

Arlington County Courthouse Integrated Energy Master Plan Phase II - District Energy March 2016



Arlington County Courthouse Integrated Energy Master Plan Study

Acknowledgements

The Project Team would like to express its gratitude to the Arlington County staff for their support in the development of this report. In particular, Chris Somers and Rich Dooley provided a great deal of support and guidance as we navigated through this project. We also would like to thank the private building owners in the Courthouse neighborhood. Their openness and willingness to share their specific building information was very helpful as we developed our strategies for the area.

About the Project Team

Ever-Green Energy

Ever-Green Energy is one of the country's premier energy system experts, with decades of experience in developing, operating, and managing district energy systems. The unique combination of technical expertise, business acumen, and operations experience has helped communities, colleges and universities, health care campuses, and government organizations advance the study, development, and operation of integrated energy systems. The Ever-Green team applies its depth of knowledge through every step of a system's development and implementation, finding sustainable solutions that are financially viable and secure a community's energy future.

Burns & McDonnell

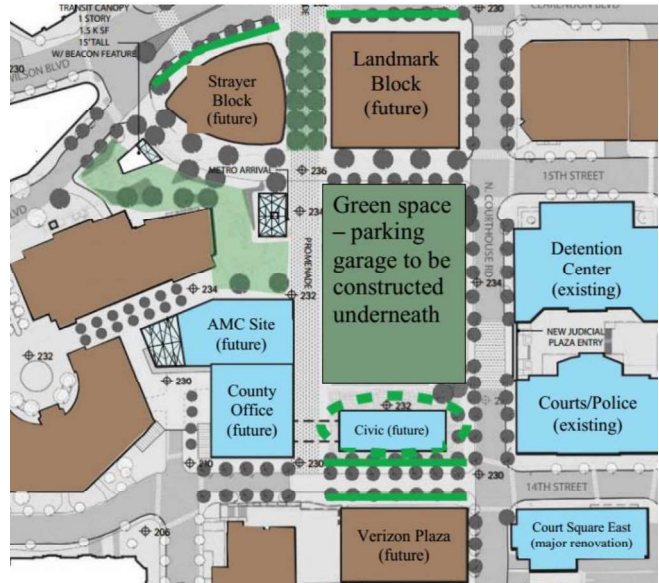
Burns & McDonnell, headquartered in Kansas City, MO, is a full-service engineering, architecture, construction, environmental and consulting solutions firm. The company's multidisciplinary staff of nearly 5,000 employee-owners includes engineers, architects, construction professionals, planners, estimators, economists, technicians, and scientists, representing virtually all design disciplines. Burns & McDonnell plans, designs, permits, constructs, and manages facilities all over the world, with one mission in mind: "Make our clients successful."

Arlington County Courthouse Integrated Energy Master Plan Study

Executive Summary

Executive Summary

Major development plans have created a significant opportunity to implement emerging technologies and efficient energy solutions in the Courthouse Square neighborhood within Arlington, Virginia. To capitalize on this opportunity, the Arlington County Courthouse Integrated Energy Master Plan Study was commissioned and is a continuation of the work established by the Arlington County [Community Energy Plan \(CEP\)](#). The CEP included 14 policies structured to improve the community's energy consumption, including creating district energy systems, deploying alternative energy sources, and improving efficiency at the building and system level. These policies outlined an approach to increase economic competitiveness, reduce greenhouse gas emissions, and improve energy reliability and security. The development plans surrounding the Courthouse Square Project offered an ideal opportunity to carry these policies forward.



In July, 2015, the County completed Phase I of a district energy feasibility study, known as the Courthouse Integrated Energy Master Plan. This Phase II Study continues the Phase I work by evaluating the feasibility of a district energy system in the Courthouse neighborhood under two scenarios, accounting for either the Landmark Block building or the Civic building being built first. Both scenarios evaluate production and distribution alternatives, and opportunities to connect other nearby public and private buildings, along with the environmental and economic benefits of each proposed solution. Alternative energy approaches were identified in both the northern and southern regions of the district that can significantly reduce greenhouse gas emissions, and create more localized, resilient, and cost-effective energy options to private and public building owners. These approaches leverage technologies that have been implemented and successful around the world, and align with the County's goals established in the CEP.

Customer Base

The Courthouse neighborhood features a diverse and unique group of public and private buildings that include four buildings owned or controlled by the County. The County buildings consist of administrative offices, a courthouse, police headquarters (Judicial Center) and a Detention Center. The development area also includes residential, hotel, retail, commercial and office buildings. The study area included approximately 40 buildings, 28 of which were surveyed.

Arlington County Courthouse Integrated Energy Master Plan Study

Executive Summary

The buildings surveyed were generally found to be operating efficiently and meet their heating and cooling needs in a cost-effective manner. Of the buildings in the study area, all of the County-owned buildings and many of the privately-owned buildings were found to have mechanical systems that are compatible with district energy systems. A summary of buildings with high connectivity potential are outlined in the table below. Future buildings, including the Landmark and Strayer Blocks, as well as Verizon Plaza, the Civic building, and the County Building/AMC block are not included in this particular table but are outlined in the Courthouse Sector Plan.

