Statement of Project Objectives
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Form Follows Function (F3): A Framework for Community-based Energy Resilience Planning in the Midwest

Project Objectives

Our objective is to expand existing energy resilience planning tools for smaller communities that are at risk of low-attention disasters. The team will assist energy resiliency planning in Duluth, MN, a City with 86,000 residents that has experienced extreme rain events, coastal flooding, and derechos in the past 10 years. The Team will streamline the use of existing tools, develop new stakeholder engagement processes, analyze assumptions against existing methodologies, develop metrics, and test replication in other communities.

B. Technical Scope Summary

Form Follows Function (F3) is an innovative and replicable community-based energy resilience planning process that integrates new and existing resilience metrics, extends preparedness and response plans, and uses top-down and bottom-up processes through deep engagement with diverse community stakeholders. To meet the critical needs of a community during various periods of grid disruption, the project focuses on energy resilience through evaluating resilience needs at the community-systems scale down to individual households. It further examines implementable solutions at the grid level through deployment of solar PV plus storage and at an individual level through distributed micro-resilience resources or DMRRs (i.e. interventions installed at a household/business level with a primary purpose of meeting the resilience needs of that one structure). The F3 Framework is applicable to communities across the nation; however, the development process and test replications focus on cold climate communities subject to multiple hazards, building on the experiences of past disasters in northeastern Minnesota. This novel community-based research approach will inform resilient energy

improvements, de-risks projects for local partners, and is responsive to, and centered-on, traditionally marginalized communities at greatest risk of negative impacts associated with climate change, disasters, and grid outages. The target geography of this project is the City of Duluth, Minnesota.

The F3 Framework planning process is designed to address the complexity of community energy resilience planning. We will create a framework and tools that incorporate the needs of utilities and governmental entities, reflect existing grid assets, and allow residents to participate in defining the critical functions required in outage scenarios. The framework will consider both individual and shared-resource levels for energy resilience. This project will use an accessible human-centered design process to inform community energy resilience plans and effective implementation pathways. The project incorporates a top-down asset-based approach to evaluate multiple publicly-owned solar plus storage sites and a bottom-up approach that will engage residents in identifying resilience needs and appropriate interventions.

The project extends current resilience planning methodologies by combining novel social science research with traditional asset-based approaches to create a planning process accessible to communities that lack extensive planning capacity. The project firmly places solar and storage solutions within the greater context of grid-system, shared, and distributed micro-resilience approaches.

C. Tasks to Be Performed

Budget Period 1

Task 1.0- Define Baseline Hazards Analysis and Disruption Scenarios
The Team will develop 8-12 grid disruption scenarios as a baseline for research, including various disruption scopes, scales, and impacts to the community. Scenario development will use existing multi-hazards mitigation plans, FEMA's Hazus program models, research of historical disasters in the target community, and stakeholder input. Disruptions scenarios may include cascading failures with other critical systems as required to adequately mitigate negative impacts from disruptions.

Subtask 1.1- Complete Past Disaster and Hazus Analysis
Team will review the St. Louis County, MN Multi-hazard Mitigation Plan to obtain a subset of past disaster experiences and projected vulnerabilities to consider in choosing disruption scenarios. The team will run Hazus models to quantify potential risks (e.g. extreme rain events, flooding, straight-line winds, blizzards) in Duluth itself. The Team

will expand geographical analysis of hazards using Hazus to determine any differences that may exist between the city of Duluth and our surrounding regional geography.

Subtask 1.2- Develop Critical Systems & Disruption Scenarios

Form a Critical Infrastructure Team (CIT), including representatives from the IOU/grid operator, municipally-owned water and gas utility, public works, waste water district, state, county, and city emergency management, and the Ready North Network. The CIT will guide scenario development (Task 1) and top-down asset identification (Task 3), along with providing feedback on other Tasks as needed. They will meet throughout the grant project period: quarterly during Year 1, and at least twice during the Year 2. The CIT will assist the development of 8-12 power disruption scenarios (e.g. grid outage during high heat event, extreme rain) with different potential negative impacts (e.g. loss of heat in extreme cold, basement flooding during extreme rain event due to loss of sump pump) in scope and scale, and a variety of mitigation solutions. Feedback from the CIT will help the Project Team: 1) form a table of disruptions scenarios, compiling scenarios and considerations for selection and 2) guide determination of assets and locations for inclusion in solar and storage planning and siting (Task 3), 3) evaluate inclusion of solutions determined through community research (Task 2).

