FEMA

U.S. DEPARTMENT OF ENERGY

HMA Hazard Mitigation Assistance

Webinar Series: Mitigating Natural Hazard Risks in the Energy Sector

Demonstrating Value: How to Use Benefit-Cost Analysis to Evaluate Energy Mitigation Projects

Tuesday, November 12, 2019 (2 - 4 p.m. ET)

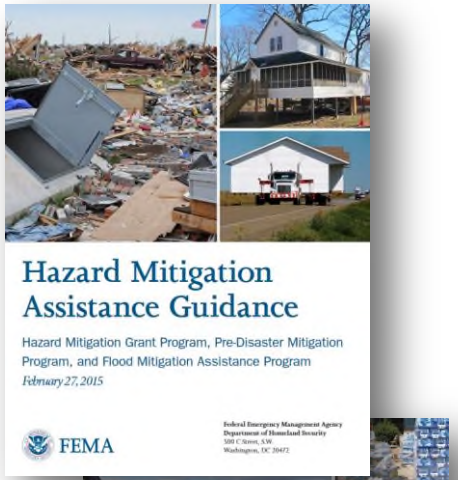
Introduction

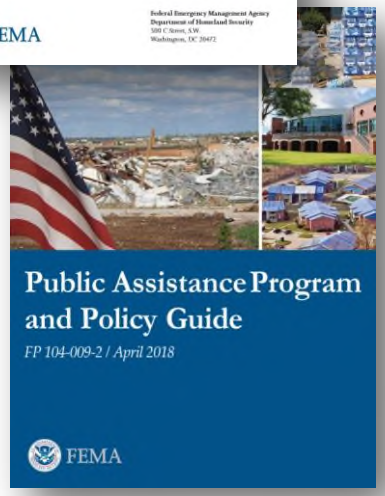
- Welcome
- Webinar logistics
- **Main presenter:**

  Tara Seibold

  FEMA Hazard Mitigation Assistance (HMA)

