



Research article

Barriers and incentives for sustainable urban development: An analysis of the adoption of LEED-ND projects



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ABSTRACT

The adoption rate for Leadership in Energy and Environmental Design – Neighborhood Development (LEED-ND) projects has varied considerably across the United States. Local governments and developers face variation in the incentives and barriers while implementing LEED-ND projects across four key dimensions – economic, policy, public awareness, and organizational. This paper investigated the drivers of variation using a mixed-methods approach including a two-stage Heckman model, a survey of Texas subdivision developers and interviews with local planning officials. Results indicate that initial public funding may lead to more LEED-ND projects being completed, but with a diminishing return as these projects become established within the region. Support for local programs including tax abatement, public-private partnerships, and other incentives were also demonstrated to help facilitate LEED-ND project adoption. Overall this paper underscored the important role, especially early on, the public sector and local governments play in initiating local LEED-ND projects to inform and motivate the land development industry.

1. Introduction

As the U.S. and larger world population trends towards living in more urbanized cities and neighborhoods, reduced environmental quality, urban sprawl, and social segregation have become increasingly salient challenges for planning and design professionals (National Academies of Sciences, Engineering, & Medicine, 2016). The intersection of prioritizing environmental considerations in land-use decisions within the United States began in the late 1960s after the passage of the National Environmental Policy Act and took shape globally within the UN's Our Common Future Report in 1984 (UN, 1984). Rio de Janeiro Earth Summit's Agenda 21 in 1992 (Lafferty and Eckerberg, 2013) stimulated local sustainability actions, leading to the expansion of planning movements such as New Urbanism and Smart Growth (Smith, 2015; Wheeler, 2013; Luederitz et al., 2013) and the development of sustainability assessment tools from individual buildings to whole neighborhoods in scale (Retzlaff, 2009; Berardi, 2012).

One of the major assessment tools to emerge was the Leadership in Energy and Environmental Design (LEED) Green Building Rating System that the United States Green Building Council (USGBC) established in 2000 (Shutters and Tufts, 2016). LEED has provided a

comprehensive set of guidelines and qualifications to recognize green building projects that take additional steps of source-reduction, energy-efficiency, and sustainable design in their construction (USGBC, 2017). In 2009, LEED launched an additional program for Neighborhood Development (LEED-ND) that looked beyond the impact of individual buildings to consider the sustainability of entire communities in their development (USGBC, 2014). The LEED-ND framework asks developers to incorporate important site selection-based considerations in the planning process such as the walkability and compactness of the neighborhood, its proximity to possible transit options, as well as its development impact on surrounding wetlands, wildlife, and agricultural uses. The LEED-ND framework, when compared to other neighborhood-scale certifications, also provides stronger emphasis on the resources, environment and location of site selection. (Sharifi and Murayama, 2015).

Within the growth and sustainable development practices that LEED-ND projects aim to implement, there remains widespread variation in which areas of the country have more robustly pursued and completed such projects (see Fig. 1).

A considerable portion of the literature's examination of what has limited LEED-ND projects has analyzed its approaches from a

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projects may face, incentives across all four dimensions that local governments and developers utilize in pursuing sustainable development projects such as LEED-ND are explored below.

2.2.1. Economic incentives

Economic development is one of the largest areas of opportunity that local governments can finance and key interventions have been found to stabilize communities (Leigh and Blakely, 2016). Research highlights the important role that local economic incentives can continue to play in nudging developers towards more sustainable building practices. For example, local governments have used Tax Increment Financing Districts (TIFs) to assist developers (Eversberg and Goebel, 2005). TIFs are established by calculating the taxes generated by a given property at a select point in time and then dedicating a loan for the total amount anticipated in future property tax increases over the current level. In terms of LEED-ND utilization, both the South Waterfront District project in Portland, OR, as well as the Town of Normal Uptown Renewal Project in Normal, IL, have included TIF funding to finance successfully completed projects (De Sousa and D'Souza, 2012; Town of Normal, 2015). In addition to TIF funding, local governments can also offer incentives through deferring land-sale proceeds and issuing debt to help finance infrastructure improvements. The 700-acre gold-certified LEED-ND Mueller neighborhood project in Austin, TX revitalized a former airfield through this approach, allowing the project to weather the 2007 recession both in terms of financing and development because of the more flexible, long-term structure of its loans (Housing and Urban Development, 2015; Sadatsafavi et al., 2014). Lastly, national policies also play an important role in providing economic incentives in the form of tax deductions for green building and sustainable design. For example, until the end of 2017 the Energy Policy Act of 2005 §179D provided developers the opportunity to deduct up to \$1.80 per square foot from taxes for achieving specific energy savings reductions above certain building code performance standards (Energy Policy Act, 2005).

