DER-CAM

DECISION SUPPORT TOOL FOR DECENTRALIZED ENERGY SYSTEMS

ANALYTICS | PLANNING | OPERATIONS

Modeling Multiple Ownership Microgrids:

Use-cases for applying DER-CAM to various microgrid ownership models

BERKELEY LAB

Overview

Purpose

To provide guidance to users about how DER-CAM can be applied to the modeling of microgrid systems operated under various different ownership models. Ownership here refers to which individuals or entities own the distributed energy resources (DER), which are responsible for the loads within the microgrid system, and which are responsible for costs and entitled to compensation from DER activity.

Microgrid Ownership Model Examples

- Single owner microgrids
  - Hospitals and public buildings
  - College campuses
  - Military Bases
- Multiple owner microgrids
  - Mixed use buildings, malls, and office parks
  - Residential microgrids (aggregated or multifamily)
  - Off-grid systems (small)
- Large or Utility owned microgrids
  - Off-grid systems (large)
  - Distribution-scale on-grid systems

DER-CAM Optimization Objective

Impact of Holistic System Optimization

DER-CAM does not optimize separate objectives for individual intra-microgrid participants. For any multiple-owner model, DER-CAM optimizes the performance of the system as a whole rather than for individual participants. While this may appear to limit the extent to which DER-CAM can be applied to multiple owner microgrids, the data and recommendations DER-CAM does produce are generally sufficient to model these systems, accurately capturing their total costs and internal operations strategies.

Understanding Holistic Objective under Multiple-Owner Models

Under a model where intra-microgrid participants' objectives are optimized individually, this behavior can be optimized to maximize the benefit to that participant, irrespective of the impact to other participants objectives and activities (and subsequently their costs and benefits). However, for a multiple-owner system to operate in a fair and sustainable way, it is important that benefits and costs are divided in a way that are (a) equitable to participants and (b) commensurate to each participants' activity.

Participants should be able to reach mutually beneficial divisions of costs under a system that has been optimized for performance holistically. That is to say, a system that has been selected to achieve the best performance in aggregate should be capable of delivering the greatest total benefits to all intra-system participants. Under this approach, participants are not permitted to increase their share of the benefits at the expense of the system as a whole. This is the approach modeled by DER-CAM

Preparing Data to Model Multiple-Owner Systems

Inputs

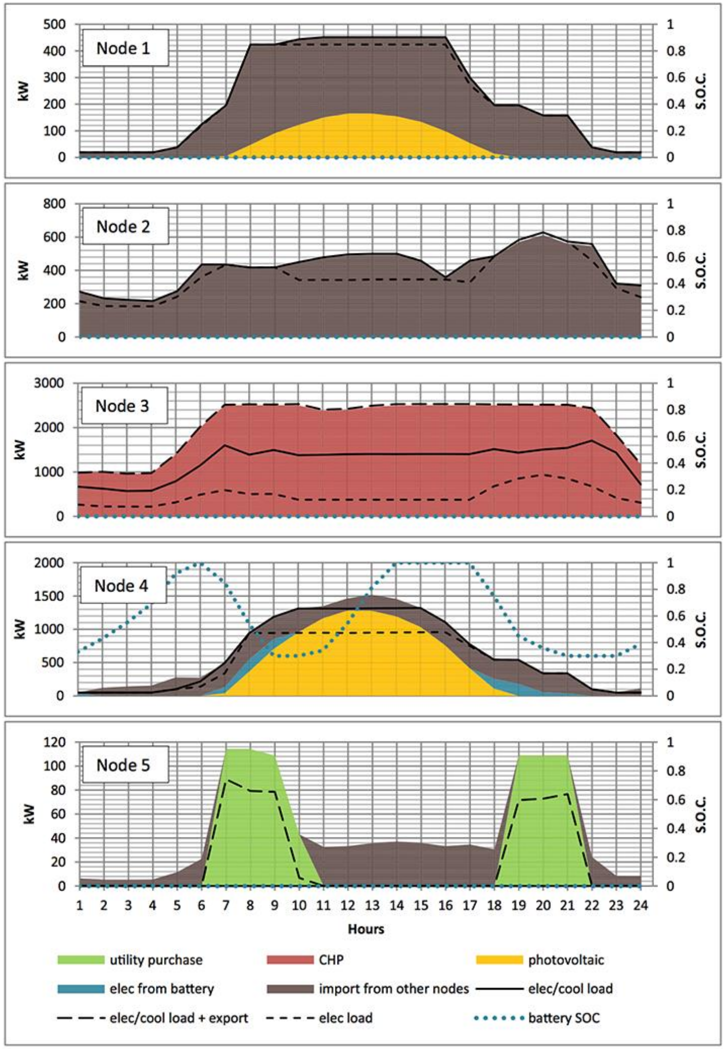
- If possible, separate nodes should be defined for each individual owner (see simple cases).
- If total number of owners is prohibitively large, an aggregated approach is required (see complex case).

