Hawaiian Electric
Maui Electric
Hawai'i Electric Light

Modern Grid Technology Workshop

May 10, 2017

Integral Analytics: Profile

Utility Customers

40+

Customer Load Shapes

500 million+

- Market leader in Distribution Grid Analytics software for Planning, Operations, Demand-Side Management, DER Valuation
- Products deliver **granular, actionable intelligence** to utilities and others to bridge long-range forecasting with near-term operational needs
- Patented architecture and methodology, based on least-cost principles
- Scalable platform for emerging system regulations in California, New York, Massachusetts, Texas, Arizona, Hawaii and other jurisdictions
- **2016 Greentech Media Grid Edge Winner/2015 Fierce Innovation Award**

Integral Analytics

Comprehensive Grid Planning for Hawaii

HPUC Order:

- "…necessary to look at the grid in the context of the **entire value chain** of the electric system"
- The aim of this process is for the HECO Companies to file a **detailed, holistic, and scenario-based** Grid Modernization Strategy for each of the utilities
- "Such investments must be **strategically calibrated** and prioritized to meet clearly defined goals in order to achieve the vision for Hawaii's integrated grid of the future. Each project or series of projects must **methodically and cost-effectively** advance this ultimate objective."

Business Requirement:

- A **granular, dynamic** distribution planning and valuation application through which HECO may forecast, capitalize and visualize network growth and manage reliability, inclusive of DER proliferation.

