Analyzing voluntary 2030 District energy programs using the Institutional Analysis and Development framework

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Abstract

Twenty-two cities across North America have joined the 2030 District energy and water conservation program. Building owners in participating cities voluntarily pledge to reduce building energy use, water use, and transportation-related greenhouse gas emissions by 50% by 2030. The 2030 Districts range in size and climate, from sprawling and warm Los Angeles to the snowy college town of Ithaca, New York. In the absence of robust climate change regulations, the 2030 Districts' voluntary, non-regulatory approach is a novel way to reduce resource use and emissions. The program allows each 2030 District to create its own approach to encourage building owners to achieve the goals. However, it is unclear whether participating buildings are actually reducing resource use and emissions. It is also unclear what, if any, methods are most useful in holding the participants accountable for meeting their voluntary goals. Therefore, we explore how Ostrom's eight design principles apply to the 2030 Districts and how they can enhance District functioning to achieve the 2030 District program goals. These principles are then more formally analyzed using the Institutional Analysis and Development (IAD) Framework. We explore the applicability of the IAD framework for the 2030 District using Grand Rapids, Michigan as a case study. The case study examines the actors and relationships hypothesized under the IAD framework. This exploratory analysis will guide the development of more detailed future investigations. The analysis will increase understanding of voluntary mechanisms to reduce energy use, water use, and transportation-related greenhouse gas emissions.

Introduction

Cities present both challenges and opportunities for resource sustainability. On the one hand, cities consume about 76 percent of global primary energy and produce a similar percentage of greenhouse gas emissions (Seto et al. 2014). Cities, on the other hand, are highly efficient in resource use. For example, per-capita greenhouse gas emissions are lower, by as much as 70 percent, in many cities compared to their respective countries as a whole (Dodman 2009). Analysts at the US Department of Energy (2016) found that cities could reduce greenhouse gas emissions by 7-19% by implementing cost-effective strategies like stricter building codes, encouraging energy efficiency, and increasing public transit. Increasing urbanization, if done with an eye toward reducing resource use and improving efficiencies, can help achieve climate change mitigation and other sustainability goals.

The conventional wisdom on collective action suggests that a global climate problem must have a global, legally-binding solution (Brennan 2009; Ostrom 2010). Ostrom proposed several research questions about collective action and global climate change:

1. "Is the conventional theory of collective action the best theory for analyzing how to reduce the threats of massive climate change, and, if not, what changes need to be made?
2. Are only global benefits generated from the efforts to reduce GHGs [greenhouse gas] emissions, or are further benefits proposed at multiple scales?
3. Would a polycentric approach [to climate change] be an improvement to the analysis of climate policy over exclusive reliance on proposing global solutions?
4. Are actions already being taken at less than global scale to reduce GHG emissions and can these cumulate to reduce the threat of major climate change?
5. When multiple governments and other organizations are involved in reducing GHG emissions, does that generate major leakages, inconsistent policies inadequate certification, gaming the system, and free riding?" (Ostrom 2010 p. 551)

In this working paper, we explore some of these questions in the context of the 2030 District program. In the absence of strong federal climate change policies in the United States, several American (and Canadian) cities are adopting strategies to reduce their energy use and carbon emissions. One such approach is the 2030 District program created by Architecture 2030 and the American Institute of Architects. Cities can participate in the 2030 District program by drawing a downtown district boundary and inviting commercial building owners to make voluntary reductions in energy and water use. The goal for existing buildings is to make 50% cuts in building fossil-fuel energy use, water use, and transportation-related greenhouse gas emissions by 2030. New buildings are held to an even stricter standard. The 2030 District program is voluntary and led by the private sector – it is not a regulation or government policy, although governmental units can participate. To date 22 cities across the US and Canada have established 2030 Districts comprising more than 400 million feet^2 (37.16 million m^2) of commercial building space (Figure 1) (2030 Districts Network 2017).

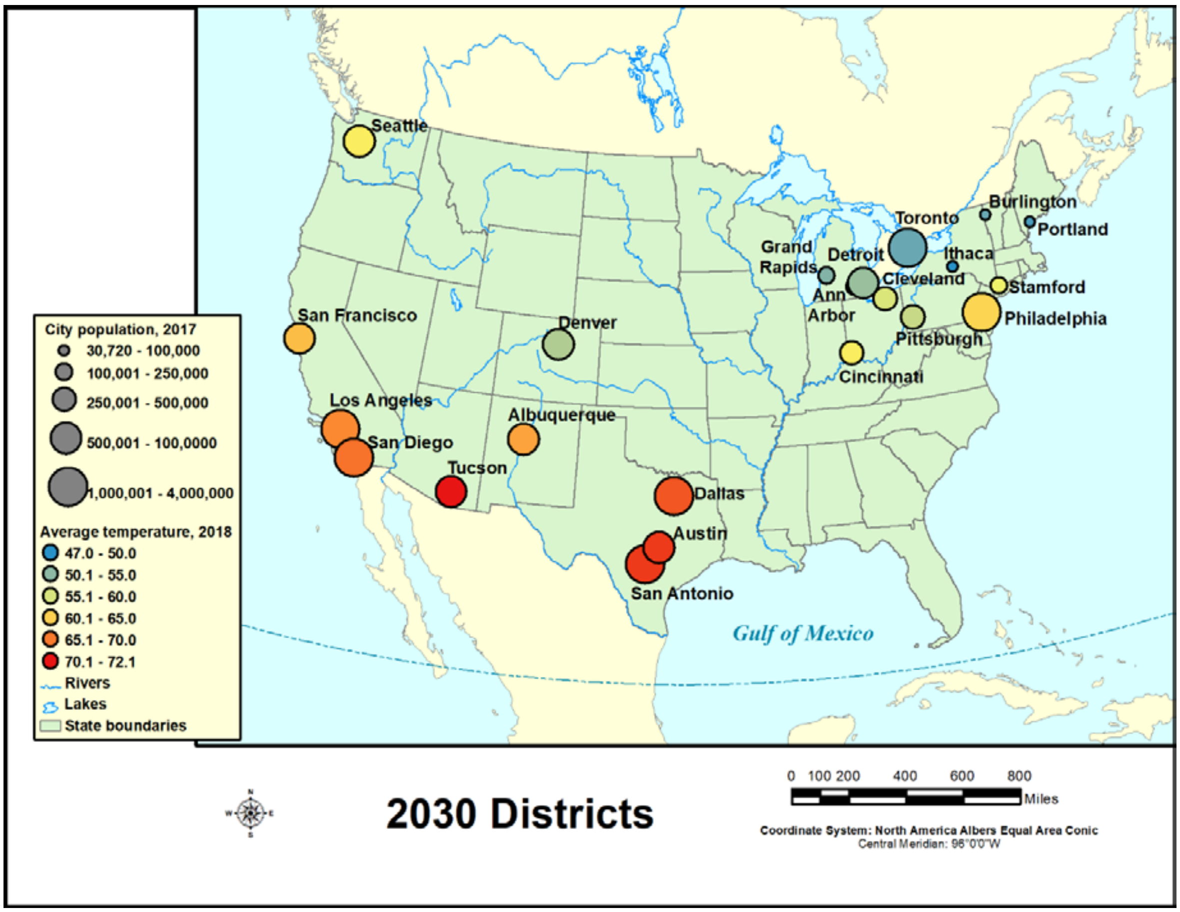

Figure 1: The 2030 District Network includes 22 cities in the US and Canada (map by E. Nordman). Ann Arbor is obscured by Detroit.

