Community energy: Design recommendations for the integration of distributed renewable energy generation into existing urban neighborhoods.

by

Thomas Schneider

BLA, South Dakota State University, 2018

A REPORT

submitted in partial fulfillment of the requirements for the degree

MASTER OF LANDSCAPE ARCHITECTURE

Department of Landscape Architecture and Regional & Community Planning
College of Architecture, Planning and Design

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2021

Approved by:

Major Professor
Dr. Sara Hadavi

Abstract

The current American energy system is being pushed beyond its limits and is not suited to address contemporary energy issues (Crabtree et al. 2011). Existing literature indicates that small-scale, distributed energy production is needed to address the shortcomings of current energy infrastructure (Yoldas et al. 2017). In the coming decades, grid modernization projects (solar production, micro-wind production, and battery storage) have the potential to significantly alter existing neighborhoods. Current research focuses primarily on technical considerations and does not substantially address the physical footprint of grid modernization within an existing community. As communities begin to consider the future of their energy systems, landscape architects can position themselves as facilitators to establish a community-driven transition to renewable energy. This research looks to identity how landscape architects can address the physical footprint and visual impact of renewable energy production in an urban setting.

A two-part methodology was developed consisting of (1) site observation and mapping, and (2) community interviews. Site observation and mapping was utilized to define an initial study area. A study site selection procedure identified the Ivanhoe Southeast neighborhood for further study. Residents of the Ivanhoe Southeast neighborhood were engaged in semi-structured interviews, using photo boards, to understand how individuals perceive the visual impact and physical footprint of solar production, micro-wind production, and battery storage in an urban setting.

Social data collected during the community interviews was then passed through a thematic coding procedure to identify key themes within the data. Themes of identity, aesthetics, function, proximity, education, and interest emerged as critical concepts for the incorporation of renewable energy in an urban setting. A series of design recommendations for each of the

identified themes were then created, based on the social data collected during the community interviews. Lastly, a conceptual design project was created that applies the design recommendations to the development of a district energy masterplan for the Ivanhoe Southeast neighborhood.

This research is intended to engage landscape architects, policy makers, engineers, local leaders, and community members in a dialogue that considers the future energy landscape in urban neighborhoods.

COMMUNITY ENERGY

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Thomas Schneider

Masters Project Report
Landscape Architecture
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01.

Introduction

Introduction

Background

Energy insecurity, energy infrastructure vulnerability, and climate change are three interconnected issues with significant implications for urban residents. Climate change is projected to increase the intensity and duration of extreme heat events and severe storms – in turn, increasing energy demand and threating physical damages to vulnerable energy infrastructure (Berry et al. 2018; Voogt 2002). As climate change and damage to vulnerable infrastructure drive energy price increases, vulnerable populations in urban areas will be particularly affected.

The impacts of climate change and the vulnerabilities of American energy infrastructure are well documented in existing literature (Goldthau 2014; Cox et al. 2019). This research looks to define vulnerable energy infrastructure and climate change as compounding factors in energy insecurity. An estimated 7 million additional Americans will face the economic, social, and health impacts of energy insecurity with just a 10% increase in household energy costs (Murkowski and Scott 2014). With the influence of climate change and the vulnerability of existing infrastructure, a 10% increase in household energy cost is not unreasonable.

To address the interconnected issues of energy insecurity, energy infrastructure vulnerability, and climate change, there is a demonstrated need to decentralize, decarbonize, and modernize the electric grid. Distributed energy systems have emerged as a potential solution to address all three components of the energy insecurity, energy infrastructure vulnerability, and climate change problem (Akbari et al. 2016). Despite significant advantages, distributed energy systems have a spatial footprint that presents itself as a significant disadvantage. Proposed distributed energy system infrastructure needs to be located in close geographic proximity to the end user, creating a situation where visual quality and location are primary concerns for local residents (EPA 2020, A). Figure 1.1 describes the central energy dilemma and anticipated solutions.

This research utilizes nine urban neighborhoods along the Brush Creek Corridor in the East Side Kansas City as a study area to identify project sites and develop design recommendations for the integration of distributed energy systems into existing neighborhoods. A qualitative approach consisting of semi-structured interviews has been applied to identify residents' perception of energy insecurity, existing conditions, and preferences for different configurations of distributed energy systems in outdoor spaces. This information will help the researcher identify and define core design principles relevant to the integration of such systems into existing urban neighborhoods. The resulting design recommendations will be applied to a projective design project within Kansas City's Brush Creek Corridor.

Beyond their application to the Brush Creek Corridor neighborhoods, the proposed place-based approach and design recommendations are intended to be applicable to other urban neighborhoods throughout the United States that have similar issues and needs. Issues of climate change, energy insecurity, and vulnerable energy infrastructure are not unique to the Kansas City region, but rather, they are issues that must be addressed across the nation. The proposed design recommendations for distributed energy systems in urban areas look to inform thoughtful integration of infrastructure in a way that drives community development. The complete research process is presented in Figure 1.5

Purpose

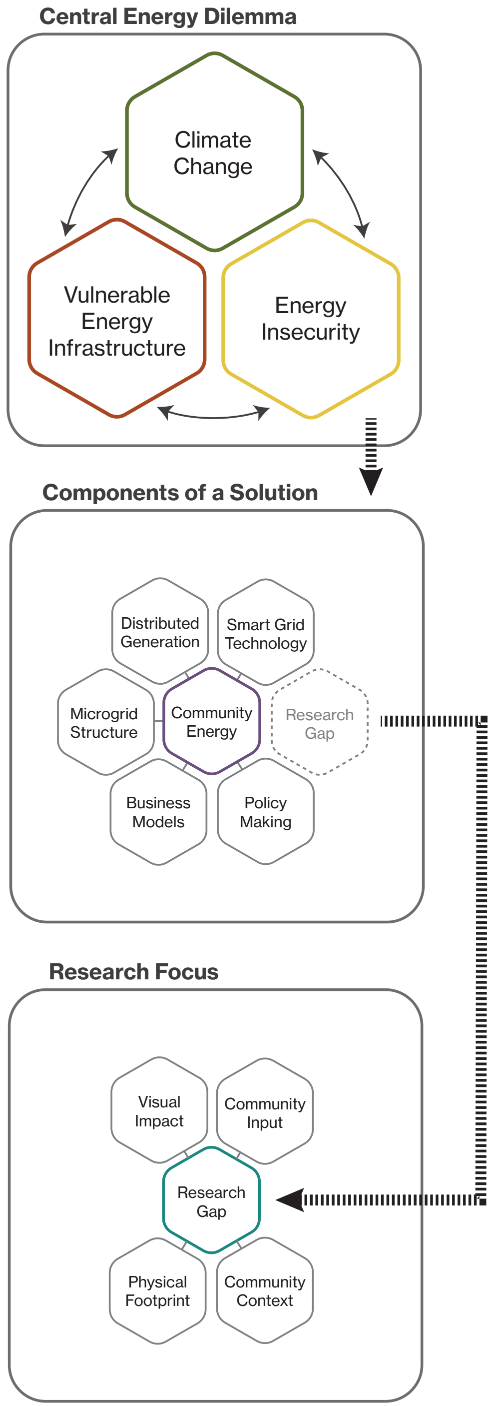
This research intends to answer the following questions:

- How can landscape architects address the physical footprint and visual impact of renewable energy production in an urban setting?
- What design characteristics of renewable energy generation are visually preferred by neighborhood residents?
- How can visual preferences be incorporated into a set of design recommendations?

Through the process of answering these questions, this research looks to fill a gap in existing literature related to visual impact and physical footprint of renewable energy generation and storage facilities in urban settings. Through this process, the researcher seeks to understand how residents feel about the prospect of having renewable energy brought into their community. Additionally, the researcher is interested in uncovering specific design characteristics that are important for community acceptance of renewable energy production and storage in an urban setting.

Figure 1.1

Relationship between the identified energy dilemma, components of a likely solution, and the gap in current literature. As community energy is considered by communities throughout the United States, physical foot, community context, community input, and visual impact must be properly considered. Currently, literature does not substantially address these areas specifically as they relate to existing urban areas.



Significance

The central energy dilemma is an active threat to the American people that requires decisive, trans-formative, and immediate action. Recent events in Texas demonstrate critical energy infrastructure failure due to extreme weather conditions. Such extreme events are often viewed as edge scenarios. How-ever, due to climate change, extreme weather events are increasing in frequency and intensity (especially flooding threatens infrastructure (Wuebbles et al. 2017). In the coming decades, extreme weather events such as flooding, tornadoes, hurricanes, winter storms, and heat waves will further strain a power grid that is already being pushed beyond its limits. The winter storm that hit Texas in February of 2021 resulted in 4 million Americans facing acute energy insecurity for nearly a week (Gellert, 2021).

The unfortunate recent events observed in Texas demonstrate a very real future condition if nothing is done to address the vulnerabilities of existing energy infrastructure in the context of climate change. As extreme weather events increase in prevalence, weather related energy disruptions continue to increase energy insecurity. An analysis of power outages identified a nearly 2% annual increase in power disruptions between 2000 and 2009 (Shield et al. 2021).

Furthermore, the annual financial impact of weather-related power outages ranges between $25 to $70 billion (Shield et al. 2021). Over the last 20 years, nearly $2 trillion in damages to energy infrastructure were observed in the United States (Clean Coalition 2020). The financial and personal impacts of the central energy dilemma clearly describe a current and pressing need to reimagine energy production and consumption within the United States.

The following series of photomontages (Figures 1.2 - 1.5) highlight the urgency and severity of each of the individual components of the central energy dilemma.

Vulnerable Energy Infrastructure

Figure 1.2
Existing energy infrastructure is expensive to maintain and is nearing the end of its designed lifespan. Long transmission lines are especially vulnerable to extreme weather events.

Climate Change

Figure 1.3
Climate change is driving an upward trend in frequency and intensity of severe storms. Billions of dollars in damages are caused by extreme weather annually.

Energy Insecurity

Figure 1.4
Monthly energy expenses are already a financial burden for 1 in 3 U.S. households. An increase in severe weather and damage to infrastructure threatens to exacerbate this issue.

Severe power cuts in Texas highlight energy security risks related to extreme weather events

Keith Everhart, Energy Analyst – Renewables Integration and Secure Electricity
Gergely Molnar, Energy Analyst – Natural Gas
Commentary — 18 February 2021

Texas on the Verge of an Energy Catastrophe: How Microgrids are Helping

February 16, 2021 By Elisa Wood 6 Comments

March 01, 2021

The Texas Power Outage and the Rise of Microgrids

Both of the partners at Emergent Research started their careers as economists, specifically energy economists.

So we've followed the Texas power outages and think just as the pandemic has accelerated digitalization and remote work trends, the Texas outage has accelerated existing trends driving the growth of microgrids and distributed power.

23 Feb 2021 | 16:30 GMT

What the Texas-Freeze Fiasco Tells Us About The Future of the Grid

The Texas electricity crisis and the energy transition

A Glimpse of America's Future: Climate Change Means Trouble for Power Grids

Systems are designed to handle spikes in demand, but the wild and unpredictable weather linked to global warming will very likely push grids beyond their limits.

Figure 1.5
News headlines following the February 2021 power grid failure in Texas. A severe weather event, driven by climate change, overwhelmed the vulnerable grid and left millions of residents facing energy insecurity. This event highlights the urgency of the central energy dilemma.

Project Overview

Chapter 02 presents the literature review in two sections. Section 1 focuses on components of the central energy dilemma and their impact on urban areas. Section 2 focuses on community energy as a probable solution to the central energy dilemma and discusses the core components of community energy. The literature review concludes by identifying a gap in existing literature that relates to the aesthetics and physical footprint of renewable energy in urban areas.

Chapter 03 presents the project methodology. This section describes the initial study area and the refinement process that was utilized to identify a specific study site. Additionally, chapter 03 describes how semi-structured interviews were conducted to facilitate conversations with residents of the study site.

Chapter 04 covers how the community interviews were recorded, transcribed, and analyzed to define key themes within the data. This chapter also describes how identified themes were translated into design recommendations.

Chapter 05 applies the design recommendations defined in chapter 04 to three projective design projects.

Lastly, chapter 06 presents project conclusions, limitations, and discussion. This chapter presents the outcomes of the research effort and proposes answers to the initial research questions based on the outcomes of the study.

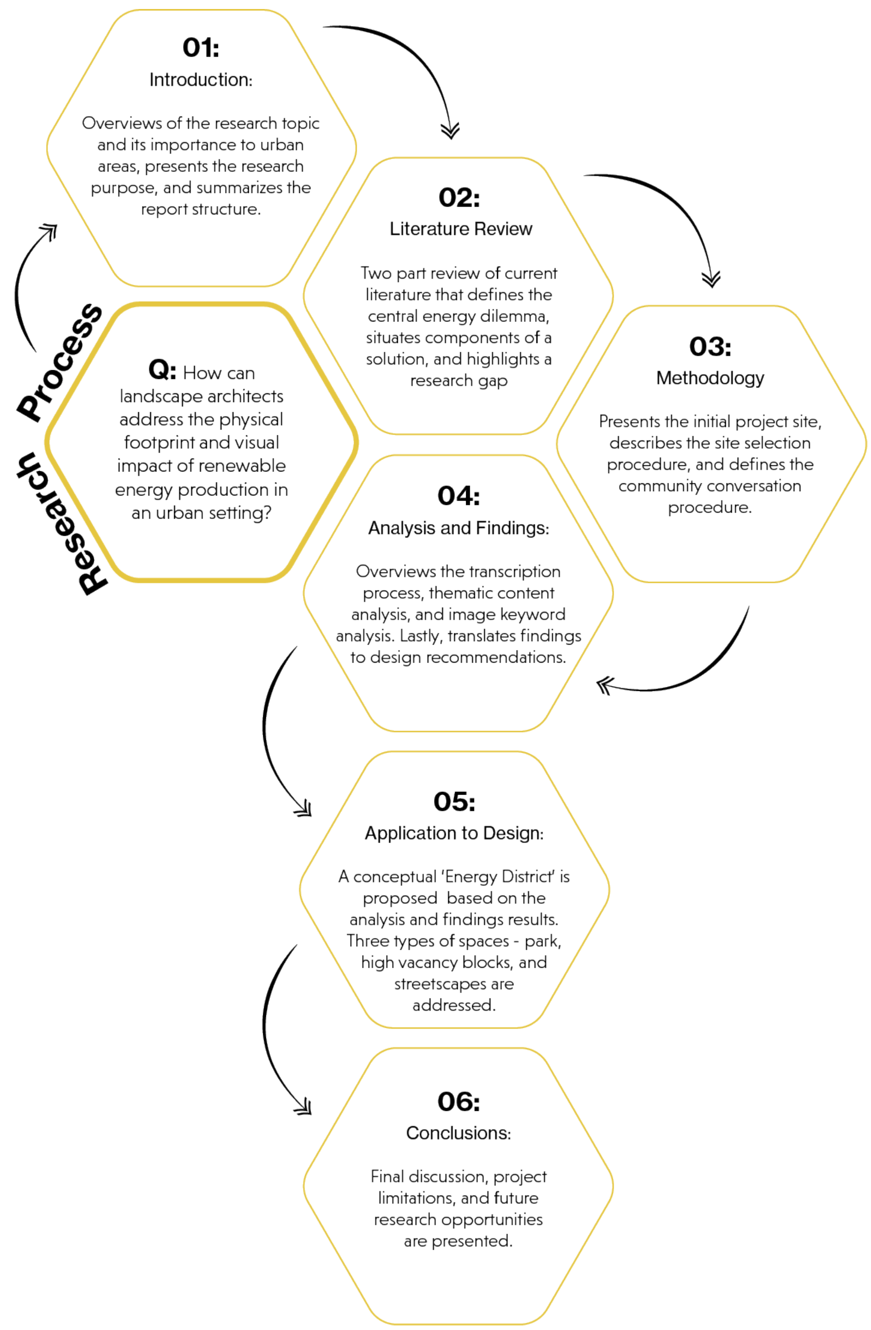


Figure 1.6
Research process and key project milestones.

02.

Literature Review

Introduction

The following literature review is presented in two parts. The first section defines the central dilemma as consisting of energy insecurity, vulnerable existing infrastructure, and climate change. Each component of the central energy dilemma will be defined in the context of this research and presented in a way that demonstrates a clear link between each component. The second section presents community energy as a probable solution to address the central energy dilemma. The literature review continues by defining a gap in existing literature related to the visual impact and physical footprint of renewable energy in an urban setting. Lastly, the chapter concludes by defining the role of landscape architects in community energy, specifically as it relates to the central energy dilemma. Figure 2.1 presents the project literature map.

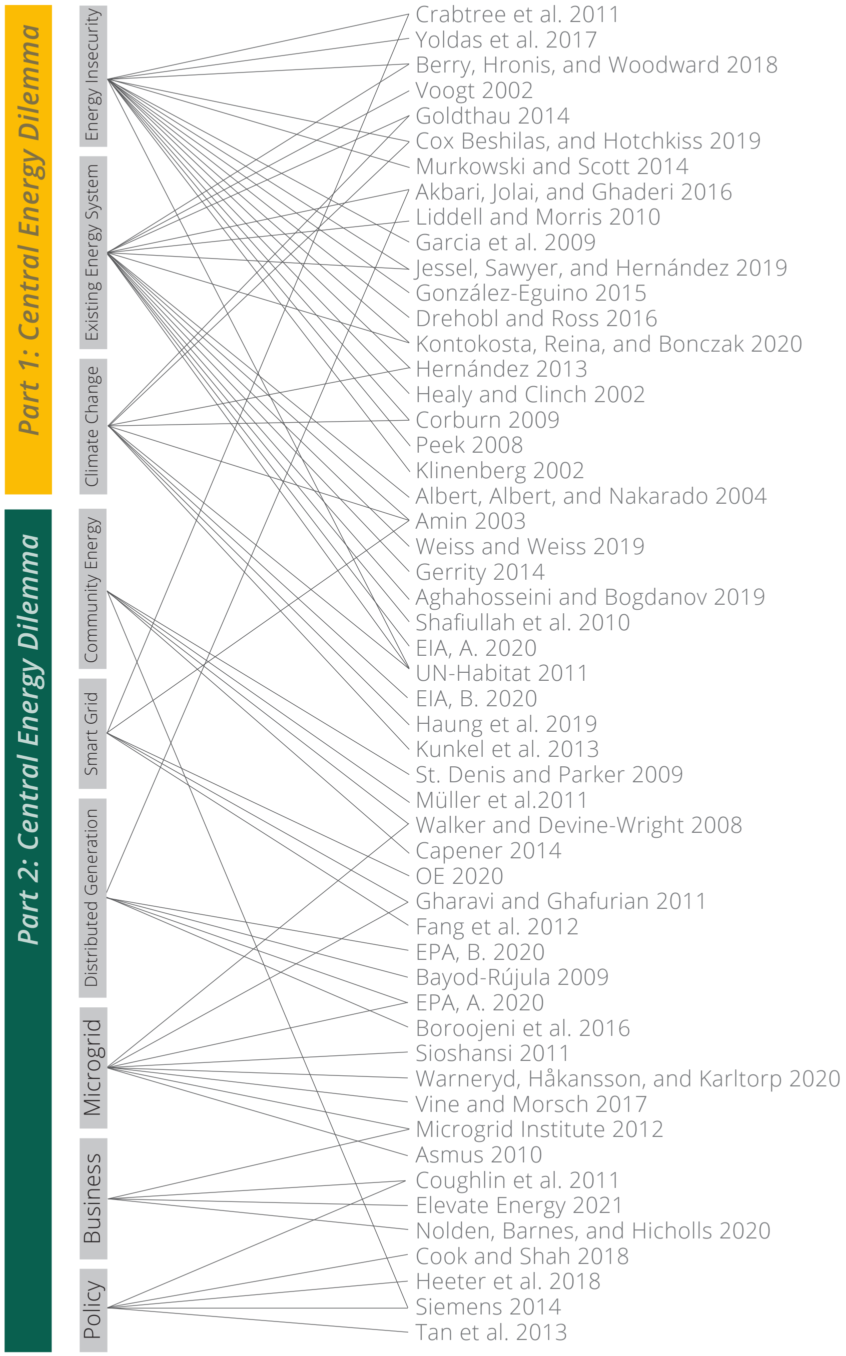


Figure 2.1
Literature mapping.

Components of the Central Energy Dilemma

Energy Insecurity

Language used to define affordable access to energy varies by region and context. In many European countries the term fuel poverty is preferred, while energy poverty is commonly used to describe conditions in developing countries (Liddell and Morris 2010). Furthermore, terms such as energy vulnerability, energy burden, and fuel poor are also commonly used (Garcia et al. 2009; Jessel et al. 2019). These terms primarily differ in how 'access' and 'affordability' are measured. Access and affordability can be measured in three categories: technological threshold, physical threshold, and economic threshold. First, the technological threshold is defined by a lack of access to modern energy service and is most used to describe access in developing countries without considering level of consumption. Second, the physical threshold is used to define the amount of people without access to enough energy to meet basic needs. The physical threshold attempts to identify if access to affordable energy is preventing people from meeting basic needs (Gonzalez-Eguino, 2015). Lastly, the economic threshold is used to define the financial burden of energy prices. Spending more than 10% of available household income on energy expenses per month is the cut off used for the economic threshold (Gonzalez-Eguino, 2015; Jessel et al. 2019). The economic threshold is used in developed countries where affordability is the primary issue. Based on the three primary methods of measuring access and affordability, this research will use the economic threshold to define energy insecurity. For the purpose of this report, anyone dedicating more than 10% of available monthly income to energy expenses is considered to be experiencing energy insecurity.

Impact of Energy Insecurity

Energy Insecurity impacts nearly 1/3 of U.S. households (Berry et al. 2018). All households are not impacted equally. Low-income and minority households are disproportionately impacted by energy insecurity. A report produced by the American Council for an Energy-Efficient Economy (ACEEE) found that African American and Hispanic households experience a higher rate of energy insecurity than white households (Drehobl and Ross 2016). An analysis of 5 U.S. cities shows that low-income households spend an average of 10 percent of their available income on energy costs. In some instances, low-income residents are spending as much as 20 percent of their income on energy expenses. In contrast, households at or above the U.S. average annual income spend on average between 1.5 and 3 percent of their income on energy expenses (Kontokosta et al. 2019). The financial impact of energy insecurity results in 1 out of 5 U.S. households reporting that they reduced or forwent basic necessities to pay energy bill (Berry et al. 2018). Additionally, 1 in 10 U.S. households reports keeping their home at an unsafe or unhealthy temperature to lower the financial burden of heating and air conditioning costs (Berry et al. 2018). As household energy costs increase, low-income households will disproportionately feel the effects (Hernández 2013).