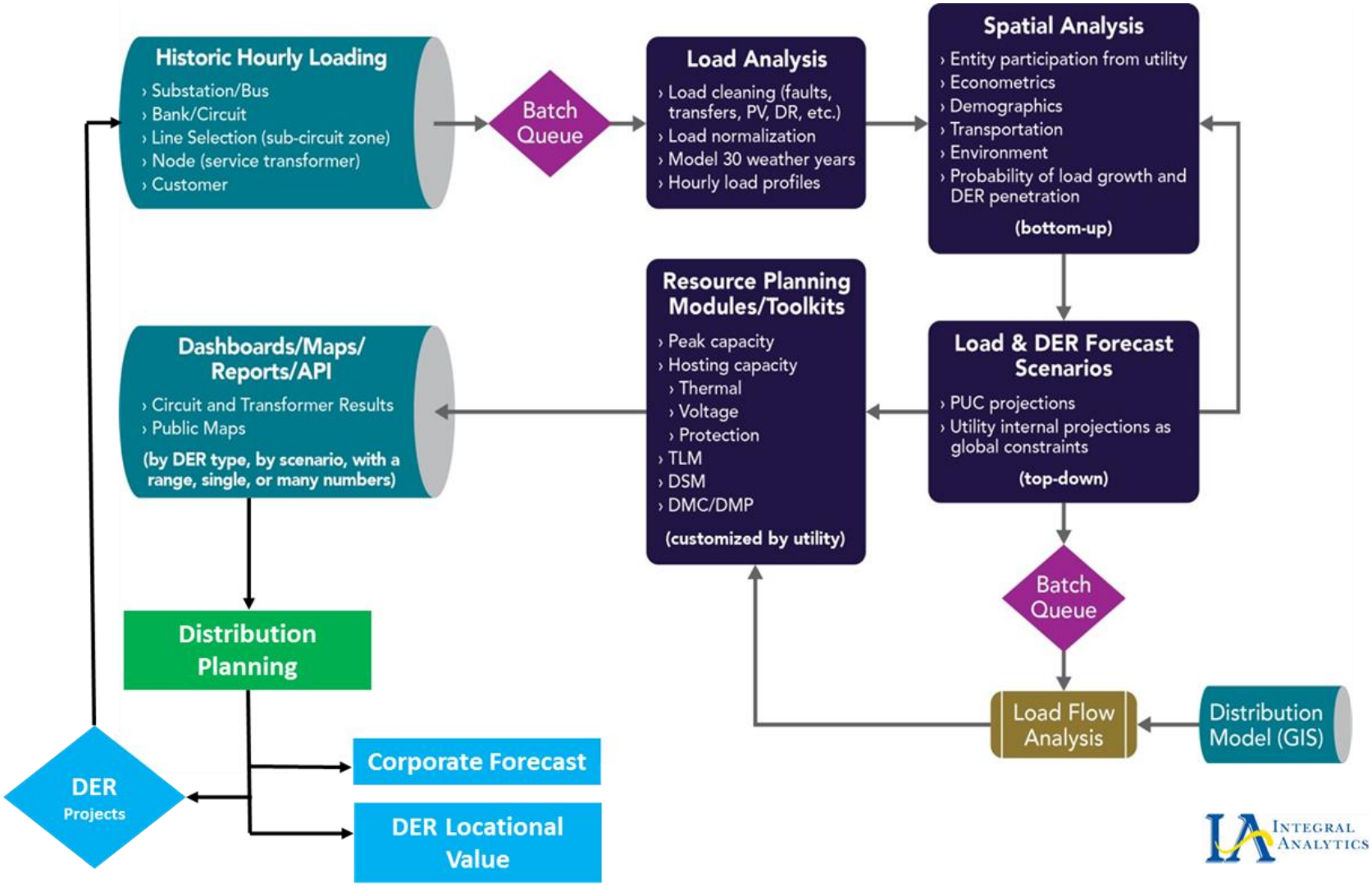
Emerging Planning Requirements: 2017

- "It's all about the load shape"
- Corporate/System Forecasting must change
  - Top-down must reconcile with granular/feeder-level
- DER proliferation requires nodal valuation, constrained by grid ops/powerflow