By recruiting building owners to adopt the District-wide goals, each 2030 District creates a collective action situation from what is normally a firm's private decision whether to invest in resource efficiency. The 2030 District program is decentralized with each city's District operating somewhat independently but under the umbrella of the 2030 District Network. The program allows each 2030 District to create its own approach to encourage building owners to achieve the shared goals.

It is unclear, however, if collective action is an effective method for reaching the resource efficiency goals. This invites several research questions:

- Why would a city voluntarily join the 2030 District program?
- Why would a commercial building owner voluntarily join a 2030 District?
- Do participating building owners reduce resource use and emissions more than non-participants?
- How do 2030 Districts hold their members accountable for meeting the voluntary goals?
- Are 2030 District cities improving resource efficiency more effectively than non-participating cities?

Therefore, we explore the decision-making processes within a 2030 District using the Institutional Analysis and Development (IAD) framework (Ostrom 2005, 2011). This working paper will focus on the goal of reducing energy use in existing buildings but it can also be applied to the program's commitments for new buildings and the water and transportation emissions goals. The paper embeds a neoclassical decision model for energy efficiency within the action situation of the IAD framework to explore how collective action within the 2030 District might affect firm-level choices. The conceptual model is then used to examine a case study of the 2030 District in Grand Rapids, Michigan. The case study will inform future research on the twenty-two 2030 Districts across North America and will increase understanding of voluntary mechanisms to improve efficiency across a variety of resources.

Institutional organization of 2030 Districts

The 2030 District program was created by Architecture 2030, which is itself a spin-off of the American Institute of Architects. Architecture 2030 was founded in 2002 by Edward Mazria with the mission of rapidly transforming "the built environmental from the major contributor of greenhouse gas emissions to a central part of the solution to the climate and energy crisis" (Architecture 2030 2019). Starting in 2006, Architecture 2030 issued a series of "challenges" including the 2030 Challenge, the 2030 Challenge for Products, and, most relevant to this paper, the 2030 Challenge for Planning. The 2030 Challenge for Planning focuses on the global architecture and planning sector. It challenges them to meet the following targets:

- New buildings and major renovations
  - "All new and renovated developments / neighborhoods / towns / cities / regions immediately adopt and implement a 70% reduction standard below the regional average/median for fossil-fuel operating energy consumption for new and renovated buildings and infrastructure. The fossil-fuel reduction standard shall be increased to :
    - 80% in 2020
    - 90% in 2025
    - Carbon neutral in 2030 (using no fossil fuel GHG emitting energy to operate or construct)
  - These targets may be accomplished by implementing innovative sustainable design strategies, generating on-site renewable power and/or purchasing renewable energy (20% maximum).
  - All new buildings and major renovations within developments / neighborhoods / towns / cities/ regions also immediately adopt and implement at 50% reduction standard below the regional average/median for:
    - CO_2 emissions from transportation
    - Water consumption" (Architecture 2030 2019).
- Existing buildings

- "By 2020, all existing buildings within developments / neighborhoods / towns / cities/ regions adopt and implement a 20% reduction standard below the regional average/median for:
    - Fossil-fuel operating energy consumption
    - CO_2 emissions from transportation
    - Water consumption
- The reduction standard shall be increased to
    - 35% in 2025
    - 50% by 2030" (Architecture 2030 2019).

To implement the 2030 Challenge for Planning, Architecture 2030 helped form the 2030 District Network. As a separate non-profit organization, the 2030 District Network was "created to develop and sustain local 2030 Districts as they empower and inspire their members and partners to achieve the energy, water, and vehicle emissions reduction targets" (2030 Districts Network 2017).

Each local 2030 District is an independent private-public partnership that agrees to adopt the Architecture 2030 Challenge for Planning targets. Each 2030 District is administered by a sponsoring organization, usually a local non-profit or a local chapter of a national organization, with assistance from an advisory board led by the private sector. In addition to the 2030 Challenge for Planning targets, a 2030 District may adopt locally-relevant metrics or targets for sustainability, health, or climate change adaptation. Membership in a 2030 District must include at least 40% property owners, managers, or developers; 20% professional stakeholders; and 20% community stakeholders. (2030 Districts Network 2017). The 2030 District Network does not provide a standard protocol for data collection, reporting, or enforcement. Each 2030 District is free to determine its own operating procedure although the districts do share best practices and lessons learned with each other through Network-led activities (personal communication, C. Holman, US Green Building Council – West Michigan Chapter 2019).

To date, few scholars have analyzed the 2030 District program. The Pittsburgh 2030 District, an early adopter, developed a protocol for measuring building energy performance and encouraging cooperation (Huddleston et al. 2014; Sharrard et al. 2014). Barnes and Parrish (2016) developed a case study library and template for the 2030 District Network's Small Commercial Toolkit. This working paper will therefore be a novel contribution to this emerging topic.

2030 Districts and the efficiency gap

The 2030 District program is premised on the existence of a resource (energy and water) efficiency gap. That is, a disparity exists between the observed use of resource efficient equipment and practices in the built environment and what is technically and economically feasible. The 2030 Districts try to not only close the efficiency gap, but also internalize the damages from greenhouse gas emissions.

Many technical assessments have tried to quantify the efficiency gap. The US Department of Energy (2016) estimated that cost effective strategies, including stricter building codes and energy efficiency, could reduce greenhouse gas emissions from cities by 7-19 percent. McKinsey & Company (2009, p. iv) estimated that "by 2020, the United States could reduce its annual energy consumption by 23 percent from a business-as-usual (BAU) projection by deploying an array of NPV-positive efficiency measures, saving 9.1 quadrillion BTUs of end-use energy (18.4 quadrillion BTUs in primary energy)." The analysts noted that the commercial sector accounts for 25 percent of that potential savings. With a $520 billion up-front investment, the US economy could reap $1.2 trillion in present value savings.

