United States Department of Energy

Better Buildings Case Competition

Welcome Home to Savings: Distributed Generation in Multifamily Housing

Team: Xenergy

EXECUTIVE SUMMARY

To achieve President Obama's goal of installing 100 megawatts (MW) of renewable energy capacity on federally subsidized housing by 2020 while meeting its own utility cost-reduction goals, the U.S. Department of Housing and Urban Development (HUD) needs to develop a comprehensive action plan across its entire assisted housing program that will simultaneously work to improve the status quo for HUD housing. Renewable energy investment and efficiency improvements are especially difficult to implement across HUD's privately owned assisted housing portfolio due to the heterogeneity of the portfolio, incentive gaps, and capital stack issues.

THE SHED SOLUTION: DISTRICT-SCALE RENEWABLE GENERATION

A system that recognizes the financial difficulties and incentive barriers of new renewable energy generation projects and reframes the problem to eliminate these issues from the scope of the project stands the greatest chance of success. By taking a district-based, in lieu of a building-by-building approach to renewable generation, HUD can incentivize community building in clustered, urban areas with high levels of privately owned assisted housing through a new program which would align the incentives of all stakeholders, decrease energy price volatility, and increase infrastructure resiliency. The Specialized HUD Energy District (SHED) solution will address the President's goal for 100 MW of renewable energy generation and provide increased resiliency and reliability of emergency systems; designated communities can be encouraged to act sustainably through their purchase of renewable energy through CCA programs established through the local public housing authority. This solution will satisfy the distributed and renewable energy generation capacity goals established by the President, remove the landlord-tenant incentive gap, and open the door to better building efficiency for privately owned, assisted housing facilities throughout HUD's diverse portfolio.

BARRIERS TO PROGRESS: CAPITAL STACK, FINANCING, AND TRANSACTION COSTS

A vast number of parties have a stake in the current operations of privately-owned multi-family buildings containing HUD units, making infrastructure upgrades (including on-site solar installations) difficult and requiring extensive negotiations between owners, creditors, and investors. This capital stack issue limits HUD's ability to provide communities with sustainable, affordable, quality housing for those in need. Unfortunately, many of these homes are located in depressed urban communities in need of revitalization, making infrastructure improvements exceedingly difficult in the highest priority locations.

In order for HUD to succeed, the issue must be approached from a "district" or "community" perspective instead of a building-by-building approach. A District-based approach will lower transaction costs, improve the efficiency of renewable systems, and provide new sources of revenue for communities. Historically, the financial incentives for affordable housing have caused a clustering of these units and buildings, especially in urban areas. Identifying highly clustered areas as the core of a new district will better support the implementation of Community Choice Aggregations (CCAs) that will use photovoltaic (PV) systems as their primary form of electricity generation to reduce costs and improve infrastructure resiliency.

INTRODUCTION

Residential utility price trends have been increasing and are projected to continue increasing over the next few years ("Short-Term Energy Outlook," 2014). Distributed renewable energy systems have the potential to stabilize electricity costs and aid affordable housing communities by providing more resilient infrastructure systems; however, these projects rarely occur due to a lack of funding and misaligned incentives.

When the Department of Housing and Urban Development (HUD) launched projects such as the HOPE VI initiative aimed at demolishing distressed public housing, households that resided in these units were provided Housing Choice Vouchers that enabled them to afford to live in privately-owned housing in low-poverty neighborhoods ("Housing Choice Voucher Program Guidebook," 2001). Low-Income Housing Tax Credits (LIHTCs) were developed to incentivize building owners to increase the adoption of assisted housing units, provided they were located within certain areas outlined by HUD. As an unintended consequence of designating areas to ease the distribution of incentives, most public and privately-owned HUD units are clustered within these areas.

In an effort to increase the availability of low-income housing, HUD designates these areas within which property owners with HUD housing units can benefit most from its incentive programs. Difficult Development Areas (DDAs) and Qualified Census Tracts (QCTs) are outlined and revised annually, with LIHTCs being one of the major drivers in establishing the growth patterns for new affordable housing units. While QCTs are areas in which at least 50 percent of the households have incomes lower than 60 percent of the Average Median Gross Income, DDAs are often designated in areas with high utility, construction and land prices ("HUD Designates LIHTC QTCs for 2013," 2013).

