Solar Development in Municipalities: Impacts of Transparency on Implementation

by

Logan Torres

Abstract: Local solar development continues to be prevalent for municipalities to reach modern standard energy goals. With this in mind, municipalities, governments, and producers of solar energy must reflect on the effect that community engagement has on solar development. Many research studies have explored certain characteristics of a community on solar development including socioeconomic backgrounds, political affiliations, and mayoral structures. Research has not yet, however, delved into the impact of transparency of knowledge from municipal sources to its constituents in the implementation of solar development. Results of a two case study comparative analysis show a correlation between municipalities that create better access to simple solar information through the Internet and the development of solar projects. These results suggest that transparency is a key line of research that should be explored to understand the success of municipal solar development projects. Further studies might suggest how municipalities can help residents understand the benefits of transitioning to renewable energy sources. This includes meeting environmental justice targets to involve, educate, and inform individuals about key issues of solar development in their communities.

Introduction

In the United States (U.S.), solar companies installed 11.2 gigawatts- Alternative Current (AC) [13.4 gigawatts-Direct Current (DC)] of photovoltaic cells in the first three quarters of 2022 (Feldman et al., 2023). For context, one gigawatt of energy can produce "enough electricity to support 750,000 homes with air conditioning running full time, [and] can reduce enough carbon dioxide emissions, which…is equal to burning eighteen billion pounds of coal" (Stein, 2023). Many solar development decisions are happening in municipalities, with many consumers now having direct involvement in solar development; a January 2022 Pew Research Center survey found that eight percent of U.S. homeowners have already installed solar panels, and an additional 39% have given serious thought to it in the past year (Nadeem, 2023).

Whether it is commercial solar development via community solar projects or individual solar panel installation, the average American is exposed to solar development in some capacity. Municipalities determine the laws and regulations around solar development that impact the decisions individuals can make. Research has also found the profound impact on green policy that municipalities can manifest (Lee and Koski, 2012). Municipal public sector transparency improves the understanding of public policy, increases policy effectiveness, and reduces political uncertainty (Tejedo-Romero and Araújo, 2018). Thus, an important question to ask is, how does transparency impact decision making on solar development in municipalities? In this research paper, I explore whether transparency, or more directly the public

publishing of *accessible* online information, incentivizes solar development. While many researchers have explored the implications of other factors of climate policy implementation on local levels, there is no direct research about municipal transparency relating to the solar development process.

What Does Solar Development Look Like in Municipalities?

Municipal solar development usually takes two forms: small-scale generation and large-scale generation. Small-scale generation operates under a distributed power model, where energy production and energy consumption are local; common examples include wind turbines and rooftop solar (Duke, 2020). The energy produced at these local sites may be consumed. When there is a lack of local energy production, individuals can still access power on the central grid, and when there is excess energy production, individuals provide energy to the central grid (Duke, 2020). There are many local and state policies that target local solar development, including net metering, Feed-In Tariffs (FITs), and Power Purchase Agreements (PPAs). Net metering regulates eligible compensation for individuals contributing to the main grid (Duke, 2020). Feed-In Tariffs provide guaranteed above-market prices for producers that commonly involve long-term contracts with companies to produce specific quantities of renewable energy (Duke, 2020). Power Purchase Agreements are financial arrangements between third-party developers that own and operate renewable energy sources and host customers (or groups of customers) that agree to use said electricity, guaranteeing profit for a predetermined amount of time. Some solutions are harder to implement on a municipal level (e.g., FITs); yet, due to national and state-level interventions/programs, municipalities still have the power to involve themselves by providing extra subsidies to draw solar development to their communities (Hempling et al., 2010). For example, the U.S. Department of Energy highly encourages the implementation of PPAs in cities (Fekete et al., 2023).

Concurrently, two options for large-scale generation include Community Choice Aggregation (CCA) and utility-scale projects. Utility-scale solar projects include utilities building solar farms to ingrain energy production into the grid; there are state regulations regarding how certain utilities manage assets within the energy production sector, so it is often a less popular option (Duke, 2020). For example, Rhode Island general laws, "§ 39-1-27.7.1" force utilities that have over 100,000 customers to relieve their holdings in energy production and decouple from energy distribution. An alternative option to utility- scale solar is CCA. The main difference between utility and CCA is that utility-scale projects run through utilities which can be state or local and not necessarily run through a municipality, whereas community aggregation allows a municipality to commit to energy deals on behalf of its citizens (EPA, 2022). Both are great ways to develop alternative energy options for individual homeowners and municipalities. The focus of this paper is on CCAs in order to explore municipal power in decision making for solar development.