Much of the efficiency gap literature comes from technical analyses like those mentioned above. Some economists have been more skeptical of a large energy gap, or whether one exists at all. Allcott and Greenstone (2012), for example, concluded that "while investment inefficiencies do appear in various settings, the actual magnitude of the Energy Efficiency Gap is small relative to the assessments from engineering analyses." These economists note that some technical analyses may underestimate some costs and risks associated with adopting efficient products. Nevertheless, economists have long recognized the existence of a variety of market failures that may inhibit the optimal investment in resource efficiency. The emergence of behavioral economics has added to this literature.

The efficiency gap: market and behavioral failures

The standard economic approach to building energy and water efficiency assumes that building owners are rational actors. As such, building owners seek to minimize their costs, both upfront and in the future. Building owners would therefore invest in energy (and water) efficiency projects until the marginal cost of the *n*th project just equals the marginal benefit – the sum of discounted savings. In this idealized world, each building owner achieves the economically efficient level of energy and water efficiency without government intervention and without coordinating with other building owners.

However, the observed behavior of building owners' investments in resource efficiency may deviate from the ideal. Gillingham and Palmer (2014) identified several market and behavioral failures that may explain this efficiency gap, some of which are relevant to the 2030 District situation. The first market failure is imperfect information. Building owners and firms may not have complete information about available resource efficiency technologies, practices, and monetary savings. Some firms perceive energy efficiency is a risky investment and decline to adopt practices recommended by an audit (Anderson and Newell 2004). A second market failure is the principal-agent issue. A tenant may pay the energy and water bills, but the building is owned by the landlord. Neither has an incentive to make capital investments in efficiency. Third is constrained credit. A high up-front cost and a lack of available credit may put an otherwise appropriate efficiency investment out of reach. Learning-by-doing, a fourth possible behavioral failure, is especially relevant to the 2030 District situation. Knowledge of energy efficiency has public good attributes – it is non-rival (non-depletable) and non-exclusive. Risk averse firms can watch others experiment with resource efficiency practices and investments, then choose those that work best. That is, some firms will "free ride" off of the investments of early adopters. The early adopters may not want to subsidize the actions of the free riders. The result is an under-investment in resource efficiency (Gillingham and Palmer 2014).

The behavioral failures described by Gillingham and Palmer (2014) fall into categories such as nonstandard preferences and nonstandard decision-making. In neoclassical economics, preferences (including time preferences) are assumed to be consistent over time. However, Tsvetanov and Segerson (2013) suggested that people may succumb to temptation in which they choose a low-cost appliance with high energy costs thus revealing time-inconsistent discount rates. Another nonstandard preference is what Tversky and Kahneman (1981) call loss aversion – the pain of losing is greater than the joy of winning an equivalent amount. Therefore the pain associated with an efficiency investment's higher capital cost may loom larger than the long-term, potentially greater savings. Behavioral failures may arise when people make decisions that deviate from the standard assumptions of neoclassical economics. For example, people have limited attention and may systematically underweight or even ignore information, including the value of future resource savings. People and firms may also use simplified rules of thumb (heuristics) to make decisions that may systematically underweight or ignore certain information (Gillingham and Palmer 2014).

These market and behavioral failures focus on the firm's private benefits and costs. In addition, the presence of external costs, such as pollution, will cause the observed investments to deviate further from the socially optimal amount. The next section formalizes the decision-making process including the market and behavioral failures.

A decision model

Allcott and Greenstone (2012) modeled an agent's (profit-maximizing firm or utility-maximizing consumer) choice whether to invest in an energy-efficient durable good, compared to an inefficient one. The two models are denoted 0 (baseline, inefficient) and 1 (efficient) and have energy intensities e_0 and e_1. The model also includes the capital cost (c) for the energy efficient good and the private cost of energy (p). The agent is assumed to have a preference (m_i) for using the durable good that depends on the biophysical and socio-economic conditions as well as individual tastes. The authors gave the example of using an air conditioner on a hot day. The model also includes a variable ξ describing the unobserved opportunity cost (may be positive or negative) and Υ describing how much weight the agent gives to energy efficiency, including informational inefficiencies. The model assumes that the capital cost occurs in the present and the energy savings occur in the future. Therefore energy savings are discounted at rate r.

According to the choice model, the agent will choose the energy efficient good when the weighted and discounted benefits in energy savings exceed the capital cost (Equation 1):

$$\frac{\Upsilon p m_i(e_0 - e_1)}{(1+r)} - \xi > c.$$

Equation 1: Choice model with information inefficiency (Allcott and Greenstone 2012).

Like Gillingham and Palmer (2014), Allcott and Greenstone (2012) noted several types of inefficiencies that may lead to an underinvestment in energy-saving goods. These include a lack of information about energy efficiency savings; presence of transaction costs that impede the transfer of information from the agent to the actual user (principal-agent problem); or a lack of access to appropriately-priced credit.

When $\Upsilon < 1$, the inefficiencies reduce the present value of the energy savings. If Υ is sufficiently small, the inefficiencies will overwhelm the savings and the agent will not choose the energy-saving good. This results in an energy efficiency gap.

The presence of unpriced externalities, such as pollution, further widen the energy efficiency gap. External social costs can be included in the model as φ. Therefore the full, social cost of electricity is $p + \varphi$. The agent will invest in the socially optimal amount of energy efficiency if the capital cost is less than the stream of weighted and discounted benefits, including externalities (Equation 2):

$$\frac{(p+\varphi) m_i(e_0 - e_1)}{(1+r)} - \xi > c.$$

Equation 2: Choice model with external cost (Allcott and Greenstone 2012).

When confronted with both investment inefficiencies and external costs, Allcott and Greenstone recommend a policy that combines a Pigovian energy tax with an incentive to increase the quantity demanded of the energy efficient good.

Ostrom (2005) noted that many experiments have challenged the assumptions of rational choice theory, namely that "valuation of all players is always focused entirely on extrinsic, immediate, net benefits to an individual" (p. 110). Embedding this choice model in the IAD framework can help identify other factors, such as social relationships, that may influence the choice to invest in efficiency.

2030 Districts and collective action

A local 2030 District is a platform for collective action on climate change at the firm and city scales while the 2030 District Network expands the scale to include cities across North America. Thus is represents a polycentric approach to climate action. The success of 2030 Districts depends on how effectively actors share information about energy efficiency and can encourage "free riders" to comply. The 2030 District itself has attributes of a public good in that the benefits, including GHG reductions and knowledge spillovers, have low extractability and low exclusivity (Ostrom 2005). Some firms may join the 2030 District to learn about what efficiency actions have worked without experimenting for themselves. This creates a disincentive to invest in risky but innovative practices.

