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## COMMUNITY RESILIENCE

Indiana faces environmental, economic, health, and infrastructure challenges that threaten its ability to remain competitive in the 21st century. The state's energy-related carbon dioxide emissions, energy expenditures, agricultural jobs, and methane emissions make the state the 13th most vulnerable to climate change's social and economic impacts.<sup>1</sup> Severe storms, floods, and extreme heat are environmental stressors that have reached historically high levels across Indiana communities, with measurable effects on agriculture, rising energy costs, and forecasted economic losses. The state's above-average vulnerability to heat- and disaster-related deaths presents serious challenges to several communities, especially those with elderly and disabled populations. Air pollution from sources, like the Whiting and Mount Vernon oil refineries, further jeopardizes Hoosiers' health. The American Society of Civil Engineers<sup>2</sup> ranks the condition of Indiana's aging infrastructure—including its roads, dams, and energy grid—below the national average. It requires substantial investment to keep pace with 21st-century demands.

These growing challenges are vulnerabilities that place an undue burden on rural and urban communities. When talking about resilience, vulnerabilities are characteristics or qualities of a system that increase the chance of harm or the severity of harm from an emergency or a long-term stressor. Who or what is at risk and the degree to which people and places can be harmed, across all dimensions, determines a community's overall vulnerability.<sup>3</sup>

For Indiana to remain competitive in the global marketplace and support the health and livelihoods of Hoosiers, state and local policy makers must consider new and innovative approaches to building resilience to these challenges—defined as a system's capacity to sustain functioning and well-being in response to disturbance, including an ability

to persist and recover, transition and adapt, or transform as necessary.<sup>4</sup> At minimum, resilience is the ability to “bounce back” from challenges. At best, it is the ability to use challenges to transform how a system functions so that it performs better.

Across Indiana's diverse landscape, urban and rural communities face varying degrees of resilience challenges. The Federal Emergency Management Agency (FEMA) Community Resilience Challenges Index (CRCI) highlights these disparities by combining data measures in six categories—social, economic, institutional, infrastructural, and environmental. More specifically, these factors range from population demographics and economic conditions to healthcare access and community capacity.<sup>5</sup> Of the 6.7 million Hoosiers, 5.3 million reside in areas facing medium challenges. While nearly one million residents are fortunate to live in areas with low challenges, about 500,000 residents reside in communities that face high challenges (Figure 1).<sup>A</sup> Particularly in counties like Marion, Lake, and Allen, residents may encounter significant hurdles in securing affordable housing, finding good jobs, accessing healthcare, and connecting with community resources crucial for building resilience. These challenges underscore the need for targeted efforts to strengthen community support systems and enhance the overall well-being of all Hoosiers.

For state and local policy makers to advance solutions, it is helpful to envision resilience to these vulnerabilities across a series of organizing dimensions: ecological, economic, institutional, social capacity and equity, and built environment/infrastructure. Each of these elements is described briefly in Figure 2. Considering vulnerabilities and resilience strategies across and between these dimensions offers state and local policy makers leverage to

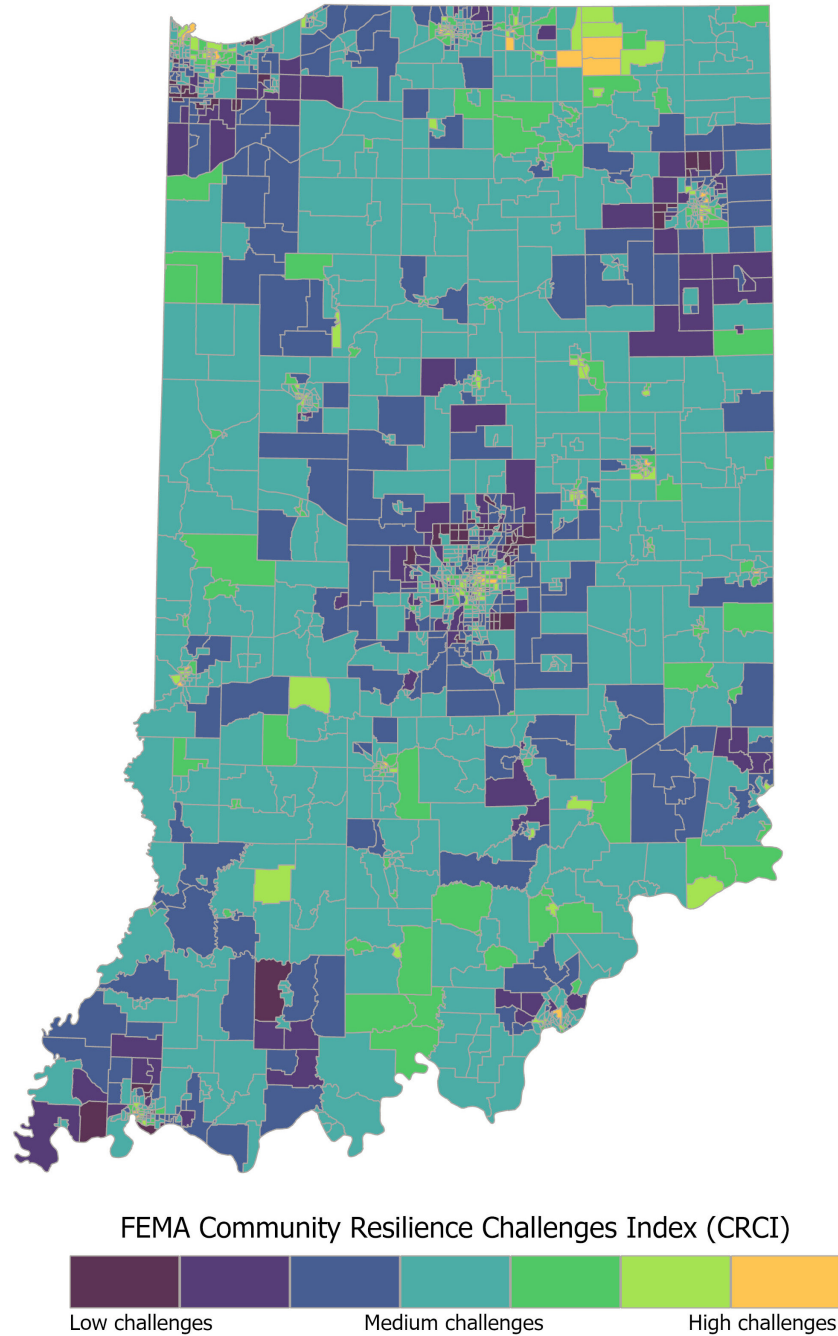
<sup>A</sup> Areas defined with low challenges have CRCI index scores in the 0–14.99 percentiles. Areas defined with medium have index scores in the 15–84.99 percentiles, and areas defined with high challenges have index scores in the 85th percentile or higher.