Outputs

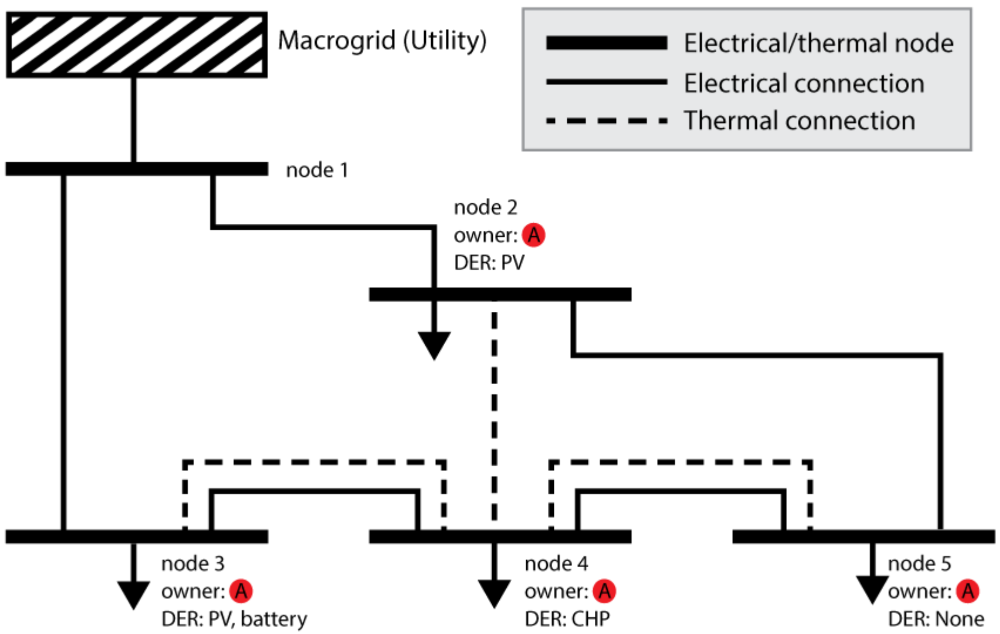
- Time-series energy provision/consumption data by source (see right) form the basis for calculating performance metrics from individual owners

Post-Processing

- Determining individual performance will depend on how energy exchange within the system is compensated
- User defined intra-system schemes may include:
  - Flat volumetric rates
  - Time-of-use structures
  - Dynamic price schemes



Case 1: Single Owner System



Example topology of single owner microgrid system

Characteristics

- Single or multiple node system
- Single owner for all loads and DERs

Inputs

- No special consideration required for defining inputs

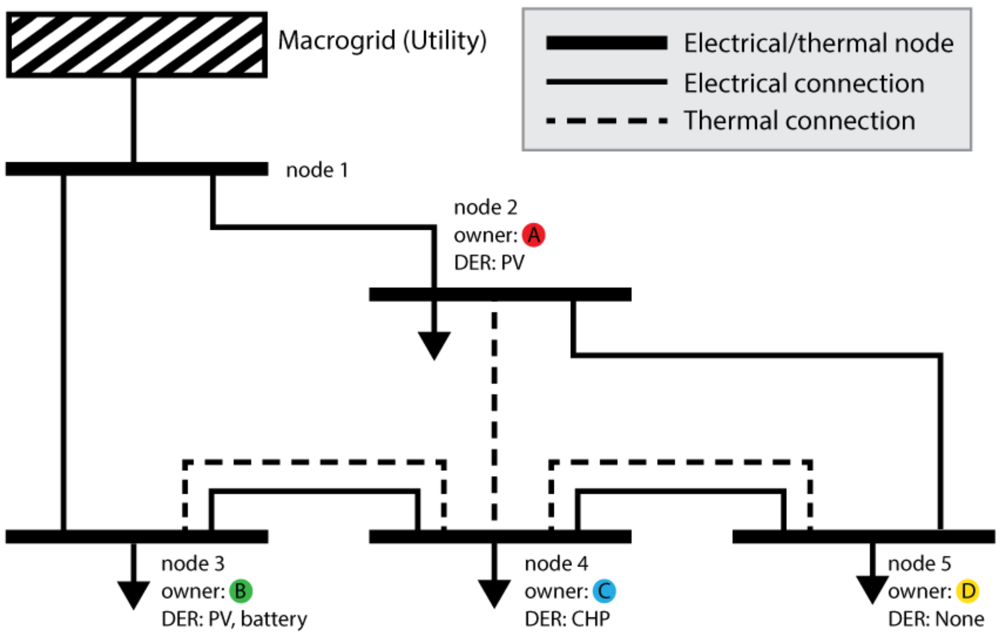
Outputs

- Default DER-CAM outputs will accurately capture costs and benefits for single owner