- Data-to-Intelligence loop must be closed
  - 1 million customer utility may produce > 500 million records per day
- Planning-to-Ops Analytics bridge must be built
  - "4 seconds to 20 years"
- Dynamic forecasting requires elastic computing

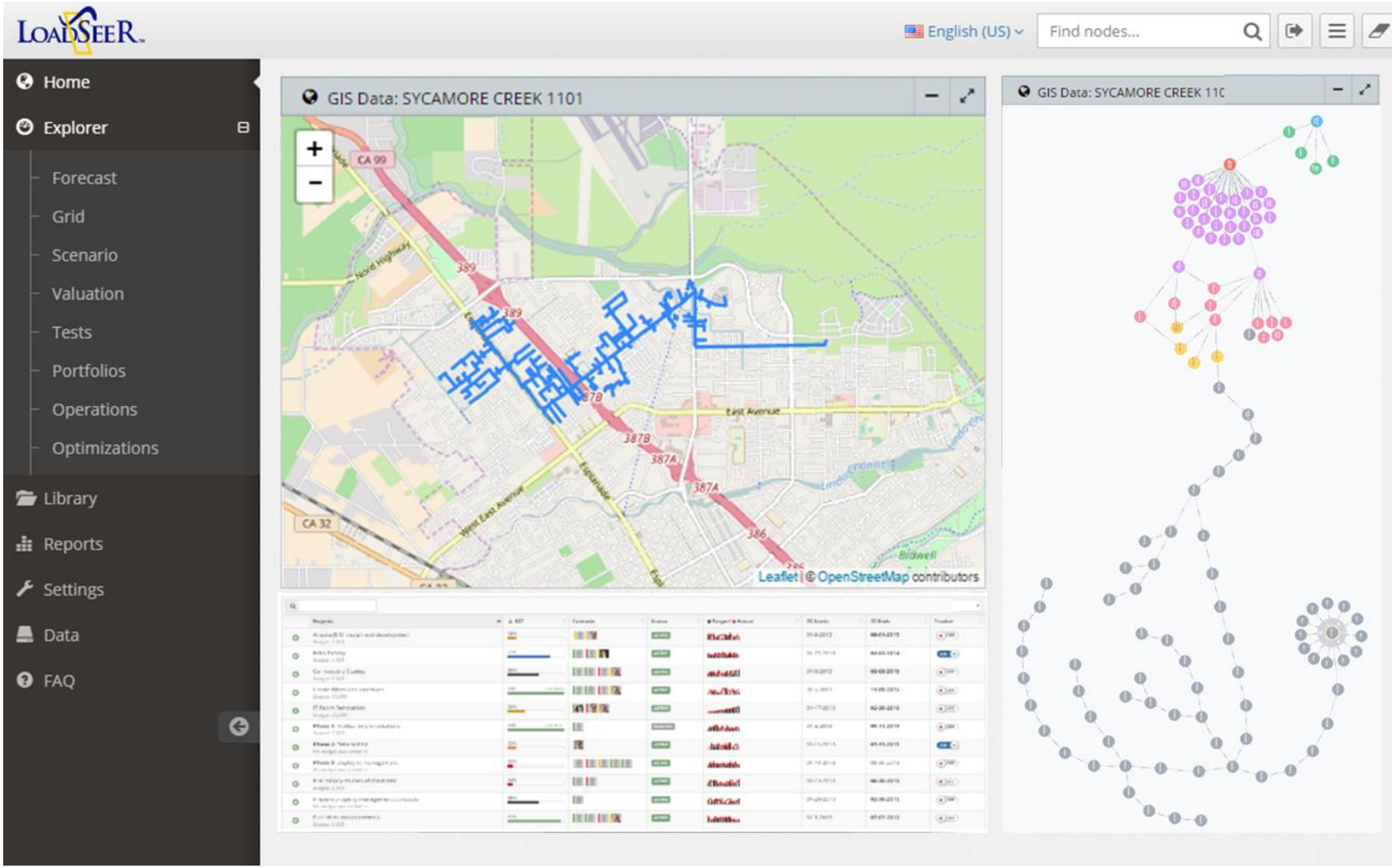
Attributes of Future-Proof Grid Edge Planning

