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U.S. Interlocal Energy Collaboration on Energy Efficiency, Sustainability and Climate Protection*

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Abstract

What factors facilitate interlocal energy collaboration? To what extent does collaboration through interlocal contractual mechanisms differ from that arising through collective mechanisms? This research attempts to answer these questions by examining the priorities of city governments with respect to energy-related issues as well as other institutional collective action (ICA) explanatory factors. Research data are drawn mainly from the 2010 national survey "implementation of energy efficiency and sustainability program" conducted by Florida State University.

The research findings indicate that cities' emphasis on common pool resources, economies of scales, and externality issues significantly affects individual choices of energy

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collaboration tools. When anticipated transaction costs are extremely high or low, informal contractual mechanisms are more likely to be employed to preserve local autonomy and flexibility; in other cases, written and formal tools for collaboration are the preferred means of imposing constraints on individual behavior and reducing the risks of defection.

Key Words: Interlocal energy collaboration, institutional collective action dilemmas, energy efficiency, sustainability, climate protection

I. Introduction

Increasing concentrations of greenhouse gases, rapidly declining biodiversity, the ongoing use of fossil fuels, the depletion of non-renewable natural resources, and the deterioration of the ozone layer cause serious environmental problems and impose health risks on human beings. In the 1970s and 1980s, a wide range of national environmental laws and policies were adopted to reduce air, water, soil and other forms of pollution (Mazmanian & Kraft, 2009), and for the thirty years since, states and localities have emphasized the design and implementation of policies for pollution control and environmental protection (Portney, 2003). Sustainable development, sustainability and sustainable community become special concerns of local governance (Rees, 1997; Richardson, 1996). In the United States, at least 25 major cities have invested in sustainability initiatives (Portney, 2003), over 500 cities have become members of the "International Council for Local Environmental Initiatives (ICLEI)" (Feiock & Kassekert, 2009), and over 1,000 municipalities have committed to reducing greenhouse gas (GHG) emissions through participating in climate protection networks (Mayors Climate Protection Center, 2007). In 2009, the American Recovery and Reinvestment Act (ARRA) made available $787 billion in grants to design and implement long-term plans, including the use of renewable energy and alternative fuels, implementation of energy conservation measures, and development of new transportation technologies and smart grid energy transmission systems (Feiock & Kassekert, 2009).

Energy collaboration through partnerships and cooperation, across levels of government, is encouraged by the U.S. Department of Energy (Department of Energy, 2003a). The Weatherization and Intergovernmental Program, for example, provides funding and technical assistance for state and local governments to adopt renewable energy planning and energy efficiency technologies (Weatherization and Intergovernmental Program, 2010). The State

Energy Efficiency Action Network (SEEAN) was created jointly by the Department of Energy and the Environmental Protection Agency. The SEEAN is an initiative to help implement cost-effective energy effort in state-wide facilities, including environmental upgrades of offices, buildings, homes and industries. It is built upon the foundational works of the National Action Plan for Energy Efficiency (NAPEE), and stimulates energy collaboration by providing funding opportunities from State Public Utility Commissions. The Department of Energy provides assistance for regional energy collaboration on energy planning as well, including financial assistance to the Southeast Energy Efficiency Alliance and the Regional Evaluation, Measurement and Verification Forum, the facilitation of services to the Mid-Atlantic Distributed Resources Initiative (MADRI), and consultations with the Western Governors' Association's Committee on Regional Electric Power Coordination (Department of Energy, 2003b).

Installing a solar photovoltaic (PV) system on a building (one aspect of what is known as green building) is one approach to enhancing energy efficiency. Freiburg, in southwest Germany, requires new buildings to install solar energy equipment. It now has over 900 solar PV system installations in buildings, and its solar energy systems, together with a combination heat and electricity plant, provide 65 percent of the power for neighboring Vauban (the neighborhood, Vauban, is a large green community of about 20,000 residents). Freiburg's interlocal energy plans include the development of the solar electric system, two wind turbines, a ground-mounted solar PV system, and a landfill gas plant (European Sustainable Urban Development Projects, 2004; Fitzgerald, 2010).

Interlocal collaboration on energy planning can be seen by innovative programs through the efforts of collaborative partnerships. Austin, Texas, in conjunction with Travis, Williamson and Hays counties, has developed a "green building program" and a private-public partnership, named as Greater Austin@work, to articulate greener visions and establish more environmentally-friendly and energy-efficient buildings. In early

2001, it rated 10 commercial buildings, 1,400 apartment units and 1,800 homes as possessing features consistent with green practices, and provided technical guidance to investors concerning energy conservation and green strategies. Austin's "GreenChoice" option allows utility customers to choose the source of their electricity—from renewable sources (wind, solar, and biogas from closed landfills) or from traditional sources such as fossil fuels. Its energy planning and the construction of a new wind turbine have generated additional renewable energy sources to power up to 20,000 buildings in West Texas (Austin Energy, 2001; City of Austin, 2001a, 2001b; Portney, 2003).

Recognizing that "no city or urban region can be sustainable on its own" (Rees, 1997: 307), many local entities have agreed to collaborate by integrating their land use plans, adopting green building standards, purchasing energy efficient devices and developing alternative fuels (Feiock & Audirac, 2009; Lubell, Feiock, & Handy, 2009). Interlocal energy collaboration is built upon networks among local energy policy actors and takes the form of institutional collective action (ICA) to cope with problems spanning jurisdictional boundaries, such as pollution, negative externalities of growth, spillover, and free-rider problems (Feiock, 2007). Through interlocal energy agreements, local governments work collaboratively on issues related to sustainability, energy efficiency and climate protection.

This study focuses on local energy efforts related to climate change issues in the U.S., including energy efficiency, climate protection and environmental works. In contrast with the conservative tendency that the U.S. Federal government shows towards international conventions (as well as agreements to cope with global warming challenges), exploring and analyzing more proactive local attitudes within the U.S. towards climate protection may be meaningful. Comparing and contrasting the Federal energy policies to local governments' may make a significant contribution to comparative studies. However, due to funding and time

limitations, this research primarily emphasizes local-level efforts, patterns, and structures, and anticipates further extending this line of inquiry to comparative studies in the future.

What factors facilitate interlocal energy collaboration, and to what extent does cooperation through interlocal agreements differ from cooperation through region organizations? This research tries to answer these questions by examining factors influencing interlocal energy collaboration in terms of climate change, energy planning and sustainability. Previous works have paid attention to the relationships between sustainability and economic development, and emphasized comparative studies of sustainable cities and communities (Fitzgerald, 2010; Peterson, 2008; Portney, 2003); some previous work looked at the development of sustainability as an outcome of policy innovation, policy choices, and instruments (Feiock, Kassekert, Berry, & Yi, 2009; Feiock, Tavares, & Lubell, 2008; Keohane, Revesz, & Stavins, 1997; Krause, 2010); some focused on case studies of local/regional experience and the problems they have encountered (Barbour & Teitz, 2009; Kraft, 2009; Lubell et al., 2009; Mazmanian, 2009; Rabe & Gaden, 2009). Generally missing from past work is an emphasis on the various tools and modes of interlocal energy collaboration (such as contractual agreements and partnership organizations), and examinations of factors facilitating the selection of any particular approach.

Why do American cities engage in interlocal energy collaboration? I look at various factors involved in local energy movement, such as the nature of problems that emerge from common pool resources (CPR), transaction costs and externality issues, resource management, local support, officially addressed energy issues, the focus on cooperation of others, and the credibility of commitments made by regional collaborative organizations. The analysis emphasizes comparisons of interlocal agreements, regional partnerships and membership organizations in response to different types of institutional collective action

dilemmas related to climate protection, energy planning and environmental protection. Research data are drawn mainly from a 2010 national survey conducted by the Askew School of Public Administration and Policy at Florida State University.

Research Design and Methodology

Data and measures of variables are mainly drawn from the 2010 nationwide survey, "implementation of energy efficiency and sustainability program," sent to all cities with populations over 50,000 and a random sample of cities with populations between 20,000 and 50,000. The response rate is 55%. Survey respondents in the 632 sample cities are city managers, staff working in mayors' offices or other city officials responsible for energy issues in the city governments. The survey questionnaires were mailed to the city managers (if the city is a council-manager city) or mayors' offices (if the city is a mayor-council city), and were followed by several phone-calls after one month elapsed. In the researcher's experience, it is usually officials responsible for local energy work who answer the survey questionnaire. Other respondents include officials in the department of environment protection, energy office, economic development office, urban planning, and so forth.

Most of America's urban population resides in medium-sized cities. These cities account for most energy use in the U.S. and are thus a particular focus in addressing the challenges associated with developing energy conservation policies and sustainability. This survey asked respondents about specific policies related to energy efficiency, sustainability and climate protection. The respondents were requested to answer survey questions in the way that best characterizes the practices of their city governments (Francis & Feiock, 2011). The 632 sample cities are diverse in their form of governments, demographic characteristics, fiscal capacities and experience in energy policy development; thus, they provide an

ideal laboratory for exploring American urban energy efforts and innovations.

Beside the 2010 nationwide survey, the research dataset includes information on the participation of city mayors in the U.S. Conference of Mayors Climate Protection Agreement, and Olberding's identification of 130 regional economic development partnerships (REDPs) in metropolitan statistical areas (MSA) in 2002. This research explores both sets of analytic results to discover why American medium-sized cities make use of different types of collaborative tools for interlocal energy collaboration. Their pursuits of sustainability, energy efficiency and climate protection shed light on similar practice of energy management challenges.

A logistic model (Chatterjee & Hadi, 2006) is employed to predict the probability of the occurrence of the dummy dependent variables (Yes=1; No=0): Yes=1=the local government participates in the collaborative tool; No=0=the local government does not participate in the collaborative tool. Maximal probability estimation is utilized to maximize the likelihood of a set of parameters given the observed data (an iterative process) (Kutner, Nachtsheim, Neter, & Li, 2005). Furthermore, I use likelihood ratio test (LR test) to examine the model fit of the logistic models. The results show that the logistic models are necessary if compared to the intercept-only models.

The following, firstly, addresses the fundamental theory relevant to the question issues—the nature of ICA dilemmas; secondly, theoretically categorizes collaborative modes and tools, bilateral contracts (such as formal/informal agreements) and multilateral collective (such as partnerships and membership organizations); thirdly, constructs hypotheses and assumptions; fourthly, clarifies the research method and design; and finally, analyzes research results and findings. The last part of this paper illustrates the implications for policy design, and provides suggestions for future energy collaboration endeavors.

II. The Nature of Institutional Collective Action Dilemmas

The ICA framework describes problems arising from fragmented authorities among local governments or agencies, particularly where independent decisions may produce negative policy consequences for others, or undermine the outcomes of another's actions. Without considering the costs or benefits accruing to others, one actor's rational choice may impose burdens (externalities) on others or otherwise make them worse off. The concept of ICA dilemmas builds upon explanations for common pool problems, transaction costs in collaborative actions, and externalities, spillover effects, and free rider problems (Feiock & Scholz, 2010a; North, 1990; Ostrom, 1990, 2005; Steinacker, 2004). Interlocal competition for development, for example, has been described as a "zero-sum" game by many observers (Barltee & Steele, 1998; Sbragia, 2000). To attract new energy enterprises and retain existing business, local governments offer subsides, tax breaks, land use incentives, tax-exempt bonds, training funds, infrastructure investments or customized incentive packages in the form of financial assistance. This sometimes enables firms to use informational advantages to exploit local governments (Feiock, 2002). It can also create economic rents that induce businesses to choose locations that do not minimize production costs, producing a geographic distribution of new capital investments that is less efficient for regional development (Burstein & Rolnick, 1995).

The benefits of energy efforts are diffuse, but the costs are concentrated (Asheim, Froyn, Hovi, & Menz, 2006; Barrett, 2003; Thompson, 2006). Some forms of pollution, such as suspended particles, give rise to cross-jurisdictional problems. Actors cannot internalize the outcomes of pollution control, and thus free rider problems emerge. ICA dilemmas in energy policy arenas can be worsened due to tragedy of the commons dynamics in climate

issues, transaction costs in developing scale economy energy planning, and externality issues in environmental protection.