2.2.2. Public awareness incentives

Public awareness campaigns can provide not only education, but generate interest through recognition, awards and demonstrating greater brand awareness for developers who are associated with green building practices (Mason et al., 2011). Studies have found that framing sustainable development not only in its environmental benefits, but in its ability to enhance social capital, localize economic development, and more efficiently manage material consumption helps support more effective involvement for targeted communities (Seyfang and Longhurst, 2013). By finding opportunities to uplift the economic benefits (i.e. practical energy savings) that sustainable building practices provide, public support for such programs may become more attractive for undecided potential developers as these benefits are highlighted (Corbett and Muthulingam, 2007).

2.2.3. Organizational incentives

Local governments can also respond to the organizational constraints they may encounter by seeking out programs that help train officials to create capacity, provide training and knowledge transfer (Johnson et al., 2004). Local governments can play a critical role in bringing public and private interests into dialogue on the topic of sustainable development and convene stakeholders together (Bell et al., 2012). Programs like C40 Mayors also work with local governments to provide outside support in identifying funding sources, sustainability networks, and access to capital through grants and other agencies (Cities Climate Finance Leadership Alliance, 2015).

2.2.4. Policy incentives

Local government can serve a powerful role in highlighting the policy context and commitment to sustainability through comprehensive plans that emphasize sustainability in local sustainability and

climate action plans (Blanco et al., 2009; Bassett and Shandas, 2010). Additional incentives such as housing density bonuses, fee reduction, and expedited permitting are all policies at the discretion of local governments to provide to incentivize sustainable development (Bhatta, 2010). As new building standards have become more stringent in spite of additional costs of providing certified buildings, investors have also been found over the long-term to benefit from higher rents, lower holding costs and lower risks of sustainably certified development (Fuerst and McAllister, 2011). Statewide planning done in Oregon and Maryland also provides an example of how strong statewide land use and environmental planning goals set in the 1970s requiring regional and local governments to meet state goals through incentives such as direct grants, technical assistance and strong mandates are still influencing development today (Abbott et al., 1994). As a result, one avenue for further implementation for sustainable neighborhood development initiatives like LEED-ND is to align their criteria with these larger initiatives.

3. Materials & methods

This paper pursued three empirical pathways: a distribution and economic analysis of U.S. LEED-ND projects, a survey of Texas developers, and informational interviews of local North Texas planning officials. The national LEED-ND project distribution analysis explored the role of public funding in achieving LEED-ND certificates with LEED-ND project data at the state level. Both the survey of local Texas developers as well as the interviews with North Texas planning officials explored the practical reasons and perceived barriers from current developers in low-saturation market regions.

3.1. State-level data analysis

This paper utilized the full data set of national LEED-ND projects available from the USGBC website and with consultation from USGBC staff (USGBC, 2018). The limited history of LEED-ND projects did not bear sufficient variation of project types for a metropolitan area level analysis and as such, the data was aggregated into states as a unit of analysis. Fig. 2 depicts a choropleth map (by quantile) of the total number of LEED-ND projects that have been initiated from 2009 to 2018. As of February 2018, 286 LEED-ND projects had either been certified or were currently registered in the United States; yet LEED-ND projects have not been pursued in many areas and where they do exist, they are geographically clustered.

Fig. 2 highlights the existing variation between states such as California (61 projects), Maryland (18) and New York (17) that have initiated a sizable number of LEED-ND projects compared with others in the Midwest and upper New England that have not yet initiated projects. Fig. 2 also reveals the uneven distribution of each state's LEED-ND completion ratio – with some high-attempt states completing fewer projects than others that had initiated fewer overall (i.e. New York has a 20% LEED-ND completion rate while several states including Nebraska and Nevada feature completion rates of 100%). The variation in projects initiated and completed across the country leads to two important related questions: which barriers and incentives for LEED-ND projects influence whether LEED-ND projects are pursued as well as their completion rates?

