Inner City Redevelopment: Brownfield Reuse and Clean On-Site Energy Generation Systems

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ABSTRACT

This paper provides information related to a new inner city redevelopment initiative that offers to merge clean, on-site energy resources called "power parks", such as combined heat and power (CHP) and district energy systems, and brownfield redevelopment planning. One goal of this initiative is to improve the marketability of brownfield sites across the US by utilizing on-site energy for improved power reliability and reduced energy cost. The concept is supported by the National Energy Policy Plan published in May, 2001, by the Bush administration.

The National Energy Policy Report gave a very specific recommendation that "…the President direct the Administrator of the Environmental Protection Agency (EPA) to work with local and state governments to promote the use of well-designed combined heat and power (CHP) and other clean power generation at brownfield sites, consistent with the local communities' interests." It was a timely recommendation in that the Northeast-Midwest Institute (NEMW) with funding from the U.S. Department of Energy's Oak Ridge National Laboratory was already engaged in a feasibility study on a Chicago brownfield site for the purpose of determining the value on-site power might add to the redevelopment opportunities on a brownfield site. The lessons learned from that project are the foundation for the information detailed. Additional multi-year funding from the EPA's Clean Energy Program has allowed this work to continue and to mature to a point where on-site energy generation and brownfield redevelopment can better begin to merge their efforts.

The opportunity to merge brownfield redevelopment with clean, on-site energy systems, like CHP, is an opportunity with clear benefit to all parties. Brownfields are often found in power constrained locations where access to a reliable energy source can be an added limitation to development. Clean, on-site energy production can produce significant environmental gains while further encouraging economic growth on industrial sites in our cities and states.

Introduction

Across the nation, in both urban and rural settings, public officials, communities and developers are grappling with the challenges associated with abandoned or underutilized industrial and commercial properties -- also known as brownfields. The U.S. Environmental Protection Agency (EPA) defines brownfields as "abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination." These properties could include once prosperous industrial areas of the Midwest; closed timber mills that dot the rural landscape of the Pacific Northeast; abandoned mining operations in Arizona and California; and idle shipyards and railroad depots in Delaware and Virginia.

Developers and investors, cautious of environmental liability, have historically shied away from these properties that where previously used for industrial or commercial activities. These properties, which are subject to many environmental regulations and procedures, can require extensive construction delays that can adversely affect the economic viability of development projects. Contamination concerns, in conjunction with other issues, have led developers to simply pass up opportunities in urban centers for ones in rural and suburban areas where land is perceived to be less expensive and free from environmental regulations.

In recent years, however, state and local governments have come to view the redevelopment of brownfields as a unique opportunity to solve many problems concurrently. Brownfield redevelopment initiatives leverage private sector investment and involvement in community revitalization activities. Many brownfields are located in established urban areas where redevelopment projects are well served by transit facilities, and other existing infrastructure.

"With minimal public investment, brownfield projects may provide environmental cleanup, reduce neighborhood blight, generate tax revenues, and create jobs — all of which helps to stabilize and enrich a community. These redevelopments usually make use of existing infrastructure, such as highways and utilities, thus maximizing the benefit of previously spent public dollars. In addition, brownfield reuse offsets development that might have occurred on rural or suburban properties, known as "greenfields," thus helping to limit urban sprawl — an increasingly high priority for many Americans" (Pepper 1997).

Projects that target blighted communities increase employment opportunities, expand the tax base, and reduce the costs associated with preventing crime in these areas. Redevelopment efforts also help to reduce hazardous chemical levels on idle properties; curb sprawl development by making more efficient use of land resources; improve air quality; reduce traffic congestion; and preserve open space and farmland

Many good examples exist that demonstrate this opportunity: 1. Lacon, Illinois, is a small rural community whose primary employer, Lacon Woolen Mill, shut down in the late 1960s leaving behind a 17-acre contaminated site. The city now controls the site and plans to rebuild an attraction for tourism and recreation, including a green area, a public park, housing, retail, and restaurants linked to an expanded waterfront. Another example is found in Allegan, Michigan, a town build on a foundation of industrial and manufacturing facilities that had been long been abandoned. Today the town serves as a commercial hub to the county supplying goods and services to the surrounding rural townships. The project has returned much previously contaminated land back to the town's tax base, cleaned up its physical environment, and restored the kind of community pride that stimulates private investment (Wells 2002).