Task 2.0 - Bottom-Up Functional Resilience Analysis through Community-based Participatory Research Methodologies

The team will develop and test a methodology for creating community-based minimum resilience baselines in response to grid disruption scenarios. Baselines include negative impacts experienced by community entities (e.g. households, businesses, institutions) as a result of those grid disruptions. The team will conduct separate focus groups with community members and organizations (e.g. food shelf, housing, transportation, etc.) to develop the list of negative experiences. Using life-safety items (e.g. loss of heat, flooding, etc.)from the focus group list, the team will conduct survey research to develop distributions of negative experiences over time as anticipated by community members and as informed by past experience. The team will analyze the survey results to determine any variances in negative impacts due to population characteristics and/or existing green and built environments. Variances of experience and a review of mitigation/adaptation solutions will then be used to define potential resilience solution sets to reach established community-based minimum resilience standards. In addition, community members will provide feedback on site-specific solutions developed through Task 1 and Task 3.

Subtask 2.1- Plan and Host Focus Groups to Translate Individual Experience & Negative Impacts

Develop questions and recruitment methodology for resident focus group and Community Stakeholder Group. Establish focus groups (2-3) of community members representing diverse populations including those traditionally marginalized and/or most vulnerable to climate disruptions. Ensure focus group participation by individuals who live in neighborhoods where potential site(s) exist as identified for Subtask 3.2. Establish focus group with the Community Stakeholder Group (CSG) that includes community organizations active in disaster preparedness, response, recovery, and resilience, and organizations that provide critical services. Based upon focus group input, develop for inclusion in the Year 2 research, 1) a prioritized list of negative impacts previously experienced, or expected due to disruption scenarios; 2) a list of actions that would be taken if affected by the disruption; 3) a list of resilience strategies that could be taken at the individual or shared level, and 4) input on any known cost considerations

Subtask 2.2- Negative Impacts Research Plan
The Team will establish a Year 2 community research plan to engage community members/organizations and determine the distribution of negative experiences of community members/organizations against time, for each discrete grid disruption scenario. It is anticipated that multiple modes of engagement including online, mail, and door-to-door canvass of the community (with oversampling in socially vulnerable areas) will be incorporated into the plan. The plan will be vetted by the CIT.

Subtask 2.3- Community-based Participatory Research and Population Analysis
Following the plan established in Subtask 2.2, the Team will recruit and train community members to conduct research. The Team will create time-based population distributions for each grid disruption scenario and associated negative experiences (e.g. distribution of when participants experience basement flooding due to grid disruption resulting in sump pump failure). An analysis will be performed on the resulting distributions to identify any significant population characteristics associated with each standard deviation.

Subtask 2.4- Development of Resilience Solution Sets and Community-based Minimum Resilience Metrics
Develop technical solution sets to mitigate negative impacts for populations identified as least resilient in the distributions completed in Subtask 2.3. These solution sets can include systems level approaches (e.g. microgrids, solar and storage), shared solutions (e.g. cooling centers with resilient power), and/or distributed micro-resilience resources (DMRR) (e.g. siphon-based backup sump pumps). Conduct two workshopping sessions with the CIT and CSG (defined in Task 2.1). Session one will determine draft community-

based minimum resilience standards and solution sets to mitigate negative impacts, session two will review cost-benefit analysis of solutions, establish final minimum resilience standards, and prioritize mitigation strategies.

Determine project and/or program recommendations needed to deploy resilience solutions at scale. Recommended program approaches will focus on deployment of shared and/or DMRRs and may include informational campaigns, regulatory approaches, direct installation, and or financial incentives. Program recommendations may include future design and implementation by the City, utilities, and/or community partners as recommended during CIT and CSG review in Task 4.