Given past distributed renewable energy hurdles and the clustering of affordable housing in neighborhoods created from previous programs, a scaled solution on a neighborhood or district scale stands to provide the greatest benefit to these communities. This report focuses on a solution best suited for HUD's diverse portfolio located in these clustered communities. Key program details, a spatial distribution analysis of HUD housing for selecting priority sites, and an outline of nationwide renewable energy and utility regulation are clearly illustrated in the three sections below.

PART 1: SPECIALIZED HUD ENERGY DISTRICTS (SHED) & THE COMMUNITY CHOICE AGGREGATION (CCA)

Given the difficulties that HUD has encountered in trying to create mixed-income neighborhoods, a new approach is needed that uses these existing patterns to present incentives for growth and identify ways to create economically vibrant rather than isolated and depressed neighborhoods. Nationally, cities are creating livable, vibrant, mixed use neighborhoods with their own character. Like the City of Villages concept in San Diego, encouraging the creation of neighborhood identities also serves as a step forward in the battle against poverty toward development ("Pilot Village Program," 2014).

The new larger scale approach being taken by many cities provides distinct advantages over programs that target individual buildings. With a district being used to identify buildings and participants, there is more room within the program to address social issues that would be ignored on a building-by-building project basis. Additionally, the push to include renewables becomes more pragmatic at a district scale and will contribute to neighborhood infrastructure resiliency where renewable systems on individual buildings would struggle to reach a threshold that can provide power to critical life, health, and safety systems.

Municipal aggregation, also known as Community Choice Aggregation (**CCAs**), allows communities interested in clean, distributed energy generation to combine their demand to contract, finance, and source renewables at a competitive price point when compared to traditional utilities ("Community Choice Aggregation," 2014). California, Illinois, Massachusetts, New Jersey, Ohio, and Rhode Island have all adopted CCAs into state law and seen proven examples of successful distributed energy projects in the past which in many cases offer a competitive, long term, low price point.

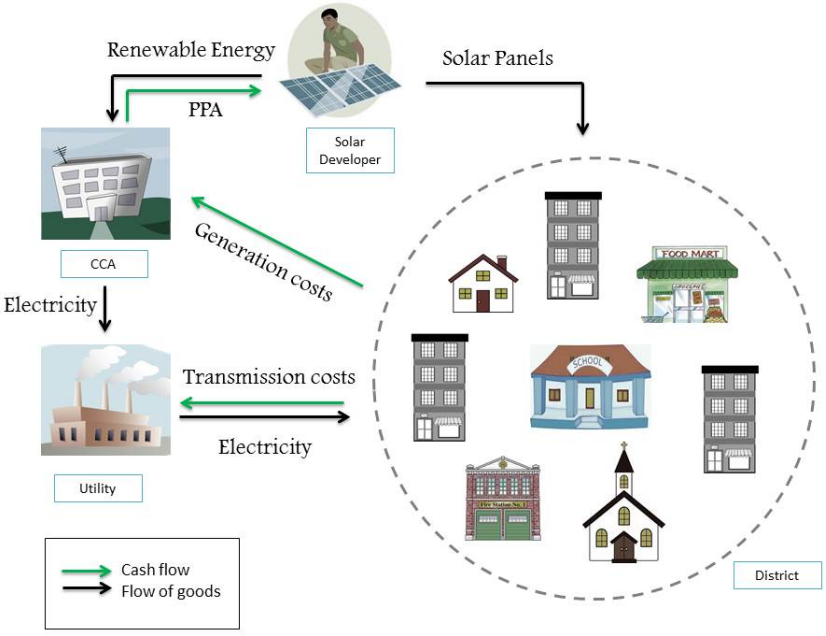


Figure 1: The Ideal SHED. Solar panels are installed on public buildings in the district, and energy generated is provided to the CCA through a Power Purchase Agreement (PPA). Electricity is then transmitted to customers in the district via the utility grid, who pay the utility for transmission and the CCA for generation of the electricity.

The SHED (Specialized HUD Energy District) solution proposes this district approach in the form of a CCA (Community Choice Aggregator) directed by HUD and implemented by the local Public Housing Authority (PHA). The CCA will be the avenue through which HUD and the local PHA can build neighborhoods and a sense of community, cleaning up the otherwise depressed and economically stagnant urban centers. SHED's approach opens the door for renewable

installations and increased resiliency in somewhat marginalized neighborhoods while also providing a new source of revenue for the local governments through renting space on the rooftops of public buildings.