Ostrom's research, however, has shown that polycentric systems, under certain conditions, can enhance innovation, learning, adaptation, trustworthiness, and cooperation among participants (Ostrom 2010). Ostrom (Ostrom 2000; Bergstrom 2010) found that sustainable resource management regimes are founded on locally-based norms of trust and reciprocity. She identified eight design principles that foster sustainable management of common-pool resources, all of which can be applied to the 2030 Districts.

1. Boundaries are clearly defined. In our case, this refers to both the geographic boundary of each 2030 District as well as which organizations are committed participants and which are not.

2. Locally tailored rules define resource access and consumption. The Architecture 2030 Challenge goals are broad but each 2030 District can determine how to define participation and commitment to the goals.

3. Bottom-up, polycentric governance enables participants, especially those most affected, to collectively change the rules of use. Each 2030 District establishes its own rules regarding reporting and compliance and does so in a highly participatory way.

4. Compliance is monitored and enforced by the group members themselves. 2030 District participants report their building energy, water consumption, and transportation emissions to the District. It is unclear however, how Districts encourage or enforce compliance.

5. The group enforces compliance through graduated sanctions based on the severity of the offense. It is unclear how 2030 Districts might sanction participants for failing to meet their commitments. It may be difficult to distinguish those who are making good-faith efforts from those who are simply free-riding.

6. Conflicts can be resolved rapidly through low-cost, local mechanisms. 2030 Districts will need to establish means for airing and resolving conflicts.

7. The local and/or national government acknowledges that the group has a right to organize. Most, if not all, 2030 Districts include the city government as a participant which suggests the cities recognize the right to organize.

8. In larger systems, governance activities occur in a hierarchy of nested enterprises (polycentricity). In this case, 2030 Districts are embedded within a city and linked to one another through the 2030 Districts Network.

Methods

Ostrom described the Institutional Analysis and Development framework in several documents (Ostrom 2005; Polski and Ostrom 2017). The IAD framework is a "multi-tier conceptual map" (Ostrom 2011) or "a systematic method for organizing policy analysis activities that is compatible with a wide variety of more specialized analytic techniques used in the physical and social sciences" (Polski and Ostrom 2017). The framework is a systems diagram that describes general relationships among the various elements. Analysts can apply different theories and develop models to test hypotheses about the relationships within the framework (Ostrom 2011).

The IAD framework consists of 1) a set of external variables (biophysical conditions, community attributes, and the set of rules that define the allowable actions); 2) an action situation in which actors use information to assess costs and benefits to obtain potential outcomes; and 3) interactions between the action situation, outcomes, and evaluative criteria. The outcomes can in turn affect the external variables and action situation. The action situation can be considered a dependent variable upon which a set of independent (external) variables act (Figure 2, Figure 3).

We used the IAD Framework to build a conceptual model of a 2030 District and used it to analyze the 2030 Districts in Grand Rapids, Michigan. We collected data to populate the framework through desktop research, document reviews, and interviewing Grand Rapids' 2030 District program manager Gillian Giem and US Green Building Council (USGBC) executive director Cheri Holman. The USGBC is the Grand Rapids district's sponsoring organization.

We obtained city-wide commercial-sector energy data from the US Department of Energy's State and Local Data portal (https://www.eere.energy.gov/sled/). Toronto, the only Canadian 2030 District, was not included in this database and was omitted from the analysis.

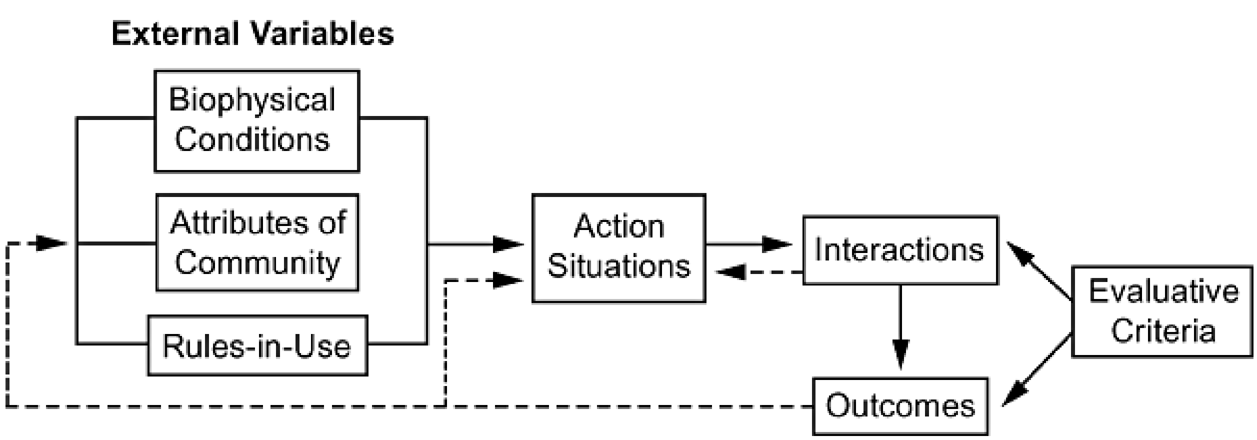

Figure 2: The Institutional Analysis and Development framework (from Ostrom 2005, p. 15).