Task 3.0 - Top-Down Asset-based Energy Resilience Planning

Project partners will identify public, institutional, and critical infrastructure sites for viability as community energy resiliency sites. Technical evaluations will be conducted on priority sites for solar, solar + storage, and/or storage options identified. Identification of legal and financial complications at each site will help establish a phased pathway for implementation. The team will develop an asset-based approach for local governments. This Task creates a vetted and prioritized site list, to unearth unknowns of future project partnerships, decreasing risk for all partners in resilient energy project development.

Subtask 3.1- Establish Asset-based Resilient Power Siting Criteria

Select a contractor to perform technical evaluation of solar + storage siting. Based on Task 1 results, outline potential project siting and evaluation criteria, including evaluation of grid outage data, past disaster damages, power resiliency for critical facilities, social vulnerability indices, and availability of publicly-owned and available sites (to include open land, large buildings, water reservoir infrastructure, closed landfills, and brownfields).

Subtask 3.2- Mapping of Solar/Storage Sites & Determination of Data Needs

Identify and map 10-15 potential sites for renewable energy and storage development which meet the Resilient Power Siting Criteria (Subtask 3.1). Determine data needs to evaluate each site for suitability, costs, and benefits. Identify the legal and financial complications associated with each site. Vet list with the Critical Infrastructure Team.

Subtask 3.3- Site Investigations and Cost Analysis

Gather data and conduct preliminary field work required to identify gaps identified in Subtask 3.2.

Task 4.0 - Form Follows Function Model and Community Energy Resilience Plan Development
The results from asset mapping and technical analysis (Task 3) will be combined with community-based minimum resilience data and strategies (Task 2) to develop a comprehensive community energy resiliency plan with identified projects (public development of solar/storage sites, shared solutions, and appropriate distributed micro-resilience solutions). Shared values and benefits from proposed approaches will be identified.

Subtask 4.1- Combined Analysis & Prioritization of Deployable Resources
Combine results from Tasks 2 & 3 to identify priority community energy resilience projects with significant overlap in technical feasibility and intended shared values and benefits. This task will establish a new priority site list of intersecting values.

Subtask 4.2- Community Energy Resilience Plan
Draft a City of Duluth community energy resilience plan and obtain feedback from the CIT and CSG. The plan will include 1) Summary of the overall planning process; 2) Description of the Critical Disruption Scenarios (Subtask 1.3); 3) Defined negative impacts with each disruption scenario (Subtask 2.1); 4) Community resilience distributions (Subtask 2.3); 5) Community-based Minimum Resilience Standards (Task 2.4), 5) Site selection rubric (Subtask 3.1); 6) Analyzed site list (Subtask 3.2); 7) Project, program, and policy recommendations (Subtask 4.1). After revision of the initial draft from CIT and CSG feedback, plan and conduct a 30-day public review of the plan using an online comment form and a minimum of one public meeting.

Task 5- Toolkit Development and Testing
This task develops the F3 approach into a replicable Toolkit and workshops the methodology with two other communities. The workshops will assist communities through creation of local community energy resilience plans. Replication communities will provide feedback on the planning methodology and toolkit. This task optimizes approaches used in Tasks 1-4 to guide smaller communities and/or those lacking resilient energy planning capabilities.

Subtask 5.1- Develop Community Energy Resilience Planning Toolkit
Development of Community Energy Resilience Planning Toolkit, including methodology for incorporating resilient power into multi-hazard mitigation planning, creation of disruption scenarios, asset-based planning approach best practices for community engagement and establishment of Community-based Minimum Resilience Standards, Duluth case-study, and plan template. Prepare for replication workshops by developing summaries of the disruption scenarios analysis conducted in Duluth, pre-panel survey

for launch in target community, and a logistics packet (e.g. scope of work, MOU template, workshop agenda) for potential host communities.

Subtask 5.2- Workshop Planning: Toolkit through Community Energy Resilience Planning Community Panels
The team will recruit two communities for implementation of a workshop on the Community Energy Resilience Planning Toolkit. This task includes workshop scheduling and logistical matters, along with recruitment. Participating communities will be provided with a stakeholder recruitment list (by type) so the community's leadership team can recruit appropriate participants for the 3-day window.

