OpenBCA

User Guide

Version 1.0
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1 Introduction

1.1 Background and Purpose of this Guide

This User Guide provides detailed guidance on how to use the Open-Source Benefit-Cost Analysis (OpenBCA) tool – a free desktop application that provides a transparent, standardized framework for evaluating the benefits and costs of grid-edge resources –often referred to as distributed energy resources (DERs). The tool is intended for use by State Energy Offices, Public Utility Commissions, investor-owned electric and natural gas utilities, consumer-owned utilities, power authorities, DER program administrators and implementers, and other stakeholders involved in planning, evaluating, or designing DER programs.

Designed to align with the National Association of State Energy Officials' (NASEO) National Standard Practice Manual (NSPM) guidance, OpenBCA allows jurisdictions to conduct cost-effectiveness analyses of DER investments and/or strategies using their unique Jurisdiction-Specific Tests (JSTs) for single or multiple DER portfolios, ensuring that the BCA test reflects the jurisdiction's specific energy policy goals, objectives, and regulatory needs. OpenBCA simplifies and streamlines the evaluation of a wide range of value streams from DER investments and provides a range of interactive options for presenting BCA results. Built to improve upon proprietary "black box" cost-effectiveness testing models, OpenBCA gives users visibility into assumptions, methodologies, and calculations used to develop DER value streams and benefit-cost analysis results. In addition to supporting custom JSTs, the OpenBCA allows users to formulate traditional cost tests (e.g., utility cost test, total resource cost test, societal cost test) to serve as secondary tests.

The underlying formulas in OpenBCA are based largely on calculation and accounting methodologies provided in the Methods, Tools, and Resources Handbook for Quantifying Distributed Energy Resource Impacts for Benefit-cost Analysis (MTR Handbook) – a companion document to the NSPM – and other key BCA resources.

OpenBCA was developed by ICF and Recurve, with support from the U.S. Department of Energy, Lawrence Berkeley National Laboratory (LBNL) and E4TheFuture. OpenBCA is copyrighted and licensed by LBNL. The project is now supported by NASEO's National Energy Screening Project (NESP), which hosts the OpenBCA webpage, organizes informational webinars, and coordinates state technical assistance with LBNL.

OpenBCA is available on NASEO's NESP webpage at https://naseo.org/nesp/openbca-tool and includes a range of technical resources, including this User Guide, to support users.

1.2 OpenBCA Alignment with NSPM

Benefit-cost analysis (BCA) often referred to as cost-effectiveness testing—is a structured approach used to evaluate whether the benefits of a resource investment exceed its costs. In the context of DERs, BCA compares the impacts of programs or strategies against their costs over time, typically using present value metrics. BCA is used to inform decisions about which DER programs, strategies or resources should be implemented, funded, or prioritized, relative to alternative resources or other DER options.

Based on the NSPM, the OpenBCA tool allows jurisdictions to create and optimize their JST for single or multiple DER portfolios. The JST is the primary cost-effectiveness test used to evaluate

DER investments within a given jurisdiction, whereby the test reflects the policy goals, regulatory framework, and priorities of that jurisdiction. As a result, JSTs can vary across jurisdictions, and therefore, under the NSPM, there is no single prescribed test that applies universally.

The NSPM sets forth a set of principles to apply in conducting BCAs. Users of OpenBCA are encouraged to consult the NSPM for guidance on applying the principles to ensure appropriate accounting of DER benefits and costs (i.e., impacts) in their BCAs.

Table 1. NSPM BCA Principles

Principle 1	**Align with Applicable Energy Policy Goals** Jurisdictions invest in DERs to meet a variety of energy goals and objectives. Accounting for the associated benefits and costs in a jurisdiction's primary BCA test helps to ensure that least-cost investments are used to achieve the goals and objectives.
Principle 2	**Treat DERS as a Utility System Resource** DERs are energy resources that can help meet utility system needs. Using consistent BCA tests, valuation methods, and assumptions when comparing DERs to traditional resources, or to other DERs, avoids bias across resource investment decisions.
Principle 3	**Account for All Relevant and Material Impacts** The relevance and materiality of impacts can vary depending on the DER type or use case. Accounting for all relevant and material impacts, even when difficult to quantify or monetize, ensures DERs are appropriately valued and avoids biased investments.
Principle 4	**Ensure Symmetry in the Treatment of Benefits and Costs** DER investments produce benefits to the utility system and to customers. Treating benefits and costs symmetrically in BCA tests, such that benefits and costs are both either included or excluded, avoids biased results and uneconomic investments.
Principle 5	**Conduct Forward-Looking, Long-Term, Incremental Analyses** BCAs address how benefits and costs will differ in the future because of a specific resource investment relative to what would have occurred absent the investment. This ensures that sunk costs do not influence investment decisions.
Principle 6	**Avoid Double-Counting Impacts** Some BCA benefits and costs can potentially be captured in more than one impact category. Clearly documenting the way in which a BCA includes all impacts in helps to avoid double-counting and either over- or under-estimating the value of DERs.
Principle 7	**Conduct BCAs Separately from Other Complementary Analyses** BCAs inform whether total benefits exceed total costs of a resource investment. Depending on a jurisdiction's policy goals, separate analyses may be warranted to inform investment decisions that address different questions than BCAs, such as rate- and bill-impact analyses.
Principle 8	**Ensure Transparency** Clear documentation of the rationale for decisions on BCA tests, complementary analyses, and associated methods, inputs, and results supports transparency. Transparency enables engagement and instills confidence in resource decision-making processes.

In addition to supporting custom JSTs, the OpenBCA allows users to formulate traditional cost tests (e.g., utility cost test, total resource cost test, societal cost test) that can serve as secondary tests. A comparison of traditional tests, relative to a JST, is provided below.

Table 2. Jurisdiction-Specific Test Compared with Traditional Tests

Test	Perspective	Key Question Answered	Categories of Benefits and Costs Included
Jurisdiction-Specific Test	Regulators or decision-makers	Will the cost of meeting utility system needs, while achieving applicable policy goals, increase or decrease?	Utility system impacts, plus those impacts associated with achieving applicable energy policy goals specific to a jurisdiction
Utility Cost Test*	The utility system	Will utility system costs increase or decrease?	Utility system impacts
Total Resource Cost Test	The utility system, plus host customers	Will utility system costs and host customers' costs collectively increase or decrease?	Utility system impacts, other fuels, host customer impacts
Societal Cost Test	Society as a whole	Will total costs to society increase or decrease?	Utility system impacts, other fuels, host customer impacts, societal impacts

OpenBCA can be used to calculate both the Ratepayer Impact Measure (RIM) Test and the Participant Cost Test (PCT) by leveraging custom value streams to model participant bill savings and utility revenue impacts.

1.3 DER Types and Use Cases Supported in OpenBCA

DERs are energy resources located on the distribution system, typically close to or at customer sites. DERs can reduce energy consumption, shift demand, generate electricity, or provide other system and customer benefits. Common types of DERs include energy efficiency, demand response, distributed generation, distributed storage, and electrification-related DERs.

OpenBCA is designed to analyze single and multiple DER types in the context of DER measures, program or portfolios, as well as certain DER 'scenarios' (e.g., microgrids, virtual power plants, non-wires solutions, and multiple on-side DERs), though in some cases with certain limitations or requirements for data input formats. For certain use cases or regulatory contexts in which DERs may be valued (e.g., procurement of DERs, distribution system planning, integrated resource planning), the tool may need modifications in methodologies, synching with other tools, and/or potentially, building more features in the basic source code of OpenBCA.

See Appendix A to this User Guide for additional information on use case application. See the NSPM for descriptions and BCA considerations for different DER types and/or DER scenarios.

1.4 Impact Values in OpenBCA

DERs can provide value to multiple stakeholders, including utilities, customers who participate in DER programs (i.e., host customers), and society more broadly. These impacts may include energy savings, reduced system costs, improved reliability, emissions reductions, and other benefits. DERs can also involve costs, such as program administration, incentives, and participant investments.

Impact values represent the individual benefits and costs included in a benefit-cost analysis. In OpenBCA, value streams are the primary mechanism for implementing a Jurisdiction-Specific Test (JST), as they define which impacts are included and how they are calculated.

Consistent with the NSPM, value streams can be grouped into the following broad categories: utility system impacts, other fuels, host customer impacts, and societal impacts. The selection of value streams should reflect jurisdiction-specific policy goals and the scope of the analysis. The full range of impacts available in OpenBCA, and associated definitions, are provided in the following NSPM-based Tables 3-9 below.

Table 3. Electric Utility System Impacts

Type	Utility System Impact	Description
Generation	Energy Generation	The production or procurement of energy (kWh) from generation resources on behalf of customers
	Capacity	The generation capacity (kW) required to meet the forecasted system peak load
	Environmental Compliance	Actions needed to comply with environmental regulations
	Renewable Portfolio Standard/Clean Energy Standard Compliance	Actions needed to comply with renewable portfolio standards or clean energy standards
	Market Price Effects	The decrease (or increase) in wholesale market prices due to reduced (or increased) customer consumption
	Ancillary Services	Services required to maintain electric grid stability and power quality
Transmission	Transmission Capacity	Maintaining the availability of the transmission system to transport electricity safely and reliably
	Transmission System Losses	Electricity lost through the transmission system
Distribution	Distribution Capacity	Maintaining the availability of the distribution system to transport electricity safely and reliably
	Distribution System Losses	Electricity lost through the distribution system
	Distribution O&M	Operations and maintenance (O&M) of the distribution system
Cross-Cutting GT&D	Risk	An adverse outcome that can occur because of uncertainty
	Reliability	The ability to prevent or avoid routine short-term outages under normal operating conditions due to fluctuating load and generation, fuel availability, and/or outage of assets
	Resilience	The ability to prepare for threats and hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions

Table 4. General System Impacts (applies to both Electric and Gas Utility System)

Type	Utility System Impact	Description
General	Financial Incentives	Utility financial support provided to DER host customers or other market actors to encourage DER implementation
	Utility Direct Investment	Direct costs for development and deployment of DERs by the utility, typically on the utility side of the meter
	Program Administration	Utility outreach to trade allies, technical training, marketing, and administration and management of DERs

Type	Utility System Impact	Description
	Utility Performance Incentives	Incentives offered to utilities to encourage successful, effective implementation of DER programs
	Credit and Collection	Bad debt, disconnections, reconnections

Table 5. Natural Gas System Impacts

Type	Utility System Impact	Description
Energy/Supply	Gas Commodity	The natural gas capacity required to meet forecasted peak load as well as the fuel and O&M impacts associated with natural gas
	Capacity	The natural gas capacity required to meet forecasted peak load
	Environmental Compliance	Actions required to comply with environmental regulations
	Market Price Effects	The decrease (or increase) in wholesale prices is due to reduced (or increased) customer consumption
Transportation	Pipeline Capacity	The transport of natural gas from delivery points located on interstate and intrastate pipelines to distribution utility city gate
	Pipeline Losses	Natural gas lost during pipeline transport
Distribution	Local Delivery Capacity	Delivery of natural gas from the distribution utility city gate to retail customers
	Local Delivery Losses	Natural gas lost on the distribution system
Cross-cutting Energy, T&D	Risk	An adverse outcome that can occur due to uncertainty
	Reliability	Maintaining the natural gas system to withstand instability, uncontrolled events, cascading failures, or unanticipated loss of system components
	Resilience	The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions

Table 6. Other Fuels Impacts

Type	Other Fuel System Impact	Description
Other Fuels (oil, propane, wood, gasoline)	Commodity	The fuel and O&M impacts associated with other fuels
	Environmental Compliance	Actions required to comply with environmental regulations
	Market price effects	The change in wholesale prices as a result of changes in customer consumption

Table 7. Host Customer Impacts

Type	Host Customer Impact	Description
Host Customer	Host portion of DER costs	Costs incurred to install and operate DERs
	Transaction costs	Other costs incurred to install and operate DERs e.g., time spent researching information, obtaining vendor quotes, filling out rebate applications
	Interconnection fees	Costs paid by host customer to interconnect DERs to the electric grid
	Tax incentives	Federal, state, and local tax incentives provided to host customers to defray the costs of some DERs

	Resilience	Ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions
	Host Customer Non-Energy Impacts (NEIs)	Benefits and costs of DERs that are separate from energy-related impacts

With regard to host customer non-energy impacts, OpenBCA does not include the full list of NEIs provided in Table 8 but instead includes three standard line items: one for electric impacts, one for natural gas impacts, and one for other host-customer impacts, such as impacts expressed in dollars per participant. To the extent that additional NEIs are calculated separately or use different valuation methods, users can model them through OpenBCA's custom value streams.