Transaction costs emerge from the process of interlocal collaboration. Transaction costs can be 1) informational and coordination costs; that is, the costs of avoiding information asymmetry and identifying mutually advantageous outcomes; 2) agency costs; that is, the costs of determining the preferences of constituencies and ensuring that public officials pursue the right things; 3) negotiation and division costs; that is, the costs of bargaining over the division of net gains; and 4) monitoring and enforcement costs; that is, the costs of monitoring and enforcing agreements (Inman & Rubinfeld, 1997, 2000; North, 1990; Park & Feiock, 2007; Steinacker, 2004). Transaction costs are inevitable because actors perceive uncertainty, the risks associated with opportunistic behavior and information asymmetries in the interaction process (Barzel, 1982, 1989; Cheung, 1974, 1983; Feiock, 2007; Hashimoto, 1979).

Ideally, interlocal energy collaboration operates on the basis of voluntary efforts and self-organized policy network activities to cope with the dilemmas posed by ICA problems. It emerges with the agreements on land use, pollution controls, transportation, purchasing, retrofits and so forth (Feiock & Audirac, 2009; Feiock & Scholz, 2010a; Lubell et al., 2009). Through collective actions and interlocal energy agreements, local governments, cities both large and small, work cooperatively to improve the effectiveness and quality of regional energy programs and policies. Participants in a membership organization can voluntarily and collaboratively develop a wide range of energy programs, such as: renewable energy (solar, wind, geothermal and biomass); new, high-efficiency transportation fuels and technologies; oil, natural gas, electricity energy production and distribution; energy efficiency in regional facilities; and energy-environment integration (i.e. using conservation to reduce air emissions) (National Association of State

Energy Officials, 2010).

This paper applies the ICA approach to explain the conditions under which local governments are likely to form collective multilateral partnerships/groups or individual, mostly bilateral, contractual agreements. It utilizes the typology of regional governance tools provided by Feiock (2009) that defines the tools of governance based on the degree of autonomy afforded local actors and they apply a contractual or collective action mechanism. This approach is based on the argument that there is an array of mechanisms that vary in the extent to which local governments self-organize within a specific policy arena, such as energy and environmental protection (Feiock, 2009; Feiock & Scholz, 2010b).

III. Tools of Interlocal Collaboration to Cope with ICA Dilemmas

Tools of interlocal collaboration to cope with ICA dilemmas are drawn from contractual mechanisms and collective mechanisms. A contractual mechanism links government units in a legally binding agreement and requires the voluntary consent of those involved. While contracts are often formal and legally binding, they can also be informal agreements enforced through embedded social relations. At the regional level, agreements and contracts emerge to form a general pattern of regional intergovernmental relationships that produce joint gains for those involved (Andrew, 2009). Under this mechanism, local actors can negotiate agreements to address the effects of regional fragmentation, such as spillover effects due to energy reduction of GHG reduction efforts (Lubell, Schneider, Scholz, & Mete, 2002). Informal agreements offer local governments the greatest degree of freedom to choose partners. This mechanism results from interaction among local officials and endogenous resources, such as trust and norms of

reciprocity, that are critical to resolving collective action problems (Ostrom, 1990).

Collective mechanisms involve multilateral actors undertaking collective decision making. Rather than bilateral bargaining, collective mechanisms rely on voting or other decision making rules to constitute self-organizing collective governance mechanisms. Collaborative partnerships and membership organizations are common structures for facilitating collectively administrative arrangements. Collective decisions impose constraints on participants, and reduce the transaction costs of negotiation and enforcement, and the risks of opportunistic behavior. A socially embedded context for collaboration thus is created for safeguarding the benefits of collective actions. Collaborative partnerships can respond to multiple uncoordinated decision issues and enhance multilateral collaboration. Watershed partnerships, formal project partnerships, and other partnership agreements, for example, establish a multilateral mechanism whereby a collection of local governments cooperate through a formal institutional structure. Membership organizations shape the social context into which organizations are embedded into the "collectively reinforced shared understandings and expectations" (Feiock, 2009: 365). Strong intra-group networking and lobbying ties force dominant actors to allow local entities less autonomy, and strengthen the binding power of organizational membership. Participation in membership organizations helps local politicians obtain symbolic creditability on local commitment of energy collaborative effort. Membership ensures engagement in policy networks, and demonstrates the willingness and capacity to carry out policy. To some extent, participating in a membership organization generates symbolic values with which to respond to demands from constituencies that help local politicians win reelections.

Figure 1 shows the tools of interlocal collaboration to cope with ICA dilemmas.

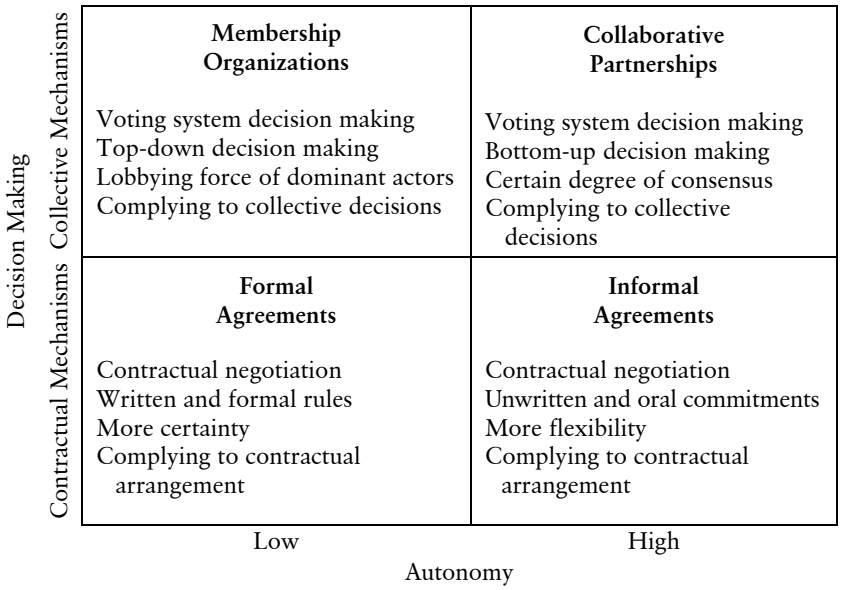

Figure 1 Tools of Interlocal Collaboration to Cope with ICA dilemmas

The collaborative tools are differentiated based along two dimensions: A) decision-making approach, and B) autonomy of local governments.

A. Decision Making—Contractual Negotiation Versus Collectively Voting Systems

The collaborative tools associated with the contractual decision-making approach links participants by the use of contractual arrangements and bilateral/multilateral bargaining. This imposes obligations on participants through written or oral agreements on joint activities. The mode of collective voting decision-making systems determines group decisions by majority voting rules or other decision-making rules. Compliance with

group decisions is required if transaction costs arising from negotiations are to be reduced.

Contractual negotiation tools (include formal and informal agreements) link individual government units through voluntary agreements and establish contractual arrangements among participants. Formal and informal agreements shape contractual relationships and produce joint benefits for the parties. Agreements are sometimes reached among more than two parties, but a dyadic relationship is typically constituted by the contracts. Contractual negotiation tools are typically bilateral, but sometimes can be multilateral agreements involving more than two participants in contractual negotiation processes. The obligations arising from partnering with localities should be addressed by written or oral agreements in order to reduce defection problems. Defection from an agreement may leave partnering cities with the burden of making additional investments in the joint actions.

Collective voting system tools (include collaborative partnerships and membership organizations) involve a larger set of actors and rely on voting or other rules rather than contractual bargaining. Instead of a contractual negotiation decision-making approach, majority voting rules (or other decision rules) can give rise to the collective decisions and shape self-organizing collective governance mechanisms with a certain degree of consensus. Complying with group decisions is necessary to maintain membership in the partnerships or organizations, so collective constraints are imposed upon participants and the transaction costs of negotiation and enforcement may be reduced. Participants are socially embedded into "collectively reinforced shared understandings and expectations" (Feiock, 2009: 365). So, actors who violate group decisions might be shut out of the social-network interactions and find themselves unable to engage in information exchange systems.

B. Autonomy—Low Autonomy Tools Versus High Autonomy Tools

The collaborative tools with LOW autonomy impose broad obligations on participants through formal and written rules in the interactions; on the contrary, the tools preserving HIGH autonomy impose only a few narrowly defined obligations on participants through flexible rules/procedurals or oral commitments.

Low-level autonomy tools (formal agreements and membership organizations) carrying formal written rules or constraints on actors create safeguards for bilateral/multilateral transactions. The contractual obligations of parties and the requirement to comply with group decisions seems to reduce uncertainty among the interactions, but, due to the low-level of autonomy preserved, the collective decisions may not reflect individual preferences and current interests on the ground. Organizational membership, especially, implies a top-down decision making mechanism, though the collective decisions might be, in part, controlled by dominant actors' lobbying. Individual actors should more or less adjust their wants in order to reach consensus on collective actions.

High-level autonomy tools (informal agreements and collaborative partnerships) carrying unwritten rules or bottom-up decision-making voting systems preserve some space for flexibility in responding to individual preferences and specific demands. Participants can reach consensus through repeated interactions and communication. The informally contractual obligations of parties, and the requirement to comply with the voting decisions, may still reduce uncertainty among the interactions, but, due to the high-level of autonomy preserved, there may be an increase in the cost of achieving consensus and consensual resolution. In the absence of written obligations and central/dominant authorities, the binding power on parties is not strong and enforcement of agreements is not guaranteed.

This is a trade-off situation. Low-level autonomy collaboration tools provide certainty in the transactions, speed up collective decisions, and enhance net incentives for participation, yet transaction costs may arise because collective actions may not reflect individual demands and preferences. High-level autonomy collaboration tools preserve flexibility, take into account actors' specific demands and interests, and allow room for further changes to collective decisions, but actors may spend much time on negotiations and communications, and the risks of defection are high due to the lack of binding power upon the parties.

What incentives encourage the adoption of collaborative tools? To what extent can the priorities of city with respect to CPR, energy efficiency and externalities affect the choice of tools to engage in regional energy collaboration? What is the nature of ICA dilemmas of interlocal collaboration relating to CPR, efficiency and externalities? The following section tries to answer these questions by exploring how interlocal energy collaboration reduces ICA problems and what other ICA explanatory factors can affect decisions to participate in interlocal energy collaboration.

IV. Reshaping Incentives of Interlocal Energy Collaboration

There are three interrelated issues surrounding energy and climate policies that can be linked to ICA dilemmas: 1) climate change and greenhouse gas emissions, 2) energy planning, and 3) environmental protection. Energy effort toward climate protection deals with the consequence of global warming and greenhouse gas emissions. The ICA dilemmas in interlocal climate movement are derived from common pool problems and the non-excludable benefits of climate-protection efforts.

Energy planning policies operate for issues related to renewable energy innovation, energy efficiency in building and energy consumption reductions. Scale economies and efficiencies

from coordination create the rationale for cross-jurisdictional and large-scale energy planning. The ICA dilemmas in collaborative energy planning are driven by transaction costs associated with mutual monitoring and the consequences of small-scale community-oriented energy policies.

Energy effort on environmental protection refers to eco-development, smart growth management, and sustainable development. The ICA dilemmas arising from such efforts are applied to externalities and spillover problems in interlocal environmental protection movements. The following addresses the theoretical hypotheses employing the ICA framework in elaborating the needs for interlocal energy collaboration.

A. Common Pool Problems and Climate Protection Policies

Common pool resources refer to a natural or created resource that is non-excludable, or costly to exclude from potential beneficiaries. Air, fish, forests, water, the atmosphere, grazing areas, parking garages or irrigation systems are typical common pool resources that may suffer from overuse or overgrazing. The use of common pool resources are unlimited in a world that is, itself, limited. Ostrom describes "the tragedy of the commons" as a consequence of individual rational choice to endlessly draw on common pool resource units (1990, 2005). "Everybody's property is nobody's property" (Gordon, 1954: 124). Degradation of the environment (i.e. acid rain) may occur when many individuals use a scarce resource in common without regulating the preservation, maintenance, and consumption of the common pool resource (Dales, 1968; Hardin, 1968; Wilson, 1985). In particular, some consumption of common pool resource is difficult to measure. The amount of sunlight, the generation of CO2 emissions and grazing ranges are difficult to observe. The consequence of overgrazing and overuse are not immediately apparent. Common pool problems thus occur due to a lack of strategies for managing scarce resources.

Ostrom (2005) illustrated common pool problems arising from human egoist assumptions; that is, individual rationality focuses on the outcomes of actions maximizing self-interest and immediate material payoffs. If it is necessary, actors will act opportunistically and leave others worse off. Individual moral hazard emerges due to bounded rationality when rewards are promised for risky behavior (Leonhardt, 2009). Opportunism refers to the combination of self-interest and guile (Williamson, 1975). Individuals will violate norms, break promises, and shirk duties when they have the chance to do so. A stable and long-term arrangement is difficult to develop or maintain, giving rise to the high costs associated with enforcement and the risks of opportunism.

