

Distributional Equity Analysis for Energy Efficiency and Other Distributed Energy Resources

June 25, 2024

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This work was funded by the U.S. Department of Energy's Building Technologies Office, under Contract No. DE-AC02-05CH11231.



Webinar Logistics

- We are recording the webinar.
- Because of the large number of participants, everyone is muted.
- Please use the Q&A box to send us questions at any time during the presentation.
- We will put the link to the slides in the Q&A box.
- We will also send links to the recording and slides to everyone registered for this webinar a few days after the webinar.



Agenda

- Welcome from the Building Technologies Office and E4TheFuture
- Background on Distributional Equity Analysis Guide
- Background on Energy Equity and Benefit-Cost Analysis
- Distributional Equity Analysis
 - Priority populations
 - Equity metrics
 - Analytical tools and data
 - Conducting a Distributional Equity Analysis (DEA)
 - Using the results of DEA and Benefit-Cost Analysis (BCA)
- Questions and answers

Please post questions in
the Q&A box





**Brian Walker, U.S.
Department of
Energy**

**Building
Technologies Office**



DOE R&D is based on partnership. This is how to work with us.

Key DOE Roles



Convene

DOE topical meetings and workshops bring innovators together to identify priority challenges



Plan

Based on those priorities DOE sets technology milestones and creates an annual SSL R&D Opportunities document



Co-Fund

DOE funds competitively awarded and cost-shared projects aligned with the plan



Share

DOE ensures open information flow and provides analyses that spur technology advances and inform future R&D priorities

Our approach follows the National Blueprint for the Buildings Sector



Reduce U.S. building emissions 65% by 2035 and 90% by 2050 vs. 2005 while enabling net-zero emissions economy wide and centering equity and benefits to communities

CROSS-CUTTING GOALS



- Equity** – Advance energy justice and benefits to disadvantaged communities
- Affordability** – Reduce energy burden and technology costs so all can benefit
- Resilience** – Increase the ability of communities to withstand and recover from stresses

STRATEGIC OBJECTIVES



Increase building energy efficiency

Reduce on-site energy use intensity in buildings 35% by 2035 and 50% by 2050 vs. 2005



Accelerate on-site emissions reductions

Reduce on-site GHG emissions in buildings 25% by 2035 and 75% by 2050 vs. 2005



Transform the grid edge

Reduce electrical infrastructure costs by tripling demand flexibility potential by 2050 vs. 2005



Minimize embodied life cycle emissions

Reduce embodied emissions from building materials and construction 90% by 2050 vs. 2005

Affordable Home Energy Shot

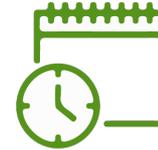
Reduce by 50%+ the cost of retrofit packages needed to decarbonize affordable housing while lowering energy bills by 20% within a decade.



50% lower
upfront cost



20% lower
energy bills



Within a
decade

Approach to Affordable Housing*

*single-family, multifamily, and manufactured homes occupied by households earning <80% of the area median income

The Energy Earthshot focuses on the challenges facing the 50M homes that make up the U.S. affordable housing stock.



Focus on multifamily and manufactured homes

Over 60% of multifamily and manufactured buildings serve as affordable housing and face unique decarbonization and affordability challenges.



Create scalable solutions that minimize disruptions to renters

Over 58% of low-to-moderate income households are renters.



Target design barriers specific to older buildings

Affordable housing is more likely to lack adequate insulation and central AC, as well as experience other non-energy hazards such as lead and mold.

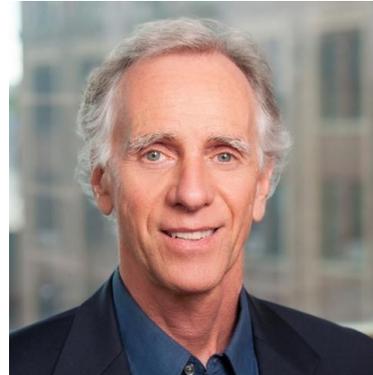
Julie Michals, E4TheFuture



Related Materials and Trainings

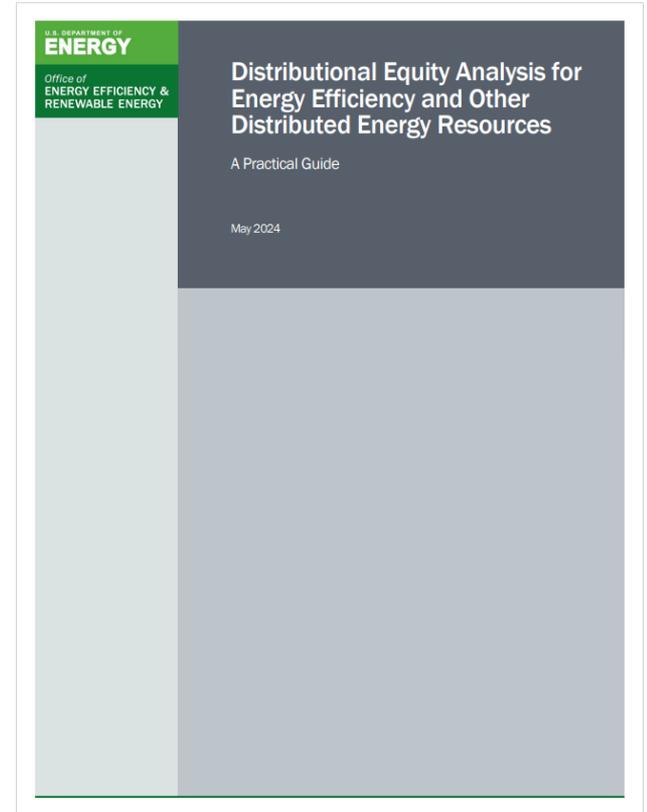
- ▶ National Energy Screening Project publications include the National Standard Practice Manual for Conducting Benefit-Cost Analysis of DERs, a **companion document to the DEA Guide**.
- ▶ Virtual Live Training on ***How to Conduct a Distributional Equity Analysis***: July 30 – Aug 2, 2024, hosted by Association of Energy Service Professionals (AESP). Register at <https://aesp.org/event/how-to-conduct-a-distributional-equity-analysis-dea-to-inform-der-investment-decisions/>. Discounted rates available for CBO rep.
- ▶ Forthcoming **DEA Case Studies in Illinois** (Q2 2025) that apply the DEA Guide. Project funded by E4TheFuture and The Joyce Foundation. Led by E4TheFuture with Synapse Energy Economics and Midwest Energy Efficiency Alliance.

Tim Woolf, Synapse Energy Economics



Distributional Equity Analysis Guide: Background

- ▶ Funded by
 - US DOE, through Lawrence Berkeley National Lab (LBNL) and E4TheFuture
- ▶ Prepared by
 - Synapse Energy Economics
 - LBNL
 - E4TheFuture
- ▶ Overseen by an Advisory Committee made up of experts in energy equity and in energy planning.
- ▶ Additional information and report available here:
 - <https://emp.lbl.gov/publications/distributional-equity-analysis>



DEA Guide: Purpose and Context

- ▶ There is increasing interest in both energy equity and benefit-cost analysis (BCA) of distributed energy resources (DER).
- ▶ BCA is not designed to address equity issues because it assesses costs and benefits of customers on average.
- ▶ This DEA Guide provides an analytical framework that can be used in combination with BCA to answer one key question:
- ▶ DEA is a nascent, emerging concept in the realm of utility regulation.
 - The DEA Guide should be viewed as early, evolving guidance for advancing this topic.
 - Additional experience, analysis, and information will be needed to build on the DEA Guide.