Table 8. Host Customer Non-Energy Impacts

Host Customer NEI	Summary Description
Asset value	Changes in the value of a home or business due to the DER (e.g., increased building value, improved equipment value, extended equipment life)
Water costs	Costs or cost savings from increased or decreased water consumption resulting from DER installation
Business Productivity	Changes in a customer's productivity (e.g., changes in labor costs, operational flexibility, costs, reduced waste streams, reduced spoilage)
Operations and Maintenance	Longer-lived equipment requiring fewer replacements over time, efficient equipment that may need servicing more frequently
Comfort	Changes in comfort level (e.g., thermal, noise, and lighting impacts)
Health and Safety	Changes in customer health or safety (e.g., fewer sick days from work or school, reduced medical costs, improved indoor air quality, reduced deaths)
Other	Amenity (e.g., reduction in refrigeration capacity from removal of inefficient second refrigerators, increases in cooking control and speed with induction cooktops) Empowerment (e.g., better sense of control of energy use) Pride (satisfaction from contributing to solutions to environmental concerns) Reduced financial stress (especially for low-income households)

Table 9. Societal Impacts

Type	Societal Impact	Description
Societal	GHG Emissions	GHG emissions created by energy generation
	Other Environmental	Other air emissions, solid waste, land, water, and other environmental impacts
	Public Health	Health impacts, medical costs, and productivity affected by health
	Resilience	Resilience impacts beyond those experienced by utilities or host customers

Note that, consistent with the NSPM principles and guidance, all utility system impacts should be included in any BCA test (primary and secondary tests), though in some cases an impact may be embedded in another impact or may not be relevant or material to certain DER types or use cases. Non-utility system impacts (e.g., other fuel, host customer, and societal impacts) may be included in a JST to the extent they are consistent with applicable energy policy goals and objectives, and to the extent they are considered relevant and material to the specific DER types or use cases being analyzed. Again, in some cases, a non-utility system impact may be embedded in another impact.

See NSPM Chapter 6 for further guidance on the full range of utility and non-utility system impacts, and illustrative examples of when impacts for specific DER types are typically a benefit, cost, or it depends on the use case.

1.5 Value Streams – Key Considerations

Comprehensive guidance on OpenBCA's impact categories and value streams, including each stream's definition, inclusion within Jurisdiction-Specific Tests (JSTs), and the calculation equations/formulae used by the tool, is consolidated in the value stream documentation deck linked here: https://naseo.org/Data/Sites/1/media/tknaseo/openbca-value-stream-summary.pdf

Consistent with NSPM principles, when defining and applying value streams, users should:

- Align selection with jurisdictional policy goals
- Ensure consistent treatment across different DERs (and other resources)
- Ensure symmetry in accounting for both benefits and costs for impacts included in the analysis
- Avoid double-counting overlapping impacts
- Use appropriate temporal and spatial resolution where possible
- Ensure transparency in assumptions, including when impacts may be embedded in other impacts.

Value streams are central to the integrity of the analysis. Thoughtful selection and configuration in the OpenBCA are essential to producing meaningful results. Please refer to the NSPM for further guidance on the above considerations.

1.6 Calculations and Methodologies in OpenBCA

OpenBCA applies a standardized calculation framework to quantify the benefits and costs of distributed energy resources based on user-defined value streams, assumptions, and input data. The general process begins with identifying relevant impacts, defining the DERs and study period, developing load impact profiles, establishing reference and DER cases, estimating marginal impacts, and calculating the value of those impacts. This process provides the foundation for quantifying value streams in a benefit-cost analysis.

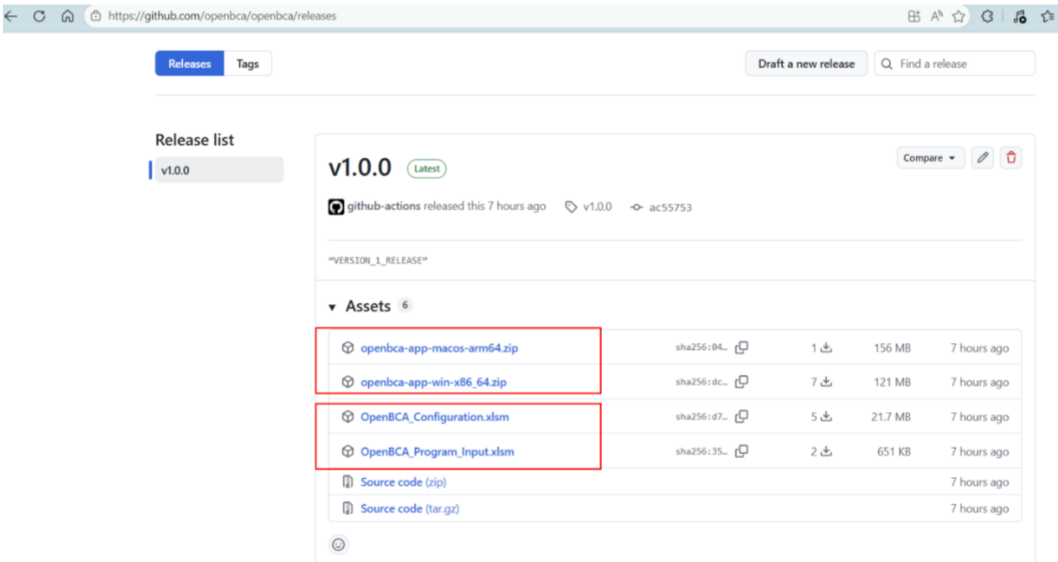
While the underlying methodology for each value stream may involve different data sources, assumptions, and analytical techniques, OpenBCA focuses on implementing those methodologies through supported calculation types and input structures. Many formulas in OpenBCA are structured as matrix-based calculations to support efficient processing of large datasets, including analyses with multiple measures, value streams, scenarios, and time-series inputs.

This User Guide explains how to configure and apply OpenBCA's calculation types, including value stream setup, temporal granularity, avoided cost inputs, load shapes, and program-level inputs. For detailed guidance on specific methodologies, supporting data, and analytical considerations used to quantify individual value streams, users should refer to the NESP Methods, Tools & Resources Handbook for Quantifying DER Impacts.

2 OpenBCA Overview: Access, and Functionality

2.1 Host Website & Files Access

Link to the GitHub Repository: OpenBCA



2.2 Installation, Inputs, and Common Issue

Detailed step-by-step instructions for getting started with OpenBCA, including screenshots, are provided in the file linked here: https://naseo.org/Data/Sites/1/media/tknaseo/openbca-step-by-step-guide.pdf

The guide covers downloading and configuring the tool, completing the OpenBCA workflow, and troubleshooting common setup errors. While the guide provides screen-by-screen instructions, Section 3 offers a higher-level overview of the process and explains how each step fits into the overall workflow.

Note: If you encounter issues during installation, please contact your IT team and share the OpenBCA Technical README for troubleshooting. In many cases, issues are caused by local firewalls or endpoint security settings.

2.3 Required Inputs

OpenBCA requires two primary input files:

- Configuration File
  Contains system-level inputs and defines the structure of the analysis, including value streams, avoided costs, and global parameters.

- Program Input File
  Contains program- and measure-level data, including savings, costs, participation, and other characteristics of the resources being evaluated.

Note: Both files MUST be completed and uploaded before running the model.

Users must ensure that the **OpenBCA Configuration.xlsm** and **OpenBCA Program Input.xlsm** files retain their original file names and extensions. The input files must not be renamed from the original versions available for download on the OpenBCA webpage. To manage multiple versions, users may store copies in separate, date-stamped folders; however, the file names of the inputs actively used by the tool should not be modified.

2.4 Different ways to use OpenBCA

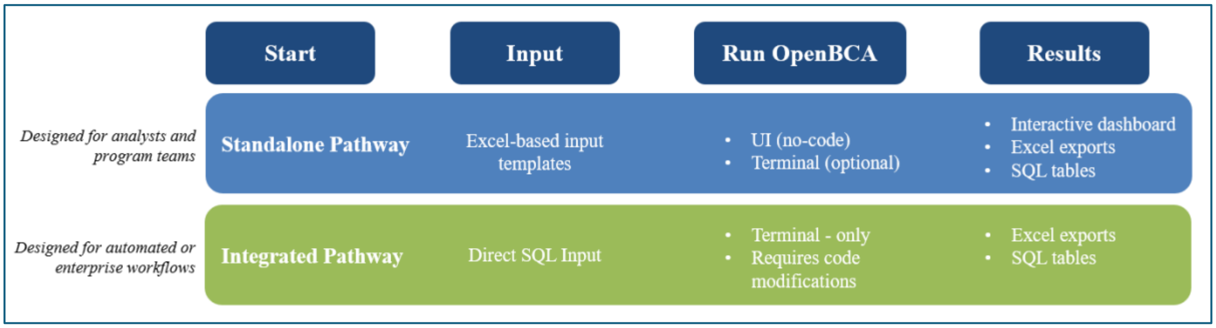
OpenBCA can be used in two primary ways, depending on user preference and technical requirements: a Standalone Pathway and an Integrated Pathway. Both pathways utilize the same core calculation engine and input structure, but they differ in how the tool is run and how data flows through the system:

- **Standalone Pathway:** OpenBCA is accessed through a desktop application, without the need for any coding. Users complete the provided Excel input templates with their data and run the analysis through a graphical user interface. The tool processes inputs internally and generates results that can be viewed in an interactive dashboard or exported as CSV or Excel summary tables. The standalone mode is ideal for most users, as it packages everything needed into a streamlined, self-contained workflow.

