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GMLC DRC Framework Application Example: Puerto Rico

Resilience Week
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PRESENTED BY

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Renewable and Distributed Systems Integration

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Step 1: Resilience Drivers Determination [Puerto Rico]

Step 1 Description

1.1. System

- System scope: 7 candidate communities (~25,000 residents)
- Planning process (and role of resilience) – Community-based

1.2 Threats

- Hurricanes, flooding
- The only electric utility is government-owned and bankrupt. The centralized, electric infrastructure is not resilient or sustainable. Highly dependent on fossil fuels.

1.3 Goals (from WEFTEC 2018 presentation Oct. 2, 2018*)

- Constant community engagement: Planning-Action-Reflection
- Implement Comprehensive Development and Land Use Plan
- Implement Sewage System
- Environmental restoration
- Design Stormwater Management Facilities
- Housing and redevelopment
- Prevent Displacement

1.4 Metrics

- Consequence categories: economic, social, critical services. Indicators: recovery costs, access to community lifeline services, critical loads not served.
- Use information from published reports: Comprehensive Development Plan for Special Planning District, Feasibility Report & Environmental Impact Statement for Local Ecosystem Restoration Project

Stakeholder Roles

- Community members and board
- Municipal government
- Electric utility
- NGOs
- Private sector partners
- Academia (e.g., UPR)

Tools and Resources

- SNL (2018), "Analysis of Microgrid Locations Benefitting Community Resilience for Puerto Rico"
- Results from Solar Colloquia (2017), DOE GEARED project GridEd
- E. O'Neill-Carrillo et al. "Capstone Design Projects as Foundation for a Solar Community," *Proceedings of the 47th ASEE/IEEE Frontiers in Education Conference* (FIE), October 2017, Indianapolis, IN.
- UPRM's undergraduate design projects and graduate theses

Challenges and Opportunities

- Access to funding
- History of environmental and social injustices
- High electric energy costs
- PREPA's IRP process
- PREB's microgrid regulation

* J. Bernagros, W. Michaels, S. Mossop, C. Muñiz Pérez. "Developing Green Infrastructure Typologies," Water Environment Federation Technical Exhibition & Conference, Oct. 2, 2018

Step 2: Baseline Resilience Analysis [Puerto Rico]

Step 2 Description

2.1 Baseline Impact Analysis

- For many years: areas without sanitary sewer system, flooding problems
- After hurricane Maria:
  - 1,000 houses severely damaged.
  - Blackout: overhead lines failed (T&D).
  - Lack of planning and preparation at the government level for an event of that magnitude. *
- Consequences *
  - Limited access to water, scarcity of food, the most vulnerable population suffered the most (elderly, people immobilized in bed, people in rural areas). Communities had to fend for themselves.

2.2 Baseline Resilience Metrics

- Relocate homes in high risk flood zones.
- Green infrastructure (including microgrids).
- Environmental restoration projects.
- Equitable development.
- Participatory democracy.
- Minimum access to electric power for those persons that need life-support devices, for those bedridden, and for the elderly. *
  - Access to medical services (e.g., # of functional pharmacies)

Stakeholder Roles

- Community members and board
- Municipal government
- Electric utility
- NGOs
- Private sector partners
- Academia (e.g., UPR)

Tools and Resources

- SNL (2018), "Analysis of Microgrid Locations Benefitting Community Resilience for Puerto Rico".
- "Community Energy Projects in the Caribbean," IEEE Technology and Society Magazine, vol. 38, no. 3, pp. 44-55, Sept. 2019.
- Results from Solar Colloquia (2017), DOE GEARED project GridEd
- Comprehensive Development Plan for Special Planning District, Feasibility Report & Environmental Impact Statement for Local Ecosystem Restoration Project.

Challenges and Opportunities

- Coordinating with partners design and implementation plans.
- High water table.
- Poor soil conditions.
- High densely populated area.

* Based on focus group April 2018, NSF RAPID project Award #1810800

Step 3: Resilience Alternatives Specification [Puerto Rico]

Step 3 Description

3.1 Technology, Policy, and Market Screening

- Mature PV Market in Puerto Rico (many local installers, trade organization – ACONER).
- Aggressive renewable energy goals.
- Existing microgrid regulation.
- Alternative technologies to meet goals: Solar energy as a focus area to pursue.
- Source of local socio-economic development through technology, citizen empowerment, environmental and social justice, aligned to sustainable energy principles.
- Constraints: Funding, interconnection with utility.