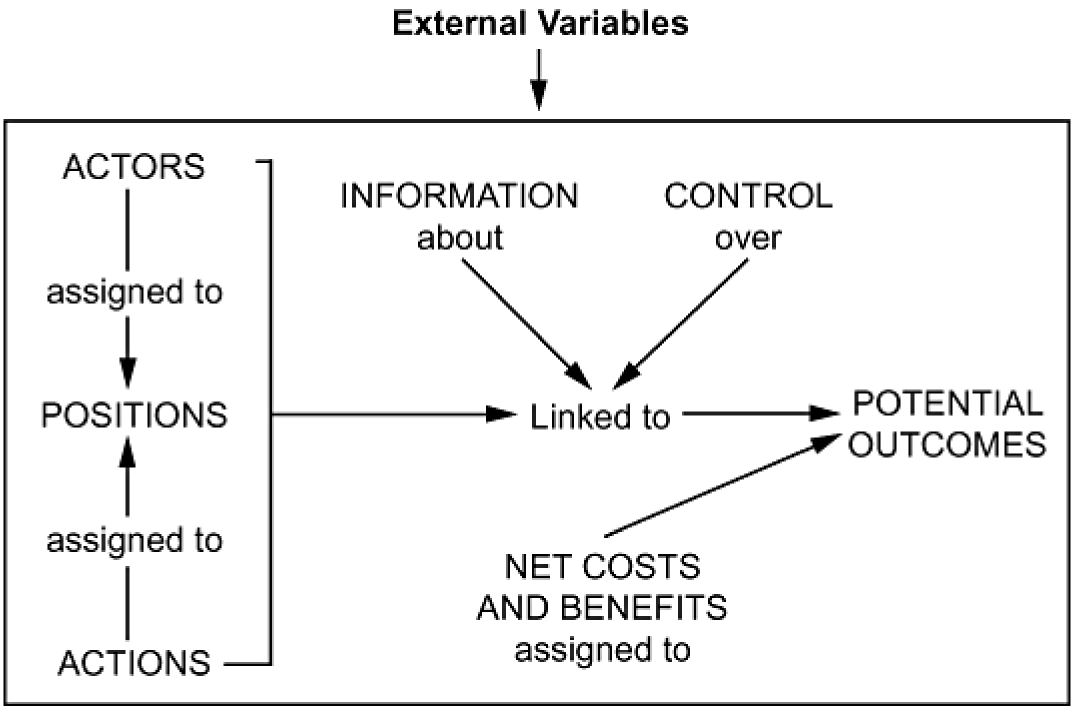

Figure 3: The structure of the IAD framework's action situation (from Ostrom 2005, p. 33).

Results

Biophysical conditions

The IAD framework provides a systematic scaffold to describe the structure of the 2030 District program (Figure 4).

The 2030 District cities range in average annual temperature from 47.0° F (Ithaca) to 72.2° F (Tucson) (Figure 1). The building energy needs for warm-weather cities, like those in the Southwest, will be dominated by electricity for cooling whereas those in the Northeast require both electricity for summer cooling and natural gas for winter heating.

Each 2030 District draws a district boundary within its downtown corridor. The Grand Rapids 2030 District recently modified its boundary to include the whole city which is unusual.

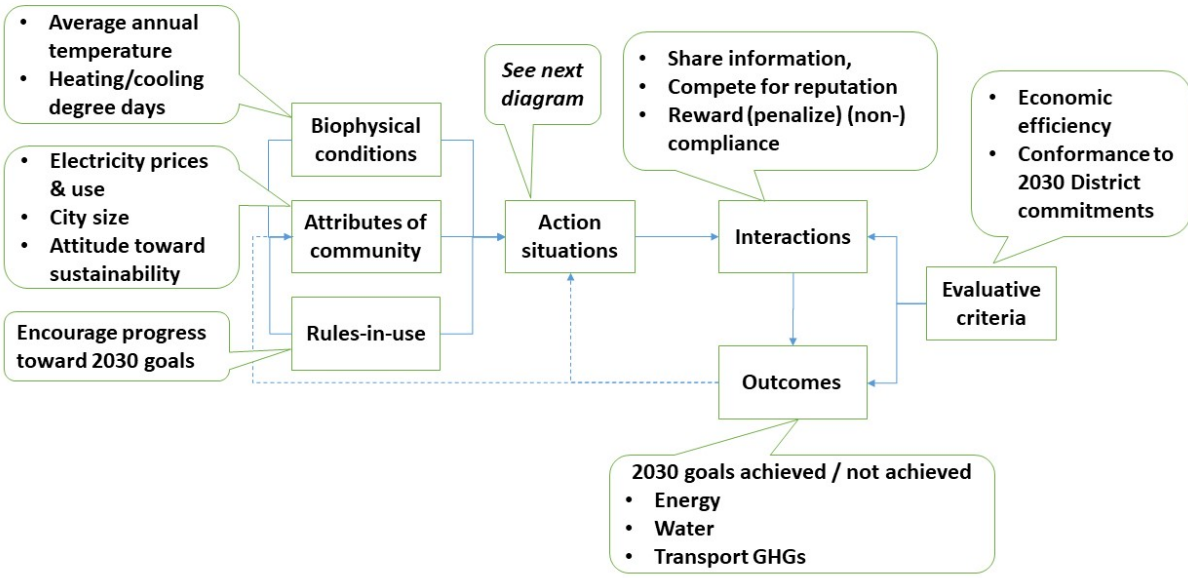

Figure 4: IAD framework (Ostrom, 2005) annotated for the 2030 Districts.

Community attributes

Cities of all sizes have established 2030 Districts, from Ithaca, NY (pop. 31,000) to Los Angeles (pop. 3.9 million). The cities also range widely in their commercial sector electricity use (Figure 5). The 2030 District cities do not show a clear pattern of electricity use compared to the population and climate cohort averages. Some cities, like Los Angeles, use much more electricity than their peers while others, like Tucson, use much less. Eleven of the 21 2030 District cities (excluding Toronto) used more electricity than their population/climate cohort average. The mean use/cohort average ratio was 1.24. Grand Rapids' commercial sector uses slightly less electricity than its peers. The data suggest that 2030 District cities are not, by and large, ahead of the curve on energy efficiency. The cities' commercial energy use overall is similar to that of their peers.