organize community-specific approaches to build capacity and adaptive processes.

There is a critical need for adaptation and transformation in Indiana communities and the systems in which they function; the world is changing and Indiana can keep pace

through the resilience of Hoosier communities. In this brief, the authors identify the vulnerabilities and the opportunities to create resilience in each of the five dimensions. Two examples of types of multi-faceted, community-scale resilience projects also are provided below.

**FIGURE 1. Resilience challenges in Indiana by census tract**



Note: Areas defined with low challenges have CRCI index scores in the 0–14.99 percentiles. Areas defined with medium have index scores in the 15–84.99 percentiles, and areas defined with high challenges have index scores in the 85th percentile or higher.

Source: Federal Emergency Management Agency

## FIGURE 2. Dimensions of community resilience

**ECOLOGICAL:** Community resilience requires protecting and enhancing the quality and quantity of natural resources and the inherent ecosystem services they provide within communities.

**ECONOMIC:** Community resilience requires building and/or maintaining the economic vitality and stability of communities through resilient business and industry, sustainable work opportunities, and supportive community policies.

**INSTITUTIONAL:** Community resilience means building and/or strengthening capacities of community-based institutions—local governments, hospitals, schools and universities, libraries, churches, and other nonprofits and charities—and linkages among them to serve their communities. This includes ensuring that these organizations are addressing their own vulnerabilities in addition to building capacity to address vulnerabilities in the community.

**SOCIAL CAPACITY AND EQUITY:** Community resilience requires growing social capacity and tailoring community action by engaging residents, protecting the social systems in communities, and addressing the variations in social capacity within and between communities.

**BUILT ENVIRONMENT:** Community resilience requires transforming the basic set of facilities, services, and physical structures communities need to address vulnerabilities. These assets include housing stock; broadband and other information technologies; electric and natural gas utilities; water/sewer/stormwater systems; roads/bridges; industrial parks and business incubators; hospitals/health care buildings; and main street/downtown buildings.

## THE ECOLOGICAL DIMENSIONS OF RESILIENCY

Ecosystems comprise complex, intertwined relationships between plants, animals, soil, water, and humans. They provide “ecological services” by reducing heat, extreme rainfall, and flooding, and improving air quality. Humans have impacted ecosystems in Indiana significantly over time. These impacts increased with European expansion and related forest clearance, wetland drainage, and the subsequent development of farmlands, cities, industry, and transportation corridors. Ongoing human development and climate change have further reduced the benefits these ecosystems provide.

Over time, society has grown to rely almost solely on traditional gray infrastructure to provide the services once provided by ecosystems. For example, in cities, constructed stormwater systems channel water to prevent flooding as land cover has shifted from green spaces to impervious surfaces. These unnatural solutions have a critical role to play. However, relying on these adaptations nearly exclusively has proven increasingly untenable. They do not truly provide resiliency to communities. Their construction

often requires high carbon emissions, and once built, climate change impacts or social change can quickly outpace their capacity.

More recently, practices that utilize natural ecosystem functions have emerged to improve local environments and make them more resilient to the negative impacts of climate change. In other words, natural ecological tools can be used to engineer more beneficial environments for humans and other organisms.