- **Integrated Pathway:** This mode is designed for advanced users or organizations seeking to integrate OpenBCA into a broader data infrastructure or custom analytics workflow. In the integrated pathway, the OpenBCA engine is executed through a command-line interface (CLI). Inputs may be provided using the same Excel templates or ingested directly into OpenBCA's database schema, bypassing Excel entirely. Outputs are written to queryable database tables, such as DuckDB or other SQL-based databases, enabling downstream analysis and seamless integration with business intelligence tools. This integrated mode is well suited for developers automating benefit-cost analysis runs or for utilities running large numbers of scenarios and consolidating results within a centralized data environment. Users planning to use the Integrated Pathway should refer to the GitHub README for detailed technical guidance on setup, configuration, and execution.

The figure below compares the Standalone Pathway and the Integrated Pathway.

Figure 1: Standalone and Integrated Pathways



2.5 OpenBCA Workflow

OpenBCA follows a structured process that mirrors the key steps in benefit-cost analysis described in Section 2.1. At a high level, the workflow consists of seven steps:

1. Define value streams (what impacts are included)
2. Configure system-level inputs (how impacts are valued)
3. Enter program inputs (what is being analyzed)
4. Uploading input files to tool
5. Validate inputs (check for errors and inconsistencies)
6. Run the model (perform calculations)
7. Review outputs (interpret results)

Each step builds on the previous one. Together, they define the scope of the analysis, the assumptions used, and the resulting cost-effectiveness metrics. These steps are described in detail in Chapter 3 of this User Guide.

2.6 User Responsibilities

The quality and credibility of OpenBCA results are directly driven by the inputs, assumptions, and configuration choices made by the user. OpenBCA is a flexible analytical framework, and users are responsible for ensuring that the analysis aligns with the policy objectives, regulatory context, and use cases at hand. In particular, users are responsible for:

- Defining value streams that accurately reflect program goals, policy priorities, and jurisdiction-specific requirements
- Selecting appropriate input assumptions, including technology performance, costs, participation levels, and avoided cost parameters
- Ensuring data quality, consistency, and completeness across all input files and scenarios
- Interpreting results within the proper analytical, regulatory, and market context

OpenBCA applies all inputs exactly as provided and does not modify, weight, or prioritize assumptions or value streams on the user's behalf. As a result, the tool does not prescribe "correct" assumptions or outcomes; instead, it transparently executes the analysis based on user-defined choices. Careful configuration, clear documentation of assumptions, and thoughtful interpretation of outputs are therefore essential to producing meaningful, defensible, and credible results that can support decision-making, regulatory review, or stakeholder communication.

Table 10 below shows what OpenBCA does and does not do.

Table 10: What OpenBCA Does and Does Not Do

What OpenBCA Does	What OpenBCA Does Not Do
• Define the impacts included in an analysis through value streams	• Define policy objectives

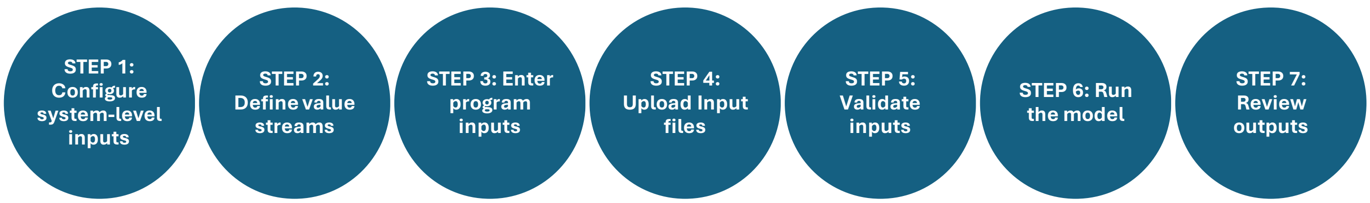
What OpenBCA Does	What OpenBCA Does Not Do
• Input system-level assumptions such as avoided costs and discount rates	• Determine which value streams are relevant to set up a JST
• Enter program and measure data	• Select appropriate avoided costs or input assumptions
• Apply consistent calculation methods across all inputs	• Provide a single “correct” answer
• Generate detailed results, including net benefits and benefit-cost ratios	

3 OpenBCA Analysis Workflow

This section provides a guide to running an analysis in OpenBCA. Each step corresponds to a key stage in the BCA process and reflects the NSPM framework for developing and applying a Jurisdiction-Specific Test (JST). The instructions focus primarily on the Standalone Pathway, in which users prepare inputs using the OpenBCA Excel templates and run the model through the desktop application. The Integrated Pathway follows the same conceptual process but uses a command-line interface and may connect directly to database-based inputs and outputs.

Figure 2 below shows the high-level OpenBCA process.

Figure 2. High-level OpenBCA Process



3.1 Step 1: Configure System-Level Inputs

Purpose

In this step, the user completes the Configuration File to establish system-level assumptions that apply across the entire analysis. These inputs define how impacts are valued over time and provide the technical foundation for later calculations.

What the User Does

The user works through the **Common Data** tab in the Configuration File, entering global assumptions and generating required worksheets. These inputs apply universally across all value streams and programs.

Enter Global Parameters

The first task is to complete the global parameters, including:

- Dollar year
- Discount rate
- Inflation rate
- Line loss assumptions
- Cost and transfer treatment framework

These inputs determine how costs and benefits are escalated, discounted, and treated in present value terms. Because they apply across the model, assumptions should be internally consistent and aligned with the intended JST.

Define Subset Names (If Applicable)

Users may define up to three subsets in the Configuration File. Subsets represent categories such as geographic areas, customer segments, or sensitivity cases that apply across value streams (*e.g.*, climate zones with distinct avoided costs). If used, subset definitions should be clearly named and applied consistently throughout the model.

3.2 Step 2: Define Value Streams (JST Design)

Purpose

This step defines the scope of benefits and costs included in the analysis and formally establishes the structure of the Jurisdiction-Specific Test.

What the User Does

The user works in the **Configuration Data** tab of the Configuration File to select, include, and configure value streams. This step translates policy and analytical decisions into the model structure OpenBCA will use for calculations.

Identify Relevant Impacts

The user determines which impacts to include, represented as value streams. These typically fall into five categories:

- Utility system impacts (electric)
- Utility system impacts (natural gas)
- Host customer impacts
- Societal impacts
- Other fuel impacts

Selections should reflect jurisdictional policy goals and the intended scope of the JST.

Configure Value Streams

In the **Test Setup** section of the Configuration Data tab, the user configures each selected value stream by specifying:

- Impact category (*e.g.*, electricity, natural gas)
- Inclusion in the test
- Applicability of subsets
- Calculation type
- Temporal granularity

These selections define how each impact will be calculated and included in results.

Specify Calculation Type and Granularity

For each value stream, the user specifies:

- Calculation type (*e.g.*, time-series, measure-specific, peak capacity-based, adders (%))
- Temporal resolution:
    - Annual values
    - Monthly values
    - Hourly time-series data
    - Custom Period data
    - Single value

Different impacts may require varying levels of granularity depending on analytical needs; for example, custom period data is appropriate when inputs are segmented across seasons or other user-defined categories, whereas hourly data should be used when corresponding value streams have hourly inputs available.

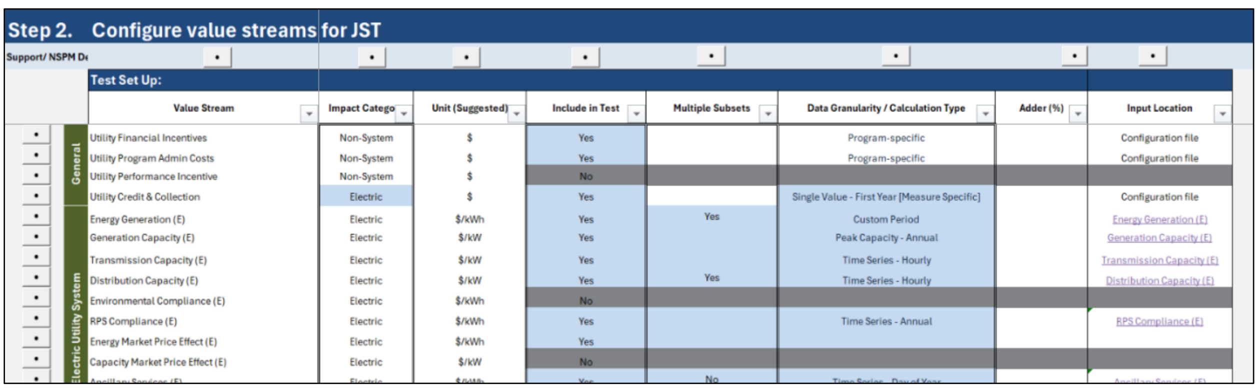
Review for Consistency

Before proceeding, the user should confirm that:

- All material impacts are included
- Benefits and costs are treated consistently
- Overlapping impacts are not double-counted
- Selections align with policy goals and the JST
-

By the end of this step, the scope and structure of the analysis should be clearly defined. Figure 1 below shows JST setup in a configuration file.

Figure 1: JST Setup in a Configuration File



Step 2. Configure value streams for JST

Support/ NSPM De

Test Set Up:

	Value Stream	Impact Catego	Unit (Suggested)	Include in Test	Multiple Subsets	Data Granularity / Calculation Type	Adder (%)	Input Location
General	Utility Financial Incentives	Non-System	$	Yes		Program-specific		Configuration file
	Utility Program Admin Costs	Non-System	$	Yes		Program-specific		Configuration file
	Utility Performance Incentive	Non-System	$	No				
	Utility Credit & Collection	Electric	$	Yes		Single Value - First Year [Measure Specific]		Configuration file
lectric Utility System	Energy Generation (E)	Electric	$/kWh	Yes	Yes	Custom Period		Energy Generation (E)
	Generation Capacity (E)	Electric	$/kW	Yes		Peak Capacity - Annual		Generation Capacity (E)
	Transmission Capacity (E)	Electric	$/kW	Yes		Time Series - Hourly		Transmission Capacity (E)
	Distribution Capacity (E)	Electric	$/kW	Yes	Yes	Time Series - Hourly		Distribution Capacity (E)
	Environmental Compliance (E)	Electric	$/kWh	No				
	RPS Compliance (E)	Electric	$/kWh	Yes		Time Series - Annual		RPS Compliance (E)
	Energy Market Price Effect (E)	Electric	$/kWh	Yes				
	Capacity Market Price Effect (E)	Electric	$/kW	No				

Generate Input Tabs

Once value streams are configured, the user uses the <u>macro buttons</u> in the **Configuration Data** tab of the Configuration File to generate the necessary input tabs.

At this stage, users will run a set of macros that automate sheet creation, guide data entry, and generate program input files.:

- **Build Value Stream:** Creates individual tabs for each value stream included in the JST, based on the Test Set-up table; users should enter input data using the selected time-series granularity, and existing tabs are not overwritten unless the calculation type has changed.
- **Input Avoided Cost Data:** Navigates to the first defined value stream, allowing users to begin entering avoided cost data.
- **Build Program Input:** Opens the program input file and generates load shape profiles consistent with the most granular calculation type specified; both electric and natural gas load shapes are created where applicable, and the program input and configuration files must be in the same folder with no changes to file names.
- **Clear All Sheets:** Deletes all previously generated sheets.