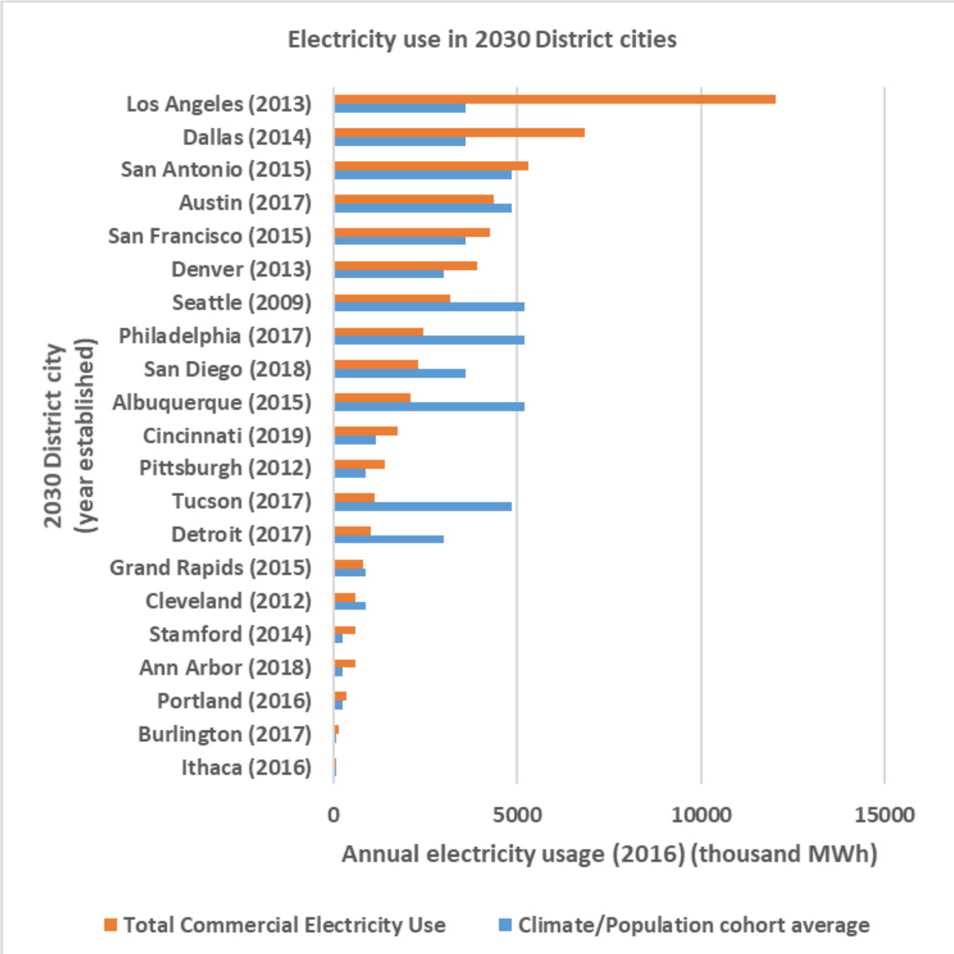

Figure 5: Commercial sector electricity use in 2030 District cities (data source: US Department of Energy 2019).

Cities may also vary in their commitment to sustainability, especially within the business community. Grand Rapids stands out as a leader in sustainability for both the corporate sector and city government. The city's business sector has been led by the office furniture manufacturers such as Herman Miller, Steelcase, and Haworth all of whom have long advocated for sustainable business practices (Nordman et al. 2017). More than 200 businesses are members of the West Michigan Sustainable Business Forum (www.wmsbf.org). Under the leadership of Mayor George Heartwell, the city government produced both sustainability and resilience plans. Mayor Heartwell spearheaded the effort to establish a 2030 District in Grand Rapids in 2015. The sustainability efforts have continued under Mayor Rosalynn Bliss. A deep and widespread commitment from the city government and the business sector is likely to be an important factor in the success of a 2030 District.

Rules-in-use

The 2030 District program established a universal set of goals based 2030 Challenge for Planning (see section *Institutional organization of 2030 Districts*). The 2030 Challenge for Planning described the energy goal as a reduction in building fossil fuel energy consumption. However, the 2030 District web page (http://www.2030districts.org/) described the energy goal as a reduction in building energy use. The 2030 Challenge for Planning is framed as an energy transition, whereas the 2030 District is framed as energy efficiency. This discrepancy seems to be unintentional and the 2030 District Network leaders are working to clarify it (V. Martinez, Architecture 2030, personal communication). We assume that the 2030 Challenge for Planning language is the official goal.

These targets, using Ostrom's language, can be considered "rules-in-form." The "rules-in-use," however, may be different for each District. Each individual District has autonomy in deciding what the incremental targets are and how to encourage compliance. Grand Rapids does not have specific rules to ensure that participants meet their targets. Instead, they focus on education and information sharing. They encourage participants to share their success stories – which often involve saving money. This is consistent with Allcott and Greenstone's (2012) choice model with informational inefficiencies (Equation 1).

The Grand Rapids district leaders (Holman and Giem, personal communication) expressed concerns that the initial focus on the 2030 commitments scared people away. They now emphasize that it's a district-level goal in which some will make reductions greater than 50% and will pull the others along. They also emphasize the benefits of joining, such as access to information, resources, and skilled professionals that can help them reduce their energy and water bills.

Action situation

The action situation is the building owner's decision whether to invest in an energy efficiency technology or practice. That decision is influenced by many actors within the District who share information about resource prices, capital costs, and the cost of pollution externalities with decision-makers within the firms (Figure 6).

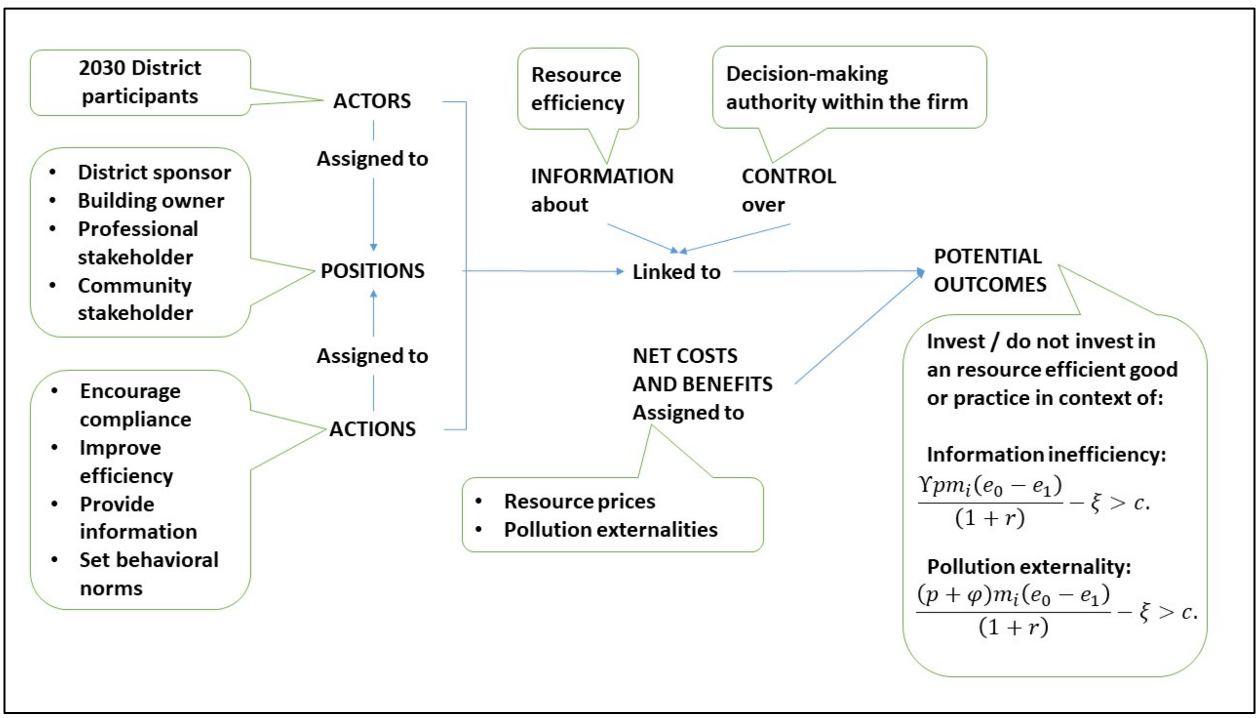

Figure 6: IAD framework action situation (Ostrom, 2005) annotated for the 2030 Districts.