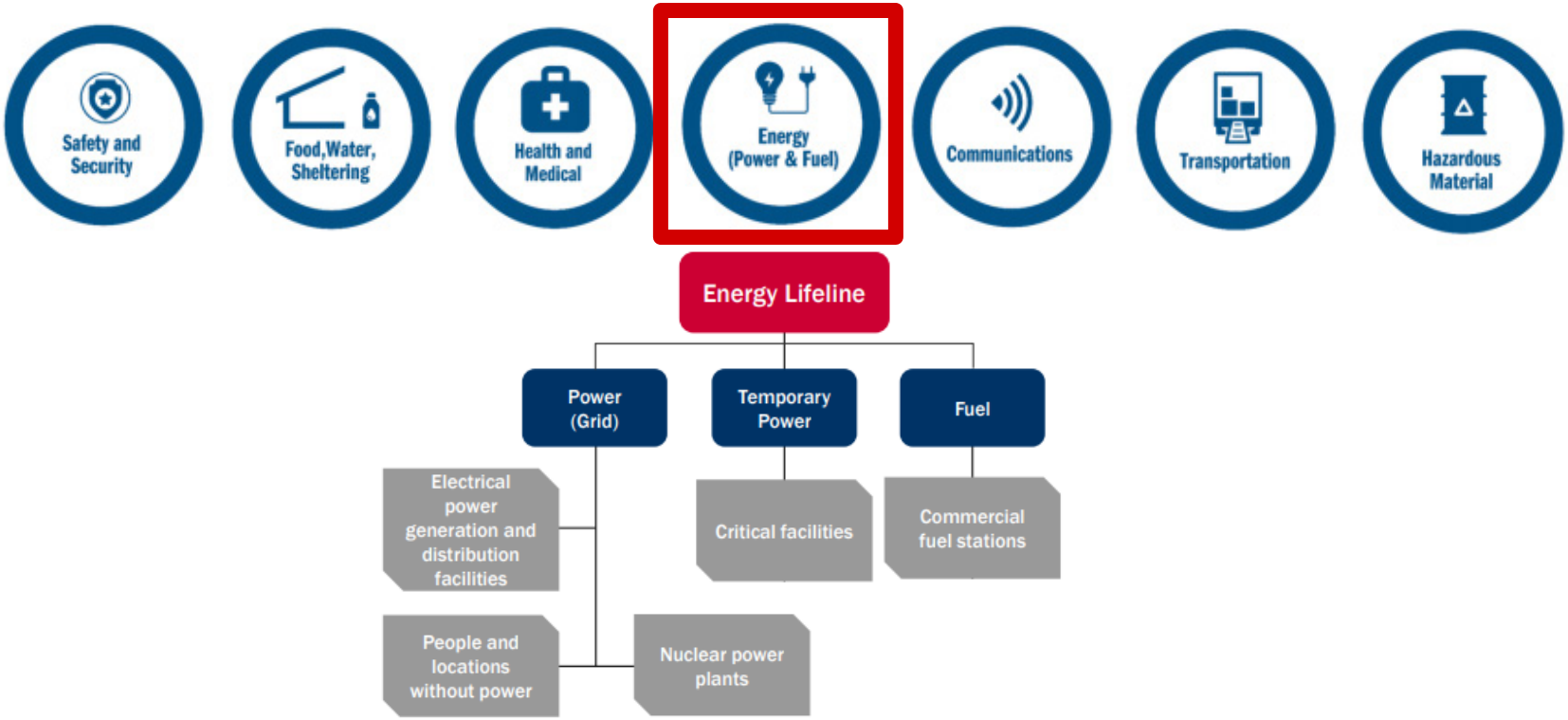
FEMA's Hazard Mitigation Grants



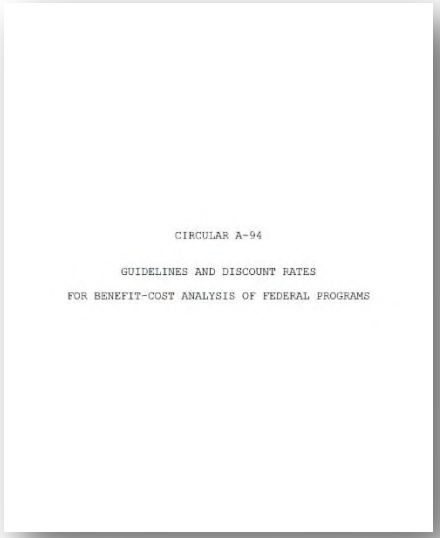


- FEMA Mission: Helping people before, during, and after disasters.
- The goal of **hazard mitigation** is to protect life and property from future disaster damages. FEMA has 3 programs that specifically fund hazard mitigation:
  - **Pre-Disaster Mitigation** (PDM) Program – will be the Building Resilient Infrastructure & Communities (BRIC) Program
  - **Hazard Mitigation Grant Program** (HMGP)
  - **Flood Mitigation Assistance** (FMA) Program
- The Public Assistance program can also fund mitigation of damaged public infrastructure.

FEMA's Energy Lifeline & DOE Role



FEMA's BCA Requirement

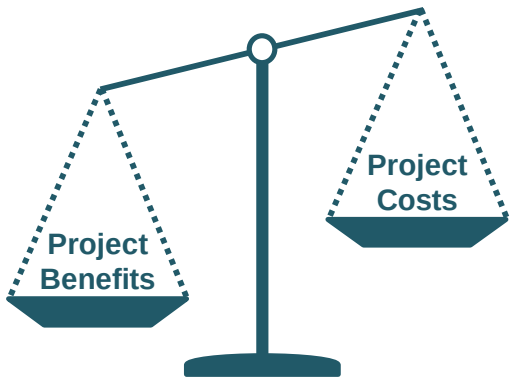

CIRCULAR A-94

GUIDELINES AND DISCOUNT RATES

FOR BENEFIT-COST ANALYSIS OF FEDERAL PROGRAMS

- FEMA has a statutory requirement to fund "cost-effective" hazard mitigation projects.
- In accordance with the White House Office of Management and Budget (OMB) Circular A-94 (*Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*), FEMA uses Benefit-Cost Analysis (BCA) to assess the cost-effectiveness of hazard mitigation projects.

Benefit-Cost Analysis (BCA)

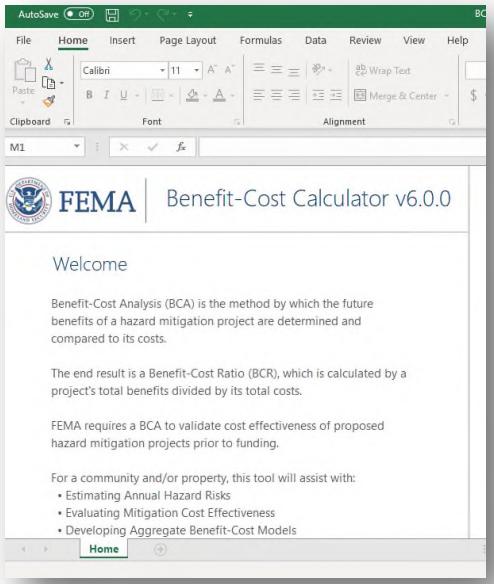


- Benefit-Cost Analysis (BCA) is the process of quantifying the benefits of an action and comparing it to its costs, resulting in a Benefit-Cost Ratio (BCR).

