ReNCAT

(Resilient Node Cluster Analysis Tool)

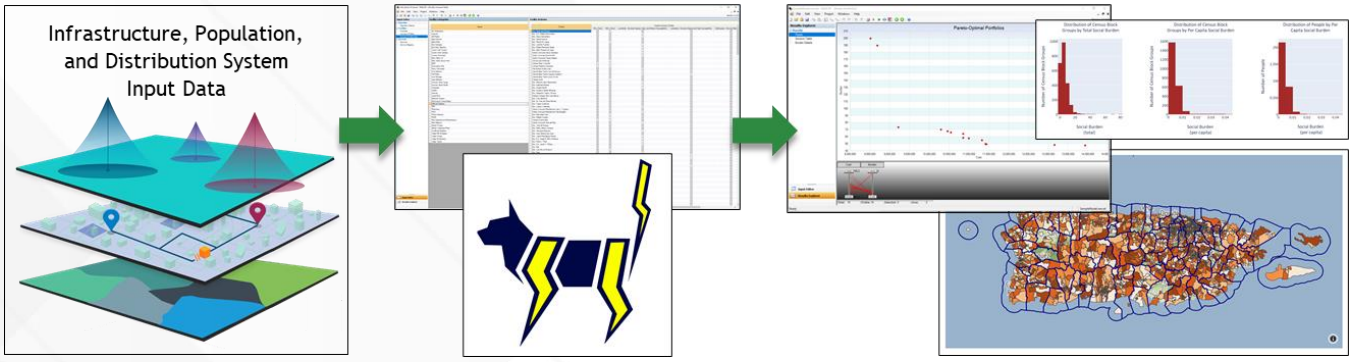
Objective

ReNCAT is used to analyze urban, suburban, and rural areas to determine optimal placement of microgrids to ensure critical services remain equitably available to the community during grid outages. ReNCAT considers the topology of the distribution system, the geographic locations of critical infrastructure, and the design basis threat (DBT) of low probability, high-consequence events in the area. The tool uses this information to prioritize areas that maximize access to critical services for the most people. This is achieved by minimizing the *social burden*, or the effort required to acquire basic services, while minimizing costs.

Tool Overview

ReNCAT uses a genetic algorithm to analyze the distribution system by sub-feeder and determine which of these to power via microgrids during a grid outage. Sub-feeders may contain both critical and non-critical loads as well as existing power generation that can be used while operating islanded from the grid. Analysts can provide both discrete and continuous generation options to power the microgrids.

A key feature of ReNCAT is understanding how critical services map to critical infrastructure. Analysts define categories for both and specify which infrastructure sectors provide which services and at what level. This mapping allows communities to prioritize keeping services online throughout the region, ensuring residents have access to these services regardless of where in the city they reside.



ReNCAT is threat-inclusive and can account for any number of threat profiles based on different scenarios that analysts and stakeholders may wish to explore. Threat profiles are represented using inclusion profiles, where analysts specify which critical assets are to remain available for possible inclusion in microgrids under each scenario. Inclusion profiles are flexible to allow for multiple threats to be combined if desired.

The objective of the optimization is to minimize the cost of the microgrid portfolio while also minimizing the social burden to acquire critical services. The social burden metric is a novel metric developed by Sandia to capture the effort and ability of residents within a given area to acquire services using proxies such as distance and household income. Social burden is assessed by census block in the area of interest. ReNCAT outputs a Pareto of various microgrid portfolios where each portfolio contains one or more microgrids. Stakeholders and analysts work together to understand the benefits of each portfolio as they tradeoff between lower burden and increased cost.

Applications

ReNCAT has been used extensively in New Orleans and Puerto Rico as well as in other US cities such as Pittsburgh and San Antonio. Projects are done in partnership with cities and utilities and have explored topics such as public versus private ownership of microgrids, microgrid placement in conjunction with other planned investments, microgrids in rural locations that lack certain critical services even while the grid is operating, microgrid configurations based on carbon emissions and renewables targets, and microgrids in locations with future projections of high electric vehicle penetration. ReNCAT is also being used by university partners for research projects.

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