# Electrify Heartland Plan

## Section 11: Emerging Technologies


**Project title:** Kansas – Missouri
Community Readiness for EV and EVSE

**Funded by:** US DOE DE-EE0005551

**By:** Metropolitan Energy Center

and Kansas City Regional Clean Cities Coalition

**With:** Black & Veatch

Metropolitan ENERGY CENTER

Kansas City Regional Clean Cities

BLACK & VEATCH

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# Electrify Heartland Plan

## Electrify Heartland Project Abstract

Electrify Heartland is an electric vehicle planning project managed by Metropolitan Energy Center. It is a product of the Greater Kansas City Plug-In Readiness Initiative, co-chaired by Kansas City Regional Clean Cities Coalition. Our goal is to produce a regional plan to prepare public resources and secure the economic and environmental benefits of plug-in vehicles within targeted metro areas with estimated 2.7M population. The targeted metro areas include Kansas City, MO & KS; Jefferson City, MO, Wichita, KS; Salina, KS; Lawrence, KS; and Topeka, KS. (14 Counties: Cass, Clay, Cole, Douglas, Jackson, Johnson, Leavenworth, Miami, Platte, Ray, Saline, Sedgwick, Shawnee, Wyandotte).

## Electrify Heartland Steering Committee

| Team | Organization | Name |
|---|---|---|
| Charging Stations | Initiatives | Troy Carlson |
| Charging Stations | LilyPadEV | Larry Kinder |
| Charging Stations | Logios | Gustavo Collantes |
| Government Policy | Polsinelli Shughart PC | Alan Anderson |
| Government Policy | Black & Veatch | Bill Roush |
| Project Administration | Metropolitan Energy Center | Ruth Redenbaugh |
| Project Administration | Metropolitan Energy Center | Kelly Gilbert |
| Public Education | Nation Ranch Marketing, Inc. | Bill Patterson |
| Training | Kansas City Kansas Community College | Bob McGowan |
| Training | National Electrical Contractors Association | Jim Cianciolo |
| Utility Grid | Black & Veatch | Sam Scupham |
| Vehicle & Fleet | University of Missouri at Kansas City | Henry Marsh |

Exhibit i-i. Electrify Heartland Steering Committee Members

# Section 11: Emerging Technologies

## Section Abstract

Advanced technology vehicles, including electric vehicles, are in themselves emerging technologies and are continually changing as adoption increases worldwide. This section includes information about advances within the Electrify Heartland project planning area with solar energy, wind energy, and wireless charging of vehicle batteries as related to EV and EVSE.

## Section Authors:

William Roush, Black & Veatch and Sebastian Ramos, Metropolitan Energy Center

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# 11 Emerging Technologies

## 11.1 Solar Photovoltaic (PV) and EVSE

### 11.1.1 Area Survey of PV installers

Electrify Heartland utility sub team asked members of the Heartland Solar Energy Industries Association about their experience regarding solar PV tied to electric vehicle charging. Information obtained indicted the following activities:

- Creighton University in Omaha, Nebraska, has 85 kW of covered parking spaces using PVs in its Cuming Street parking lot.[1]
- SWT Energy of Lincoln, Nebraska, has relationships with suppliers of pre-engineered hardware for PV covered parking and EVSE.[2]
- Solar Design Studio in Prairie Village, Kansas, has developed designs for PV covered parking with EV charging.[3]
- Cromwell Environmental, Lawrence, Kansas, has worked with a carport manufacturer in the Kansas City area on three projects totaling about 30 kW of covered PV parking.[4]

### 11.1.2 Solar Carport and EV Charging Products

In the U.S., several companies are addressing the PV carport market, which is a market that could become tied to the EV charging market.

- Schletter, a larger company involved in many kinds of PV racking, is promoting Park@Sol©, an engineered solar carport product with a variety of foundation options and scalability from one unit to many much larger areas. They emphasize streamlined manufacturing and fast installation with no welding required.
- SunDurance Energy and Solaire Generation offer a solar parking lot canopy for installations like the 120kW system installed at the New Jersey Meadowlands Commission headquarters in Lyndhurst, NJ.

[1] BYRNES, ROBERT. 9 MAR. 2012. E-MAIL.
[2] SCHANTELL, RANDY. 9 MAR. 2012. E-MAIL.
[3] SOLGER, BOB. 9 MAR. 2012. E-MAIL.
[4] ROGGE, CHRIS. 9 MAR. 2012. E-MAIL.