Air, climate and the atmosphere are common, non-excludable pool resources. Common pool problems emerge due to increasing greenhouse gas (GHG) emissions that cause climate change and global warming. Economic dependence on carbon intensive industries, per capita high-level CO2 emissions, and the small percentage of the population using light-mode transportation (e.g. walking, bike, and bus) damages the atmosphere and leads to climate change (Betsill, 2001; Brody, Zahran, Grover, & Vedlitz, 2008; Collier & Löfstedt, 1997). GHG emissions are not immediately apparent and are hard to observe. The tragedy of the commons occurs due to the lack of strategic plans on the preservation, maintenance, and regulation of the consumption of the common pool resource.

Facing the challenges of global warming, cities in a region can develop bilateral or multilateral collaborative plans on climate change strategies. They can enforce a set of pollution control standards in business and industry, reduce emissions from transportation, and develop nuclear power and techniques for carbon capture and sequestration (Urpelaine, 2009). Reducing GHG and curbing the concentration of carbon dioxide in the

atmosphere are two targets of climate policies (Brody et al., 2008; Lutsey & Sperling, 2008; Titus, 1986, 1998).

When a city sets climate protection and GHG reduction as policy priorities, it is more likely to join a bilateral/multilateral collaborative mechanism on climate protection, such as the participation in U.S. Mayors Climate Protection Center, and to seek to achieve Kyoto Protocol targets. Complying with the decisions of the membership organization imposes constraints on emission standards, but seems not too difficult because the city itself has expressed a willingness to enact a similar pollution control standard on GHG reduction. Common pool and free ride problems can be reduced by behaving in ways to achieve the Kyoto Protocol targets, which corresponds with individual rational choice and preferences derivative of self-interest.

"Linkage is everything" (Fitzgerald, 2010: 176). To accomplish climate protection policy goals, city decision makers should create or maintain connections among actors on climate protection policies, industries and groups. City priorities on climate change issues enhance functional collaborating service activities based on mutual understanding among actors. Energy collaboration between Los Angeles and China's Jiangsu Province, for example, is drawn upon their goals and priorities on climate protection and green economic development. They collaborated on developing renewable energy planning through agreements on the exchange between expertise and the privilege of markets access (Fitzgerald, 2010). This collaboration generates benefits for both localities: Los Angeles keeps its climate change agenda on track, and China's Jiangsu Province becomes a large solar energy producer.

Hypothesis 1: The higher the priority given climate protection issues, the greater the likelihood of city participation in regional energy collaboration mechanisms.

Individual participation in energy collaborative efforts on climate change issues aims mainly at goals set by agreements forged by the climate protection movement. In the 2005 U.S. Conference of Mayors Annual Meeting, 141 mayors signed a climate protection agreement demonstrating their cities' commitment to strive jointly for the Kyoto Protocol targets. These targets include 7% GHG emission reduction from 1990 levels by 2012, and efforts to establish a national emission trading system. Localities can take various collaborative actions toward climate protection, including designing urban forest restoration projects, implementing anti-sprawl land-use policies, and participating in public information campaigns (Mayors Climate Protection Center, 2008). Transportation and green transit strategies are one of the policy options. According to Jepson (2004), a bicycle access plan, greenways development, and pedestrian access plans were ranked highly as possible energy saving actions. Cities can increase regional public transit in their jurisdictions, develop green transit technologies based on alternative fuels and hybrid technologies, or reduce vehicle miles traveled through the use of transit passes, carpool programs, limitations on parking availability, pedestrian infrastructure, bike sharing programs, etc. These efforts can improve air quality and make significant reductions in GHG emissions.

The climate protection movement requires a larger set of participants engaged in collaborative efforts in order to have significant effects on GHG reduction and air quality improvements. So a "collective mechanism" may be preferred when individual actors face a choice of collaborative tools. Membership organizations, especially, are useful in creating the context and social structures that will require participants to comply with a specific GHG emissions standard. Multilateral agreements can be formed through routine meetings, such as the U.S. Conference of Mayors Annual Meeting. Through face-to-face communication, trust and reciprocity are enhanced and mutual consent is

strengthened. However, local autonomy may be lessened due to the binding power of collective constraints.

Hypothesis 1a: The collective mechanism of membership organizations is more likely to be selected as a tool of interlocal collaboration on climate protection actions.

B. Transaction Costs, Scale Economies and Energy Planning

The choices between coordinating within a fragmented local government system and forming a consolidated one was studied in the earlier literature in order to understand integrated strategies to enhance large-scale and cross-jurisdictional interests (Bish & Ostrom, 1973; Ostrom, Tiebout, & Warren, 1961; Steinacker, 2004). Economies of scale can be achieved by matching the scope and jurisdiction of service delivery boundaries. Scale economies are built upon the joint construction of region-wide infrastructure, dense nodes and ties of buyer-supplier networks, incentives provided to attract industrial clusters, training skillful workers, joint funding for resource flow intensity, and so forth (Faruqee, Laxton, Muir, & Pesenti, 2006; Porter, 2000). The total available benefits for participants are increased through cooperative actions, coordinative agreements or the policy options of annexation or consolidation (Libecap, 1989; Ostrom, 1990).

Scale economies can be achieved through interlocal horizontal integration. However, transaction costs may occur due to political barriers to implementation. Local politics, individual preferences, demographic characteristics, and self-interest rational choices generate diverse demands and calls for local autonomy. Especially in an uncoordinated, fragmented local government system, local entities need not necessarily work together if the transaction costs exceed the benefits of collective action.

Self-organizing mechanisms can reduce the transaction costs associated with interlocal integration (Feiock & Scholz, 2010c). In

contrast with mandated consolidation by a higher levels of government, voluntary collaboration avoids the potential conflicts involved in local politics and maintains the autonomy of local actors. A consensus reached among all participants is required for the enhancement of mutually advantageous resolutions. Flexible rules, procedures and exchange processes can ensure the best fit with individual conditions and respond to locally specific demands. The costs resulting from information asymmetries, uncertainty and distrust can be reduced because no one can be in a more advantageous position if they take further actions.

Voluntarily interlocal energy planning through collaborative mechanisms can reduce transaction costs on developing scale economies in the energy industries. Through interlocal agreements or partnerships, cities in a region work together to achieve economies of scale, and resource flow intensity on renewable energy industries can be enhanced. This voluntary collaboration treats local actors as a joint unit yet preserves their autonomy and special interests. Since consensus on the energy planning agreements is required by the voluntary nature of their actions, individual actors do not have to worry about the risks of opportunistic behavior and uncertain or unexpected outcomes. For example, City A and City B have an energy plan to work together on cost-effective improvements to buildings in their jurisdictions. They may collaboratively enact energy efficiency initiatives for funding opportunities, or adopt cross-jurisdictional efficiency guidance for energy conservation. The cities are doing things as usual, but in a collaborative manner to achieve scale economies. Via voluntarily collaborative mechanisms, consensus and mutual understanding can be reached, transaction costs for monitoring or enforcing the bilateral agreements can be reduced, and the effect of scale economies can be achieved easily. Repeated communication and interactions create flexibility for City A and City B to respond to specific concerns and demands. In such a situation, high transaction costs driven by individual bounded rationality and self-interest preference are less likely to emerge.

When reducing energy costs becomes a policy goal priority, the local government works on energy conservation, the use and development of new technologies, and use of renewable energy as major components of its energy plans. Energy planning can include cost-effective improvements to buildings, including efforts to replace heating and inefficient systems, adding insulation, retrofitting windows, doors and applications, etc. Some planning of energy efficiency initiatives provides property owners with funding opportunities to retrofit their buildings; some impose strict energy efficiency standards; while some others emphasize the effect of energy planning on economic development. Los Angles, for example, implemented retrofitting programs and energy efficiency standards in its jurisdiction. Cambridge, Portland and Milwaukee adopted funding programs to encourage energy efficiency investment by residents and business owners. New York and Pittsburgh focus on the effect of green industries on economic development (Portney, 2003).

Interlocal horizontal integration in energy planning can help achieve the effect of scale economies through joint efforts to reduce energy consumption or to enact energy efficiency initiatives. Cities in California, for example, jointly offer consumers options to receive electricity generated from renewal sources (i.e. windmills), and the increased demand for renewal sources encourages the growth and development of renewable energy industries from cities state-wide. The aggregate effort from cities state-wide bolsters the outcomes of energy conservation planning, and individual cities reap the benefits of collective action and economies of scale. Thus, the positive effects of scale economies emerge. Energy consumption in Santa Monica, CA, dropped from 6.45 million BTUs (mBTUs) to 5.77 mBTUs over the period from 1990 through 1997, although the overall electricity use increased. San Francisco, CA, further adopted an indicator project in 1997 to reduce city-wide energy consumption, and a program to pursue resource-efficient city buildings. San Jose, in 1998, even started a green building program to encourage the installment of energy

efficiency equipment (Portney, 2003).

The priorities of cities with respect to energy conservation increase the "political feasibility" of its participation in bilateral or multilateral energy plans. Interlocal collaboration on energy planning establishes the image with a progressive plan for long-term development (Milbrath, 1984). When a city prioritizes the reduction of energy costs, it may target energy conservation, a pro-growth agenda and the interests of the "growth machine." Selective benefits of providing functionally collaborative service to elected and appointed officials are generated through interlocal energy collaboration. Localities can benefit from the policy networking interactions and promising future for the local environment (Feiock & Kassekert, 2009). Interlocal collaboration on energy planning becomes "politically correct" actions (Rudin, 1999) and the basis of further environmental steps.

To accomplish the city goals of energy-cost reductions, a collaborative network is needed to be established. Innovations associated with renewable energy, for example, are connected to policies that increase demand for solar and wind energy. Promoting energy efficiency and green industrial development results in a growth in green jobs, and is linked to green economic development and social/environmental justice. These linkages require interlocal energy collaboration to achieve economies of scale in terms of clustered industries, infrastructure, job-training, information networks, research and technology (Faruqee et al., 2006).

Hypothesis 2: The higher the priority of energy efficiency and planning issues, the greater the likelihood of city participation in regional energy collaboration mechanisms.

Bilateral (or multilateral) informal agreements are more likely to be selected as the means of pursuing interlocal collaboration on energy planning. Individual preferences can be diverse due to the uncoordinated, fragmented nature of local government systems.

Local autonomy should be preserved to ensure that responses to diverse demands are driven by local politics, individual preferences, demographic characteristics, and self-interested rational choices. Informal agreements can be flexible enough to respond to individual diverse demands and, simultaneously, have enough binding power to reduce the risks of defection. It creates multifunctional institutions to safeguard the enforcement of collective decisions, yet still preserves the autonomy of local actors through processes of negotiation and communication. The mechanisms of informal agreements create flexible rules, procedures and exchange process which can respond to individual specific concerns, and produce outcomes having the best fit to individual conditions. In contrast to formal agreements, informal agreements maintain some space for flexibility in the contracts, yet still carry obligations to the parties and create the safeguard hats to mitigate defection problems.

The mechanisms that do not preserve high-level autonomy, such as joining membership organizations, are "less" likely to be selected because compliance with a collective constraint is not necessary to develop a successful energy plan. Paying too much attention to compliance with group rules may result in high agency costs for individual local actors. Few (only 92) U.S. cities have complied with common constraints on efficiency standards for new buildings due to individual concerns regarding the costs of such developments for business and industry. The most popular strategy is the use of LEED (the U.S. Green Building Council's Leadership in Energy and Environmental Design) green building rating system, which offers guidance and assessment for new buildings. But, most LEED standards apply only to certain types of projects or buildings above a certain size (Fitzgerald, 2010).

Interlocal energy planning is not necessary for investing in new technologies or building projects, which are theoretical illustrated to have "asset specificity" and are linked to risks associated with high-transaction cost problems (Brown & Potoski,

2005; Williamson, 1975). The adoption of efficiency guides, for example, may not involve a large investment. The costs due to defection may not become unaffordable burdens. Division costs and enforcement costs may not be high because whether "in" or "out," the collaborative adoption plans do not greatly affect local developments in energy industries. Thus, the risks of defection and opportunistic behavior are less likely to arise. Informal agreements can be sufficient to bind individual behavior through repeated interaction and communication.

Hypothesis 2a: The contractual mechanism of informal agreements is more likely to be selected as a tool of interlocal collaboration in making energy planning.