Actors, positions, and actions

The actors in this case are the 2030 District participants which fall into one of four positions: the District's sponsoring organization; the building owners, managers, and developers; professional stakeholders; and community stakeholders. Only the building owners, managers, and developers are charged with meeting the 2030 Challenge for Planning targets. The others provide support by facilitating the flow of information, encouraging compliance, and setting behavioral norms (District sponsors); providing audits and other services (professional stakeholders); and providing institutional and policy support (community stakeholders).

For Grand Rapids, having a strong local champion to help establish the 2030 District was critical. And for Grand Rapids, that champion was Mayor George Heartwell. According to USGBC West Michigan executive director Cheri Holman, Mayor Heartwell was leaving office due to term limits and wanted the 2030 District to be part of his legacy. The Grand Rapids 2030 District grew from a proposal to an official district in about five months (August – December 2015) – a relatively quick evolution. The city has continued to be a strong supporter of the 2030 District under Mayor Rosalynn Bliss. This suggests that having a vocal champion (not necessarily the sponsoring organization) may be an important factor in the success of a 2030 District.

Information and control

The 2030 District's main benefit is access to information. Considerable information about energy efficiency is publicly available from, for example, government agencies at the state and federal levels and NGOs. However, this information is dispersed and not necessarily easily accessible to non-experts. Private consultants may be too expensive for some participating building owners. The 2030 District lists the following benefits that can be accessed by participating property owners:

- "Assessment of current building performance relative to 2030 District goals
- Anonymous benchmarking against local peer buildings
- Guidance for moving toward 2030 District goals
- Training and ongoing support through educational workshops on tools and best practices
- Innovative software platforms to track and analyze performance
- In-kind member professional services and contributions, including project scoping and feasibility
- Influence on District-related policy, including incentives" (2030 Districts Network 2019).

In this context, information and professional expertise is a club good. That is, it is not depletable (non-rival) but it is exclusive. One must join the 2030 District to get access to these resources.

Cheri Holman, executive director of the USGBC West Michigan described the 2030 District as a way for participants "to all talk to each other." She described situations in which the city may be making one commitment and the energy utility another. "The 2030 District helps us communicate," she said, so they can work on solutions together.

Decision-making control can also influence progress toward the 2030 District targets. Allcott and Greenstone (2012) describe how principal-agent problems can exacerbate the energy efficiency gap. Renters may pay the monthly electricity bills but lack control over capital investments in appliances or infrastructure. Landlords may be responsible for these capital investments but may not be able to command higher rents from a more efficient building. The 2030 District program is open to building owners, property managers, and developers who have direct control over investments in resource efficiency. It is not aimed at renters of commercial units, although the landlord could join. A local example is the Amway Grand Plaza hotel which is a member of the Grand Rapids 2030 District. The hotel has made significant investments in efficiency. However, hotel guests don't directly pay for electricity and water use which presents a principal-agent problem. Hotels often use informational cards and other behavioral "nudges" to encourage guests to reuse towels or bedsheets. Studies have shown that such messaging can be effective if it is carefully framed (Shang et al. 2010; Lee and Oh 2014). Such "social marketing" practices could be used in other similar situations within the 2030 Districts.

Many cities, including those with 2030 Districts, have legal authority to set building codes that can include energy efficiency. Michigan, however, sets a statewide building code and prevents local governmental units from setting their own legal standards. As a city, Grand Rapids has no control over building codes for energy efficiency and therefore cannot legally enforce the 2030 District goals. It must rely on voluntary adoption and compliance.

Net costs and benefits

The literature on the energy efficiency gap suggests that the net present value cost of many efficiency options is less than the net present value benefit – that is, a firm will save money in the long run (McKinsey & Co. 2009). As Allcott and Greenstone (2012) noted, firms may not invest in the optimal amount of energy (or water) efficiency because of a lack of knowledge or lack of access to credit.

The 2030 Districts, in theory, should reduce the transaction costs of searching for efficient goods and practices. Participating property owners gain access to low-cost audits from qualified professional service members. Property owners also gain information about low-cost loans for efficiency projects through state and federal programs.

Property owners know their energy and water costs because they pay the bills. However, they often do not know what other owners of similar buildings are paying. 2030 District participants enter their energy use information and building type into tools like Energy Star Portfolio Manager (US Environmental Protection Agency 2019). The tool enables the property owner to compare their energy costs against an industry average for that building type. Grand Rapids district leader Cheri Holman noted this can be a powerful tool for identifying problems that the business owner did not even know they had. Currently, the Grand Rapids 2030 District does not publicly report the energy use of individual participants.

Potential outcomes

We embedded Alcott and Greenstone's (2012) individual decision models (Equation 1 and Equation 2) within the action situation (see previous section *A decision model* for equation details).

$$\frac{\Upsilon p m_i (e_0 - e_1)}{(1 + r)} - \xi > c.$$

Equation 3: Choice model with information inefficiency (Allcott and Greenstone 2012).

$$\frac{(p + \varphi) m_i (e_0 - e_1)}{(1 + r)} - \xi > c.$$

Equation 4: Choice model with external cost (Allcott and Greenstone 2012).

In this application, p is the private cost of electricity (or other fuels and water) in the particular 2030 District, m_i is the usage preference which varies by the District's biophysical conditions, Υ is the weighting variable that includes informational inefficiencies, and φ is the external cost of pollution, specifically greenhouse gases. The other variables are the same as in the standard model.

The lead actors (building owners) use their own information and that of the 2030 District itself and the professional stakeholders to evaluate the upfront costs and discounted stream of benefits to determine which efficiency investments (outcomes) are worthwhile.

As one of the 2030 District leaders in Grand Rapids, Holman's (personal communication) impression was that the decision to invest in energy efficiency is still largely driven by private, not social, costs and benefits. She said, "I highly doubt any CEO or CFO for that matter is sitting in a room going, because we're in the 2030 District, we better do this project. 'I know it's going to cost us but...' That's probably not happening." This suggests that District members are probably not voluntarily internalizing the social costs of pollution in their decision-making.

Interactions

Ostrom (2011) wrote "Instead of making completely independent or autonomous decisions, individuals may be embedded in communities where initial norms of fairness and conservation may change the structure of the situation dramatically. Within these situations, participants may adopt a broader range of strategies. Further, they may change their strategies over time as they learn about the results of past actions (Boyd and Richerson 1985)."

