Hawaiian Electric

National Academies Workshop

February 3, 2020

Agenda

- Hawaiian Electric Overview
- Distribution Planning
- Planning Tools
  - LoadSEER
  - Synergi
  - PSSE
- Grid Needs Infrastructure Planning

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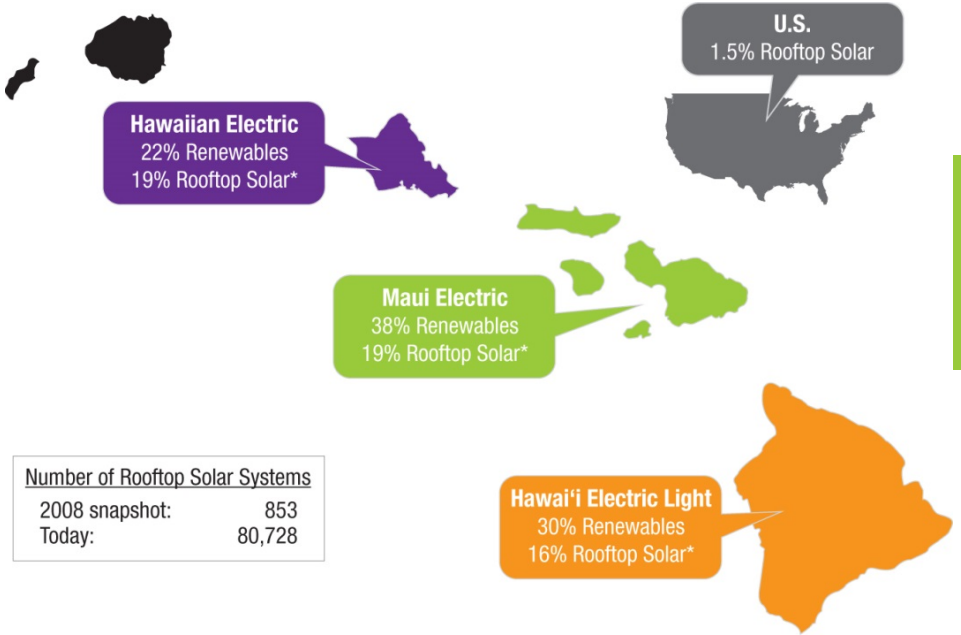
PACIFIC
OCEAN
HAWAII

Hawaiian Electric Companies lead U.S. in rooftop solar

Island of Oahu
Customers: 305,000
Generating capability: 1,756 MW
Peak Load: 1,184 MW

Island of Hawaii
Customers: 84,000
Generating capability: 293 MW
Peak Load: 190 MW

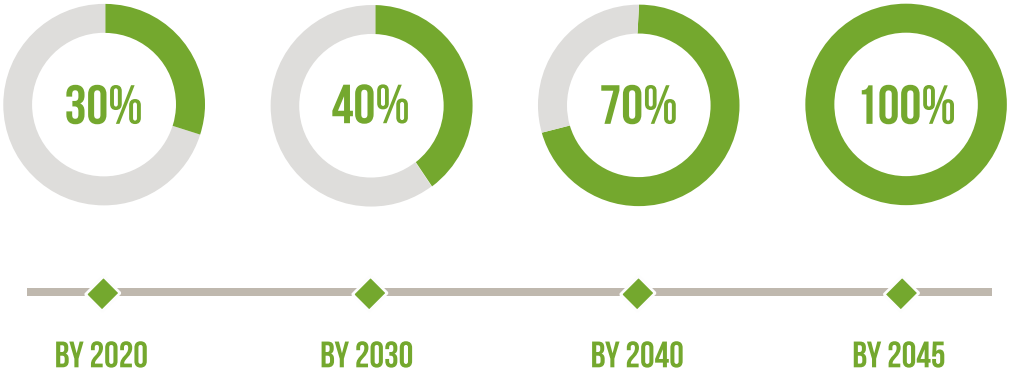


Islands of Maui, Molokai, and Lanai
Customers: 71,769
Generating capability: 284 MW
Peak Load (Maui): 190 MW

*Percentage of residential customers with rooftop solar approved or installed as of 9/30/19

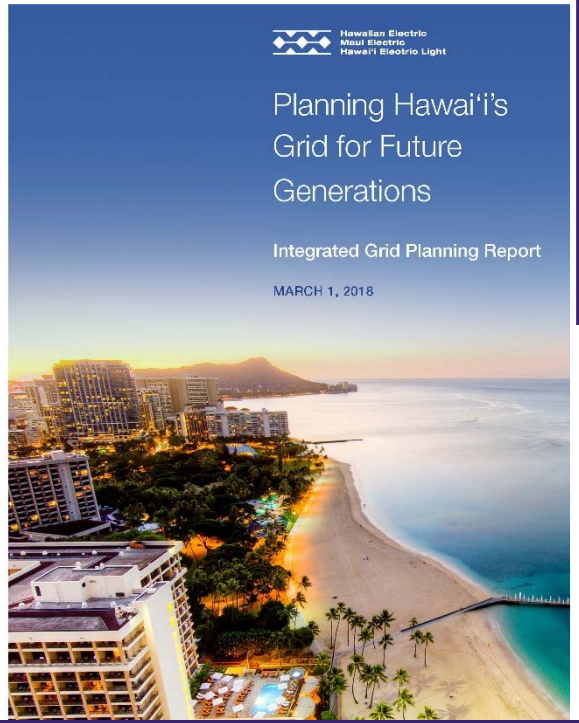
2045 GOAL:

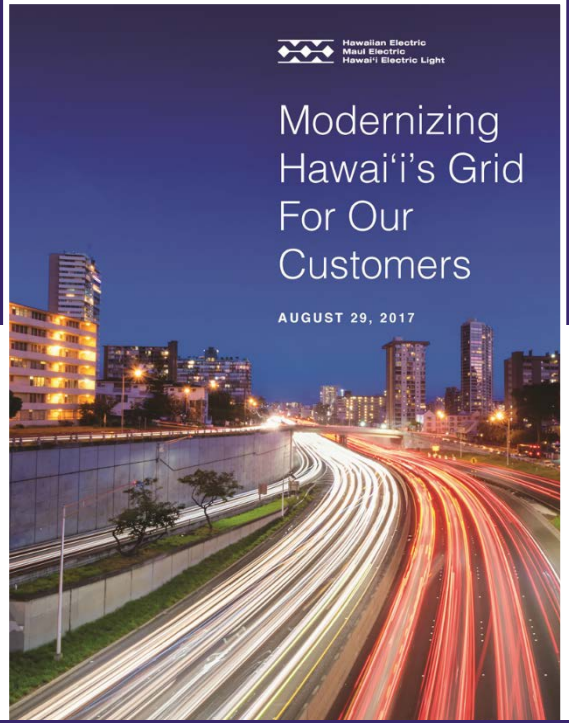
100% Renewable Energy

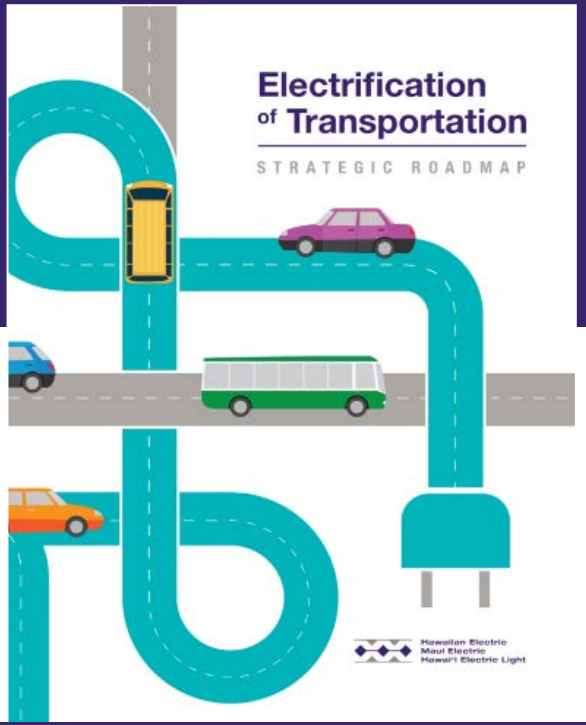


Hawai'i has the most ambitious clean energy goals in the nation – 100 percent of electricity sales will come from renewable resources by 2045 and the state will be carbon-neutral

Innovative strategies lead our transformation







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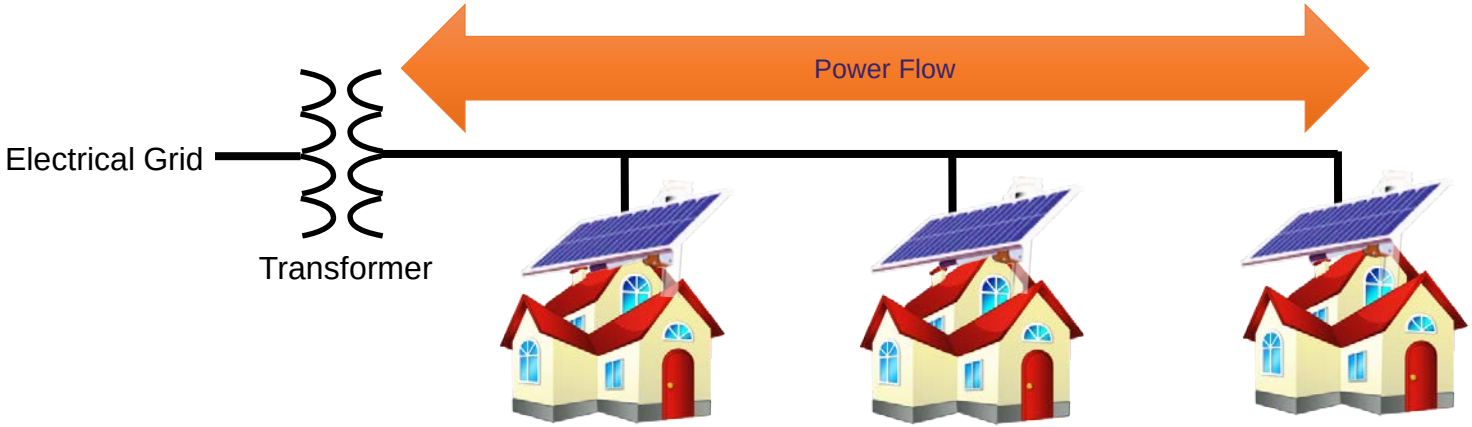
- **Distribution Planning**
- Planning Tools
  - LoadSEER
  - Synergi
  - PSSE
- Grid Needs Infrastructure Planning