$$\frac{\text{Benefits}}{\text{Costs}} = \text{BCR}$$

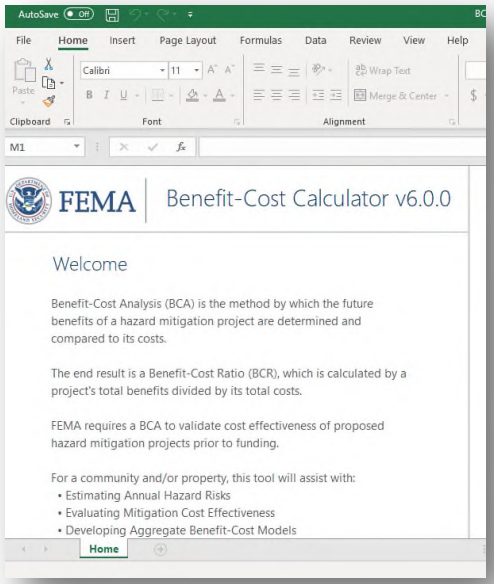
- Hazard mitigation projects must have a BCR of at least 1.0 to be eligible for FEMA funding.

FEMA's BCA Toolkit



- To facilitate the process of preparing a BCA, FEMA has developed software called the BCA Toolkit.
- The BCA Toolkit is an Excel-based tool that calculates a Benefit-Cost Ratio (BCR) for a hazard mitigation project.
- Primary users are FEMA grant applicants; however, it can be used to analyze any hazard mitigation project regardless of size or funding source.

FEMA's BCA Toolkit



- Required component of FEMA hazard mitigation grant applications
- Department of Housing and Urban Development (HUD) Community Development Block Grant Mitigation (CDBG-MIT) grant applicants may also use the BCA Toolkit to validate cost-effectiveness

How is the BCR Calculated?

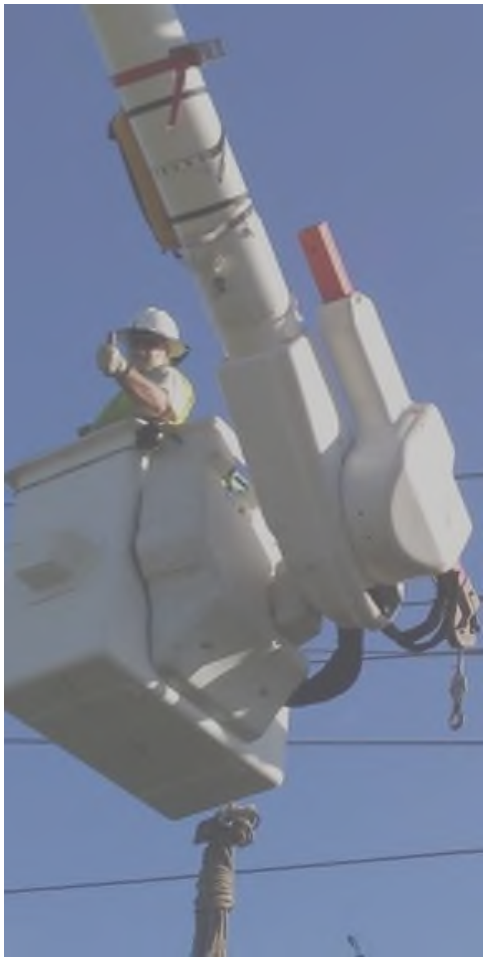
$$\frac{\text{Benefits}}{\text{Costs}} = \text{BCR}$$

- This equation is deceptively simple.
- What count as benefits? How do we quantify them?
- The calculation also takes into account things like project useful life, project effectiveness, hazard risk, and discount rate.

What Count as Benefits?

- Benefits in a FEMA BCA are any future costs or losses that are avoided as a result of the mitigation project.
- These future costs or losses can include:
  - “Direct damages” (structural & contents damage, etc.)
  - Displacement costs
  - Loss of function
  - Emergency management costs
  - Deaths and injuries

What Count as Benefits?



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- For example, if a community strengthens its power lines, it is less likely to lose power.
- Not only does the electrical service itself have a value, but there may be fewer repair costs and emergency management costs, such as sending out workers to close a road with live wires.
- These avoided costs would be counted as benefits of the mitigation project.