What are the distributional equity impacts of utility resource investments in the context of cost-effectiveness evaluations?



Several Dimensions of Equity (“System-Wide Equity”)

Recognition

Recognizing the historical, cultural and institutional dynamics and structures that have led to energy inequities

Procedural

Promoting inclusive, accessible, authentic engagement and representation when developing or implementing programs and policies

Distributional

Promoting the equitable distribution of benefits and burdens across all segments of a community and across generations

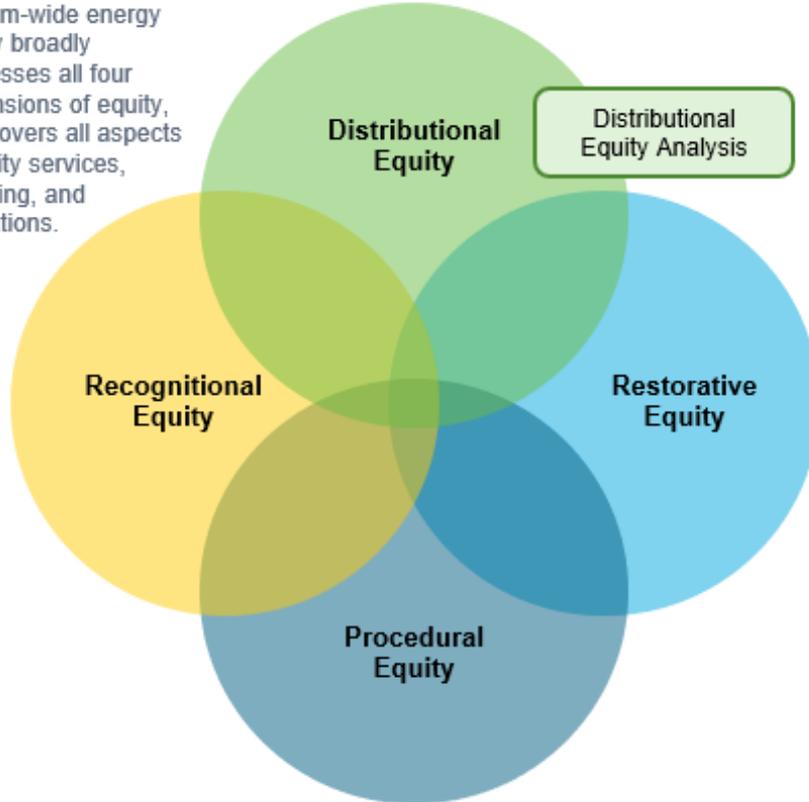
Restorative

Addressing reparations for past inequities, rectifying practices that perpetuate inequities, promoting accountability for key decision-makers



System-Wide Equity Assessment Compared with DEA

System-wide energy equity broadly addresses all four dimensions of equity, and covers all aspects of utility services, planning, and operations.



Distributional
Equity Analysis

+

Benefit Cost
Analysis

DEA addresses one aspect of distributional equity:

What are the distributional equity impacts of utility resource investments in the context of cost-effectiveness evaluation?



DEA Can Be Used with BCA to Address Distributional Equity

DEA can be conducted alongside BCA

- Provides information on equity that BCAs cannot provide
- DEA uses many of the same inputs, methods, and assumptions as BCA

Key differences between DEA and BCA

- DEA separates customers into priority populations and other customers.
- DEA includes additional metrics to provide energy equity data

Together the two analyses can inform decisions about whether and to what extent utilities should invest in DERs to meet articulated energy and equity goals

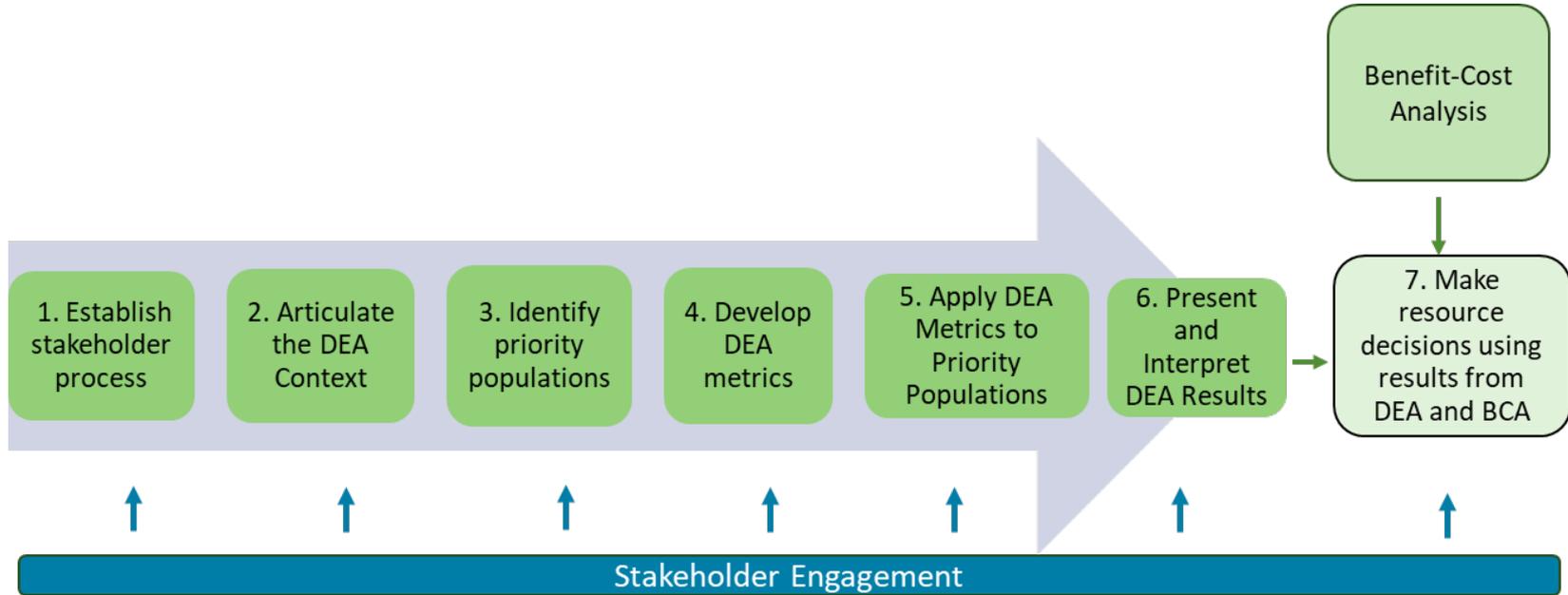


Summary of Differences Between BCA and DEA

	Benefit-Cost Analyses	Distributional Equity Analyses
Purpose	To identify which DER programs utilities should invest in	a) To identify how DER programs impact priority populations b) To identify which DER programs utilities should invest in
Costs and Benefits	Costs and benefits across all customers on average	a) Costs and benefits for priority populations b) Costs and benefits for other customers
Impacts Analyzed	<ul style="list-style-type: none"> • Utility system impacts • Participant impacts • Societal impacts 	Depends on choice of DEA metrics
Metrics	<ul style="list-style-type: none"> • Costs (PV\$) • Benefits (PV\$) • Net present value (NPV) • Benefit-cost ratio (BCR) 	Examples: <ul style="list-style-type: none"> • Rates (\$/kWh) • Bills (\$/month) • Participation rates (% of eligible customers) • Energy burden (% of income spent on energy bills) • Service shutoffs (% change) • Environmental impacts (change in PM 2.5 emissions)