C. Externalities, Spillovers, Free Ride Problems and Environmental Protection

Externalities emerge where cost or benefit spillovers exist. The term refers to outcomes that are directly or indirectly affected by the decisions of neighboring local actors. City tax and expenditure decisions, for example, may have positive or negative effects that spill over the boundaries of its jurisdiction to affect neighboring cities, firms and households in the area (Netzer, 1997). Externalities, spillovers and free rider issues involve a win-lose situation. Urban sprawl can be one source of externalities in that decisions on urban land use management, waste water control, the use of natural resources, service provision, sanitation systems, transportation developments, and pollution prevention plans produce environmental externalities in neighboring suburban areas. Negative externalities and spillovers prompt local policy actors to respond to demands for the best integrated solutions (Brueckner, 1998; Feiock, 2004). Nevertheless, free rider problems produce high-transaction costs that affect individual decisions on collective action. In some cases, individuals can benefit from collective efforts

without contributing or formally joining an alliance (Feiock, 2002; Olson, 1965; Ostrom, 1998). "The temptation to free-ride, however, may dominate the decision process, and thus all will end up where no one wanted to be" (Ostrom, 1990: 6). A cross-jurisdictional environmental movement can be more costly because each local actor has a self-interested incentive to withhold contributions and to free ride on others.

Some observers suggested that collaboration is the best way to internalize development externalities (Park & Feiock, 2005). Through collaborative planning, individuals voluntarily work together and contribute to the integrated solutions for cross-boundary problems. Interlocal bilateral/multilateral collaboration on environmental protection can facilitate eco-development, smart growth management, and sustainable development plans. Voluntary agreements on fund transfers, land use, large-scale environment management strategies, and investment in green industries overcome many ICA dilemmas in terms of externalities, spillover effects and free rider problems.

Sustainability refers to the development of "sustainable biological resource use," "sustainable agriculture," "carrying capacity," "sustainable energy," "sustainable society and economy" and "sustainable development" (Brown, Hanson, Liverman, & Meredith, 1987: 713-719). It roots in biology, the biophysical environment, and ecological carrying capacity, and focuses on the sustainability of the Earth's resources and environment. The concept of sustainability applies to most issues involving environmental protection of ocean fisheries, forests, and the use of soil (Portney, 2003).

Mazmanian and Kraft (2009) identify sustainable development as an important phase in the environmental movement from 1990 to present. When environmental protection becomes a policy goal priority for a city, eco-centric ethics and harmonious relationships between human and natural systems become import points of focus. The goals of environmental protection can be pursued by interlocal

agreements, collaborative partnerships, informal policy networks for sustainable development, and the adoption of Total Quality Environmental Management (TQEM). The philosophy driving the implementation of sustainable communities emphasizes collective outcomes and performance, and new mechanisms to balance the needs of economic development and environmental protection. The points of intervention are an itemized list of priorities, industrial contribution to environmental strategic planning, and individual lifestyle choices. Information and data management needs include the establishment of criteria and indicators on sustainability, eco-human support system thresholds, ecological footprint analysis, and computer modeling of human-natural systems interactions. The predominant political institutional context for sustainable actions is built upon mechanisms created to enforce collective decisions, such as local/regional cooperation, partnerships and community consensus building (Mazmanian & Kraft, 2009).

City priorities on environmental protection can be identified by the actions taken towards sustainable community development, eco-development and green job creation. "Politically correct" actions in pursuit of a goal may facilitate the formation of interlocal agreements, and establish clustered green industries for renewable energy innovation and regional infrastructure. Green job-training creates linkages between sustainability and regional economic development. Environmental protection efforts give rise to collaborative relationships among local units, and increases the likelihood to take place functionally collaborating service activities based on the concerns for promising sustainable visions for city future.

Hypothesis 3: The higher the priority given environmental protection issues, the greater the likelihood of city participation in regional energy collaboration mechanisms.

Interlocal collaboration toward environmental protection emphasizes solutions to negative externalities, spillovers, urban

sprawl and free rider problems. Bilateral or multilateral agreements on environmental protection strategies, partnering in green industry investment, and collaboration on land use and fund transfers are common examples. To overcome the consequences of uncoordinated development, individual actors prefer to make use of collaborative mechanisms that preserve local autonomy, remain flexibility, and are responsive to individual preferences and local diversity.

Collaborative mechanisms that might be selected are collaborative partnerships, and formal and informal agreements. Joining a collaborative partnership means taking part in development plans. Multi-actor participation in a partnership can internalize the consequences of externalities and result in a collaborative solution to overcoming spillover and free rider problems. A certain degree of consensus is required to form a partnership, so individual demands and preferences can be responded to through the decision making mechanisms of the partnership. Formal and informal agreements create contractual arrangements among actors. The burdens and benefits of the collaborative effort are negotiable, and can be reallocated through the decisions of bilateral/multilateral agreements. Individual local governments can share in the costs of infrastructure development, and, simultaneously, their specific demands can be satisfied as a result of repeated communication and interactions.

Membership in an organization as collective mechanism is "less" likely to be selected. Under the research design, the measure of membership organization relies on city mayors' participation in the Climate Protection Agreement. The content of targeted strategies focuses on the reduction of carbon dioxide emissions and the symbolic value of mayors' efforts in pursuit of protection. Signing an agreement indicates the mayors' commitment to comply with group rules and, consequently, local autonomy and the choice sets of energy actors are limited. However, environmental protection and externality issues involve in a win-lose situation

rather than a symbolic effort toward green commitment. Issues associated with environmental protection can be, to a great degree, locally fragmented and diverse, and need to be treated individually. If the collective actions are symbolic collaboration, or fail to reflect the specific interests of local actors, the costs of externalities or spillovers will remain. In addition, the scope of collaboration on environmental protection can be narrower if compared to collaboration on climate change policies. The number of participants involved in a collaborative project or agreement for environmental protection can be two or more, but are less likely to be more than one hundred. A collectively imposed constraint on participants is not necessary for the success of the effort.

Hypothesis 3a: The collective mechanism of membership organizations is less likely to be selected as a tool of interlocal collaboration for environmental protection actions. Bilateral or multilateral agreements on environmental protection actions can include partnering on green industry investment, and collaborating on land use and fund transfers.

In short, interlocal energy collaboration is drawn from the need to address ICA dilemmas related to climate protection, energy planning and environmental protection issues. Energy policy

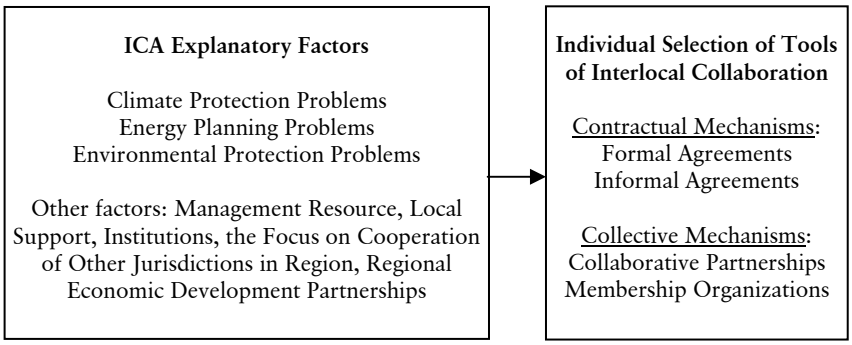

Figure 2 Conceptual Framework of Interlocal Energy Collaboration

priorities are hypothesized to affect the participation of individual cities in regional collaborative mechanisms. Cities can work collaboratively on energy policies through bilateral/multilateral agreements, or in collaborative partnerships/groups, to deal with challenges from global warming, energy consumption and pollution. Figure 2 displays the conceptual framework of this study, and the following sections illustrate other ICA explanatory factors and to what extent they can affect interlocal energy collaboration.

Key terms clarification

Some key terms are used interchangeably according to the above theoretical construction as well as hypothetical inference (H1~H3). For avoiding confusion, the following lists three groups of interchangeable words which are drawn from three categories of theories and concepts, and are used toward parallel purposes under the designed research scope:

- **Climate change:** climate protection, common pool problems, the non-excludable benefits of climate-protection effort, climate protection policies as well as strategies, climate protection problems.
- **Energy planning:** renewable energy innovation, energy efficiency of building and energy consumption reductions, scale economies and efficiencies from coordination, transaction costs in the process of energy coordination, energy planning problems.
- **Environmental protection:** ecodevelopment, smart growth management, sustainable development, externality and spillover problems, spillovers, free ride problems, environmental protection problems.

D. Other ICA Explanatory Factors

(A) Management Resources

"Resource flow intensity" is a dimension of intergovernmental relationships according to Van de Ven (1976). Resource exchanges,

such as fund transfers, create an intensive resource flow in investment, and thereby shape interdependent relationships among actors and affect human behavior to a great extent (Berardo, 2010). In fragmented systems, resource management and exchange provide incentives to collaborate, and create conditions in which partners in joint ventures perceive the need to overcome ICA dilemmas and realize the importance of intergovernmental ties and collaborative relationships. Aggregating resources through networking is one of the purposes of interlocal collaboration. In the presence of sufficient quantities of financing, information, or other resources, rational actors are more like to engage in collaborative mechanisms in order to secure access to such resources. The benefits that accrue from such engagements argue for establishing more trustworthy relationships in order to ensure the continuation of the larger exchange system. In this way, engagement in future collaborative actions is encouraged continuously. Interlocal collaborative mechanisms create the policy arenas of the theoretical tools of "resource dependence" approach (Agranoff & McGuire, 1998; Blau, 1964; Hanf & O'Toole, 1992; Rhodes, 1981, 1986; Scholz, Berardo, & Kile, 2008; Wondolleck & Yaffee, 2000). No organization is self-sufficient, and dependence on resource exchange increases the willingness of institutions to create and maintain long-term collaborative relationships within exchange networks.

Financial support from local budgets, intergovernmental grants, state expenditures and federal funding, provide resource flow intensity for interlocal energy collaboration. California's Green Wave Initiative, for example, sought $1.5 billion in state funds to invest in energy planning technologies (Fitzgerald, 2010). Given sufficient resource flow intensity, interlocal collaboration emerges out of shared activities, establishing opportunities for networking and the promotion of collective interests. Allocating resources to interlocal energy collaboration is one means of incorporating into a city budget designated funding for sustainable

development projects, energy conservation or climate protection activities. Resource investment can be made in terms of the expertise, time, and information necessary to design and plan changes in of alternative fuels and renewable energy, transportation technologies, energy conservation strategies, and energy transmission systems.

The American Recovery and Reinvestment Act (ARRA) in 2009 introduced $787 billion in grants to create jobs, promote economic growth and develop long-term plans. The funds were to flow from the federal government into cities and counties, and encourage collaborative strategies for tackling long-neglected challenges, including energy conservation, sustainability and environmental protection (Autodesk, 2011). In doing so, the ARRA provided substantial funding for investment in technologies to stimulate collaborative innovation and the implementation of renewable energy plans. The Department of Energy followed up on the ARRA operation by providing applicants with funding services, including loan guarantees, tax credits and grants for energy efficiency, collaborative energy infrastructure and storage, fossil energy, hydrogen and fuel cells, nuclear energy, renewable energy, state and local energy plans and transportation (Department of Energy, 2011). These efforts reinforced connections between local governments, energy and green industries, research institutions and non-for-profit organizations (Feiock & Kassekert, 2009).

Hypothesis 4: The more management resources dedicated to energy policies, the higher the likelihood of city participation in regional energy collaboration mechanisms.

(B) Local Support

According to Marvin and Guy (1998), the "new localism" of environmental policy is driven by a philosophy stance "that ordinary people are most likely to pay attention to the physical environment where they see and experience it, and that the

governance mechanism in cities are most likely to be responsive to the environmental concerns of their citizens" (Portney, 2003: 16; Selman, 1996). Indeed, local support is the best reason for environmental protection movement and sustainable development.

When a city has strong local support for climate protection policies, energy conservation planning, and sustainable community development, city decision makers are more likely to engage in interlocal collaborative mechanisms, increasing the reputational credit attendant on such service provision, and protecting incumbents from electoral threats (Bickers, Post & Stein, 2010). And yet, cities must regularly seek to cut costs or provide a better quality of public goods and services. Seeking to establish service provision partnerships with neighboring cities creates political and professional incentives for the city's participation in regional collaborative mechanisms. Such collaborative efforts establish the economic rationale for service provision in response to local demand for better energy policy. The motivation to join a collaborative partnership with other cities or enter into a formal or informal partnership can be illustrated in terms of "efficiency gains" (Drier, Mollenkopf, & Swanstrom, 2001; Stein, 1990; Waste, 1998) which provide a positive image of incumbents with a demonstrated problem-solving capacity and thereby enhance their political prospects (Schlesinger, 1966).