This paper tests the hypothesis that a state (acting as a proxy for local governments within its jurisdiction) with more public funding provisions is more likely to have pursued more LEED-ND project certifications. The main independent variables include the proportion of public-funded LEED-ND projects for each state (operationalized as any LEED-ND project with the owner listed as a government entity) and the proportion of privately funded projects (see Equation (1)).

$$PUB_i = \frac{\text{No. of publicly funded projects}_i}{\text{Total number of projects}_i} \quad (1)$$

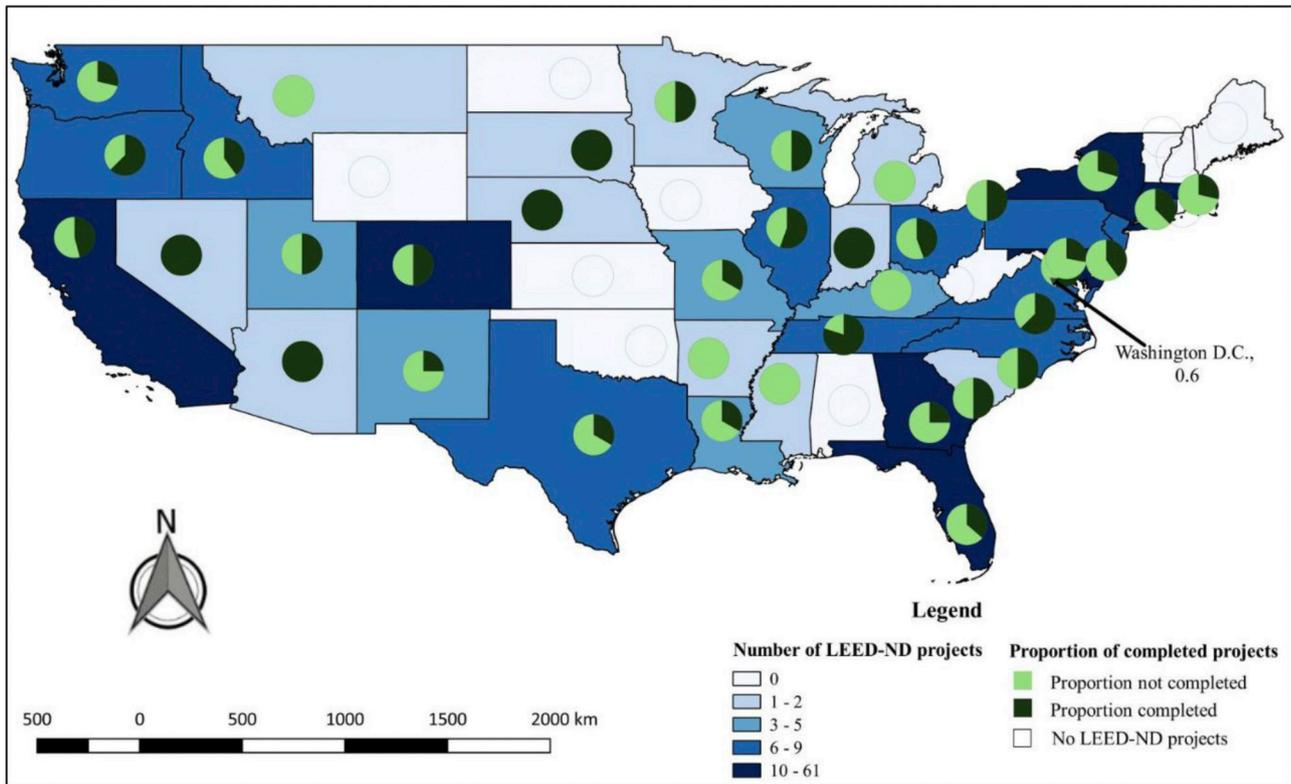


Fig. 2. Spatial Distribution of LEED-ND Projects by State (as of February 2018)¹ 1: Note – while not on the map, Alaska does not have any LEED-ND projects currently registered, and Hawaii has 5, 3 of which are certified and one of those at the platinum level.

Table 1
Descriptive analysis.

	Count	Mean	S.D.	Min	Max
Log (completed)	33	0.9437	0.7876	0	3.33
Prop. private funds	38	0.6451	0.2926	0	1
Prop. public funds	38	0.1864	0.2595	0	1
Prop. public funds squared	38	0.1004	0.2339	0	1
Economic Growth in 2011 ^a	51	3.4824	3.5047	-3.10	24.50
Avg. project size	51	55.7212	99.2288	0	607.46
Political ideology ^b	51	-1.73	11.5932	-22.00	40.00
Population 2011 (in millions)	51	6.11	6.9072	0.57	37.69
Ave. density of cities in a state (1000 people/mi ²)	51	7.594	4.43	23.49	18.10

^a Since the dependent variable in the model was aggregated from 2009 to 2017, a near approximation of the middle point of project adoption was selected as between 2011 and 2012 with the assumption that the political and economic impacts on LEED-ND were consistent during the full period.

^b More positive values indicate the state is considered more strongly supportive of the Democratic party, more negative values for the Republican party.