3.2 Resilience Mitigations Identification

- UPR-Mayaguez energy workshop to community leaders (2017).
- Community leaders participation in Solar Colloquia (2017).
- Preliminary assessment of common buildings rooftops.
- After the hurricane, three PV systems installed in community centers.
- Technology investment portfolios: Donations, proposals seeking funding.
- Leverage on near future construction of new sustainable housing.

Stakeholder Roles

- Community members and board
- Municipal government
- NGOs
- Private sector partners
- Academia (e.g., UPR)

Tools and Resources

- SNL (2018), "Analysis of Microgrid Locations Benefitting Community Resilience for Puerto Rico"
- UPRM Sunshot project report (2018), "Rooftop Solar Challenge to Induce Market Transformation in Puerto Rico".
- UPRM's undergraduate design projects and graduate theses.
- Results from Solar Colloquia (2017), DOE GEARED project GridEd.
- Comprehensive Development Plan for Special Planning District, Feasibility Report & Environmental Impact Statement for Local Ecosystem Restoration Project.

Challenges and Opportunities

- Need for community capacity building.
- Getting support for environmental restoration and infrastructure improvements.

Step 4: Resilience Alternatives Evaluation [Puerto Rico]

Step 4 Description

4.1 Resilience Metrics Improvement Analysis

- Consequence-focused performance metrics with mitigations.
- Evaluate resilience mitigations by calculating consequence-focused performance metrics (repeating steps 2.1 and 2.2 with mitigations).
- "What if" scenario: how would community energy systems help in a future emergency?

4.2 Multi-Stakeholder Investment Optimization

- Engage relevant stakeholders to negotiate weights for multiple resilience metrics.
- Prioritize investment portfolio through multi-metric optimization
- Collaboration with SUNY-Buffalo on survey to be distributed in the communities.

Stakeholder Roles

- Community members
- Community board
- Municipal government
- NGOs
- Private sector partners
- Academia (e.g., UPR)

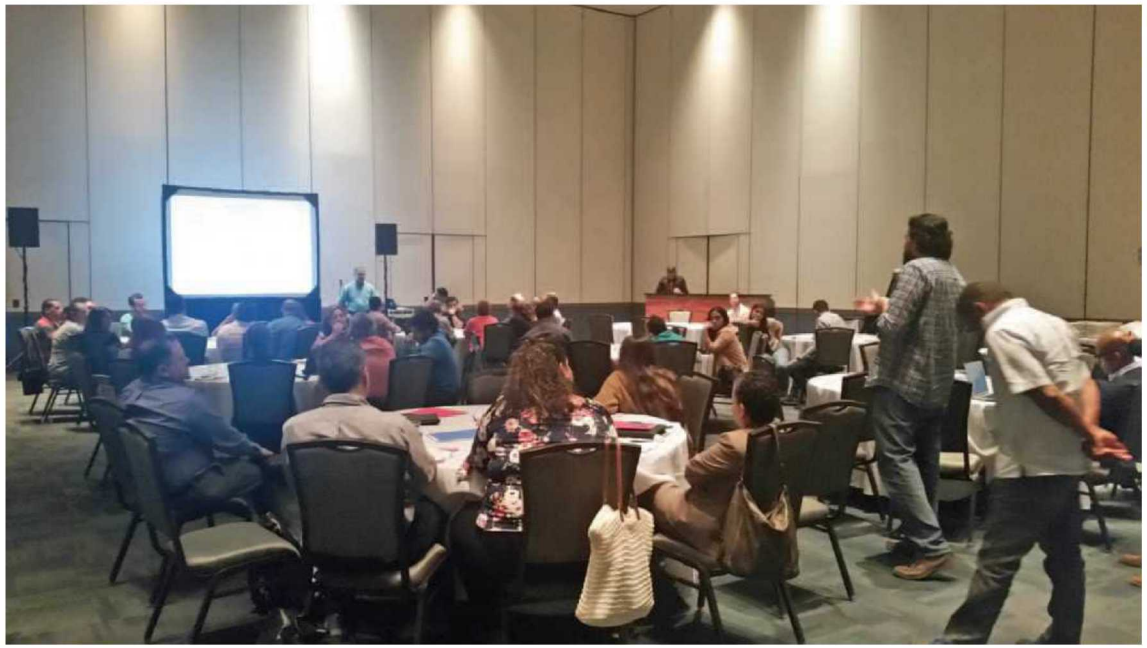
Tools and Resources

- SNL (2018), "Analysis of Microgrid Locations Benefitting Community Resilience for Puerto Rico".
- UPRM Sunshot project report (2018), "Rooftop Solar Challenge to Induce Market Transformation in Puerto Rico".
- Comprehensive Development Plan for Special Planning District, Feasibility Report & Environmental Impact Statement for Local Ecosystem Restoration Project.