Potential “Damages” from Power Outages

- Loss of electrical service
- Loss of function for public services (fire, police, hospital, public buildings, airport, etc.)
- Contents damages
  - Spoiled food, electronics damage, etc.
- Displacement costs
  - For residential: cost to stay in a hotel
  - For public facilities: cost to move to a temporary location
- Repair costs
- Emergency management and response costs
  - The police work overtime to direct traffic

Quantifying Loss of Service

- Electrical Service = $148 per person per day
- This is an estimate of the value to society of electrical service.
  - Takes into account residential, industrial, and commercial users
  - If you would like more information about how this value was developed, you may request the Standard Values Methodology Report from the BCA Helpline (bchelpline@fema.dhs.gov)
- FEMA updates these values periodically.

What Don’t Count as Benefits*

- Secondary effects of project – for example, increased employment or economic growth
- Anything not quantifiable – for example, increased “resilience” of community
- Energy cost savings
- Reduced pollution or greenhouse gas emissions

*In FEMA BCAs

FEMA's BCA Toolkit – History

- After a 1999 GAO report about FEMA's BCA process, FEMA developed the BCA Toolkit to standardize methodologies.
- In 2006 and 2007, FEMA re-engineered the BCA Toolkit, establishing the currently-used methodologies, equations, and standard values.
- BCAs performed in the BCA Toolkit comply with guidance in OMB Circular A-94.

FEMA's BCA Toolkit

- Newest version – Version 6.0 – is an Excel-based add-in.
- Download instructions at www.fema.gov/benefit-cost-analysis.
- The tool calculates a BCR for a project by estimating the damages before and after mitigation (i.e. the benefits of the project) and dividing by the costs.

$$\frac{\text{Benefits}}{\text{Costs}} = \text{BCR}$$

Benefits = Damages Before Mitigation – Damages After Mitigation

Before We Dive Into the BCA Toolkit…

- We will cover specific data requirements in a moment.

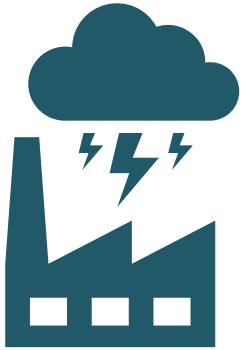
- The following questions will help you frame your BCA:
  - **What is the overall intent** of your project?
    - This is different than the physical work being performed.
  - **What facilities or public services will be protected** by the project?
    - Utilities, fire, police, gov't services, etc.
  - **What is the level of effectiveness** of your project?
  - **What damages occurred** that can be directly tied to the hazard being mitigated (i.e. the power outage)?

What Data Do I Need?

Overall project data:

1. **Project location and hazard being mitigated**
   - Do not impact calculations, more for tracking purposes
2. **Project cost**
3. **Project useful life**
   - BCA Toolkit Help Content provides standard values for many project types

What Data Do I Need?



For each facility being protected:

1. **Year built**
2. **Number of customers** or **annual budget** (depends on facility type)
3. **Past or estimated damages** – in dollars and/or number of days service impacted, preferably associated with Recurrence Intervals (RIs)
4. **Level of project effectiveness**

Past or Expected Damages

Benefits = Damages Before Mitigation – Damages After Mitigation

- To calculate the benefits of the project, the software bases it on past or expected damage amounts entered by the user.
  - Must be damages that would be mitigated by the project.
- Ideally, the damage amounts are associated with a Recurrence Interval (RI) – i.e. $60,000 of damage in the 1% annual chance storm.
  - RI = The likelihood of a hazard event **of specific severity, at that location**.
- If you do not know the RI for any of your damage events, you need at least 3 past events, and the software will calculate the RIs for you.

Project Effectiveness

Benefits = Damages Before Mitigation – Damages After Mitigation

- To properly estimate the damages after mitigation, the software needs to know what the level of project effectiveness is.
  - Recurrence interval + damage amount (in dollars or number of days service would be impacted)
  - For example: In the **500-year event**, we expect **one day of lost service** even after the mitigation project is complete. This is also called “residual damages.”
- In most cases, this needs to be determined by the project engineer.

Example: Campus Microgrid

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Basic Campus Info:

- 10,000 residents
- Most buildings built after 1990

Critical Facilities/Functions Protected:

- Electrical service
- Police station
- Health clinic
- Educational facilities

Example: Campus Microgrid

energy.gov

Basic Project Data:

- Project Useful Life: 30 years
- Initial Project Cost: $2.2 million
- Annual Maintenance Costs: $5,000

Example: Campus Microgrid

energy.gov

Structure 1: Utilities (Electrical service)

- Year Built: 1990
- Number of Custome[illegible]00
- Past Damages:

Year	RI	Impact (Days)	Contents Damage
1995	?	2	$14,000
2001	?	3	$25,000
2013	?	1.5	$10,000
2016	?	2.5	$22,500