Key Stages to Conducting a DEA



Stage 1. Establish Community & Stakeholder Process

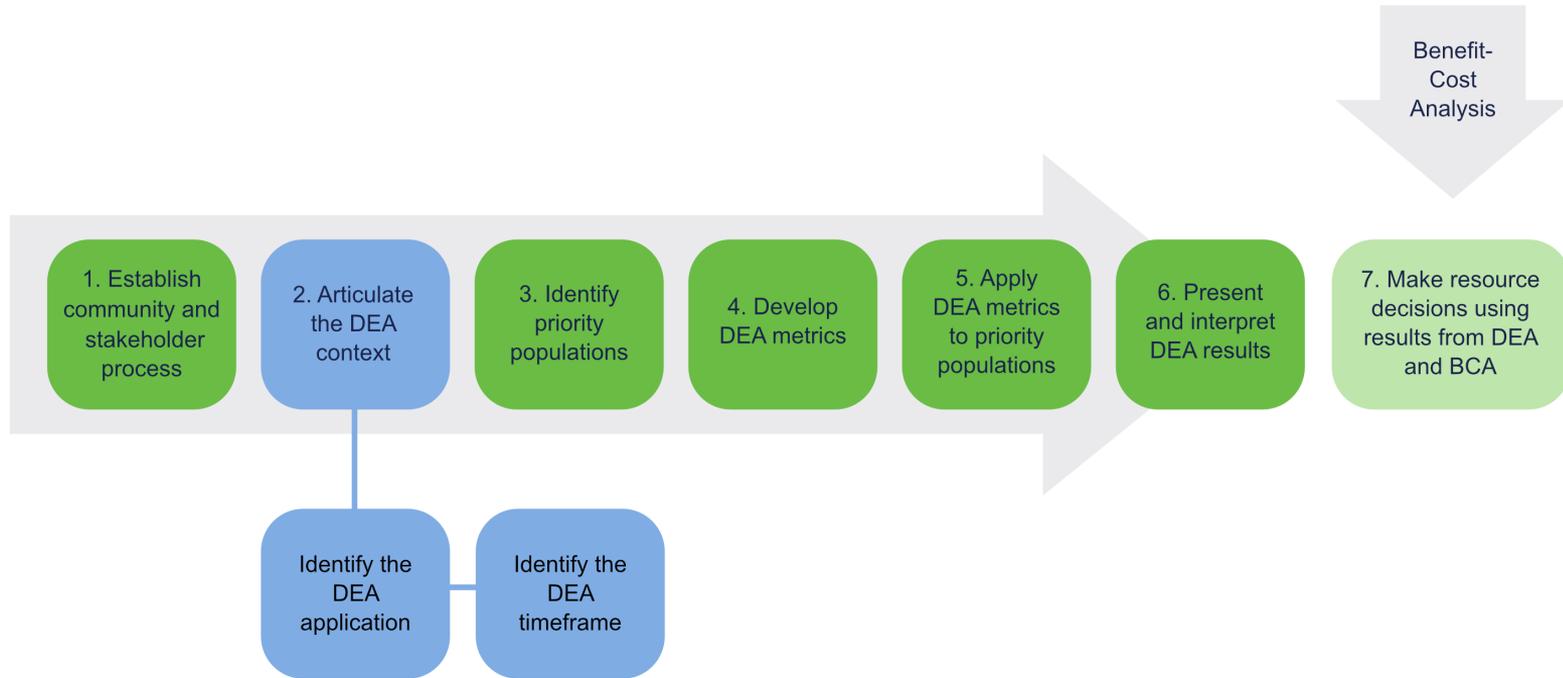
- ▶ A robust stakeholder process is critical to support DEA.
- ▶ Stakeholder and community process should include representatives from a diverse cross-section of customers that represent the priority population.
 - These representatives often face barriers to participation in public utility commission processes.
 - The barriers should be recognized and addressed in designing the stakeholder process.
- ▶ Robust stakeholder and community input should be used in all stages of DEA.
- ▶ Equity-oriented community and stakeholder processes are markedly different from utility decision-making processes used today.
- ▶ LBNL has a forthcoming companion document, Engagement Guide for Distributional Equity Analysis, available at: <https://emp.lbl.gov/energy-equity>.

“**Community**” refers to any people with a shared identity within or across different geographic areas and includes urban, rural, tribal, and indigenous people.

“**Stakeholder**” refers to representatives or members of priority populations, advocates (e.g., environmental justice, low-income customer, consumer) and other interested or concerned parties.



Stage 2. Articulate the DEA Context



Determine the DEA Application

Single DER

For assessing one DER program in isolation.

Examples: A single EE program, a low-income EE program, a single DG program, a community solar program, a distributed battery program.

DER Portfolio

For assessing multiple “like” DERs in aggregate.

Examples: an EE portfolio, a portfolio of net energy-metered practices, a portfolio of distributed battery programs.

Multiple DERs

For assessing and comparing different DERs, either of the same or different types.

Examples: EE vs. EE; DG vs. DG; EE vs. DG; DG vs. storage.

Multiple DER Portfolios

For assessing and comparing portfolios of different DER types, to optimize all DERs within a utility’s service area.

Examples: portfolio of EE vs. portfolio of DG vs. portfolio of storage.

Determine the DEA Timeframe

Retrospective

Timing: Conducted after a DER program or technology has been implemented.

Purpose: For evaluating program performance and identifying opportunities for continuing and improving future program designs.

Data and metrics: Can be sourced from actual, historical data and results.