In addition to financial impacts, there are also health and social impacts of energy insecurity. The primary cause of health-related impacts of energy insecurity is the inability to maintain a safe and comfortable interior temperature. During periods of extreme heat or extreme cold, thermal discomfort and episodic shivering are common for those experiencing energy insecurity (Healy and Clinch 2002). Cardiovascular illness, breathing issues, heat stroke, hypertension, anxiety, and depression are also common health impacts of energy insecurity (Corburn 2009). The financial, health, and social impacts of energy insecurity contribute to an environment that perpetuates a cycle of low educational attainment for children facing energy insecurity (Peek 2008).

Social Factors of Energy Insecurity

Age, race, gender, employment status, education level, and income are primary indicators used to identify potentially vulnerable populations in relation to energy insecurity (Jessel et al. 2019). However, demographic factors alone do not provide a complete picture of those most vulnerable to the impacts of energy insecurity. The social context of a neighborhood also plays a role in how vulnerable a particular person is to the health impact of energy insecurity. If a person does not leave the house frequently, and lacks social interaction within the community, they are more likely to experience negative health impacts of energy insecurity (Klinenberg 2002). Place-specific neighborhood factors also play a role in how vulnerable a particular community is to energy insecurity. Aging and neglected infrastructure suggest housing quality (Klinenberg 2002). Quality of housing plays an active role in energy insecurity as older houses are typically not as energy efficient, leading to higher heating and cooling costs when compared to newer houses of a similar size (Hernández 2013).

Chronic vs. Acute Energy Insecurity

Energy insecurity can be classified as either chronic or acute. Chronic energy insecurity is an ongoing issue that households persistently deal with on a month-to-month basis. Chronic energy insecurity is primarily predicated on the social factors of energy insecurity previously defined (Jessel et al. 2019). Acute energy insecurity is defined as a short-term interruption to the energy supply. Primary causes of acute energy insecurity are disruption to service and non-payment shut offs. Natural disasters and weather conditions are common disruptions to service that result in acute energy insecurity. A tornado may take down transmission lines, preventing power from reaching the consumer resulting in acute energy insecurity (Jessel et al. 2019).

Vulnerabilities of The Existing Energy Grid

Often considered "the largest and most complex system of the technological age", the North American power grid is composed of two major and three minor grids (Albert et al. 2004). Conceptually, the existing energy grid can be described using a hub-and-spoke model. Power is generated at fossil fuel-based power plants and then distributed to the end user, frequently long distances, across transmission lines (Amin 2003). Energy produced within the hub-and-spoke model is one-directional; meaning, power is produced at the source and subsequently flows to the end-user.

Despite its impressive nature, the existing energy grid is outdated and increasingly vulnerable to a variety of threats (Weiss and Weiss 2019). For one, the age of existing infrastructure is a vulnerability. On average, power plants are over 30 years old and over 70% of transmission lines are more than 25 years old (Gerrity 2014). As existing energy infrastructure nears the end of its usable lifespan, modern concepts such as renewable energy generation must be accounted for.

The existing energy grid is not designed to support the more sophisticated demands of renewable energy generation (Aghahosseini et al. 2019). Renewable energy generation brings challenges of intermittent power production, voltage fluctuation, load management, and energy forecasting among others (Shafiullah et al. 2010). As renewable energy generation increases in prevalence, the existing energy grid is vulnerable to the limitations of current infrastructure.

Lastly, transmission lines are a significant vulnerability in both physical structure and function. Upwards of 90% of all power outages are due to the distribution of energy across extensive transmission lines (Amin 2003). Furthermore, when new transmission lines are needed to service new areas, issues of land acquisition, regulatory approval, and funding are significant barriers (EIA 2020, A).

Climate Change and Urban Areas

Urban areas play a significant role in climate change on two fronts. First, urban areas contribute significant carbon emissions that drive climate change. According to the United Nations, between 30 and 40 percent of all greenhouse gases are produced in cities (UN-Habitat 2011). Of the total greenhouse gas production in urban areas, energy production accounts for 26.9% of all greenhouse gas production (EIA 2020, B). Second, the urban heat island effect (UHI) will compound the effects of climate change on urban residents. The urban heat island effect is projected to increase the temperatures in urban areas by an additional 1.2 – 5.4°F by 2050 (Haung et al. 2019). The resulting temperature increase will increase the total amount of cooling degree days, a measure of days in which air conditioning is required to maintain safe interior temperatures (Kunkel et al. 2013). Increasing temperatures will increase residential energy consumption and threatens to exacerbate energy insecurity in vulnerable urban areas (Hernández 2013). As urban areas around the world set aggressive carbon reduction goals to combat climate change, renewable energy production in urban areas presents an opportunity to address climate change while modernizing energy infrastructure.

Community Energy

Definition and Components

In recent years, communities have begun to pursue community energy production at the local level as a viable alternative to the hub-and-spoke model of traditional energy production and distribution. This transition is driven by a desire to reduce carbon emissions, stabilize energy prices, and create a more resilient energy system (St. Denis 2009). A precise definition of community energy is not universally agreed upon. Government leaders, practitioners, and academics alike generally refer to community energy as consisting of local energy production, with an emphasis on renewable energy. Community energy is also characterized by collective ownership and collective benefits (Muller et al. 2011). The most widely agreed upon definition was put forth by Walker and Devine-Wright in 2008 who define community energy as having a high degree of shared ownership over energy production and a collective benefit (Walker and Devine-Wright 2008). For the purpose of this research, the term community energy will refer to the Walker and Devine-Wright's definition. Widespread adoption of community energy has the potential to significantly address all three components of the central energy dilemma. However, significant technical, financial, and policy issues must first be overcome.

Components of community energy implementation can be broadly classified into five categories: smart grid technology, distributed generation, microgrid structure, business models, and policy. Current research has focused significant effort on these five categories in a push to accelerate the decentralization and decarbonization of energy production (Capener 2014). The following subsections briefly overview existing literature for each of five components of community energy as they relate to the central energy dilemma.

Smart Grid Technology

According to the office of electricity, the current electric grid is being asked to meet demands that it was not designed to meet "being pushed to do more than it was originally designed to do" (OE 2020). With a growing demand for carbon-free energy, the need to integrate renewable energy production is rapidly increasing (Crabtree et al. 2011). However, as previously described, the existing energy grid is not designed to handle the complexities of renewable energy production. To meet this challenge, significant research effort is currently focused on developing smart grid technology.

The term 'smart grid' can be characterized by the integration and communication of all components of the energy grid, from production to consumption, through modern hardware and software (Krause 2018; Yoldas et al. 2017). Advancements in information and communication technologies provide the smart grid with distinct advantages over the existing grid in two main areas.

First, a smart grid allows for vastly superior monitoring and response when compared to the current grid. The current grid utilized electromechanical components, requires manual monitoring and restoration, and has very few sensors. In comparison, a smart grid has many sensors that provide real time information to self-monitoring systems (Fang et al. 2012; Gharavi and Ghafurian 2011). Smart grid technology also provides the consumer with real-time usage information rather than having to wait until the end of the month to see how much energy they have already used (Gharavi and Ghafurian 2011). In the event of a power outage, the current grid has a limited ability to respond. In contrast, the network of sensors and information technology that make up the smart grid allow for an automated response that allows energy to be rerouted in order to maintain service and provide the grid operators a pinpointed location of the interruption.

Second, smart grid technology provides the infrastructure needed to integrate renewable energy resources (Gharavi and Ghafurian 2011). The current grid is designed with a one-way flow of electricity from producer to consumer (Amin 2003). This infrastructure does not permit energy to be put back into the grid. In order for renewable energy resources, such as solar and wind, to be broadly implemented, the current grid needs to be updated with smart grid technology that is designed to allow for a two-way power flow (Krause 2018).

Smart grid technology is not intended to replace the current grid, but rather provide technological updates that modernize the current grid and allow for increased functionality of current energy infrastructure (Gharavi and Ghafurian

2011). Widespread adoption of community energy will require continued advancements and the implementation of smart grid technology.

Distributed Generation

The generation of power at or near the point of consumption is referred to as distributed generation (EPA 2020,B). In contrast to the current hub-and-spoke-model of energy production, distributed generation features a network of smaller energy production facilities. Traditional, fossil-fuel based power production produce between 100MW to 1GW of energy while distributed generation typically produces between 1kW to 1MW of energy (Bayod-Rújula 2009). Distributed generation systems include solar photovoltaic panels, small-scale wind turbines, natural-gas-fired fuel cells, and diesel backup generators (EPA 2020, A).

Advantages of distributed generation include increased reliability, lower investment costs, decarbonization of energy production, and the ability to incorporate renewable energy resources. With the demonstrated advantages, interest in the adoption of distributed generation has gained significant attention over the last decade (Tan et al. 2012). Furthermore, the utilization of distributed generation can facilitate the incorporation of smart grid technology by increasing the flexibility of the electric grid (Boroojeni et al. 2016).

Microgrid Structure

The concept of a microgrid has emerged as a key component of energy infrastructure modernization that will allow for widespread implementation of renewable energy through distributed generation (Yoldas et al. 2017). Conceptually, microgrids can be thought of as a system that incorporates both smart grid technology and distributed generation to create a small electric grid, or a "microgrid". Microgrids produce, consume, and store energy within a defined boundary (Sioshansi 2011).

Microgrids can either be connected to the larger macrogrid or can operate completely independently (Vine and Morsch 2017). The ability to operate independently from the existing macrogrid is known as 'islanding' and is a distinct advantage of a microgrid (Warneryd et al. 2020). The ability to disconnect from the macrogrid offers increased grid resilience to severe storms. In the traditional grid model, any disturbance to transmission lines "upstream" will result in everyone "downstream" losing power. In a microgrid, disruptions in the power supply are identified by smart grid components, power is rerouted automatically, and the impact of the disturbance is minimized (Vine and Morsch 2017).

Traditionally, microgrids have been utilized on a campus-scale for institutions such as hospitals, military bases, or universities.

However, microgrids can range in size from a single building up to community scale (Microgrid Institute 2012). With the advancement of smart grid technology and distributed generation, community scale microgrids are increasing in prevalence and will play a significant role in the energy systems of the next 30 years (Asmus 2010).

Business Models

Initial investment costs of renewable energy systems are largely prohibitive for individual consumers. Community energy looks to address this challenge by pooling knowledge and financial resources. Three general business models have emerged to address the financial challenges of community energy. These models differ based on who owns the installation and how participation is carried out (Coughlin et al. 2011; Elevate Energy 2021).

First, a utility-sponsored model may be implemented. Utility-sponsored models allow customers interested in participating in renewable energy the opportunity to buy into a solar project on a monthly basis. Customers pay into the program and receive proportional benefits based on their contribution. Participants in a utility-sponsored model do not have any ownership of the renewable energy installation, but they do receive direct financial benefit (Coughlin et al. 2011).

Second, the special purpose entity model allows a group to establish a business with the singular purpose of developing a community energy project. Within this model, individual investors must navigate complex financial and legal considerations that come with running a business. This model is typically employed by existing companies with the intent to allow consumers to buy solar panels in a shared installation (Elevate Energy 2021; Coughlin et al. 2011).

Lastly, a non-profit model allows for donors to support community energy projects that do not directly benefit themselves. This model is financed through donations and grants and is intended to benefit low-income residents and allow equal access to affordable, renewable energy. A non-profit entity maintains ownership over the installation while community members benefit from decreased energy expenses (Coughlin et al. 2011).

Much effort is currently underway to define alternative models or modify existing models to reduce the financial barrier of community energy. Increasingly complex models are currently under development that empower community groups to take control of their energy future (Nolden et al. 2020).

Policy Making

Widespread adoption of community renewable energy is not only limited by technical and financial challenges, but also by policy. Depending on location, community energy projects must navigate local, city, state, and federal policy. This complexity influences adoption of community energy programs leading some states and municipalities to have significantly higher adoption of community energy (Cook and Shah 2018). Researchers are looking to identify how energy policy impacts the adoption of community energy and how low- and middle-income consumers are impacted (Heeter et al. 2018). Due to the highly varied nature of policy from one location to another, this report cannot include all current and proposed energy policy. Rather, this section is intended to highlight the role that policy plays in the adoption of community energy programs. Energy policy is an ongoing area of research interest that is being actively explored.

Research Gap

American energy production is undergoing a transition from centrally located fossil-fueled power generation, to distributed renewable energy production (Asmus 2010; Tan et al. 2012). As this transition occurs, community energy systems rely on emerging technological research into smart grids, distributed generation, and microgrids. Furthermore, ongoing research into best practices for business and policy models is also essential. Current research is active in the areas of technology, business, and policy in an effort to increase the widespread adoption of community energy. However, current research does not substantially consider the visual impact and physical footprint that community energy will have on urban areas. Renewable energy production within an existing community may not be desirable for all people (EPA 2020, A; Siemens 2011). This research examines this issue through the lens of landscape architecture and looks to address this research gap by developing community driven design recommendations for the integration of distributed generation into existing urban neighborhoods.

03.

Methodology

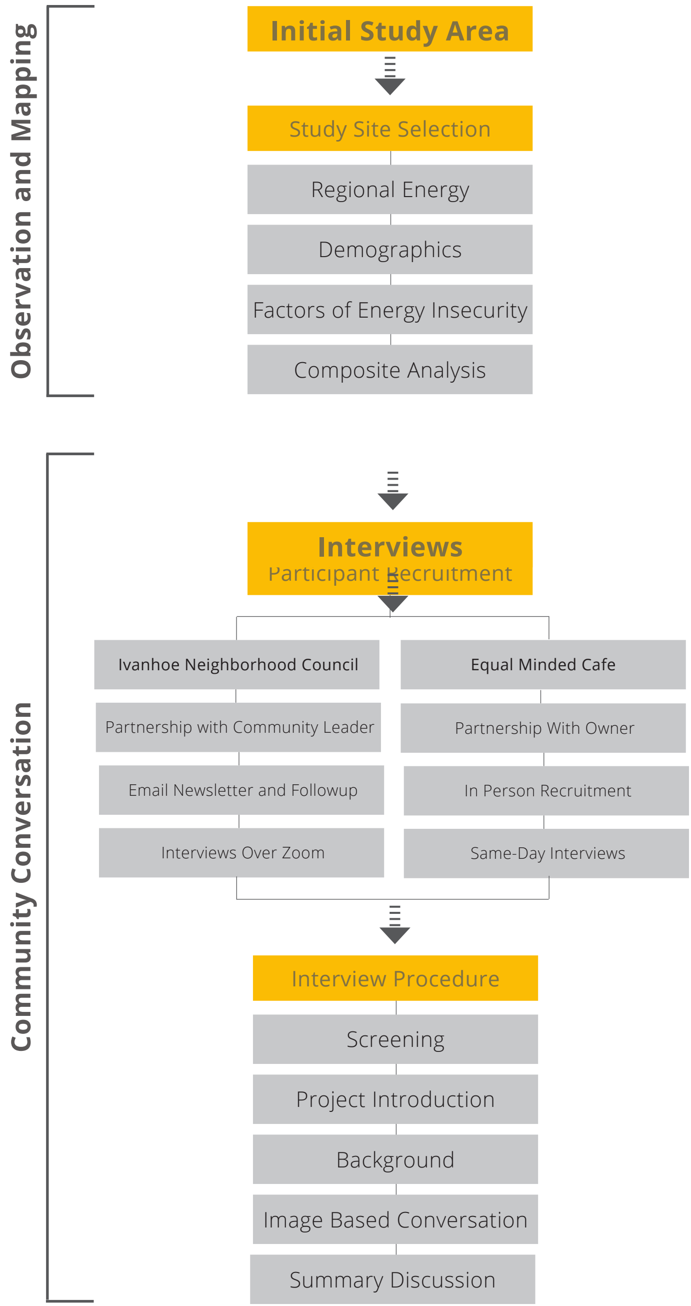


Figure 3.1
Methodology framework.

Study Site

Nine urban neighborhoods on the north side of the Brush Creek corridor in East Side Kansas City Missouri were initially selected for study. Collectively, these nine neighborhoods are referred to as the Brush Creek Community in this report. The study area is bordered on the south by Brush Creek, on the north by East 39th street, on the east by the Blue River, and on the West by Gillham road (Figure 3.2). The Brush Creek Community is home to 14,950 residents and is zoned primarily as single family residential.

The Brush Creek Community was selected as the study site for this research as the nearly 15,000 residents are particularly vulnerable to the combined impacts of energy insecurity, climate change, and aging energy infrastructure. The primary factors of energy insecurity identified in the literature review, including income level, educational attainment, race, and employment status, seem to be associated with energy insecurity impact of Brush Creek Residents more strongly than that of residents of the surrounding area. Within the Brush Creek Community, 28% of residents live below the federal poverty line compared to 11% nationally. The median household income within the Brush Creek Community is $29, 672 compared to the 2019 U.S. average household income of $68,703 (Census 2019).

Furthermore, historic redlining practices within Kansas City led to a sharp racial divide along Troost Avenue that may have significantly influenced the factors of energy insecurity within the Brush Creek Community. Currently, 60% of Brush Creek Community population is Black (primarily east of Troost, and 32% are white (primarily west of Troost). The demographic and socioeconomic makeup, combined with the urban context, situate the Brush Creek Community extremely well as a study area for the development of a community driven set of design recommendations for the integration of distributed generation into existing urban neighborhoods.

Data Collection

This research relies on two primary methods for data collection. First, a detailed site study was completed using remote and on-site observations and mapping. Second, semi-structured interviews with image boards were conducted directly with community members. The following two sections detail the site study and interview methods, and describe how the two methods were used together to generate meaningful information.

Study Site Selection Procedure

A robust community mapping process was completed to understand the current conditions of the study area. Data from the most recent census, Kansas City's Mid-America Regional Council, and the United States Energy Information Administration was collected for analysis. Using the collected data, three types of mappings were created. The first mapping (Figure XX) was used to define a reliance on fossil fuels for energy production. Additionally, the first mapping highlights the substantial transmission distance required from production to consumption. As defined in the literature, transmission lines are particularly vulnerable to damage during severe storms. The transmission distance required to bring energy to the Brush Creek Community highlights this vulnerability.

The second set of mappings present the demographics and socioeconomics of the Brush Creek Community and compare the results to Jackson County as a whole. Figures 3.3, 3.4, and 3.5 are used to contextualize the character of the study site.

Initial Study Area

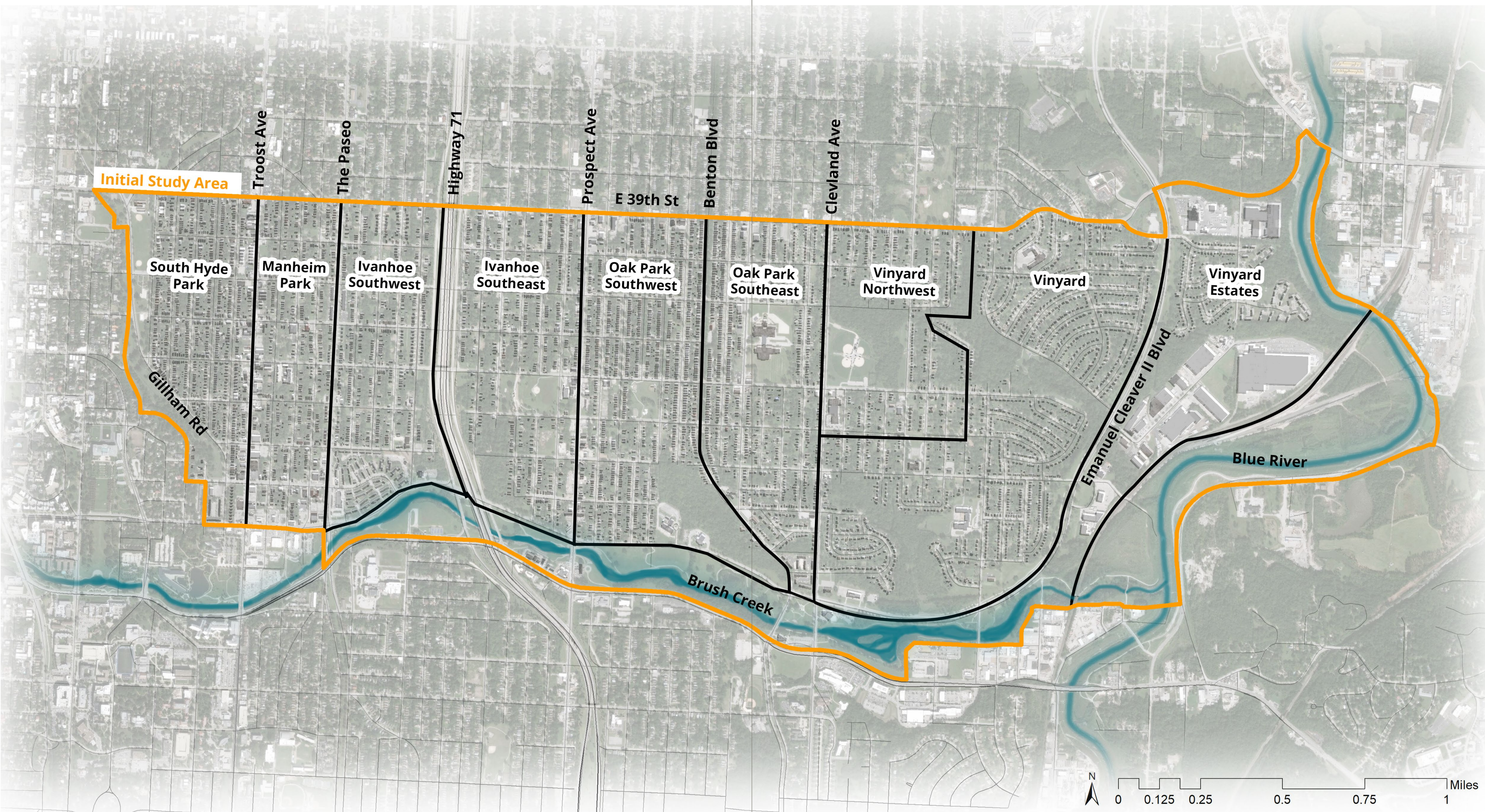


Figure 3.2
The initial study area included nine neighborhoods in Kansas City, Missouri.

