freeman, 2004; Wasserman and Faust, 1994). Bodin and Prell (2011, p. 10). It can show us the structure of networks by quantifying and visualizing personal or organizational connections, and the network enablers of communication and collaboration. SNA has previously been used to identify bridging organizations and characterize their role (Biedenkopf, et al., 2017; Fliervoet, Geerling, Mostert, & Smits, 2016; Rathwell and Peterson, 2012).

A standard SNA starts with delimiting the network boundary and then displaying network elements, such as actors, links, distance, centrality, and density. Actors are defined as ‘discrete individual, corporate or collective social units’ (Wasserman and Faust, 1994) and treated as the ‘nodes’ of a network. Node position and size show the influences of actors. Actors can be put into different groups and displayed using different colours and shapes. Relationships are ‘the collection of ties of a specific kind amongst members of a group’ (Wasserman and Faust, 1994) and treated as the ‘links’ of a network, graphically displayed as straight lines. The length of these lines represents the distance between actors and is an indicator of network cohesion. Links are the primary unit of analysis.

There are two centrality indicators. Degree centrality is the number of ties of an actor, representing the influence of this actor in the network. Betweenness centrality is the probability of an organization being on the shortest path between any two organizations in the network (Fliervoet et al., 2016). It was calculated by taking every pair of the network and counting how many times a node can interrupt the shortest paths between the two nodes of the pair, expressed as percentage. It is a more useful measure than degree centrality, because it can help identify the bridging agents of the network (Freeman, 2004). Actors with high betweenness centrality often serve as a broker or mediator for connecting subgroups and facilitating the flow of information (Bodin and Crona, 2009). Network density is the number of ties in the network divided by the maximum number of ties possible (Borgatti, Everett, & Freeman, 2002). Density is a measure of overall connectivity; the denser network is generally more conductive to collaboration (Olsson, Folke, & Berkes, 2004). Cross-boundary exchange is the ratio of collaborative links within and between groups of actors, which is an indicator of network heterogeneity. These indicators are used in the present study to identify groupings and assess the potentials for collaboration, and identify actors who occupy key positions in the network and promote collaborations.

*3.2 The Guangdong Emission Trading Scheme*

Located near the South China Sea and encompassing the Pearl River Delta, Guangdong Province is one of the largest urban agglomerations in China, with a population of over 113 million. Guangdong is a fast-growing economy and has been the single largest one within China. Its GDP reached US$1,414.8 billion in 2018, which was approximately 10% of the country’s total GDP (National Bureau of Statistics of China, 2019).

Guangdong Province is highly industrialized. Over the past three decades, the southern province has supported many emission-intensive industries, making it one of the largest greenhouse gas emitters in China. In 2011, Guangdong was selected by the central government as one of the seven cities and provinces to introduce a pilot ETS. All of these ETSs have adopted local rules on carbon emissions, formulated methods and guidelines for accounting emissions from regulated enterprises, and established reporting platforms.

Established in 2013, Guangdong’s cap-and-trade system currently covers 388 Mt of CO2 emissions from over 250 entreprises from six industries, including electricity generation, iron and steel, cement, papermaking, aviation, and petrochemicals (Wang, Liu, Tan, & Liu, 2019). All enterprises with annual emissions exceeding 20,000 tons of CO2 in the four industries were listed as compliance enterprises and accounted for approximately 55 percent of the total emissions in Guangdong Province (Guangdong DRC, 2013). A conservative approach was employed by Guangdong Development and Reform Commission (DRC) to measure and examine industrial emissions with convenient methodologies. Only core companies were included in the pilot ETS, and an estimated emission cap was acceptable for most participants; this approach proved to be crucial to the operational stability of ETS at the initial stage (Chen et al., 2017). A combination of free allocation and an auctioning mechanism for allowance allocation is adopted in the Guangdong ETS.

The Guangdong ETS remains a pilot scheme at the time of writing. Our study tracked its first four years of development and investigated the ways in which state and non-state actors coordinated and participated in the capacity building activities that were directly linked to this ETS.