Some policies that encourage both scales of solar development include Renewable Energy Credits (RECs), local permit process streamlining, and creation of ordinances for solar workforce development via K-12 education requirements. Renewable Energy Credits are "when one megawatt-hour (MWh) of electricity is generated and delivered to the electricity grid from a renewable energy resource" (EPA, n.d.).

Different REC systems can occur, but the general idea is that RECs can be used for monetary incentives to increase renewable energy production. Local permitting is also a large contributor to the slow development of solar sites due to stringent checks that increase bureaucratic involvement (EPA, n.d.). Ordinance creation for workforce development and education for training solar developers is critical in creating municipal ties to solar development (EPA, n.d.). All of these forms of solar development will inform how solar development is tracked within municipalities and are important to understand before exploring municipality transparency's effect on development.

Possible Influences in Municipal Solar Development Implementation

When discussing the impact of transparency in influencing municipal implementation of policies, it is important to further explore alternative influences. Although no studies were found describing research on solar development within municipalities, there are studies that explore "Green Building" or Leadership in Energy and Environmental Design (LEED) initiatives. Both Green Building and LEED involve in how buildings are constructed in municipalities. LEED and other "Green Building" initiatives entail infrastructure policy choices involving significant investment, making them a good proxy for solar development. Potential factors affecting the implementation of municipal policy are generally focused around individual consumer impacts on solar development: education level of citizens, access and desire to consume information regarding solar technology, race and socioeconomic status, and local government structures. Additionally, researchers have also explored the implications of mayoral agendas on local government climate policy. However, researchers have shown the critical importance of transparency in general municipal implementation (i.e., financial and political decisions), unlike many of its aforementioned counterparts (Brás, G. R., and Dowley, 2021).

Exploring the possible influences of individual education on solar development in municipalities is essential. For certain programs, such as net metering, individuals might be educationally trained to push for transformational policies regarding projects like home solar development. In a study exploring solar adoption in Wisconsin, Schelly (2014) found that the most common traits of residents who adopted solar development were those with technical backgrounds or interest in solar technology. Schelly's study demonstrated that a lack of scientific knowledge about climate change and the importance of solar technology can deter individuals from buying solar panels. Individuals did report that accessible information regarding solar panels is useful in understanding the adoption of solar technology, especially with the inundation of information via the Internet. Schelly (2014) also reported that the primary beneficiaries of solar development projects are those with technological literacy. Another key factor for household decisions about adoption of rooftop solar was love of and access to the environment. Educational access and personal interest also demonstrated a role in the adoption of solar in Wisconsin. The study did not include municipal transparency.

The connection between municipal energy policy implementation and race and socioeconomic status (SES) has been explored very little. In a study examining LEED-focused municipalities, Cidell and Cope (2013) found that demographic factors like race and SES did not explain the outcome. Rather, policy making is a better marker of success in improving the sustainability of buildings within a city. However, Cidell and Cope did not confirm that policy making consistently led to definitive action within implementation structures. A large amount of literature on environmental justice found that inequities in

environmental policy implementation may be linked to race, ethnicity, and SES (Konisky, 2009; Switzer, 2017). However, because Konsky and Switzer reported no direct links between race and SES and municipal level energy decisions, race and SES could be contributing factors to differences in implementation among municipalities.

Another area of interest in municipal implementation structures is the difference between "right-wing" versus "left-wing" government decisions. In an analysis of the 50 U.S. states, Tolbert et al. (2008) described "right-wing" governments as committed to reducing public spending and significantly more likely to adopt e-government projects, thereby transitioning information access online, which indicates reduced costs and greater municipal efficiency. While explicating the determinants of "right-wing" governments in general policy making, solar development is not something that has been shown to be partisan locally. Over 73% of Americans identifying as Republican approve of increasing solar development (Kennedy and Spencer, 2021). Conversely, in a study conducted in Europe and Portugal, Brás and Dowley (2021) found that more highly populated areas and areas governed by "left-wing" parties demonstrated higher levels of financial efficiency via municipal implementation using online platforms. Some connection between party alignment and implementation exists, but there is no clarification on what type of political relationships affect solar development in local spaces.

Understanding the implications of governmental actors is also important in exploring the impact of transparency, specifically regarding the role of a mayor within a municipality. In studies regarding "Green Building" policy implementation, hierarchical models indicate that mayoral leadership in climate change policy fosters "Green Building" policy implementation (Bassett and Shandas, 2010; Pitt, 2010). This research showed the impact of mayoral decisions but does not show any other factor as being important within policy implementation. Furthermore, their studies regarded energy efficient buildings and not solar development directly.