**"Several Midwestern companies are addressing the photovoltaic carport market which is building strong ties to the EV charging market."**

- Baja Construction, Inc., with several U.S. locations, has become somewhat specialized in offering Solar Carports, Solar EV Charging Stations, Solar Truck Bays and Solar RV/boat storage. Baja suggests that solar carports in paid parking lots, such as sports venues, have a potential for an additional revenue stream, charging a premium for shade and snow shelter.
- Chevron Energy Solutions offers to run empty conduit underground from AC switchgear to the base of carport columns, allowing easier retrofit of EV chargers at a later date.
- For EPRI, John Hallihan manages a solar carport and EV charging project in Tennessee and notes that this type of EV charging aligns well with workplace charging.
- Demand Energy, Liberty Lake, WA, has parking lot installations of EV charging combined with about 30 kW of PV and 100 kW of energy storage.
- Inovateus Solar, South Bend, IN, has several vendor partnerships to build solar carports with EV charging stations and are active in the Midwest.[5]
- Evergo/Merit Charge, a division of a large metal building company that is very active in the solar industry, has an operational PV/EVSE carport at their headquarters. Their EVSE system allows for credit card transactions on site rather than through a phone call or proprietary network[6].
- On September 24, 2012, Tesla Motors announced an EV charging system called Supercharger. The first six California locations feature a solar canopy generating power to offset electricity used for automotive fuel. The charging system is being done in cooperation with SolarCity, a leading installer of home and commercial PV systems. The charging stations offer recharges at no cost. The Supercharger system is not compatible with other EV charging systems.
- While the company has not tied it directly to EVSE support, Petra Solar has a utility-owned, utility pole-mounted solar offering that has some smart grid capability. Their SunWave solar product of single modules on single utility poles uses ZigBee wireless supported by either cellular, Ethernet, or WiMax backhaul networks. When installed throughout a neighborhood (with heavy EV and EVSE penetration, for instance) it could give a utility the potential to leverage future applications such as smart grid management solutions at the distribution level

[5]Matz, Michael. "Parking Lots and PV." *Photon Magazine* 2012: 41. Print.

[6]Lehrman, Matt 15 Oct. 2012. E-mail.

combined with a level of solar support including reactive power (VAR) and some mitigation of power factor instability[7].

- Kansas City, MO based Premier Carports offers pre-engineered carports that include solar.[8]
- Also in Kansas City, Milbank Manufacturing, long active in electrical metering systems, is now manufacturing and marketing EVSE and solar equipment.

### 11.1.3 EV Charging Efforts in Education

At the University of Kansas, the KU EcoHawks have built a solar energy station on campus consisting of six 180 W solar panels that allowed recharging the car batteries of an electric vehicle. Kansas State University (K-State) is moving toward a study of solar charging of electric vehicles in a micro-grid using innovative power electronics design. The K-State effort hopes to include cooperation through its Industry/University Cooperative Research Centers Program (I/UCRC) with the University of Texas at Austin and Texas A&M University National Science Foundation – supported program (EV-TEC I/UCRC), which conducts research on the role of electric vehicles in the convergence of transportation and electric power infrastructures.

Kansas City Joint Apprenticeship Training Center built a solar canopy adjacent to their Level 2 EVSE. The solar panel was built as a part of a session of the Electric Vehicle Infrastructure Training Program (EVITP).

**"Solar carports and EV Charging Efforts featured at University of Kansas, Kansas State University and Kansas City Joint Apprenticeship Training Center."**

### 11.1.4 Solar Incentives and EV Charging

Because solar equipment is eligible for a 30 percent Federal Investment Tax Credit (ITC), and this credit includes racking systems, there is an issue of whether the carport structure is eligible for the solar tax credit. The solar ITC expires December 31, 2016. The Solar Electric Power Association 2012 Tax Manual includes this statement on solar carport tax treatment:

> *Credits can be claimed only on equipment as opposed to buildings. Not all structures are considered buildings for tax purposes. In general, a structure that is little more than a shell to house equipment is considered part of the equipment. However, if the structure includes office space or a control room, then it is usually considered a building.*

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[7]"SunWave Pole-Mount Solutions." *Petra Solar*. N.p., n.d. Web. 10 Dec. 2012. <http://www.petrasolar.com/products/sunwave-smart-solar-energy-solutions/sunwave-pole-mount-solutions>.