An example of these ecological tools is “urban green infrastructure”—the network of green spaces across communities that are managed for their benefits or “ecosystem services” to the community. Urban trees and forests, parks, bioretention areas, green roofs and walls, and community gardens are all types of “ecosystem services.” Their services to communities are equal to and often more cost-effective than traditional gray infrastructure. This is due, in part, to the co-benefits provided by well-maintained green infrastructure. For example, a community can provide shade for a bus stop with tree canopy cover or a built shelter. While the shelter has a limited function (shade), the tree canopy provides multiple additional functions—absorbing

carbon dioxide and air pollutants, mitigating flooding by slowing and absorbing rainwater, and conserving biodiversity by providing habitat for wildlife and pollinators. Yet, green infrastructure and ecological systems more broadly—as much as they are effective tools in community resilience—are themselves vulnerable assets requiring management and policy to support their functions.<sup>6</sup>

## HOW ARE ECOSYSTEMS VULNERABLE TO STRESS?

Healthy ecosystems have several vulnerabilities. They are vulnerable to changes in climate that can impact their viability and stability. In addition, invasive species can introduce vulnerability into ecosystems by replacing more robust ecological webs with organisms that simply grow faster. This climate-induced vulnerability can be seen in impaired waterways, where excess nutrients and too-warm water encourage the growth of pervasive algae, which kills off other organisms and can turn water bodies toxic. Additionally, in both agricultural and urban environments, chemicals used to control nuisance organisms result in a simplified ecological web more vulnerable to disease and death. When human activities and climate change factors degrade ecosystems' functionality, careful management is necessary to ensure they remain healthy and balanced. Land-use planning, zoning and other land-use regulations, or development schemes do not generally consider ecosystems. Thus, healthy ecosystems get little in the way of institutionalized protection.

## HOW CAN ECOSYSTEMS BE MORE RESILIENT?

Recognizing the inherent value of ecosystems and protecting and investing in them at the same level as other valued aspects of the landscape is critical to building their resiliency. Dr. Elinor Ostrom—a Nobel Prize winner in economics who identified that resilience to change and stress requires an array of tools (including some that are nature based)—championed this concept. For example, nature-based development includes urban parks and waterways with native plantings. These developments serve as local cooling assets, and they are designed to flood during extreme storm events—relieving pressure on urban stormwater systems. The positive ecological value of this type of development includes not only the foregone fiscal costs from flood damage and urban heat but also human health and other cobenefits that natural systems can

provide. If society valued the nature-based components of new developments as much as the tax base they generated, urban landscapes with far more environmental resilience would proliferate. Such landscapes are more just, equitable, and adapted to human activity and climate change pressures.

Opportunities for leaders:

- Support legislation that encourages climate-forward zoning and development codes that preserve green space and promote the development of urban green infrastructure alongside economic development.
- Help fill regulatory gaps that maintain functional natural systems like wetlands and forests—protecting their biodiversity, connectivity, and equitable accessibility.
- Develop and implement strategies for building nature-based solutions and green infrastructure into state operations and facilities exemplifying best practices.
- Encourage the valuation of ecosystems and their services in benefit/cost analyses for public investments (e.g. the USDA Forest Service's i-Tree program that puts dollar values on urban forest benefits).<sup>7</sup>
- Support legislation to stop the sale of the state's worst invasive plant species to preserve ecosystem function across natural spaces.

## THE ECONOMIC DIMENSION OF RESILIENCY

Having a healthy and resilient economy is crucial to community resiliency. Community resilience depends, in part, on diverse and adaptive economies that serve business interests by maintaining competitive advantage and avoiding risks. Indiana communities and the private firms driving their economies—from manufacturers of steel, automobiles, chemicals, or pharmaceuticals to agriculture to the service sector—are no exception.

## HOW ARE LOCAL ECONOMIES VULNERABLE TO STRESS?

Many disturbances and stressors, including shocks and slower-moving shifts, can make local economies vulnerable. The shock of the COVID-19 pandemic impacted Indiana's manufacturers by hindering workers' ability to come to work to produce goods. It also changed consumer habits,

shifting where and how goods were purchased and requiring suppliers and the service industry to adapt rapidly.

Climate change is a slower, pressing challenge that impacts local economies. Higher heat and greater fluctuations in precipitation affect the agricultural sector and its timber and row crop production. More frequent and stronger storms increase the chances that transportation corridors and power lines will be damaged—limiting firms' ability to produce and move their goods. Changes in consumer demand, cultural shifts, and global economic trends—particularly the movement toward greater corporate social and environmental responsibility—also influence businesses and their choices of location.

Markets and private enterprises are changing. They demand that certain conditions be met in host communities, including stronger environmental policies and more resilient, adaptable communities. While firms operate locally, they also must be responsive to the concerns of stakeholders and customers globally. For example, Amazon required access to renewable energy for the location of its HQ2. While Indiana presented an attractive proposal overall, the corporation did not select Indiana, in part, because of its environmental issues and lack of renewable energy at that time.