Hypothesis 5: The greater local support for energy policies, the greater the likelihood of city participation in regional energy collaboration mechanisms.

(C) Institutions

Formal institutions and constraints addressing energy and climate issues can reduce transaction costs and distrust among actors involved in interlocal energy collaboration. As such, institutional design offers efficient solutions to collective action problems (North, 1990; Ostrom, 1990, 1998, 2005). By organizing human interactions and constraining individual behavior, institutions reduce transaction costs, uncertainty, risk,

and opportunism, and make the outcomes of human behavior predictable. Transaction costs include the measurement, enforcement, and policing of bilateral and multilateral agreements, and emerge from the processes of negotiation, communication or interaction. In an interlocal energy agreement on pollution control, for example, City A agrees to provide land for building a wastewater treatment plant, and City B promises to offer technical support. Transaction costs emerge from the process of negotiating and enforcing the agreement, and measuring the value of the goods exchanged: the land and the technical services. Uncertainty emerges from the risk that one party will abandon the agreement due to out of self-interest or a focus on short-term payoff and opportunism.

According to North (1990), institutions guide human behavior and reduce uncertainty by providing guidance on how to act in particular situations. They reduce transaction costs in exchange relations by promulgating codes of conduct and ensuring that exchanges are impersonal. Additionally, risk-averse individuals will be more likely to collaborate if addressing institutions in specific action arenas. Institutions can take the form of formal constraints—from constitutions to statutes, common law or specific bylaws—or general rules, particular specifications and policies. California's Global Warming Solutions Act of 2006, for example, requires a 25% reduction in carbon emission by 2020, and its statewide replication of Oakland's Green Jobs Corps Act establishes rules for implementing energy effective programs (Fitzgerald, 2010). These institutions impose constraints on individual behavior and specify action goals, shape collaborative efforts, structure collective incentives, and help in avoiding the tragedy of the commons (Ostrom, 1990).

Hypothesis 6: The more officially addressed energy issues, the greater the likelihood of city participation in regional energy collaboration mechanisms.

(D) Focus on Cooperation of Other Jurisdictions in the Region

Interlocal collaborative plans can be facilitated by focusing on cooperation of other jurisdictions in region. A transportation infrastructure project, for example, can be redesigned to reduce CO2 emissions if so motivated by other jurisdictions. Once the groundwork is set for larger-scale regional cooperation, individual local actors will be more likely to choose bilateral or multilateral collaborative tools for investing in the transportation infrastructure to improve air pollution controls, environmental protection, energy conservation, or reduce greenhouse gases. Information and coordination costs in interlocal bilateral and multilateral organizations can be reduced by involving policy actors in well-organized regional information systems and coordinative networks. When individual actors in the surrounding area have participated in regional climate protection efforts and demonstrated a willingness to adhere to the constraints of regional standards, common pool problems will more likely be solved. Additionally, monitoring and enforcement costs may be lowered because enforcing such agreements often require no more work of individual actors. Negotiating and division costs may not be high because the nodes and ties of the energy policy networks have already been established, and trust and reciprocity among actors can be enhanced through working to understanding each other's concerns on each point. The risks of opportunistic behavior and defection can be low as well.

Hypothesis 7: The more focus there is on cooperation of other jurisdictions in region, the greater the likelihood of city participation in regional energy collaboration mechanisms.

(E) Regional Economic Development Partnerships

The likelihood of interlocal energy collaboration depends on agents having the requisite reputations and social capital to make possible credible collaborative commitments. Interlocal energy collaboration is built upon networking, information links, and

affiliation networks. Regional collaborative organizations provide channels for information exchanges, construct nodes, and bind networking ties of which strengthen the foundations of interlocal energy collaboration. One of the institutional mechanisms for networking regional collaboration in the U.S. is REDPs. A regional partnership for economic development is defined as an organization, group or alliance, typically taking the form of cooperative units of local governments, often with help from nonprofit organizations and private firms, and tasked with promoting economic development across multiple jurisdiction (Olberding, 2000, 2001, 2002). Regional partnerships build interlocal collaborative networks, and emerge out of patterns of voluntary cooperation and self-organizing activities.

Hypothesis 8: The more REDPs in the jurisdiction, the greater the likelyhood of city participation in regional energy collaboration mechanisms.

In summary, interlocal energy collaboration through bilateral/multilateral collaborative mechanisms can enhance the collective benefits realized by scale economies, and produce integrated solutions to common pool problems, spanning-jurisdictional externalities and avoiding free-rider problems. Realizing a city's priorities on climate protection, energy efficiency and environmental protection can lead to a reduction of transaction costs in regional energy collaboration. The resources available to energy policies enhance resource flow intensity and the need for resource management among energy networks. Local support of energy policies increases political feasibility and decreases the political risks to enforcing interlocal energy agreements. Officially addressing energy issues through regulations or policies imposes constraints on actors and reduces transaction costs on energy collaboration. The focus on cooperation with other jurisdictions in the region motives the city's choice to participate in regional collaborative energy actions and increases their willingness

to solve common problems. REDPs create opportunities for networking interactions to enhance actors' credibility with regards to collaboration commitments, and, directly or indirectly, strengthen social capital in interlocal energy policy networks.

V. Research Design and Methodology

The primary dataset are drawn from the 2010 nationwide survey "Implementation of energy efficiency and sustainability program" investigating all cities with populations over 50,000 and a random sample of cities with populations between 20,000 and 50,000. This survey was conducted by the Askew School of Public Administration and Policy at Florida State University. The response rate is 55%. Other dataset include the information of 1) city mayor participation in the U.S. Conference of Mayors Climate Protection Agreement, and 2) Olberding's identification of 130 REDPs in MSA in 2002. Merging these data sets, this research explores why American medium-sized cities participate in different types of collaborative tools for interlocal energy collaboration. Appendixes reveal the measurement of variables, descriptive statistics and correlation matrix. A series of control variables are included: race, log population, per capita income in 1999, and forms of government.

A. Factor Analysis

Management Resource. Principal components analysis is employed to extract the "management resource" factor from the three measures of funds, time and expertise, and information resources. Factor analysis models observed variables as linear combinations of the potential factors plus "error" terms, and searches for joint variations in response to unobserved latent variables. Resource management is measured by 1) funds, 2) time

and expertise to design and plan, and 3) information resources. These three measures are theoretically interdependent and can contribute jointly to the concept of "resources." When one city has enough funds to undertake energy work, it can hire energy and technical experts for long periods of time to develop energy plans. So the resources needed for "time and expertise to design and plan" can be raised along with increasing funding opportunities. Similarly, the increased funds or time/expertise resources can aid in obtaining information resources for undertaking energy projects. The three measures—funds, time/expertise and information resources—are logically correlated and interdependent. The use of factor analysis helps gain information about the interdependencies between observed variables and can reduce the set of variables in a dataset. Figure 3 displays the final factor structure of "management resource" and the rotated factor loadings of the three resource categories. Only factors with an eignevalue greater than one are retained. The final factor structure shows that the three resource categories have similar loadings to the final factor. Their loadings range from 0.64 to 0.79.

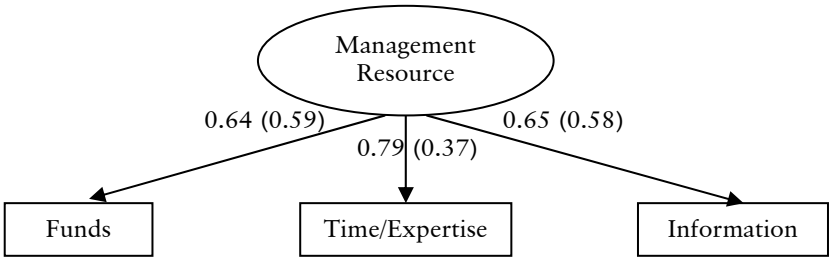

Figure 3 Final Factor Structure of "Management Resource" in Interlocal Energy Collaboration

* Rotated factor loadings (uniqueness in parenthesis) of: 1. Funds; 2. Time/Expertise to design and plan; and 3. Information resource.
* Eigenvalue of the final factor "management resource"=1.46, chi2 (3)=540.21, p=0.00

Institutions. Factor analysis provides estimates of how much of the variability in policy institutions is due to common factors. It converts attributes of observed variables into scores and identifies hidden dimensions which may not be apparent from direct analysis. Here, the variable "institutions" is measured by 13 energy issues officially addressed by regulation or policies: 1) green buildings, 2) retro-firing existing buildings for energy efficiency, 3) alternative transportation systems, 4) green procurement, 5) technology innovation/demonstration projects, 6) energy efficient devices (appliances, lighting, etc.), 7) energy efficiency systems (building controls etc.), 8) inventory of greenhouse gas emissions,

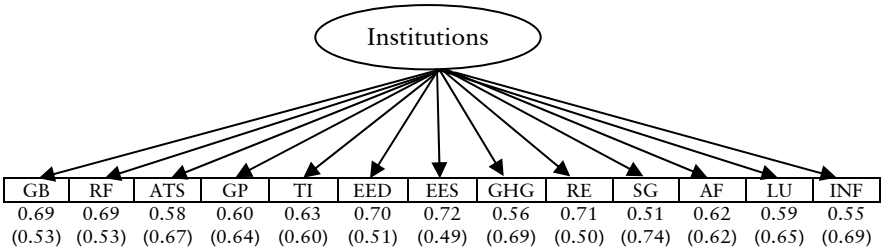

Figure 4 Final Factor Structure of "Institutions" in Interlocal Energy Collaboration

* Rotated factor loadings (uniqueness in parenthesis) of officially addressing the following energy issues through regulation or policies:
1. GB=Green buildings
2. RF=Retro-firing existing buildings for energy efficiency
3. ATS=Alternative transportation systems
4. GP=Green procurement
5. TI=Technology innovation/demonstration projects
6. EED=Energy efficient devices (appliances, lighting, etc.)
7. EES=Energy efficiency systems (building controls etc.)
8. GHG=Inventory of greenhouse gas emissions
9. RE=Renewable energy
10. SG=Smart grid/net metering
11. AF=Alternative fuels
12. LU=Incorporating energy use in land use decisions
13. INF=Provide information about efficiency to employees/residents

*Eigenvalues of the final factors; "Institutions"=5.14, chi2 (78)=3122.87, p=0.00

9) renewable energy, 10) smart grid/net metering, 11) alternative fuels, 12) incorporating energy use in land use decisions, and 13) providing information about efficiency to employees/residents. Factor analysis is employed to extract factors/attributes within the 13 observed variables and detect the hidden dimensions in the measures. Figure 4 displays the final factor structure of "institutions" and the rotated factor loadings of the 13 items of energy institutions. Only those factors with an eigenvalue greater than one are retained. The final factor structure shows that the 13 measures of institutions have similar loadings to the final factor of "institutions." Their loadings range from 0.51 to 0.71.

Focus on Cooperation of Others. Factor analysis is employed when variations in three or four observed variables mainly reflect the variations of a single unobserved variable. Here, the variable "Focus on Cooperation of Others" is measured by the degree to which 1) jurisdictions in the region work cooperatively on climate change issues, 2) jurisdictions in the region work cooperatively on energy planning issues, and 3) jurisdictions in the region work cooperatively on sustainability issues. The three observe variables'

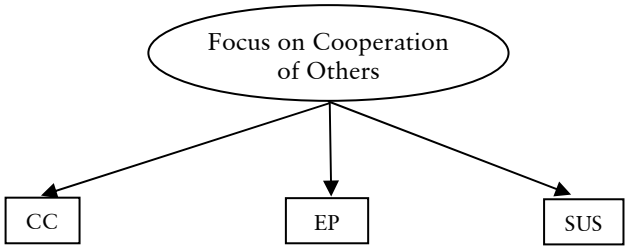

Figure 5 Final Factor Structure of "Focus on Cooperation of Others" in Interlocal Energy Collaboration

* Rotated factor loadings (uniqueness in parenthesis) of:
1. CC=Jurisdictions in region work cooperatively on climate change issues
2. EP=Jurisdictions in region work cooperatively on energy planning issues
3. SUS=Jurisdictions in region work cooperatively on sustainability issues
* Eigenvalue of the final factor "Focus on Cooperation of Others"=2.28, chi2 (3)=1390.44, p=0.00

pair correlations are 0.75, 0.78 and 0.83 respectively, and all are present at a significant level. In fact, the three measures inherently reflect a single unobserved variable—focus on cooperation of others—and I cannot find a distinct difference in the variation of the three observed data points. Thus, employing factor analysis might provide a good choice to solve collinearity problems.