[8]"Solar Infrastructure." *Premier Carports*. N.p., n.d. Web. 10 Dec. 2012. <http://www.premiercarports.com/SOLAR.HTML>.

Interested parties should consult with tax advisors to determine whether the carport structure in a specific installation is eligible for the 30 percent ITC.

## 11.2 Wind Energy

### 11.2.1 Wind Speed and Strength in the Planning Area

Wind power is an emerging energy source that could potentially provide the planning area with an enormous amount of energy. Being in the Great Plains Wind Corridor, the planning area receives a fair amount of wind, which further enhances its capability to support wind energy.

**"Wind energy produces about 1 percent of the energy in the US, at roughly 25 billion kWh."**

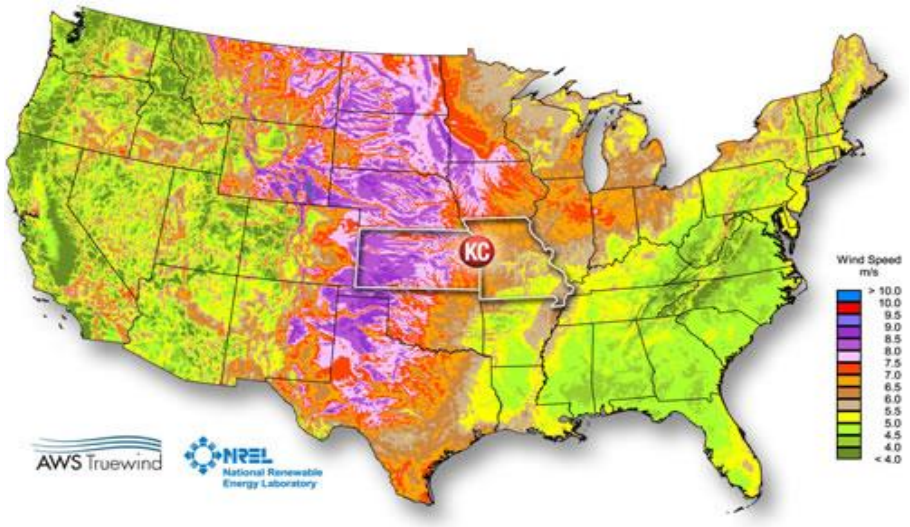



Exhibit 11-1 Wind Speed in the United States

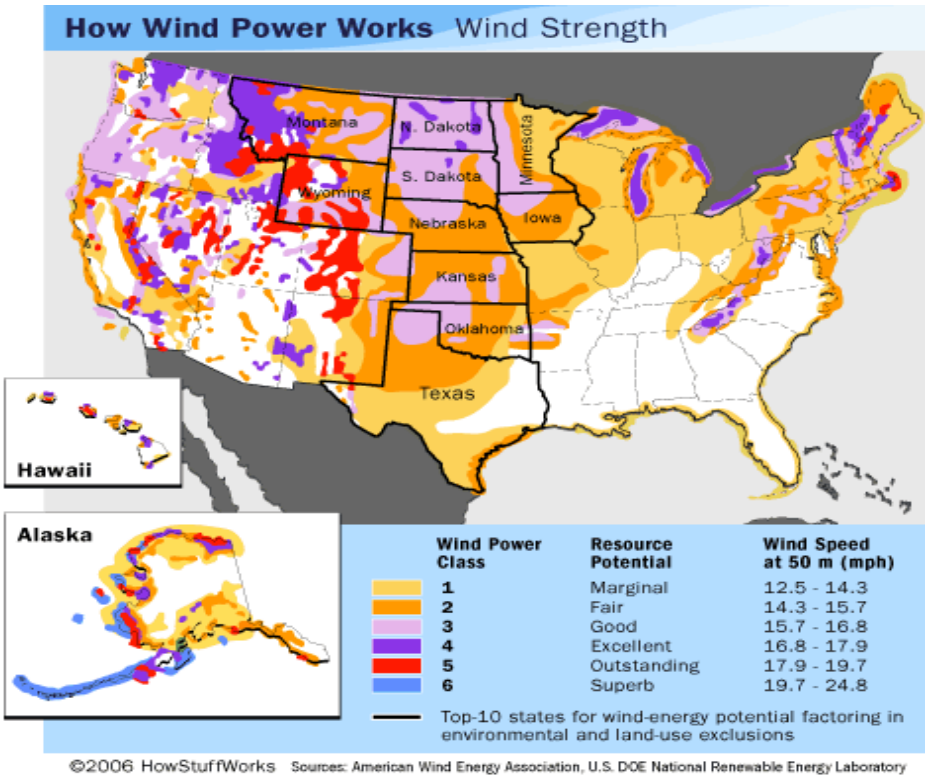
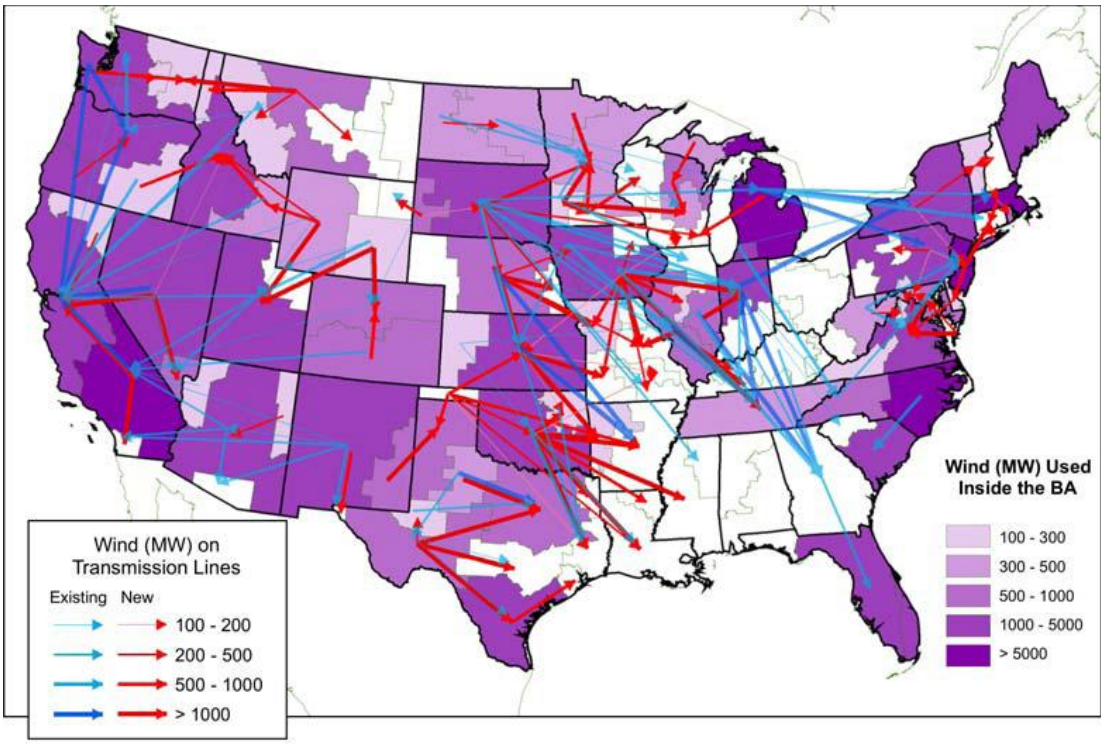



Exhibit 11-2 Wind Strength in the United States

Currently, wind energy produces about 1 percent of the energy in the US, at roughly 25 billion kWh. However, there is potential for far more. The total electricity generation in America is 3.6 trillion kWh, but the estimated potential amount of wind energy is over 10 trillion in the US. In order to produce this energy, all of the smaller windmills would need around 9 mph winds and larger ones would require 13 mph, all quite common in the US and especially Kansas. In addition to this, wind energy increases exponentially in accordance with its speed, meaning higher wind speeds produce far more energy at a quick rate. The pricing estimates of using wind power vary. For the east coast it was estimated to be about 93 billion, which is a fraction of the cost of the savings to be had from using it. As the Midwest has more wind than other parts of the nation, much of the wind energy will need to be transmitted to clear up congestion in our area and transmit it to other places with less wind.