## HOW CAN LOCAL ECONOMIES BE MORE RESILIENT?

The movement toward greater corporate social and environmental responsibility also offers an opportunity for Indiana and its communities. As markets change and consumers demand that companies be more responsible, policy tools and programs that facilitate diversification and adaptation to socially and environmentally responsible behavior can provide competitive advantages to firms. These policy interventions also have the potential to directly reduce the vulnerabilities that climate and environmental change pose to risk-avoidant businesses.

Federal funding opportunities from the Inflation Reduction Act and the Infrastructure Investment Jobs Act have offered a unique opportunity to drive the economy while supporting resilience. Communities across the state are receiving grants stemming from these laws, and more opportunities are coming. Policy makers can facilitate

coalition building and grant coordination to bring more of these funds to the state for resilience projects that grow job opportunities for a new green economy.

Energy production diversification—including expanded renewable energy resources—is underway in Indiana due to regulatory pressures and the reduced economic costs associated with alternate sources. This diversification, accompanied by improvements to the electrical grid, will allow communities and the businesses located there to be more resilient and adaptable to future changes. With fluctuations in fossil fuel costs, investments in renewable energy can provide price stability for businesses and households in Indiana.

Communities and firms benefit when firms proactively address environmental and climate impacts. Businesses can ensure operational continuity by evaluating and responding to risks for climate-related disruptions. For instance, companies can adapt their supply chains to reduce vulnerabilities to extreme weather events. A food manufacturer that previously used a supplier vulnerable to hurricanes might collaborate with Indiana farmers to ensure a stable supply of ingredients during climate-related disruptions.

Companies that effectively monitor and manage emissions, water use, and waste disposal can avoid the costs of regulatory penalties. Such sustainable operating practices can benefit firms by streamlining operations and providing cost savings. Companies that use LED lighting and optimized HVAC systems can reduce energy use and expenses. Waste reduction—recycling or reusing materials during production—can minimize sourcing and disposal costs. Companies that adopt the principles of a circular economy—such as designing products for longevity and easy repair—reduce the use and expense of raw materials and enhance efficiency. These and other efforts help to foster public trust and goodwill with local communities and customers.

In the tight labor market, purpose-driven workplaces can be a tool to attract skilled workers. Initiatives such as volunteer programs, sustainability training, and carbon footprint reduction projects can help to attract and retain talent.



Adaptability to changing consumer preferences and regulatory landscapes can be a strategic advantage in accessing capital. Investors and lenders consider environmental performance when making decisions—particularly for socially responsible investors. By integrating environmental stewardship into their operations, firms can access capital more effectively and lower borrowing costs. Small and medium firms—an important part of the Indiana economy—are not immune to these dynamics. These firms must raise capital and work with larger, publicly listed companies like Lilly, Cummins, and Corteva. Larger firms increasingly require their suppliers to demonstrate adaptability and resiliency in the ever-changing business environment.

Opportunities for leaders:

- Support coalition building and coordination across communities seeking federal funds for resilience projects.
- Facilitate the diversification of energy sources—including renewable generation—and electrical grid improvement to ensure that businesses and communities have access to a reliable and adaptable energy supply.
- Support private sector risk mitigation through incentives for resiliency planning—particularly for small and medium firms.
- Facilitate collaboration among Indiana firms and suppliers to reduce risks associated with global impacts from climate change and other significant disruptions while supporting the local economy.
- Review and update state and local regulations to ensure companies are not hampered in adapting to changing consumer demands.

## **INSTITUTIONAL DIMENSIONS OF RESILIENCY**

Formal institutions like local governments and agencies, as well as community organizations, are the foundation of resilient communities. When a disaster or long-term stress impacts people or businesses, local institutions act as a bridge to practical support, resources, and information. Institutions rely on trust to be effective, and some community members will have strained relationships with formal institutions. For example, community health

clinics, churches, and social clubs can connect with people in ways the city government, health department, or housing authority cannot. Leaders must nurture a variety of organizations—both formal and community based—and foster cooperation across organizations and between trusted organizations and government agencies at the local, state, and federal levels.

Formal and community institutions can increase local resilience in the short term by strengthening the community's ability to manage in times of crisis and the long term by helping community members adapt to these challenges over time. Leaders must assist each institution in managing its own risks and enhance an organization's capacity to support the community during difficult times.

### **HOW ARE INSTITUTIONS VULNERABLE TO STRESS?**

Institutions increase local resilience but are themselves vulnerable to both short- and long-term risks. A disaster or disruption in the community—like a tornado or a broken water main—can interrupt an organization's operations and affect its ability to provide basic services in the short term. In the long term, ongoing issues create financial challenges for an organization. For example, hotter summers can stress aging facilities and increase energy bills year after year.

Institutions also bear the weight of increased stress on community members. When a community loses a large employer and neighbors need support with food and housing, the institution tries to serve its constituents while also struggling with decreased donations and fewer volunteers. An institution's own vulnerability and the increased stress on those it serves magnify the impact of climate change and other challenges and reduce that institution's ability to support the community.