EXISTING AND NECESSARY REGULATORY SUPPORT

The district approach is feasible in some states but not others. Massachusetts and California, for instance, have passed legislation that specifically supports the creation of CCAs. Other states have passed laws that support virtual net metering programs between multiple properties to enable community scale renewable generation programs ("Virtual Net Energy Metering," 2013). Analyzing the policy framework in each state, HUD can follow a clear triage system based on greatest potential benefit.

States with abundant access to cheap fossil fuels like coal for electricity generation are less likely to see the benefits of a renewable CCA. Renewables at the SHED/CCA scale are not yet able to out price markets with the lowest rates in the U.S. Somewhat counterintuitively, the most attractive markets may be those with what is traditionally considered to be a limited solar resource, such as Massachusetts.

Net metering policies require a utility to buy excess electricity from distributed generation sources, like PV arrays. ***Virtual net metering*** allows the renewable energy generated on one meter to be traded to a customer on a separate meter. Policies vary by state, with some programs limited to a single multi-tenant building, as is done in California, open across multiple buildings as seen in Colorado ("Virtual Net Metering and the Future of Community Solar," 2014).

California	Colorado	Arizona	Connecticut	Kentucky
New Jersey	Delaware	Texas	Hawaii	Louisiana
Massachusetts	Vermont	New Mexico	Wisconsin	West Virginia
Ohio	Minnesota	New York	Missouri	Idaho
Illinois	New Hampshire	Pennsylvania	Maine	Virginia
Rhode Island	Washington	Maryland	Iowa	South Carolina
		North Carolina	Kansas	Mississippi
		Oregon	Montana	Nebraska
		Michigan	Florida	Wyoming
		Nevada	Indiana	Alabama
			Tennessee	Alaska
			Utah	South Dakota
			Georgia	Oklahoma
			Arkansas	North Dakota

Figure 2: A triage system for HUD's use when establishing priority sites.

- Green: CCA laws already in place.
- Light Green: Support for community-scale renewables, through virtual net metering.
- Yellow: States have a light focus on renewables and may have established a Renewable Portfolio Standard (RPS) or net metering legislation.
- Orange: Renewable energy policies are in place, but do not specifically address solar potential.
- Red: Little to no legislation supporting renewable generation capacity, often have easy and cheap access to fossil fuels such as coal.

HUD'S ROLE

HUD would not create the CCA itself. Instead, HUD will provide a forum and place for communication between landowners within a pre-determined "district" to investigate if there is potential for a CCA in their area. Local Public Housing Authorities (PHAs) will act as the catalyst by applying knowledge of local regulation and utilizing relationships with local governments and organizations to initiate the process to create the CCA and the SHED. The CCA will function as the core of the new SHED created by HUD and the local PHA. Community buildings like schools, police and fire stations, and libraries will be used to hold the solar installations for the SHED and the CCA will serve as the operating utility for the neighborhood. In this way, the CCA becomes the manager of renewable energy supplies that are designed to power emergency systems in public community buildings and serve as a safe haven for

catastrophic events.

BUSINESS STRUCTURE

The CCA will work with solar developers to pool private investment for the installation of 1-2 MW in solar photovoltaic generation capacity across publicly owned community buildings in the SHED. These investors will be guaranteed a particular return on their investment from the solar installation (through a power purchase agreement, or PPA, set between the developer and the CCA); once that return is achieved, the controlling ownership interest in the installation will shift back to the CCA through a partnership tax flip structure. At this point, the CCA can buy out the remaining investors and maintain control and ownership over the solar array at minimal cost to the organization or the customers that it serves.

The CCA has the ability to negotiate electricity rates that can ultimately result in lower costs. The City of Chicago, for example, offers rates which save customers about 21% ("City of Chicago," 2014) and various past examples and feasibility studies show this potential rate decrease ("Community Choice Aggregation – The Viability of AB 117," 2005). Even though CCAs are federally tax-exempt organizations, the relationship between the CCA, developer, and investors allows for the inclusion of some federal tax credits as benefits to the project as opposed to the case of a CCA installing a solar array independently.