1. Built-to-Scale: Software, not Studies
2. Dynamic: IRPs to DRPs to ICAs to DERMS
3. Scenario Engine at the Core
4. Interoperability with powerflow/GIS/SCADA
5. Unified Platform to support many stakeholders:
   - Transmission/Distribution/Ops/Fuels
   - Corporate Forecasting
   - Regulators
   - Market Participants
6. Drive to the Premise

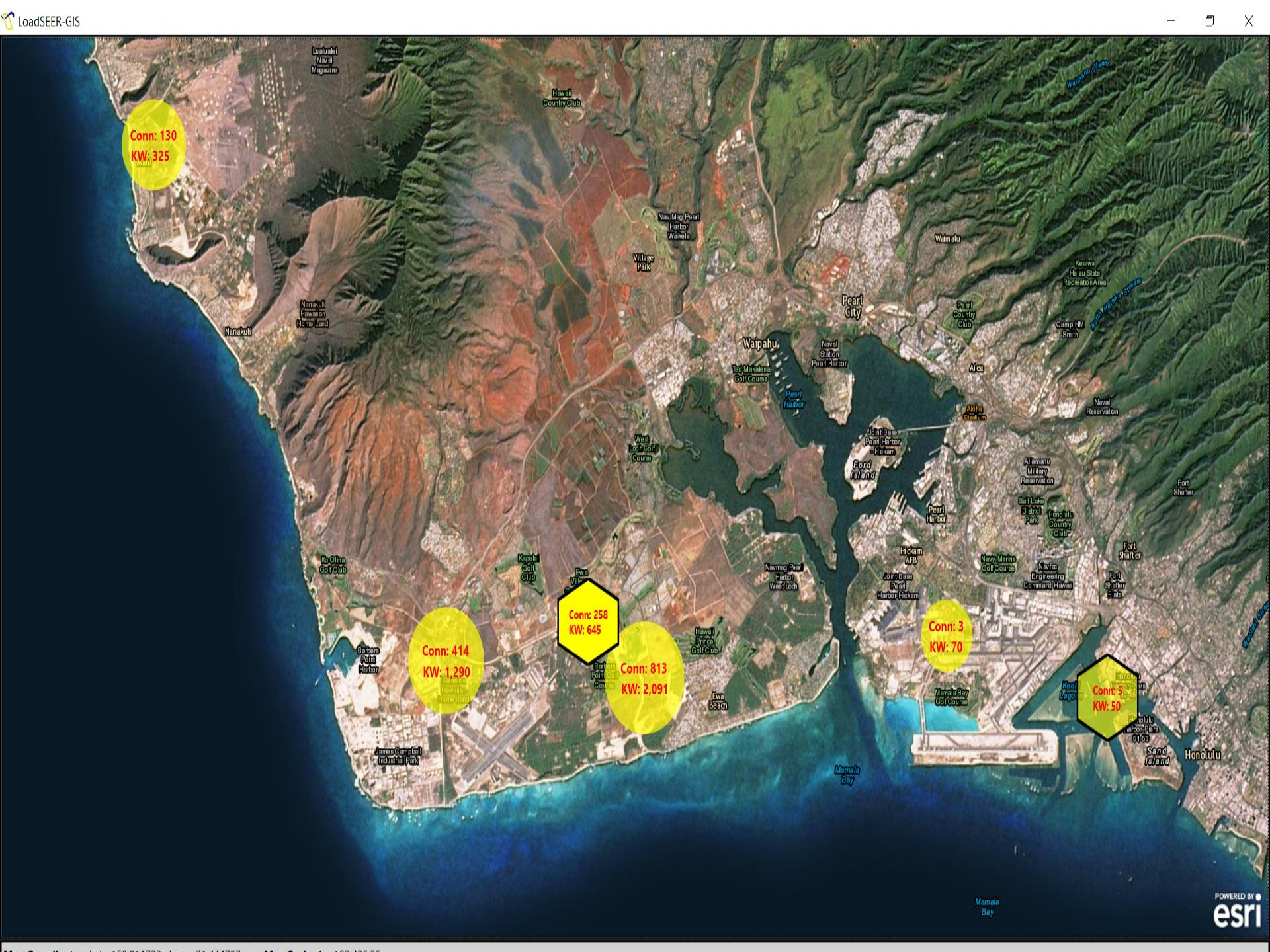
Integrated Planning Software-Enabled Flow