Figure 5 displays the final factor structure of "focus on cooperation of others" and the rotated factor loadings of the three categories of energy issues. Only those factors whose eigenvalue are greater than one are retained. The final factor structure shows that the three categories of energy issues have similar loadings to the final retained factor. Their loadings range from 0.84 to 0.9.

B. Models and Estimations—Logistic Models

A logistic model is the analytic method employed in this research. In the first model, the dependent variable is city selection of informal agreements as a tool in collaborative mechanisms; in the second model, the dependent variable is city selection of formal agreements as a tool in collaborative mechanisms; in the third model, the dependent variable is city participation in membership organizations as a tool of collaborative mechanisms; and in the fourth model, the dependent variable is city participation in collaborative partnerships as a tool of collaborative mechanisms. The dependent variables are all dummy variables (Yes=1; No=0). Logistic model is employed to predict the probability of the occurrence of the dummy dependent variables (Chatterjee & Hadi, 2006). Logistic model uses cumulative logistic function to look at the linear-in-the-coefficient equation (Gujarati, 1992). Maximum likelihood estimation is utilized to maximize the likelihood of a set of parameters given the observed data (iterative process) (Kutner et al., 2005), and a likelihood ratio test (LR test) is adopted to examine the model fit of the logistic models. The results of these models and estimation show that, if compared to the intercept-only models, the logistic models are meaningful and necessary.

Table 1 Incentives to Participate in Informal and Formal Agreements

Variables	Informal Agreements		Formal Agreements	
	Coefficients (Standard Error)	Odds Ratio	Coefficients (Standard Error)	Odds Ratio
Climate Protection	0.61* (0.32)	1.83*	0.29 (0.37)	1.34
Energy Planning	2.04* (1.10)	7.72*	-0.04 (0.74)	0.96
Environmental Protection	-0.32 (0.63)	0.73	0.30 (0.75)	1.36
Management Resources	-0.36** (0.17)	0.70**	-0.28 (0.20)	0.76
Local Support				
Community Support	-0.13 (0.22)	0.88	-0.29 (0.65)	0.75
Business Group Support	0.28 (0.23)	1.32	0.31 (0.27)	1.37
Environmental Group Support	-0.16 (0.11)	0.85	0.07 (0.14)	1.07
Institutions	0.39** (0.13)	1.48**	0.40** (0.15)	1.49**
Others' Focus on Cooperation	0.76** (0.12)	2.14**	0.77** (0.14)	2.17**
REDPs	-0.07 (0.28)	0.94	-0.23 (0.33)	0.80
Log Population	3.59e-08 (2.48e-07)	1	1.29e-07 (2.46e-07)	1
Form of Government	-0.19 (0.24)	0.82	0.36 (0.29)	1.43
Race	-0.85 (0.88)	0.43	-0.68 (1.10)	0.51
Income	-0.00** (0.00)	1.00**	-0.00 (0.00)	1.00
Constant	-2.70* (1.38)		-2.94** (1.26)	
Observation	629	629	629	629
LR Chi2(16)	114.91	114.91	74.74	74.74
Prob>Chi2	0.00**	0.00**	0.00**	0.00**

Note: 1. REDPs=Regional Economic Development Partnerships
2. *p<0.1 **p<0.05
Source: The author.

VI. Research Findings

A. Incentives to Select Contractual Tools

Bilateral (or multilateral) formal agreements and informal agreements are contractual mechanisms that can be applied to interlocal energy collaboration. As outlined in previous work, several incentives are hypothesized to affect individual governments to apply various collaborative tools. The following presents the results of the empirical analysis predicting city use of formal or informal agreements. The results indicate that priorities with respect to common pool resource and scale economy issues, available resources, officially addressing energy institutions, and the focus on cooperation with other jurisdictions in the region can be factors with a significant influence on the selection of bilateral/ multilateral contractual tools.

Participating in a collaborative mechanism may shape the action situation for mutual understanding such that local actors are more likely to solve common problems. Some factors can facilitate engagement in both formal and informal agreements because the binding power of contractual arrangements can reduce the risks of opportunism in a great extent. Here, I examine separately the factors linked to informal agreements and formal agreements, and then compare and integrate the results of these analyses.

Interpretation of research results

City's priorities with respect to "climate protection" and "energy planning" have positive and significant effects on the selection of "informal agreements" as the tool of interlocal energy collaboration. The statistical findings prove the research hypotheses 1, 2 and 2a.

Joining in an informal agreement, bilateral or multilateral parties can make oral commitments to implement the policies related to measuring GHG emissions and tracking mutual achievements relative to the target/standard GHG emission reduction. Repeated communication and interactions shape the

context for mutual understanding and bind actors together. Informal agreements facilitate exchanges of information if any critical issues arise in terms of climate challenges. By participating in the contractual relationships, individual actors connect and become active members of the climate protection movement. A shared belief system is established through repeated and frequent interactions. Actors are more likely to behave in ways designed to reduce CO2 emissions because they believe that what they are doing is for their mutual advantage.

Interlocal informal agreements can facilitate the development of scale economies in terms of clustered industries, infrastructure, job-training, information networks, research and technology. Voluntary collaboration, through informal agreements, treats local actors as a joint unit, yet preserves most of their autonomy and special interests. Flexible rules, procedures and exchange processes can ensure the best fit to individual conditions and respond to locally specific demands. Interlocal energy planning is not necessary involved in much investment in new technologies or building planning. More commonly, they might engage in cost-effective improvements to buildings, funding energy efficiency initiatives, and adoption of regional efficiency standards. Because the investment and the costs due to defection may not be huge, informal agreements, and repeated interaction and communication, could be enough to bind individual behavior.

The "management resource" factor has a negative and significant effect on the selection of "informal agreements" as the tool of interlocal energy collaboration. This statistical finding rejects research hypothesis 4.

Resource availability is hypothesized to increase the incentives to collaborate on energy resource management. However, there is a competing school of thought on this theoretical point. Meaning that when resource availability is not an obstacle to local energy efforts, powerfully incentivized local actors tend to keep the tasks in-house rather than contracting them out. Engagement in informal agreements is

less likely to emerge because rational actors may not obtain further benefit from engaging in collaboration.

The "officially addressing energy institutions" factor has a positive and significant effect on the selection of both formal and informal agreements as the tools of interlocal energy collaboration. The statistical findings prove research hypothesis 6.

Official codes, such as green building rating systems, provide energy efficiency standards for new buildings, specify action goals for bilateral/multilateral actors, and shape interactions aimed at energy planning. Formal rules can reduce monitoring and enforcement costs in contractual agreements. Deviant actors can be punished via institutional action and the invocation of constraints, and transaction costs thereby reduced.

The "focus on cooperation of other jurisdictions" factor has positive and significant effects on the selection of both "formal agreements" and "informal agreements" as tools of interlocal energy collaboration. The statistical findings prove research hypothesis 7.

Focusing on cooperation with other jurisdictions in region, cities can develop well-organized regional information systems and coordinative networks, and demonstrate their willingness to behave in ways consistent with the regional consensus. Doing so helps to build the network foundations for facilitating engagements in formal or informal agreements on energy collaboration. Transaction costs may not be high because the nodes and ties of energy networks have been established through others' efforts on collective actions. Cities are likely to join formal and informal agreements on energy collaboration when most their neighbors are "in" the energy networks, and existing nodes and ties encourage local actors to engage in bilateral/multilateral agreements and behave in way consistent with the regional consensus.

B. Incentives to Select Collective Tools

Multilateral partnerships and membership organizations are collective mechanisms that can be applied to interlocal energy

Table 2 Incentives to Engage in Membership Organizations and Collaborative Partnerships

Variables	Membership Organizations		Collaborative Partnerships	
	Coefficients (Standard Error)	Odds Ratio	Coefficients (Standard Error)	Odds Ratio
Climate Protection	0.60** (0.24)	1.82**	0.43* (0.25)	1.54*
Energy Planning	-0.27 (0.39)	0.76	-0.26 (0.42)	0.77
Environmental Protection	-0.81** (0.39)	0.45**	-0.38 (0.42)	0.68
Management Resources	-0.01 (0.11)	1.00	-0.47** (0.14)	0.62**
Local Support				
Community Support	0.37** (0.18)	1.45	0.14 (0.19)	1.16
Business Group Support	0.09 (0.18)	1.10	0.05 (0.19)	1.05
Environmental Group Support	-0.06 (0.09)	0.94	0.03 (0.10)	1.03
Institutions	0.32** (0.11)	1.38**	0.44** (0.12)	1.55**
Others' Focus on Cooperation	-0.07 (0.10)	0.93	0.83** (0.11)	2.30**
REDPs	-0.46** (0.23)	0.62**	-0.23 (0.24)	0.80
Log Population	7.83e-06** (1.65e-06)	1**	1.73e-08 (2.35e-07)	1.00
Form of Government	-0.00 (0.19)	1.00	0.33* (0.20)	1.40*
Race	2.06** (0.69)	7.85**	-0.40 (0.74)	0.67
Income	-0.00** (0.00)	1.00**	-0.00** (0.00)	1.00**
Constant	-2.71* (0.85)		-1.82** (0.90)	
Observation	629	629	629	629
LR Chi2(16)	129.92	129.92	161.22	161.22
Prob>Chi2	0.00**	0.00**	0.00**	0.00**

Note: 1. REDPs=Regional Economic Development Partnerships 2. *p<0.1 **p<0.05
Source: The author.

collaboration. As outlined in previous work, several incentives are hypothesized to encourage individual governments to apply various collaborative tools. The following presents the results of the empirical analysis predicting city use of collaborative partnerships or membership organizations. The results indicate that CPR priorities and externalities, available resources, local support, officially addressing institutions related to energy issues, the focus on cooperation with other jurisdictions in region, and the appearance of REDPs can have significant effects on the selection of multilateral collective tools.

As described earlier, some factors stress the symbolic value of energy efforts and underscore the value of membership in climate protection organizations in demonstrating mayors' commitment to environmental movements. Some factors focus on the consequences of externalities and spillovers, preserve only low levels of local autonomy and are not appropriate means of reflecting individual concerns, but rather create barriers to collective action. Some factors can facilitate participation in both collaborative partnerships and membership organizations because existing constraints and regulations promulgate codes of conduct and encourage becoming embedded in the institutionalized context of collective energy actions. Some factors become obstacles to interlocal collective collaboration due to the risks of having to shoulder high burdens in cases where there is a limited choice set available to actors. Here, I examine separately the factors linked to membership organizations and collaborative partnerships, and then compare and integrate the results of these analyses. Table 2 presents the statistic results.

Interpretation of research results

City priorities with respect to climate protection have positive and significant effects on the selection of membership organizations and collaborative partnerships as tools of interlocal energy collaboration. The statistical findings prove research hypothesis 1.

In order to achieve a significant reduction of GHG emissions

and improve air quality, a multilateral and collective mechanism is selected in order to involve a large set of participants in climate protection movement. This mechanism imposes constraints on individual behavior and creates a context requiring compliance with group decisions. Collective interests can be achieved, or at least symbolically achieved, via the binding power of collective mechanisms in which participants are socially embedded in collectively reinforced shared understandings and expectations. Hence, collective mechanisms establish channels for collaborative action and information exchange, and create social networks with broad nodes and ties.

City priorities on environmental protection have significant but negative effects on the selection of membership organizations as the tool of interlocal energy collaboration. The statistical finding proves research hypothesis 3a.[1]

Environmental protection and externalities involve win-lose situations rather than symbolic efforts toward green commitments. Interlocal collaboration for environmental protection emphasizes solutions to negative externalities, spillovers, urban sprawl and free rider problems. Locally, issues touching on environmental protection can be highly fragmented and diverse. If collective mechanisms emphasize symbolic collaboration, or cannot reflect the specific interests of local actors, the negative effects of externalities or spillovers will remain. This is especially so if group

[1] According to the statistic results shown by "Table 3 Incentives to engage in membership organizations and collaborative partnerships," as the independent variable (IV)—"goal priority on environmental protection and externality issues" increases 1 unit, the occurrence probability (odds) of the dependent variable (DV)—"selection of membership organizations" decreases 55% (=1-odds ratio 0.45), holding other variables as constant. Although the correlation matrix analysis (Appendix C) shows that membership organization (DV) is not significantly correlated with environmental protection (IV), this information merely indicates the "pair correlation" of the DV & IV, without holding other factors as constant. In fact, the research results should take into account the contextual as well as control factors; that is, the influence of other variables. Under the research scope, the interpretation of the statistic results should rely on the logistic models instead of the correlation matrix analysis.

constraints in membership organizations are too inflexible to reflect individual interests and preferences. Collective rules preserving low autonomy may become barriers to repeated rounds of negotiation and communication.