Total Between Balancing Areas Transfer >= 100 MW (all power classes, land-based and offshore) in 2030.
Wind power can be used locally within a Balancing Area (BA), represented by purple shading, or transferred out of the area on new or existing transmission lines, represented by red or blue arrows. Arrows originate and terminate at the centroid of the BA for visualization purposes; they do not represent physical locations of transmission lines.

Exhibit 11-3 Wind Energy Transmission in the United States

The actual cost of wind energy is quite cheap, however. In recent years, cost of wind power has been rated at 5 to 6 cents per kilowatt-hour, which is about 2 cents cheaper than coal. The price of coal can also fluctuate quite a bit, and if you factor in things such as the health costs associated with coal, it actually costs around 9 to 27 cents per kilowatt-hour. Natural gas isn't much better; however, there haven't been many accounts of the energy costs of it, as its still being developed. Beyond the actual cost savings of wind energy, there exist other benefits. It is a clean energy source that leaves behind no pollution or damage to the environment.

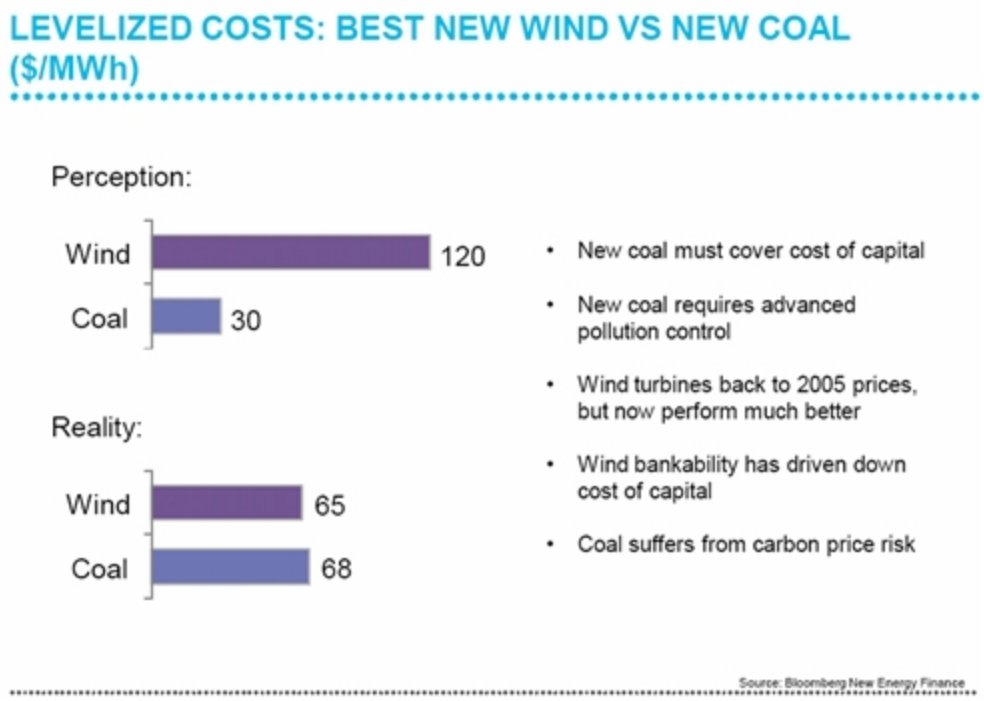



Exhibit 11-4 Cost comparisons between best new wind and new coal: perception and reality

A common complaint lodged at electric cars is that they still get their power from the electric grid, that is, coal and other fossil energy sources. Also, an increased amount of them could overburden the electric grid in some parts of the country. Wind energy could help alleviate that problem by providing an additional, clean energy alternative. However, wind energy is not always stable. While the Midwest may have a fair amount of wind, fluctuations may lead to shortages if sufficient wind is not available. Of course, other energy sources could also be used to fill these gaps, such as solar power. Researchers at Princeton University are experimenting over whether wind energy could be stored in batteries to be used later, during these lulls in wind. If wind energy cannot be sufficiently stored, excess energy could also be used to further power EVs, as they could basically be batteries on wheels. Spain has already acted on this idea and made a functional wind-powered EV charging station in Barcelona. New York has followed with their own 4 kW sky pump that provides energy for electric vehicles.