### **HOW CAN INSTITUTIONS BE MORE RESILIENT?**

Formal and community-based institutions can increase their resilience—hardening themselves against short- and long-term shocks and stresses. Resilience efforts should focus on core services and any services most needed in times of crisis. For example, an organization's work could rely on food delivery, refrigeration, bussing kids, computer systems, quick deployment of snowplows, or

communicating with community members, each of which has its own unique vulnerabilities. Organizations should evaluate risks specific to these services and invest in backup systems and strategies for both management and infrastructure—such as a plan for decision making if key employees cannot get to the office, or a battery backup for the walk-in cooler. Organizations should be proactive in approaching everyday and long-term challenges. They must take steps to operate efficiently—especially in their facilities and vehicles—to reduce exposure to risks like high costs, supply chain issues, or a drop in donations.

While institutions know best where investments in resilience will have the most impact within their organizations, most will lack the capacity, funds, and knowledge to identify and implement the best strategies. Leaders can bridge this gap with local, state, and federal programming.

Opportunities for leaders:

- Help institutions create nimble, flexible, and resilient energy systems, including on-site solar energy and battery storage. Essential agencies—such as hospitals and water utilities—must also be assisted in creating microgrids and redundant energy feeds. Financial assistance, technical support, and modern building and zoning policies all help increase access to smart local energy solutions. Institutions with resilient energy systems will not only be able to continue offering services during disasters but also help manage the energy grid load and reduce energy costs as long-term stressors like climate change impact utility systems.
- Create utility audit and rebate programs for institutions to understand their facilities better. Such programs can help reduce the need for energy, water, and sewer capacity. Organizations with efficient facilities are less vulnerable to utility price fluctuations and disruptions and can reinvest long-term savings in programs that serve community members.
- Help institutions transition to electric vehicles and advise institutions on using bi-directional charging to provide emergency power. Electric vehicles have lower energy and maintenance costs than gas and diesel vehicles and improve local air quality while serving as a rolling battery backup.

## HOW CAN INSTITUTIONS SUPPORT RESILIENCE IN THE COMMUNITY?

Institutions—from a neighborhood church to a county hospital—are often at the front lines serving vulnerable community members. When disaster strikes the community, people seek out resources and information, gathering in trusted locations—like schools, parks, libraries, community centers, and places of worship. When people struggle with longer-term stresses, like high air-conditioning bills during a hot summer or a personal struggle with chronic illness, they often turn to these same trusted organizations for help.

Institutions can embrace both short-term and long-term roles by actively participating in local-level disaster planning, joining communication and information-sharing networks, and investing in programs that help the people they serve become less vulnerable. Leaders can support institutions with high-level facilitation and additional resources.

Opportunities for leaders:

- Encourage and fund the creation of “resilience hubs.” Resilience hubs are neighborhood-scale institutions that help people prepare for emergencies and navigate stressors, while also responding directly to disasters and emergencies (See “Resilience strategies in action”). Institutions designated as resilience hubs can provide continuous support before, during, and after emergencies and increase the personal and household resilience of those they serve.
- Include institutions in multi-hazard mitigation planning. Broaden the invitations to participate in emergency management planning and exercises to include locally trusted institutions as stakeholders. Increase institutional capacity to support the community in emergencies by incorporating the needs of these organizations into the plan and including strategies to reduce their vulnerability. Institutions are valuable assets in emergency management.
- Update building and zoning codes to support institutions—and the people they serve—in risk reduction and increasing resilience. Local and state policies on, for example, urban farming, stormwater management, energy efficiency, or solar and other on-

site energy generation, can either encourage or limit the creation of sustainable neighborhoods.

- Invest in programs, outreach, and education that reduce vulnerability and increase individuals' preparedness, in partnership with trusted institutions like schools, healthcare systems, and community-serving organizations. Special populations like the unhoused, the elderly, non-English speakers, and children will especially benefit from targeted support to avoid harm and increase personal resilience. Personal resilience translates to fewer resources needed from formal and community institutions.
- Support long-term collaboration among institutions at a local level. Foster a network of community-serving organizations and facilitate access to funding, resources, and information needed to care for community members in times of crisis. A resourced and connected network of neighborhood- and community-scale organizations can use informal and trust-based outreach to increase the reach of traditional and formal emergency management and communication.

## **SOCIAL CAPACITY AND EQUITY DIMENSIONS OF RESILIENCY**

Social capital—the network of relationships and trust within and between individuals and organizations—significantly enhances communities' capacity to share information, foster cooperation, and mobilize collective action to mitigate climate risks and facilitate recovery from climate-related shocks and disasters.<sup>8,9,10</sup>

The strength of social networks and community trust significantly influences the ability of communities to withstand and recover from shocks and crises. Communities with robust social capital—characterized by trust, norms of reciprocity, and thriving civil society—are better equipped to navigate adversity. When communities possess strong internal bonds and connections to broader networks, they are better prepared to exchange knowledge, share resources, establish norms of mutual support, and develop innovative institutions to address emerging challenges.