The management resource factor has negative and significant effects on the selection of collaborative partnerships as the tool of interlocal energy collaboration. This statistical finding rejects research hypothesis 4.

The available resources for exchange and management, theoretically provide incentives to participate in partnerships or membership organizations. However, there is a competing school of thought which holds that when local actors are self-sufficient in terms of resources they will find it less necessary to partner of others to create joint ventures in furtherance of multilateral intergovernmental ties and collaborative relationships. There is less need to participate in resource exchange systems if self-sufficient local actors can pursue their ends without engaging in supplier-receiver networks.

The local support factor has positive and significant effects on the selection of membership organizations as the tool of interlocal energy collaboration. This statistical finding proves research hypothesis 5.

Participating in a membership organization for energy collaboration is of symbolic value to demonstrating successful efforts in the energy field. Community support of energy efforts facilitate the selection of membership organizations as the tool of collaboration because the symbolic values of such mechanisms can protect incumbents from electoral threats through propagating a positive image of professionalism in a problem-solving capacity that allows incumbents to claim credit for service provision.

Local political markets focus on the relationships between supplier and demand. Interest group attitudes toward energy efforts are hypothesized to affect decisions on interlocal energy collaboration due to the power of advocacy coalitions. However,

surprisingly, the statistical results show that interest groups (business versus environmental groups) do not have a significant effect on local engagement in any tool of energy collaboration. It is possible that local interest groups focus on the big picture of service delivery systems instead of how their governments carry on functionally collaborative service activities. They may focus on policy selection rather than policy tool selection. They may be concerned with the outcomes of energy policies, but fail to pay attention to how local governments accomplish their ends. In fact, interest group attitudes may not matter to interlocal relations in terms of the selection of collaborative tools as they focus would be on the consequences of economic development instead of whether the work is done collaboratively or independently.

The officially addressing energy institutions factor has positive and significant effects on the selection of both collaborative partnerships and membership organizations as the tools of interlocal energy collaboration. The statistical findings prove research hypothesis 6.

Institutions guide behavior and reduce uncertainty by providing criteria for making decisions. They shape the incentives to multilaterally collaborate in that individual behavior is embedded in an institutionalized context. Risk-averse individuals are more likely to participate in multilateral partnerships and membership organizations if institutions are formally addressed in energy issues. Such institutions as pollution control standards promulgate codes of conduct, shape collective interests, clarify green mission goals and can help actors avoid the tragedy of the commons.

The focus on cooperation of other jurisdictions factor has positive and significant effects on the selection of collaborative partnerships as the tool of interlocal energy collaboration. The statistical finding proves research hypothesis 7.

With the focus on cooperation of others, mutual advantages can be realized easily because cities become embedded in contexts

that favor collaboration. Cities can both contribute to multilateral-actor projects or partnerships, and transaction costs associated with multilateral energy projects/partnerships can be lowered as trust and reciprocity are enhanced through mutual-understanding and interaction.

Not surprisingly, the focus on cooperation of others does NOT have a significant effect on the selection of membership organizations as the tool of collaboration. Participation in climate protection membership organizations typically involves the symbolic value of mayors' commitments to environmental protection. The "in-versus-out" decision with respect to the membership organization is highly referred to individual decision-making rather than dependence upon neighbors' attitude. Others' attitudes toward regional cooperation are visible through the operations of actual collaborative activities. These may not react to symbolic collaboration, but indeed shape collective actions embedded in the context of regional network mechanisms.

The REDPs factor has negative and significant effects on the selection of membership organizations as the tool of interlocal energy collaboration. The statistical finding rejects research hypothesis 8.

REDPs concern business and industrial development. If cities appear to have REDPs, this implies strongly a local demand for economic development. Here, the concerns for environmental protection seem to rival the purpose of REDPs. Members in REDPs can organize and aggregate the influence and power of business groups or other interest groups, and raise obstacles to local participation in climate protection efforts.

Besides, participating in membership organizations has a symbolic value for mayors' commitment to climate protection. The effort of REDPs may distract local focus from the environmental movement and result in less need for demonstrating mayors' commitment. Given the competition between advocates of economic development and environmental protection, the effort of REDPs would undermine energy policy planning and

implementation, and, consequently, there is less need for interlocal energy collaboration.

VII. Conclusion

"No city or urban region can be sustainable on its own" (Rees, 1997: 307). Collaborative efforts through a variety of policy tools and mechanisms have become increasingly popular (Lubell et al., 2009). Interlocal energy collaboration is built upon the network structures among local energy policy actors. It takes the form of institutional collective action (ICA) to cope with problems spanning jurisdictional boundaries, such as pollution, negative externalities associated with growth, spillover effects, and free-rider problems (Feiock, 2007).

This study differentiates the collaborative mechanisms based on the autonomy of local actors and the application of contractual versus collective mechanisms. Contractual mechanisms (include formal and informal agreements) are typically bilateral interlocal governance tools, but sometimes can be multilateral agreements involving more than two participants with the process of contractual negotiation. Compared to contractual mechanisms, collective mechanisms (include partnerships and membership organizations) involve many more multilateral actors in determining collective decisions. Voting or other decision rules can provide the basis for self-organizing collective governance mechanisms. Collective decisions impose constraints on participants, so the transaction costs of negotiation and enforcement can be reduced.

The practice of contractual versus collective mechanisms implies four quadrants of tools for interlocal collaboration. The first quadrant is collaborative partnerships presenting a tool of collective mechanisms that preserves high local autonomy. The second quadrant is membership organizations presenting a tool of collective mechanisms that preserves low local autonomy. The

third quadrant is formal agreements presenting a tool of contractual mechanisms that preserves low local autonomy. The fourth quadrant is informal agreements presenting a tool of contractual mechanisms that preserves high local autonomy.

The research results indicate that some factors influence collaboration generally and have positive or negative influences for policy in each of the four quadrants. On the other hand, some factors influence some types of collaboration but not others. Figure 6 shows the tools of interlocal collaboration to cope with ICA dilemmas. Within each cell, the theoretical factors that had a significant influence on collaboration are reported.

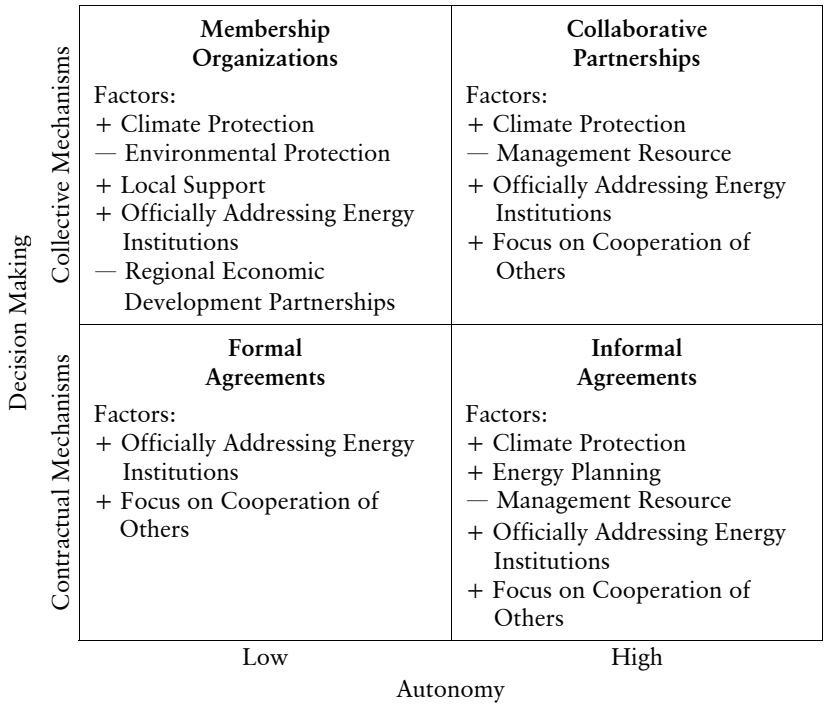

Figure 6 Tools of Interlocal Collaboration to Cope with ICA Dilemmas

The research findings stress that cities' priorities on energy-related issues greatly affect individual decisions in the selection of tools of action with respect to energy collaboration. Some theoretical hypotheses are confirmed. Concerns with energy planning issues significantly facilitate engagement in informal agreements, and concerns for climate protection issues significantly facilitate the engagement in most tools of collaboration. Indeed, the focus on common pool resource (CPR) and scale economy issues explain why medium-sized American cities participate in bilateral/multilateral collaborative mechanisms. It illustrates the need to reduce transaction costs among interlocal energy collaboration; thus, it is anticipated that a useful collaborative tool will be one well suited to coping with ICA dilemmas.

The selection of membership organizations is discouraged by a city's focus on externalities and spillover issues. Issues related to environmental externalities are highly fragmented. A collective tool preserving low local autonomy is not useful and produces negative consequences for environmental equality because the room for negotiation is limited by inflexible rules and group constraints.

The results of cooperating actions of others also provide important insights. Social network analyses of dyadic network ties have found that the characteristics of potential collaborators are important, but comparative research has focused on the characteristics of the ego (the cities that potentially participates in a collaboration) rather than the alters (other communities that participate). This analysis confirms the importance of alters. Individual actors are encouraged to join the collaborative networks when their neighbors respond positively over the cooperation.

Community support facilitates participation in membership organizations. Also, participation has symbolic value in demonstrating mayors' commitment to climate protection, and can provide a positive image to help incumbents obtain support from the constituency. Officially addressing energy institutions can reduce transaction costs arising from distrust and uncertainty.

Institutional design and the enactment of formal rules of games make interlocal collaboration more likely.

Some theoretical hypotheses are NOT confirmed. Resource is hypothesized to be positively associated with energy collaboration due to the incentives to resource management and exchange. The statistical results reject this hypothesis. Alternatively, it may be fair to say that when resource availability is not an obstacle to local energy effort, actors can operate their energy policies without exchanging resource with others. Actors are therefore less likely to participate in the networks for the sake of resource management. Surprisingly, there is a negative association between the appearance of REDPs and participation in membership organizations. Given the conflict between economic development and environmental protection, the cumulative effort of REDPs seems to undermine local energy work. This is especially so where participation in membership organizations emphasizes the symbolic value of climate protection commitments. Activities held by REDPs distract local focus from climate protection, and shift residents' attention to job training or other economic development activities. Without local attention on climate protection issues, city mayors are less likely to participate in the national program of Mayors Climate Protection Agreements. Although REDPs can help establish social capital in policy networks, they discourage energy collaboration due to the underlining differences with, and relative power of, economic development coalitions.

Implications for Policy Design

Interlocal energy collaboration is built upon the action situation in which collaborative effort is encouraged and mutual advantages can be achieved. When transaction costs associated with uncertainty, opportunism and distrust exceed the expected outcomes of collective benefits, the engagement in collaborative mechanisms become meaningless and is less likely to emerge. City

priorities on CPR, economies of scale and externalities imply a need for integrated solutions to cope with ICA dilemmas. But local conditions can vary highly, so the selection of collaborative tools becomes critical to reflect properly local needs and demands.

Tools that favor flexible rules and procedures are applied when transactions involve extremely high transaction costs (such as externalities and environmental protection problems in highly fragmented areas), or involve extremely low transaction costs (such as implementing collective guidance for cost-effective improvements on buildings). When anticipating that negotiations will carry extremely high transaction costs, actors need room for repeated interaction and communication to ensure the chosen solution is the best fit for individual conditions and the present situation. Otherwise, transactions may not reflect participants' specific needs and concerns. When anticipating extremely low transaction costs, or the transactions are not critical and burdens of defection would be low, informal agreements can be enough to bind individual behavior and oral commitments prove sufficient to facilitate trust and reach a consensus.