Regional Energy Context

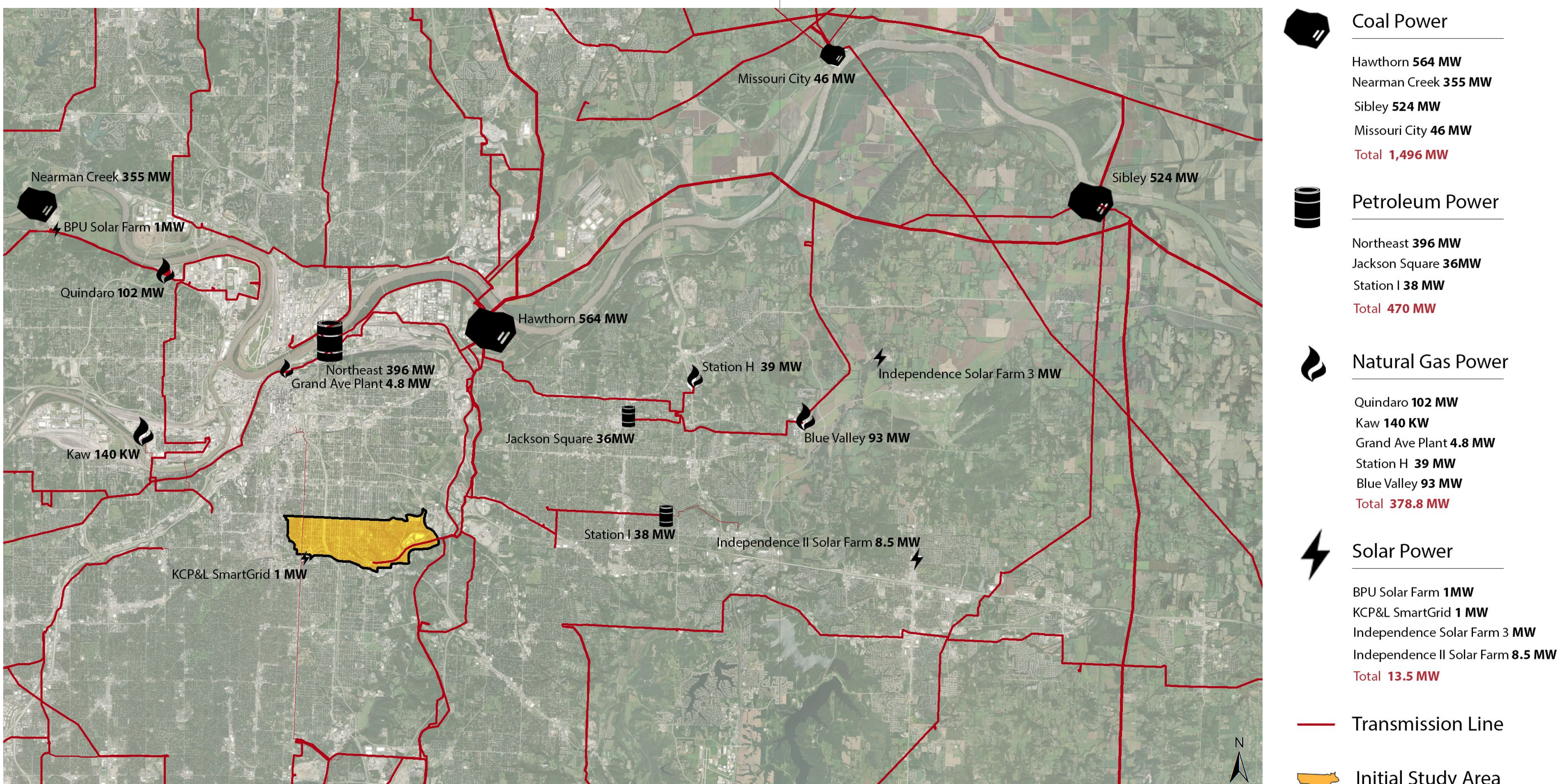


Figure 3.3
The initial study area relies almost entirely on the Hawthorn coal powered power plant. An extensive network of transmission lines are highlighted in red. The regional energy system is aging and vulnerable to the impact of sever storms.

Demographic Context

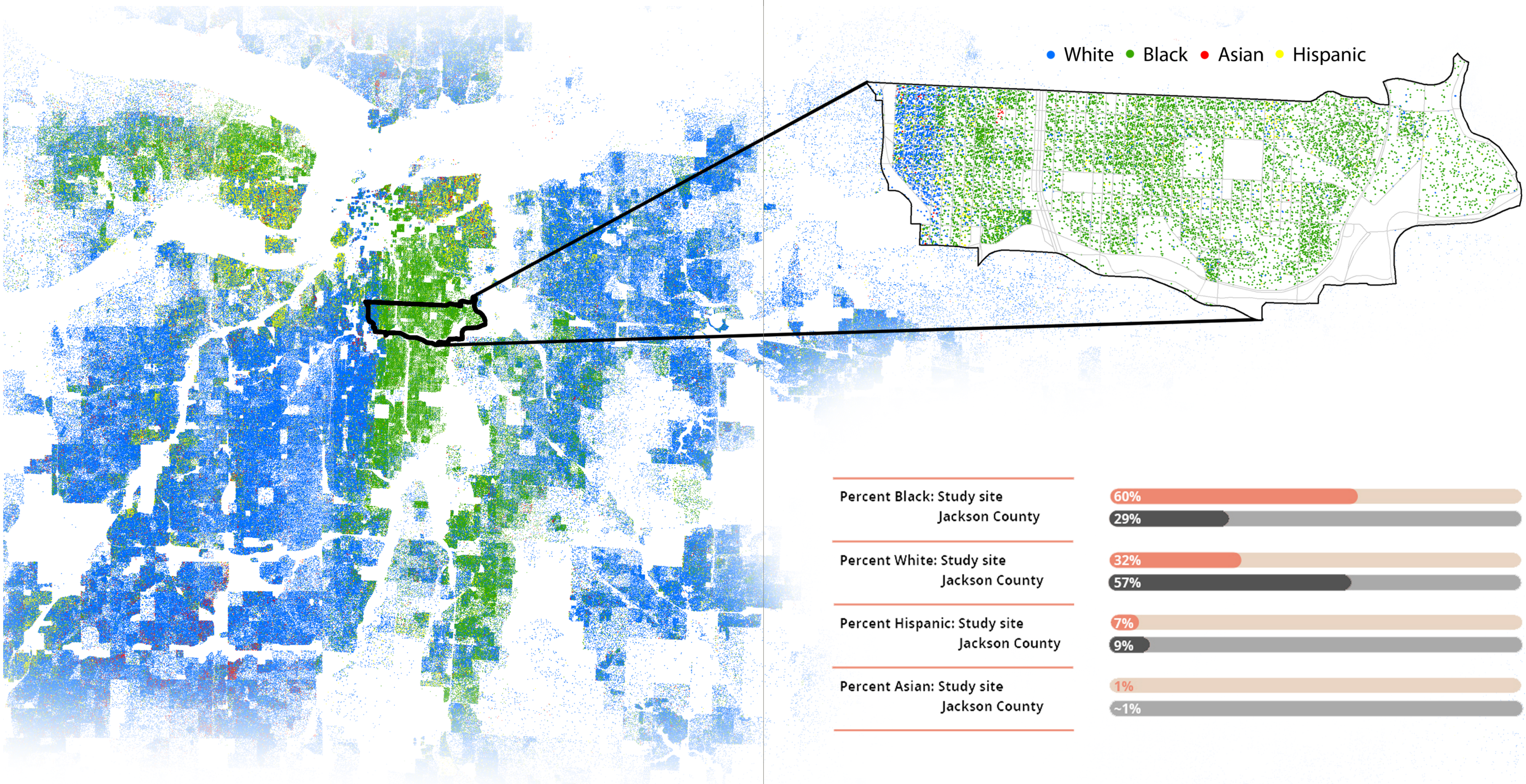
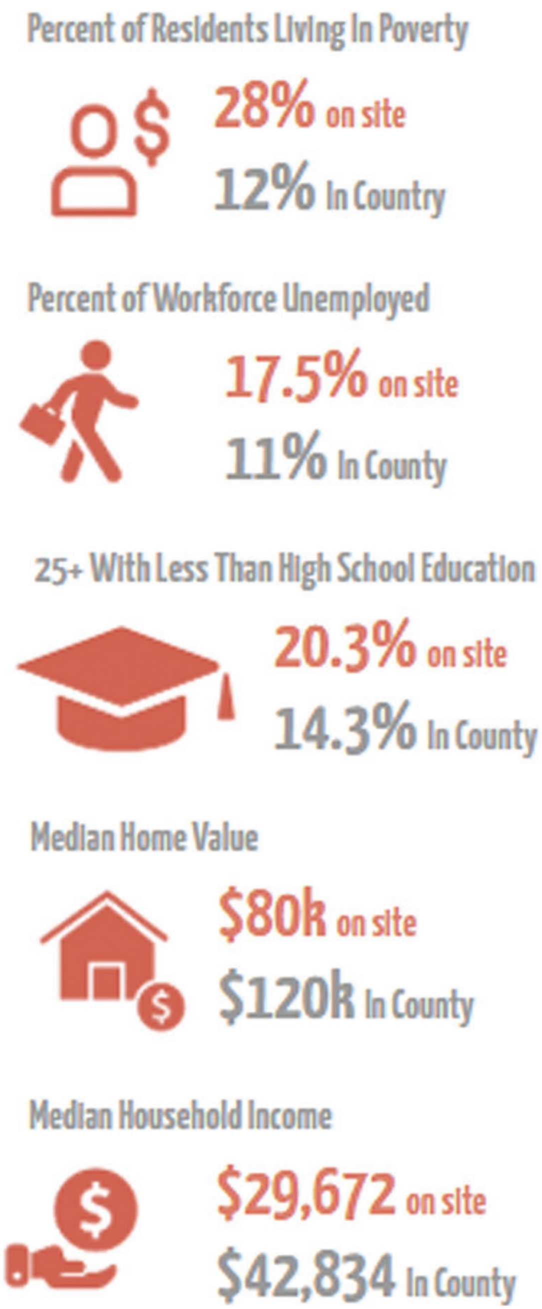


Figure 3.4
The above racial dot density map highlights population density and racial make up of the initial study site. A sharp divide between primarily white and primarily black neighborhoods can be observed along Troost Avenue.

Figure 3.5

Indicators of energy insecurity within study area compared to county context.



The third, and final, set of mappings were created to spatially present the primary indicators of energy insecurity within the initial study site. Mappings for unemployment (Figure 3.6), education (Figure 3.7), age (Figure 3.8), and income (Figure 3.9) were created using ArcGIS software using the most recent Census data. The resulting maps were first considered individually to assess which areas of the Brush Creek Community were facing the most significant challenges.
For each of the four indicators of energy insecurity, a focus area was defined at the Census tract level. The focus areas describe where within the Brush Creek Community the influence of energy insecurity is most severe. Each of the four factors of energy vulnerability mappings were layered on top of one another to define the most vulnerable area within the initial study boundaries. Figure 3.10 describes the layering approach used to identify the refined study site. Figure 3.11 depicts the refined study site.

Unemployment

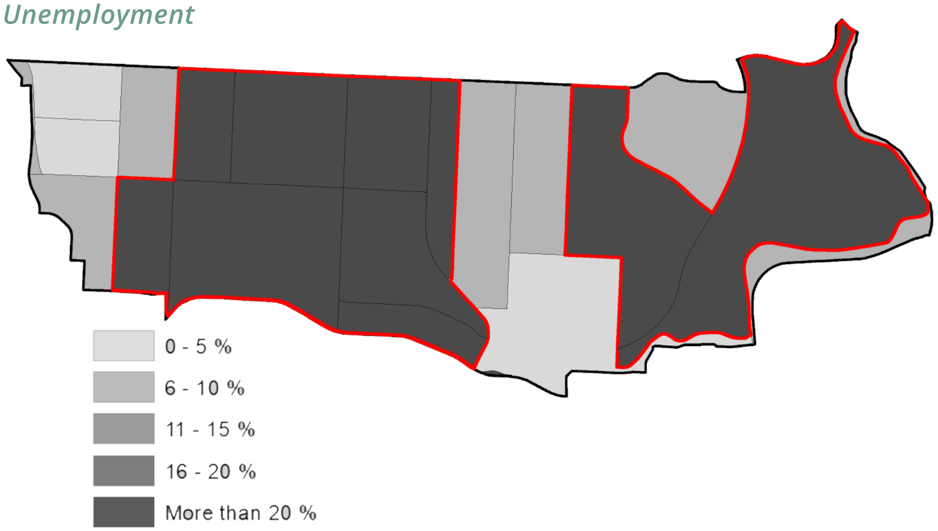


Figure 3.6
Unemployment is a key indicator of energy insecurity. The darkest areas of the map depict where unemployment is most severe within the initial study area.

Education

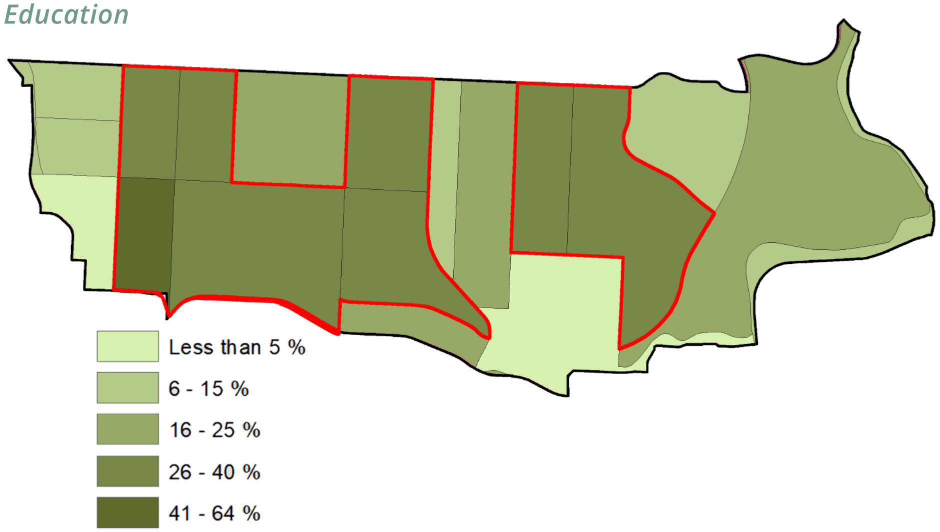


Figure 3.7
Within the study area, the areas highlighted in red have the lowest percentage of residents aged 25+ with less than a high school diploma.

Age 75+

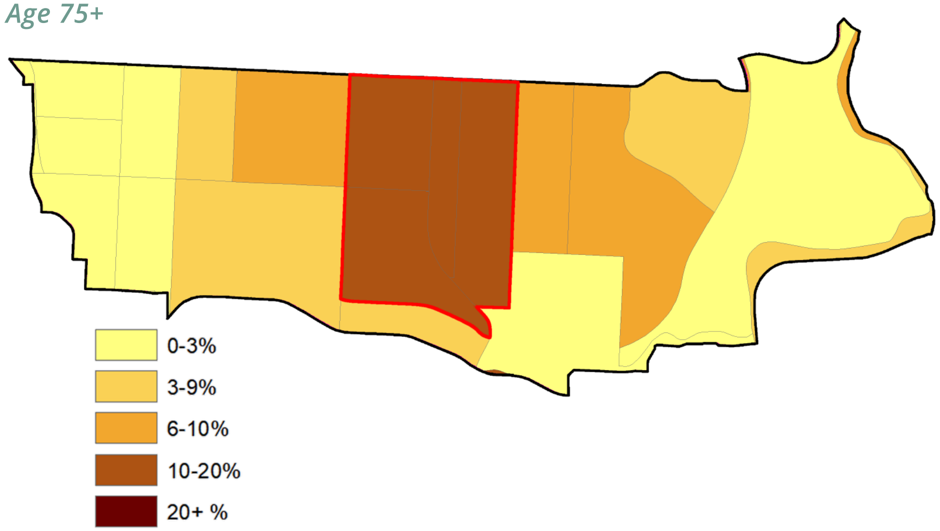


Figure 3.8
Elderly residents are most likely to feel the adverse impacts of energy insecurity. The dark areas of the map have the highest percentage of residents aged 75+.

Income

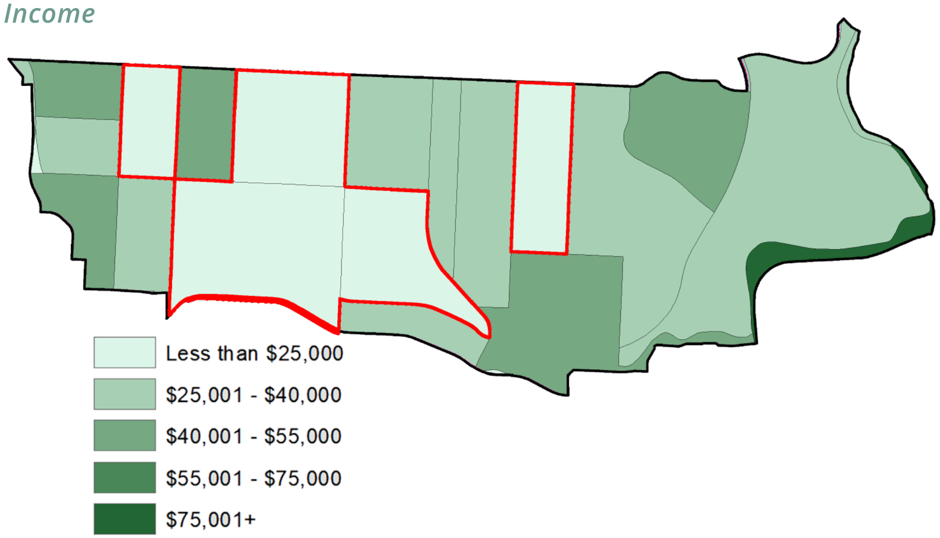


Figure 3.9
Low and fixed-income residents are most at risk of fluctuating energy prices and are most susceptible to energy insecurity when energy prices increase.

Figure 3.10
Layering the indicators of energy insecurity allows the initial study area to be narrowed down into a refined project site.

Community Conversation

Interview Tool

Semi-structured interviews using photo boards were conducted with members of the Ivanhoe and Oak Park Neighborhoods. An interview protocol was constructed to guide conversation and prompt participants to expand on their ideas. The interview tool consisted of five sections, three of which utilized photo boards. The complete interview tool is available in Appendix B.

Participant Recruitment

Interview participants were recruited in two primary ways. First, a partnership with the Ivanhoe Neighborhood Council was established. An informational flyer and summary text were provided to the Ivanhoe Neighborhood Council for distribution throughout the community via email.
The Ivanhoe Neighborhood Council also arranged for participants to utilize their facility to facilitate remote interviews over zoom for anyone interested in participating who did not have access to a computer or Internet at home. The partnership with the Ivanhoe Neighborhood Council generated approximately 10 interviews that were conducted remotely on Zoom.
As responses to email and phone messages dwindled, it was clear that an alternative participant recruitment process was needed in order to collect data in the limited time-frame of the study.

Refined Study Site

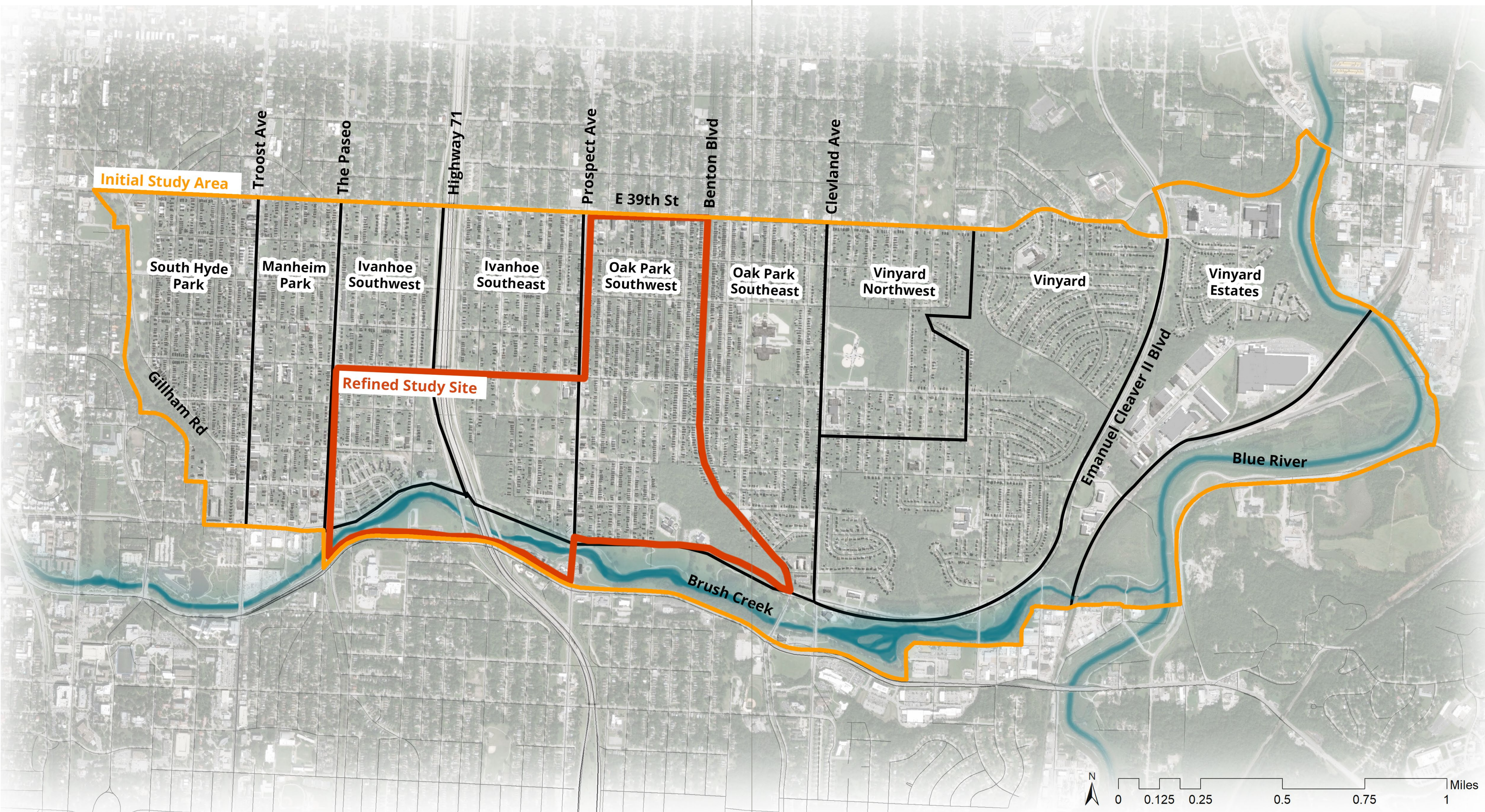


Figure 3.11
The site selection procedure was utilized to narrow the project focus from 9 neighborhoods to the above refined study site.

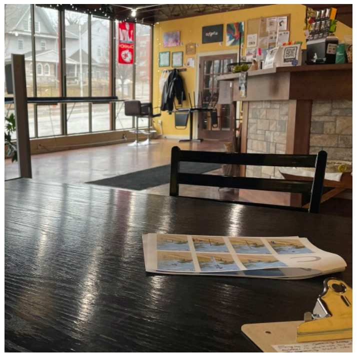


Figure 3.12
In person interviews were conducted within the Equal Minded Cafe with members of the community.

Participant Recruitment Continued

The second recruiting method was to spend time throughout the month of January 2021 in a local café and coffee shop. Equal Minded Cafe & Event Center was utilized to recruit participants on both weekdays and weekends in an attempt to reach as many people as possible. Potential participants were approached for same day interviews within the café. Figure 3.12 shows the interview setting.

Figure 3.13 describes the location of both community partners utilized to recruit participants.

