



Forensic, Open Source Cost Benefit Analysis Practices

**Aram Shumavon, Kevala, Inc.
Benchmarking Grid Integration Costs in High
PV Penetration Scenarios Workshop
September 19, 2017
National Renewable Energy Lab, Golden, CO**



Kevala company overview and relevant projects

Forensic cost modeling

Possible Demo

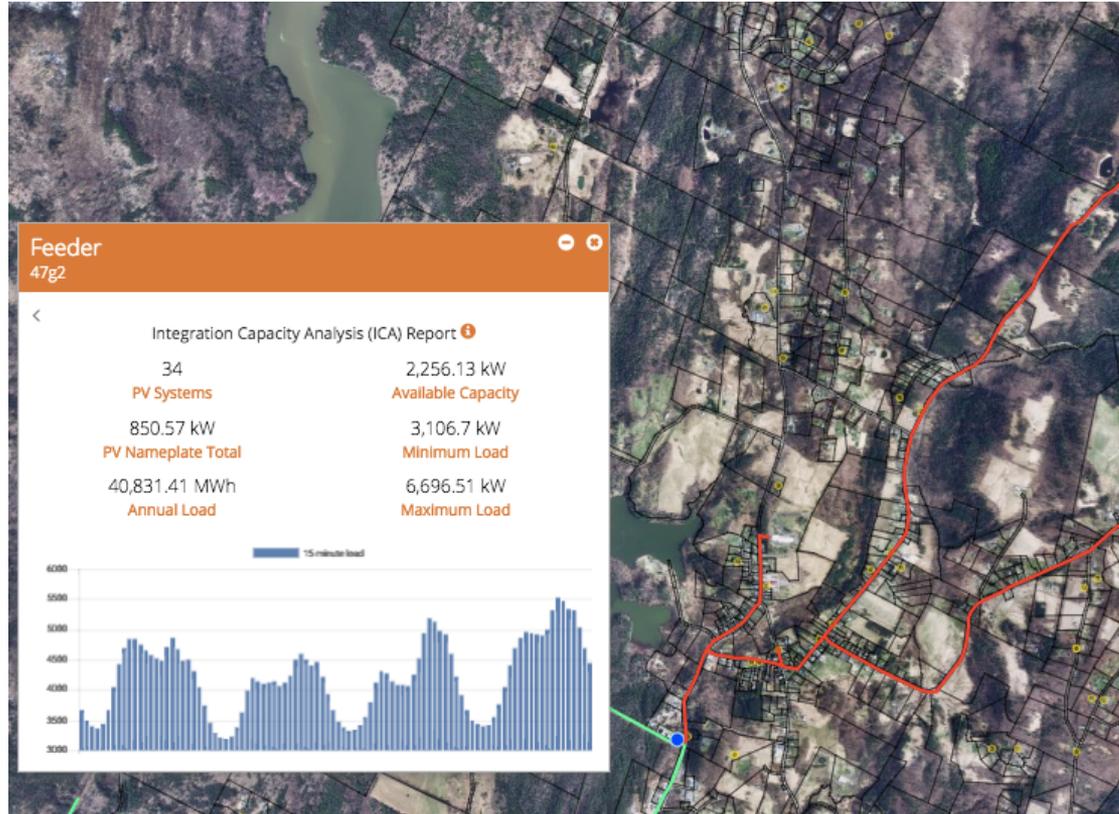
San Francisco Based data and analytics company that maps energy infrastructure and the built environment, load, generation, and pricing data.

DOE SunShot Awardee – Grid Assessor

Hawaii – Pathways to an Open Grid

Customers include: Solar and storage developers, utilities, regulators, EV OEMs, NGOs

Grid Assessor



Pathways to an Open Grid - O'ahu



Query: MTS

Place Labels Feature Popup

Fuel Type: Solar

Azimuth: S E W

Cost Basis Year: 2011

Ancillary Services: 2%

Planning Reserve Margin: 15%

Demand Side Resource: 1

Price Cap: 50

Inflation Adj: 1%

Busbar Cost: \$82.79

Integration Cost: \$7.50

TransCost: \$19.12

Energy Value: 95.76%

On Peak Availability: 16.17%

Capacity Factor: 32.24%

Run Clr Print Print Legend

Waimanalo substation

Integration Capacity Analysis (ICA) Report

240 PV Systems	9,562.43 kW Available Capacity
2,982.19 kW PV Nameplate Total	12,544.62 kW Minimum Load
159,800.41 MWh Annual Load	32,356.44 kW Maximum Load

15 minute load

Energy	Losses	Ancillary Services	Emissions	Capacity	T&D Cost	Avoided RPS	Total Levelized Value
76,921.37	23,801.93	1,538.43	14,626.76	6,784.00	68,926.29	0	192,598.77

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Operate on the assumption that PV is what matters

- 1) When you hear hooves, think horses, not zebras
- 2) Easily observable

Caveats:

- The allocation of value for BTM load reduction gets harder to model as wholesale prices go negative during some periods, but it exists
- Other DER will continue to provide grid benefits through export and BTM services separate from PV production periods

Evidence of integration costs are everywhere:

Visual inspection

FERC filings

Rate cases/applications for cost recovery

Interconnection requests/PAR reports

Data Requirements - Overview



Load

- Shape

- Magnitude

Distributed Generation

- Location

- Size

- Performance

Distribution infrastructure:

- Topography (mesh/radial, length, service area)

- Voltage

- Protection equipment

Amount of existing/queued DG

Removal/installation of circuit protection equipment

Thermal overload on transformer

Conductor limitations

Special protection schemes

Obtaining Data About Probable Upgrade Triggers



DG surveys

Feeder topography acquisition

Interconnection data

DG Surveys - Kevala's Trace Assist



The screenshot displays the Kevala Trace Assist software interface. On the left, a satellite map shows a coastal area with various colored lines (orange, purple, green, blue) overlaid on the terrain, representing different utility traces. Several blue location pins are scattered across the map. On the right, a street-level view shows a road with 'Kevala St' painted on it. A search bar at the top right of the map area contains the text '65 Kevala St, Kailua, Hawaii' and a 'View on Google Maps' link. At the bottom of the interface, there is a control bar with the following elements: a text field containing 'HECO_dist_sub4' and '21.394,-157.7', a question 'Is substation?' with 'Yes' and 'No' radio buttons, a green button labeled 'trace feeders', and two more green buttons labeled 'previous substation' and 'next substation'.

DG surveys – Kevala’s Solar Spotter



Possible solar:
31125

Confirmed found:
54

Remaining solar:
31071

START

STOP

PREV ROW

NEXT ROW



- Available = exists *somewhere*
- Accessible = can be used by external processes
- Machine Readable = can be used by computers

Data gaps



Load

SCADA-based 8760 load curves

DG

Storage/non-PV DER

Distribution infrastructure

Secondary

Operations

Special Protection Schemes

NB – NOT tap changes!

Calculating costs – Kevala's DERwin model



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Layers

- HI_HECO_solar
- HI_HECO_substations
- HI_HECO_3phase_feeders
- HI_Oahu_buildings
- HI_HECO_substation_serv_area

Energy	Losses	Ancillary Services	Emissions	Capacity	T&D Cost	Avoided RPS	Total Levelized Value
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Thank you
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