DISTRIBUTION OF RENEWABLE GENERATION

SHED's CCA core allows many of the capital stack and split incentive issues, typically seen blocking building-by-building solutions, to be bypassed. The formation of a SHED district allows the solar installations to be allocated to a specific set of buildings that hold federally subsidized housing units, supporting President Obama's goal to have these solar arrays located "at" federally subsidized housing buildings ("President's Climate Action Plan," 2013). The physical on-site installation of a solar array however, would understandably cause issues with lenders and other stakeholders involved with the individual buildings. By installing the solar panels off-site but still within the SHED and CCA territory, the buildings, building owners, and tenants can all still benefit without having a significant effect on the property tax regime or restrictions on building improvements. Furthermore, by siting PV installations on larger, community buildings, installations will be cheaper per kWh, allowing for the efficient installation of PV.

PART 2: SPATIAL ANALYSIS OF HUD HOUSING

The diversity of privately owned HUD facilities makes the creation of a uniform solution difficult and impractical. The relevant facilities range in age by decades and sport varying generations of central systems. Instead, a spatial analysis that identifies those properties most in need can go a long way toward maximizing the impact of HUD's efforts. A cursory evaluation of privately owned HUD properties shows high concentrations of these facilities in urban centers, with many built before 1990. Of the building portfolio managed by HUD, those structures in urban cores built (or last renovated) before 1990 represent the low-hanging fruit with the most to gain from renewable installations and resiliency improvements.

Though these areas were developed to provide for mixed-income communities, results from spatial analyses indicate higher patterns of clustering in affordable housing units than other units,

specifically within high-density metropolitan areas. A 2011 study prepared by the Affordable Housing Cadre confirmed that with the exception of Dallas and Houston, most assisted housing units in metropolitan areas were distributed within short distances of each other, usually within DDAs and QCTs **("Exploring the Spatial Distribution of LIHTC Properties," 2011).** Data from the HUD user database was then used to conduct a spatial analysis on New York and Boston, two of the metropolitan areas with high concentrations of HUD housing to identify target areas within urban centers that had not undergone significant renovation since 1990. Conducting a spatial analysis of HUD properties allows efforts to begin in areas of highest concentration, and therefore greatest opportunity.

The Choice Neighborhoods Program (CNP) is a HUD initiative that was built on the foundation of the HOPE VI initiative, to rehabilitate distressed federally assisted housing and create mixed-income, high-opportunity communities. ("Choice Neighborhoods," 2014) Local leaders, residents and other stakeholders apply for a grant that allows them to plan and implement neighborhood transformation. Currently, HUD has awarded grants to 8 applicants including Boston, Seattle and Chicago through a rigorous screening process. The CNP sets a strong foundation to further HUD's mission of creating high opportunity neighborhoods by decreasing levels of clustering in metropolitan areas.

PART 3: SHED ANALYSIS

The SHED model stands on significant advantages compared to many of its peer programs and provides solutions to each of the four core issues identified by HUD in the case.

1. ***Recommendations for priority sites*:** SHED provides HUD with guidelines for identifying neighborhoods within states that have the legal framework in place to support CCAs. Within those states, neighborhoods will be identified in major cities based on spatial "urban center" classifications already determined by HUD through the Low Income Housing Tax Credit program.

2. ***A Replicable Process for Executing Individual Projects*:** By working with channels already established by the local PHAs, SHED is able to make a replicable process out of scenarios that are nearly guaranteed to present unique challenges in each location. HUD is in a position where it can walk through the same steps in the process with each local PHA, but variations in the process are absorbed by the local PHA as the expert on, and liaison to, the local government. The local PHAs act as a buffer for HUD, allowing HUD to repeat a simple series of steps to establish each SHED and letting the PHA work closely with partners already established in the community.

3. ***Identify actions HUD can undertake to accelerate the installation of renewable capacity***: As the CCA is established within the SHED, the CCA will work with solar developers to install new and expand existing renewable infrastructure on publically owned buildings. The basic purpose of the CCA is to provide renewable energy at a level that will guarantee the operation of emergency systems in the event of a natural disaster or another catastrophic event. A base capacity of approximately 2MW per CCA will go a long way toward supporting emergency systems and contribute to President Obama's 100MW goal by 2020 as the program expands.

4. ***Ways to engage and motivate key stakeholders*:** Stakeholder engagement is a large part of any project and the CCA model will guarantee that dialogue and interest is successfully maintained. The solar developer that works with the CCA will establish private sector interest in the community and promote an investment-worthy outlook for the neighborhood. The local PHA will also engage government and community groups to implement the program and establish the SHED, bringing in local partners throughout the process to either personally or financially invest and commit to the project. Building owners and tenants will be engaged through lower utility prices, increased employment opportunities, and a revitalized neighborhood with increased community interactions.