Post-Processing

- No additional post-processing required

Case 2: Simple Multiple-Owner System Single Grid Connection



Example topology of simple, multiple-owner microgrid system with single connection to grid

Characteristics

- Single grid connection
- Multiple load or DER owners
- Manageable # of total owners (e.g. < 20)

Inputs

- Multiple nodes, at least 1 per owner
- Separate owner loads and DERs by node

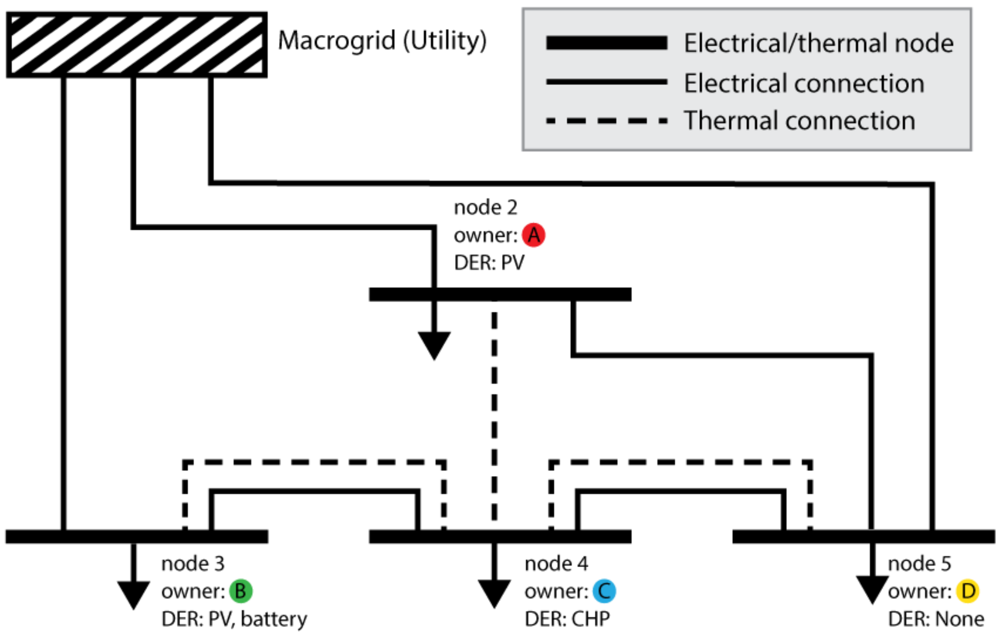
Outputs

- DER-CAM outputs reflect total system performance
- Individual values rely on nodal energy provision/consumption time series data

Post-Processing

- User must define intra-system accounting and pricing schemes
- Apply pricing to individual time series data to determine costs and revenues by owner

Case 3: Simple Multiple-Owner System
Multiple Grid Connections



Example topology of simple, multiple-owner microgrid system with multiple connections to grid

Characteristics

- Multiple grid connections
- Multiple load or DER owners
- Manageable # of total owners (e.g. < 20)

Inputs

- Multiple nodes, at least 1 per owner
- Separate owner loads and DERs by node
- Be aware of intra-system arbitrage potential if tariffs vary by owner/node.