To control for additional influences, data about each state's economic growth, average density of highly populated areas, population and the average LEED-ND project acreage size were collected from the USGBC databased and U.S. Census Bureau and added as control variables (see Table 1). A measure of political ideology at the state level (Cook Partisan Voting Index) was also included to account for political ideology influencing state-level sustainability-oriented policy adoption (Cook Political Reports, 2018; Krause, 2011).

A Heckman selection model was used to account for the potential of a strong self-selection bias in whether a state pursues LEED-ND projects (Heckman, 1977). The following equation indicates the model specifications:

$$\ln C_i = \beta_0 + \beta_1 PRIV_i + \beta_2 PUB_i + \beta_3 PUB_i^2 + \beta_3 Avg. ProjSize_i^2 + D_i + EG_i + \epsilon_i \quad (2)$$

Selection model:

$$= \gamma_0 + \gamma_1 EG_i + \gamma_2 D_i + \gamma_3 POP_i + \gamma_4 Density_i + \omega_i \quad (3)$$

where $\ln C_i$: Log number of LEED-ND certification in the state i ,

EG_i : Economic Growth 2011–2012 in the state i ,

D_i : Cook's Partisan Voting Index for the state i (+ Democrat, - Republican),

POP_i : Population in 2011 in the state i (per 100,000),

$Density_i$: An average density of populated areas in the state i

$PRIV_i$: The proportion of privately funded LEED ND projects within the state i

PUB_i : The proportion of publicly funded LEED ND projects within the state i

$Avg. ProjSize_i$: The average size of LEED-ND project within the state i

This two-step analysis provided actual estimates for public and private funds in terms of LEED-ND certificate completions in a state. In addition, because of collinearity limitations, the percentage of non-profit funded projects in a state was excluded in the model. The log-level regression analysis was adopted because the distribution of the dependent variable (the number of LEED-ND projects) was positively skewed (see Fig. 1).

3.2. Developer survey and local planning interviews

The paper also conducted a survey across the state of Texas to assess the feedback from the critical perspective of developers. The research team worked with local developers to create a 22-question online survey (see appendix) comprised of multiple-choice and short-answer questions pertaining to developer's level of exposure to and perspectives of the current market for LEED-ND in Texas. The initial outreach list of approximately 3,000 developers statewide was populated through

working with local developers with connections to larger state networks and offices throughout Texas. The survey was administered to a smaller pilot group within the list in August 2016 and then extended to the full list in November and December 2016.

Overall, 36 participants (1.2% response rate) from throughout Texas took the survey. The developers who responded came predominantly from private industry backgrounds that featured a mix of project work (more than one selection was possible)—mixed-use (50%) and single/multi-family residential (44.4%) projects were the most represented with fewer focusing on office (33.3%), senior living (5.6%), and retail (2.2%) projects. The land-size the respondents worked with was also quite varied, with the majority developing average parcel sizes between 1 and 20 acres. The respondents mainly worked in the Austin metro region with clusters representing Dallas-Fort Worth (DFW) and the San Antonio metro area as well, consistent with the Austin region's larger concentration of sustainability projects relative to other Texas metro areas (Guy and Moore, 2004).

The paper also conducted five interviews with planners throughout the Dallas Fort-Worth metro area in July 2017 to identify barriers and incentives from the North Texas planning community's perspective. These interviews (see appendix) provided insights from key local government stakeholders in the Texas sustainable development market while grounding the research in local perceptions and practices held by city planning officials regarding the LEED-ND program.

4. Results

4.1. State-level data analysis

The result of the Heckman model estimation is shown in Table 2.

Whether a project utilized public funds, as a single term and a squared term, was found to be statistically significant at 1% and 0.5% levels respectively in Model (1). To investigate the relationship between the level of public funding and how many LEED-ND projects were certified within a state, a scatterplot was created with a fitted regression line. This plot found an inverse U-shape relationship between the ratio of public funding for LEED-ND projects within states and the number of projects that became LEED-ND certified for that state. In other words, as the ratio of public projects increased within a state, the number of LEED-ND certificates also increased until an inflection point (approximately 40% of projects receiving public support) where further increases to the ratio of public funds within the state experienced a lower marginal effect (see Fig. 3).

The model specification with the other control variables is shown in Models (1)–(3) of Table 2. Because the LEED-ND certification program is designed for mainly urban environments and density has been found to be a statistically significant factor for other city or county level sustainability analyses (Homsy and Warner, 2014) a density control variable was included to better distinguish its role in whether a state successfully completed LEED-ND projects. The average density of highly compact cities (population > 10,000) in a state was not found to be statistically significant in this analysis. In the selection stage of the two-level regression model, only population was found to be statistically significant and positively related to whether a state pursued LEED-ND projects. In the second stage, the more liberal a state's average voter ideology was (Cook Political Reports, 2018), the more likely the projects in that state were to obtain a LEED-ND certificate. Additionally, the economic growth rate was found to be statistically insignificant, highlighting that the political character of a state was more predictive of the number of successful LEED-ND completions rather than its overall economic performance over that same time period.