Tools that carry written rules or constraints create more certainty in bilateral/multilateral transactions, and are likely to be applied when expected transaction costs fall in the midrange. The listed obligations assumed by participants seem necessary for the success of collective actions, so the collaborative tools preferred would be those which do less to preserve local autonomy. Although responsiveness in the transactions is needed, the burdens are affordable if the collective decisions do not exactly respond to individual preferences. In fact, any collective action is inevitably involved in a sacrifice of some degree of freedom. Every actor should more or less adjust its wants in order to reach a consensus on collective actions, and to pursue the maximum collective interests for the groups, alliances, partnerships or organizations.

To conclude, expected transaction costs on energy collaboration are of the greatest concern to local actors. As local

conditions vary, city policy decision makers need to select the best fit collaborative tools in response to action in situation. In future research, it would be meaningful to further explore other factors influencing the selection of collaborative tools and modes, and look at multiple issues related to the leveraging of other factors.

Appendix A Variable Measurement

Dependent Variables		Measurement
Contractual Mechanisms	Formal Agreement	Q31-4. Has your government engaged in any of the following collaborative actions relating to sustainability, energy efficiency or climate protection? —Entered into a formal agreement with one or more local governments on energy issues. (Coding: Checked=1=Engaged; Not checked=0 =Not engaged)
	Informal Agreement	Q31-3. Has your government engaged in any of the following collaborative actions relating to sustainability, energy efficiency or climate protection? —Entered into an informal agreement with one or more local governments on energy issues. (Coding: Checked=1=Engaged; Not checked =0= Not engaged)
Collective Mechanisms	Collaborative Partnerships	Q 31-2. Has your government engaged in any of the following collaborative actions relating to sustainability, energy efficiency or climate protection? —Joined a collaborative partnership with other local entities (Coding: Checked=1=Engaged; Not checked=0= Not engaged)
	Membership Organizations	City mayor participation in the U.S. Conference of Mayors Climate Protection Agreement, which represents the promise to collaboratively reduce the greenhouse gas emissions. (Coding: Participated=1; Not participated=0)

Independent Variables	Measurement
Climate Protection	Q2-3. To what extent are the following goals a priority in your local government?—Green house gas reduction (Coding: 5=Very high priority; 4=High priority; 3 =Medium priority; 2=Low priority; and 1=Not a goal)
Energy Planning	Q2-4. To what extent are the following goals a priority in your local government?—Reduced energy Costs (Coding: 5=Very high priority; 4=High priority; 3 =Medium priority; 2=Low priority; and 1=Not a goal)
Environmental Protection	Q2-2. To what extent are the following goals a priority in your local government?—Environmental Protection (Coding: 5=Very high priority; 4=High priority; 3 =Medium priority; 2=Low priority; and 1=Not a goal)

Note: The Q2 answer-options applied in this research are: 2) environmental protection, 3) green house gas reduction, and 4) reduced energy costs. If the respondents give credits on garbage treatment issues as goal priority, they would rather check Option 2) environmental protection instead of Option 3) green house gas reduction; if the respondents point to the reduction of carbon dioxide as a priority, they would prefer to check Option 3) green house gas reduction rather than Option 2) environmental protection. The three answer-options may, to some extent, overlapped, but they are clearly distinct.

Independent Variables	Measurement
Management Resource	Q17. On a scale from 1="not an obstacle" to 5="sustainable obstacle," please rate the following factors with respect to your local government's ability to reduce overall energy consumption. —Cost/lack of funds; —Lack of time/expertise to design and plan; —Lack of informational resources (Recoding: 5="Not an obstacle" to 1="sustainable obstacle")

Local Support	Q5. To what extent would the following individuals or groups support or oppose energy conservation and climate protection efforts by your local government? **Community Support:** Neighborhood Organizations, Home-owner Associations **Business Support:** Chamber of Commerce/Business Association, Real Estate Developers, Large Business Corporations **Energy Interest Group Support:** Environmental Groups (Coding: Strongly support=5; Moderately support=4; Neutral =3; Moderately oppose=2; Strongly oppose=1) Note: Use "average value" to represent category of group attitude toward energy effort.
Institutions and Constraints	Q6. Which of the following energy/climate related issues does your jurisdiction officially address (e.g. through regulation or policies) as it relates to government facilities and community at large? (Original coding: number of checks in the "government facilities" column and in the "community at large" column.) 1) Green buildings, 2) Retro-firing existing buildings for energy efficiency, 3) Alternative transportation systems, 4) Green procurement, 5) Technology innovation/demonstration projects, 6) Energy efficient devices (appliances, lighting, etc.), 7) Energy efficiency systems (building controls etc.), 8) Inventory of greenhouse gas emissions, 9) Renewable energy, 10) Smart grid/net metering, 11) Alternative fuels, 12) Incorporating energy use in land use decisions, and 13) Provide information about efficiency to employees/residents.
The Focus on Cooperation of Other Jurisdictions in Region	Q30. To what extent do jurisdictions in your region work cooperatively on climate change or energy issues? —Climate Change; —Energy Planning; —Sustainability (Coding: Great extent=2; Somewhat=1; Not at all=0)
Regional Economic Development Partnerships	The appearance of regional economic development partnerships in metropolitan statistical areas (MSA) (Coding: Yes=1; No=0)

Appendix B Descriptive Statistics

Dependent Variables	Numbers of observation	Percentage (%)
Formal Agreements		
Yes	82	12.97
No	550	87.03
Total	632	100.00
Informal Agreements		
Yes	127	20.09
No	505	79.91
Total	632	100.00
Collaborative Partnerships		
Yes	243	38.45
No	389	61.55
Total	632	100.00
Membership Organizations		
Yes	272	43.04
No	360	56.96
Total	632	100.00
Number of Tools Selected		
0	221	34.97
1	214	33.86
2	105	16.61
3	68	10.76
4	24	3.80
Total	632	100.00

Independent Variables	Numbers of observation	Percentage (%)
Climate Protection		
1	89	14.08
2	118	18.67
3	227	35.92
4	134	21.20
5	64	10.13
Total	632	100.00
Energy Planning		
1	36	5.70
2	19	3.01
3	98	15.51
4	283	44.78
5	196	31.01
Total	632	100.00
Environmental Protection		
1	33	5.22
2	27	4.27
3	160	25.32
4	295	46.68
5	117	18.51
Total	632	100.00

Independent Variables	Numbers of observation	Percentage (%)
Resource—Funds		
1	288	45.57
2	139	21.99
3	97	15.35
4	30	4.75
5	17	2.69
6	61	9.65
Total	632	100.00

Resource—Time/Expertise		
1	99	15.66
2	153	24.21
3	165	26.11
4	99	15.66
5	54	8.54
6	62	9.81
Total	632	100.00
Resource—Information		
1	15	2.37
2	34	5.38
3	125	19.78
4	166	26.27
5	225	35.60
6	67	10.60
Total	632	100.00
Community Support —Neighborhood Organizations		
1	1	0.16
2	3	0.47
3	178	28.16
4	247	39.08
5	203	32.12
Total	632	100.00
Community Support —Homeowner Associations		
1	6	0.95
2	37	5.85
3	317	50.16
4	234	37.03
5	38	6.01
Total	632	100.00

Business Support —Chamber of Commerce/ Business Associations		
1	3	0.47
2	28	4.43
3	200	31.65
4	306	48.42
5	95	15.03
Total	632	100.00
Business Support —Real Estate Developers		
1	12	1.90
2	76	12.03
3	353	55.85
4	166	26.27
5	25	3.96
Total	632	100.00
Business Support —Large Business Corporations		
1	7	1.11
2	31	4.91
3	265	41.93
4	267	42.25
5	62	9.81
Total	632	100.00
Interest Group Support —Environmental Groups		
1	7	1.11
2	29	4.59
3	143	22.63
4	120	18.99
5	333	52.69
Total	632	100.00

Institutions—Green Buildings		
0	241	38.13
1	269	42.56
2	122	19.30
Total	632	100.00
Institutions—Retro-Firing Existing Buildings for Energy Efficiency		
0	154	24.37
1	325	51.42
2	153	24.21
Total	632	100.00
Institutions—Alternative Transportation Systems		
0	244	36.81
1	258	40.82
2	130	20.57
Total	632	100.00
Institutions—Green Procurement		
0	316	50.00
1	293	46.36
2	23	3.64
Total	632	100.00
Institutions—Technology Innovation/Demonstration Projects		
0	292	46.20
1	268	42.41
2	72	11.39
Total	632	100.00

Institutions—Energy Efficient Devices (Appliances, Lighting, etc.)		
0	127	20.09
1	344	54.43
2	161	25.47
Total	632	100.00
Institutions—Energy Efficiency Systems (Building Controls etc.)		
0	149	23.58
1	373	59.02
2	110	17.41
Total	632	100.00
Institutions—Inventory of Greenhouse Gas Emissions		
0	364	57.59
1	182	28.80
2	86	13.61
Total	632	100.00
Institutions—Renewable Energy		
0	301	47.63
1	229	36.23
2	102	16.14
Total	632	100.00
Institutions—Smart Grid/Net Metering		
0	444	70.25
1	138	21.84
2	50	7.91
Total	632	100.00

Institutions—Alternative Fuels		
0	290	45.89
1	270	42.75
2	72	11.39
Total	632	100.00
Institutions—Incorporating Energy Use in Land Use Decisions		
0	363	57.44
1	186	29.43
2	83	13.13
Total	632	100.00
Institutions—Provide Information about Efficiency to Employees/Residents		
0	255	40.35
1	205	32.44
2	172	27.22
Total	632	100.00
Focus on Cooperation of Others—Climate Change		
0	354	56.01
1	220	34.81
2	58	9.18
Total	632	100.00
Focus on Cooperation of Others—Energy Planning		
0	308	48.73
1	225	40.35
2	69	10.92
Total	632	100.00

Focus on Cooperation of Others—Sustainability		
0	283	44.78
1	269	42.56
2	80	12.66
Total	632	100.00
Regional Economic Development Partnerships		
Yes	124	19.62
No	508	80.38
Total	632	100.00

Appendix C Correlation Matrix

	1	2	3	4	5	6	7
1 Formal Agreements	1.00						
2 Informal Agreements	0.51**	1.00					
3 Collaborative Partnerships	0.39**	0.37**	1.00				
4 Membership Organizations	0.02	0.06	0.15**	1.00			
5 Climate Protection	0.12**	0.19**	0.17**	0.18**	1.00		
6 Energy Planning	0.07*	0.14**	0.07*	0.00	0.37**	1.00	
7 Environmental Protection	0.08*	0.11**	0.07*	0.00	0.44**	0.57**	1.00
8 Resources	-0.05	-0.09**	-0.15**	0.04	0.07	0.01	0.05
9 Community Support	0.05	0.11**	0.13**	0.19**	0.32**	0.22**	0.24**
10 Business Group Support	0.12**	0.15**	0.14**	0.15**	0.27**	0.18**	0.23**
11 Environmental Group Support	0.03	-0.03	0.00	-0.04	0.05	0.10**	0.07*
12 Institutions	0.21**	0.25**	0.28**	0.24**	0.34**	0.19**	0.21**
13 Focus on Cooperation of Others	0.31**	0.35**	0.42**	0.06	0.23**	0.17**	0.16**
14 Regional Economic Development Partnerships	-0.01	0.01	-0.02	-0.04	0.06	0.03	0.02
	8	9	10	11	12	13	14
8 Resources	1.00						
9 Community Support	0.03	1.00					
10 Business Group Support	0.05	0.57**	1.00				
11 Environmental Group Support	0.09**	-0.06	0.06	1.00			
12 Institutions	0.07*	0.33**	0.32**	0.03	1.00		
13 Focus on Cooperation of Others	-0.15**	0.13**	0.21**	0.05	0.32**	1.00	
14 Regional Economic Development Partnerships	0.01	0.06	0.04	0.03	0.06	0.02	1.00

*p<0.1 **p<0.05

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美國地方政府的能源合作模式：能源效率、永續性以及氣候防護策略

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摘 要

地方政府的能源合作行為主要在於化解制度主義之集體行動困境，冀克服外部性、跨行政管轄以及搭便車的問題。實務上，美國地方政府的能源合作可窺見於節能減碳協定、跨域污染防治、綠色採購、增修綠能建築等，其合作模式可分為「契約合作機制」及「集體合作機制」。本研究於2010年進行全美國中型都市調查，研究結果顯示，當預期交易成本極高或極低時，地方政府傾向使用非正式口頭承諾來約定，意於保留最大地方自治空間及彈性。而當預期交易成本為中等程度時，正式管道合作較易進入政策選項，用以規範行為者，並降低不履行義務的風險。

關鍵詞：地方政府能源合作、制度性集體行動困境、能源效率、永續性、氣候防護