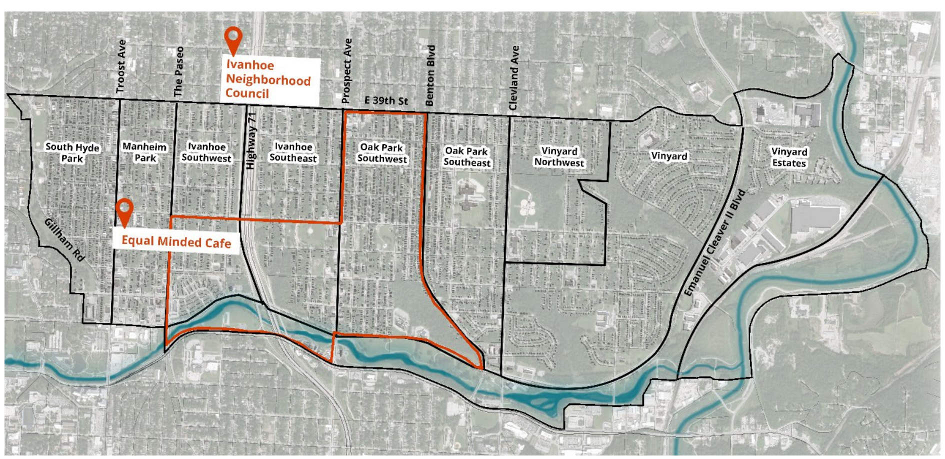


Figure 3.13
The Ivanhoe Neighborhood Council and Equal Minded Cafe were both key partners in participant recruitment.

Interview Procedure

Both participants that were recruited for Zoom interviews and participants that were recruited at Equal Minded Café completed the same procedure with the primary difference being the collection of audio data. Participants were initially informed of the researcher's name, the name and purpose of the study, the structure of the interview, and were made aware of the anonymous audio recording for later transcription and analysis. Next, participants were asked a series of brief demographic questions to ensure eligibility to participate in the study. In accordance with the approved IRB protocol, only participants between the ages of 18 and 65 that were resident of the refined study site were interviewed. Following the completion of the introduction and demographic questions, the main body of the interview could take place.

First, participants were asked a series of background questions relating to their familiarity with renewable energy. These questions were intended to provide context for the answers to the subsequent sections of the interview.

Second, the first set of image-based questions about different forms of renewable energy in a neighborhood park setting were asked. The imagery included a spectrum of integrated to stand alone installations. Participants were asked to respond with initial thoughts, preferences, and concerns. Their answers prompted follow up questions that looked to uncover the rationale behind their response. Participants were also asked to identify two images that they would most like to see within their neighborhood.

The next set of image-based questions asked participants to respond to different options for battery storage facilities. Again, participants were asked the same set of questions as the first image set and were asked to identify two preferred installations. The process was repeated a third time for images related to the installation of renewable energy within the streetscape setting.

Lastly, a series of reflection questions were asked of participants. These questions were designed to understand how participants feel about the potential of the presented imagery coming into their neighborhood. This series of open-ended questions opened up a broader conversation about urban renewable energy and how participants view the impact of the potential changes of the presented imagery.

For remote participants that were reached using Zoom, the built-in recording function was utilized to collect anonymous data. Following the completion of the interview. The audio only file was archived for future analysis. For in person participants at Equal Minded Café, an external microphone was connected to an iPhone 12 to record audio. The mobile application "Rev Voice Recorder" was used to collect the audio.

Responses

In total, 25 interviews were conducted with members of the community. Interview responses included 11 female and 14 male participants. Figure 3.14 describes the age and gender make up of interview participants. Of the interviewed participants, 20 were current residents, 2 were former residents, and 3 lived very nearby.

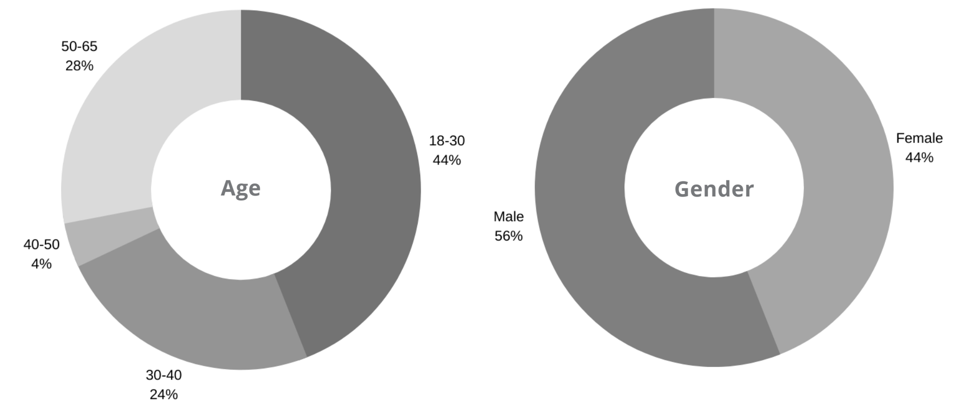


Figure 3.14
Age and gender composition for interview participants.

04.

Analysis and Findings

Thematic Content Analysis

Thematic content analysis began with an overview of all audio recordings. During the familiarization process, each recording was listened to and notes were taken on particularly interesting points, concepts, or ideas. Following an overview of the audio recordings, a manual transcription process was completed. Audio from each interview was played and transcribed into a plain text word document. A new plain text word document was created for each of the 25 interviews. Completion of the audio transcription process resulted in interview data totaling 40,000 words.

Following familiarization and transcription, the entire data set was reviewed using a descriptive coding process. The coding process involved highlighting key ideas or concepts and assigning the selected text a descriptive code. For example, one interview participant stated “I am basic. I like, you know if it is a car, it should look like a car. If it is a panel, it should look like a panel. It doesn’t have to be disguised or dressed up or dressed down.” This statement was assigned to the descriptive code “Aesthetics”. This process was repeated until the entirety of the data set was reviewed. Upon completion of the descriptive coding process 30 unique codes were identified.

Next, an excel spreadsheet was created to collect and organize the coded data set. Participants were listed down the left-hand side of the table and codes were listed across the top of the chart. Coded data from the plain text transcriptions was next moved into the data table in relation to its code and participant number. Reference Appendix C for the coded data table. The coded data table facilitated two types of review. First, the data table allowed analysis of each code. By reviewing individual columns, conclusions could be drawn that relate to how the specific code was talked about across participants. Second, reviewing rows allowed for analysis of how each participant talked across codes. This review process was foundational for the identification of themes.

Lastly, analysis of the coded data table allowed for a further reduction of codes into themes. Defined themes consist of multiple codes that share a central idea. Themes were identified following a detailed analysis of the coded data chart. Ultimately 6 central themes were identified following the familiarization, transcription, and coding processes.

Completion of the thematic content analysis provides insight into how participants view renewable energy in an urban setting and what their concerns are while providing valuable context for their image preference selections.

Image Key Word Analysis

The image keyword analysis is applied specifically to identify key words used to describe the presented imagery. An excel spreadsheet was first set up to collect the data. Image numbers are listed down the left-hand side and participants are listed across the top of the table. The full image keyword table can be found in Appendix C. The key word analysis began with a review of the transcribed data set. Any time in the transcription that a participant spoke directly about an individual image, those comments were included in the image analysis key word chart. Similar to the thematic content analysis chart, the image key word chart allowed for the data to be reviewed both across participants and as individual participants.

Additionally, during the interview process, participants were asked to identify their top 2 preferences for each image set. The image preference results were tallied in the keyword analysis table.

Data from the keyword analysis was utilized to understand how the preferred imagery was talked about in comparison to the rest of the imagery. The keywords associated with both desirable and undesirable imagery were considered in the development of design recommendations.

Findings

Results of the thematic content analysis and image keyword analysis were utilized to inform 6 themes relating to the integration of renewable energy in an urban area. Figure 4.1 describes the consolidation of codes into themes. This research suggests that themes of identity, aesthetics, function, proximity, education, and interest are critical to the successful implementation of renewable energy in an urban setting. The following sections present each theme, the included codes, the key findings from that code, and the resulting design recommendations. This process is described in Figure 4.2

Coding Analysis

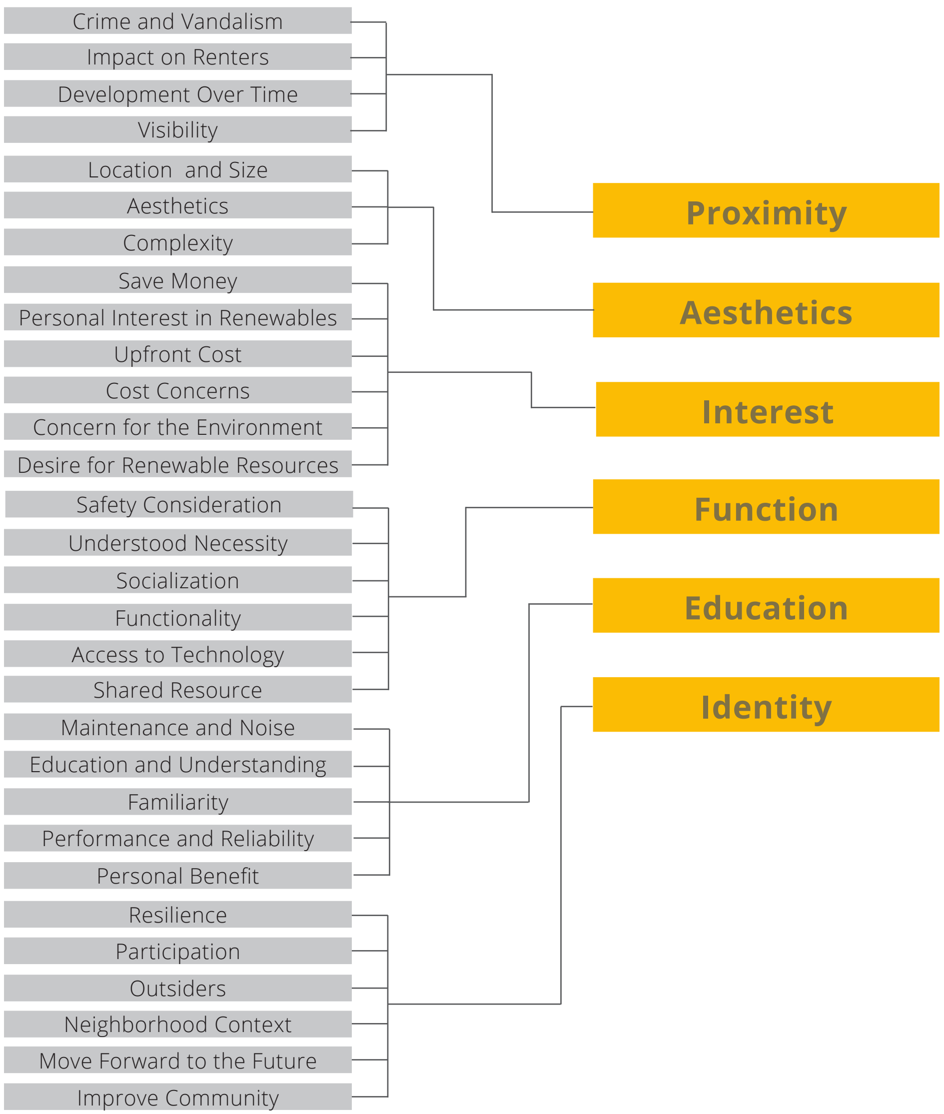


Figure 4.1
Initial review of transcribed data identified 30 ideas. Subsequent review and analysis grouped multiple similar groups into 6 key themes.

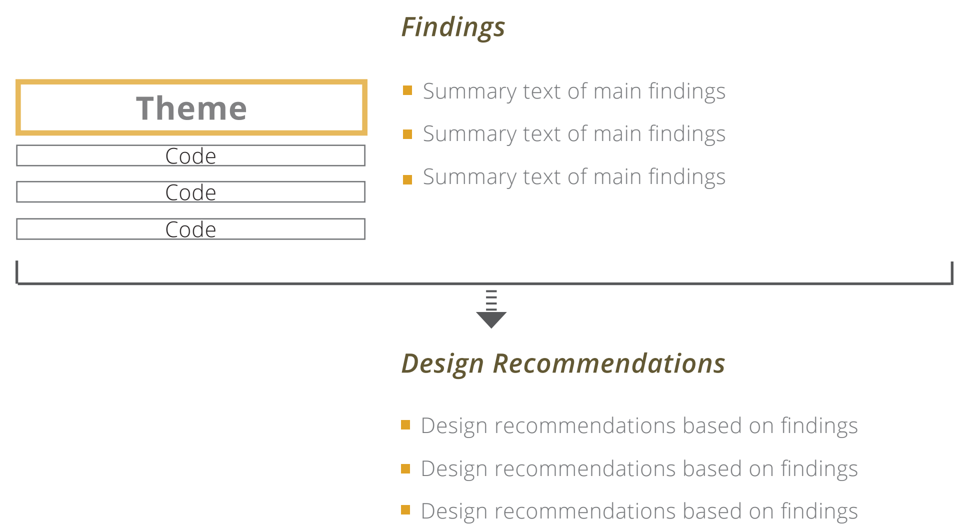


Figure 4.2
Key findings for each theme were identified based on the interview data. Design recommendations for each of the six identified themes were then created in response to the theme findings.

Figure 4.3 *Image Set A: Neighborhood Park Key Words*

The following key words were most frequently used to describe the presented imagery. Outlined imagery was identified by participants as most preferred. Bold text indicates increased frequency of use by participants. Image keyword data was also considered in the creation of the design recommendations.

Little
Individual
Unsubstantial
Small
Tip Over
Self-sufficient
Multi-Use
Ambiguous
Costly
Individualized
Helpful

Gathering
Funky
Functional
Limited Use
Too Accessible
Open
Sculptural
Artistic
Confusing
Leisure
Modern

Technology
Unattractive
Open
Shelter
Incorporated
Socialization
Gathering
Useful
Usable
Seating
Charging

Image Keyword Analysis

Structure
Fits In
Attractive Presentation
Desirable location
Familiar
Usable
Inconspicuous
Unchanging Experience
Functional
Gathering
Socialization

Space Age
Abstract
Attractive
Out of Sight
Wide Open
Different
Modern Art
Nelson Atkins
Trees
Unclear
Interesting

Familiar
Waste of Space
In the Way
Breaks up Landscape
Easily Damaged
Intrusive
Eye Sore
Traditional
Chunky
Bulky
Neutral

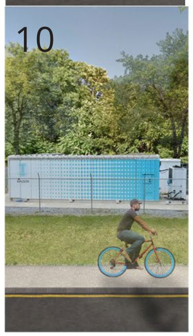
Initially Unclear
Tree-Like
Fits into Landscape
Whimsical
Artsy
Innovation
Curious
Unique
Nelson Atkins
Harmless
Duel-Purpose

Figure 4.4 ***Image Set B: Battery Storage Key Words***

The following key words were most frequently used to describe the presented imagery. Outlined imagery was identified by participants as most preferred. Bold text indicates increased frequency of use by participants. Image keyword data was also considered in the creation of the design recommendations.

Fine
Educational
Informational
Modern
Professional
Interaction
Instruction
Cute

Temporary
Industrial
Fine
Shipping Container(Negative)
Hunk of Metal
Draws Attention (Negative)
Eye Sore
Private
Port-A-Potties
Factory



Industrial
Prison
Fixing Up
Powerful
Secure
Eyesore
Unfriendly
Machinery
Unappealing
Unwelcoming

Unclear
Dangerous
Cool
Odd
Interesting
Incorporated
Interactive
Fun
Usable
Unsafe

Placemaking
Rad
Art Crate
Understandable
Art Installation
Okay
Desirable
Easy
Quick Adoption

Fine
Okay
Neutral
Compact
Run-of-the-mill
Whatever
Unhelpful
Standard
Curious

Blend In
Preferred
Unbothered
Blend In
Familiar
Nothing New
Air Conditioning Unit
Typical

Figure 4.5 ***Image Set C: Streetscape Key Words***

The following key words were most frequently used to describe the presented imagery. Outlined imagery was identified by participants as most preferred. Bold text indicates increased frequency of use by participants. Image keyword data was also considered in the creation of the design recommendations.


15

Very Nice
Standard
Looks Cool
Practical
Easy
Blend In
Functional
Shade
Easy
Blends In
Enjoyable


16

Gathering
Funky
Functional
Limited Use
Too Accessible
Open
Sculptural
Artistic
Confusing
Leisure
Modern


17

Desirable
Crafty
Normal
Traditional
Slender
Artful
Busy
Functional
Art
Modern Pleasing
Snazzy


18

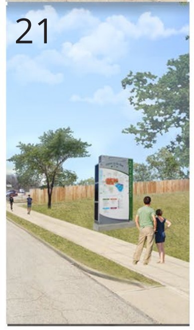
Structure
Fits In
Attractive Presentation
Desirable location
Familiar
Usable
Inconspicuous
Unchanging Experience
Security
Minimal
Stands Out


19

Space Age
Abstract
Attractive
Out of Sight
Wide Open
Different
Modern Art
Nelson Atkins
Trees
Unclear
Interesting


20

Familiar
Waste of Space
In the Way
Breaks up Landscape
Easily Damaged
Intrusive
Eye Sore
Traditional
Chunky
Bulky
Neutral


21

Security
Identity
Blend In
Easy
Street Car Tie-In
More of the Same
Unclear
Too Big
Informational

Identity

Resilience
Participation
Outsiders
Neighborhood Context
Move Forward to the Future
Improve Community

Findings

- Expressed desire to demonstrate that the neighborhood is advancing.
- Project to others that the neighborhood is not being left behind.
- Interest in developing neighborhood identity and pride through renewable energy
- Participants expressed desire to participate in something bigger
- Branding and signage of renewable energy installations can strengthen sense of community.
- Desire for community ownership for community benefit - Hesitant of the intentions of outsiders.
- Desire for community partnerships with local artists, community gardens, and churches to increase involvement.
- Desire to influence the identity through participation in design.
- The Nelson-Atkins Museum of art is a source of pride and participants express a desire for installations that build upon that identity.
- Neighbors helping neighbors through energy production and storage is reflective of the spirit of living in an urban community.

Design Recommendations

- Community energy installations should be located near prominent community institutions (churches, schools, etc.).
- Incorporate wayfinding and branding throughout the project area to clearly define the project site as a community energy district.
- Work to strengthen, rather than replace, existing local identity through community energy.

Aesthetics

Location and Size
Aesthetics
Complexity

Findings

- Artistic installations are preferred, even with a higher degree of complexity and larger physical footprint.
- Familiar applications are preferred.
- Similarity to existing infrastructure is not desired.
- Present installations as what they are.
- Clustering and repetition can be overpowering.
- Singular, well integrated, large installations are preferred over several smaller installations.
- Open to a wide range of aesthetics within the urban environment.
- Aesthetics come second to functionality when deciding preference.
- Installations do not need to blend in, but they should fit in.
- Vacant lot improvement through renewable energy is desirable to address underutilized space.
- Descriptions such as bulky, clunky, or busy are most commonly used to describe undesirable installations.

Design Recommendations

- Limit the percentage of the project area that is visually broken up by renewable energy instillations.
- Preserve sight lines
- Maximize usage of existing surfaces (i.e. roof surfaces, park structures, etc.).
- Establish partnerships with local artists.
- Incorporate installations with a greater degree of visual quality and function rather than undertaking efforts to disguise or hide installations.
- Avoid industrial elements and simplify surface complexity.

Function

- Safety Consideration
- Understood Necessity
- Socialization
- Functionality
- Access to Technology
- Shared Resource

Findings

- Clear preference for installations with dual functionality
- Art is a defined secondary function and significantly influenced preference
- Colored company branding was preferred over unpainted.
- Functionality was the defining factor for image preference
- Installations should be significant enough for tangible benefits.
- Desire to access and use technology in outdoor spaces in association with energy production.
- Safety concerns were most prominent for installations that had the largest on-ground footprint.
- Fencing was both desirable and undesirable. In situations where safety was a concern, fencing was preferred. In situations when safety was not a concern, fencing was undesirable.

Design Recommendations

- Establish multi-function installations that promote social interaction.
- Design projects of all scales should plan for, and accommodate energy production.
- Highly visible and frequently accessed locations should provide additional functionality such as seating, charging, shade, or art.
- Minimize on-ground footprint for production installations. Moving panels and turbines out of the line of sight is desirable.

Proximity

- Crime and Vandalism
- Impact on Renters
- Development Over Time
- Visibility

Findings

- Significant support and excitement for incorporation into local community.
- No major aversion to seeing the presented imagery on a daily basis.
- Desire to incorporate installations within clearly defined public space
- Preference is contingent upon additional functionality.
- Well integrated installations are preferred. Preference for things that are not necessarily hidden, but that blend into the context.
- Strong desire to watch community energy develop over time.
- The use of vacant lots of battery storage is generally accepted. An over abundance of vacant lots limits concerns of limiting housing development.
- Theft and vandalism are of greatest concern for ground level installations.
- Concerns of vandalism are closely associated with ongoing maintenance.

Design Recommendations

- Highly trafficked areas should emphasize additional functionality and aesthetics.
- Less visible installations should focus less on function and aesthetic and more on production.
- Limit visual impact of installations near the edges of the project site.
- Implement design strategies to limit the visual impact from any one perspective.
- Intentional phasing is key. Emphasize tangible benefits first to build interest and increase acceptance.
- Limit physical access directly to solar installations at ground level.

Education

- Maintenance and Noise
- Education and Understanding
- Familiarity
- Performance and Reliability
- Personal Benefit

Findings

- Strong desire to know what is going on, what the installations are, and what the benefits are
- Consistently stressed the importance of signage
- Branding, advertising, and storytelling were frequently mentioned to increase community acceptance
- Tangible benefits are key, and a personal story that residents can identify with
- Proposed changes are welcome, but clear understanding of every step from planning to post implementation must be clear.
- Comfortability with the idea of urban renewable energy is associated with familiarity. The more familiar the installation is, the more comfortable the idea becomes.
- Concerns about performance and reliability should be addressed through active education.
- Level of acceptance may evolve as participants become more knowledgeable about the installations.

Design Recommendations

- Strong presence of educational signage near highly visible installations.
- Situate educational resources in highly trafficked walkways.
- Target educational signage where urban users are already spending time such as bus stops.
- Develop a detailed hierarchy of educational opportunities that includes park programming, jobs training, social media campaigns, and physical signage.

Interest

- Save Money
- Personal Interest in Renewables
- Upfront Cost
- Cost Concerns
- Concern for the Environment
- Desire for Renewable Resources

Findings

- Many residents have already actively considered renewable energy for their own homes, but found the upfront cost prohibitive.
- Even with high interest in renewable energy, participants were unclear of the steps to move forward with renewable energy.
- Interest is driven primarily by personal cost considerations and followed by concern for the environment.
- Participants stated that they would feel good about having renewable energy in their community.
- Concern for tax increases and overall increase in their monthly bill.
- Preference for community solutions and shared ownership.
- Participants express frustration with current limited options for energy source. Especially the lack of control over how energy is produced.