The federal government, largely through programs at EPA and HUD, has long recognized the need to encourage and support the redevelopment of brownfield sites, only recently has it become clear that on-site energy systems can aid in this work especially older cities where infrastructure is already overburdened. With this connection, the Department of Energy and the Clean Energy Program at EPA are now part of the family of federal efforts to merge these two opportunities.

On the energy side of the equation, the on-site energy system or power park design concept can include both renewable and fossil energy generation, storage and energy efficiency technologies. Many of these innovative energy technologies alone and in hybrid configurations (typically pairing an intermittent renewable with conventional generation), are

found in applications, such as combined heat and power (CHP), supplying power, both thermal and electrical, in grid and off-grid markets.

Power parks are an integrated "systems approach" to delivering power when and where it is needed. These systems are designed to be more energy efficient and environmentally sound by utilizing far less fuel to generate the same or better power than any previous central power generation or delivery system. Some compare this change to that experienced in the computer industry with the transition from solely relying on main frames to greater reliance on laptops, or with energy, from solely relying on central power plants to a greater reliance on on-site energy technologies.

Power parks are a key strategy for realizing the goal of accelerating the deployment of renewables and cleaner distributed energy systems and technologies. Currently few of these developments exist in the United States. They are more common in other parts of the world such as South America, Europe, and Asia.

The following are the remarks of Mr. David Garman, Assistant Secretary, Energy Efficiency and Renewable Energy at the annual brownfields conference, Brownfields 2001, held in Chicago, Illinois, on September 24, 2001:

> "Today I want to briefly talk about the nexus between energy and brownfields. We at the Department of Energy see brownfields as a strategic opportunity for local and state governments and the private sector to maximize the Nation's assets. There are over 450,000 potential brownfield sites, in all states and virtually every city. The benefit of distributed generation is that new clean energy technologies (including photovoltaics and fuel cells) can generate power on-site; this power can either be consumed by the power producer or can be sold back to the grid."

Even before these words were spoken by Assistant Secretary Garman, the NEMW had engaged a brownfield/CHP project funded by Oak Ridge National Laboratory to do a feasibility study on a brownfield site outside of Chicago.

The Chicago Brownfield/CHP Project: The Beginning

In September, 2000, the Northeast-Midwest Institute, Kattner/FVB (District Energy, Inc.), and the CANMET Energy Centre in Ontario, Canada, working with the City of Chicago and the Department of Energy, Chicago Regional Office, on a feasibility study. The purpose of the study was to demonstrate how a combined heat and power or district energy system might improve the development advantage of an existing inner city brownfield site in Chicago at the West Pullman site.

The West Pullman brownfield, a 160-acre site on the Chicago's far south side consists of numerous parcels of land with historical industrial uses ranging from undeveloped lots to lots with vacant buildings to lots with tenanted buildings. Land acquisition, assembly, and cleanup (both publicly and privately funded) are currently underway. As the City gains control of additional parcels, the sites are tested and cleaned-up. The City is now preparing several sites within the business park for industrial redevelopment.

One mechanism being considered for the West Pullman brownfield site is to develop it with on-site power access in the form of a "power park." As stated earlier, power parks are

collections of optimized distributed energy resource systems and processes joined by a minigrid, often by a district energy loop and advanced telecommunications technologies. They are generally grid-connected but can operate as power islands when appropriate.

The purpose of the DOE funded Chicago brownfield/CHP project was to develop a market attraction tool for the City of Chicago to utilize in its effort to find a developer for the West Pullman site. It is expected that a developer thus attracted would utilize on-site power generation as part of their development plans. An inner city brownfield site has certain perceived drawbacks for developers such as perceived or real contamination, liability issues, and delayed redevelopment. It is believed that a market analysis of what an on-site power system, with its accompanying innovative energy and renewable technology, might act as a counter balance to these drawbacks thereby enhancing the development opportunity.

There were lessons learned from this project that were found to be valuable beyond the life of this effort. Though the Chicago site was not ultimately determined to be a viable one for on-site power, the work done there produced an invaluable foundation of knowledge for future applications and a criteria guidebook was initiated to capture the lessons learned.