HUD can apply SHED to a variety of settings. The CCA-supportive states are the most promising locations; however, many other states exist with tradable net metering policies and tax incentive programs that make 1-2MW district scale solar installations attractive investments. As a visionary, HUD is in the unique position of being able to design the program as it sees fit, passing that design on to local PHAs for implementation. Minimal resources need to be committed at the federal level, yet a majority of the benefits and savings seen from these projects are passed through to HUD as reductions in utility bill allowances and housing voucher subsidies. SHED is compatible with all types of federally supported housing programs and the Low Income Housing Tax Credit program, including Section 8 and the Housing Choice Voucher Program. Compatibility and adaptability makes SHED an easily replicable program across the country as an easy to execute avenue for savings and renewable energy.

Additional benefits can be generated through the SHED structure by setting up a Managed Energy Services Agreement **(*Appendix A*).** The CCA will function as the principal managing agent in the MESA, essentially functioning as the utility from the point of view of the building owner and tenants. Utility bills will be distributed from the CCA to the owner and tenants, contrary to the original CCA model where the utility company maintains control of the billing process. In turn, the CCA passes the utility payment on from the building owner and tenants to the utility.

MESA agreements allow the building to install efficiency improvements without any concern over the incentive gap. Similar to the method in which the CCA uses private investment to cover the initial cost of the solar installations, private capital can cover the up-front cost of the efficiency improvements made to the individual buildings. The CCA maintains ownership of the system throughout the term of the contract, avoiding capital stack issues for the owner, and can sell the system at the end of the contract (with accelerated depreciation) or remove the components altogether.

Before the efficiency improvements are installed in the building, the CCA baselines the facility and determines the current monthly utility use. The billings generated by the CCA throughout the term of the MESA will reflect utility expense norms determined through the initial audit, avoiding any increase in spend for the building owner or tenants. Since this baseline is determined by the CCA, the building will already have seen reductions in energy spend from the lower priced energy offered by the CCA when the building's participation began. Over the term of the MESA, the CCA is generating revenue from efficiency improvements that save beyond

those initial price savings from participating. The performance pressure rests with the CCA and the owner does not face any risk with lenders over additions that would affect the value of the property.

Revenue generated through MESAs can then be pushed back into the community. Since the CCA is a not-for-profit, the funds raised can go toward other infrastructure projects in the SHED or toward revitalization efforts that can boost economic activity. Part of the savings may go toward a revolving fund that can continue to front capital for additional renewable and efficiency improvements throughout the SHED. Other chunks may help improve green spaces in urban centers, buy new materials for schools, or help establish local businesses and community groups. In the long run, the CCA can prove to be a strong force for the proliferation of renewable energy generation technologies, energy efficiency technologies, and for investment in marginalized and otherwise economically depressed neighborhoods in urban cores.

CCAs also enable the buildings in any given SHED to enroll and participate in a demand response program. The cash flow from the utility in exchange for meeting demand response requirements can enhance the payback of projects for investors and provide additional incentives for the community to establish the CCA. Demand response aggregators often provide additional controls for building systems that allow for increased precision in operation and can serve as an easy toggle switch for peak reduction programs ("Demand Response," 2014). With a large number of buildings opting into the CCA, the CCA itself can become the customer for the demand response aggregator, providing a centralized recipient of financial incentives and a single contact or point of control with which the aggregator and utility can maintain contact. More information on demand response programs can be found in (***Appendix B***).

The reductions during a demand response event typically come with a significant financial reward, the bulk of which can go toward community improvement efforts and create a revolving fund for efficiency improvements and other renewable installations beyond the base load capacity of the CCA.

CONCLUSION

It is clear that the traditional agency and capital stack issues are major obstacles to building improvements and renewable installations on a building-by-building scale, but a solution proposed on the neighborhood, community, or district level overcomes those barriers. Pooling resources from, and cooperating with, local governments and organizations to create an economically vibrant neighborhood engages a different set of stakeholders that are all on the same side of an issue. Instead of balancing investment and interests from parties that receive uneven benefits, investors in a solar developer that is contracted by a CCA to install renewable generation that will benefit an entire community in a top-down approach, initiated by HUD, that provides a net benefit to all involved without encountering split incentives.

HUD should begin with a pilot SHED/CCA project that, once proven successful, can serve as a platform for CCA legislation advocacy. A well-implemented solution with proven results can set HUD up to be a major supporter of legislation that stands to improve all of its facilities across the country. Through the SHED program HUD can continue its mission to provide affordable, quality, sustainable housing for those in need.