Recommendations

- Entry and participation to community energy programs should be clear and understandable.
- Consider financial models that reduce or eliminate upfront cost burden and distribute expenses over time.
- Establish preliminary interest groups to gage neighborhood interest.
- Facilitate the development of community energy systems that provide residents choice and control over their energy systems.

Summary of Findings

Results described under 'findings' for each of the six identified themes provide meaningful insights useful in answering the proposed question "What design characteristics of renewable energy generation are visually preferred by neighborhood residents?"

Participants utilized language such as familiar, educational, artful, easy, and appropriate to describe preferred imagery. Conversely, language such as industrial, unhelpful, standard, and bulky were commonly used to describe the least desirable imagery.

Furthermore, results of the thematic content analysis provide additional clarification to the proposed research question. Each of the six identified themes provides specific desires, concerns, fears, and indifferences expressed by participants. When considered together, the results of the Image keyword analysis and the thematic coding process provide meaningful insight into how urban residents view the physical footprint and visual impact of renewable energy.

With an understanding of how urban residents view the physical footprint and the visual impact of community energy installations, the findings are next to be translated into ideas used to answer the research question "How can visual preferences be incorporated into a set of design recommendations?" Each of the six themes detail specific design recommendations informed directly by the community conversations.

In the final chapter, the research findings are applied to a design outcome used to answer the primary research question "How can landscape architects address the physical footprint and visual impact of renewable energy production in an urban setting?"

05.

Application to Design

Application to Design

The first half of the project methodology focused on observation and mapping and utilized a site selection procedure that defined the southern half of the Ivanhoe Southeast neighborhood as being vulnerable to energy insecurity. The second half of the methodology focused on the creation of design recommendations derived from community conversation.

The following conceptual design project merges the results of both halves of the methodology by applying the proposed design recommendations to the identified vulnerable neighborhood of Ivanhoe Southeast.

Ivanhoe Energy District

The Ivanhoe Energy District is composed of three complementary components that make up a larger district energy masterplan. Each of the three components build upon one another to create a conceptual community energy masterplan that integrates renewable energy infrastructure into an existing urban area.

(1) The Ivanhoe Neighborhood Energy Corridor - A proposal to strengthen identity through renewable energy and build awareness.

(2) Ivanhoe Neighborhood Energy Storage - An approach to vacant lot improvement for community energy storage facilities.

(3) Ivanhoe Energy Park - A neighborhood park redevelopment for energy production.

The proposed community energy masterplan is conceptual in nature and is intended to advance community conversation rather than provide a rigid solution.

Community conversations support a desire for community energy projects in urban areas. The following conceptual design depicts one possibility for bringing community energy to the Ivanhoe Southeast neighborhood.

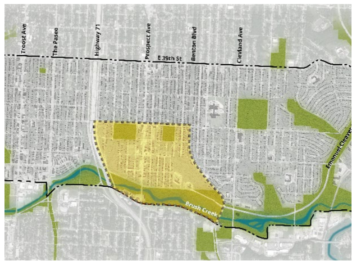


Figure 5.1
Ivanhoe Energy District Key Plan

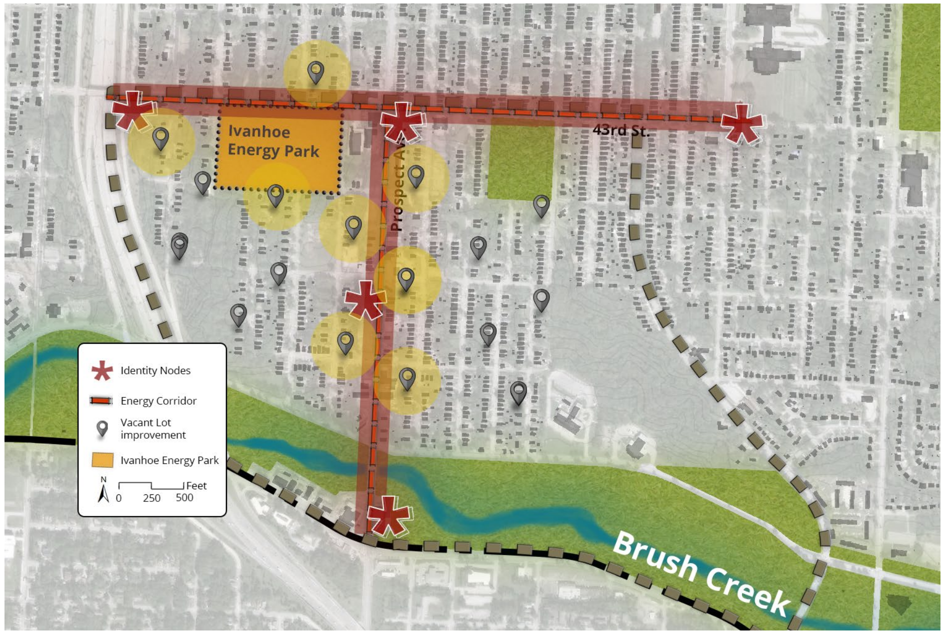


Figure 5.2
Overall project masterplan for design interventions based on research findings. Ivanhoe Park, adjacent vacant lots, and the streetscapes of 43rd and Prospect are highlighted.

Ivanhoe Neighborhood Energy Corridor

Figure 5.3
Key plan describing the location of the neighborhood energy corridors within the proposed Ivanhoe Energy District.

Site Selection

Primary vehicle and pedestrian corridors of 43rd street and Prospect avenue were selected for development into the Ivanhoe Neighborhood Energy Corridor. Both 43rd street and Prospect avenue are highly trafficked by local residents as well as greater Kansas City drivers as they pass through the Ivanhoe Neighborhood. This site selection aims to increase awareness of the newly established energy district both within and outside of Ivanhoe.

Site Programming

The Ivanhoe neighborhood energy corridor programming consists of streetscape improvements targeted at developing identity around urban renewable energy generation. Branding and wayfinding are abundant through the corridors to identify the newly defined energy district. Furthermore, streetscape improvements such as charging stations and new site furnishings further define the district. Lastly, clusters of streetscape improvements are located near key bus stops to further increase awareness and familiarity.

Application of Design Recommendations

Consistent, unified branding through the development of district branding primarily addresses the defined recommendations for identity. Additionally, streetscape improvements throughout the energy corridor target the design recommendation of function. Furthermore, by strengthening branding near areas of high pedestrian and vehicular traffic (such as bus stops) the Ivanhoe neighborhood energy corridor begins to address awareness and understanding. As more significant urban renewable energy projects are established in the community, local residents are already familiar with the concept and benefits. Community conversations indicated that local residents are excited about urban community energy production, but the process and implementation should be clear and understandable. Through wayfinding, branding, and streetscape improvements, the Ivanhoe neighborhood energy corridor will serve to lay the foundation for further community energy projects.

Section Focus

The following section describes the location of identity nodes and energy corridors. Additionally, this section includes a conceptual design proposal for an Ivanhoe neighborhood energy district signage family. The signage family includes educational, wayfinding, and branding sign examples for use throughout the Ivanhoe Energy District. Lastly, a before and after perspective is included to visualize the application of the proposed design concept.

Figure 5.4
An inventory of existing neighborhood characteristics identifies existing bus stops, vacant lots, and local businesses to inform the location of identity nodes and energy corridors.

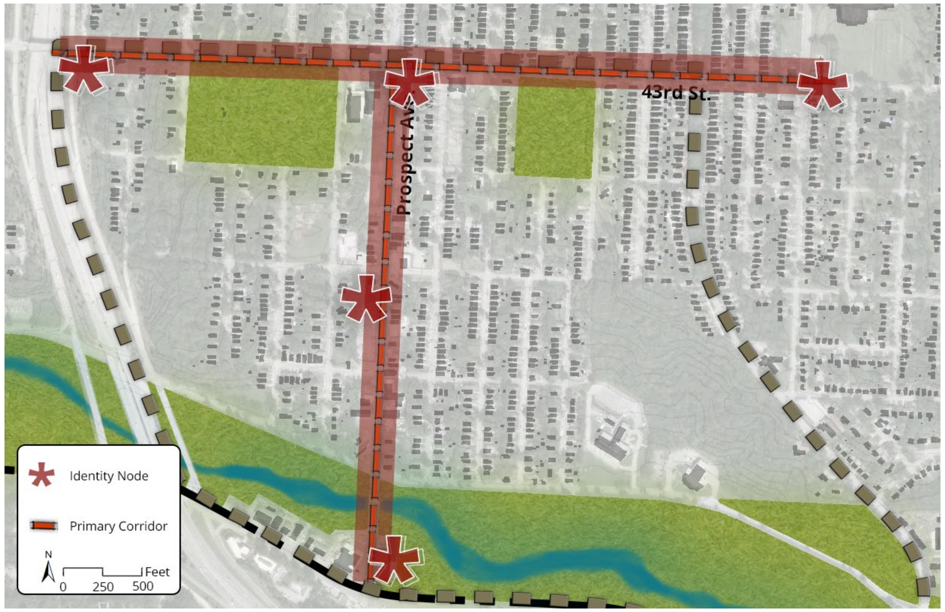


Figure 5.5
Prospect Ave and 43rd Street are identified for development into the Ivanhoe neighborhood energy corridor. Identity nodes capitalize on existing pedestrian traffic to increase awareness and familiarity throughout the district.

Identity Nodes

Identity node locations are clusters of wayfinding, branding, and streetscape improvements relating to urban energy. Identity node locations were selected for their proximity to existing bus stops and increased presence of pedestrian traffic. Streetscape improvements in these locations provide the greatest degree of functionality.

Energy Corridors

Streetscape improvements are intended to link identity nodes while increasing identity and walkabilty. These improvements include the incorporation of additional site furnishings. To strengthen identity and reinforce the energy corridor concept, site furnishings should include elements of renewable energy such as solar powered charging benches.

Small charging stations for phones and tablets were identified by interview participants as being useful in a streetscape setting. Locating charging stations throughout the energy corridor provides a tangible benefit for local residents.

District branding, pictured in Figure 5.6 and 5.7, clearly defines identity and should be consistent through the energy corridor, vacant lot development, and neighborhood park settings. The following section describes district branding in detail.

District Branding | Signage Family

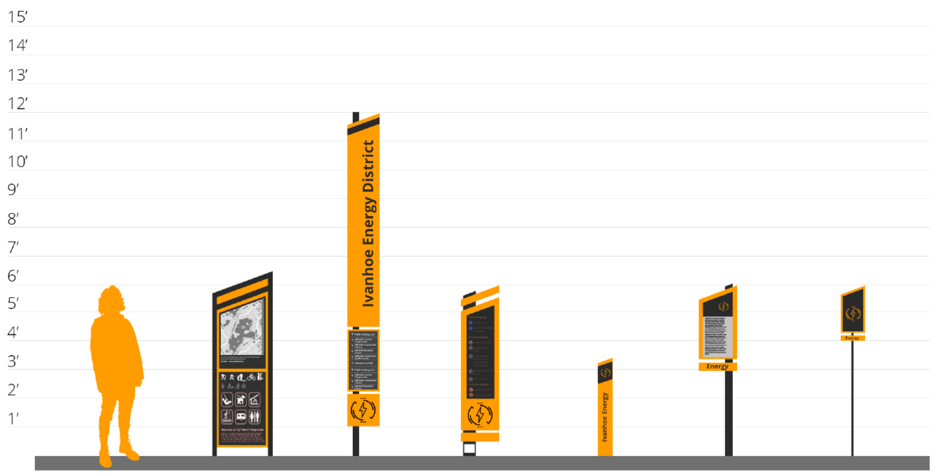


Figure 5.6
Examples of branding and signage for the Ivanhoe Energy District. Informational signage provides educational opportunity and enhances awareness. Additionally, consistent branding ties together various elements of the district energy masterplan to increase clarity throughout the entire district. Pictured signage is ideal for vacant lot redevelopment projects and the Ivanhoe Neighborhood Energy Park.

Figure 5.7
Examples of branding and signage specifically for the streetscape setting. Street signs, lighting elements, and bus station kiosks are depicted.

Figure 5.8
Existing conditions along Prospect Avenue. Overhead transmission lines are highly visible and do not contribute to development of district identity.

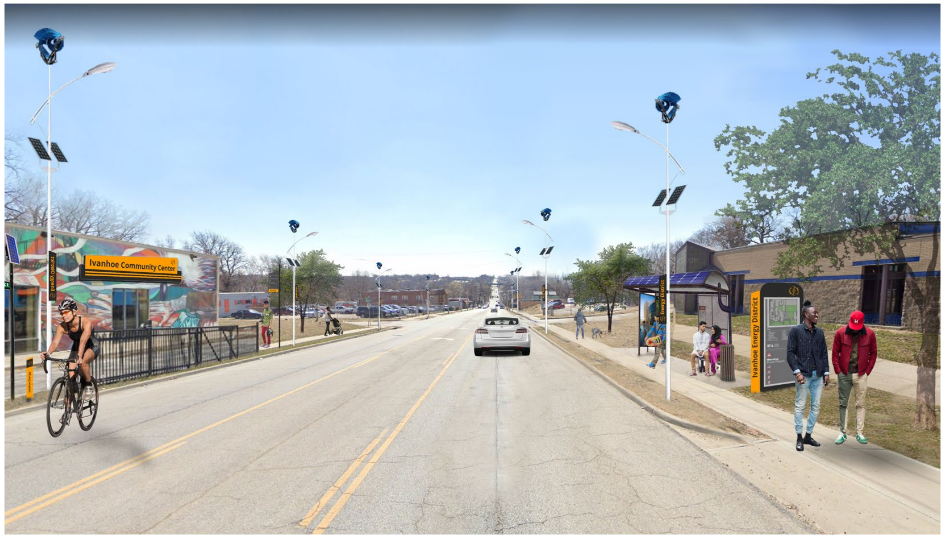


Figure 5.9
Proposed conditions along Prospect Avenue in the development of identity through renewable energy. Streetscape improvements are clustered near high traffic areas.

Figure 5.10
Key plan describing the location of vacant lots for development along the energy corridor.

Ivanhoe Neighborhood Energy Storage

Site Selection
Neighborhood energy storage sites were selected based on the presence of 1 or more adjoining vacant lots. Additionally, even distribution throughout the district was influential in site selection.

Site Programming
The following section describes a spectrum of potential site programming that ranges from limited additional functionality to high additional functionality based on proximity to the Ivanhoe Energy Corridor. Detailed information on site programming is presented in the following section.

Application of Design Recommendations
Ivanhoe Neighborhood Energy Storage primarily addresses the themes of proximity and function with education, aesthetics, and identity also playing supporting roles. First, due to the proximity of selected energy storage lots to residential units, the proposed vacant lot redevelopment focuses on limiting the visual impact of infrastructure from the edges of the site and emphasizing additional functionality. Furthermore, the proposed design promotes social gathering to promote education, awareness, and familiarity with the proposed energy storage infrastructure. Lastly, consistent branding in the form of the proposed signage family helps to unify this redevelopment effort with the larger concept of the Ivanhoe Energy District.

Figure 5.11
Elements of district energy masterplan are connected through the energy corridors. Streetscape improvements and branding link together Ivanhoe energy park and vacant lots.

Battery Storage Functionality Typologies

Social data results from community conversations supported the development of residential vacant lots for energy storage. However, participants indicated that their overall excitement for such installations was directly related to additional functionality and potential benefits. The following section presents a proposed spectrum of additional functionality that can be paired with energy storage during the development of vacant lots for energy storage. The proposed spectrum is directly related to the proximity and visibility to high traffic areas. Within the Ivanhoe Energy District conceptual plan, visibility and proximity to high pedestrian and vehicular traffic areas (Prospect and 43rd St.) was utilized. The following section describes characteristics of additional functionality for limited, moderate, and high visibility.

Limited Visibility and Proximity

Lots with limited visibility and low proximity to highly trafficked areas should consider elements of additional functionality that are less financially intensive. Elements such as site furnishings, art murals, and device charging provide a degree of additional functionality that directly benefits residents of the immediate area

Moderate Visibility and Proximity

Energy storage installations for lots deemed to have moderate visibility and proximity should consider elements of additional functionality with a higher degree of community participation. Elements such as community gardens, meadow plantings, and outdoor movies provide tangible benefits to residents that extend beyond the immediate area.

High Visibility and Proximity

Lots with the highest degree of visibility and proximity to heavily trafficked areas should provide the highest degree of additional functionality. Elements such as shelters, dog parks, and playground equipment provide significant benefit to the entire community and further awareness and familiarity with renewable energy storage.

The proposed spectrum of functionality should be adapted by the community on a case by case basis. The proposed elements of added functionality serve to start a conversation and encourage the community to envision a new type of energy infrastructure installation.

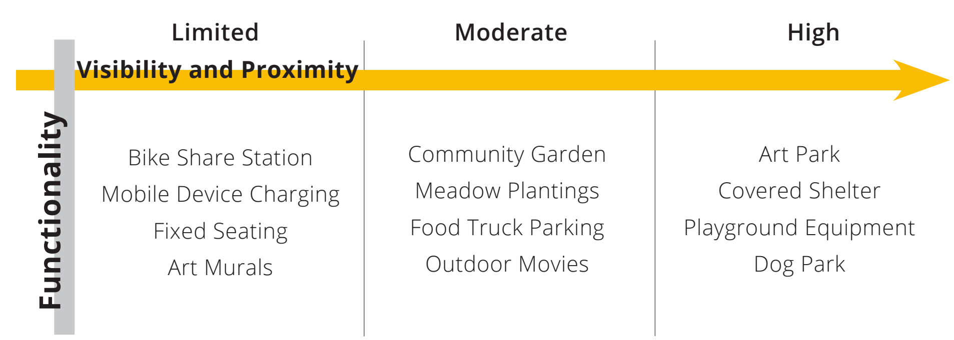


Figure 5.12
Matrix of battery storage additional functionality.

Battery Storage // Community Garden

A conceptual design for a high visibility vacant lot was completed to demonstrate how energy storage can be paired with community gardens to provide tangible benefits for local residents. The proposed design adheres to the design recommendations by limiting visibility from the street, limiting complexity, limiting physical footprints, and bring production into a familiar roof top setting. The proposed design provides a social gathering space that integrates energy production and consumption directly with the community.

Figure 5.13
Vacant lot development key plan.

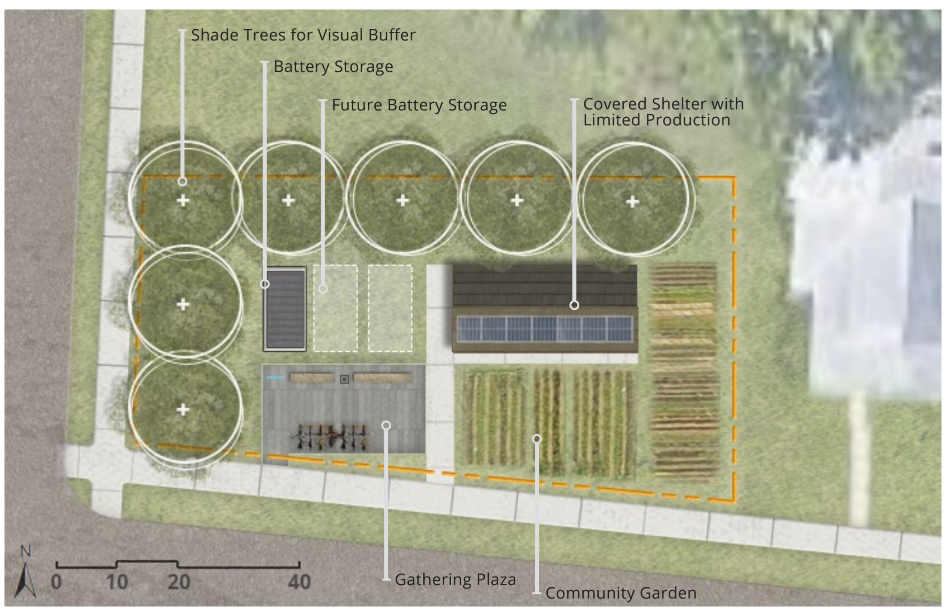


Figure 5.14
Plan view masterplan for community energy storage within vacant lots.

Figure 5.15
Existing Conditions

Figure 5.16
Presentation of a design concept for energy storage.

Ivanhoe Neighborhood Energy Park

Figure 5.17
Key Plan depicting the location of the Ivanhoe Energy Park within the Ivanhoe Energy District.

Site Selection
Ivanhoe park was selected for development into the community's core energy production location primarily due to its proximity to the identity corridors, adjacency to local community buildings, and size. Additionally, Ivanhoe park is an underutilized community asset with significant opportunity for improvements.

Site Programming
The Ivanhoe energy park is focused primarily one capitalizing on the open space and terrain of the site to establish community energy production. The proposed design maintains its identity as a neighborhood park for families while building additional social spaces and strengthening the community connection.

Application of Design Recommendations
With an emphasis on energy production, elements of visual impact are at the forefront of design decision making. By taking advantage of the grade change in the middle of the park, the proposed design seeks to limit the overall visual impact, maximize sight lines, and minimize the physical footprint of production equipment. Social spaces emphasize identity through programming and placemaking efforts. By integrating social spaces and energy production, the proposed design solution aims to transform how the community views energy production and consumption.

Figure 5.18
Retained Existing Features

Existing mature vegetation and infrastructure to be maintained is highlighted on the left.

Additionally, the proposed design maintains current functionality while incorporating additional functionality around retained features.

Figure 5.19
Key connections

Connections to adjacent neighborhoods and community centers are identified. Highlighted connections ensure the design proposal fits contextually within the neighborhood.

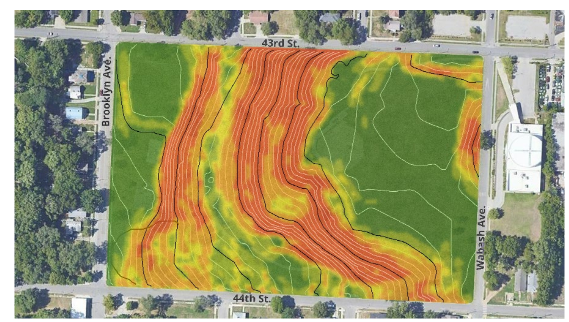


Figure 5.20
Slope analysis

Significant east-west grade change provides unique design opportunities for the integration of renewable energy in an urban park. The proposed design capitalizes on grade change to minimize visual impact of renewable energy production.

Figure 5.21
Veiwsheds

Existing viewsheds provide unique experiences depending on the approach. The proposed design capitalizes on these unique perspectives to integrate energy production into an existing neighborhood park.