*3.3. Data collection and analysis*

The network boundary was specified with the relational approach, which relies on the authors’ knowledge about the relationships among network constituents as well as on the actors themselves to nominate additional actors for inclusion (snowballing technique). Between June and October 2017, one of the co-authors conducted resident research at the China Emissions Exchange (CEEX) in Guangzhou. We contacted potential interviewees through the CEEX and requested referrals to other actors they had come across or collaborated with in any process crucial to the development of the ETS. Forty-five organizations were finally identified in this research, including government agencies, SOEs, private consultancy firms, industry associations, universities, think tanks, GONGOs, independent NGOs, and international organizations. They had varying degrees of involvement in the governance of the Guangdong ETS. For example, the Guangdong DRC was the decision-maker, whereas green groups merely observed, sponsored, and participated in capacity-building activities. These organizations were divided into nine sub-groups according to the nature of business (Table 1). The label ‘Operational Entity’ (OE) borrows from the name given to some organizations recognized under the United Nations’ Clean Development Mechanism (CDM), i.e., Designated Operational Entity, which is an independent auditor accredited by the CDM Executive Board to validate project proposals and verify whether implemented projects have achieved planned greenhouse gas emission reductions. Three of the four OEs in our study specialize in the validation and verification of emissions reductions, whereas the remaining one facilitates the trading of emissions reductions and allowances.

Census approach provides a roster (positional method) to which respondents can refer. It was adopted for the complete network data collection. At least one representative from each listed organizations was interviewed. Screening criteria included the sector represented (to ensure relevance and diversity) and the role of the person interviewed (to ensure an informative conversation). More than half of the respondents have reached a management level (e.g., director, head, or chairperson). These respondents included senior government officials, business executives, industry representatives, and experienced researchers who designed the ETS. The majority of them were based in Guangzhou, the capacity city of Guangdong.

Data for the SNA were gathered by a structured questionnaire. The researchers developed the questionnaire based on desktop research and document searches, event observations, informal conversations, and pilot interviews conducted with contacts to which they had access. The questionnaire included a list of the forty-five organizations known to be involved in the capacity development process of the Guangdong ETS. Each respondent identified from this list those with which they had interactions during the process of policy development. They were then asked to indicate the strength of each of these interactions by selecting one of the following options: (1) yearly or less, (2) quarterly, (3) monthly, (4) weekly and (5) more than weekly (frequency of interactions for work related to the ETS).

All but two of the questionnaires were completed in face-to-face interviews. During the interviews, we also asked open-ended questions about the respondent’s participation in policy development, their role, organizational relationships, collaborations, and challenges[[1]](#footnote-1). Forty-one interviews were recorded and transcribed.

 The analysis was performed using the UCINET, which is one of the most popular software programmes tailored made for SNA. The numerical data representing the relationships amongst actors were extracted from the completed questionnaires and translated into an adjacency matrix, which is the SNA data input format used in the UCINET. These data were then used to identify the nodes and links, and calculate the density and centrality metrics. Results are presented in tables and graphs, as shown in the next section.

**4. Findings**

*4.1 Overall network structure*

Nodes and links are presented in Figures 1 and 2. All links are shown in Figure 1, whereas only high-frequency links are included in Figure 2, i.e. frequency of interaction being monthly, weekly and more than weekly, which indicate strong ties. The size of the nodes is determined by betweenness centrality, an indicator of importance in connecting actors with each other. Active organizations, defined in terms of betweenness centrality, are placed at the centre and regarded as key bridging organizations (e.g. G1, G3, Y3 and X1). G1, the China Emissions Exchange (CEEX), can be seen as the most important one.

Table 2 displays a set of network statistics, including the number of nodes and links, network density, degree centralization and cross-boundary exchange, for all-frequency and high-frequency networks separately. The all-frequency network (i.e., frequency of interaction ranging from yearly or less to more than weekly) has a higher value of network density than the high-frequency network, indicating greater connectivity. The degree centralization statistics suggest that a small group of organizations frequently interacted with others and were very active in building closer connections. Moreover, both networks have a moderately high value of cross-boundary exchange, showing that group members were able to interact and communicate with members of other groups. It is worth noting that the high-frequency network has members from all of the nine organizational sub-groups listed in Table 1, suggesting high organizational heterogeneity.