Strong community bonds—often referred to as “horizontal ties”—are vital for cultivating and building community resilience. Neighbors helping one another with practical

assistance—like snow removal, grocery delivery, sharing crucial information, or providing emotional support—exemplify this type of social capital. Equally important are “vertical ties,” or trust in institutions. When residents believe their voices matter and that decision makers are responsive, they are more inclined to cooperate with and support new policies and initiatives, which is essential for effective crisis response and long-term recovery.

The most resilient communities cultivate both strong horizontal and vertical ties. This combination fosters an environment of mutual support and collaboration, enhancing the community's capacity to adapt and thrive in the face of challenges.

## **HOW ARE COMMUNITY SOCIAL NETWORKS VULNERABLE TO STRESS?**

Lack of trust, absent social infrastructure, corruption, xenophobia, and historic or institutionalized discrimination present serious challenges to fostering community trust and tear and tug at our social fabric. A 2022 Gallup poll revealed that average confidence in major U.S. institutions—including the presidency, Congress, and the Supreme Court—had reached a new low of 27%, marking a significant decline from previous years.<sup>11</sup> The same poll revealed that trust in media has dropped across party lines, and trust in police fell from 69% to 64% in 2021 to 64% in 2022. At the local level, trust in the police, churches and religious organizations, and public schools has declined among Republicans, Democrats, and Independents.

A lack of adequate social infrastructure poses a significant challenge to building trust and facilitating social ties in communities. Social infrastructure includes the physical spaces and community institutions that foster social connections and promote community vitality. This includes libraries, parks, and community centers. When these essential elements are lacking or underfunded, communities suffer. Social isolation, inequity, and a diminished sense of belonging can become pervasive. Children may lack safe spaces to learn and play, communities lack spaces to gather and participate in important religious and cultural events, and individuals may face barriers to participating fully in civic life. Addressing the deficit in social infrastructure is crucial for building stronger, healthier, and more resilient communities.



Historic and institutionalized discrimination also poses a threat to the well-being and progress of communities. It creates deeply entrenched inequalities in access to opportunities, resources, and justice—leading to intergenerational cycles of poverty, limited social mobility, and marginalization. These systemic biases erode trust in institutions, fuel social unrest, and hinder economic growth. They also perpetuate harmful stereotypes and prejudice, creating a hostile environment for targeted groups and impeding efforts to build inclusive and cohesive communities. Various factors fuel this hostile environment, including economic anxieties, political rhetoric exploiting fears about immigration, and the spread of misinformation on social media. The COVID-19 pandemic further exacerbated these tensions, with certain groups being scapegoated and targeted due to their perceived association with the virus's origins. This rise in xenophobia manifests in increased hate crimes, discriminatory policies, and a general climate of hostility towards immigrants and minority groups. Addressing historic and institutionalized discrimination is not only a moral imperative but also essential for fostering a just and equitable society where everyone can thrive.

## HOW CAN COMMUNITY SOCIAL NETWORKS BE MORE RESILIENT?

Policy makers and community leaders should prioritize initiatives that foster trust, reciprocity, and civic engagement to strengthen social capital. This can involve supporting existing social institutions—such as faith-based organizations, sports clubs, and other formal and informal groups—and encouraging community involvement in planning and decision making processes. By leveraging the strengths of these preexisting networks, communities can better adapt to challenges and even drive transformative change.

Investing in community spaces—such as parks, libraries, and community centers—also builds the social fabric of neighborhoods. These spaces provide opportunities for people to connect, interact, and build relationships, fostering a sense of belonging and shared purpose. Prioritizing the creation and maintenance of these vital hubs empowers residents to engage in civic life, support local businesses, and cultivate a vibrant community where everyone feels welcome and valued.

Further, the digital age presents new opportunities. Platforms like Nextdoor offer a virtual place where neighbors can connect, exchange information, and build relationships. This digital evolution has the potential to reshape existing social dynamics and community structure. The round-the-clock nature of these platforms creates a space for ongoing, ambient interaction, allowing connections to form and deepen organically over time. This shift signals a broader transformation in how we understand and cultivate community in the 21st century, where technology plays an increasingly central role in facilitating social ties and fostering collective resilience.

Additionally, innovative approaches like time banking and community currency programs have the potential to strengthen social ties and deepen reservoirs of social capital. Time banking—which facilitates the exchange of services within a community—improves social capital and health outcomes, particularly among low-income individuals. Community currencies, earned through volunteering or bartering, can also foster trust and cooperation.<sup>12</sup> Such initiatives, along with those focused on leadership to build human capital, can indirectly bolster social capital, even when not explicitly designed to do so.<sup>13</sup> Embracing these strategies can help communities cultivate the resilience and interconnectedness needed to thrive in an increasingly complex world.