Challenges and Opportunities

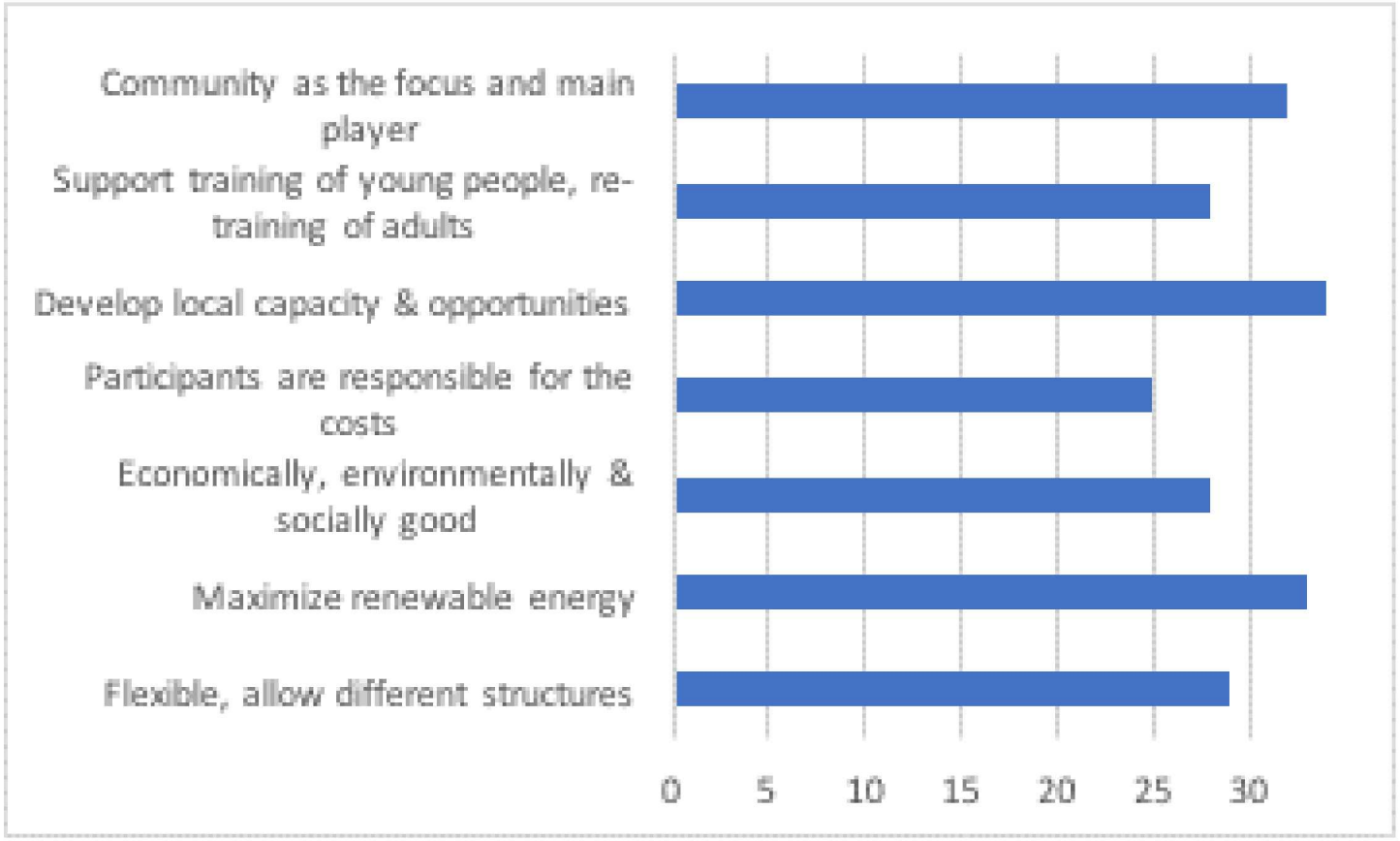
- Need for community capacity building.