4*.2 Network sub-groups*

A group-level analysis was conducted by re-drawing the network and computing network statistics for each sub-group. Results are presented in Figure 3. The clusters formed are displayed in different colours. Each cluster represents the territory of an organizational group in the network. Most of the links in the all-frequency network are attached to research institutes (*red colour*), OEs (*blue colour*), semi-official associations (*green colour*), carbon asset management enterprises (*pink colour*), and international organizations (*yellow colour*). However, bigger circles are found in the upper end of the figure (the size of the nodes is determined by betweenness centrality) This implies that some organizations and sub-groups were well connected as well as important for building connections for other organizations, whereas some others were well connected only.

Table 3 shows network statistics for each sub-group. The degree centrality and betweenness centrality of a sub-group indicate its influence and ‘bridging’ ability in the network respectively. Research institutes and OEs achieved higher values on both measures, whereas government agencies and civil society organizations scored low values. In general, the number of sub-group links increases with the number of group members. However, some small sub-groups, particularly the OEs, have many links, relative to group size.

Figure 3 further shows that these links are concentrated in two OEs (G1 and G3). Research institutes have a larger group size than OEs, but they have one common feature. Figure 4 presents a graph based on centrality statistics (blue and red solid lines) and relative group size *(dotted line)*, which is the ratio of the number of actors in a sub-group and the total number organizations included in this study (i.e. 45). The values of degree centrality and betweenness centrality of OEs and research institutes are higher than the relative group size. This implies that the influence and ability to mediate connections were highly concentrated in these two sub-groups, particularly the OEs.

The opposite case is true for government agencies, civil society organizations, compliance enterprises, and carbon asset management enterprises, whose centrality values are lower than the relative group size. It is noteworthy that although the government agencies held considerable decision-making power, they did not play a pivotal role in constructing the network for supporting capacity development.

*4.3 Network actors*

This section identifies bridging organizations in the network of actors by presenting actor-level centrality statistics. The most important ones are the CEEX. Ceprei Certification (CEP), Guangdong Research Center for Climate Change (RCCC), and Guangdong Low Carbon Development Promotion Association (LCDPA), all scoring much higher than the average value across the entire network (Table 4). The first two are OEs and have higher scores on both measures, whereas the other two include a research institute and a semi-official association. With significantly higher values of betweenness centrality than the rest of the network, these organizations were therefore regarded as the key bridging agents supporting the network for capacity development in Guangdong. This can be further demonstrated through an ego network analysis, described below.

An ego network consists of a focal node (ego) and the nodes to whom the ego is directly connected to (alters) and the ties among the alters. The ego network of G1 is presented in Figure 5. Thirty-eight organizations (blue nodes) had directive connections (red lines) with G1, whereas only 6 organizations (grey nodes) did not have such a connection. The ego network of G1 covered most of the interactions in the full organizational social network. Broker scores indicate the potential that ego is the "go-between" for pairs of other actors. G1 acquired the highest brokerage score of 410 among the whole egonet basic measures, which means 410 pairs of actors would not have been connected directly without the mediation of G1. Three other organizations, namely G3, Y3 and X1, also returned very high broker scores, indicating their significant mediating impacts.

 Most importantly, these bridging organizations connected peripheral actors to powerful decision-makers. Peripheral actors include some of the non-state actors, such as compliance enterprises, civil society organizations, and carbon asset management enterprises. These actors are often considered to be key stakeholders in the governance of climate change and carbon markets in China (Huang, 2013; Liu, et al., 2017; Shen, 2015), but have been shown earlier to be poorly connected in the governance network. Our study includes two decision-making government agencies overseeing the implementation of the Guangdong ETS and all pilot ETSs in China, i.e. the Guangdong DRC and the National Development and Reform Commission (NDRC). We interviewed the chiefs or deputy chiefs of the policy-making departments of these two DRCs.