Opportunities for leaders:

- Expand funding programs designed to build trust and social ties in neighborhoods and communities, like the Office of Community and Rural Affairs Building Socially Connected Communities Program.<sup>14</sup>
- Support programs connecting individuals and families living in poverty with community volunteers and resources to help them achieve financial stability and self-sufficiency (e.g., Circles Indy<sup>15</sup>).
- Promote community events that promote inclusiveness, facilitate community dialogues, and celebrate diversity, such as the Indiana University Indianapolis Spirit & Place Festival<sup>16</sup> and the Nationalities Council of Indiana's Indy International Festival.<sup>17</sup>
- Celebrate the work done by organizations that engage communities in creating vibrant spaces, such as Keeping Indianapolis Beautiful.<sup>18</sup>

## BUILT ENVIRONMENT DIMENSIONS OF RESILIENCY

The built environment provides the infrastructure to support human society, including water, sewer, electric, and broadband systems; roads, bridges, rail, ports, and airports; as well as schools, hospitals, factories, and housing. These structures are built with materials that embody the carbon emissions associated with their extraction, transportation, manufacturing, and construction. They are operated primarily with energy systems that also create carbon emissions. Those emissions are the primary driver of climate change creating a range of increasing threats to the built and natural environment that provide the foundation for community capital. Much of our current infrastructure was designed and built in an era before climate change risks were widely recognized. Fortunately, Indiana is among the leading states in the nation for the adoption of clean energy technologies, including renewable wind and solar energy. The state also has made major progress in improving the built environment's energy efficiency, mostly due to life-cycle cost savings associated with new energy-saving technologies. Opportunities exist to leverage an influx of federal funding to accelerate energy efficiency and renewable energy in the built environment while enhancing community resilience to climate change impacts.

### HOW IS THE BUILT ENVIRONMENT VULNERABLE TO STRESS?

According to the National Centers for Environmental Information, Indiana has experienced 27 billion-dollar disasters in the past five years (2019–23), with over 70% from severe storms.<sup>19</sup> Over the past 20 years, flooding has had the highest level of risk and impacts on the built environment in Indiana.<sup>20</sup> Climate change is driving heavier rainfall across the state resulting in more frequent flooding. Added heat and moisture in the atmosphere increase the severity of thunderstorms, resulting in significant impacts on buildings, transportation, electric utility, and communications infrastructure. Tornado Alley is moving eastward from the Great Plains toward Indiana. Extreme heat associated with climate change is among

the deadliest climate-related disasters—especially in the poorest neighborhoods in urban areas with the least tree cover and the greatest urban heat island effect.<sup>B,21</sup> Stalled high-pressure areas can exacerbate extreme heat over time and increase drought, wildfires, and air pollution.<sup>22</sup>

Extreme heat also impacts the built environment by softening runways, buckling highways and rail lines, rupturing water lines, increasing fire risk, and increasing demand for electricity for air-conditioning.

### HOW CAN THE BUILT ENVIRONMENT BE MORE RESILIENT?

The built environment can become more resilient through adaptation planning and design that anticipates the impact of climate change. For example, buildings should be designed to withstand higher wind loads accompanying a derecho.<sup>C</sup> Reducing carbon emissions can mitigate the long-term impacts of climate change. For example, designing more efficient buildings that utilize on-site renewable energy will offset their electricity use.

Mitigation and adaptation are essential for addressing climate-change risks in Indiana. Where market-driven strategies are not enough to encourage mitigation and adaptation, government incentives, voluntary guidelines, or regulations may be required to catalyze change.

Opportunities for leaders:

- Utilize federal funding to update Indiana's energy and building codes. The state's current codes are among the most outdated in the country. This will save millions of dollars in energy bills, improve public health and safety by reducing pollution, mitigate climate change by reducing carbon emissions, and create more resilient communities with more disaster-resistant built environments.
- Provide public dashboards with energy-metering transparency and other performance data to track the performance of all state-owned buildings. Tracking this data resembles providing car buyers with information

B "Heat islands are urbanized areas that experience higher temperatures than outlying areas. Structures such as buildings, roads, and other infrastructure absorb and re-emit the sun's heat more than natural landscapes" and rural areas. "Urban areas, where these structures are highly concentrated and greenery is limited, become 'islands' of higher temperatures."<sup>20</sup>

C A derecho is a long-lived windstorm associated with a band of fast-moving thunderstorms or showers.

on how many miles per gallon they can expect for the vehicles they purchase.

- Incentivize solar energy development on former mines, landfills, brownfields, and superfund sites to maximize renewable energy production on unproductive land. This land use can be particularly important to create economic development opportunities in coal and energy communities.<sup>D</sup>
- Focus economic development efforts on locating renewable energy and clean industry projects on former coal-fueled power plant sites to ease the transition to clean energy and provide job opportunities where needed most. These sites have extensive existing transmission and transportation infrastructure that can be used to leverage development. Federal funding is available to support development and redevelopment in these coal and energy communities. In addition, firms can benefit from federal Advanced Energy Project (48C) tax credits<sup>23</sup> specifically designed to make these transitional investments more attractive.
- Adopt flood maps that reflect the current and future impacts of extreme weather and utilize them as a basis for regulating the design of built environment projects. These policies—informed by accurate hydrologic models—should discourage risky development of current and future flood areas. Projects built to last 50 years—especially those financed with taxpayer dollars—should not be allowed on sites that will experience flooding during that life cycle.