The user is not manually creating these sheets; instead, they are generated automatically based on the value stream configuration. This ensures that the structure of the inputs aligns with the selected commodities, calculation types, and granularity.

Populate Avoided Cost and System Data

After running **Build Value Stream** to generate the input tabs, use **Input Avoided Cost Data** to navigate to the first value stream worksheet. The user then enters avoided cost and other system-level data into the corresponding worksheets.

This may include:

- Avoided energy costs
- Avoided capacity costs
- Environmental or emissions values
- Other system-level inputs tied to selected value streams

Depending on the configuration, the user may be entering multiple time series granularity of data:

- Annual values
- Monthly values
- Hourly time-series data
- Custom Period data
- Single value
- Adders (%)

At this stage, the user is populating the data that will be used to assign value to DER impacts. Careful attention should be paid to units, time resolution, and whether values are expressed in real or nominal dollars.

Define Subsets (If Applicable)

If the analysis includes subsets or scenarios, the user defines them in the **Configuration File**. Subsets may represent:

- Geographic differences
- Constrained vs. unconstrained system conditions
- Sensitivity cases (e.g., low/medium/high avoided costs)

By default, the tool includes one subset called "Default System Input," and users can add up to three additional subsets. Results can be viewed either independently for each subset using filters or collectively across all subsets. When using multiple subsets, users must ensure that naming conventions and data structures remain consistent so that inputs can be accurately mapped during later processing.

What to Check Before Moving On

Before proceeding, the user should confirm that:

- All global parameters are complete and consistent
- Value streams are correctly defined and aligned with policy goals
- Input tabs have been generated successfully and filled out
- Avoided cost and system-level data have been fully populated
- Units are consistent across inputs

- Load shapes must align with the value stream that uses the highest time-series granularity

By the end of Step 2, the **Configuration File** should fully define how impacts are valued in the analysis. Figure 4 below shows the value stream setup table, and Figure 5 shows a sample avoided cost input tab.

Once the configuration is complete, the user should run the **Build Program Input** macro to navigate to the program input file. If the program input file is saved in the same folder as the configuration file, it will open automatically; otherwise, use the built-in file explorer to locate and open the file.

Figure 2: Value Stream Setup Table

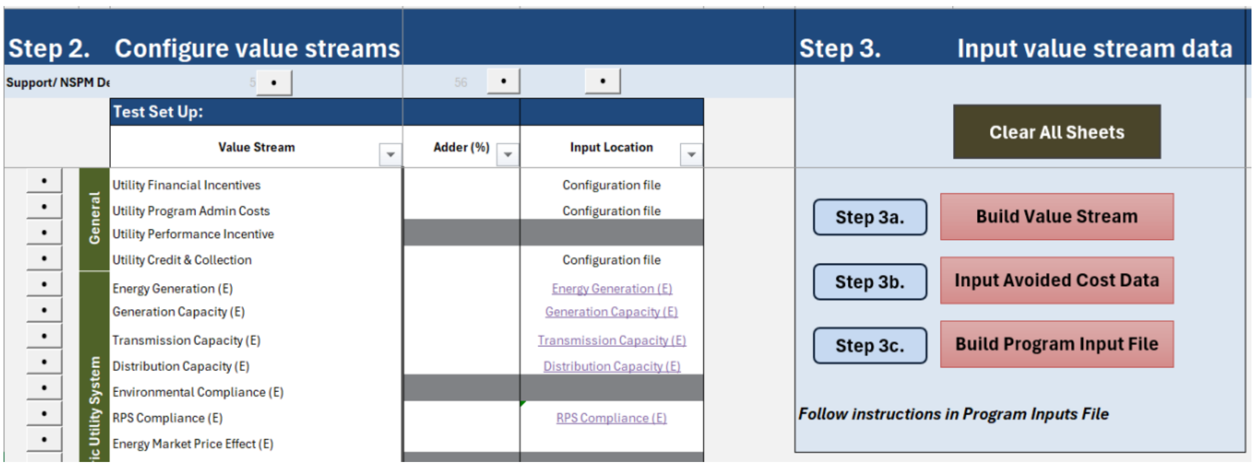
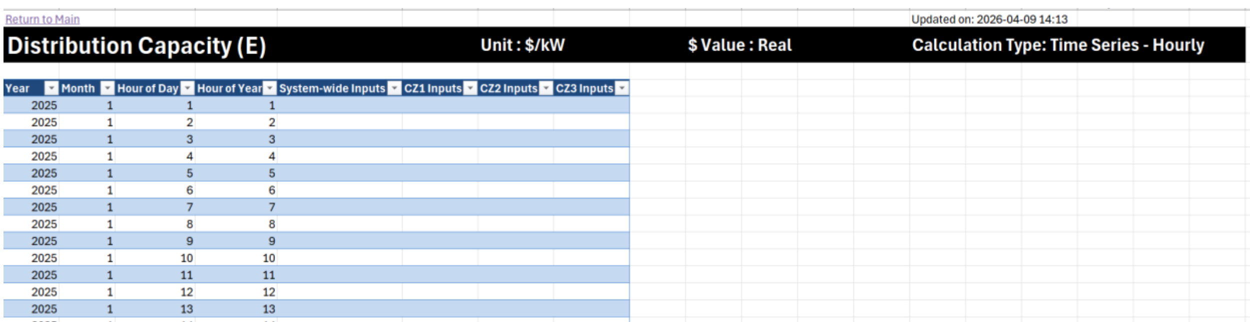


Figure 3: Sample Avoided Cost Input Tab


Return to Main

Updated on: 2026-04-09 14:13

Distribution Capacity (E) Unit : $/kW $ Value : Real Calculation Type: Time Series - Hourly

Year	Month	Hour of Day	Hour of Year	System-wide Inputs	CZ1 Inputs	CZ2 Inputs	CZ3 Inputs
2025	1	1	1				
2025	1	2	2				
2025	1	3	3				
2025	1	4	4				
2025	1	5	5				
2025	1	6	6				
2025	1	7	7				
2025	1	8	8				
2025	1	9	9				
2025	1	10	10				
2025	1	11	11				
2025	1	12	12				
2025	1	13	13				

3.3 Step 3: Enter Program Inputs

Purpose

In this step, the user completes the **Program Input File**, which defines the programs, measures, or scenarios being evaluated. While Step 2 defines how impacts are valued, this step defines what is being analyzed.

What the User Is Doing

The user works through the **Program Input File** tab by tab, entering measure-level and program-level data and ensuring alignment with the value streams and system-level assumptions defined in the Configuration File.

Enter Program-Level Inputs

Next, the user enters program-level inputs in the corresponding tab. These inputs apply at the program or portfolio level rather than to individual measures.

This may include:

- Program administration costs
  - Captures utility-incurred administrative costs not passed through to other parties (*e.g.*, workforce development, EM&V, overhead).
- Incentives
- Other aggregated program costs

The user must ensure that program names and identifiers match those used in the measure-level inputs so that results can be aggregated correctly.

Enter Measure-Level Inputs

The first task is to complete the measure-level inputs, in the **"Measure Inputs"** tab. Each row represents a single measure or intervention.

The user enters:

- Unique ID
- Measure name
- Program name
- Effective Useful Life (EUL)
- Net-to-Gross (NTG) ratio
- Participation or installation counts
- Incremental costs
- Any applicable non-energy or participant impacts

At this stage, the user is defining the core characteristics and expected performance of each measure.

Assign Subsets (If Applicable)

If subsets were defined in the **Configuration File**, the user assigns each measure to the appropriate subset.

This ensures that:

- The correct avoided costs are applied
- The analysis reflects spatial or scenario differences

Note: Consistency between the **Program Input File** and **Configuration File** is essential.

Enter Savings and Assign Value Streams

The user enters savings per unit for each applicable value stream in the measure input tab, including:

- Entering annual gross savings by Impact Category (*e.g.*, electricity, natural gas)

- Ensuring savings align with the value streams defined in Step 2 in terms of granularity.

If a measure affects multiple commodities or value streams, all relevant impacts must be entered. For example, a measure may reduce natural gas use while increasing electricity use.

Define and Populate Load Shapes

Use the **Define Load Shape Names** tab to specify the electric and natural gas load shapes used in the analysis. These load shape names are later selected in the **Measure Inputs** tab.

- For each load shape, specify:
  - A descriptive load shape name
  - The load shape type:
    - **Absolute savings** (e.g., kWh or therms)
    - **% normalized profile** (values sum to 1)
- If using a **% normalized** load shape:
  - Enter the corresponding annual electric and/or natural gas savings in the Measure Inputs tab
  - OpenBCA multiplies the annual savings by the normalized profile to calculate time-series savings

Load shape types and required granularity are automatically populated based on the Configuration File settings. After adding or modifying load shape names, use the Update Load Shape Names button to refresh the load shape tables. This is a critical step because timing of savings directly affects calculated benefits.

Use the **Electric Load Shapes** and **Natural Gas Load Shapes** tabs to enter values for each load shape defined in the **Define Load Shape Names** tab. These tabs are generated automatically using a macro from the Configuration File and include only the load shapes that existed at the time the macro was run.

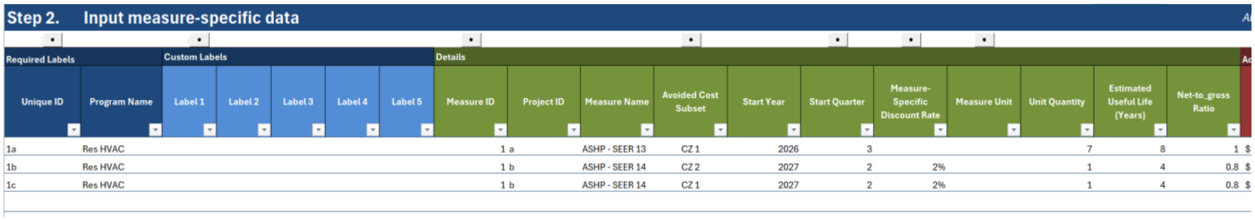
- To complete load shape inputs:
  - Enter values for each defined electric and/or natural gas load shape
  - Populate values according to the required time-series granularity shown on the tab (e.g., hourly)
  - Ensure values align with the value stream that uses the **highest time-series granularity**

What to Check Before Moving On
Before proceeding, the user should confirm that:

- Each measure has a unique ID
- Program names match across tabs
- Units are consistent (*e.g.*, kWh, therms, dollars)
- Savings, costs, and load shapes are complete
- Measures are correctly mapped to value streams and subsets

By the end of Step 3, the Program Input File should fully describe the measures and programs being analyzed, including their costs, savings, time-series, and scope. Figure 4 below shows a sample Measure Inputs tab.