Subtask 5.3- Workshop Implementation: Community Energy Resilience Planning Community Panels
The team will implement the Community Energy Resilience Planning Toolkit with two communities. The workshop will then be conducted within the community including stakeholder interviews, site visits, and public presentations. Each community will be provided a post-meeting report including next steps for full plan creation. A debrief will be conducted with the leadership teams in each replication community to evaluate the process and potentially revise the toolkit and plan template to make them more beneficial.

Subtask 5.4- Dissemination and Reporting
Project dissemination will include submitting papers and presentations to relevant publications and conferences. Outreach efforts may target climate, adaptation, emergency government, and energy professionals as well as potential community-based user groups like local governments, environmental justice organizations, and social service providers. Articles/presentations will be developed regarding 1) Community-based Minimum Resilience, 2) Integration of Asset-based and Community-based planning methodologies for resilient power prioritization, 3) Community-based Energy Planning Toolkit application. The Toolkit itself will be published online.

Subtask 5.5- Final Reporting
All required reports and deliverables are submitted to the DOE.

End of Project (EOP) Goal: The Final Deliverable will be a Community Energy Resilience Planning Toolkit and three case studies reflecting the use of the Toolkit. Toolkit will contain methodologies for developing and analyzing deployment of renewable resources, community-based shared solutions, and distributed micro-resilience resources. Case studies will show use of the toolkit and demonstrate the development of minimal resilience standards.

D. Project Management and Reporting

Recipient will be responsible for programmatic, technical, and financial program management. Reports and other milestones will be provided in accordance with the Federal Assistance Reporting Checklist following the instructions included therein. Project update teleconferences will be held approximately monthly (or on an alternate schedule if requested by DOE), except where replaced by in-person status meetings or demonstrations. Recipient travel will be carried out as budgeted and necessary to complete the project goals.

. Milestone Table

Milestone #	Anticipated Month of completion	Performance Metric	Success Value	Assessment Tool / Method of Measuring Success Value	Verification Process	Metric Justification, Additional Notes
1.1.1	3	Critical Infrastructure Team	Critical Infrastructure Team established.	Count. 1 meeting of CIT has been held.	Submission of meeting summary to DOE.	1) CIT informs disruption scenario development and selection.
1.3.1	3	Resilient Power Siting Criteria	Resilient power siting criteria rubric.	Count. 1 resilient power siting evaluation rubric approved by Critical Infrastructure Team.	Submission of resilient power siting rubric to DOE	1) Siting of resilient power assets are contingent on multiple criteria, rubric research will include evaluation of grid outage data, past disaster damages, power resiliency for critical facilities, and social vulnerability indices, outline potential project siting and evaluation criteria.
1.1.2	6	Disruption Scenarios	A minimum of 8 grid disruption scenarios.	Count. 8 or more diverse grid disruption scenarios have been identified for the target community with an indication of likelihood and severity.	List of grid disruption scenarios sent to DOE.	1) To ensure applicability to the larger Midwest region, any known variance in hazards/disruption scenarios between Duluth and the broader Midwest will be noted for incorporation in the Task 5 toolkit. 2) List will be inclusive of any identified cascading disruptions to critical infrastructure.
1.3.2	9	Technical Analysis Consultant(s)	Technical consultants selected.	Count. 1 or more technical consultants have been selected	Consultant list provided to DOE	1) Consultants procurement required to address the technical,

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				through the City RFP process.	with site-specific SOW.	legal, and financial evaluations of sites.
1.3.3	9	Resilient Power Site Identification	A minimum of 10 prioritized sites for resilient power development.	Count. 10-15 potential sites are identified and prioritized according to the site selection rubric (Subtask 3.1).	List of sites with technical, legal, and financial evaluation plans.	1) Initial sites will be prioritized according to the site selection rubric established in subtask 3.1. 2)Each identified site will have an evaluation scope of work and consultant procurement reflective of that scope completed (legal, financial, technical, structural, etc.) to inform Task 4.
1.2.1	10	Focus Groups	A minimum of 3 focus groups have been held.	Count. A minimum of 3 focus groups have been held including at least 2 with community members and 1 with the Community Stakeholder Group.	Focus group questions, dates, and participation information submitted to the DOE.	1) Participation by organizations will be submitted. 2) Community member involvement will be documented through the number of attendees and demographic breakdown, but not by individual.
1.2.2 (DEI)	10	Membership of Community Focus Groups	A minimum of 2X the baseline community percentage of BIPOC, individuals with disabilities, and low-income participate in focus groups.	Variation. 2X the population percent of low-income, BIPOC, and individuals with disabilities.	Demographic breakdown of community and focus groups presented to DOE.	1) BIPOC individuals, individuals with disabilities, and low-income households are traditionally marginalized and most vulnerable to climate impacts. Ensuring deeper guidance by these populations through focus group participation will aid in creation of a research plan most likely to reach these groups.