The statistical analysis highlights that initial public funding supporting LEED-ND projects may play a critical role in increasing the completion likelihood of LEED-ND projects. As a result, a strong case can be made that initial limited government support (i.e. tax incentives, reduced permitting times, etc.) plays a significant role in helping

Table 2
Heckman selection model.

	Model (1)	Model (2)	Model (3)
Log (LEED-ND project certification)			
Prop. public funds	2.892** (1.41)	2.951** (1.45)	2.800 (1.71)
Prop. public funds ²	-3.495** (1.52)	-3.338** (1.53)	-3.014* (1.72)
Prop. private funds	0.817 (0.55)	0.880 (0.54)	1.063** (0.45)
Avg (Proj. size)		-0.001 (0.00)	-0.002 (0.00)
Democracy			0.022** (0.01)
Economic Growth 2011			0.008 (0.06)
_cons	0.500 (0.44)	0.500 (0.41)	0.400 (0.37)
select			
Economic Growth 2011	-0.099 (0.06)	-0.093 (0.06)	-0.079 (0.07)
Democracy	0.022 (0.02)	0.026 (0.02)	0.014 (0.02)
Population 2011 in 100000	0.031* (0.02)	0.031* (0.02)	0.029* (0.02)
Avg.Density	0.047 (0.12)	0.033 (0.12)	-0.054 (0.12)
_cons	-0.680 (0.56)	-0.699 (0.56)	-0.575 (0.54)
athrho	-16.526*** (0.10)	-16.130*** (0.20)	-16.766*** (0.22)
Insigma	-0.277** (0.11)	-0.279** (0.13)	-0.376** (0.13)
Log likelihood	-47.764	-47.573	-45.406
N	51	51	51

Note: *p < 0.05, **p < 0.01 ***p < 0.001.
The robust or sandwich estimator of variance is used.

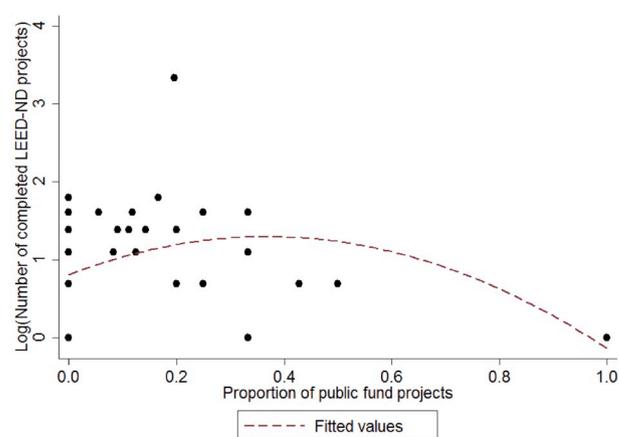


Fig. 3. Scatterplot of the number of LEED-ND projects completed and the proportion of public funding by state with fitted regression line.

stimulate private investment for LEED-ND projects especially in areas without current activity. However, Fig. 2 also indicates that the relative impact of public funding may diminish after initial levels of LEED-ND projects are completed in a state. Additionally, as other studies highlight, funding alone is not the only key driver for successful sustainable development adoption - it is also critical for local government to involve the community in making decisions on policy design and local spending priorities (Laurian and Crawford, 2016; Whittemore, 2013).

4.2. Developer survey

Highlighting the limited exposure LEED-ND projects have within the

overall developer market in Texas, only 50% of the developers surveyed ($n = 36$) had heard of LEED-ND projects before and of those only six (28.6%) had previous LEED-ND building experience (see appendix for full details).

4.2.1. Public awareness dimension

As only three LEED-ND projects have been certified in Texas (as of this publication), most developers revealed they had first learned of LEED-ND through sources outside of LEED-ND, including other USGBC projects, reading technical publications or sustainability oriented websites, or at a meeting for the Congress of New Urbanism. The survey also asked the developers if they had development experience with other sustainability certifications. Two-thirds of those that had successfully completed a LEED-ND project mentioned they had had prior experience with other sustainability certifications while roughly half of those with no LEED-ND experience still had sustainability experience. For those who had completed sustainability certification developments, projects ranged from other LEED office and commercial buildings to working with Greenbuild, Energy Star for buildings, and local programs.