Some factors have been shown to be possible determinants of solar development implementation, yet transparency within municipal functions is regarded as a critical portion of municipal policy implementation. First, the gap between policy creation and implementation is defined as an area of concern in research. A focus on implementation is key in exploring the connection between transparency and solar development (Lewis, 2013). Second, in considering processes like utility-scale solar siting, integration of social consideration is often overlooked, leading to negative impacts for residents post-implementation (Sward et al., 2021). Third, processes such as transparency could potentially help improve social considerations and implementation strategies through the dissemination of accessible information. Finally, forms of transparency, such as community boards, have been proven to increase positive policy implementation in municipalities (Pitt, 2010; Switzer, 2017). For all of these reasons, transparency reveals itself as the most critical lens to explore municipalities.

Method of Analysis: Transparency and Solar Development

Transparency in municipal settings is most often tied to the accessibility of online information (Brás and Dowley 2021). I focused on five general criteria in summarizing a city's relationship with transparency: 1) whether there was a website holding information about solar development (YES/NO), 2) if so, how many clicks it took to receive relevant information, 3) presence of executive summaries or streamlined reports (YES/NO), 4) if yes, the number, and 5) whether there was a board of citizens involved in deciding energy projects and other initiatives (YES/NO). When comparing transparency with municipal implementation for solar development, I focused on critical implementation strategies in the aforementioned sections, which culminated in six criteria: 1) CCA implementation (YES/NO), 2) PPA implementation (YES/NO), 3) FIT implementation (YES/NO), 4) Net Metering Implementation (YES/NO), 5) number of ordinances passed that include policies regarding solar development (including education and workforce training), and 6) REC program implementation (YES/NO). For those not indicated as YES or NO questions, the information was compiled via a numerical response. Each section also has further descriptions, which help illuminate more of the story behind transparency and solar development implementation in each municipality.

In order to account for possible demographic factors, mayoral status, and time constraints, I selected two cities to be analyzed: Dayton, Ohio, and Athens-Clarke County, Georgia. Table 1 shows the demographic and mayoral characteristics of each town. Although not exact in proportions, each city is comparable in the amount of educational attainment, median household income, racial composition, municipal government style, and elected official party affiliation.

Table 1: Demographics (Athens-Clarke County vs. Dayton)

Demographics	Athens-Clarke County, Georgia	Dayton, Ohio
Total Population	137,571	127,358
"White Alone" Population	54.7%	50.7%
"Black or African American" Population	27.8%	38.5%
Household w/h Computer	94.5%	87.5%
High School Degree Attained	89.7%	85%
Median Household Income	$43,466	$37,536
Mayoral System	Mayor and Commissioner (Elected)	Mayor and 4 Commissioners (Elected)
Party Affiliation of Current Mayor	Kelly Girtz, Democratic Affiliation	Jeff Mims, Democratic Affiliation

Some challenges to note include the number of samples. It is important to recognize that although many confounding factors in each city were accounted for via preliminary research, a sample size of two cities only implies inter-city-specific results. No statistical significance tests were performed to determine the statistical significance of the demographic data with municipal solar development implementation. The research project aims to start the conversation regarding municipal transparency with the hope of expanding this project to include more factors and cities.

Data Collection and Analysis: Does Transparency Matter?

The analysis of four available information pages that are accessible through government and externally related pages when searching "Solar Development in [INSERT CITY]" yields many interesting findings. First, a comparison of the accessibility and transparency of each city shows a moderate amount of information released. It is apparent that the total presence and amount of executive statements and comparable material make Athens-Clarke County, Georgia, more accessible to the general consumer. When exploring data collected on municipal implementation, there is a trend in Athens-Clarke County, Georgia, to have more implementation strategies, especially those that empower residents to install solar panels (Table 2).

Second, it is important to recognize that CCA is implemented in Dayton, Ohio, with Gem City Solar, which is a compact of cities in Montgomery County, Ohio (Table 2). This is very common within CCA movements but requires the involvement ~~o~~f all cities and parties and, therefore, it is not an independent implementation of solar development. Community Choice Aggregations target large-scale production for energy rather than small-scale energy production, but both are still categorized as municipal interventions in solar development.

Third,while a significant amount of information and research is still needed to further explore this hypothesis, when comparing Dayton and Athens-Clarke County, there is a possible positive association between transparency and municipal implementation (Table 2, Table 3).