Figure 4: Sample Measure Inputs Tab



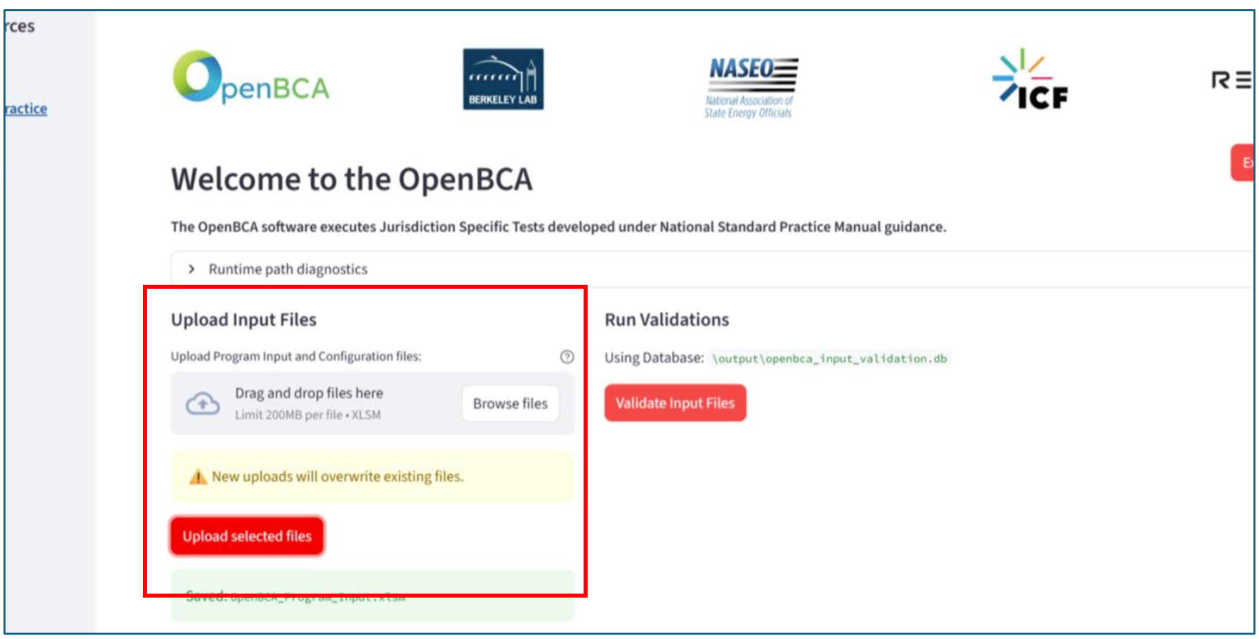
Step 2. Input measure-specific data																			
Required Labels		Custom Labels					Details												Ad
Unique ID	Program Name	Label 1	Label 2	Label 3	Label 4	Label 5	Measure ID	Project ID	Measure Name	Avoided Cost Subset	Start Year	Start Quarter	Measure-Specific Discount Rate	Measure Unit	Unit Quantity	Estimated Useful Life (Years)	Net-to_gross Ratio		
1a	Res HVAC						1	a	ASHP - SEER 13	CZ 1	2026	3			7	8	1	$	
1b	Res HVAC						1	b	ASHP - SEER 14	CZ 2	2027	2	2%		1	4	0.8	$	
1c	Res HVAC						1	b	ASHP - SEER 14	CZ 1	2027	2	2%		1	4	0.8	$	

3.4 Step 4: Upload Input templates to the OpenBCA tool

Once all Configuration and Program Input files are complete, open the OpenBCA Application Home Page to upload the input files. The application can be downloaded from the website or the GitHub repository.

- To upload input files:
  - Click Browse Files and select the completed:
    - OpenBCA Configuration File
    - OpenBCA Program Input File
  - Click Upload Selected Files to load the files into the application
- After uploading:
  - Confirm the files were successfully uploaded
  - Proceed to Validate Input Files before running the model

Figure 5: Upload Input files to OpenBCA



3.5 Step 5: Validate Inputs

Purpose

In this step, the user verifies that all inputs in both the **Configuration File** and **Program Input File** are complete, internally consistent, and properly formatted before running the model. Validation helps identify errors that could otherwise lead to failed runs or incorrect results.

What the User Is Doing

The user runs validation checks and reviews the input files for issues related to completeness, formatting, and alignment across inputs. This step involves both using built-in validation tools and performing manual checks to confirm that inputs are conceptually sound.

Confirm Conceptual Soundness

Validation is not only technical but also conceptual. The user should review whether:

- Value streams reflect intended policy goals
- Assumptions are reasonable and well-supported
- Data input accurately represents the programs being analyzed

This step is critical because validation tools cannot assess whether inputs are appropriate from a policy or analytical perspective.

Run Validation Tools

The first task is to run any available validation tools or macros within the OpenBCA interface or input files. These tools scan the input files and flag issues such as:

- Missing required fields
- Invalid or inconsistent formats
- Duplicate or missing identifiers
- Misaligned time-series data

These automated checks provide a first pass at identifying potential issues.

Check Alignment Across Files

Beyond automated checks, the user should manually confirm that inputs are aligned across the Configuration File and Program Input File.

Key alignment checks include:

- Value streams defined in the Configuration File match those used in the Program Input File
- Program names and identifiers are consistent across all tabs
- Subsets are defined and assigned consistently
- Load shapes align with avoided cost granularity

This step ensures that the model can correctly connect system-level assumptions with program-level data.

Verify Units and Data Consistency

The user should confirm that:

- Units are consistent (*e.g.*, kWh, therms, dollars)
- Savings, costs, and avoided costs are expressed in compatible units
- Time-series data are aligned in terms of resolution and structure

Note: Even if inputs pass automated validation, inconsistencies in units or structure can lead to incorrect results.

Review Errors and Warnings

After running validation, the user reviews all flagged errors and warnings.

- Errors typically indicate issues that must be resolved before the model can run (*e.g.*, missing required inputs or invalid formats).
- Warnings may indicate potential issues that do not prevent execution but could affect results (*e.g.*, unusual values or incomplete optional fields).
    - Warnings may allow the model to run but may produce inaccurate results.

The user should address all errors and carefully review warnings to determine whether corrections are needed.

What to Check Before Moving On

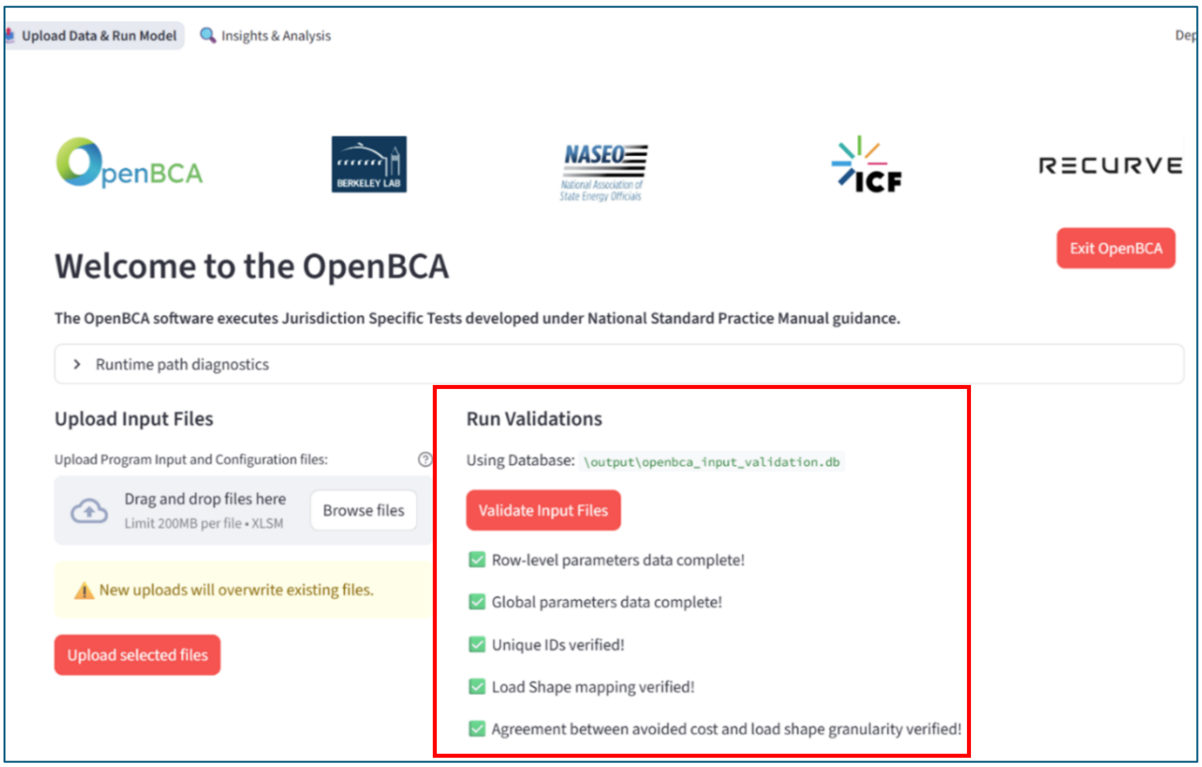
Before proceeding, the user should confirm that:

- All validation errors have been resolved
- Warnings have been reviewed and addressed as needed
- Inputs are aligned across files
- Units and formats are consistent
- Assumptions are reasonable and documented

By the end of Step 4, the input files should be complete, consistent, and ready for model execution.

Figure below shows a sample validation results screen.

Figure 8: Sample Validation Results Screen



3.6 Step 6: Run the Model

Purpose

In this step, the user executes the OpenBCA model to calculate benefits, costs, and cost-effectiveness metrics based on the inputs provided in Steps 2 and 3.

What the User Is Doing

The user initiates the model run through the OpenBCA interface and monitors the process to ensure successful execution. At this stage, the user is transitioning from input preparation to calculation and results generation.

Initiate the Model Run

The user begins by selecting the option to run the model within the OpenBCA interface.

This action triggers the model to:

- Read inputs from the Configuration File and Program Input File
- Apply value stream definitions and calculation methods
- Combine savings, costs, and avoided cost data

The user does not need to perform calculations manually; the model handles all computations.

Depending on the size and complexity of the analysis (*e.g.*, number of measures, time resolution, number of value streams), execution time may vary.

Address Execution Errors (If Any)

If the model encounters errors during execution, the user should:

- Review error messages or logs
- Identify the source of the issue (*e.g.*, missing data, misalignment, formatting errors)
- Return to the input files to correct the issue

In most cases, execution errors indicate issues that were not fully resolved during validation. Errors will be displayed in a log console. If the user is unable to determine the source of an execution error after reviewing error messages and input files, the recommended approach is to troubleshoot systematically and narrow the issue.

The user should first re-run the validation step (Step 4) to confirm that no errors or critical warnings were missed. Next, the user can isolate the issue by simplifying the analysis, such as:

- Running the model with a reduced set of measures or a single program
- Temporarily removing recently added inputs or value streams
- Testing with a simplified version of the input files

This process helps identify whether the issue is tied to a specific measure, value stream, or dataset.

If the issue persists, the user should review any available error logs or detailed messages generated during execution, as these often point to specific fields, tabs, or data structures causing the problem.

What the Model Does Behind the Scenes

During execution, OpenBCA:

- Applies savings and load shapes to avoided cost data
- Calculates benefits and costs for each value stream
- Aggregates results across measures, programs, and time
- Applies discounting to convert results into present value terms

These steps are performed automatically based on the inputs provided.