Prospective

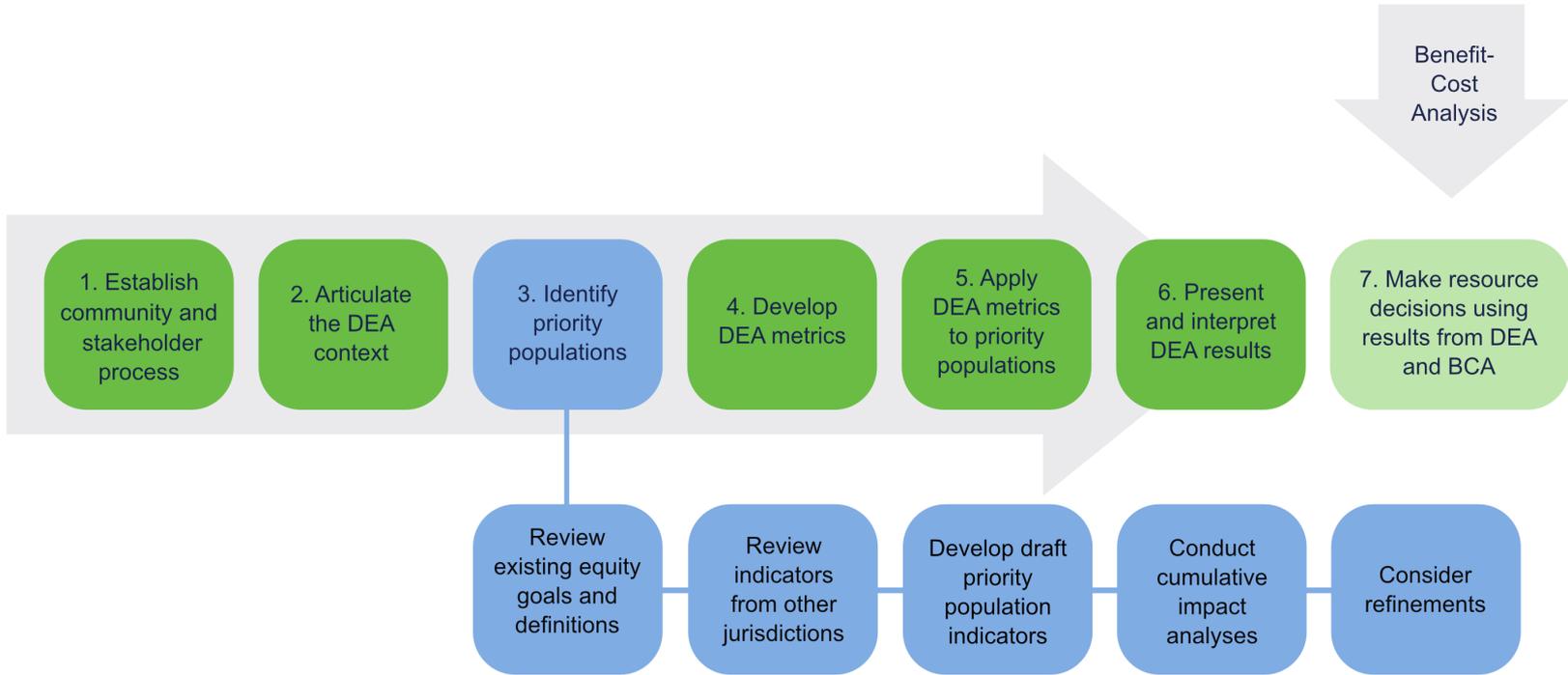
Timing: Conducted before a DER program or technology has been implemented.

Purpose: For evaluating whether to implement a program. Or for determining ways to improve program designs.

Data: Requires forecasts of data and estimates of results. This can be especially challenging when identifying participation of priority populations.



Stage 3. Identify Priority Populations



Priority Populations – Key Concepts

- ▶ The DEA Guide uses the term “priority populations” to indicate those customers and communities that will be evaluated separately to assess equity impacts.
- ▶ Many terms are used to represent the concept of priority populations:
- ▶ Priority populations should be identified using each jurisdiction’s equity policy goals along with stakeholder input.
- ▶ A variety of indicators can be used to determine which customers and communities should be included in a priority population. These fall into several categories:
 - Income, population health, poor environmental conditions, access to services, existing inequities.

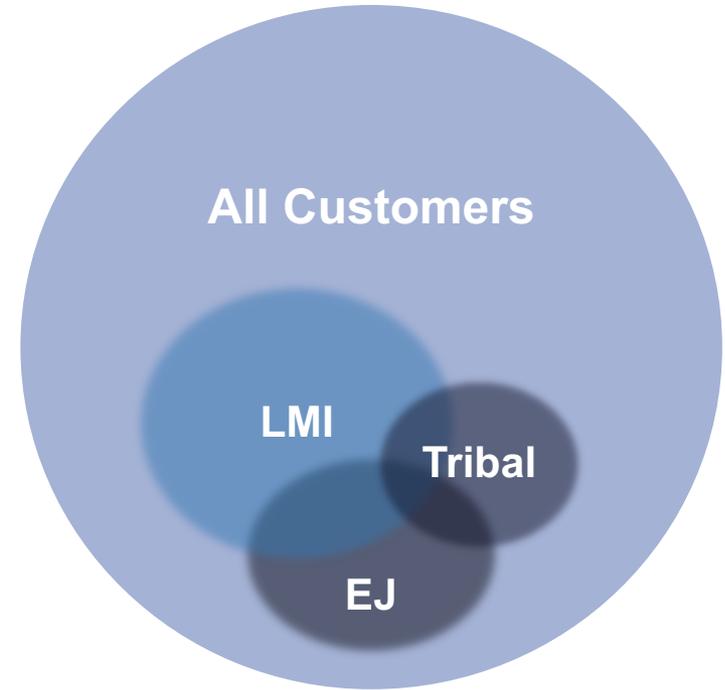


- disadvantaged
- overburdened
- marginalized
- underserved
- vulnerable
- environmental justice communities
- frontline communities
- highly impacted communities
- target populations