Result: Intuitive, Multi-Stakeholder Platform

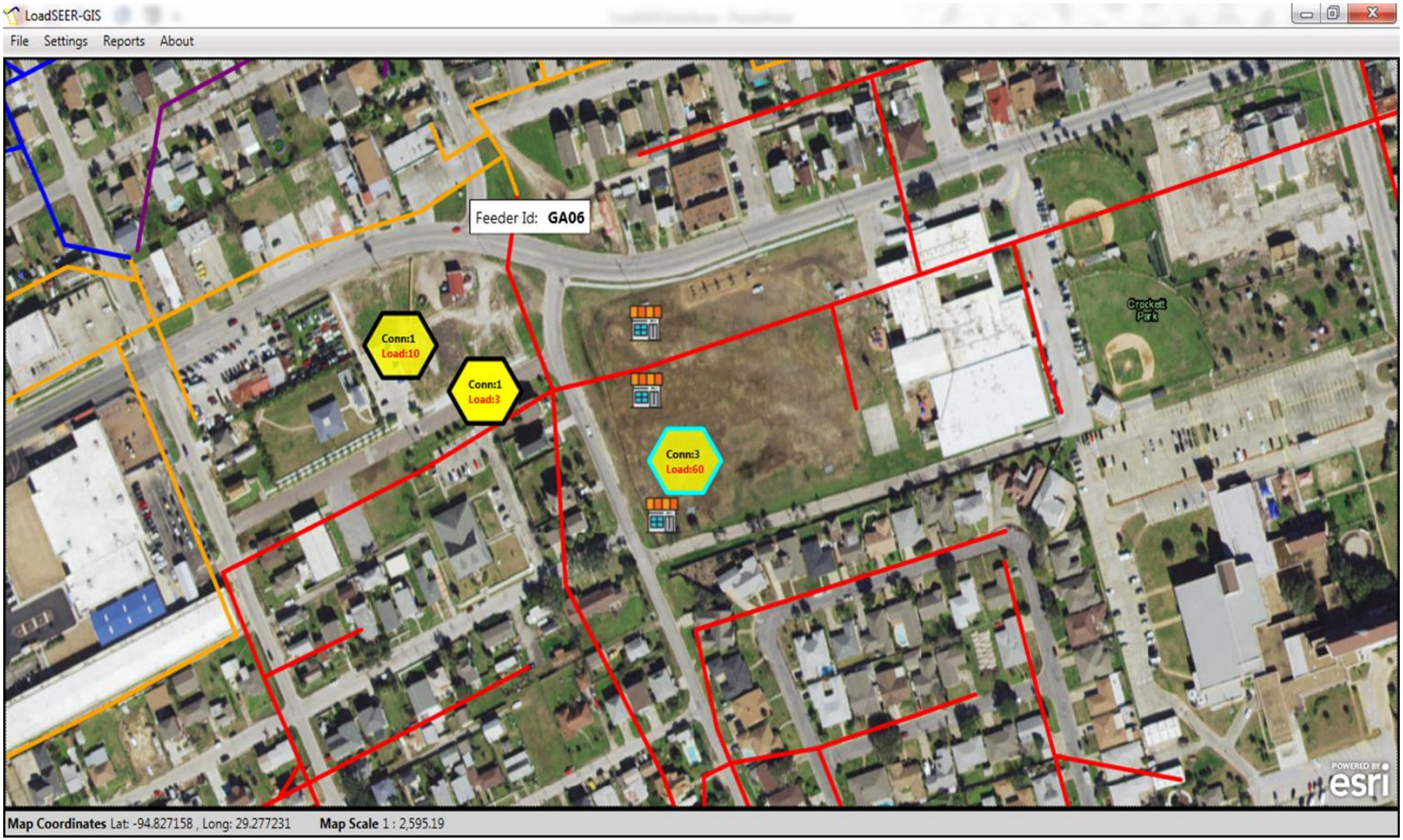


Integral Analytics


LoadSEER-GIS
Conn: 130
KW: 325
Conn: 414
KW: 1,290
Conn: 258
KW: 645
Conn: 813
KW: 2,091
Conn: 3
KW: 70
Conn: 5
KW: 50
Nanakuli
Waipahu
Pearl City
Ewa Beach
Honolulu
Ford Island
Pearl Harbor
Hickam AFB
Mamala Bay
Sand Island
POWERED BY esri