Confirm Successful Completion

Once the model run is complete, the user should confirm that:

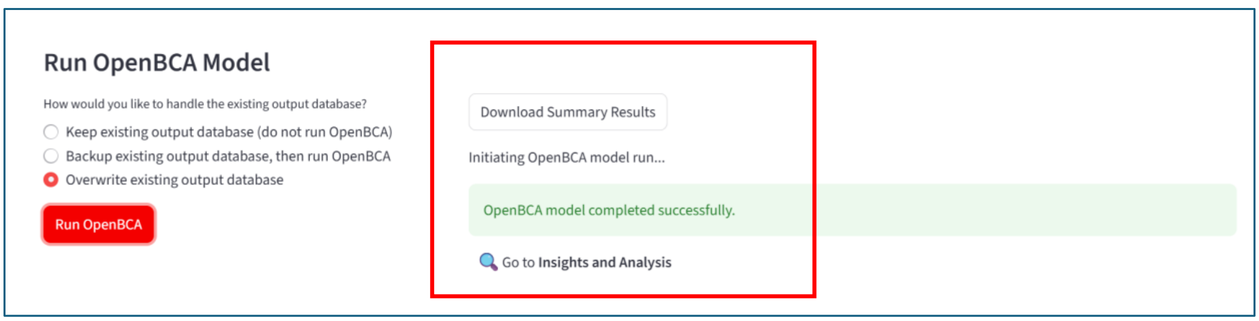
- The run completed without errors
- Output tab and results are generated
- Results appear complete and populated

When verifying that the results appear complete and populated, the user should confirm that all expected output tables and fields contain values and are fully filled in, rather than showing blanks, zeros where values are expected, or error messages. Specifically, the user should confirm that:

- Summary metrics such as NPV, BCR, total benefits, and total costs are present and populated
- Value stream results are displayed for all included streams (*e.g.*, energy, capacity, emissions, costs)
- Measure- and program-level results include values for each defined measure or program
- Time-series or annual output tables are filled across all expected years or time intervals
- No cells display errors (*e.g.*, #N/A, #REF) or unexpected null values

This confirms that the model has successfully processed the inputs. At this point, the analysis results are ready for interpretation in Step 6. Figure below shows the model run execution screen with "Run" button.

Figure 9: Model Run Execution Scree



3.7 Step 7: Review Outputs

Purpose

In this step, the user reviews and interprets the results generated by OpenBCA. The goal is to understand whether the analyzed programs or measures are cost-effective under the defined Jurisdiction-Specific Test (JST), and to identify the key drivers of those results.

What the User Is Doing

The user opens and reviews the model outputs, examines summary metrics and detailed breakdowns, and assesses how results align with expectations, assumptions, and policy objectives. This step involves both reviewing numerical outputs and interpreting their meaning in context.

Access Output Files and Results

The first task is to locate and open the output files generated by the model. These may include:

- Summary results tables
- Measure- and program-level results
- Value stream breakdowns
- Supporting data tables

Depending on the OpenBCA interface, outputs may be available as downloadable files, structured tables, or dashboard views.

Review Summary Metrics

The user begins by reviewing the key summary metrics, including:

- Net present value (NPV) of benefits and costs
- Benefit-cost ratio (BCR)
- Total benefits and total costs

These metrics provide a high-level view of whether benefits exceed costs under the defined JST.

Examine Value Stream Breakdown

Next, the user reviews the breakdown of results by value stream.

This step helps answer questions such as:

- Which value streams contribute most to total benefits?
- Which costs are most significant?
- Are results driven by a small number of assumptions or inputs?

Understanding the contribution of individual value streams is critical for interpreting results and identifying key drivers.

Review Results by Measure and Program

The user then examines results at a more detailed level, including:

- Measure-level results
- Program-level results
- Aggregated portfolio results (if applicable)

This allows the user to:

- Compare performance across measures or programs
- Identify high-performing or underperforming components
- Understand how individual elements contribute to overall results

Check for Reasonableness and Consistency

The user should assess whether results are reasonable and consistent with expectations.

This includes checking:

- Whether magnitudes of benefits and costs are plausible
- Whether results align with known program characteristics
- Whether any unexpected or extreme values appear

If results appear inconsistent or surprising, the user may need to revisit inputs or assumptions.

Interpret Results in Context of Assumptions

At this stage, the user interprets the BCA results with consideration of the inputs and assumptions used.

This includes recognizing that:

- Results reflect the selected value streams
- Results depend on avoided costs, discount rates, and other inputs
- Results are aligned with the defined JST

The user should consider how different assumptions or value stream selections might change outcomes.

Export and Document Results

The user may export results for reporting, further analysis, or stakeholder review.

This includes:

- Saving output files
- Extracting key tables or metrics
- Documenting assumptions and inputs used

What to Check Before Moving On

Before finalizing the analysis, the user should confirm that:

- All expected outputs are present and complete
- Summary metrics are consistent with detailed results
- Key drivers of results are understood
- Any unexpected findings have been investigated

At this point, the analysis is complete and ready for interpretation and application.

Figure below shows a sample summary results dashboard. Figure below shows a sample program-level results table.

Figure 10: Sample Summary Results Dashboard

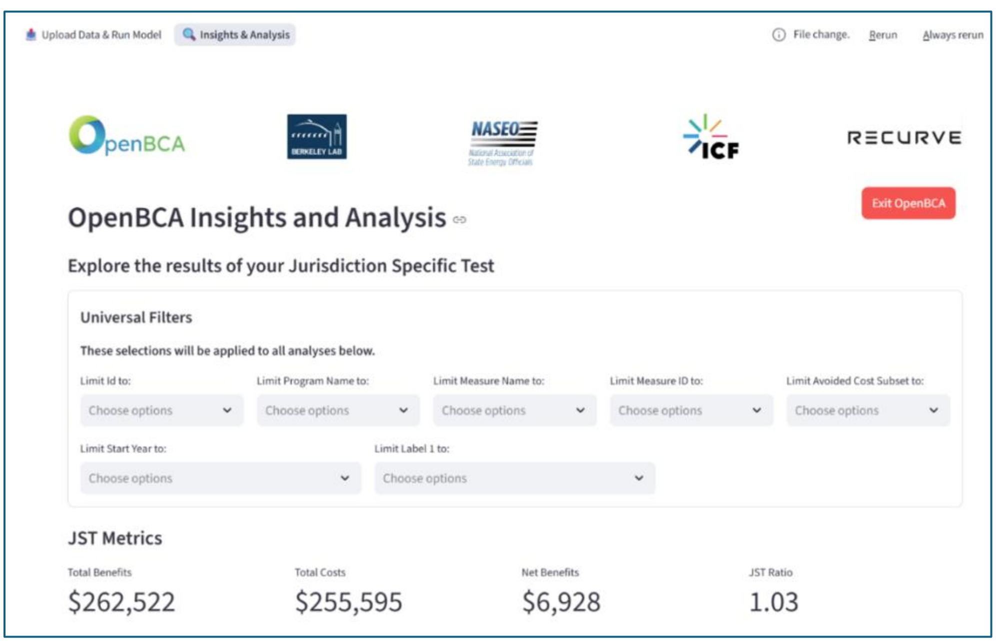


Figure11: Sample Program-level Results Table


Portfolio Analysis
Display
Figures
Tables
Create Categories From
Program Name
Measure Name
Measure ID
Avoided Cost Subset
Start Year
Waterfall Steps
Impact Category
Value Stream
Plot
Benefits vs Costs
JST Ratio vs Net Benefits
Benefit and Cost Breakdown
Dollars ($k)
196.9
45.4
41.8
5.9
2.3
1.3
1.2
0.5
-29.6
-126.7
139.0
Electric
Non-System
Natural Gas
Tax Incentive
Host Customer NEIs
Propane
Societal Resilience
Host Customer Reliability
Admin
Measure Cost
Total
Benefits vs Costs by Program Name
Comm Market
Res Market
Water Saver
Benefits ($k)
Costs ($k)
Zoom:
0.00

4 Understanding and Interpreting Results

4.1 Overview

This section provides guidance on how to interpret results generated by OpenBCA. While the tool produces quantitative outputs, those results must be understood in the context of the assumptions, inputs, and policy objectives that define the analysis. Consistent with the NSPM, benefit-cost analysis is not intended to produce a single "correct" answer. Instead, it is a structured approach for comparing resources and informing decisions based on jurisdiction-specific goals.

4.2 What the Results Represent

The key metrics from a BCA are broken out in the JST Metrics section:

- Benefits: Total benefits included in the analysis based on the configured value streams
- Costs: Total costs included in the analysis based on the configured value stream
- Net Benefits: Total benefits minus total costs, expressed in present value term
- BCA Ratio: Represents the ratio of total benefits to total costs

A positive Net Benefit or a BCR greater than one indicates that benefits exceed costs under the defined JST. These indicators reflect the results under the **specific JST configuration** used for the run. These metrics are useful for evaluating cost-effectiveness and comparing options; however, they should always be interpreted with consideration of the assumptions and scope of the analysis. Different JST configurations may yield different results for the same resource, and these differences reflect underlying policy and methodological choices rather than inconsistencies in the tool.

4.3 Value Stream Breakdowns (What Drives the Result)

OpenBCA provides benefit and cost breakdowns by value stream. Interpreting results requires understanding what drives them, including which value streams contribute most to total benefits and total costs. Reviewing value stream breakdowns can help identify whether results are robust or heavily dependent on a small number of assumptions.

4.4 Comparing Measures, Programs, Portfolios, and Scenarios

OpenBCA supports comparisons across measures, programs, portfolios, and scenarios. Such comparisons are only meaningful when conducted using consistent assumptions and a common JST. Users should ensure value streams, avoided costs, discount rates, and other key inputs are aligned across scenarios being compared.

Both net benefits and benefit-cost ratios should be considered when evaluating alternatives, along with any additional metrics relevant to policy goals (such as emissions reductions or equity impacts).

4.5 Using Results to Inform Decisions

Ultimately, OpenBCA results are intended to inform (not replace) decision-making. They can be used to identify cost-effective programs, compare resource options, support regulatory filings, and inform program design. However, they should be considered alongside policy objectives, stakeholder input, and other qualitative factors. OpenBCA provides a structured and transparent framework for evaluating DER investments, but the quality and usefulness of its results depend on thoughtful configuration, clear alignment with policy goals, and careful interpretation of both quantified and unquantified impacts.

5 Common Pitfalls and Best Practices

5.1 Overview

This section describes common issues that may affect the accuracy, consistency, and interpretation of OpenBCA results. These issues generally involve incomplete or inconsistent value-stream definitions, misalignment with policy objectives, mismatched temporal granularity, incorrect units, or poor-quality input data. Users should review these considerations when configuring an analysis and before relying on model outputs.

5.2 Incomplete or Inconsistent Treatment of Impacts

Omitting, mischaracterizing, or inconsistently applying relevant impacts can bias results and make comparisons across measures, programs, or scenarios misleading. For example, including a benefit for one resource while excluding the corresponding cost—or applying different treatment to otherwise comparable resources—can create an asymmetrical analysis.

Users should ensure that:

- Included value streams reflect the relevant and material impacts identified through the JST-development process.
- Benefits and costs are treated symmetrically.
- Comparable resources use consistent assumptions and methodologies.
- Utility system, host-customer, and societal impacts are included only when consistent with the analytical perspective of the JST.
- The treatment of incentives, NTG, and transfer payments is consistent with the selected Cost Framework.