 The figures below show how a group of peripheral actors was connected to the DRCs with and without the presence of a bridging organization in the network. Figures 6 and 7 include the DRCs, the carbon asset management enterprises, who provide advice on the trading of emissions allowances and the management and accounting of emissions to polluting entreprises, and G1 (the CEEX) and G3 (the CEP), the sector-specific bridging agents of these entreprises. Without G1 and G3, there were only two intergroup ties between carbon asset management enterprises and the DRCs (the red lines through S1, a Beijing-based consultancy), whereas their local (Guangdong) counterparts had no direct access to the government. With G1, the number of intergroup ties increased to twelve, and any two nodes can be connected within two steps (Figure 6). With G3, the number of intergroup ties increased to ten (Figure 7), although it did not have any direct connections with Z1 and S4. Thus, the presence of G1 and G3 substantially improved connectivity.

Figure 8 includes compliance entreprises that are regulated by the ETS and Y3 (the RCCC). Without Y3, there was only two intergroup ties. The presence of Y3 added six more intergroup ties, making any two nodes connected within two steps.

4.4 The quality of network connections

The strong network connections were instrumental for capacity development, especially for sharing resources and exchanging knowledge. Elite research institutes and OEs collaborated with each other to co-organize large-scale specialist training classes and sent their experts to lead these activities. To strengthen the collaboration in capacity development, some of these organizations created the National Carbon Market Capacity Building (Guangdong) Center (hereafter ‘Guangdong Center’). The Guangdong Center is an institutional innovation that successfully brought together qualified experts and consultants from elite research institutes and OEs to provide information and skills to entreprises and practitioners. In addition, cooperation agreements were established between some research institutes and semi-official associations. The latter group assumed responsibilities for offering public training and enrolment because they had greater access to enterprises as well as social actors. The small but close-knit network of bridging organizations facilitated the sharing of expertise and contacts.

Another form of capacity-building activity enabled by this network was the ‘low-carbon salon’ (低碳沙龙), which was a series of informal knowledge exchange workshops usually organized by the bridging organizations in Guangdong once a month. These workshops involved presentations, discussions and sharing on topics such as low-carbon development, ETS operation, carbon asset management and green financial innovations. Although these workshops were open to public and did not charge any fee, most of the participants came from private businesses and had an interest in new policy requirements and carbon market innovations. Workshop speakers included experts from elite research institutes, OEs, and private businesses and consultancies actively involved in carbon trading. Occasionally, government officials also participated in these workshops to introduce the latest developments in the Guangdong ETS. These workshops offered a networking opportunity, as one of the bridging organizations suggested:

[Private businesses] were quite active in our workshops, from which they received the latest information about the carbon market. Moreover, these workshops offer a platform for them to make connections with government officials… As speakers, these businesses can also make themselves known to other participants by which to strengthen their influence in the Guangdong carbon market’ (Interview with a research institute, July 2017)

Therefore, the ‘low-carbon salon’ was effectively a hub for all parties to exchange their knowledge and views about the ETS and related policy or practice.

 The Guangdong Center and the ‘low-carbon salon’ are two important innovations created and run by those bridging organizations, who can be seen as *Tertius iungens* (Obstfeld, 2005). These and other innovative activities discussed above were driven by these *Tertius iungens* actively bringing together different parties involved in the implementation of the Guangdong ETS. The strong commitment and ability of these bridging organizations to uniting other organizations enabled state actors to govern the ETS more effectively. Although state actors did not have many direct links to some of the non-state actors in the network that supported capacity development in Guangdong, they gained such links through bridging organizations. These bridging organizations were pivotal to coordinating the network and facilitating the communication between actors who would otherwise have limited opportunities for exchange. The links between state and non-state actors provided conditions for public-private and multi-stakeholder partnerships, which benefit the network as a whole and form the very basis of collaborative governance.

**5. Discussion: the hybridity of bridging organizations**

Organizational attributes can explain the ability of the bridging organizations to connect actors and the agential opportunities available to them. These attributes include organizational structure, origin, and history, which result in varying degrees of hybridity.

Hybrid actors transcend the private-public dichotomy. They adhere to the public mandate to provide the public goods and benefit from different forms of close attachment to the government (Chen, 2017), while also pursuing private interests or growing economically independent of their public patrons (Schröder, 2012). Schröder (2012) has suggested that the activities of hybrid actors were effective in diffusing the CDM in China and facilitating the local CDM markets. Their close ties to the state were instrumental.