The Allcott and Greenstone (2012) model is framed as a one-time decision made by the agent (building owner). By expanding the analysis to include the community, the IAD framework allows us to consider how the other actors within the 2030 District can influence a building owner's decision about efficiency investments. The rules-in-use may influence the decision-making as well. This may happen through formal rules, such as the defined 2030 District goals, or informal norms and expectations of incremental progress. 2030 District building owners report progress on energy efficiency projects (outcomes) which in turn inform, in the short term, the decisions of other in the action situation and, in the long run, the attributes of the community and the rules-in-use.

Grand Rapids 2030 District Program Manager Gillian Giem noted the importance of these community interactions. "We are finding that conversations are happening that would not have happened otherwise," she said. Giem relayed an anecdote she heard from the Pittsburgh 2030 District about accountability for making progress toward the shared goals. She said that the Pittsburgh 2030 District leader would contact each participating building owner every quarter to check in on their progress. "You don't want to disappoint someone you trust," Giem said. "In some quarters you [the building owner] don't have anything to report but they were like, 'You just wait until next quarter.'" That sense of community, shared purpose, and even a little bit of healthy competition may influence the decision to adopt a more efficient product.

Evaluative criteria

Criteria can be used to evaluate a set of outcomes. Ostrom (2011) lists several commonly used evaluative criteria: economic efficiency, equity through fiscal equivalence, redistributional equity, accountability, conformance to values of local actors, and sustainability. The 2030 District participants are likely to consider the economic efficiency of their investments. As voluntary adopters of the 2030 Challenge for Planning, they are also likely to consider the 2030 targets as well, which align with "conformance to values of local actors." Sustainability is also likely to be an evaluative criterion at the firm and District scales.

The Grand Rapids experience supports this. At a recent conference, the Grand Rapids 2030 District featured three small businesses who used the District's small business toolkit. All three had saved considerable money by improving energy efficiency in a cost-effective way. The USGBC's Cheri Holman emphasized that economics is part of the sustainability "triple bottom line" (along with social and environmental dimensions). Companies that are constantly aiming to make their operations more resource efficient are likely to be more sustainable.

One challenge that Grand Rapids and other Districts face is developing methods for measuring and evaluating progress toward the 2030 Challenge for Planning goals. The Pittsburgh 2030 District has been a leader in this area and has established a protocol that others are adopting and modifying. The Pittsburgh District starts with the Commercial Building Energy Consumption Survey to determine the national median building energy consumption values for a range of building types. The unit of measurement, including both heat and electricity, is energy unit intensity (EUI) (kBTU/ft^2/year). The water and transportation metrics have local, not national, baselines (Sharrard et al. 2014). Grand Rapids has made progress in establishing its baseline for energy but is still working out the details for the water and transportation measurements.

Outcomes

The IAD framework can be used to both predict and evaluate outcomes. The main outcome of the 2030 District program is meeting the 2030 Challenge for Planning goals. The IAD framework helps identify the factors that may influence this outcome. Analysts can build models to test hypotheses about the likelihood of success given different biophysical, community, and institutional conditions.

The 2030 Districts are encouraged to issue periodic progress reports. Pittsburgh again is a leader in documenting the incremental outcomes in its annual progress reports (available at http://www.2030districts.org/pittsburgh/annual-progress-reports). By 2017, Pittsburgh had achieved a 12.0% energy reduction, 14.5% water reduction, and saved $26.7 million. Burlington, Cleveland, Ithaca, Philadelphia, San Francisco, and Stamford have also released at least one progress report. The Grand Rapids District, like many others, has not yet released a progress report.

Discussion

The 2030 Challenge for Planning goals for building energy use are unlikely to be achieved simply by fixing the energy efficiency gap. Even the most optimistic assessments (like McKinsey & Co. 2009) do not find a 50% energy efficiency gap. However the efficiency gap can be the "low-hanging fruit" that can be picked to satisfy the interim targets. The remainder of the 2030 Challenge for Planning targets will need to be addressed by internalizing the external costs of greenhouse gas pollution from building energy use. This will likely require additional costs to the participating firms. A key question for future research is whether firms acting collectively can pressure one another to take on these additional costs.

As noted at the beginning of this working paper (page 1), Ostrom (2010) proposed five research questions regarding collective action and climate change. The preliminary analysis of the 2030 Districts, particularly the experience of Grand Rapids, offers some suggestions:

First, the 2030 District program offers the opportunity (if not the outcome) to voluntarily reduce greenhouse gases from building energy use and transportation in the commercial sector. If it is successful, it will represent a departure from the conventional theory of collective action that such challenges can only be solved from top-down government intervention.

Second, the analysis suggests that reducing greenhouse gases can be achieved by improving energy efficiency. Although the magnitude of the energy efficiency gap is unclear, the 2030 Districts can provide information about cost-effective energy and water efficiency projects of which participants were otherwise unaware. Without a price on carbon emissions, simply reducing the energy efficiency gap is unlikely to achieve the 50% reducing in fossil fuels from building energy use by 2030.

Third, the 2030 District uses a polycentric approach with decision-making happening at independent commercial business with interactions with city government, and stakeholders (both professional and community). Just as firms are linked within a 2030 District, the Districts are linked within the 2030 District Network. This may facilitate information sharing and organizational learning. Private-public partnerships at the city level, like the 2030 District program, may take on greater significance as the US federal government chooses not to implement a coherent energy-climate policy.

Fourth, 22 cities across North America have adopted 2030 Districts. Most Districts have not yet reported progress toward their 2030 Challenge targets and some are still developing metrics to define the baseline (inadequate certification). Although this indicates that some action is being taken, it is presently unclear if these actions can have a meaningful effect on global climate change. Because the program is voluntary, 2030 Districts are unlikely to shift activities to locations outside the district boundaries (leakage).

Fifth, the 2030 Districts decentralized approach enables rules and practices to be tailored to local conditions. As seen with building codes in Grand Rapids, some localities are limited by state policy. Incentives for free riding exist within each 2030 District, but the extent to which it happens is largely unknown.

In future research, we will use a mix of qualitative interviews with key informants and quantitative surveys of 2030 District participants to explore some of these questions in greater detail.

Conclusions

The transition to a sustainable urban energy system is a complex challenge. The IAD framework enables researchers to view the individual firm's decision-making process in the context of the biophysical setting, community attributes, and the rules-in-use.

This descriptive analysis showed that the IAD framework is a useful tool for describing the setting and relationships within a 2030 District. It proved useful for generating hypotheses to be testing in future research studies. This will help inform not only the 2030 District program, but also other polycentric approaches to common-pool resources and public goods.

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