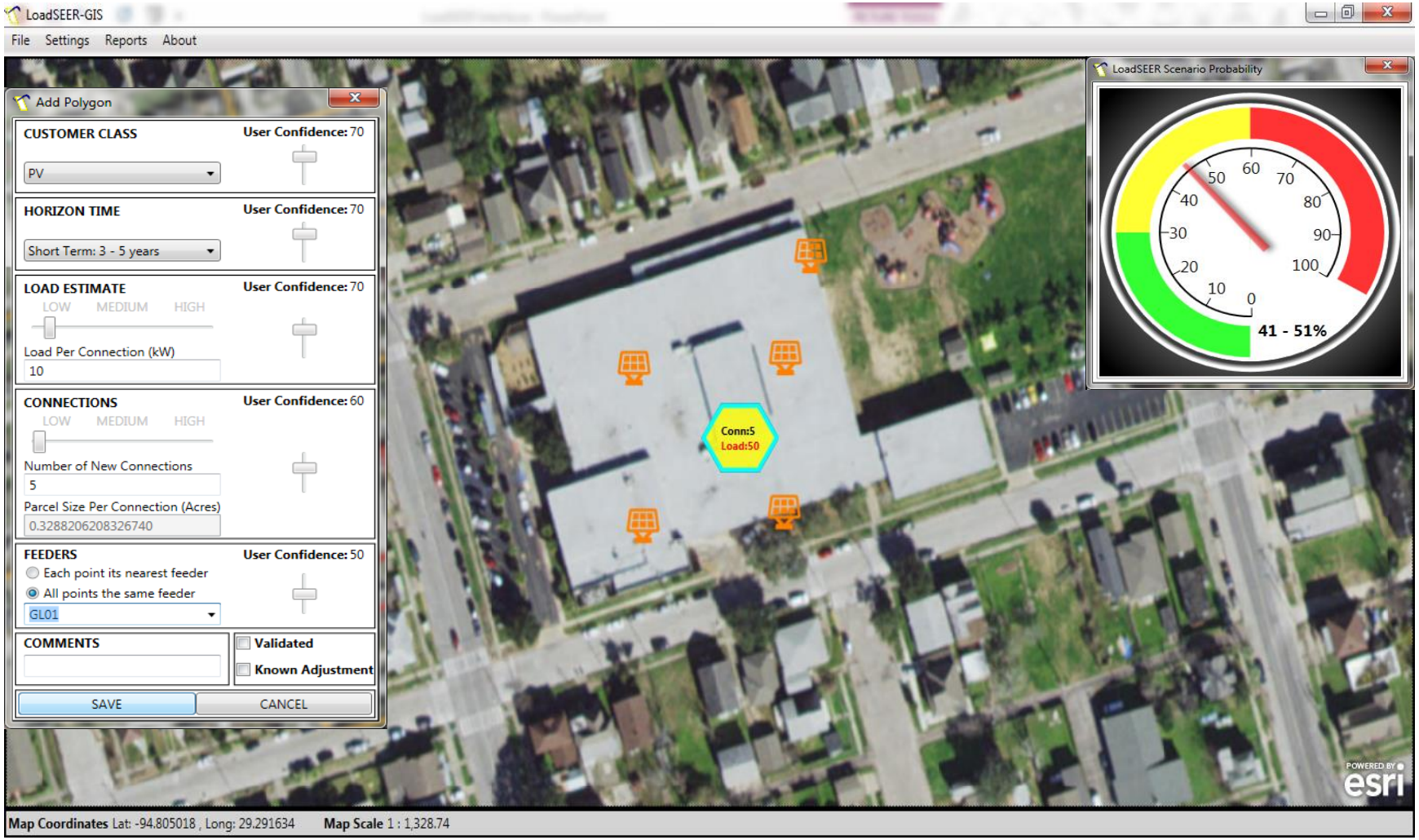

LoadSEER-GIS
Hawaiian Home Land
Kapolei Golf Club
Kapolei Park
Kapolei
Maluohai Hawaiian Home Land
Kaupea Hawaiian Home Land
Kapolei Hawaiian Home Land
Navmag Pearl Harbor West Loch
Coral Creek Golf Course
Hawaii Prince Golf Club
Ewa Beach Golf Club
Barbers Point Golf Course
Kalaeloa Hawaiian Home Land
Hoakalei Country Club
Ewa Beach
Oneula Beach Park
Conn: 258
KW: 645
Conn: 30
KW: 75
Conn: 120
KW: 300
Conn: 22
KW: 220
Conn: 380
KW: 950
Conn: 122
KW: 305
Conn: 12
KW: 120
Conn: 287
KW: 716
Conn: 254
KW: 695
POWERED BY esri

Nodal Growth + DER + Powerflow = Holistic



Integral Analytics

Scenario-Driven DER Planning



INTEGRAL ANALYTICS

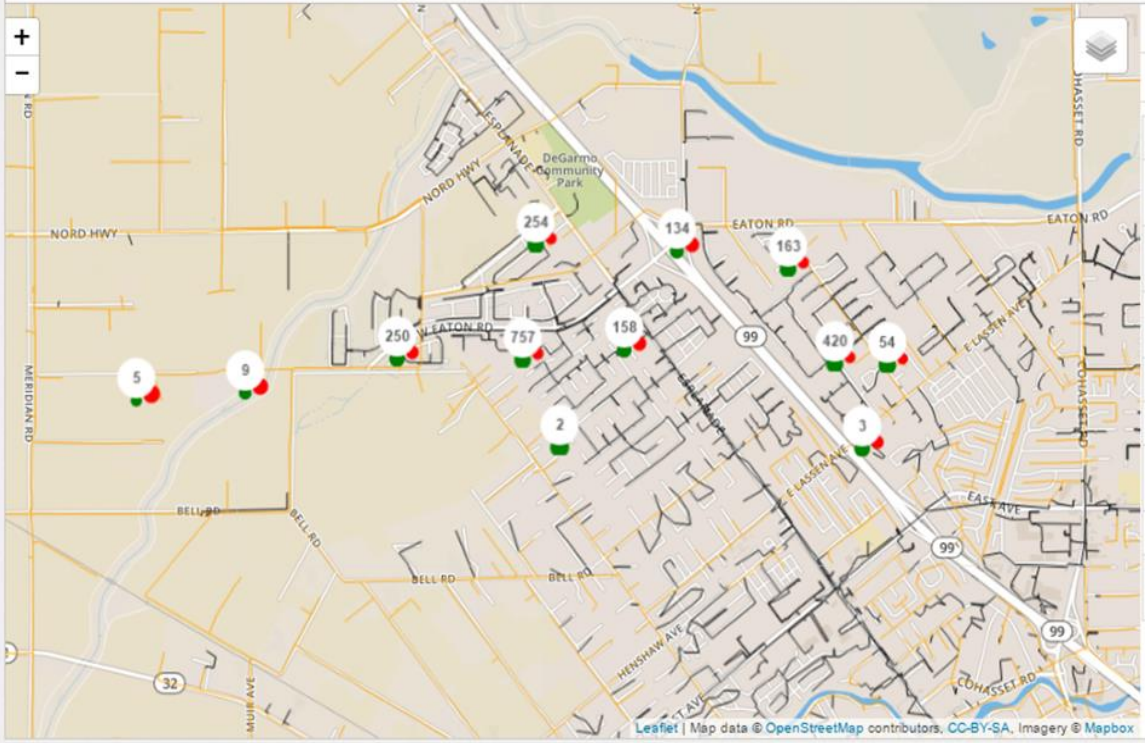
Nodal Value of DER…Integrated to Planning

LoadSEER

English (US)

Node Viewer

Node Financials Zoomlevel: 14 active Layer:



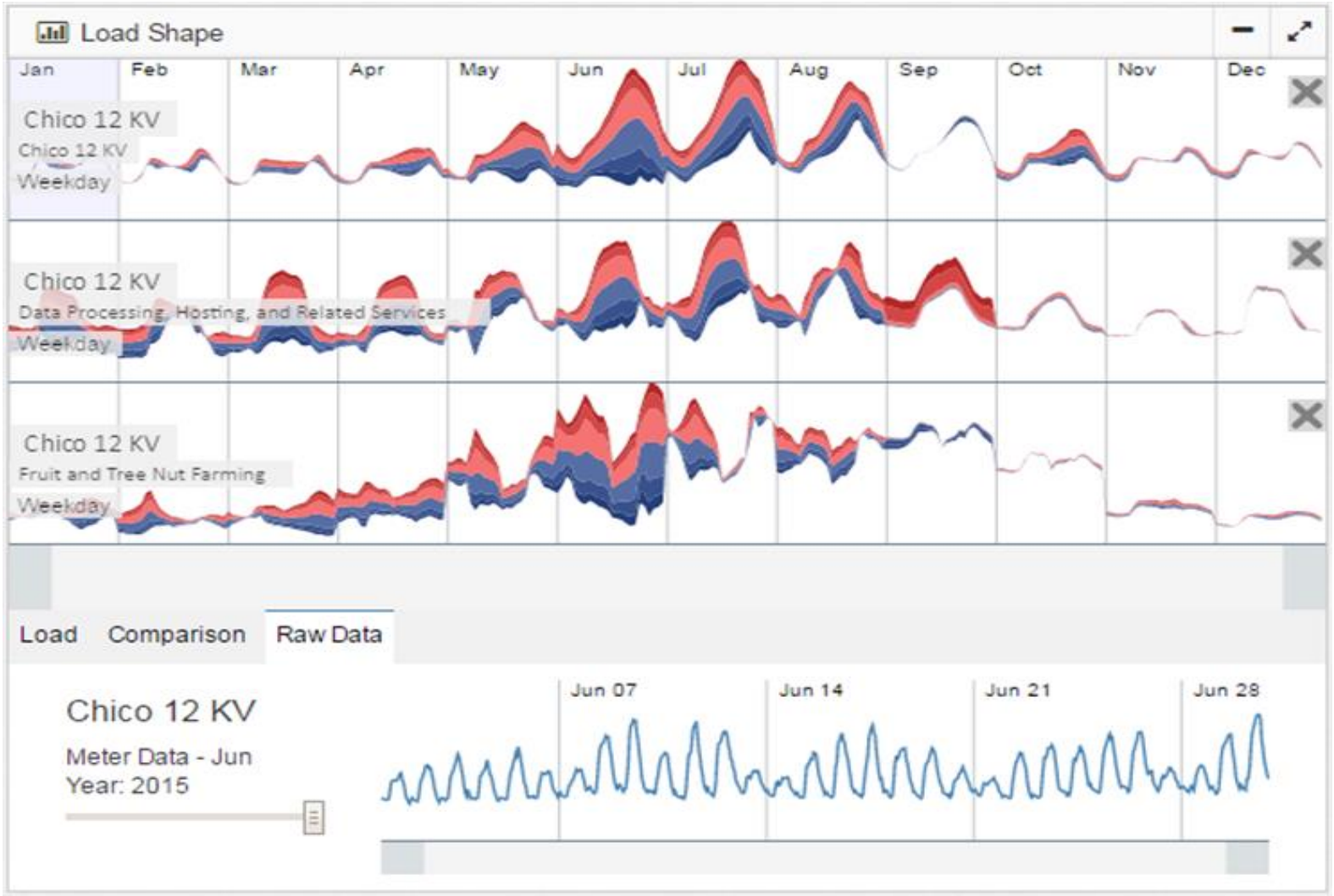
Visible Extent

Measures

	Solar	HVAC	Lighting	Total
Avoided Capacity Cost ($Kw):	2,094,950	2,254,595	2,512	4,352,057
Avoided Energy Cost ($Kwh):	937,762	857,790	26,830	1,822,382
Avoided Kwh (x yrs):	1,578,374	1,411,724	41,235	3,031,333
Avoided T&D ($):	411,843	666,980	1,224	1,080,047
Bill Savings ($):	7,133,133	7,232,972	157,677	14,523,782
Participant Test (Avg):	0.42	1.24	24.60	8.75
Trc Test (Avg):	0.53	1.70	29.07	10.43
Adoption Probability (Avg):	0.63	0.64	0.39	0.56