 As reported earlier, OEs, research institutes, and semi-official associations have the highest levels of betweenness centrality. The degree of hybridity varies across these organizations. The RCCC has the lowest betweenness centrality score among the four (Table 4), but is the closest to the government. Established by the Guangdong DRC and Sun Yat-sen University, the RCCC is an elite research institute designated to provide technical advice and support to the DRC. In the development of the ETS, the RCCC found itself in a tremendously important role unmatched by any other non-state actor in Guangdong. For example, the key members of the RCCC, trusted by the DRC, assumed responsibility for overseeing and advising the DRC on the allocation of emission allowances, a game-changing task initially assigned to official think tanks, notably the Guangzhou Institute of Energy Conversion of the Chinese Academy of Sciences. Despite operating like a technical arm of the DRC, the RCCC is endowed with a greater flexibility:

These organizations [official think tanks] are research-oriented. The staff are too specialized, mostly PhDs and professors. Their role is limited when it comes to daily operation. Thus, later we switched to the RCCC …… They are more flexible because of their age and credentials. They can do both research and practical work. At this stage, we don’t have much research to do, but we need more technical support for practice, some fine-tuning and routine tasks. (Interview with DRC - August 2017)

Also, the university-based research centre has expertise in engineering and applied sciences, which is practical and valuable to industry. The technical strength and operational flexibility allow the RCCC to provide consultancy services and compete with privately owned consultancies for government tenders and service contracts, which usually involve interactions with compliance entreprises (Interview with a carbon asset manager, August 2017). The RCCC has become a broker through which compliance entreprises learn about the latest policy requirements and how to overcome the challenges they bring forth.

 The CEEX is more entrepreneurial and has the highest betweenness centrality score (Table 4). A subsidiary of the China Canton Exchange Group (a SOE), the CEEX is the only one in Guangdong with the authority to operate a carbon emission trading platform. Over the past few years, it has successfully organized many capacity-building activities for businesses, such as training workshops and seminars. However, the hybridity of the CEEX is reflected in the nature of those actors to which it is held accountable. While the parent company of the CEEX is a larger SOE, it is accountable to both the Guangdong DRC and the Municipal Government of Guangzhou. The CEEX therefore pursues (or is expected to pursue) both public and private interests. Being the sole operator of the trading system and closely working with the DRC, it is one of the most welcomed partners to private carbon asset management entreprises (not being SOEs). By collaborating with the CEEX, these entreprises can share their skills through lecturing in fee-paying training workshops (from which they can also recruit new customers) and gain first-hand insights into the relatively young and developing market mechanism. Another reason is that private carbon asset management entreprises are rather marginalized in the network. They are keen on bidding for government tenders and service contracts as a source of income, but would only succeed if partnering with those with access to the government.

 The RCCC and CEEX do not only build connections for private entreprises, but also for international organizations. As a carbon market analyst of an international organization suggests:

We can’t directly participate in policy formulation like the government’s think tanks do. We are not an official channel for communication. But we can indirectly influence policy formulation through participating in sharing and exchange activities organized by the RCCC and CEEX. (Interview with an international organization, October 2017)

 The CEP is similarly hybrid in nature. It is responsible for the emissions measuring, reporting, and verification (MRV) system and related policy-making tasks, and has been described by other interviewees as the second most important organizations (after RCCC) in the governance of Guangdong ETS. Established in 1956 as a state research institute, the CEP currently operates as a private entreprise, but continues to report to the Chinese Ministry of Industry and Information Technology.

The most clearly hybrid actor is the Guangdong Center established in August 2016. The Guangdong Center is an officially recognized institution and one of many with the same brand name established across China to meet the growing need for capacity development, driven by the prospects for nationwide emission trading. Although it operates under the mandate and leadership of the NDRC and Guangdong DRC, its actual work is undertaken by elite OEs and research institutes, especially the CEEX, the CEP, and the RCCC.

The form of organizational hybridity has qualitative impacts on collaborative governance. This can be articulated in terms of the three main functions of climate change governance networks, namely, information sharing, capacity building, and rule setting (Andonova et al., 2009). To illustrate with the two most influential organizations: the RCCC has a clearer ‘public face’ and stronger presence in rule-setting activities (e.g. allowance allocation), while being active in the other two areas. On the other hand, the CEEX, essentially a business, has made greater efforts to enable different parties to interact and communicate with each other. Its *proactive* role in information sharing and capacity building is evidenced by the highly inclusive training activities it has organized and the joint projects it has established. The form of hybridity determines the function and role a hybrid organization plays in a governance network (or the intensity in which it is involved).