The Brownfield/On-Site Energy Guidebook

The Brownfield/On-Site Energy Guidebook[1] has been created recently as a result of the lessons learned at the Chicago site but in anticipation of working with EPA and DOE on additional brownfield sites in the United States. The guidebook as it currently exists is intended to guide brownfield redevelopers in determining in advance whether or not an on-site energy generating capability would be desirable and feasible in terms of financial, political, and technical considerations.

While the guidebook criteria currently number eleven, not all the criteria need be present for a site to be a good candidate for selection. The guidebook is merely a guide for the parties to more quickly access a site to see if certain aspects make the potential of on-site energy generation feasible or unfeasible. They are intended as a first level tool to determine if the site is a good candidate for additional investment of time and resources. It is also important to note that there is no attempt to prioritize the criterion as that must be determined as more sites are reviewed and the criterion honed by more experience and data.

The eleven criteria are listed below and followed with more direct questions to address as part of the determination:

1. Are ownership issues fully resolved?
    - Is the site wholly owned by the municipality/state or at least under the control of one entity? If parts of the site are held under different ownership at the point of redevelopment, this can present problems in terms of common interests, ease of decision-making, and a timely end-result.
2. Is power in the local area expensive?
    - Is it expensive for customers to purchase power from the electric utility? High power prices (over 8 cents per kilowatt-hour or kWh) help make CHP more cost-effective.

[1] Located and regularly updated at: http://www.nemw.org/energy_brownfield.htm.

- Can excess power be sold to the utility or to other users at a relatively high price? Although there are usually significant barriers to sale of excess generation at reasonable prices, if these barriers are successfully overcome, the ability to gain revenue from power sales can help make CHP more cost-effective.

3. Is the local power utility receptive to on-site energy?
   - Does the utility have transmission and distribution (T&D) constraints that will motivate it to encourage generation of power by CHP facilities at the brownfield site?
   - Does the utility have policies and procedures that make it relatively easy to interconnect CHP facilities?
   - Does the utility have standby power tariffs that provide relatively low costs for standby power capacity for on-site energy facilities?
4. Are energy loads consistent?
   - Is the power, heating and cooling requirements steady throughout the year? This helps, as opposed to energy requirements varying significantly on a daily and/or seasonal basis.
   - What is the composition of the expected development? Mixed use is preferred (office, retail, hotel) and industrial loads are preferred. Uses that provide thermal loads beyond the 9-5 business day are attractive.
5. Is fuel accessible and relatively cheap?
   - Can fuel such as natural gas be cost-effectively accessed? Natural gas access depends on the capacity of gas transmission and distribution piping systems compared to the requirements of the distributed energy facility. Access to natural gas at a high pressure helps make CHP more cost effective.
   - Can gas be purchased at a low cost relative to the power value? Low natural gas prices are important to the economics of gas-fired CHP. Prices under $3.00 per thousand cubic feet (MCF) are desirable. The cost of converting fuel to power depends on the type of CHP installed, which is dependent on the size of the energy requirements being served. In addition to the level of gas cost, the relationship of the gas cost to the value of generated power is important.
6. Is the development dense enough to justify integration of energy systems?
   - How is the area zoned? What are height restrictions?
   - What is the expected density of development? The more square feet per acre, the better -- highly packed multi-story buildings are better than spread-out, lower buildings. A reasonable threshold is at least 25,000 SF of conditioned building space per acre. This is an important criterion but there may not be much data to rely on.
   - Will significant development occur relatively soon (within 5 years)?
   - How close to each other are the near-term building projects?
   - Are there one or more large, early tenants that can serve as an anchor load?
7. Is the development big enough to be served by cost-effective technology?
   - How many square feet of building space are ultimately expected for the development area? Larger developments will have more options for CHP systems. Larger developments translate into larger energy requirements, which makes it possible to install CHP systems with lower costs per unit of output. A reasonable minimum is 2 million square feet of building space.

8. Is on-site energy being considered at the right time?
   - Is the redevelopment effort "ripe" enough to see substantive action in the near term?
   - Is distributed energy being considered early enough in the planning process to have an impact on the redevelopment planning?
   - Does the redevelopment effort have momentum? Are the right players actively pursuing it? Do they have good financing prospects?
   - Does redevelopment effort have champions in the local business or political community?
9. Can an energy facility be sited and permitted?
   - Are there air emissions restrictions that would constrain implementation of distributed energy facilities?
   - Are there other siting or permitting barriers?
10. Are there existing energy facilities that can be re-used?
   - Are there existing infrastructure assets (buildings, boilers, chillers, power generation, steam or hot water piping, chilled water piping) that can potentially be re-used for the energy plant and distribution systems?
11. Is the reliability and quality of power and other energy supply important?
   - Do the potential customers place special value on power and thermal supply reliability (minimal interruptions in supply) and power quality (e.g., consistent voltage)? This can be the case with data centers, research facilities and certain types of manufacturing operations, for example.