"Primary" Damages

"Secondary" Damages

- Expected Damages After Mitigati[illegible] days impact in 100-year event, $5[illegible] contents damage

These should be damages resulting from the power outage that are not captured under the other structures. For example: Spoiled food in the dining hall

Example: Campus Microgrid

energy.gov

Structure 2: Critical Facility (Police)

- Year Built: 1991
- Number Served: 15,000
- Past Damages:

Year	RI	Impact (Days)	Emergency Response Costs
1995	?	2	$8,000
2001	?	3	$15,000
2013	?	1.5	$7,000
2016	?	2.5	$19,000

- Expected Damages After Mitigation: 0.5 days impact in 100-year event, $3,000 in emergency response costs

Example: Campus Microgrid

energy.gov

Structure 3: Critical Facility (Health clinic)

- Year Built: 1994
- Annual Budget: $7M
- Past Damages:

Year	RI	Impact (Days)
1995	?	2.5
2001	?	3.5
2013	?	2
2016	?	3

- Expected Damages After Mitigation: 1 day impact in 100-year event

Example: Campus Microgrid

energy.gov

Structure 4: Critical Facility (Education)

- Year Built: 1990
- Annual Budget: $40M
- Past Damages:

Year	RI	Impact (Days)
1995	?	2
2001	?	3
2013	?	1.5
2016	?	2.5

- Expected Damages After Mitigation: 0.5 days impact in 100-year event

BCA Toolkit Demo

Example: Puerto Rico PV & Storage Energy Resiliency Project

Basic Info:

- Project Cost: $239,900
- Goal: To increase residential energy resiliency and reduce energy consumption from the grid.
- Scope: 20 homes in Caguas and Arecibo

Critical Facilities/Functions Protected:

- Electrical service (20 homes x 2.81 people per household = 56 customers)

Example: Puerto Rico PV & Storage Energy Resiliency Project

Structure 1: Utility (Electrical service)

- Past Damage Events:
  - 50-year event (Hurricane Maria)
  - 75 days of power outage
  - $20,000 contents damage ($1,000 per home)
  - $481,500 in displacement costs (calculated using standard per diem rates)
    - 20 households x $167 x 75 days = $250,500
    - 56 people x $55 x 75 days = $231,000

Example: Puerto Rico PV & Storage Energy Resiliency Project

Structure 1: Utility (Electrical service)

- After-Mitigation Damages:
  - In the 100-year event, 0.5 days of impacted service, $5,000 in contents damage, and $0 in displacement costs.

BCA Toolkit Demo

Limitations of FEMA's BCA Toolkit

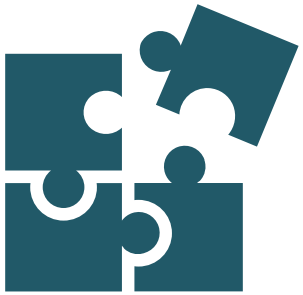
- Garbage in = garbage out
- Intended to perform BCA for physical projects, not programs or plans
- Assumes hazard risk is static over the project useful life
- Assumes costs associated with power outages are simply a factor of the service population and outage duration, whereas in reality long-term power outages may have additional, escalating costs

DOE's Interruption Cost Estimate (ICE) Calculator

The **Interruption Cost Estimate (ICE) Calculator** is an online tool, sponsored by DOE's Office of Electricity Delivery and Energy Reliability and hosted by DOE's Lawrence Berkeley National Laboratory. This tool:

- Enables users to estimate the economic costs of actual or hypothetical service outages to consumers.
- Is based on customer data collected by more than 30 major utilities across the U.S.
- Is easy to use. The user specifies the number of affected customers (by type), the location, and the duration of the outage. (ICE is not applicable for outages lasting longer than 24 hours.)
- ICE has more than 5,000 users, some outside the U.S.
- More information is available at https://icecalculator.com/home

Common BCA Challenges & Issues



- Lack of documentation for data entered
- Insufficient data or documentation on project effectiveness
- Lack of damage history
- Including damages that would not be mitigated by project
- Lack of recurrence interval (RI) data or incorrect interpretation of RI
- Not including all protected structures

BCA Resources

- BCA Toolkit Help Content
- Technical assistance available through the BCA Helpline (bchelpline@fema.dhs.gov)
- State Hazard Mitigation Officers (SHMOs) and FEMA Regions
- Advance Assistance under HMGP and BRIC can provide funding for engineering analyses and data collection to support BCAs
- FEMA's BCA training course materials are available online: https://www.fema.gov/media-library/assets/documents/182462
- https://www.fema.gov/benefit-cost-analysis

Questions?