Table 2: Transparency Metrics vs. Municipal Implementation					
Transparency Metrics	**Athens-Clarke County, Georgia**	**Dayton, Ohio**	*Municipal Implementation*	**Athens-Clarke County, Georgia**	**Dayton Ohio**
Information Pages For SD*	**4 Information Pages** (All on One Centralized Database) Renewable Energy Overview (Solar Array) Solar Permitting Process Renewable Energy Project Sustainability Office	**3 Information Pages** (All One Centralized Database) Sustainability Office Building Permitting Process Environmental Advisory Board **External Source** Gem City Solar	**CCA Implementation**	**NO**	**YES**
# Of Clicks to Receive Information **(Not Including First Google Search)**	Renewable Energy Overview: **1-2 Clicks** Solar Permitting Process: **2 Clicks** Renewable Energy Project: **2 Clicks** Sustainability Office: **2-4 Clicks**	Sustainability Office: **2-3 Clicks** Building Permitting Process: **2 Clicks** Environmental Advisory Board: **1 Click** Gem City Solar**: 1 Click**	**PPA Implementation**	**YES** *At minimum, two ongoing PPA projects were identified*	**NO**
Presence of ES or CM***	**YES**	**NO** *Dayton Sustainability Plan and GHG emission plan there is no mention of SD in ES.*	**Permitting Streamline**	**YES**	**NO**
# Of ES or CM **(over all four information pages)**	**2 executive summaries 2 presentation slide decks 5 videos 1 informationa l graphic 1 flowchart**	**1 executive summary 0 slide decks 0 videos 1 informational graphic 0 flowcharts**	**Net-metering Implementation**	**NO** *But there are state-wide programs that support this in the county*	**NO**
Presence of Board w/h Citizens	**NO** *But, there is a Sustainability Office that handles and disseminates pertinent solar development information.*	**NO** *But there is a board of officials without involvement from the local citizens*	**# Of Ordinances Regarding SD**	**2 Ordinances**	**2 Ordinances**
			REC Implementation	**NO** *But the city does advertise federal energy tax credits*	**NO** *But the state of Ohio has RPS+ standards to meet*

* SD = Solar Development ; **ES = Executive Summary ; ***CM = Comparable Material ; RPS+ = Renewable Portfolio Standard, which is a policy style that can include RECs

Table 3: Supplemental Notes

Supplemental Notes For Athens-Clarke County, Georgia

- Video for the solar array description was insightful and easy to understand.
- Flowchart was digestible for non-experts trying to install solar panels.
- Videos were available but less intuitive; need background on municipal energy systems to comprehend.
- Information Page provided the most information of all websites but was very difficult to navigate.

Supplemental Notes For Dayton, Ohio

- The Sustainability Office does not have a specific page for solar development or solar permitting, even though they are involving themselves in projects like Gem City Solar and CCA initiatives. Furthermore, the website has a severe lack of general information.
- The environmental advisory board does not have its own page within the municipal website.
- Gem City Solar is a county movement to install solar that will be directed to surrounding communities and other actors. How it is being implemented in Dayton and the involvement of the municipality is unknown and not described within any accessible documents to the public, but is easily assumed to be a part of CCA.

Sources regarding data collection can be found in "Data Collection Citations" Section.

Transparency Creating Easier Pathways to Solar Development

Transparency can be an impactful area to explore, and cities can easily improve with the invention of modern technology and access to the Internet. Pew Research determined that over 97% of Americans possess a cellular device, meaning even low-income and historically marginalized individuals have the potential to access solar development knowledge in one Google search (Sidoti, 2024). From making solar permitting flow charts to advertising Community Choice Aggregation effectively on municipal pages, there is great potential for true transparency improvement within cities. Implications for other types of development within cities that likely follow the same model are vast, and can potentially assist in meeting certain educational criteria for environmental justice if utilized correctly. Generally, access to easy information can help average citizens understand city and state regulations to make critical shifts to renewable energy, further allowing residents to advocate for progress for their own renewable energy. Many average Americans could be enfranchised to develop solar or push for the development of solar if they had access to simple information that municipalities strived to disseminate.

I recommend that further research compile data for more municipalities that have similar demographics and use statistical analysis to explore the significance of these observed associations. Qualitative interviews of residents and municipal officials can further enlighten the connection between transparency and municipal implementation by including stakeholder perspectives on access to solar development implementation and how cities manage solar deployment. Further examination of transparency in solar development using both quantitative

and qualitative methods is needed. It is important to focus on transparency through a solution-based lens. If this research is continued, an engaged scholarship, including the implementation of different transparency strategies to meet environmental justice and other criteria, should be included.

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