**6. Conclusions**

In this paper, we have delineated a network of actors involved in the development and governance of the Guangdong ETS. Focusing on capacity development collaborations, the paper has identified key actors who coordinated the network, and provided some explanations about the enabling conditions.

 Findings from our SNA show that the network was oligopolistic. Connections were mediated by only a few organizations. There were tendencies for decentralization, where elite research institutes, OEs and semi-official associations have partially substituted state actors in the area of capacity development. While state actors assumed a back-seat role, there were numerous cross-sector organizational interactions. Many activities of capacity development, which is a function of environmental governance (Andonova et al., 2009), were collaborative, creating conditions for collaborative governance in Guangdong.

 The actor-level analysis has identified four bridging organizations. The group-level analysis shows that, although compliance entreprses were the regulatory target of the ETS, they were poorly connected with the state. Private carbon asset management entreprises were in a similar situation, but had strong connections with other non-state actors. Bridging organizations, such as the RCCC, the CEEX and the CEP, have improved the linkages between state and non-state actors. They were strongly influenced by the public mandate and expected to deliver public service, while pursuing their own private interest or growing economically independent of their public patrons. Hybridity was most clearly found in a flagship capacity-building initiative, i.e., the Guangdong Center, which was jointly established by the state and many of these bridging organizations and staffed by a company controlled by a SOE.

These findings demonstrate the important role of some organizations in building linkages and collaborations which are conductive to robust governance (Berke, 2007; Cash et al., 2003; Brown, 1991; Crona and Parker, 2012; Rathwell and Peterson, 2012; Gupta et al., 2016). A more important insight is that these organizations can potentially make further contributions to the decentralization of environmental policy-making and management in China, while allowing centralized forces to hold authority. A number of organizations and initiatives with a bridging function have emerged in this country to influence climate change-related policy and management practice (Schröder, 2012; Francesch-Huidobro and Mai, 2012; Mah and Hills, 2012; Chen et al., 2017; Lo and Howes, 2015; Lo and Yu, 2015; Lo et al., 2018). A departure from earlier studies, such as Rathwell and Peterson (2012), Berdej and Armitage (2016), and Nguyen et al. (2016), is that the bridging organizations and initiatives discussed in the present study have a relatively higher degree of hybridity.

Organizational hybridization is not a recent phenomenon in China. Schröder (2012) has demonstrated how local CDM centers facilitated the development and governance of the pre-2012 Chinese carbon markets that were driven by international demand. The role of these centers, as a hybrid actor, has diminished as the CDM is declining, but new ones have been created since China’s pilot ETSs commenced in 2013 and 2014. These include the Guangdong Center and other similar capacity-building centers established at the provincial level. Like the CDM centers, these new ETS centers and the underlying networks are likely to be organized in different ways and coordinated by different combinations of actors. Although Guangdong has demonstrated the importance of hybrid organizations for climate change governance, the implications of organizational hybridity may vary across the country. Unlike the CDM centers, however, these ETS centers do not receive a significant amount of direct financial or technical support from international organizations, but from local research institutes, OEs and semi-official organizations. The localization of governance networks is likely to be a common experience driven by the implementation of the Chinese ETSs.

Climate change governance in China has to navigate between centralizing and decentralizing forces. If hybrid actors are instrumental to this endeavor, we should expect a process of localization in the core territory of the network and diffusion of these organizational norms across the country. The new ETS centers are an indication. They have a high potential to become a transformative institutional innovation for improving climate change governance in China, and therefore further research is required to explore their contributions and impacts.

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1. Because this SNA study focuses on a specific policy issue, i.e. the ETS, we asked our interviewees to respond to these questions based on their involvement in the ETS and related activities. As a result, the connectivity identified in our study is issue-specific. However, the interviewees were asked to respond as a representative of their organization (or a unit/department of a larger organization) so that organizational connectivity can be detected. [↑](#footnote-ref-1)