When asked to choose what kind of additional information would help lead them to pursue LEED-ND development in the future, those who had already completed LEED-ND projects answered at a much higher rate across the categories. For those who were unfamiliar with LEED-ND, the additional information cited as most important included other environmental performance information (heat mitigation, storm-water management, etc.) followed by energy-saving performance, and eligible locations of most suitable LEED-ND sites.

4.2.2. Organizational dimension

While surveying the state's development community, it was important to understand what their organization's current priorities as well as any barriers for pursuing new projects were. Table 3 highlights the relative weight that competing priorities played within the decision made by developers to pursue a new project—ranging from long-term economic returns (the highest rating) to social equity concerns (the lowest rating). While social equity received the lowest prioritization, this survey found that Texas developers prioritized three other development organizational goals ahead of short-term economic gain when evaluating future projects.

4.2.3. Economic dimension

The survey also examined the biggest concerns present for developers in pursuing comprehensive certifications like LEED-ND. For those who had not already pursued LEED-ND projects, the largest concern was the developer's perceptions of higher construction costs and the concern for a noticeable return on their investment. For those who had prior LEED-ND experience, the main limitation identified for pursuing further LEED-ND projects provided was the cost of certification fees.

Practical incentives for implementing LEED-ND projects were also explored including reducing permitting fees and providing tax incentives or density bonuses. One takeaway from the survey was that 75% of developers unfamiliar with LEED-ND identified tax incentives (Talen, 2011) as one of the top ways cities could help developers pursue

Table 3
Prioritization of Texas development organizational goals.

Important Development Strategies	Average Likert Scale Rating (5 being highest; 1 being lowest)
Long-Term Economics	4.3
Improving Quality of Life	3.86
Environmentally Friendly	3.69
Short-Term Economics	3.52
Creating An Iconic Place	3.5
Social Equity	2.9

certification, compared to only 61% of developers familiar with the program.

4.2.4. Policy dimension

Developers also highlighted permitting schedule challenges and additional requirements for the certificate as impediments to their participation in LEED-ND projects. One developer cited the restrictions the LEED-ND framework places going “counter to typical development patterns, e.g. parking quantity and placement” as the largest barrier for participation – highlighting a question from developers of whether such guidelines should lead or follow current public demand (see appendix for full details). For those who had not already pursued LEED-ND projects, the largest concern along the policy dimension, was the uncertainty regarding the approval timeline and an interest in streamlining the process.

4.3. Interviews with local planners

Most of the DFW-area local planner interviewees held positive views about the LEED-ND program; however, they also emphasized that its substantial costs and the time required to pursue accreditation were significant barriers resulting in the program not being discussed within many conversations with stakeholders in their community including developers.

4.3.1. Economic dimension

Most of the planners interviewed came from cities that provided little to no current local tax incentives and few if any benefits offered to developers who pursued LEED-ND projects. However, some were creative in partnering with a school or local community to provide grants, tax abatements and fee waivers, largely through economic development. Financial constraints were often the largest barrier for pursuing LEED-ND integration. One planner described it as such: “in my experience, there are few developers willing to invest the money to go through the certification process.” Another highlighted that implementing sustainability into development projects did not have to be cost prohibitive, but in current market conditions the extra fees matter.

4.3.2. Organizational dimension

An additional restriction identified comes from the limited time and resources each planning office has to devote to the competing priorities of long-term sustainability considerations squared with more short term local economic gains for the city. In comparison to prioritizing explicit sustainability goals, most of the planners interviewed focus their local incentives towards redevelopment of retail sites as well as downtown development in order to provide support for geographic or redevelopment hardship. Both Grodach (2011) and Whittemore (2013) also found planners in Dallas-Fort Worth use economic and development frames much more often than sustainability frames. One development review manager reported: “we are just trying to survive this current round of development. As the city continues to redevelop, I think we will need to examine sustainability more closely.”

4.3.3. Policy dimension

Location factors were also identified as barriers for the DFW city planners' ability to engage with LEED-ND programs. For example, planning officials highlighted how LEED-ND program's requirements to build with smart location and linkage in mind limited the ability to site new environmentally-minded developments while juggling other competing priorities (e.g. wetlands protections, FEMA (Federal Emergency Management Agency) requirements, limited mass transit corridors, and concerns about developments proximal to tracts with health concerns such as brownfields and landfills). As one community development planner said, “talking about [LEED-ND] and influencing change are two different things. Having a project-based neighborhood program is holistic, and developers understand the importance of things like

Table 4
Summary of findings across the four dimensions – economic, policy, public awareness, and organizational.