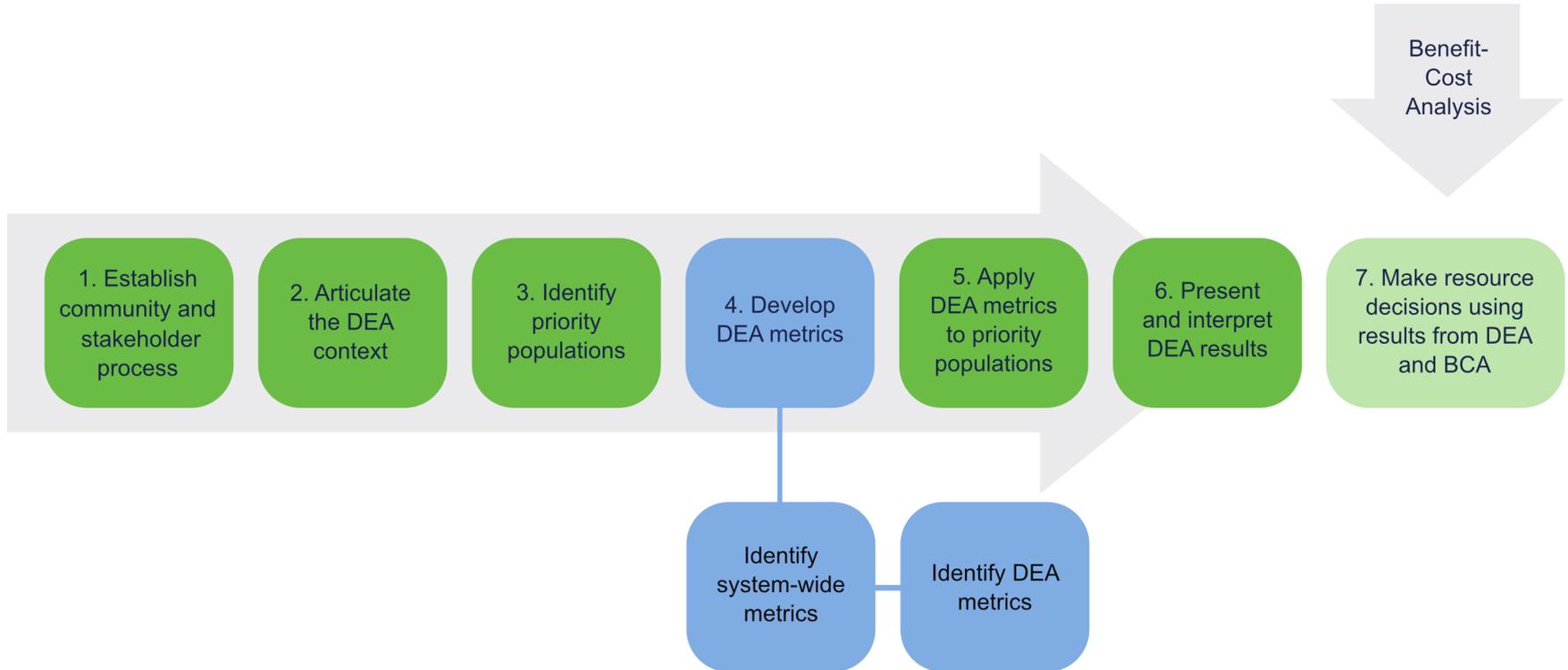


Potential Tradeoffs In Defining Priority Populations

- ▶ In some cases, actions to improve equity might require increased costs,
 - which are likely to be borne by the other, non-priority customers.
- ▶ Therefore, determining the scope of the priority population might require a tradeoff between:
 - The number of customers who might benefit from actions to improve equity, and
 - The number of customers who might have to pay for those actions.
- ▶ There might be some vulnerable customers on the margins.



Stage 4. Develop DEA Metrics



Establish DEA Metrics – Key Concepts

- ▶ Metrics are an essential element of DEA because they determine which aspects of equity will be evaluated.
- ▶ DEA metrics should be identified using each jurisdiction’s equity policy goals along with stakeholder input.
- ▶ There are many metrics that can be used for system-wide equity assessments.
 - These are used to address the full range of equity issues facing customers: recognition, procedural, distributional, and restorative.

But systemwide metrics need to be winnowed down for distributional equity analysis.

Some metrics overlap with each other or overlap with results of the BCA.

Some metrics might not be relevant for distributional equity.

Some metrics might not be affected by the DER investment under consideration.

Too many metrics might complicate the DEA and make the results hard to interpret.

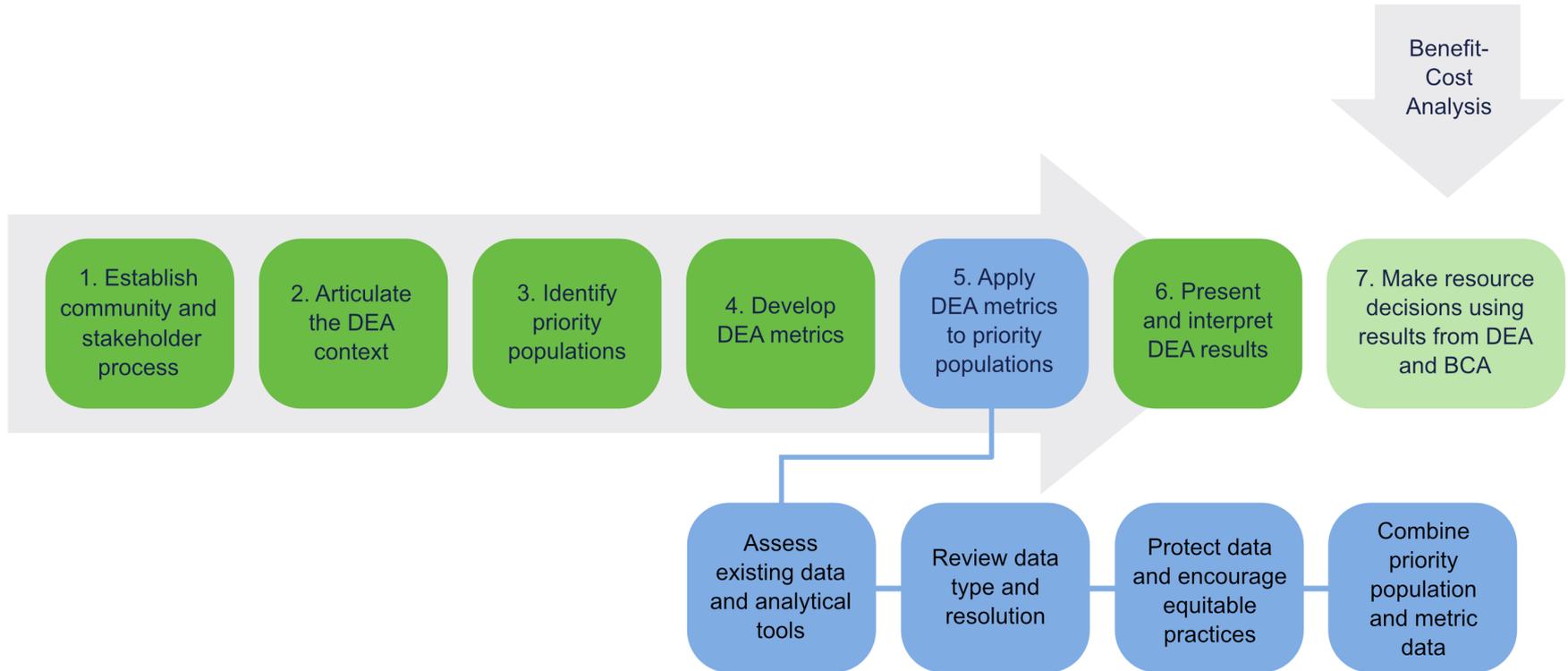


DEA Metrics: Examples

DEA Categories	Subcategory	Potential DEA Metrics
Access	Participation for DER being evaluated	Participants as percent of eligible customers
Economy	Jobs	Workforce development, job training, clean energy apprenticeships in priority populations
	Utility dollars invested	Utility funds invested in businesses and contractors located in priority populations
Affordability	Change in rates	Percent change in rates
	Change in bills	Percent change in bills
	Energy burden	Percent change in energy burden
Public Health	Health, safety, and comfort	Change in medical costs, change in lost workdays, lost school days, maternal health impacts, % of homes at unsafe temperatures
	Health impacts	Change in rates of hospital admissions, asthma, cancer risk
Shutoffs	Shutoffs	Change in number of shutoffs or frequency of shutoffs
Reliability and resilience	Outages	Change in number and duration of outages on the utility system
		Change in number and duration of outages at the customer level



Stage 5. Apply DEA Metrics to Priority Populations



Data Requirements

DEA requires a great deal of data; some publicly available, some not.

Demographic and Socio-Economic Data

Often can be obtained from nationally available public data, e.g., the U.S. Census Bureau. Can also be collected through community surveys, opt-in participation questions, or other state and local data collection.

Utility Data

Includes billing data, customer account data and addresses, rate information, bill information, participation in DER programs, geographic data, and more. Can often be obtained from utilities, but there are significant data privacy and security challenges.

Energy Impacts

Some utility impacts can be captured using publicly available data, such as government-collected health or environmental data.



Review Data Type & Resolution



Household level: data associated with a utility account, such as an address, customer information, enrollment data, or billing data.

- A large amount of utility data might be available at this level.