Milestone #	Anticipated Month of completion	Performance Metric	Success Value	Assessment Tool / Method of Measuring Success Value	Verification Process	Metric Justification, Additional Notes
1.2.3	12	Community-based research design for Impact Distributions and Minimum Resilience Standards	Vetted year-2 community-based research plan.	Count. 1 community-based research plan developed. Plan includes collection and analysis methodologies for establishing impact distributions and establishing resilience standards, and training specifics for community-based researchers.	Research plan submitted to DOE.	1) Methodologies for resiliency to be determined within this research and the community-based process.
1.2.4 (DEI)	13	Canvasser Training	75% or greater of trained canvassers reflect BIPOC and or individuals traditionally underrepresented in STEM fields.	Percent. 75% or greater represent DEI populations.	Demographics of trained canvassers presented to DOE.	1) Black, indigenous, and people of color, along with women, individuals with disabilities, and LGBTQ+ populations are underrepresented in STEM fields and as vendors.
1.2.5	15	Resilience Distributions	A minimum of 8 resilience distributions indicating population experiencing negative effects of grid disruptions over time.	Count. 8 or more statistically significant community-based minimum resilience distributions.	Graphic representation of resilience distributions presented to DOE.	1) Distributions represent a diversity of likely grid outages as specified in Task 1 and the negative impacts as experienced by residents/organizations. 2) Research will be used to inform the development of subtask 2.4's Community-based minimum

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						resilience standards and solution sets.
1.3.4	18	Resilient power site analysis report	Prioritized site analysis report including barriers and action plan.	Count. 1 City of Duluth Community Energy Resilience Site Analysis Report vetted by Critical Infrastructure Team.	Report submitted to the DOE.	1)Report includes a summary of the analysis process for each site. 2) Technical, economic, and legal barriers are identified overall and per site. 3) Report format informs toolkit development.
1.2.6	18	Community-based Minimum Resilience Standards and Potential Solution Sets	Community-based Minimum Resilience Standards are approved by 90% or greater of CIT	Count. 8 or more Community-based Minimum Resilient Standards approved.	Memo detailing the approved standards and summarizing the methodology submitted to the DOE.	1) Minimum resilience standards help establish an understanding under different scenarios of which populations are least resilient and a goal for increasing resilience for those populations. 2) Minimum resilience standards will guide approaches and scale of projects and programs to move populations below that standard to minimum resilience.
1.4.1	21	Duluth Resilience Plan and Planning Template	Community Energy Resilience Plan approved by 90% of the CIT and CSG.	Count. 1 resilience plan template and 1 completed use of the template (City of Duluth case study).	Template and case study submitted to DOE.	1) City of Duluth plan will serve as an implementable example informed by top-down and bottom-up planning. 2) Template will include process instructions for application by other communities as part of the final project toolkit.

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1.5.1	21	Replication communities	MOUs established with two communities to hold planning workshops.	Count. 2 Memorandums of Understandings established with replication communities to host workshops and develop community resilience plans using the Toolkit established in Subtask 5.1.	MOUs submitted to DOE.	1) MOU will provide methodology and responsible party information for testing the Community Energy Resilience Planning Toolkit. 2) Workshops with other communities are anticipated in month 22.
EOP.1	24	Planning Toolkit	Vetted Community Energy Resilience Planning Toolkit	Count. 1 Community Energy Resilience Planning Toolkit vetted by project leadership team and two replication communities.	Community Energy Resilience Planning Toolkit submitted to DOE.	1) Community Energy Resilience Planning Toolkit and Plan Template optimized for cold climate communities with populations under 250,000, including vetted methodology and metrics for establishing Community-based Minimum Resilience Standards and integrated resilient power solutions sets.