Wind energy will also revitalize rural areas by adding a new source of property taxes as well as more industry. Wind turbines also don't interfere with agriculture and can be set amidst fields with little problem. A farm sized turbine can even produce excess energy for farmer-owners, allowing them to feed extra energy to the grid. Wind energy can also support local communities by being run by businesses in the area. This leads to money recirculation through the community.

## 11.3 Wireless Charging

Wireless energy has been around since the time of Nikola Tesla, however only recently has it been considered as a viable option. Wireless energy is based on the concept of magnetic resonance coupling. This relies on two coils of the same frequency being a few feet from one another, with one receiving an electric current. Because of their being on the same frequency, the magnetic current results in a transfer of electric energy from the one receiving the current to another. While there are no current cost estimates of wireless energy, it is known that energy efficiency runs at about 40 percent or more, however this is sure to rise as technology improves. Currently, this technology is primarily emphasized on smaller devices such phones, laptops, controllers, and so on, but the possibilities for larger machines is open. Current experiments show energy can be transferred through walls and obstacles, and have no harmful effects to anyone or anything around.

Wireless EV charging could provide another option. While companies such as Evatran in the US have piloted EV wireless charging, and the major car manufacturers are interested in future development, wide spread adoption will be in the future. Currently, electric vehicles batteries have a charge that lasts for about 100 miles and takes several hours to recharge, making it quite inconvenient. An experiment by Stanford proposes lining highways with the coils that would provide energy to the battery of electric vehicles as they drive on the highways. The coils provide about 10 kilowatts of energy at 6.5 feet, which is about 97% efficiency. Wireless energy could provide a comprehensive solution to the current complaints of electric vehicles, if implemented properly.

Sources for research on Wireless Charging include:

http://news.stanford.edu/news/2012/february/wireless-vehicle-charge-020112.html

http://www.qualcomm.com/solutions/wireless-charging/wipower

http://suite101.com/article/the-future-of-wireless-energy-transfer-a207875

## 11.4 About the Author

**Sebastian Ramos** completed research in a variety of alternative fuel and emerging technologies as an intern with the transportation programs of Metropolitan Energy Center. Mr. Ramos earned a Bachelor of Environmental Science from University of Missouri – Kansas City.

**William Roush** is a renewable energy specialist in Black & Veatch's Consulting Engineering Services group, providing feasibility studies, due diligence, planning, and project development support for a variety of energy technologies, including wind, biomass, solar,

energy storage and electric vehicles. Mr. Roush has nearly 30 years of experience with renewable energy. This includes 10 years as the owner of a solar photovoltaic product manufacturing and system integration company. Mr. Roush is currently the President of the Heartland Chapter of the Solar Energy Industries Association. In addition, he serves on the Solar Electric Power Association's Central Region Advisory Board and was a founding member of the Mid-America Electric Auto Association.

**Kansas City Regional Clean Cities Coalition** Administered by Metropolitan Energy Center, the coalition is a public-private partnership among fleet managers and manufacturers, vendors and service providers in the alternative fuels and vehicle industries. It works in communities across Kansas and in western Missouri. Kansas City's coalition is a partner since 1998 with the U.S. Department of Energy's Clean Cities Program, whose mission is to advance the energy, economic, and environmental security of the United States by supporting local actions to reduce petroleum use in transportation. The coalition administers more than $40 million in clean transportation projects in Kansas, Missouri, Iowa and Nebraska. For more information visit www.metroenergy.org/kccleancities.aspx.About

**Metropolitan Energy Center** is a nonprofit organization with a threefold mission to create resource efficiency, environmental health, and economic vitality in the Kansas City region. Over the past three decades, MEC has grown to be a recognized catalyst for regional energy partnerships that satisfy the triple-bottom-line approach. Founded in 1980, MEC is a catalyst for community partnerships focused on energy conservation. It works through a variety of educational and training programs, including Kansas City Regional Clean Cities Coalition, Home Performance, Project Living Proof and EnergyWorks KC. Every energy dollar conserved through MEC's work remains available for investment in the local economy. MEC was awarded more than $17 million in federal funding for transportation projects in recent years and is a partner in other multi-million-dollar projects in Kansas and Missouri. MEC has been the recipient of many awards recognizing its contribution to energy conservation and was host of the national Affordable Comfort Conference in 2003 and 2009