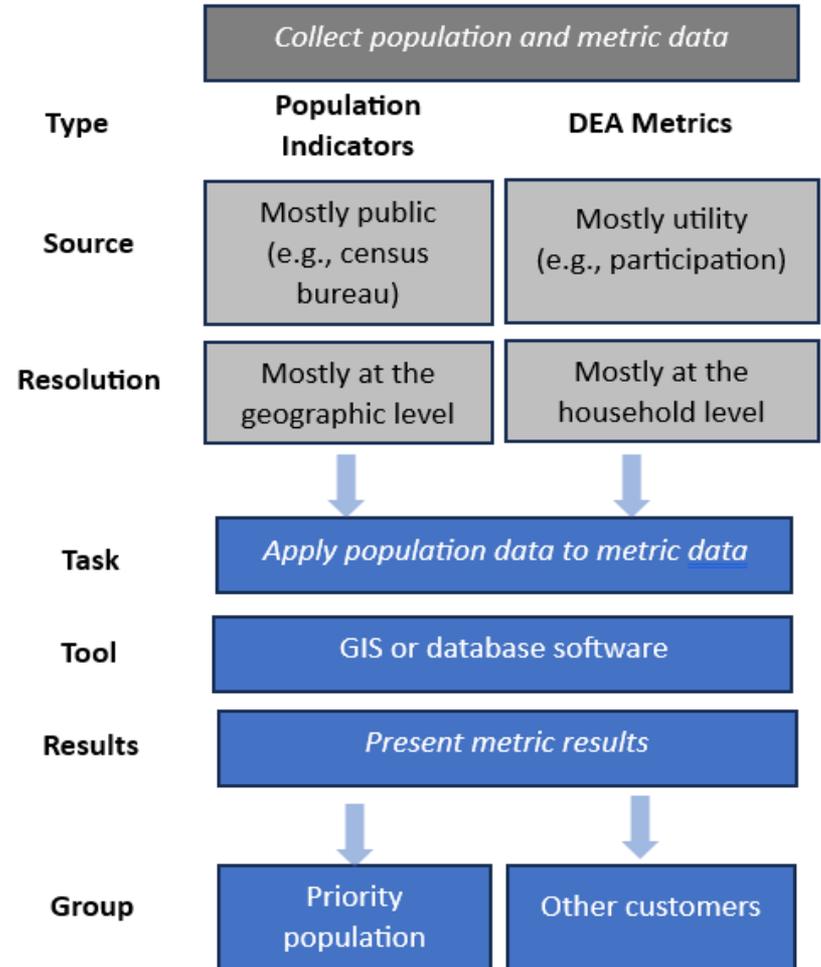
Geographic Level: data associated with a defined geographic area, such as a county, zip code, census tract, or census block group.

- A large amount of socio-economic data are available at this level.
- The DEA will have better resolution by using the smallest area possible for the geographical-level data, otherwise too large an area can obscure the impacts on individual households or businesses.
- Even with better resolution, it might still be difficult to accurately represent the impacts on priority populations – depending on the homogeneity of each area.

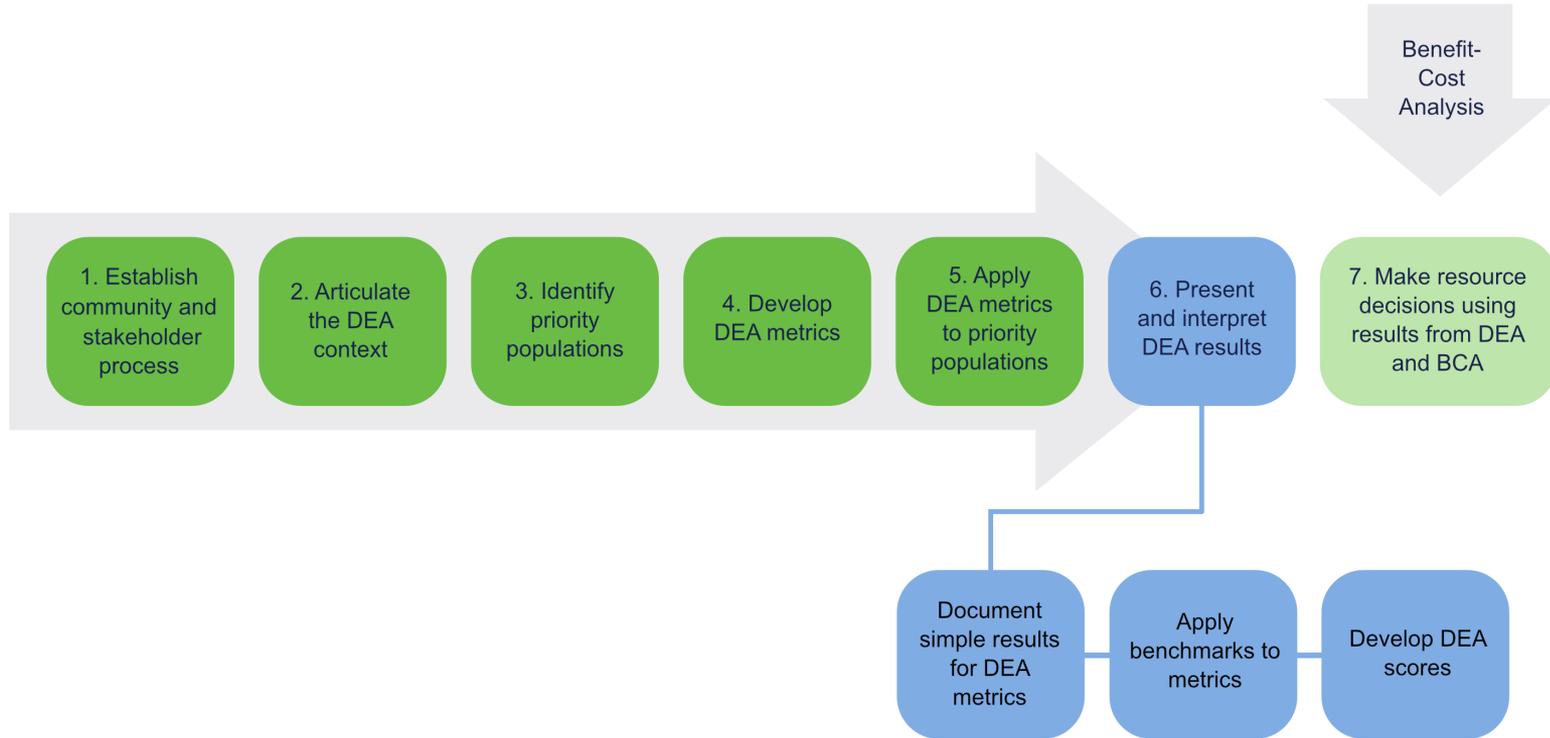


Priority Population and Metric Data

- ▶ To apply metrics to priority populations, the data for each need to be at the same level of resolution.
- ▶ For example, if the population indicators are available at the geographic level (such as census tract), and the DEA metric data are at the household level (such as utility account addresses), then the household-level data must be aggregated up to the geographic level.



Stage 6. Present and Interpret DEA Results



Three Options for Presenting Results

- ▶ **Simple results:** Includes unadjusted results for each DEA metric separately for priority population and other customers.
- ▶ **Benchmarked results:** Includes simple results for each metric alongside metric-specific benchmarks.
- ▶ **Weighted DEA scores:** Applies multi-attribute analysis (MAA) to benchmarked metrics to calculate DEA scores. Weighted scores for each DEA metric can be aggregated to present net scores for priority population and other customers.