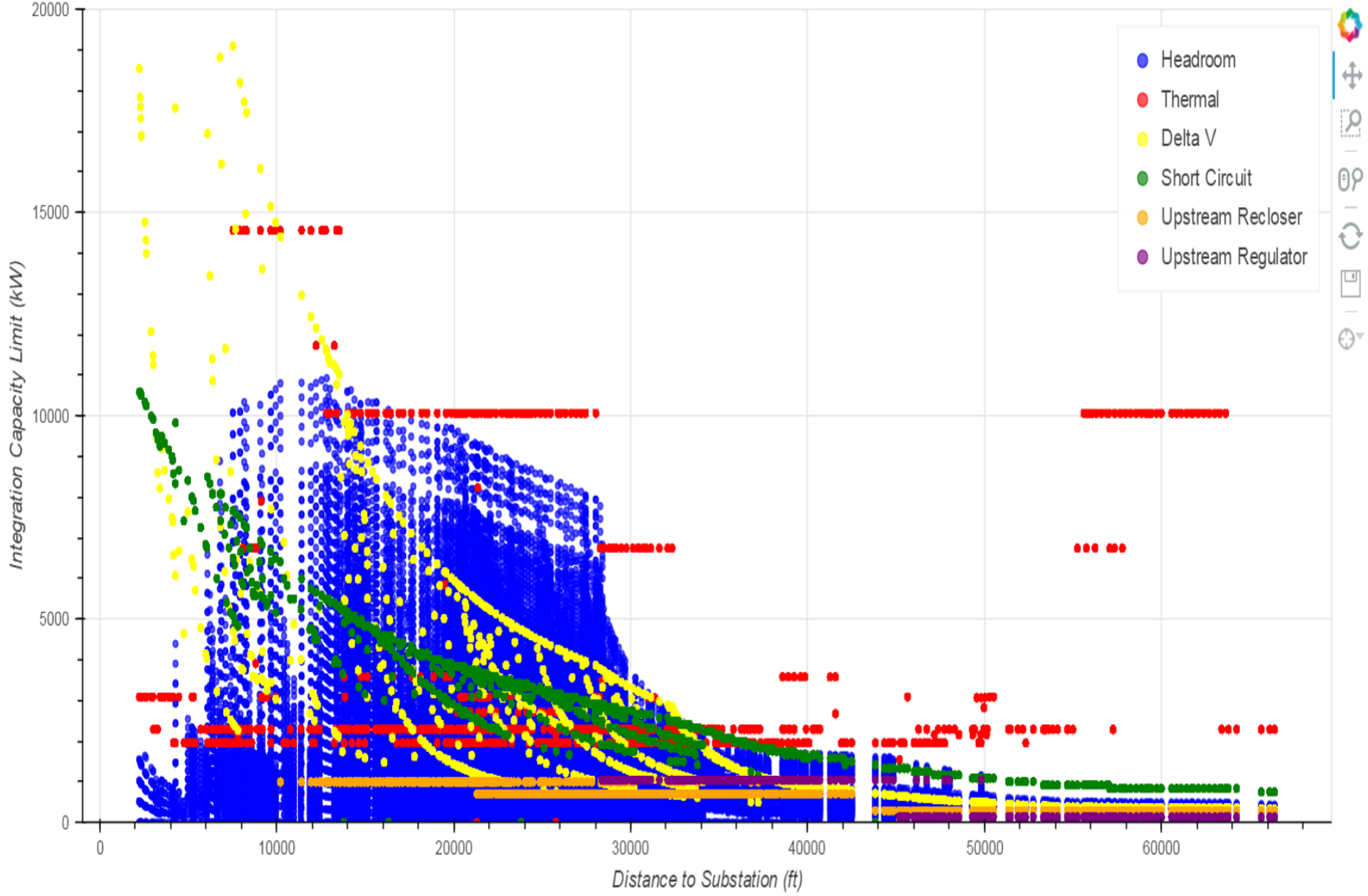
Integral Analytics

Importance of Load Shapes



Integral Analytics

Hosting Capacity: Single Feeder, Hourly Impact



Integrated Planning Tenets

- Flexibility
- Interoperability
- Scalability
- Driven by Cost-Effectiveness/Valuation
- Serving Multiple Stakeholders