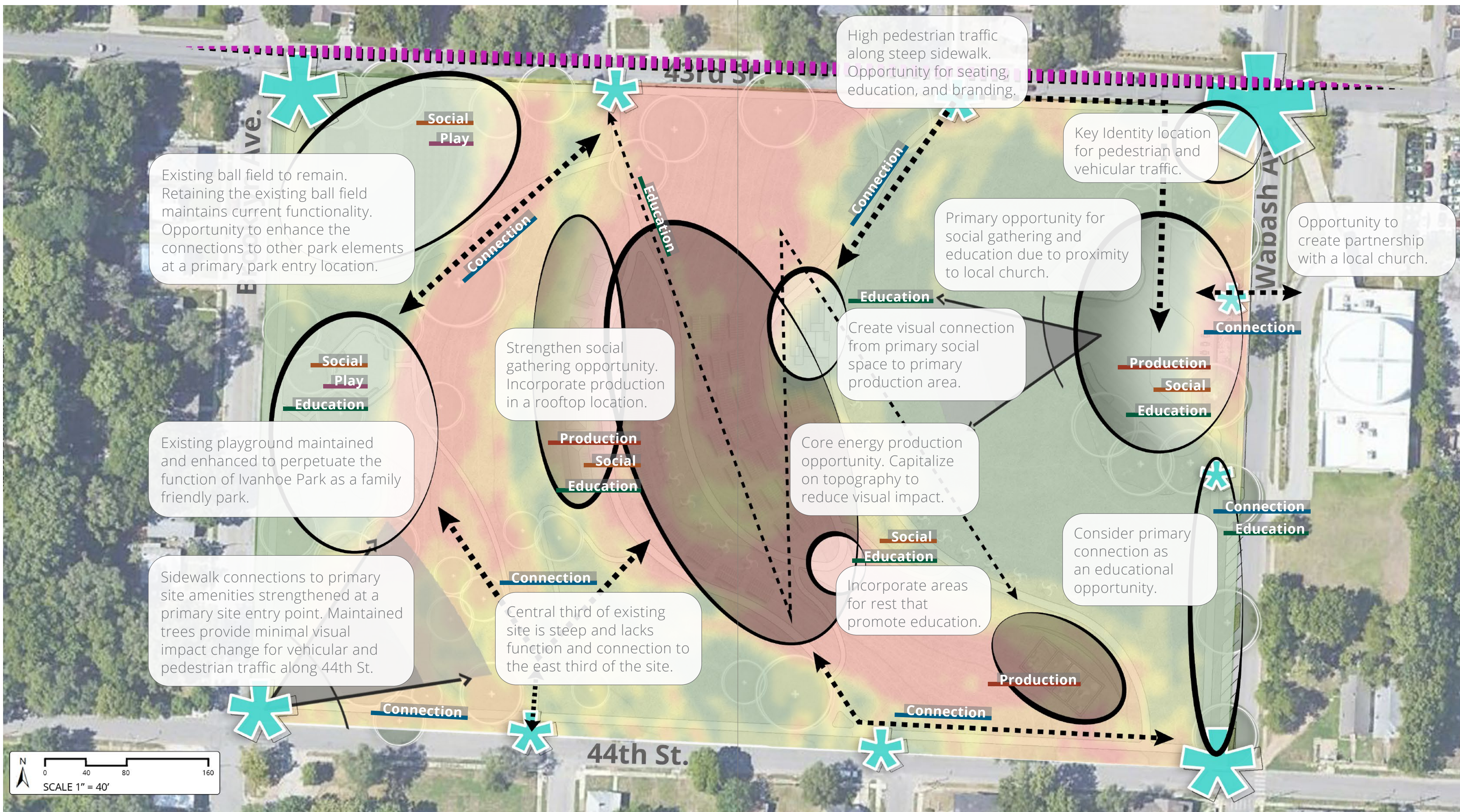


Figure 5.22
Site analysis and location of key programming elements.

Figure 5.23
Ivanhoe Energy Park presents district energy production along side social and educational opportunities. Design reflects the proposed design recommendations.

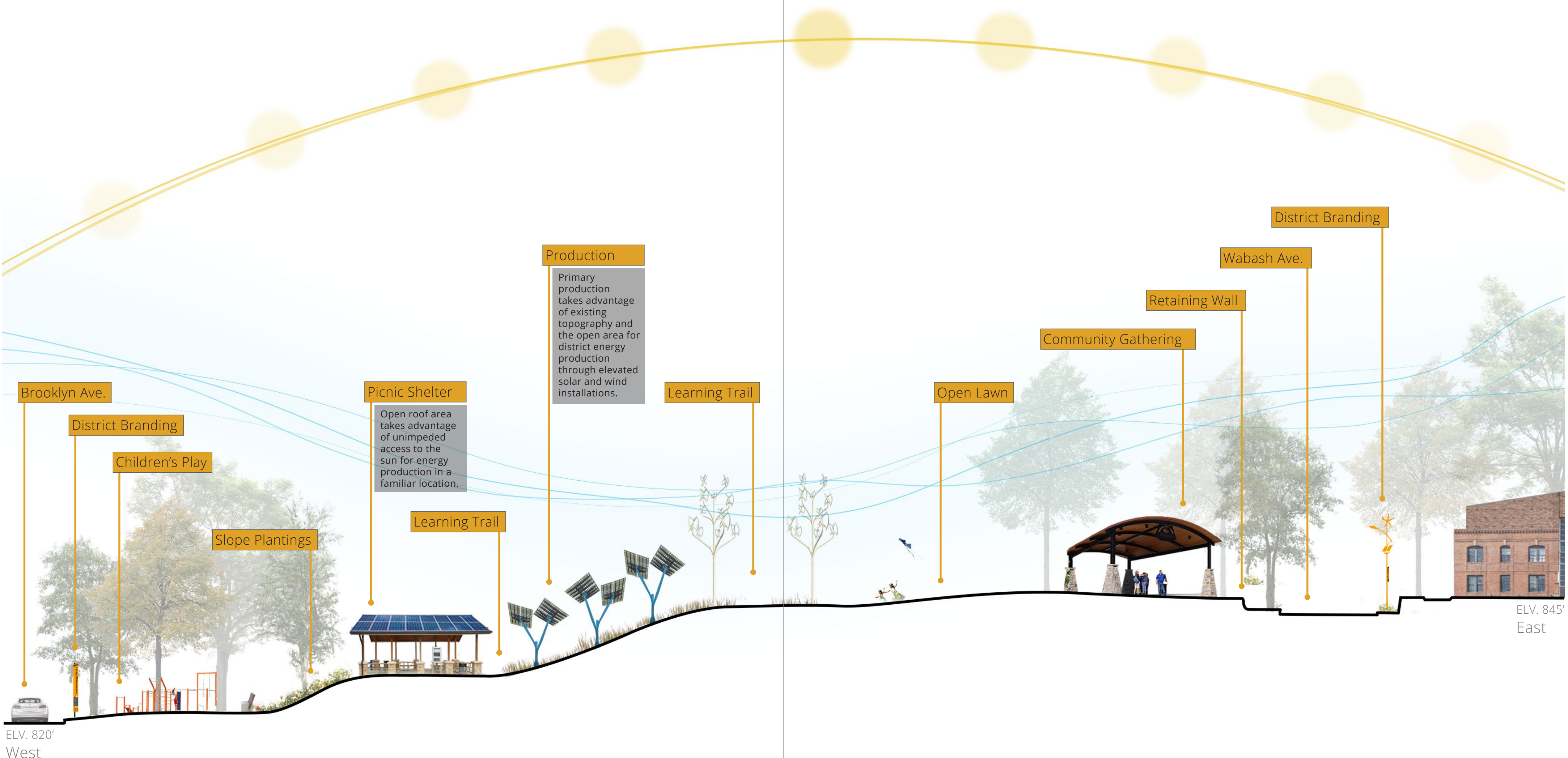


Figure 5.24
East-West Ivanhoe Energy Park transect.

Social Gathering and Energy Production

Adjacency to the Prince of Peace Missionary Church near the corner of Prospect and 43rd street provides the ideal location for the development of a community gathering plaza that builds familiarity and awareness of community energy through its design and programming.

The energy education plaza features design elements of wayfinding and branding that tie the project into the overall district energy plan. Additionally, the plaza provides a covered shelter and restrooms that facilitate jobs training and educational programs. The energy education plaza is designed to be the heart of the Ivanhoe energy district by providing a comfortable social space to gather that promotes conversations about energy production and consumption within the community.

Furthermore, the design of the energy plaza ties into themes of aesthetics and identity. By partnering with local artists, creative placemaking elements will be incorporated throughout the design that strengthen community identity through renewable energy. The proposed plaza sets aside the northeast corner of the site for an energy related art installation that displays live energy production vs. energy consumption stats within the community.

Figure 5.25
View towards the west across the existing conditions of Ivanhoe Park. Existing space is underutilized and is limited in functionality.

Figure 5.26
Proposed energy education plaza incorporates elements of social gathering while promoting comfortability and familiarity with renewable energy production within an urban area.

Conceptual Phasing Approach

A shift to community energy is a complex endeavor that requires significant time, energy, and financial investment by the community and collaboration between a range of stakeholders. As such, urban energy projects should begin with deliberate dialogue. In this context, “dialogue” refers to structured communication amongst stakeholders that is designed to provide an environment in which all participants’ voices to be heard and valued (Black 2015). As an ongoing event, successful dialogue requires mutual respect between participants and a shared interest in a common goal (Craig 2008). In this way, successful dialogue aims to achieve creative outcomes to complex problems. The following conceptual phasing is proposed for community energy projects.

Immediate Goals:

- Identify strategic partners
- Initiate community engagement efforts

Phase 1:

- Introduce community energy concept
- Build awareness
- Engage in Dialogue
- Complete demonstration project

Phase 2:

- Catalyst projects
- Spark Interest
- Broaden Acceptance
- Drive Investment
- Demonstrate personal benefits

Phase 3:

- Infrastructure build out
- Establish identity and branding
- Full realization of personal financial benefit on monthly energy bills

Long-term Goals:

- Establish a complete community energy district that produces and consumes all of its energy within a defined geographic area.
- Establish the Ivanhoe Energy District as a regional demonstration project.
- Post-implementation evaluation of project successes and limitations.

In summary, the conceptual phasing approach focuses on (1) Establishing communication and engaging community members (2) Demonstrating value, benefit, and necessity and (3) Building infrastructure that defines the Ivanhoe Southeast Neighborhood as a regional leader in community energy.

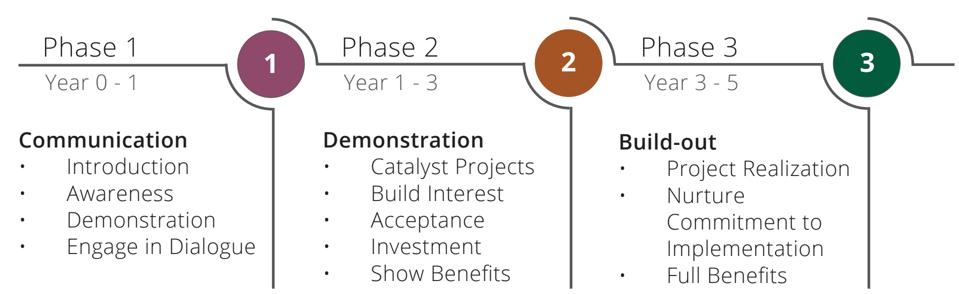


Figure 5.27
Project phasing proposes objectives for three project phases along with ambitious completion timelines to drive a focused development effort.

06.

Conclusions

Conclusions

As the negative impacts of climate change continue to threaten vulnerable energy infrastructure, an increasing number of people are threatened by energy insecurity. A fundamental shift in the approach to energy production and consumption is needed to address an ever growing energy dilemma.

Community energy presents itself as a probable solution to address each of the three components of the central energy dilemma. However, the physical footprint and visual impact of community energy infrastructure cannot be ignored. A full fledged adoption of community energy is certain to impact the character of the neighborhood and the visual quality of the landscape. This research looks to get out ahead of these changes to promote a conversation that shifts perspectives on community energy from that of infrastructure development to a broader discussion on neighborhood advancement through community energy.

This research set out to address the question "How can landscape architects address the physical footprint and visual impact of renewable energy production in an urban setting?" Through conversations directly with urban residents, preferences and their underlying rational were identified for renewable energy infrastructure in an urban setting. Findings from this analysis were then applied to conceptual project that utilized the defined recommendations to demonstrate how a community energy masterplan might look for the Ivanhoe Southeast neighborhood.

The conceptual design proposal for the Ivanhoe Energy District is not intended to serve as the final outcome but rather as a catalyst for conversation. As urban areas begin to actively consider community energy projects, this research aims to facilitate conversation and guide initial design development.

In addition to defining a series of design recommendations for the implementation of renewable energy in an urban area, this research also defined a desire by urban residents to increase their participation in energy production and consumption. The results of social data collected as a part of this research effort support the idea that urban residents are interested in playing an active role in their energy and climate future. However, little to no options are currently available to individual community members to participate in renewable energy. Energy cost and source of production are not viewed as something that individual consumers have control over.

Community energy provides urban residents a viable option to reduce their personal environmental impact and to lower their monthly energy expenses, without the overwhelming burden of individual renewable energy installations. Community energy can positively benefit the environment, address serious deficiencies in existing infrastructure, and reduce individual financial burden. Additionally, community energy presents the opportunity for urban residents to actively engage with their energy future and drive neighborhood improvement through renewable energy.

Furthermore, this research highlights the role that landscape architects can play in the development of community energy systems. Community energy can, and should, be viewed in the same light as green infrastructure. At least in part, the concept of green infrastructure applies a design perspective to an issue that is traditionally viewed as requiring a technical solution. This research highlights a prime opportunity for landscape architect to mirror the success of the green infrastructure concept by leading community energy project as a design response to a technical issue.

This research is intended primarily for landscape architects, planners, and community leaders. A broader audience for this research includes concerned citizens and those looking to bring new ideas to local leaders.

The purpose of this research is to define the necessity of community energy as a solution to the energy and climate issues that communities are currently facing, and to demonstrate design solutions that provide a high degree of community improvement.

Results from this research are not generalizable. However, the methods defined in chapter 03 can be applied to urban areas across the United States considering community energy projects. This research is not intended to replace a robust community engagement process, but rather to advance general knowledge on the design of renewable energy systems in urban areas and allow designers to bring forth more informed concepts to the community.

This work not only addresses a gap in existing literature related to the physical footprint and visual impact of renewable energy in urban areas, but also makes the case that landscape architects have an essential role to play in the development of community energy projects.

Limitations

This research aimed to connect directly to the residents of the Ivanhoe Southeast neighborhood. Due to the ongoing global pandemic, connecting with this population was exceedingly difficult. A lack of community events and public gathering made establishing relationships with local residents challenging. The first 11 participants responded to email request for participation. There is a likelihood that these participants are more interested in renewable energy at baseline than other community members. It is possible that this factor introduced bias into the data. A larger sample size would strengthen the research results.

Furthermore, in-person interviews were completed at a coffee shop in Mannheim Park, a neighborhood directly adjacent to the target neighborhood. Due to a lack of community events and meetings in Ivanhoe Southeast, expanding the target area to include Mannheim Park provided access to a larger number of potential participants. Neighborhood characteristics in Mannheim Park are nearly identical to Ivanhoe Southeast and were determined to be acceptable for inclusion in the study.

Additionally, attention was paid to visit the coffee shop at different times throughout the day and week to reach the largest audience possible, but it is likely that certain populations were excluded from the data due to when and where the data was collected.

Lastly, semi-structured interviews and the subsequent transcription and analysis procedure are time intensive. The project timeline precluded a larger, more representative sample size. A longer data collection process is necessary to collect participants' responses that reach the entirety of the target population. While the research results are not entirely representative to the initial target population, the collected data provides valuable insights that future research can build upon.

Future Research

Future research can benefit from the results and findings of this report. Specifically, future research should look to test the defined themes among a larger sample size. This effort would strengthen the generalizability of the findings of this research.

Additionally, this research focused on individual renewable energy elements in general settings. Future research can look at specific design solutions within parks, more specifically how current function and proposed function are balanced. How much of an existing park can be taken up for energy use and is that different for different types of parks?

References

Aghahosseini, Arman, Dmitrii Bogdanov, Larissa S. N. S. Barbosa, and Christian Breyer. 2019. "Analysing the Feasibility of Powering the Americas with Renewable Energy and Inter-Regional Grid Interconnections by 2030." Renewable and Sustainable Energy Reviews 105: 187–205. https://doi.org/10.1016/j.rser.2019.01.046.

Akbari, Kaveh, Fariborz Jolai, and Seyed Farid Ghaderi. 2016. "Optimal Design of Distributed Energy System in a Neighborhood under Uncertainty." Energy 116. 567–82. https://doi.org/10.1016/j.energy.2016.09.083.

Albert, Réka, István Albert, and Gary L. Nakarado. 2004. "Structural Vulnerability of the North American Power Grid." Physical Review E 69, no. 2. https://doi.org/10.1103/PhysRevE.69.025103.

Amin, M. 2003. "North America's Electricity Infrastructure: Are We Ready for More Perfect Storms?" IEEE Security Privacy 1, no. 5: 19–25. https://doi.org/10.1109/MSECP.2003.1236231.

Asmus, Peter. 2010. "Microgrids, Virtual Power Plants and Our Distributed Energy Future." The Electricity Journal 23, no. 10: 72–82. https://doi.org/10.1016/j.tej.2010.11.001.

Bayod-Rújula, Angel A. 2009. "Future Development of the Electricity Systems with Distributed Generation." Energy, WESC 2006, 34, no. 3: 377–83. https://doi.org/10.1016/j.energy.2008.12.008.

Berry, Chip, Carolyn Hronis, Maggie Woodward. 2018. "One in Three U.S. Households Faces a Challenge in Meeting Energy Needs" Washington, DC: U.S. Energy Information Administration.

Black, L. W. 2015. Dialogue. In K. Tracy, C. Ilie, & T. Sandel (Eds.), The International Encyclopedia of Language and Social Interaction (pp. 364-372). Malden, MA: Wiley.

Boroojeni, Kianoosh G., M. Hadi Amini, Arash Nejadpak, S.S. Iyengar, Bakhtyar Hoseinzadeh, and Claus Leth Bak. 2016. "A Theoretical Bilevel Control Scheme for Power Networks with Large-Scale Penetration of Distributed Renewable Resources." In 2016 IEEE International Conference on Electro Information Technology (EIT), 0510–15, 2016. https://doi.org/10.1109/

Capener, Pete. 2014. "What is Community Energy and Why Does it Matter?". Community Energy England.

Census. 2019. "Income and Poverty in the United States: 2019." The United States Census Bureau. Accessed October 31, 2020. https://www.census.gov/library/publications/2020/demo/p60-270.html.

Clean Coalition. 2020. "Community Microgrids." Accessed March 22, 2021. https://clean-coalition.org/community-microgrids/.

Cook, Jeffrey J, and Monisha R Shah. 2018. "Focusing the Sun: State Considerations for Designing Community Solar Policy," https://doi.org/10.2172/1419711.

Corburn, Jason. 2009. "Cities, Climate Change and Urban Heat Island Mitigation: Localising Global Environmental Science." Urban Studies 46, no. 2: 413–27. https://doi.org/10.1177/0042098008099361.

Coughlin, Jason, Jennifer Grove, Linda Irvine, Janet F. Jacobs, Sarah Johnson Phillips. 2011. "Guide to community solar: Utility, private, and non-profit project development". 1-56

Cox, Sadie, Laura Beshilas, Eliza Hotchkiss. 2019. "Renewable Energy to Support Energy Security" U.S. Global Change Research Program, https://doi.org/10.793 0/NCA4.2 018.CH4.

References

Crabtree, George, Jim Misewich, Ron Ambrosio, Kathryn Clay, Paul DeMartini, Revis James, Mark Lauby, et al. 2011. “Integrating Renewable Electricity on the Grid.” AIP Conference Proceedings 1401, no. 1: 387–405. https://doi.org/10.1063/1.3653865.

Craig, R. T. 2008. The rhetoric of ‘dialogue’ in metadiscourse: Possibility-impossibility arguments and critical events. In E. Weigand (Ed.), Dialogue and rhetoric (pp. 55-67).

Drehobl, Ariel, and Lauren Ross. 2016. “How Energy Efficiency Can Improve Low Income and Underserved Communities.”

EIA, A (Energy Information Association). 2020. “Electricity Explained – How Electricity is Delivered to Consumers”. Washington, DC: United States Energy Information Administration.

EIA, B (Energy Information Association). 2020. Missouri State Profile and Energy Estimates. Washington, DC: United States Energy Information Administration.

Elevate Energy. 2020. “Three Common Community Solar Business Models” Accessed February 11, 2021. https://www.elevateenergy.org/programs/solar-energy/community-solar/business-models/

EPA, A (Environmental Protection Agency). 2020. “Distributed Generation of Electricity and Its Environmental Impacts.” Environmental Protection Agency. Washington, DC.

EPA, B (Environmental Protection Agency). 2020. “Sources of Greenhouse Gas Emissions. Environmental Protection Agency. Washington, DC.

Fang, Xi, Satyajayant Misra, Guoliang Xue, and Dejun Yang. 2012 “Smart Grid — The New and Improved Power Grid: A Survey.” IEEE Communications Surveys Tutorials 14, no. 4: 944–80. https://doi.org/10.1109/SURV.2011.101911.00087.

Garcia, Marta, Ron Campbell, Lorraine Donaldson, Mauro Brolis, Stefania Ghidorzi, Daphne Vaning, Muriel Wart, Didier Cherel, Sophie de Canson, Dierre Nolay, Dmilie Salesse-Gauthier, Sandrine Bursi, and Emmanuel Posussard. 2009. “Tackling Fuel Poverty in Europe: Recommendations Guide for Policy Makers”. European Fuel Poverty and Energy Efficiency.

Gellert, Tess. 2021. “Texas Power Outage Crisis A Foreboding Sign Of Climate Change.” The Organization for World Peace. https://theowp.org/reports/texas-power-outage-crisis-a-foreboding-sign-of-climate-change/.

Gerrity, Sarah. 2014. “Understanding the Grid”. Department of Energy. Washington, DC.

Gharavi, Hamid, and Reza Ghafurian. 2011. “Smart Grid: The Electric Energy System of the Future [Scanning the Issue].” Proceedings of the IEEE 99, no. 6: 917–21. https://doi.org/10.1109/JPROC.2011.2124210.

Goldthau, Andreas. 2014. “Rethinking the Governance of Energy Infrastructure: Scale, Decentralization and Polycentrism.” Energy Research & Social Science 1: 134–40. https://doi.org/10.1016/j.erss.2014.02.009.

González-Eguino, Mikel. 2015. “Energy Poverty: An Overview.” Renewable and Sustainable Energy Reviews 47: 377–85. https://doi.org/10.1016/j.rser.2015.03.013.

Healy, Jonathan, and J. Peter Clinch. 2004. “Quantifying the Severity of Fuel Poverty, Its Relationship with Poor Housing and Reasons for Non-Investment in Energy-Saving Measures in Ireland.” Energy Policy 32: 207–209. https://doi.org/10.1016/S0301-4215(02)00265

Heeter, Jenny S., Lori A. Bird, Eric J. O’Shaughnessy, and Samuel Koebrich. 2018. “Design and Implementation of Community Solar Programs for Low- and Moderate-Income Customers,” https://doi.org/10.2172/1488510.