Benchmarks:

A set of standards or goals by which success can be measured and can be used to draw more informed conclusions.

Examples:

- Targets for DER participation
- Targets for reducing energy burden
- Caps for reasonable rate impacts



Example: Simple Results

Metric	Priority Population	Other Customers
Participation Rate (% of eligible population)	11%	22%
Long-Term Average Rates (% change)	0.9%	0.9%
Participant Bills (% change)	-4.6%	-2.5%
Number of shutoffs avoided	20	1
Customer reliability (% change in CEMI)	-2%	-2%

Conclusions:

- ▶ Priority customers' participation rate is lower than other customers.
- ▶ Long-term average rates will increase slightly for all customers.
- ▶ Priority customers participants will see significant reductions in bills.
- ▶ DER will reduce shutoffs, mostly for priority population.
- ▶ DER will provide modest benefits in terms of reliability.



Example: Benchmarked Results

Simple Results

Metric	Priority Population	Other Customers	Priority Population Benchmarks
Participation Rate (% of eligible population)	11%	22%	20%
Long-Term Average Rates (% change)	0.9%	0.9%	1.5%
Participant Bills (% change)	-4.6%	-2.5%	-3%
Number of shutoffs avoided	20	1	8
Customer reliability (% change in CEMI)	-2%	-2%	-1%

Conclusions:

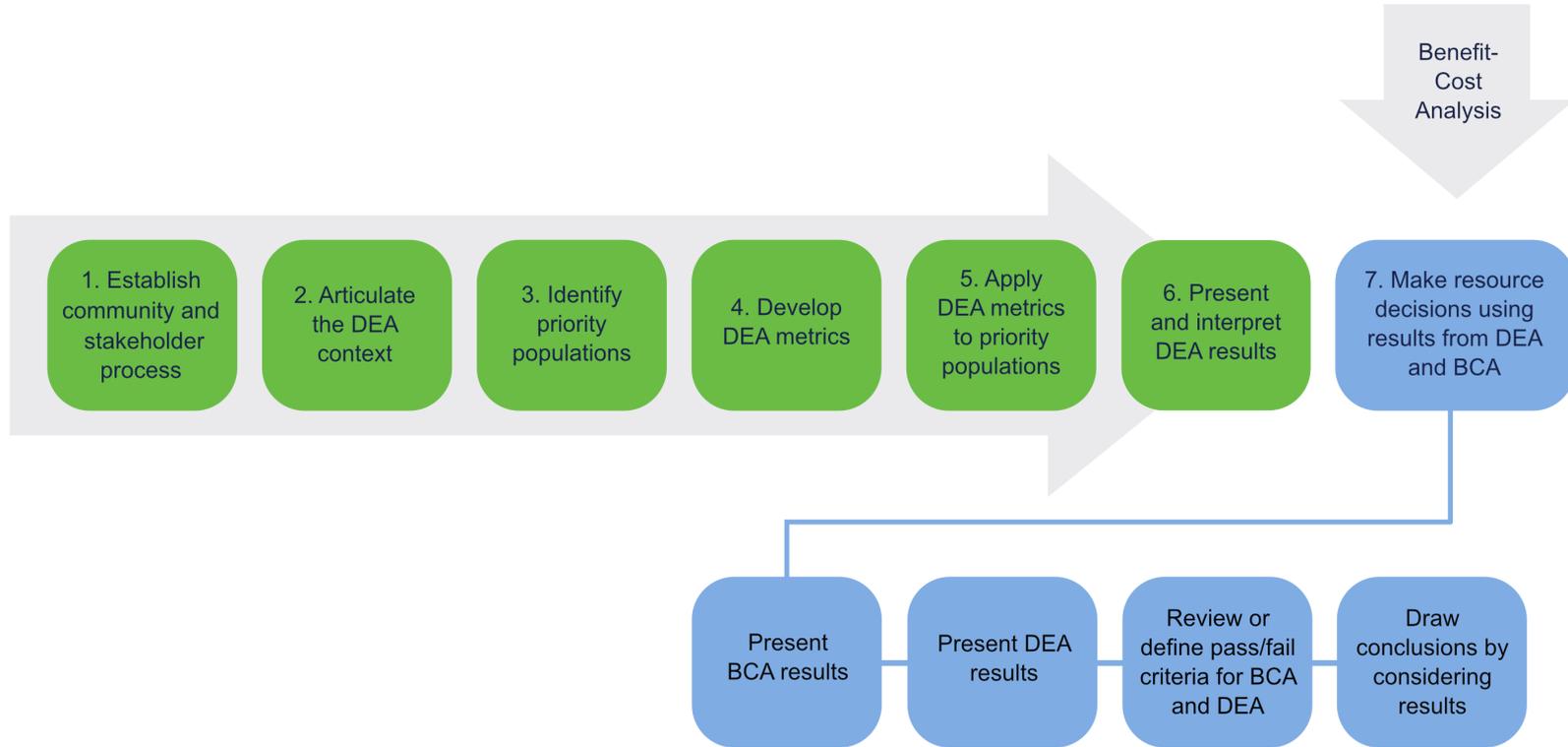
- ▶ Priority customers' participation rate is below the benchmark. (-)
- ▶ Long-term average rates are within the rate increase cap. (+)
- ▶ Priority customer participant bill reductions exceed the target. (+)
- ▶ Priority customer reduced shutoffs exceed the target. (+)
- ▶ Reliability benefits exceed the target.(+)

Bottom Line:

- ▶ DER program would improve equity across all the benchmarks if it were redesigned to increase priority population participation.

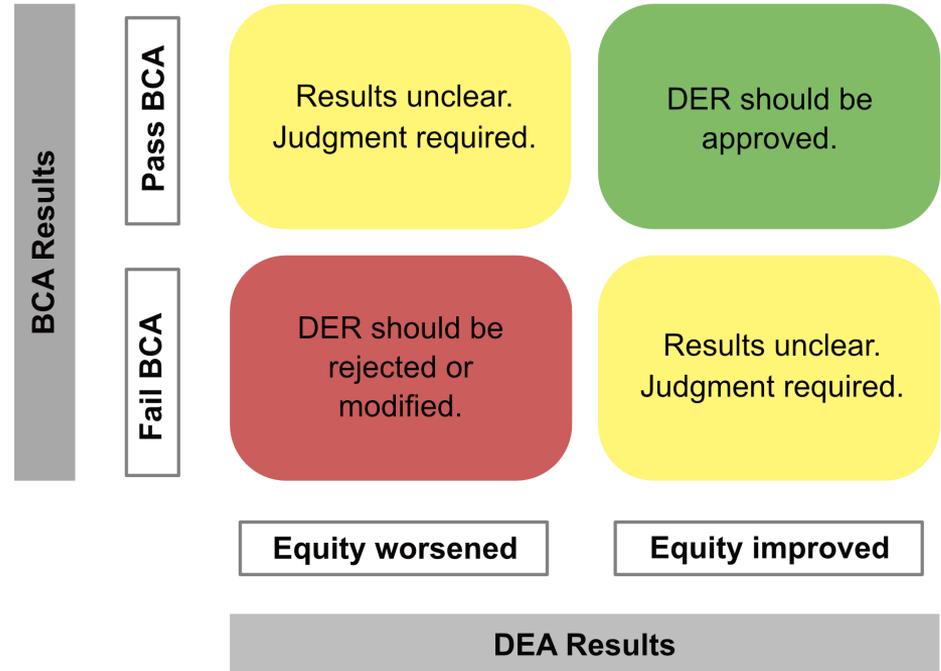


Stage 7. Make Decisions Using Both DEA and BCA Results



Draw Conclusions from the DEA and the BCA

- ▶ If BCA passes and equity is improved, then DER program should be approved.
- ▶ If BCA fails and equity is worsened, then DER program should be rejected or modified.
- ▶ Otherwise, the combined results are unclear, and judgment is required.
 - There might be situations where equity benefits outweigh negative BCA results and vice versa.