APPENDICES

A) Managed Energy Services Agreement (MESA)

In a typical MESA financing model, project developers coordinate with an Energy Services Company (ESCO) to install energy savings equipment in a building while also arranging for the necessary capital through a contract that typically spans 5-10 years ("Innovations and Opportunities in Energy Efficiency Finance," 2012). The developer owns, operates and maintains the equipment for the period of the contract, allowing the MESA itself to be accounted for as an operating expense, off the building owner's balance sheet. The developer conducts or arranges for a baseline audit of the building before signing the agreement, but unlike most other financing models where this is used simply to project savings which are seen immediately by the customer, the customer continues to pay their historic utility bill for the contract period. The developer serves as the middle-person between the utility company and the customer, positioning itself as the sole point of contact for all payments. By collecting baseline utility payments directly from tenants and paying the actual utility bills, the developer is able to capture all of the savings from the project. At the end of the term of contract, the developer can opt to purchase the equipment from the developer at fair market value.

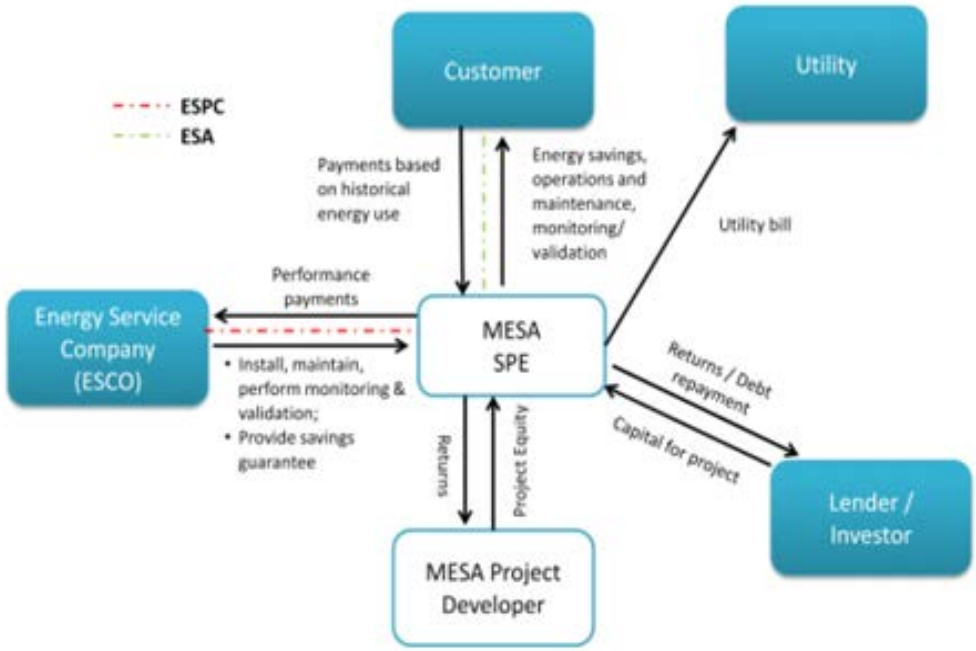


Figure 3: Typical MESA structure compared to the ESA and ESP models. The MESA model differs from the ESA (green dotted line) in that the MESA positions itself between the utility and the customer, paying bills and collecting savings over the term of the contract. Energy Service Companies (ESCOs) typically use an Energy Service Performance Contract (red dotted line), wherein periodic payments are made by the customer for its services.