References

Hernández, Diana. 2013. “Energy Insecurity: A Framework for Understanding Energy, the Built Environment, and Health Among Vulnerable Populations in the Context of Climate Change.” American Journal of Public Health 103, no. 4: 32–34. https://doi.org/10.2105/AJPH.2012.301179.

Huang, Kangning, Xia Li, Xiaoping Liu, and Karen C Seto. 2019. “Projecting Global Urban Land Expansion and Heat Island Intensification through 2050.” Environmental Research Letters 14, no. 11. https://doi.org/10.1088/1748-9326/ab4b71.

Jessel, Sonal, Samantha Sawyer, and Diana Hernández. 2019. “Energy, Poverty, and Health in Climate Change: A Comprehensive Review of an Emerging Literature.” Frontiers in Public Health 7. https://doi.org/10.3389/fpubh.2019.00357.

Klinenberg, Eric. 2002. Heatwave: A Social Autopsy of Disaster in Chicago. The University of Chicago Press.

Kontokosta, Constantine E., Vincent J. Reina, and Bartosz Bonczak. 2020. “Energy Cost Burdens for Low-Income and Minority Households: Evidence From Energy Benchmarking and Audit Data in Five U.S. Cities.” Journal of the American Planning Association 86, no. 1: 89–105. https://doi.org/10.1080/01944363.2019.1647446.

Kunkel, Kenneth E, Laura E Stevens, Scott E Stevens, Liqiang Sun, Emily Janssen, Donald Wuebbles, Michael C Kruk. 2013. “Regional Climate Trends and Scenarios for the U.S. National Climate Assessment: Part 4. Climate of the U.S. Great Plains.”

Liddell, Christine, and Chris Morris. 2010. “Fuel Poverty and Human Health: A Review of Recent Evidence.” Energy Policy 38, no. 6: 2987–97. https://doi.org/10.1016/j.enpol.2010.01.037.

Microgrid Institute. 2012. “About Microgrids” Accessed September 12, 2020. http://www.microgridinstitute.org/microgrid-background.html

Müller, Matthias Otto, Adrian Stämpfli, Ursula Dold, and Thomas Hammer. 2011. “Energy Autarky: A Conceptual Framework for Sustainable Regional Development.” Energy Policy, Sustainability of biofuels, 39, no. 10: 5800–5810. https://doi.org/10.1016/j.enpol.2011.04.019.

Murkowski, Lisa, Tim Scott. 2014. Plenty at Stake: Indicators of American Energy Insecurity. An Energy 20/20 White Paper. Washington, DC.

Nolden, C., J. Barnes, and J. Nicholls. 2020. “Community Energy Business Model Evolution: A Review of Solar Photovoltaic Developments in England.” Renewable and Sustainable Energy Reviews 122: https://doi.org/10.1016/j.rser.2020.109722.

OE (Office of Electricity). 2020. “Grid Modernization and the Smart Grid”. Office of Electricity. Washington, DC.

Peek, Lori. 2008. “Children and Disasters: Understanding Vulnerability, Developing Capacities, and Promoting Resilience — An Introduction.” Children, Youth and Environments 18, no. 1: 1–29.

Shafiullah, G M, Amanullah M. T. Oo, Dennis Jarvis, A B M Shawkat Ali, and Peter Wolfs. 2010. “Potential Challenges: Integrating Renewable Energy with the Smart Grid.” In 2010 20th Australasian Universities Power Engineering Conference, 1–6.

Shield, Stephen A., Steven M. Quiring, Jordan V. Pino, and Ken Buckstaff. 2021. “Major Impacts of Weather Events on the Electrical Power Delivery System in the United States.” Energy 218. https://doi.org/10.1016/j.energy.2020.119434.

Siemens. 2014. “Microgrids as a solution to integrate renewable generation.” Siemens. Munich, Germany.

References

Sioshansi, Fereidoon P. 2011. “Smart Grid: Integrating Renewable, Distributed and Efficient Energy. San Diego.” Elsevier Science & Technology, 2011. http://ebookcentral.proquest.com/lib/ksu/detail.action?docID=788015.

St. Denis, Genevieve, and Paul Parker. 2009. “Community Energy Planning in Canada: The Role of Renewable Energy.” Renewable and Sustainable Energy Reviews 13, no. 8: 2088–95. https://doi.org/10.1016/j.rser.2008.09.030.

Tan, Wen-Shan, Mohammad Yusri Hassan, Md Shah Majid, and Hasimah Abdul Rahman. 2013. “Optimal Distributed Renewable Generation Planning: A Review of Different Approaches.” Renewable and Sustainable Energy Reviews 18: 626–45. https://doi.org/10.1016/j.rser.2012.10.039.

UN-Habitat. 2011. Global Report on Human Settlements 2011 Cities and Climate Change. United Nations Human Settlements Programme.

Vine, Doug, and Amy Morsch. 2017. “Microgrids: What Every City Should Know” Center for Climate and Energy Solutions

Voogt, J.A. 2002. Urban Heat Island. Munn, T., Ed., Encyclopedia of Global Environmental Change, Wiley, Chichester, Vol. 3, 660-666.Wuebbles et al 2017

Walker, Gordon, and Patrick Devine-Wright. 2008. “Community Renewable Energy: What Should It Mean?” Energy Policy 36, no. 2: 497–500. https://doi.org/10.1016/j.enpol.2007.10.019.

Warneryd, Martin, Maria Håkansson, and Kersti Karltorp. 2020. “Unpacking the Complexity of Community Microgrids: A Review of Institutions’ Roles for Development of Microgrids.” Renewable and Sustainable Energy Reviews 121. https://doi.org/10.1016/j.rser.2019.109690.

Weiss, Matthew, and Martin Weiss. 2019. “An Assessment of Threats to the American Power Grid.” Energy, Sustainability and Society 9, no. 1: 18. https://doi.org/10.1186/s13705-019-0199-y.

Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, B. DeAngelo, S. Doherty, K. Hayhoe, R. Horton, J.P. Kossin, P.C. Taylor, A.M. Waple, and P. Weaver. 2017. Executive summary. In: Climate Science Special Report: Fourth National Climate Assessment, Volume I U.S. Global Change Research Program, Washington, DC, USA, pp. 12 34, doi 10.7930/J0DJ5CTG

Yoldaş, Yeliz, Ahmet Önen, S. M. Muyeen, Athanasios V. Vasilakos, and İrfan Alan. 2017. “Enhancing Smart Grid with Microgrids: Challenges and Opportunities.” Renewable and Sustainable Energy Reviews 72: 205–14. https://doi.org/10.1016/j.rser.2017.01.064.

Appendix A.

KANSAS STATE UNIVERSITY | University Research Compliance Office

TO: Dr. Sara Hadavi
Landscape Architecture/Regional and Community Planning
Seaton Hall

FROM: Rick Scheidt, Chair
Committee on Research Involving Human Subjects

DATE: 01/22/2021

RE: Proposal #10355.2, entitled "Design Preferences for the Integration of Renewable Energy Production Into Existing Urban Neighborhoods."

A MINOR MODIFICATION OF PREVIOUSLY APPROVED PROPOSAL #10355.1, ENTITLED, "Design Preferences for the Integration of Renewable Energy Production Into Existing Urban Neighborhoods"

The Committee on Research Involving Human Subjects at Kansas State University has approved the proposal identified above as a minor modification of a previously approved proposal, and has determined that it is exempt from further review. This exemption applies only to the most recent proposal currently on file with the IRB. Any additional changes affecting human subjects must be approved by the IRB prior to implementation and may disqualify the proposal from exemption.

Unanticipated adverse events or problems involving risk to subjects or to others must be reported immediately to the IRB Chair, and / or the URCO.

It is important that your human subjects project is consistent with submissions to funding/contract entities. It is your responsibility to initiate notification procedures to any funding/contract entity of changes in your project that affects the use of human subjects.

Appendix B.

Discussion of Photo Set Two: Neighborhood Setting

The following series of 7 images present a series of scenarios in which renewable energy has been integrated into residential neighborhoods.

- Please describe to me your initial thoughts and reaction to the images in front of you.
- If what you see in these images are going to be installed near your home, what concerns do you have?
- A greater number of small batteries is required to reach the capacity of a singular large battery. What are your thoughts on a smaller number or large batteries as opposed to many smaller batteries?
- Please select two images that you most prefer.
  - What aspects of these two images were most influential in your selection?

Discussion of Photo Set Three: Streetscape Setting

The following series of 8 images present a series of scenarios in which renewable energy has been integrated into neighborhood streets.

- Please describe to me your initial thoughts and reaction to the images in front of you.
- If what you see in these images are going to be installed along streets you frequently drive, what concerns do you have?
- Please select two images that you most prefer.
  - What aspects of these two images were most influential in your selection?

Reflection Discussion

- How do you feel about having renewable energy production nearby your home?
- Where could the presented imagery be placed within your neighborhood?
- What qualities and characteristic of renewable energy are most important to you to ensure that future energy systems are accepted by the community?
- How, if at all, would a direct financial benefit (in the form of a reduced monthly energy bill) impact your idea of the presented imagery?

Conclusion

Your responses have been recorded anonymously and do not contain any identifying information. Do you wish to have your responses included as a part of the research study?

Thank you for your time and participation. Interview responses will be collected, transcribed, and analyzed for trends. The identified trends will then be utilized to inform design recommendations for incorporating renewable energy systems into urban areas. A projective design project will apply the community feedback into a prototypical project that will be used to further the conversation on renewable energy in urban areas.

Thanks again.

Design Preferences for the Integration of Renewable Energy Production into Existing Urban Neighborhoods

Debriefing:

My name is Thomas Schneider, and I am a graduate student at Kansas State University. The research project I am working on is titled "Design Preferences for the Integration of Renewable Energy Production into Existing Urban Neighborhoods". In the next 20 years, renewable energy systems such as wind and solar power will have a significant impact on urban neighborhoods. This study aims to understand community knowledge of, and attitudes towards, renewable energy in an urban setting to better inform the design of future energy systems. Your participation in the following interview is entirely voluntary and anonymous. You are free to withdraw at any point or skip answering any questions you do not wish to answer. Your participation will take approximately 15 minutes. Audio of the conversation will be recorded for later transcription but will be kept anonymous.

Demographic Questions:

The interview will begin with a brief demographic questionnaire to ensure that a representative data sample has been collected.

- Age range: 18-30 30-40 40-50 50-65
- What is your gender?
- Are you a current resident of Ivanhoe Park or Oak Park?
- Are there children in your household?

Background Question:

The following questions will be asked to give context to the respondent's level of familiarity with renewable energy and its benefits.

- Does the source of energy for your household matter to you?
- How familiar are you with renewable energy systems such as wind, solar, and battery storage?
- What is your understanding of the impact that renewable energy could have on your community?
- What do you think about your energy costs? Are they too much? Is it a concern?

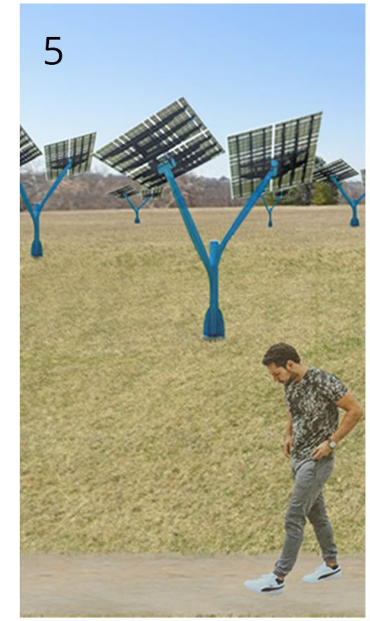
Discussion of Photo Set One: Neighborhood Park Setting

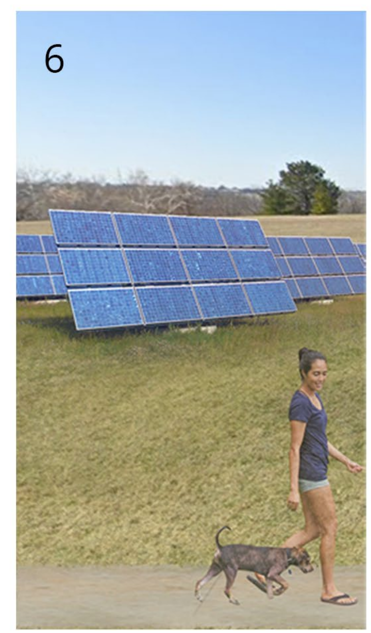
The following series of 7 images present a series of scenarios in which renewable energy has been integrated into a local park.

- Please describe to me your initial thoughts and reaction to the images in front of you.
- If what you see in these images are going to be installed in your nearby neighborhood park, what concerns do you have?
- Please select two images that you most prefer.
  - What aspects of these two images were most influential in your selection?

Appendix B.

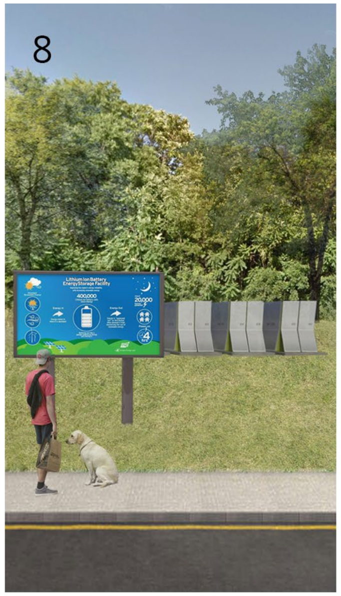
A
Image Set

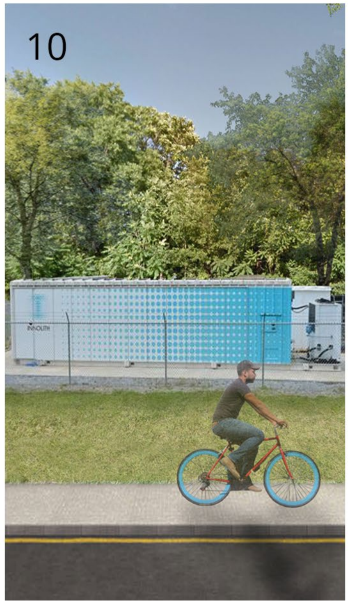


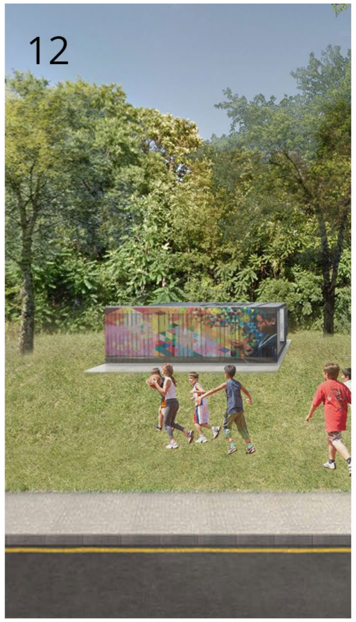


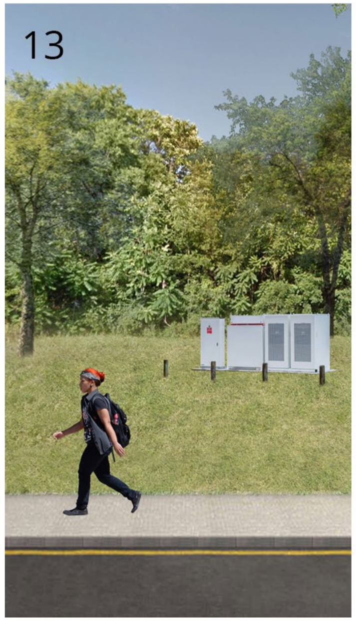
Appendix B.

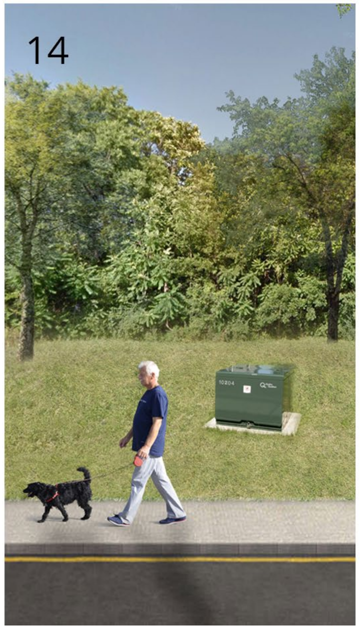
B
Image Set





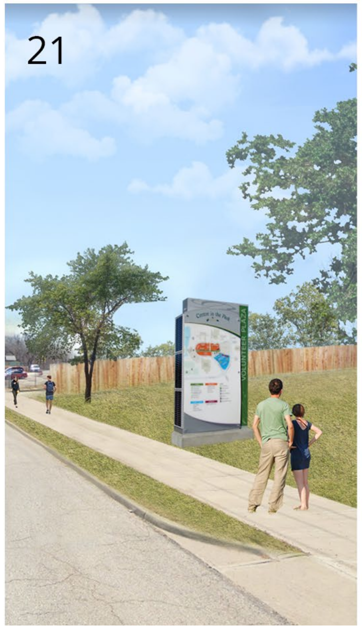






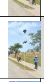
Appendix B.

C
Image Set



Appendix C.

Image Keyword Analysis

	Image Number	Preferred Choice	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant 7	Participant 8	Participant 9	Participant 10	Participant 11	Participant 12	Participant 13	Participant 14	Participant 15	Participant 16	Participant 17	Participant 18	Participant 19	Participant 20	Participant 21	Participant 22	Participant 23	Participant 24	Participant 25
	Image 1	2	Desirable because it is little.		Individual		Small, not a fan. Unsubstantial	Tip over		Charging	self-sufficient Practical	Low Energy Individual		Low Individual		Positive		Multi-use Tower Inconspicuous	Small	Helpful				Costly, individuated, ambiguous		Not useful.	
	Image 2	11		People can sit and charge. The other ones are okay, but prefer this one. 2 and 3 look better.		Not attractive to me	Functional	Open Limited Users	Roof		Interesting Sculptural Artistic				Confusing	Leisure			Like the modern look.		Activity		Funky, Fun				Usable
	Image 3	11	Technology	People can sit and charge. The other ones are okay, but prefer this one. 2 and 3 look better.		Not attractive to me		Too accessible Open	Roof		Shelter		Incorporated			Leisure space	Seating Charging		Shelter		Groups of people			Gathering and social space	Useful		Usable
	Image 4	20	I like that best, because of the structure.		would be the best because then it would just fit in with the surrounding area. Number 4 without question.	Liked\ the way it is presented	utilizes like a roof top does, so it is already space that is already well utilized for solar gain	Best Relaxed Environment Inaccessible	Cool Great design	Preexisting Structure		Familiar		I like how the roof is utilized	Usable	Doesn't change the experience	Amazing shade	Inconspicuous	Shelter					Intriguing	Functional	Not a good value	Usable
	Image 5	5			it's kind of looks like a space age art or obstacle course.	. That is kind of abstract in the way that it is presented	Out of sight line	Open Space Wide open	Different			Modern art	Nelson Artful	Interesting, but uncertain		Too much space	Trees							Unclear, Interesting		Funky	Interesting look
	Image 6	1	Familiar	It depends on the space that it takes up.		Like the way that it is presented.	it gets in the way of people running or kind of breaks up the landscape a bit.	Easily Damaged		Intrusive.	Takes up space eye sore	Traditional		Typical	In the way. Too much	Too much space	Neutral	Open and accessible to vandalism	Takes up too much space.	Clunky Biggest bang for you buck	Would not want to see.	Too much, Too bulky				Poor visibility. Safety concern	Utilitarian
	Image 7	20	Initially unclear. "Oh wow, those look like real trees.		Fits better into a regular landscape.	Interesting look like a funny looking tree	Could be placed next to existing trees. Cool.	Looks like trees. Blends in	Trees Artwork		Artistic Duel-purpose	Whimsical	Trees Artsy	I have never seen anything like that before. Innovational	Trees are interesting	Does not seem like it could do any harm.	Amazing during the summer		Tie into Nelson. Tree like sculpture Artistic	Tie into nelson			Curious Tree-like	Ambiguous		Funky	Unique
	Image 8	10				fine	Education. Likes to learn, tells you why this big thing is here.		Education	Information		Modern			Professional	Projection/Screen Information	Giant Tablet		Community interaction Instruction	I love it because of the sign		Cute					Education
	Image 9	7		there are sometimes vandals that we don't want to have to keep fixing it up.	Industrial	fine, hidden	Landscaping is cool. I like the plants.				Industrial		Hunk of metal	Interesting Draws attention	Private Eye Sore		Port-a-Potties		Dislike because it looks temporary			No, it sort of reminds me of the factory. Factories are not appealing but they are around.	Unappealing, but like the shrubs.	Outhouse	Shipping container, less desirable	Shipping container	Crate
	Image 10	6		there are sometimes vandals that we don't want to have to keep fixing it up.	Industrial	fencing is fine, may want to touch	Not a fan. Same as you see right now. Makes me think of prison.	Secure Powerful	Protection	Eyesore	Unfriendly unwelcoming			Undesirable fencing. Company branding.	Private	Modern (Enjoyable)		Just doesn't look good Machinery look Inviting to vandalism	shipping container			I don't think 11 is a good idea. It seems like it would be bad.	Unappealing	Boarder wall. Looks like a trailer	Shipping container		Barbed wire
	Image 11	7	Initially unclear, I like the ones with kids in them.		number 11 with what looks like climbing rocks for children.	Play area not a good idea.		dangerous	Cool Multiple Purpose	Interesting Odd		No Issues	Incorporated			Cool arrangement Unsafe			interactive Fun	Interactive	Nice because kids are playing on it	I don't think 11 is a good idea. It seems like it would be bad.	Interesting. I love the idea of those.			good use of space.	Pretty cool, usable
	Image 12	12	I like the ones with kids in them.		art number 12 almost looks like a creative placemaking project. looks similar to what is the boxes that are	fine		rad because it looks like an art crate Secure		I love art.	Integrated Understandable			Art installation.	Desirable		Pretty		local artists, cool	Artistic	Pretty picture wrapped around a big ugly box.	Okay		Attempt at art	Incorporates art and color.	Quick adoption, Easy, best	
	Image 13	0				fine			Okay	Neutral	Compact	Whatever	Run-of-the-mill			Familiar Unhelpful			standard, dislike	Nothing new, falls lower because of that.				Curious	Wouldn't want more of 13 and 14. Don't like standard box		
	Image 14	1				fine			Preferred	Don't bother me.	Blend In	Turn off	Run-of-the-mill			Familiar			standard, dislike	Nothing new			Typical	Air Conditioning Unit. Does not blend in.	Wouldn't want more of 13 and 14. Don't like standard box.		
	Image 15	7	Does this have heat? I love the bus stop idea.		But I do like 21. I think having something at the bus stops would be very good.	They all appear to be pretty much the same		Bad Ass Heat		Cool Looks good	Standard				Practical	Easy Shade			Blend in	Great and easy. No change to my current walk				Fits Context			enjoyable
	Image 16	20			I like number 16 because it is sort of artistic and different. 16, The top part [wind turbine] takes your attention away from		Yard art. Aesthetic appeal. Artistic.	Nelson vibe Crafty Artsy	Artwork		Traditional		Bulky		Modern Artistic Stands out	Great		Piece of art		Artistic Draws attention. Enjoy its movement.	Pleasing Mobiles		I don't think I care for 16 as much.	Pedestrian	Busy	Too big.	snazzy
	Image 17	6	I like this one.		Drawn first to the panel		Don't like green color Classic	Cool Crafty	Normal		Traditional	Traditional Kansas Windmill	less distracting. Slender Artful-twist	Busy		Functional not outstanding	Interesting piece of art	Neutral	Modern		Pleasing			Okay			snazzy
	Image 18	2			Drawn first to the panel		Security camera on top?		Minimal						Stands out.	No			Modern					Irregular			
	Image 19	5			then I like number 19 because it is slick and not as visible.		I like the way the lights are shaped. The traditional fan shape would work.		Eye Catching		Interesting Modern Technological				Unclear	Not the way		it is not too far out.	Modern Not a fan because that wouldn't fit into the neighborhood.		Eye catching					Preferred for the small profile	
	Image 20	2					Familiar setting		Minimal		Discrete Traditional				Blends in	Familiar			Blend in		More of the Same				Too busy		enjoy because of no wind
	Image 21	6	I also like this one.		once you start creating identity markers throughout the neighborhood it sets the tone for something else			Security (Tagging)								Amazing similar to the street car			Blend in	Easy, ties into the streetcar	More of the Same			Unclear		Too big	Informational

Appendix C.