Solar Community Colloquia, April 2017



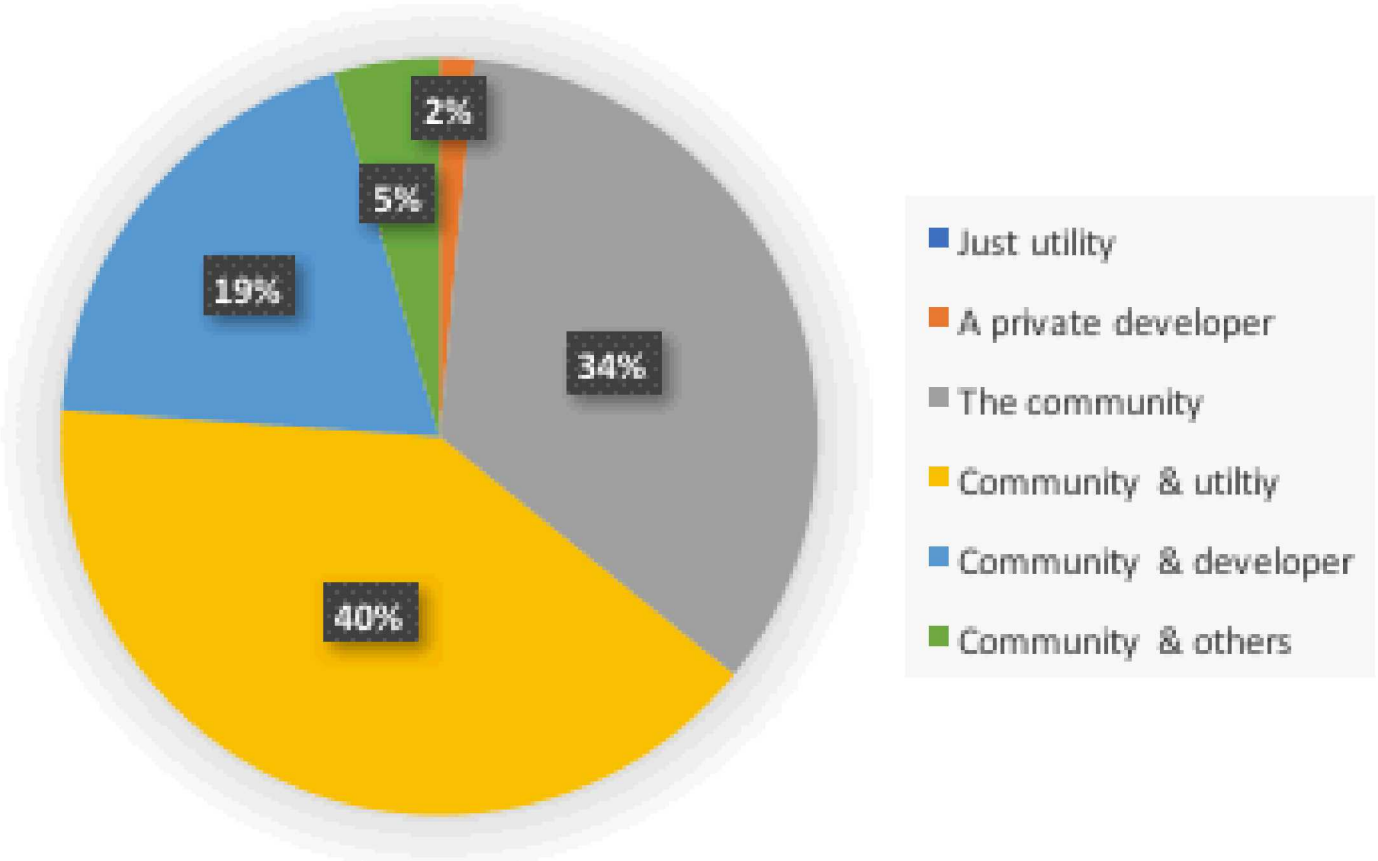
Images from: E. O'Neill-Carrillo, I. Jordán, A. Irizarry-Rivera, R. A. Cintrón. "The Long Road to Community Microgrids," *IEEE Electrification Magazine*, vol. 6, no. 4, December 2018, pp. 6 – 17.

Ideal characteristics of a community energy project (from Solar Colloquia 2017)



Images from: E. O'Neill-Carrillo, E. Mercado, O. Luhring, I. Jordan and A. Irizarry-Rivera, "Community Energy Projects in the Caribbean: Advancing Socio-Economic Development and Energy Transitions," *IEEE Technology and Society Magazine*, vol. 38, no. 3, pp. 44-55, Sept. 2019.

Management preferences for a community energy project (from Solar Colloquia 2017)



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