## RESILIENCE STRATEGIES IN ACTION

Communities across the U.S. have adopted customizable and innovative approaches to address vulnerabilities across the five dimensions. Leveraging individual actions that produce co-benefits across dimensions is an efficient and effective overall resilience strategy. The two case studies that follow demonstrate that opportunities to build resilience in one dimension provide resilience in others.<sup>E</sup>

## COMMUNITY RESILIENCE HUBS

A resilience hub is a community-serving facility upgraded to support residents' physical and social needs. Resilience hubs can coordinate communication, distribute resources, protect health and safety, and improve the sustainability and quality of life for a neighborhood and its residents. Resilience hubs use everyday opportunities to create strong community ties, help vulnerable community members, and contribute to the long-term sustainability of a community. These resilience-building activities often include addressing food insecurity—sometimes through co-located gardens—and educating community members on issues ranging from personal finances to managing health conditions to civic engagement. In emergencies, a hub switches into response mode—which could mean providing a safe place for threatened residents to gather; powering computers, radios and refrigeration; providing COVID-19 tests; or checking on elderly neighbors during heat waves.

Resilience hubs require careful planning and investments in services and programs, communications, facilities, power, and the operations necessary to address the demands of an emergency, recovery from an emergency, and ongoing daily needs. Hubs should be in convenient and accessible locations. They should be provided flexibility in zoning and code enforcement to support resilience activities such as urban farming and renewable energy storage. These hubs and their host institutions also must be integrated into emergency planning and communications and resource distribution networks.

### Example: Bryant Community Center Resilience Hub (Ann Arbor, Michigan)<sup>24</sup>

The nonprofit Community Action Network operates a resilience hub in partnership with the city of Ann Arbor. The facility manages stormwater on site and provides a kitchen and food pantry to distribute food to kids and families. Solar panels with a battery backup power the hub. It also provides day-to-day programming and education for youth and families, including a bike repair workshop, neighborhood energy assessments, and a community policing partnership.

<sup>D</sup> The federal government developed the terms coal community and energy community. They refer to mining communities as well as communities with high concentrations of coal-dependent jobs.

<sup>E</sup> Many more examples are featured on IU's Environmental Resilience Institute Toolkit, which is searchable by topic and region. <https://eri.iu.edu/erit>.

### FIGURE 3. Bryant Community Center Resilience Hub (Ann Arbor, Michigan)



Photo courtesy of Melissa Stults.

## MICROGRIDS

A microgrid is an electrical system that typically includes a solar photovoltaic and/or wind power source combined with a battery backup system—often with a generator to recharge the battery when renewable sources are not adequate. These systems are typically tied to the main grid via automatic switches to isolate the facility from the grid and derive power from the battery storage. Renewable energy and a backup generator can actively recharge the battery storage if required. Microgrids have high upfront costs compared to diesel or natural gas generators. However, they have lower life-cycle costs, less air pollution, no noise, and are not subject to the fuel shortages that often occur during major grid outages. Microgrids can be scaled to a single residence, a public school, a university campus, an industrial complex, an airport, or an entire community.

Microgrids provide reliable, resilient, affordable, and efficient electric power. They are more resilient to increasingly severe weather events than traditional systems. They can provide ancillary services to keep critical facilities operational during grid outages. Microgrids support a more resilient grid and increase the deployment of energy efficiency and renewable energy sources. The value of microgrids can be measured in lower utility bills; continuity of services; avoided outage costs; and health, safety, and environmental benefits.<sup>25,26</sup>

Microgrid development can be challenging due to their novelty, substantial upfront costs, and complexity.<sup>27</sup> State policy makers can facilitate the development of these

systems by providing education and technical assistance as well as regulatory certainty for owners and developers. They also can provide access to capital through government-sponsored funding and financing programs and public-private financing. Government-sponsored funding and finance projects include state revolving loan funds, grant and incentive programs, state-supported green banks,<sup>28</sup> and state and local government green bonds.<sup>29</sup> Public-private capital financing, such as Commercial Property Assessed Clean Energy (C-PACE),<sup>30</sup> provide additional alternatives to building capital packages for microgrid projects.

### Example: Microgrid at water pollution control plant (Fort Wayne, Indiana)

Fort Wayne installed a 6.71 megawatt floating solar photovoltaic system with battery backup at its sewer plant. This system will provide backup power to the water and sewer plants in the event of a grid failure while reducing operating costs and emissions.<sup>31,32</sup>

### FIGURE 4. Microgrid at Fort Wayne, Indiana Water Pollution Control Plant



Photo courtesy of KPC Media.



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