Additional Points

- ▶ DEA is a complex process that is likely to be time- and resource-intensive.
 - Streamlined practices can be used if time and resources are limited.
 - The stakeholder process should never be streamlined.
 - Start with a relatively narrow DEA application, such as assessing a well-established energy efficiency portfolio.
 - Use existing definitions of priority populations in the jurisdiction.
 - Use existing equity metrics or those used in other jurisdictions.
 - Use mapping and modeling tools that have already been established in the jurisdiction.
 - Focus on the simple and benchmarked results. Skip the DEA scoring techniques.
 - Establish clearly defined pass/fail criteria early in the DEA process.

- ▶ While the Guide focuses on DEA for DERs, the concepts and principles can be applied to other utility investments:
 - Example: When evaluating the cost-effectiveness of a new power plant.
 - Example: When evaluating the cost-effectiveness of a new transmission line.
 - In many cases, these other investments create more equity concerns than DERs.



Questions & Answers



Links to Select Relevant Resources

[Energy Equity \(LBNL\)](#)

[Distributional Equity Analysis for Energy Efficiency and Other Distributed Energy Resources: A Practical Guide](#)

[Engagement Guide for Distributional Equity Analysis \(forthcoming\)](#)

[U.S. Department of Energy-National Lab Equity Summit: Grid Planning and Operations](#)

[Advancing Equity in Utility Regulation](#)

[Assessing the Current State of U.S. Energy Equity Regulation and Legislation](#)

[State Requirements for Electric Distribution System Planning](#)

[Evaluating community solar as a measure to promote equitable clean energy access](#)

[Modeling the potential effects of rooftop solar on household energy burden in the United States](#)

[The National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources](#)



Appendix

Project Team and Advisory Committee



DEA Project Team - Berkeley Lab

Berkeley Lab's Electricity Markets and Policy Department informs public and private decision making within the U.S. electricity sector through independent, interdisciplinary analysis of critical electricity policy and market issues. We envision a clean, efficient, reliable, and affordable electricity system that meets the United States' diverse and growing energy needs. This project builds on a strong analytical foundation on [energy efficiency and DERs](#).

Example [equity research](#):

- [Assessing the Current State of U.S. Energy Equity Regulation and Legislation](#)
- [Advancing Equity in Utility Regulation](#)
- [Characterizing local rooftop solar adoption inequity in the US](#)
- [National Community Solar Partnership](#)
- [An Assessment of Evaluation Practices of Low- And Moderate-Income Solar Programs](#)
- [Energy Efficiency Financing for Low- and Moderate-Income Households](#)
- [Customer outcomes in Pay-As-You-Save programs](#)
- [Who is participating in residential energy efficiency programs?](#)
- [Deferred Payment Loans for Energy Efficiency](#)



Natalie Mims Frick



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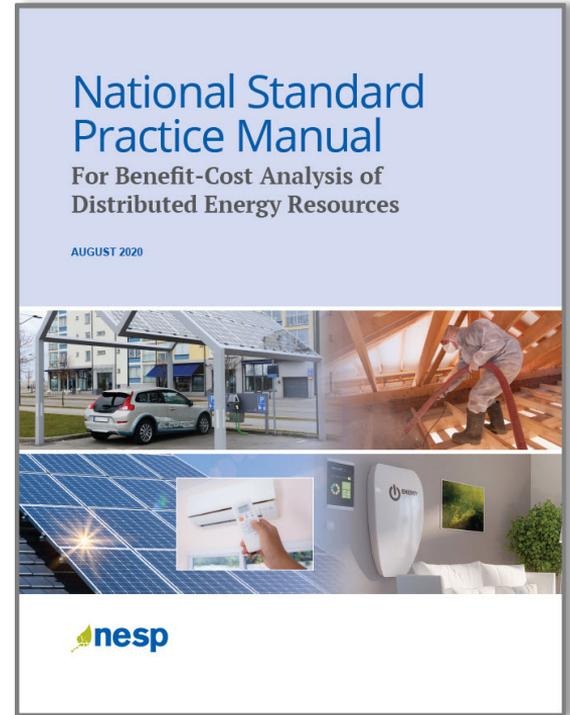
DEA Project Team – E4TheFuture

E4TheFuture – manages and coordinates the National Energy Screening Project, a stakeholder organization that works to improve cost-effectiveness screening practices for distributed energy resources (DERs).

Key products to date:

- [National Standard Practice Manual for DERs](#)
- [Methods, Tools and Resources Handbook for Quantifying DER Impacts for Benefit-Cost Analysis](#)
- [Database of Screening Practices](#)

Julie Michals
Director of Valuation



DEA Project Team – Synapse Energy Economics

Synapse Energy Economics

- Leader for public interest and government clients in providing rigorous analysis of the electric power and natural gas sectors
- Staff of 40+ includes experts in energy, economic, and environmental topics

Tim Woolf

- Lead author of National Screening Practice Manual and companion documents

Alice Napoleon

- In charge of Synapse equity initiatives

Synapse is committed to providing meaningful data and analysis to support important dialogue and efforts towards an equitable distribution of energy system benefits and burdens.



Tim Woolf
Senior VP



Alice Napoleon
Principal Associate



DEA Guidance Document: Advisory Committee

Name	Affiliation	Name	Affiliation
Adam Zoet	Minnesota Department of Commerce	Jennifer Yoshimora	Pacific Northwest National Laboratory
Amanda Best	Maryland Public Service Commission	Jennifer Snyder	Washington Utilities and Transportation Commission
Amanda Dewey	American Council for an Energy-Efficient Economy	Jeremy Peterson	Excel Energy
Ankit Jain	California Public Utilities Commission	John Howat	National Consumer Law Center
Anne Dougherty	Illume Advising	Justin Schott	Energy Equity Project
Aubrey Newton	Northwest LECET NW Cooperation Fund	Kate Strickland	Smart Electric Power Alliance
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Danielle Sass-Byrnett	National Association of Regulatory Utility Commissioners	Nancy Seidman	Regulatory Assistance Project
Danilo Morales	Massachusetts Department of Energy Resources	Patrick Cicero	Pennsylvania Office of Consumer Advocate
Debra Gore-Mann	Greenlining Institute	Sarah Moskovitz	Illinois Citizen's Utility Board
Divesh Gupta	Baltimore Gas and Electric	Sonja Berdahl	National Renewable Energy Laboratory
Dylan Voorhees	Vermont Energy Investment Corporation	Steve Schiller	Consultant
Elaine Prause	Regulatory Assistance Project	Subin DeVar	Initiative for Energy Justice
Erin Cosgrove	Northeast Energy Efficiency Partnership	Theresa Schmidt	Consumers Energy
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