With the belief that more effort needed to be invested in this work, the NEMW approached the Environmental Protection Agency's Clean Energy Program Office with a proposal to expand and test the criteria on more brownfield sites. Funding was approved based the NEMW's extensive experience with both brownfield redevelopment work; the clean energy program it has run for some years; and, the recent experience with the Chicago project detailed above. The following is a discussion of the ongoing project work occurring to hone and test the guidebook criteria for their validity and effectiveness but also to continue an exploration of the potential benefits brownfield redevelopment might gain from the use of clean, on-site energy systems. It is expected that the ultimate deliverable for this work will be more of these developments occurring around the nation.

Ongoing Brownfield/On-Site Energy Projects in the United States

The EPA through its Clean Energy Program has funded additional work with the Northeast-Midwest Institute at other brownfield sites in the United States. Two sites were selected by an advisory committee consisting of representatives from EPA, NEMW, and the private sector who work in brownfield redevelopment and on-site energy development. The marriage of the brownfield and energy sectors is an important aspect of the overall project because there is a need for these sectors to better understand the issues each face in accomplishing the brownfield/CHP policy recommendation found in the National Energy Policy Report.

Additionally, DOE through the Distributed Energy Resources Program has allocated separate money to two brownfield sites for technical feasibility studies to further determine

the applicability of CHP to redevelopment of these sites. The two sites listed below are the ones DOE selected to fund and also the ones that the NEMW, through its advisory committee using the criteria guidelines, has selected.

These projects will be showcased over time at conferences and in case studies. A special web page has been developed that will regularly post updates to the progress of these feasibility studies and updates to the brownfield/CHP guide book criteria. Find the web site (which also links the applicable EPA and DOE web sites) at: http://www.nemw.org/energy_brownfield.htm.

The current two projects include:

Project 1. TeleCom City, Massachusetts Brownfield Showcase Community and its work to develop reliable, cleaner on-site energy capability

The Cities of Everett, Malden and Medford, Massachusetts have embarked on a regional technology development project, called TeleCom City®. In July 1996, the Massachusetts state legislature passed an act creating the Mystic Valley Development Commission (MVDC), a public body politic and corporate, to pursue the TeleCom City® project. The MVDC is made up of the mayors of the 3 participating cities and one designee appointed by each mayor and the governor or her designee.

The goal for the TeleCom City® project is to convert a 200-acre brownfields site into a state-of-the-art telecommunications research and development park and a riverfront park for residents. At full build-out, TeleCom City® will comprise 1.8 million square feet of new office, research and development and manufacturing space.

The future telecomm/R&D tenants will require high quality, reliable power for their data-intensive operations. In order to address these energy concerns, the Commonwealth of Massachusetts, in partnership with the MVDC, propose to study the feasibility of siting a combined heat and power (CHP) system on the TeleCom City® site, which will utilize newer, cleaner technologies to provide high quality, reliable power for the development that is energy efficient and environmentally sound. The study will analyze the technology options and design system alternatives that meet the needs of the project, as well as, potentially meeting energy needs outside the project area, in the surrounding community. The technologies being considered include natural gas engines, advanced turbines and microturbines, fuel cells, and renewables such as photovoltaics. This feasibility study will also include an analysis of financing opportunities for the installation of the system.

It is also important to point out that the technologies discussed above rely on natural gas or renewable fuels; whereas, the utility industry relies heavily on oil. Consistent with the current national security issues, it is important to consider options that will decrease our nation's dependence on oil.

Through a very successful request for proposals process, the advisory committee to this project chose a Boston engineering firm, Vanderweil Engineers, to do the DOE funded feasibility study for TeleCom City. Vanderweil submitted a proposal that clearly shows they know what they are dealing with in terms of a CHP energy system and their have on staff good expertise in terms of environmental issues around brownfield redevelopment. The need for both talents in house or available though sub-contrast is critical to the success of this initiative. Vanderweil also agreed to work with the advisory team and NEMW to test and hone the criteria for the CHP/Brownfield guidebook. Vanderweil's final feasibility study

results will be available within six months of the March, 2003, start date of their contract. The advisory team, which includes the NEMW, meets regularly to review next steps.