Thematic Content Analysis

	Desire for renewable resources	Move forward to the future	Improve community	Improve and expand over time	Save money	Concern for the environment	Interest in renewable energy	Shared resource	Cost concerns	Access to technology	Functionality	Socilization	Understood necessity	Saftey considerations
Participant 1	Most people have heard of solar energy and they would like to get it, but the costs have been prohibitive. and I thought wow that would be great, how can we get that here?	doesn't make as much sense as much as it once used to.			spend less money, that is my primary consideration	Second of all, I just think it is better for us to use renewable sources instead of depending on doing it the same way we have been doing it. The planet cannot support the way that we are doing it.	I used to read about that because I wanted to do that	that you don't have to put panels on your house so the community can access it	I think that most people spend a lot of their disposable income on that [energy].	so number 4 means that they can use technology with it?	Because I can see that we would get more use out of it along with its intended purpose. Would there be heat provided for people? In favor of duel use. Not only can you use it for not just the community, but also for powering things in the community like streetlights and security cameras.			If they can be integrated and have some kind of safety or warning. I do think there should be some sort of fencing around it.
Participant 2							I have been interested for a while, but I didn't know much how to go about it.				Number 2 and 3 look better and people can sit and charge and work from the system.			
Participant 3	But the reality is, that we need to have more sustainable energy.	I like 21 because once you start creating identity markers throughout the neighborhood it sets the tone for something else. Yes, for me it has to do with creating a new sense of perspective for the neighborhood. Ivanhoe is a very old neighborhood. Homes are 75-100 years old even when you do some outside renovations, they are still old. But this creates a new wave of a presence in the neighborhood. Even though it is an old neighborhood, even though it is a low-income neighborhood, we are advancing with the rest of the world.	To me, number 12 almost looks like a creative placemaking project.		Lower energy bills which result in families not spending an overabundance on energy.	Concern for the environment. And a cleaner environment overall.		Lower energy bills which result in families not spending an overabundance on energy.		Where you can almost charge your phone or charge the scooters or stuff like that?	I think the aesthetic choice would be number 4 because it looks like it is on top of a pergola. Number 4 to me would be the best because then it would just fit in with the surrounding area. Then we can get more use out of it. I also like number 11 with what looks like climbing rocks for children. But I do like 21. I think having something at the bus stops would be very good.			One thing that I would be concerned about would be how would the system be protected from children getting in, from people who just want to do damage, umm weather or not the systems are hot. Are the surfaces hot. Again, is anything emitting or bouncing off things with this system that wasn't with the old system. How safe is it for me to walk down the street under this?
Participant 4	I would love to have solar. I think most people would.	I have been to Africa a few times. I've seen some of the newer housing elements that they have put up that have solar panels on top of them. So, if it can be done there, in rural areas, when you have major cities, it seems like it should be able to be done there as well.				Number 1, coal is dead you know and oil, to try and continue to try and use those resources is depleting the earth.			Well, my current costs are expensive.					Because is incorporated as a part of a play area. I don't think that would be very safe.
Participant 5	as renewable as possible.		I kind of like big projects. I just want to do it big, rather than to just do it small.			Just environmental concerns, global warming.	I would feel good about it (having renewable energy)	And I guess localized production, like a small grid set up so it is more secure to power outages. So, they don't affect large areas.	: It can be pretty expensive. Our attic here is not very well insulated. I can tell we are getting a lot of heat loss. It is a little bit of a concern for me.		I would think 2 aesthetically and functionally looks good to me. And 4, for the same reasons. Functionality in a way that does not sacrifice aesthetics. : Yeah, I mean, same sort of reason as for the covering over the picnic tables in the park setting for 15. It is already a rooftop setting. I like that. Utilizing a space that is already there.			I would assume that all of the live wires would be isolated. Maybe preventing kids from climbing on top of them. Something like that. But 18 kind of looks like it might have a camera on top, is that true?
Participant 6	There are ways that we can save on oil on gas No, I think it is rad man. I wish you could do it today. If I had a ton of money, I would give it to you today.	I am tired of the way things are. Something like this would be new and hip and awesome.		You are always going to have those hatters, you are always going to have those who don't want change, but once you see it go into effect, their whole attitude changes.			Imagine if all these houses had it? It would be so much better.		I'm spending so much money a month on gas on electricity all this stuff where electric can be used for solar panels all kinds of things that we can be doing. I'm paying $130 a month in electric. I'm helping my mom out because she is back on her bills.		What I would do is expand number 4. Throw in some couches, a relaxed environment. This is bad ass. 15. Could this incorporate heat? This right here [the bus stop] would be your main sell.I think it would be pretty rad to go to any park and have something like this and be able to bring your computer and work. Imaging being able to take your computer outside. Be able to take your mask off and not have that anxiety around you. That would be really cool. But with this one [number 5], you have the park trees, and open space. If you have a wide-open space where people can still get around it and the energy can hit it. That would be great. People can still hammock in the treesThis guy has his computer set up. He can do his work and not have to wear his mask. During the winter it can provide heat. During the summertime it can provide air conditioning.	If someone is walking by and there are already people sitting there, there is no room for any more people. You would louse traffic in this spot because of that.		Its secure. Therefor you can't really do anything to it. And number 10 is secure. Looks like it has a bit more power. It is more safe. I think the fence is a really good idea, especially since you have so much going on. Now with the crate [number 12] you don't need a fence just because no one is going to try and break into a crate. I would put a sign. Like how you have this [points to the first battery on the page]. I would put this next to the crate. So, people know there is something in there that could kill me.]. I get it, it's a fun little activity, it just takes one kid to be curious and get a stick. You know. If I had kids, and I knew what that was, I would say no, you can't go over there.
Participant 7	It would be great if we could get more solar here and have alternative sources of energy.		: It depends on how much, but I think paying a bit more for something that looks better is worth it. Beautifying while also providing alternative sources. I would like it. That would be cool. That would be great.	But I think it is a matter of changing people's habits. Habit changing is difficult. Until you see other people doing it. Getting groups together. Having groups that are talking about this would be helpful.		pollution and climate change. So that really would not be a driving force. It would really be about the environmental impact. You know pollution from coal and that sort of stuff.					It has usable space and people can go do stuff here. : You know, the usable ones are nice. 11 is nice. 12 is colorful. You know I like those better than the fenced off ones. But I like usable ones. Ones that can serve multiple purposes. 11 looks cool. And I like 11 because it looks like it's got something usable. Multiple uses. You get this double value, trying to get people to be attracted to it.			Probably 5 because it gives you more sight.
Participant 8		[illegible]				[illegible]		[illegible]			I think that I would only like the larger ones if it was a piece of art. (Preferences are contingent upon other functions).. [illegible]	[illegible]		[illegible]
Participant 9	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]					[illegible]			
Participant 10	[illegible]								[illegible]					[illegible]
Participant 11			[illegible]			[illegible]					[illegible]			
Participant 12		[illegible]				[illegible]					[illegible]		[illegible]	

	Location and size	Crime and vandalism	Aesthetics	Complexity	Maintenance and noise	Resilience	Education, understanding, familiarity	Performance and reliability	Upfront cost	Participation	Personal benefit	Outsiders	Impact on renters	Visibility	Neighborhood Context
Participant 1	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]		[illegible]						
Participant 2	[illegible]	[illegible]			[illegible]	[illegible]									
Participant 3	I think the aesthetic choice would be number 4 because it looks like it is on top of a pergola. Number 4 to me would be the best because then it would just fit in with the surrounding area. Then we can get more use out of it. Ivanhoe, like a lot of urban neighborhoods you know, low income, poverty, people are looking to steal anything that they think they could sell.	My only concern with it would be how easy it would be for someone to actually access the panels and either damage them or steal them. We have recently begun to see people tagging things in the neighborhood that appear not to belong to anyone. Now, initially, there is going to be some vandalism.	And then also I think the surrounding area, is it possible to do any kind of beautification in the surrounding area so that it does not just look like a big field of solar panels. I think the aesthetic choice would be number 4 because it looks like it is on top of a pergola. Number 4 to me would be the best because then it would just fit in with the surrounding area. Then we can get more use out of it. Something like number 12 looks similar to what is the boxes that are out now, just with a mural on it. It doesn't draw attention. Yeah, we already have those industrial looking ones in the neighborhood, and they are ugly. For me, on 17 and 18 I am drawn [illegible]				Again, if there is an aesthetic appeal added to it, I am not going to be saying why is that big electrical component added to my neighborhood.My concern would be understanding, if there was not an education period, what it means for the solar panel to be sitting there.	Are they as effective as the solar panels? I am assuming there would be some loss with number 7.	Not that the artistic part of it does not drastically add to the cost of the structure. When you are low income, you are going to see that as a waste of moneyFor something like this there is an initial cost. So, what is the return on investment for the actual homeowner. To show why this is worth investing in. If I as a homeowner and my 20 neighbors on the block, have a savings that outweighs the total cost of the unit, then it makes sense to me.	And also, something where there is an opportunity to vote on what it will look like or having the opportunity for local residents to be able to design something. We do have a few artists that are visible in the community.	when you are very low income it can seem that things are put in place that do not benefit me to the same degree as providing something where I can make more money to sustain my family.				I think the aesthetic choice would be number 4 because it looks like it is on top of a pergola. Number 4 to me would be the best because then it would just fit in with the surrounding area. Then we can get more use out of it. And again anything that is not going to look so industrialized and can become a part of the neighborhood and create some beauty and you know.
Participant 4	But those that are in park-like settings, or vacant lots I think that would be appropriate. I do not think they should be sitting next door to someone's house that type of thing. An area that would better present them as what they are. : Next to your home, no. In a shared community you know a park or a couple of vacant lots that area accessible, that type of thing. A park you can designate a certain area for these units. With the vacant lots you can do the same thing. Preferably a couple of connected lots depending on how many panels you want to use. I have seen them up close, they are some big buggers. So, something like that may not need to be in the city, it may need to be out of the city. In number 7, if those are turbines, that might be appropriate for communities or neighborhoods?		I am basic. I like, you know if it a car, it should look like a car. If it is a panel, it should look like a panel. It doesn't have to be disguised or dressed up or dressed down.				I think people would probably need to be posted that they are wind turbines, just looking at them. They look like a funny looking tree. I think there should be eduaational signs. I don't have any problems with signage saying that this is what it is so that people know what it is.	I know that there is some draw backs to that, but I think that would be a great source of energy, as well as the solar panels. Well, any one of them would work.	people would be concerned about the initial costs, because I have talked to a few people about having it installed on my home and it is expensive.					Well, they are basically saying, look at me, I am a solar panel. They are not hiding anything. Up front and center. I think that they should be more hidden (relating to batteries).	
Participant 5	Yeah, I like 4 a lot. Because it utilizes like a roof top does, so it is already space that is already well utilized for solar gain. I am not really a huge fan of 6 because it gets in the way of people running or kind of breaks up the landscape a bit. Especially if you are walking on a pathway, you can't see past that solar array. I like 5 a lot because it seems like it solves that problem. Those arrays are up. It allows people to walk under them. It seems like you could strategically place those maybe close to some trees. But that is cool. : Yeah, I think that goes back to the breaking up the landscape thing. Might as well break it up as least as possible. As fewer installations of that as possible. Yeah, on top of buildings. There are a number of urban farms in the area that may be interested. Like I am an urban farmer. I have about an acre and a half that I farm. I can see that being incorporated if there is some kind of community benefit. Or like on busy corner next to a busy bus stop. Like that one in the park had. Where you could tie in some phone charging stations. Those would be off the top of my head.		I like the mural and the planting idea. I don't see why they can't be combined. My ideal set up would be the signage from 8 with the plantings, plus the mural. I'm not a big fan. At least not of that style of fencing. It looks like that is the kind with the angled barbed wire fencing that you see around transformers now. It makes me think of prison. I would prefer to see a tall wooden fence.I like the way that the lights are shaped on 19. I guess the fan [traditional windmill] could work. Personally, I am just not a fan of the green color turbine in the center. 17 has a classic wind turbine look			And I guess localized production, like a small grid set up so it is more secure to power outages. So, they don't affect large areas.	I like that a lot, it explains why there is a big thing just sitting there. And there is a nice educational component. I could probably learn quite a bit if someone could explain how energy is stored in battery and how it is converted from solar. So yeah, I really like number 8 for that reason. For something that is kind of novel and something that people are not used to seeing, it might just help people just accept that it is there and have a reason that it is there. I always just find those things very interesting. I think that any sort of the large installations would benefit from signage. I like the way that it looks. It looks like some yard art that I have seen before. 17 has a classic wind turbine look				if there is a cost savings that could be helpful. I guess I would say, providing a tangible benefit. Like the phone charging station, those would be a good sell for people. Like I didn't' really highlight that I liked the phone charging station in the park, but that may have been more of an aesthetics thing. But if something like that tied more into one of those gazebos over the park benches. Or next to a bus stop. Something that is immediately useful for people. There are a lot of people that do framing and roofing that could incorporate solar. And if it did have a benefit for them in the immediate future, that could be a selling point.				
Participant 6	And you are not having to build them everywhere. You don't want to have to put a box on this corner and a box on that corner. Neighborhoods where you have those decrepit neighborhoods where they are kind of failing. Maybe put something like that over there. Something new to the area. Help them out with their bills and stuff like that. The parks for sure.. If you were going to put this one [number 6] where are you going to put that? You have to think about space. You have to think about real estate, property, permits, the neighbors. You just have one empty lot with solar panels and a fence. Don't go into the neighborhoods right away. Let them see how it helps the community in the parks, and then over time the idea will sell itself.	I would get rid of 1 2 3 and number 6. The only reason why is because you will have certain people that are looking to destroy things. This can get destroyed, this can get destroyed, this can [pointing at all of the images that are accessible from the ground]. Just tip this over [number 1]. We just need to fortify number 4 a bit more. Add an alarm, raise it up, that way it would stay safe. What's important is that the surface stays clear. Some punk kid would come by and knock one out with a rock.	Number 12 is rad because it looks like an art crate		And then I like 21, but then you have to think about security. A plastic film around it. You are going to have people coming up and tagging it.				I would do fewer larger ones. That way you are cutting down the cost. No not really, if you want to make it look nice that is something that you can do with this one down here because you already have the art around it. There is really no reason to invest in planting around it.			if we would just get corporate people to understand that the younger generation has a good point. but they are more concerned with making money. The corporate companies have to benefit in some way. But it's like we talked about, you have these big companies. KCPL. You are doing something like this for free, for people. How are you going to be able to sell something that is free to somebody that is used to making a lot of money. This is great, but now the energy that you are taking from this area, is taking away from their profits.	Or then if you do something like that, they might have to knock down a home that could have been a potential renters spot	Yeah number 7 actually looks like trees. That way it's kind of blends in. That way it does not stand out.	I like 16 and 17. The way you have it, is artsy and crafty, and has a nelson vibe to it and its just easy to look at. 17 has a cool art fixture on top of it. 16, 17 and 15 are my favorite.
Participant 7	I think any of them would fit into the neighborhood. I Like the multiple small ones like 14. I think in this neighborhood. I think urban neighborhoods would be great.	Although I know that you have got to worry about vandalism. I understand why you might need that (a fence). It is unfortunate that you would need that. But basically, if you are trying to build it and protect it. I prefer that you not have to have it, but I understand. I am all for diversifying. I think these different things would be good.	See I like them. I think they have done a good job of making them attractive. I like 16, that's pretty cool. It looks a lot like an artwork. 17 is more close to normal and that is okay. But I like the artwork looking things. 19 is kind of cool stuff that has a little bit more eye catching. The more desirable ones are the ones that look more artistic. The artistic looks to them. That would be one of my interests. Trying to see that.		I like 15. I do not know if you know this. But the bus stop on 43rd and Troost used to have a top on in, but someone ran their car into it. That's the only concern that I have about this stuff.	I think probably several smaller would be better, because that way if one of them goes out, you have the other ones. That is the smarter design.	Yeah, it is important for people to know what is going on. We have a lot of social media in this neighborhood. People try to talk to each other. So, I think people would know, but for new people coming in, yeah that would be important. At least to have it some place. I have looked at a lot of them. So, I am used to seeing them. They look fine. They look great.								
Participant 8	I think the ones that stand out to me the most are the seating arrangements. Because I think those are already being [illegible]	[illegible]	[illegible]				[illegible]					[illegible]		[illegible]	
Participant 9	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]			[illegible]				[illegible]	[illegible]
Participant 10	[illegible]		[illegible]		[illegible]		[illegible]	[illegible]						[illegible]	[illegible]
Participant 11	[illegible]		[illegible]	[illegible]				[illegible]		[illegible]				[illegible]	
Participant 12	[illegible]		[illegible]				[illegible]		[illegible]					[illegible]	

Appendix C.

Thematic Content Analysis

	Desire for renewable resources	Move forward to the future	Improve community	Improve and expand over time	Save money	Concern for the environment	Interest in renewable energy	Shared resource	Cost concerns	Access to technology	Functionality	Socilization	Understood necessity	Saftey considerations	Location and size	Crime and vandalism	Aesthetics	Complexity	Maintenance and noise	Resilience	people to know those things. Education, understanding, familiarity	Performance and reliability	Upfront cost	Participation	Personal benefit	Outsiders	Impact on renters	Visability	Neighborhood Context
Participant 13	I know in Kansas you can pay for your electricity to come from renewable sources. Sadly, that is not something that I have access to, but I would love that.	It just looks nicest. It looks modern, it looks progressive. Like you are moving in the right direction				Human driven climate change. I don't really think about the impact specifically on the urban setting. More of how it will impact jobs or food production or the environment as well.	but it is hard to say why would I personally buy solar panels because it is not. I kind of see it as me doing this doesn't really make an impact but if everyone does it, yes. I love it. I think that is one part of living in an urban community. It would be nice to have it close by everyone is helping .	but it is hard to say why would I personally buy solar panels because it is not. I kind of see it as me doing this doesn't really make an impact but if everyone does it, yes. I love it. I think that is one part of living in an urban community. It would be nice to have it close by everyone is helping .	I feel like switching to renewables would be more expensive, but that is something that I would be willing to pay for. I think fewer larger ones. I don't know if it is a practicality, if it would be useful to have smaller ones more spread out, but I would prefer the large one. I know people would hate it if their energy bills were going to go up $20, they would be like no way! But if it was the other way people would be very happy.		I like number 4 just because it is usable still. I would want to maintain function and maybe have a double purpose. but these [number 4] have some of the additional benefits.			I mean I like that, but I worry that they might be damaged or hurt the kids.	Oh, I see. Yeah, I like 1 4 and 7. Number 4 definitely because the rest of these take up a lot of space. I think so. In an urban setting that would be nice, I really like 16, It looks modern, it would do really well in an urban setting. It almost adds like an artistic style. The only thing that stands out is that some of them are not the best looking or they just take up space, but other than that. I think I like the functionality along with the purpose. When you can have the solar panels on top of the pavilion or something like that where I think these [number 6] would just interfere with the park.	people might mess with them. Honestly, I am afraid of vandalism. That's why I am not a fan of these, because I feel like thieves would mess with them [number 6]	Yeah, I do like those. I like these 2,3,5 because they are more modern. I feel like 6 would not be a big hit. I don't think people would be a big fan because, I don't know, they just kind of seem - almost too much. I am not a big fan of 9 and 10 because they seem fenced off and private and it just seems, I have seen a bunch of stuff like this and it is kind of an eye sore. But I really like 12 where it is a larger battery, but it's kind of hidden and looks nice. Hopefully you can add some art to it. I like when new technologies are flashy almost, just to draw attention to it and show what it is.		I mean I like that, but I worry that they might be damaged or hurt the kids.		I have seen stations like that before and I always think that is really cool. I am not a big fan of 19. I am not really sure what that is.			but it is hard to say why would I personally buy solar panels because it is not. I kind of see it as me doing this doesn't really make an impact but if everyone does it, yes. I love it. I think that is one part of living in an urban community. It would be nice to have it close by everyone is helping .				Yeah, I think people would like that. The smaller ones, you could always try and hide those, but there would be a lot more of them.16 and 18 would be my preference because they stand out. I also like 20 because it doesn't stand out.	
Participant 14		[illegible]	[illegible]						[illegible]		[illegible]			[illegible]	[illegible]		[illegible]				[illegible]		[illegible]					[illegible]	[illegible]
Participant 15	[illegible]						[illegible]				[illegible]			[illegible]		[illegible]	[illegible]							[illegible]					
Participant 16		[illegible]	[illegible]								[illegible]				[illegible]	[illegible]	[illegible]				[illegible]							[illegible]	[illegible]
Participant 17		[illegible]		[illegible]					[illegible]		[illegible]				[illegible]		[illegible]				[illegible]		[illegible]					[illegible]	
Participant 18			[illegible]	[illegible]							[illegible]				[illegible]	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]	[illegible]					[illegible]	[illegible]
Participant 19		[illegible]				[illegible]						[illegible]		[illegible]	[illegible]		[illegible]	[illegible]				[illegible]	[illegible]			[illegible]		[illegible]	
Participant 20	[illegible]		[illegible]				[illegible]		[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]							[illegible]	
Participant 21							[illegible]		[illegible]		[illegible]	[illegible]		[illegible]	[illegible]		[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]
Participant 22	[illegible]					[illegible]		[illegible]		[illegible]					[illegible]		[illegible]				[illegible]								[illegible]
Participant 23							[illegible]		[illegible]		[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				[illegible]		[illegible]			[illegible]	[illegible]