Previous Literature	Current Study
<p>Barriers</p> <p>Economic</p> <ul style="list-style-type: none"> • Cost (both certification process and components) (Rabb, 2013) • Perception of risk and limited demand (Freybote et al., 2015) • Short-term view (Healey, 1995) • Principal Agent problems (split incentives) Regales (2017) • Access to financing (Cities Climate Finance Leadership Alliance, 2015) <p>Policy</p> <ul style="list-style-type: none"> • Additional Regulations • Limited flexibility in framework (Suzer, 2015) and site locations (Smith and Bereitschaft, 2016) <p>Public Awareness</p> <ul style="list-style-type: none"> • Limited opinion priorities (Geels, 2013) • Limited awareness concerning Neighborhood Sustainability Assessment tools such as LEED-ND (Sharifi, 2016; Rabb, 2013) • Limited participation (Bell et al., 2012) <p>Organizational</p> <ul style="list-style-type: none"> • Limited leadership prioritization and capacity (Grodach, 2011; Whittemore, 2013) • Limited coordination (Carli et al., 2018) • Opposition from industry (Saha and Paterson, 2008) • Siloed responsibility (Sekerka and Stimmel, 2011) <p>Incentives</p> <p>Economic</p> <ul style="list-style-type: none"> • Reduction of costs through taxes, or subsidies (with policy) Talen (2011), (Eversberg and Goebel, 2005) • Minimizing economic risk (Rabb, 2013) • Improving public and private funds access, grants (Blanco et al., 2009) <p>Policy</p> <ul style="list-style-type: none"> • Expediting permit process (Hawkins and Wang, 2013) • Density bonuses (Bhatta, 2010) • Integrating sustainable development elements, benchmarks or life cycle assessments within planning framework (Blanco et al., 2009; Bassett and Shandas, 2010) <p>Public Awareness</p> <ul style="list-style-type: none"> • Education & publicity (McNeal et al., 2014; Foss, 2018) • Providing recognition or awards, demonstrating greater brand awareness (for developers) (Mason et al., 2011) <p>Organizational</p> <ul style="list-style-type: none"> • Providing strong vision/prioritization of additional key areas (Sizbo, 2016) • Providing access to capital (Cites Climate Finance Leadership Alliance, 2015) • Providing training and knowledge transfer • Convening public/private stakeholders together (goals (Johnson et al., 2004), providing a framework for identifying local sustainability goals (Maclaren, 1996) 	<p>Economic</p> <ul style="list-style-type: none"> • Developers identified costs (both in construction as well as certification fees) as one of the largest barriers, along with uncertain return on investment • Planning officials identified limited budgets as a major barrier <p>Policy</p> <ul style="list-style-type: none"> • Developers identified additional certification steps as large barrier along with limiting site criteria <p>Public Awareness</p> <ul style="list-style-type: none"> • Developers identified limited exposure to LEED-ND programs • Planning officials highlighted a perceived lack of public engagement or market demand for sustainably developed neighborhoods <p>Organizational</p> <ul style="list-style-type: none"> • Developers identified long-term economic returns as more important than other goals including environmental and social equity concerns • Planning officials identified limited time for focusing sustainable development over other city priorities <p>Economic</p> <ul style="list-style-type: none"> • Developers identified reducing costs and/or providing tax incentives • Planning officials identified creative partnering with a school or local community to provide grants, tax abatements and fee waivers <p>Policy</p> <ul style="list-style-type: none"> • Local planning officials have considered ways to integrate principles into current recommendations, including supporting language in long-term visionary documents and standard ordinances related to reducing energy consumption and expediting sustainable design-oriented permitting process to clarify timeline/process <p>Public Awareness</p> <ul style="list-style-type: none"> • Developers did not identify LEED-ND certifications as providing local recognition or prestige • Developers did identify other environmental performance information (heat mitigation, storm-water management, etc.) and energy-saving performance as areas to improve public awareness around • Planning officials identified highlighting evidence of long-term financial benefit as a key incentive to drive further interest <p>Organizational</p> <ul style="list-style-type: none"> • Local planners identified the key role they can play in bringing partners together for stakeholder meeting and in identifying most suitable LEED-ND sites locally, but also identified limited time and resources as preventing this facilitation often.

pedestrian walkability and connectivity with pretty pictures. However, seeing it built [through so much red tape] is another story.”