Project 2. Des Moines, Iowa, Brownfield Showcase Community and their work to develop an Agri-Business Energy Park utilizing a waste stream as an alternative fuel supply

The City of Des Moines is currently engaged in a brownfield redevelopment project that offers unparalleled opportunities for the implementation of Combined Heat and Power technologies designed to function as a district energy system. The project is a 1,100-acre, EPA-designated brownfield site known as the Des Moines Agrimergent Technology Park. The Park, described as a "techno-industrial" park, will foster inter-industry synergies that take advantage of the accelerating shift of a world economy driven by heavy manufacturing to one driven by technology-based manufacturing and services. The site currently houses salvage yards, an agricultural chemical manufacturer, and other industrial facilities. Redevelopment plans focus primarily on industrial and recreational development, with a reuse plan that promotes the use of environmentally conscious and sustainable development approaches.

The Park design will accommodate many different functions—from research, to prototype development, to full-scale production—as well as provide gathering spaces to stimulate new ideas, commercial service areas, recreational and/or physical fitness opportunities, exhibit space and other uses. Environmentally friendly buildings designed with quality, energy efficient materials and effective waste minimization and recycling processes will be encouraged. Increased land use densities will be advocated whenever possible.

Redevelopment will eliminate slum and blight, curtail urban sprawl, enhance recreational opportunities, and protect and beautify the environment. The Park will also generate an excellent return on public and private investment. Projections call for the creation of 6,500 jobs and an increase in the tax base from $12.7 million to just over $420 million at build-out.

In addition, this project presents outstanding opportunities for successful replication of CHP implementation in brownfields redevelopment and other applications. Provisions for an environment in which interrelationships among physical, intellectual, economic, and social resources are recognized and encouraged have drawn the attention of both regional and national leaders. The whole of the recognition generated by this project puts forth a tremendous opportunity to showcase and advance the benefits of CHP technologies to an audience that is both diverse and extensive.

Since this project also received money from the Department of Energy for a CHP/brownfield feasibility study the same as TeleCom City, they are in the process of modeling their request for proposals (RFP) process after TeleCom City's and their RFP should be released shortly. This project will offer a different set of demands for the engineering study than did TeleCom City and therefore should offer a different way to examine the criteria guidebook viability.

The most significant difference is in the cost of electricity between the Boston area and Des Moines with Des Moines' power cost being almost a third the cost of Boston's electricity. Also, constraints on access to transmission/distribution girds in Des Moines are

virtually non-existent. The fact that Des Moines has access to literally free feed stock from its tenants' agricultural waste makes it attractive as an on-site fuel resource to a CHP facility. The results of the feasibility study will be available approximately six months for the point an engineering firm can be chosen and a contract negotiated – probably by the end of the year. It is expected that the guidebook criteria will also be utilized and tested through this project as well.

Summary

The bottom line for this work is that we now have a reference guidebook which can be utilized by any party wishing to determine if they should explore further the technical and regulatory feasibility of using a clean on-site energy system/power park concept design on a brownfield site. Where the criteria clearly show there will be great difficulty placing an on-site energy system, such as a CHP system, on a site then the developer can better prepare for what they might face. Where the criteria show the benefits are likely to outweigh the effort and cost of installation, i.e., lower energy costs, more reliable power, better marketability of the site, easier environmental permitting, etc., then the developer can take steps include a plan for the energy system as part of the entire project.

The eleven criteria, and any additional ones as they are added, are being tested on actual brownfield sites and the results of this ongoing work will help to make the guidebook more robust and credible for both energy and brownfield communities. That is the intended outcome of the additional feasibility studies in Des Moines and TeleCom City. Also, it is hoped that by guiding the process through the necessary stages, we can also see actual projects go on line (iron in the ground). If it can be proved that clean, on-site energy systems add value to the marketability to a brownfield site and therefore greater economically viability to inner city redevelopment, then we will certainly see more of these projects be successfully started and completed. This is the theory behind the Administration's energy policy recommendation and behind the work the NEMW continues to believe will return long term benefit to our cities and states.

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