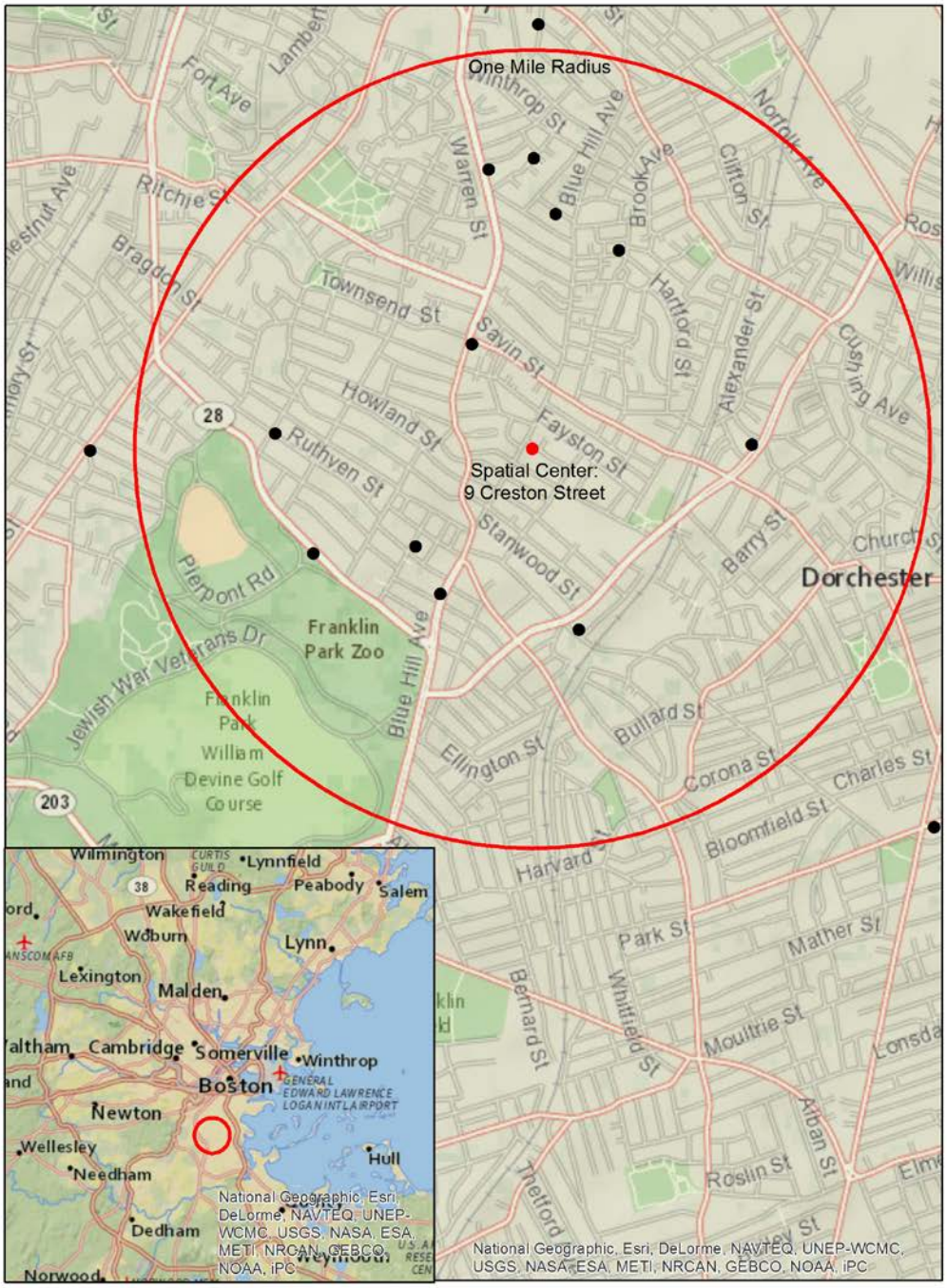
B) Demand Response

Demand response programs were established by utilities to both maintain grid stability and reduce the need to engage “peaker plants” for additional electricity generation during times with the greatest demand on the grid. Typically, periods of peak demand (when the most energy is demanded from generators) occur in mid to late afternoon hours and can vary by season and geographic location. The finite amount of electricity on the grid limits the amount that can be distributed to businesses, homes, and other users. Demand that outpaces the available supply destabilizes the grid and can cause brown or blackouts. Demand response programs are targeted at these end users to reduce consumption at peak hours and maintain grid stability.

Instead of paying to add additional generating capacity for a short period of time, the utility will provide financial incentives that climb up to the cost of engaging that extra generation capacity. In some cases this could include cash payments or changing rate structures that allow customers that reduce during demand response events to pay less for the remaining energy that they still consume. Demand response programs also look at mechanisms to shift production schedules to off-peak hours. For instance, shifting the steel production of an electric arc furnace from a mid-afternoon shift to a late night or early morning schedule would not only save the company money by being in a more affordable peak rate schedule, it would also allow the company the opportunity to participate in a demand response program through the local utility and be rewarded with cash incentives.

C) Spatial Analysis

Spatial analysis of federally subsidized housing in the Boston, MA metropolitan area:



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