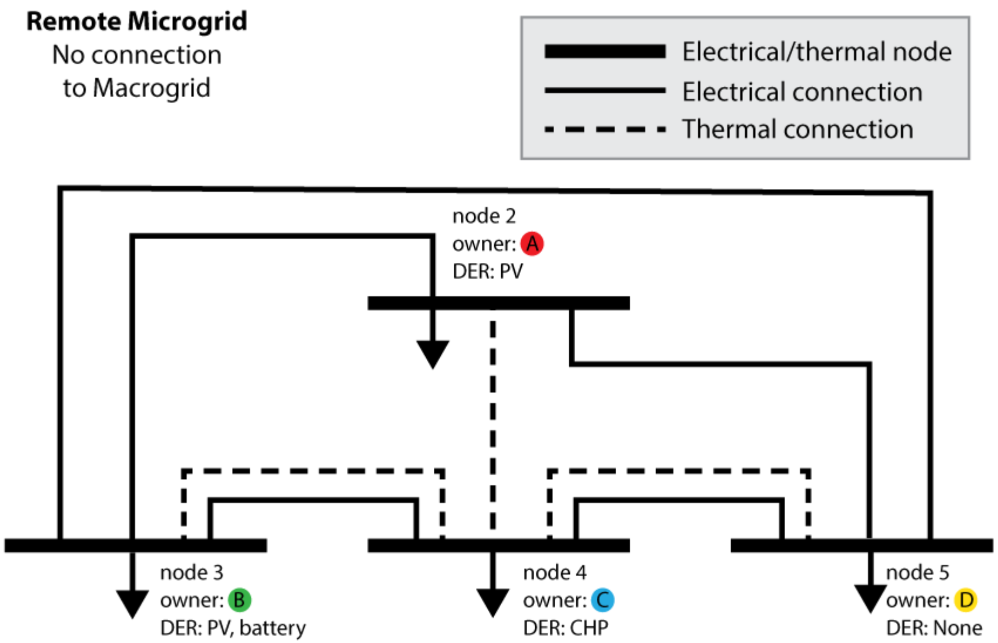
Outputs

- DER-CAM outputs reflect total system performance
- Individual values rely on nodal energy provision/consumption time series data

Post-Processing

- User must define intra-system accounting and pricing schemes
- Apply pricing to individual time series data to determine costs and revenues by owner

Case 4: Simple Multiple-Owner Off-Grid System



Example topology of simple, off-grid multiple-owner microgrid system. (No grid connections)

Characteristics

- No grid connection
- Multiple load or DER owners
- Manageable # of total owners (e.g. < 20)

Inputs

- Multiple nodes, at least 1 per owner
- Separate owner loads and DERs by node

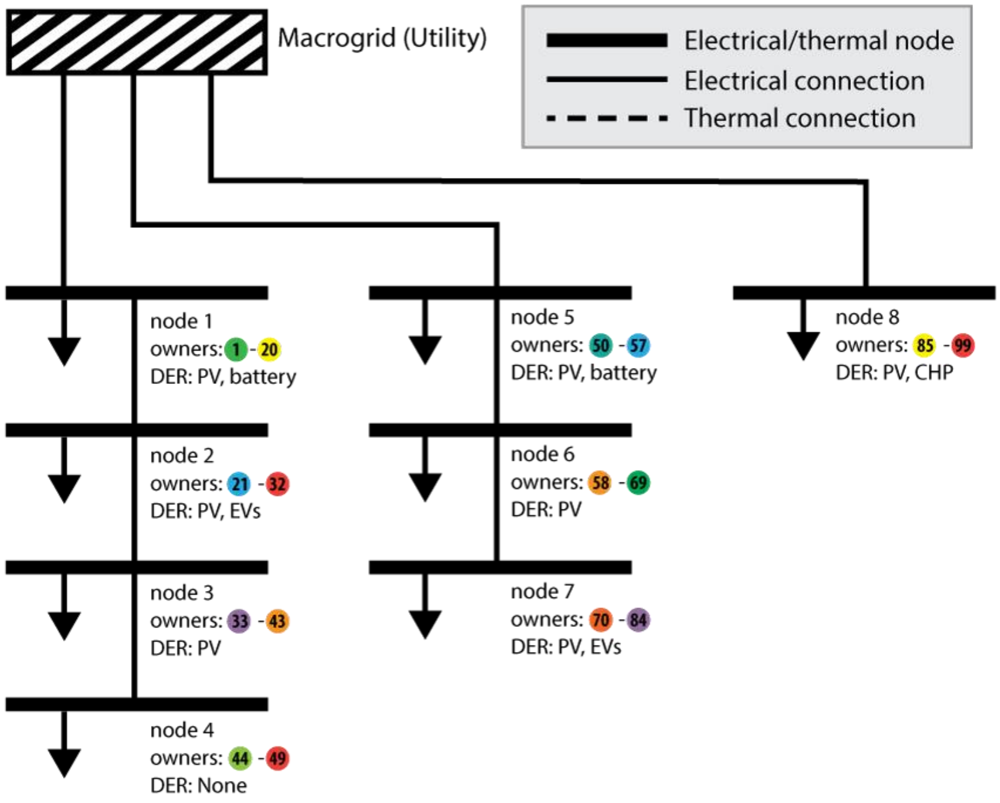
Outputs

- DER-CAM outputs reflect total system performance
- Individual values rely on nodal energy provision/consumption time series data

Post-Processing

- User must define intra-system accounting and pricing schemes
- Apply pricing to individual time series data to determine costs and revenues by owner

Case 5: Complex Multiple-Owner System



Example topology of complex, multiple-owner microgrid system with single grid connection. Note aggregation of loads and DERs at each system node.