5.3 Misalignment with Policy Objectives

A central principle of the NSPM is that cost-effectiveness analysis should align with jurisdiction-specific policy goals. OpenBCA does not determine which impacts should be included in a JST. Those decisions should reflect the jurisdiction's applicable policies, regulatory objectives, and analytical purpose. Impacts such as emissions reductions, resilience, equity, and host-customer non-energy impacts should therefore be included or excluded through a deliberate and documented process.

A resource may produce different cost-effectiveness results under different JST configurations because each configuration may represent a different set of policy objectives and impacts. Users should interpret results relative to the purpose and scope of the applicable JST rather than relying solely on whether a benefit-cost ratio exceeds a particular threshold.

5.4 Transparency and Documentation

Transparency and documentation are essential for credible interpretation. Communicating what is included and excluded helps ensure that results are understood and appropriately applied. Transparent documentation supports stakeholder engagement, reproducibility, and confidence in the analysis. Conversely, insufficient documentation of assumptions, methodologies, and included impacts can make results difficult to interpret and reduce stakeholder confidence.

Consistent with NSPM principles, users should clearly document:

- Value streams included and excluded
- JST configuration and analytical perspective

- Cost Framework and NTG assumptions
- Key input assumptions and data sources
- Avoided-cost sources and applicable subsets
- Proxy values and methodological choices
- Known data limitations
- Differences among scenarios and sensitivity cases

5.5 Misalignment of Temporal Granularity

OpenBCA requires alignment between the temporal granularity of avoided costs and savings load shapes. Mismatches, such as pairing hourly avoided cost data with annual load shapes, can lead to errors or inaccurate results. Best practice is to ensure that load shapes meet or exceed the granularity of the highest-resolution avoided cost data.

Users should verify that:

- Savings profiles provide sufficient resolution for the avoided-cost data being applied.
- Hourly profiles and avoided costs use the same hour convention, such as hour beginning or hour ending.
- Annual savings are allocated across time periods using an appropriate and properly normalized load shape.
- Analysis periods are sufficient to represent the applicable measure lives and impacts.

Where high-resolution data are not available, users should document limitations and consider the potential impact on results.

5.6 Data Quality and Input Errors

Errors in input data, including incorrect units, missing values, or inconsistent identifiers, can lead to incorrect results or model failures. Even when the model runs successfully, poor data quality can produce misleading outputs.

Users should carefully review all inputs, ensure consistency across files, and use validation tools to identify and resolve issues. Clear documentation of data sources and assumptions is also recommended.

6 Advanced Topics

6.1 Overview

OpenBCA supports advanced analytical capabilities that allow users to examine uncertainty, compare alternative assumptions, and refine an analysis as additional information becomes available. These capabilities can help users understand what drives cost-effectiveness results, evaluate the robustness of findings, and assess how different policy or analytical choices affect outcomes. Advanced analyses should be designed carefully, documented clearly, and interpreted in the context of the applicable Jurisdiction-Specific Test (JST), policy objectives, and available data.

6.2 Sensitivity Analysis

Sensitivity analysis evaluates how results change when one or more key assumptions are varied. This helps identify the inputs that have the greatest influence on net benefits, benefit-cost ratios, and other reported metrics. It can also indicate whether a result remains relatively stable across a reasonable range of assumptions or depends heavily on a particular input.

Common parameters evaluated through sensitivity analysis include:

- Avoided-cost values
- Discount rates
- Net-to-Gross (NTG) ratios
- Measure expected useful lives
- Participation levels
- Measure costs and savings
- Load shapes and peak-demand impacts
- Escalation and inflation assumptions

Sensitivity cases should use reasonable ranges supported by available data, prior studies, regulatory guidance, or professional judgment. When presenting results, users should clearly identify the assumptions changed in each case and distinguish the sensitivity cases from the primary analysis.

6.3 Scenario Analysis

Scenario analysis allows users to compare broader combinations of inputs, value streams, program characteristics, or policy assumptions. Unlike a sensitivity analysis, which often changes a limited number of variables, a scenario may represent a distinct program design, policy framework, forecast, or future system condition.

Scenario analysis may be used to evaluate:

- Alternative policy frameworks or JST configurations
- Different program or portfolio designs
- High and low cost or performance cases
- Alternative avoided-cost forecasts
- Different participation or adoption pathways
- Alternative technology mixes
- Inclusion or exclusion of specific value streams

For comparisons to be meaningful, users should apply consistent definitions, calculation periods, dollar years, and reporting conventions across scenarios unless those elements are intentionally varied. Reviewing both net benefits and benefit-cost ratios can provide a more complete understanding of how the scenarios differ.

6.4 Avoided-Cost Subsets and Differentiation

Avoided costs may vary by location, customer type, system condition, or analytical case. OpenBCA supports subsets that allow users to represent these differences without creating an entirely separate value stream for each variation.

Subsets may be used to represent:

- Constrained and unconstrained geographic areas
- Different utility service territories or climate zones
- Customer classes or market segments
- Alternative high, base, and low avoided-cost cases
- Other defined categories that require distinct avoided-cost inputs

Subsets should be clearly named and applied consistently throughout the analysis. Users should also document the basis for assigning measures or programs to a subset. Time-dependent differences, such as peak and off-peak values, should generally be reflected through the applicable temporal avoided-cost inputs rather than treated as spatial subsets unless they also represent distinct analytical categories.

6.5 Cost Frameworks, NTG, and Transfer-Payment Treatment

OpenBCA's Cost Framework determines how Net-to-Gross (NTG) ratios, customer incentives, and other transfer payments are applied based on the impacts included in the Jurisdiction-Specific Test (JST). Users may select from three frameworks:

- USI — includes utility system impacts only. Utility-paid customer incentives are treated as costs because the recipient is outside the analytical perspective.
- USI + Non-USI — includes utility and non-utility system impacts, such as host-customer impacts. Incentives exchanged between parties represented in the analysis are treated as transfer payments and excluded from net resource costs.

NTG represents the share of program impacts attributable to the program; the remaining share represents impacts associated with free riders. Users should select the framework that aligns with the perspectives and value streams included in the JST and clearly document the selected framework, NTG assumptions, and treatment of incentives.

6.6 Uncertainty and Non-Quantified Impacts

Not all relevant impacts or uncertainties can be quantified or monetized with sufficient confidence. Data limitations, methodological uncertainty, or the absence of established valuation methods may prevent some impacts from being included directly in OpenBCA calculations. Examples may include certain health, equity, or other non-energy impacts.

Users should identify material impacts excluded from the quantitative analysis, document why they were not quantified, and describe their potential relevance to the results. When appropriate, users may also present supporting qualitative evidence or conduct sensitivity analysis using a reasonable range of proxy values. OpenBCA results should therefore be interpreted alongside non-quantified impacts, data limitations, policy objectives, and other relevant qualitative considerations.

6.7 Iterative Analysis and Refinement

Benefit-cost analysis is often an iterative process. An initial analysis may rely on simplified assumptions or preliminary data, with inputs refined as measured performance data, updated forecasts, or more detailed cost information become available.

Users may iteratively:

- Update avoided-cost inputs
- Refine load shapes and savings estimates
- Improve measure and program cost estimates
- Update participation forecasts
- Expand or revise value-stream coverage
- Correct data-quality or validation issues
- Revisit JST assumptions as policies or analytical needs change

Each iteration should be documented so users can distinguish changes in the underlying data from changes in methodology or policy assumptions. Maintaining clear scenario names, input versions, and supporting documentation can improve transparency and make results easier to review and reproduce.

Appendix A. OpenBCA Applications

Use Cases	Core Functions	Potential Functions
This list of use-cases are examples of common BCA applications from a regulatory, planning, and practitioner's perspective.	The OpenBCA tool is built around the following core functions and can support most use-cases within such categories independently.	For various use-cases, the tool will likely need modifications, synching with other tools, and/or building more features in the basic source code.
1. Pilots, Programs, and Portfolios		
a. Single-DER Measure: DER measures are energy resources on the distribution system that are sited at or near customer facilities and include equipment or behaviors within EE, DR, DG, DS, EV, and BE, and include both prescriptive and custom measures. <u>Applications:</u> -- Single-DER pilots -- Single-DER programs -- Single-DER portfolio planning	The tool is designed to conduct a BCA for single-DER measures (i.e., the same DER in pilot, program, or portfolio form) and will support various applications.	
b. Multi-DERs: Building up multiple DER measures into program and portfolio level groupings. Applies to utility programs and can apply to governmental programs. <u>Applications:</u> -- Multi-DER pilots -- Multi-DER programs -- Multi-DER portfolios -- BCA post Evaluation, Measurement & Verification -- Government DER Programs	The tool is designed to conduct BCA for multiple DER measures/projects with many identifiers for screening at pilot, program, and portfolio levels. The tool will support these applications (see right column for government DSM/DER programs).	If government-run initiatives (e.g., state energy office DER programs) differ from utility programs, it could require external tools or editing features to incorporate a peripheral analysis into the results.
2. Procurement and Planning		
a. Non-Wires/Non-Pipes Alternatives and Location-Specific Evaluations: A program that applies a single- or multi-DER solution to	If infrastructure costs can be transformed into $/kw-year (or similar units) to as align with capacity inputs, OpenBCA can be used without any modifications. For more typical	In the case of applications that look at one-time investment cost and years of a deferral, the tool itself cannot assess a deferral period and henceforth a deferral benefit. This can be done

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address geographically-specific system constraints in order to defer or avoid investments in capacity infrastructure.	applications, see the 'one-time investment' line item below.	independently or through modifications in the tool source code.
b. Integrated Resource Planning: A process where utilities plan for future energy needs and assess both supply and demand side resources in order to provide reliable customer service and meet other state goals and objectives.	IRP models can provide inputs to the OpenBCA model for avoided costs, and the OpenBCA outputs can feed back into the IRP model. This is an iterative approach.	The tool is not intended to be an IRP model in terms of least-cost assessment of generation and transmission mix. This is the function of IRP Modeling Tools (e.g., Integrated Planning Model (IPM), EnCompass, Plexos, Resolve) to analyze assets for operations. The two models could ultimately be integrated or co-optimized.
c. Distribution System Planning: A process through which utilities identify and evaluate investments needed to maintain and modernize the distribution grid while supporting safety, reliability, resilience, affordability, and the integration of grid-edge resources. The Berkeley Lab Interactive Decision Framework for Integrated Distribution System Planning provides additional guidance on the broader planning process. Applications: -- Grid Modernization and Infrastructure Analysis -- Integration of Localized Distribution and	DSP models can provide externally developed planning and engineering inputs—such as location-specific needs, avoided or deferred infrastructure costs, constraint timing, and reliability or resilience values—to evaluate the cost-effectiveness of DER alternatives and portfolios. Results can feed into an iterative distribution-planning process.	OpenBCA is not intended to replace distribution system planning or power-engineering tools. It does not identify grid constraints, select specific infrastructure investments, or assess engineering feasibility—for example, whether a conductor on a particular circuit should be upgraded. Traditional grid investments, such as vegetation management, undergrounding, and grid hardening, may also provide reliability, resilience, or safety benefits that are not directly comparable to the load-impact profiles of DERs. Engineering tools such as CYME should therefore be used to evaluate technical system needs and solutions, while OpenBCA can use outputs from those analyses to assess the economic

Use Cases	Core Functions	Potential Functions
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Transmission Planning Efforts		merits of DER alternatives. These tools may be used in parallel and could potentially be integrated, but OpenBCA is not a substitute for power-engineering analysis.
d. DER Potential Studies: Potential technical, economic, and/or achievable DER adoption of utility driven DER programs that inform IRPs and other utility system planning processes.		The tool is not intended to be a potential study tool, which usually requires enhanced features like participation forecasting and acceptance curves. OpenBCA features can be used in-conjunction with or integrated into potential study tools for potential assessments.