In the end, while the current barriers identified in the interviews and survey are numerous, there was also considerable local interest expressed in working together with LEED-ND. Many planners and developers agreed that LEED-ND provided a useful framework; one commented that the program provides “a lot of opportunities, and beyond doing it for prestige, the process is there, you just have to be creative.” Another summed up the future direction of the city in explaining that as soon as more incentive programs are figured out, “we may have LEED-ND projects heading this way.”

5. Discussion

The paper's mixed-method approach provided several findings that make important contributions to the literature. Table 4 below summarizes the main takeaways of this study in terms of the barriers and incentives in comparison to prior literature.

The statistical analyses highlighted that support from the public sector is positively correlated with whether a project receives LEED-ND certification within a state. This study's clear link between local governments utilizing financial incentives and increased local adoption

levels of LEED-ND projects highlights the potential of utilizing economic development tools in creating more public-private development (Skelcher, 2005). While key factors in previous literature associated with successful sustainable development outcomes such as urban density were not found to be significant, this study finds a level of significance ($p < 0.05$) and effect size (greater than 40% initial increase) associated with projects with public funding that provides a powerful starting point.

The Texas developer survey provided an individual-level window into the decisions, perceptions, and experiences regarding LEED-ND projects as well as why many private firms remain uninterested in pursuing such projects. While barriers and incentives across all four dimensions – economic, policy, public awareness, and organizational (Table 4) - were explored, developers identified the current cost and fees of pursuing LEED-NDs project as the most common obstacle of implementation and expansion. Many of the individual responses referenced that the LEED-ND certification alone was not “financially worth it” as it currently stands due to the additional costs associated with pursuing such projects. One developer reflected that “I just don't think they are cost effective,” and while it may help with neighborhood resistance towards development there is not “a lot of bang for the buck.” Developers did not identify LEED-ND certifications as providing

local recognition or prestige, but did identify other environmental performance information (heat mitigation, storm-water management, etc.) and energy-saving performance as areas that would help drive interest with more information available locally.

Planning officials identified the need for evidence of long-term financial benefit and case studies like LEED-ND's Local Government Guide (USGBC, 2011) as a key incentive to generate further awareness and interest locally. Local planners also spoke to the key role they play in identifying the local sites most suitable for sustainable development like LEED-ND and in bringing public and private partners together for stakeholder meetings, but also highlighted the limited time and resources available for this type of facilitation.

The Texas developer survey highlighted that a minority of the respondents had familiarity with LEED-ND projects and those that had heard of the program before had done so through other community resources and networks. Public choice theory research highlights that elected officials largely respond to the most vocal and organized platforms (Boyne, 1998) from regular citizen and community groups and if neighborhood sustainability assessment tools like LEED-ND are to have success in expanding the regions they are pursued, proponents must engage the developer community and larger public in ways that influence stakeholders. In response, one of the largest opportunities for increasing participation lies in identifying local approaches to improve the level of education and training regarding the community benefits (both monetized and non-monetized) from sustainable development. Especially in areas of the country where LEED-ND projects have not yet gotten off the ground, research has highlighted the importance of not only following standard sustainability reporting design (Maclaren, 1996), but in local officials designing public processes where stakeholders can feel comfortable and respected in talking about diverse perspectives and identifying integrated solutions through seeking common ground and goals (McNeal et al., 2014; Tretter, 2013).

Recommendations for future studies include incorporating data that features additional details regarding LEED-ND project history, specific funding sources, and disaggregated project expenses as the current USGBC database online is limited and full information wasn't always available for each project's background. Including such granularity along with a narrower local unit of analysis can shed additional light on distinguishing the relative impact that different types of economic incentives (subsidies, tax deductions, transfer payments, etc.) provide. More advanced time series models to control for temporal variance should also be considered along with surveying additional populations of local planning officials and developers.

6. Conclusion

To enhance the ongoing progress being made by U.S. cities to address significant issues associated with sustainability, land-use, and urban sprawl, it is essential that research continue to examine the economic dimension of local barriers and incentives for programs like LEED-ND. As the current study's results suggest, local governments not only play an informed organizational role in their support for programs that expand public awareness behind the benefits that come from sustainable development, but can also influence local decision-making economically. The paper's analysis highlights that initial public funding can play a significant role in helping stimulate private investment for LEED-ND projects, especially in areas without current activity. As programs like LEED-ND become more established, local governments have the opportunity to influence the land development industry and local planners to adopt more sustainable design when planning new neighborhoods through incorporating key principles within their zoning and permitting policies as well. By creating best-fitting incentives for local communities across all four dimensions explored in the paper – economic, policy, public awareness, and organizational – stakeholders have the potential to find avenues to advance the broader

triple-bottom line sustainable development goals provided within programs like the LEED-ND framework.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jenvman.2019.04.020>.

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