	Heating	DHW	Cooling
Building Count	15	10	26
Load	37.0 MMBtu/hr	12.0 MMBtu/hr	8,100 Tons
Energy	46,000 MMBtu	25,000 MMBtu	13,800,000 Ton-hrs
Utilization Hours	1,200	2,100	1,700

Buildings compatible with a district energy system

Proposed Solutions

Given the dynamic conditions and systems within the buildings in the Courthouse neighborhood, the Project Team evaluated energy solutions that are accommodating of these diverse needs. As the needs of the northern Courthouse neighborhood buildings are significantly different than those of buildings in the southern area of the district, the Project Team evaluated two distinct energy strategies that accommodate the technical and financial needs of as many buildings as possible, while addressing the factors listed above.

In the event that the Landmark Block building is built first, the existing and planned buildings in the northern area of the district could be served by a traditional four-pipe DE System connected to a combined heat and power (CHP) plant in either the Detention Center or the Judicial Center. If the Civic building was built first, buildings in the southern area could be served by a low-temperature, two-pipe system that relies primarily on recovered energy from existing sanitary sewer mains that run along Fairfax Drive.

The two potential systems are presented independent of each other and have been modeled separately. However, if both systems were built, integration of the systems could be valuable, particularly by having the northern system provide redundancy to the southern system. The systems could be developed individually, with the timing of each dependent upon the needs of existing customer buildings, as well as the construction schedule of upcoming development.

Arlington County Courthouse Integrated Energy Master Plan Study

Executive Summary

Solutions and Benefits for the Northern District

The proposed northern DE System has been modeled to operate in conjunction with existing steam and hot water boilers in order to most efficiently serve connected loads. Functioning as a base-load resource, the CHP plant could generate electricity throughout the year, reducing Judicial Center and Detention Center electric grid demands by over 800 kW. Adding CHP at the Judicial Center/Detention Center campus would also provide the campus with the ability to operate as a microgrid in the event of a disruption on the Dominion grid, providing the County with a greater energy security. It is also important to note the environmental benefits of this approach. Implementation of the northern district energy system solution is predicted to achieve greenhouse gas emission reductions of 16-20%. Results are summarized in the table below, with more information on the northern DE System in Section 9.2.1.

	Net NPV Savings	Rate of Return	GHG Emission Reductions
Implementable Now Option 1	(\$357,000)	3%	16%
Implementable Now Option 2	\$141,000	4%	17%
Landmark Comes Online	\$1,020,000	8%	20%
Landmark Plus Strayer	\$2,188,000	12%	20%

Financial and greenhouse gas emission savings for the proposed northern DE System

Solutions and Benefits for the Southern District

Given the mechanical configuration of the existing buildings in the southern area of the district, the Project Team recommends that the southern DE System could be a low-temperature district energy system that utilizes low-grade waste energy as the primary energy source, which is a carbon-free and renewable energy resource.

The wastewater flowing through this area can retain an immense amount of energy that is not currently being utilized at another point in the system. This latent energy could be withdrawn from the wastewater system and transferred (via a heat exchanger that separates the loops) into a low-temperature district energy system. This energy would then be carried through the low-temperature DE System to the end users where the water temperature is raised or lowered to be used for heating or cooling. This type of system has been used effectively and successfully in other locations in the United States and internationally.

Arlington County Courthouse Integrated Energy Master Plan Study

Executive Summary

The economic and environmental benefits of a southern DE System are highly dependent upon the amount of natural gas that is displaced for heating the buildings in the winter. As such, the benefits become significant if the existing buildings upgrade their heat pumps to more efficient units. This approach is predicted to reduce GHG by 63%, as shown in this table.

	Net NPV Savings	Rate of Return	GHG Emission Reduction
Current Building Operating Conditions	\$400,000	4%	7%
With Optimized Heat Pumps in Year 15	\$820,000	8%	30%
With Optimized Heat Pumps in Year 10	\$1,060,000	10%	41%
With Optimized Heat Pumps in Year 5	\$1,320,000	12%	52%
With Optimized Heat Pumps in Year 0	\$1,560,000	15%	63%

Financial and greenhouse gas emission savings for the proposed southern DE System

Conclusion

Successful implementation of district energy in the Courthouse neighborhood would provide lower cost energy, reduce greenhouse gas emissions, and improve energy resiliency of essential County services. The development of the proposed southern DE System is primarily dependent upon the construction of the future buildings and the interest of existing building owners to connect to the system. The County could engage in discussions with owners of the southern buildings to establish an interest in the proposed systems, and a plan for heat pump change out as the Civic Building and other new buildings are constructed. The County could also collaborate with the developers of the future buildings to educate them on the optimal building design for connecting to the proposed system.

Implementation of CHP as part of the northern DE System presents itself as the best immediate opportunity to move toward the energy vision for the Courthouse neighborhood, and takes a step toward the resilience and climate goals established by the County in its CEP. The initial system would provide economic benefits to the County, while establishing a platform for leveraging future growth and integration with the neighborhood. In addition, the initial system would reduce the carbon

Successful implementation of district energy in the Courthouse neighborhood would provide lower-cost energy, reduce greenhouse gas emissions, and improve energy resiliency of essential County services.

Arlington County Courthouse Integrated Energy Master Plan Study

Executive Summary

dioxide emissions by 16-20%. Representatives of privately-owned buildings in the neighborhood have also expressed an interest in the proposed system, as it aligns well with many of their individual missions.

The Landmark Block is currently anticipated to be completed in mid-2019. To coincide with that development schedule, development of the proposed northern DE System would need to commence no later than January 2017. Items requiring attention include: establishing an organizational structure, customer outreach, plant siting, utility coordination, design, permitting, contract and easement development, establishing financial ratings, and reaching out to the community.