Appendix B. Glossary

Analysis period: the time period over which cost-effectiveness analysis should be conducted. (See "Expected useful life" and Appendix **Error! Reference source not found.**.)

Ancillary services: services required to maintain electric grid stability. They typically include frequency regulation, voltage regulation, spinning reserves, and operating reserves, either traded in wholesale energy markets or self-supplied by utilities.

Avoided costs: the costs of those electricity and gas resources (e.g., generation, transmission, and distribution system infrastructure) that are deferred or avoided by the DERs being evaluated for cost-effectiveness. (See Chapter **Error! Reference source not found.**.)

Benefit-cost analysis (BCA): a systematic approach for assessing the cost-effectiveness of investments by comparing the benefits and costs of alternative options. BCA is also commonly referred to as cost-effectiveness analysis.

Bill impact analysis: indicates the extent to which customer bills are affected for customers that participate in DER programs and those who do not.

Cost-effectiveness: when investment in a resource is worthwhile; measured by the benefits of investing in a resource being greater than the costs of investing therein.

Discount rates: a component of cost-effectiveness analysis which reflects a "time preference"—the relative importance of short- versus long-term impacts. A higher discount rate gives more weight to benefits and costs relative to long-term benefits and costs, while a lower discount rate gives greater weight to long-term impacts.

Distributed energy resource (DER): electricity and gas resources sited close to customers that can provide all or some of their immediate power needs and/or can be used by the utility system to either reduce demand or provide supply to satisfy the energy, capacity, or ancillary service needs of the grid (DOE 2019a). These include energy efficiency, demand response, distributed generation, distributed storage, electric vehicles, and building electrification.

DER programs: include passive and performance-based programs, initiatives, and policies that encourage customers to adopt DERs. Examples include traditional utility EE programs, traditional utility DR or bring-your-own-device (BYOD) programs, EV managed charging programs, distributed storage incentives, and investments in EV infrastructure.

Double-counting: the inclusion of overlapping impacts in analyses and thus counting one effect more than once.

Effective useful life (EUL): the average time over which a DER measure results in energy savings (or use) including the effects of equipment failure, removal, and cessation of use.

Energy efficiency (EE): Resources that include technologies, services, measures, or programs that reduce energy consumption by host customers and that are funded by, promoted, or otherwise supported on behalf of all electricity and gas utility customers. (See Chapter **Error! Reference source not found.**.)

Environmental compliance: the process by which utility systems adhere to federal, regional, and state/local laws designed to manage and mitigate the ecological impact of energy production. These regulations typically require a reduction in emissions from energy generation or place limits on allowable levels of emissions from new or existing energy resources.

Forward-looking analysis: captures the difference between benefits and costs that would occur over the lifetime of the DERs and those what would occur absent the DERs.

Free-ridership: DER savings that would have occurred in the absence of the program.

Greenhouse gas (GHG) emissions: gases that trap heat in the atmosphere (including carbon dioxide, methane, nitrous oxide, and fluorinated gases) emitted from human activities, primarily burning fossil fuels for electricity generation, transportation, industrial processes, commercial and residential heating, and agriculture.

Host customer: The owner/occupant of the site at which BTM DERs are installed and/or operated. In some cases, these are program participants, e.g., participants in a DR or EE program. In other cases, there is no program, e.g., EV owners.

Incremental analysis: consists of changes that will occur as a result of the DER relative to a scenario where the DER is not in place.

Integrated resource planning (IRP): a long-run planning process for vertically integrated utilities that evaluates DERs and utility-scale generation for meeting peak and energy demands.

Load shape: a numerical profile of electricity consumption (measured in kilowatts, kW, or megawatts, MW) over a specific time period—typically 24 hours, a month, or a year, illustrating when and how much energy is used, highlighting daily, weekly, or seasonal peaks and valleys.

Lost revenues: When DERs reduce consumption of electricity or gas, which can result in fixed costs being spread across a smaller volume of sales, putting upward pressure on rates.

Impacts: both the benefits and the costs of a supply-side or demand-side resource.

Jurisdiction: any region or service territory to be served by the DERs under analysis. This includes a state, a province, a utility service territory, a city or a town, or some other jurisdiction covered by regulators or other entities that oversee DER initiatives.

Jurisdiction-Specific Test (JST): the primary test created by a jurisdiction following use of the NSPM BCA Decision Framework. It embodies all of the key principles of cost-effectiveness analyses and accounts for that jurisdiction's applicable policy goals by including impacts identified as relevant to that jurisdiction's goals and objectives.

Net present value (NPV): calculates the value of all future program or project benefits minus all costs, adjusted for the time value of money by discounting them to the present. A positive NPV indicates that the program or project benefits are greater than the program or project costs.

Non-energy impacts (NEI): are impacts of DERs other than direct energy and demand impacts. While these impacts can be non-energy benefits and related costs, most are considered benefits (non-energy benefits, or NEBs). Examples include reduced emissions, comfort and productivity improvements, local economic development, and reduced risk of utility service disruptions or price spikes.

Non-pipes solution: alternatives to meeting on-system natural gas demand that delay or avoid the need for investment in traditional resources such as pipelines, storage capacity, winter-peaking services, and distribution system infrastructure.

Non-wires solution (NWS): also known as non-wires alternative (NWA), geotargeting, and market-based alternative or solution. This is a strategy of deploying DERs in a specific geographic area for the purpose of deferring or avoiding new investments in equipment, distribution, or transmission lines. (See Chapter **Error! Reference source not found.**.)

Participant Cost Test (PCT): a cost-effectiveness test, as provided in the 2001 *California Standard Practice Manual*, which includes the benefits and costs experienced by host customers.

Participation impacts: indicate impacts participating customers will experience from participating in a DER program, in terms of bill reductions or increases.

Policy neutrality: a core component of the NSPM guidance. The NSPM does not advocate for any policy or cost-effectiveness test but rather sets forth a BCA Decision Framework that a jurisdiction can use to review its existing policies to develop a cost-effectiveness test which reflects local policy objectives.

Primary cost-effectiveness test: the cost-effectiveness test that a jurisdiction uses to determine whether a DER (or set of DERs) has benefits that exceed costs, and therefore merits acquisition or support from utilities or other energy providers.

Proxies: simple, quantitative values that can be used as indirect indicators for values not monetized by conventional means, which can be applied to any type of benefit or cost that is hard to monetize and is expected to be of significant magnitude. (See Appendix **Error! Reference source not found.**.)

Public health: Impacts include health impacts beyond host customer impacts, and typically health impacts associated with improved or worsened air quality impacts, where impacts are accounted for in terms of e.g., reduced healthcare costs.

Rate impact analysis: assessment of the extent to which investing in a resource will impact customer rates, sometimes in the form of a Ratepayer Impact Measure (RIM) test. This is a separate type of analysis from cost-effectiveness, which assesses whether the benefits of investing in a resource outweigh the costs.

Regulators and other decision-makers: refers broadly to any entity that oversees and guides DER analyses and associated investment decisions. This includes Public Utility Commissions, State Energy Offices, and boards of public power authorities and municipal or cooperative utilities.

Regulatory perspective: the perspective of regulators or other decision-makers that oversee resource investment choices, including energy generation and T&D infrastructure. This perspective is guided by the jurisdiction's applicable energy policy goals—whether in laws, regulations, organizational policies, or other codified forms—under which it operates.

Reliability: the ability to maintain power delivery to customers in the face of routine uncertainty in operating conditions, as in cases of fluctuating load and generation, fuel availability, and outage of assets under normal operating conditions (NREL 2022). Reliability addresses high-frequency, low-impact events, meaning the anticipated disruptions associated with normal operating conditions (i.e., "blue sky" days) (NARUC 2025).

Renewable Portfolio Standard (RPS): a regulatory mandate to increase production of energy from renewable resources such as wind, solar, biomass, and other alternatives to fossil-fuel-based electric generation.

Resilience: the ability to prepare for threats and hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions (The White House 2025). Resilience addresses low-frequency, high-impact events.

Risk: an adverse outcome that can occur because of uncertainty. In statistical terms, risk is the expected value of a potential loss (Ceres 2012). Meaning, risk is the probability of an adverse outcome occurring multiplied by the consequence of the outcome.

Secondary cost-effectiveness test: a cost-effectiveness test that supports use of the primary test by helping enhance stakeholders' overall understanding of DER impacts by answering additional questions regarding utility DER investments. The impacts included in secondary tests are driven by the purpose of the secondary analyses, including informing decisions on how to prioritize DERs; informing decisions regarding marginally cost-effective DERs; encouraging consistency across DER types; and considering other types of effects on customers. (See Section **Error! Reference source not found.** and Appendix **Error! Reference source not found.**.)

Societal Cost Test (SCT): a cost-effectiveness test, as provided in the 2001 *California Standard Practice Manual*, which includes the benefits and costs experienced by society.

Spillover: installation of DERs by customers who did not directly participate in a DER program but were nonetheless influenced by the program.

Symmetry: a key principle for the treatment of benefits and costs which is necessary to avoid bias toward any one resource, whereby both benefits and costs are included (or excluded) for each relevant impact. If each type of impact is not treated symmetrically, the result will be a sub-optimal selection of resources.

Total Resource Cost Test (TRC): a cost-effectiveness test that includes the benefits and costs experienced by the utility system, plus benefits and costs to the program participants.

Transfer payment: a one-way payment of money for which no money, good, or service is received in exchange. This is uncommon in DER BCAs.

Transparency: a key principle whereby cost-effectiveness practices fully document all relevant inputs, assumptions, methodologies, and results.

Utility: any entity that funds, implements, or supports DERs using customer or public funds that are overseen by regulators or other decision-makers. This includes investor-owned utilities; publicly owned utilities; municipal utilities; cooperative utilities; program administrators; community choice aggregators; regional transmission organizations and independent system operators; federal, state, and local governments; and other energy service providers. **Utility expenditures** refer to spending by any of these entities on DERs.

Utility Cost Test (UCT): a cost-effectiveness test includes the benefits and costs experienced by the utility system. This test is also known as a Program Administrator Cost Test (PACT).

Utility system: all elements of the electricity or gas system necessary to deliver services to the utility's customers. For electric utilities, this includes generation, transmission, distribution, and utility operations. For gas utilities, this includes transportation, delivery, fuel, and utility operations. This term refers to any type of utility ownership or management, including investor-owned utilities, publicly owned utilities, municipal utility systems, cooperatives, etc.