Characteristics

- Single grid connection
- Multiple load or DER owners
- Prohibitive # of total owners (e.g. > 20)

Inputs

- Multiple nodes, multiple owners per node
- Aggregation of loads at each node

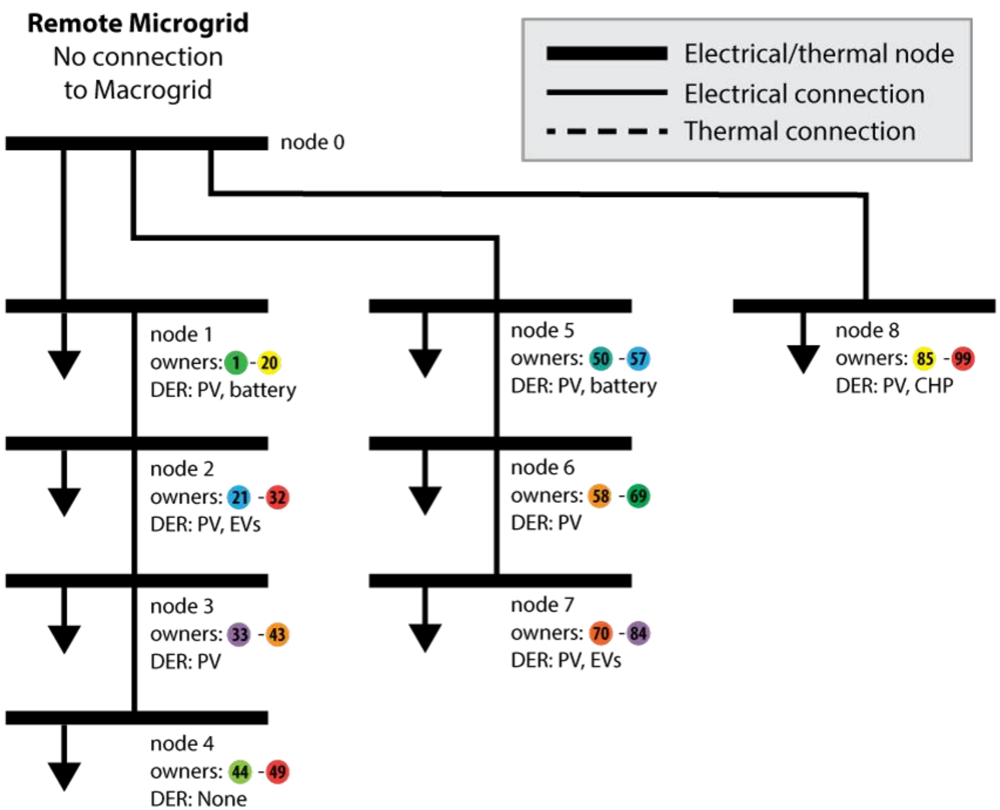
Outputs

- DER-CAM outputs reflect total system performance
- Individual values rely on nodal energy provision/consumption time series data & understanding of aggregation at each node

Post-Processing

- User must define intra-system accounting and pricing schemes
- User must disaggregate data for individual nodes to determine individual owner data
- Apply pricing to individual disaggregated data to determine costs and revenues by owner

Case 6: Complex Multiple-Owner Off-Grid System



Example topology of complex, off-grid multiple-owner microgrid system. (No grid connections). Note aggregation of loads and DERs at each system node.

Characteristics

- No grid connection
- Multiple load or DER owners
- Prohibitive # of total owners (e.g. > 20)

Inputs

- Multiple nodes, multiple owners per node
- Aggregation of loads at each node

Outputs

- DER-CAM outputs reflect total system performance
- Individual values rely on nodal energy provision/consumption time series data & understanding of aggregation at each node

Post-Processing

- User must define intra-system accounting and pricing schemes
- User must disaggregate data for individual nodes to determine individual owner data
- Apply pricing to individual disaggregated data to determine costs and revenues by owner

Conclusions

- DER-CAM's optimization approach presents some limitations in modeling multiple-owner microgrids
- DER-CAM's holistic optimization finds solutions that deliver maximum benefits to the system as a whole
- DER-CAM's flexibility in configuring systems, defining inputs, and generating detailed outputs allow these systems to be modeled with accuracy