Distribution Planning has two core functions

1. Plan the Distribution system's capability to serve new and future electrical load – process required to provide power to customers
2. Safely interconnect DER (PV, DR, EV, ESS, etc.) and transmit distributed power across system (2-way flow) while maintaining power quality and reliability for all customers



Distribution Planning (with DER)

Traditional Planning (Without DER)	Current Planning (With DER)
Distribution Voltage Levels	Distribution and Secondary Voltage Levels
Primarily concerned with thermal overloading and undervoltage	Concerned with thermal overloading, undervoltage, overvoltage, and dynamic power quality impacts
Analytical techniques and equipment specified have been used for 40+ years	Studying equipment and customer assets that are constantly evolving
Desktop computing, Synergi, and PSSE modeling tools are utilized for studies	Advanced computer modeling tools are utilized for the studies (Synergi, PSSE, LoadSEER, PSCAD)
	Load forecasting and hosting capacity analyses

The dynamic nature of loads and DER creates a need for more granular analysis

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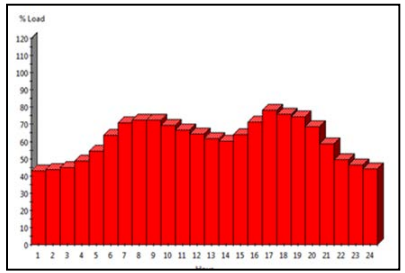
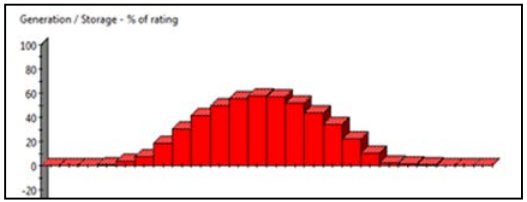
LoadSEER: Time Series Load/DER Forecasts

- LoadSEER produces load forecast profiles that include:
  - DER program forecasts
  - Electric Vehicle forecasts
  - Economic and geospatial variables to forecast load growth (i.e., GDP, tourism, land use, income, county zoning, etc.)
- Traditionally, non-coincident peak loading was used which may lead to conservative load projections (i.e., peak load for new service is added to peak load for feeder to obtain projected feeder peak load)
- Load profiles provide more granular projections and provide the basis to analyze both traditional and non-wire solutions

Load forecast profiles



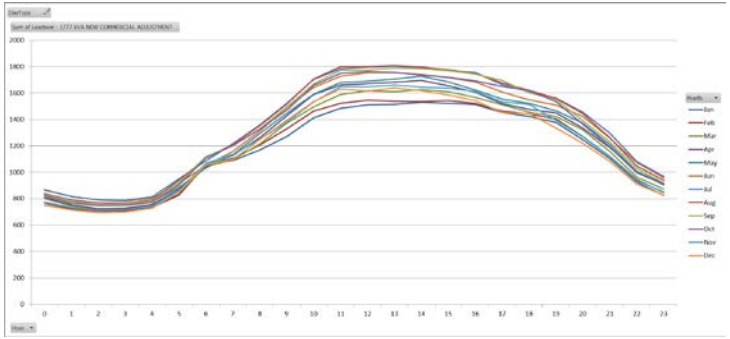
DER forecast profiles



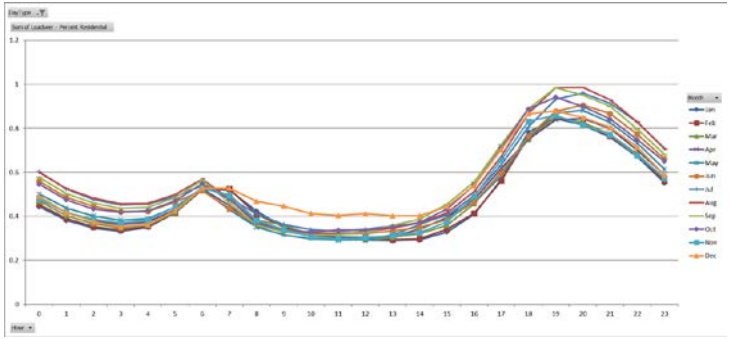
LoadSEER Load Profiles

- LoadSEER produces load profiles for new load addition (services) based on default or actual load shapes and can be shown as a 576 profile (24 hour, monthly profile for weekday and weekend) 24x12x2 = 576
- Commercial and residential load profile have been created based on actual HECO commercial and residential customer load profiles
- These “default” load profiles are scalable and may create new profiles given a peak value

New Commercial



Residential

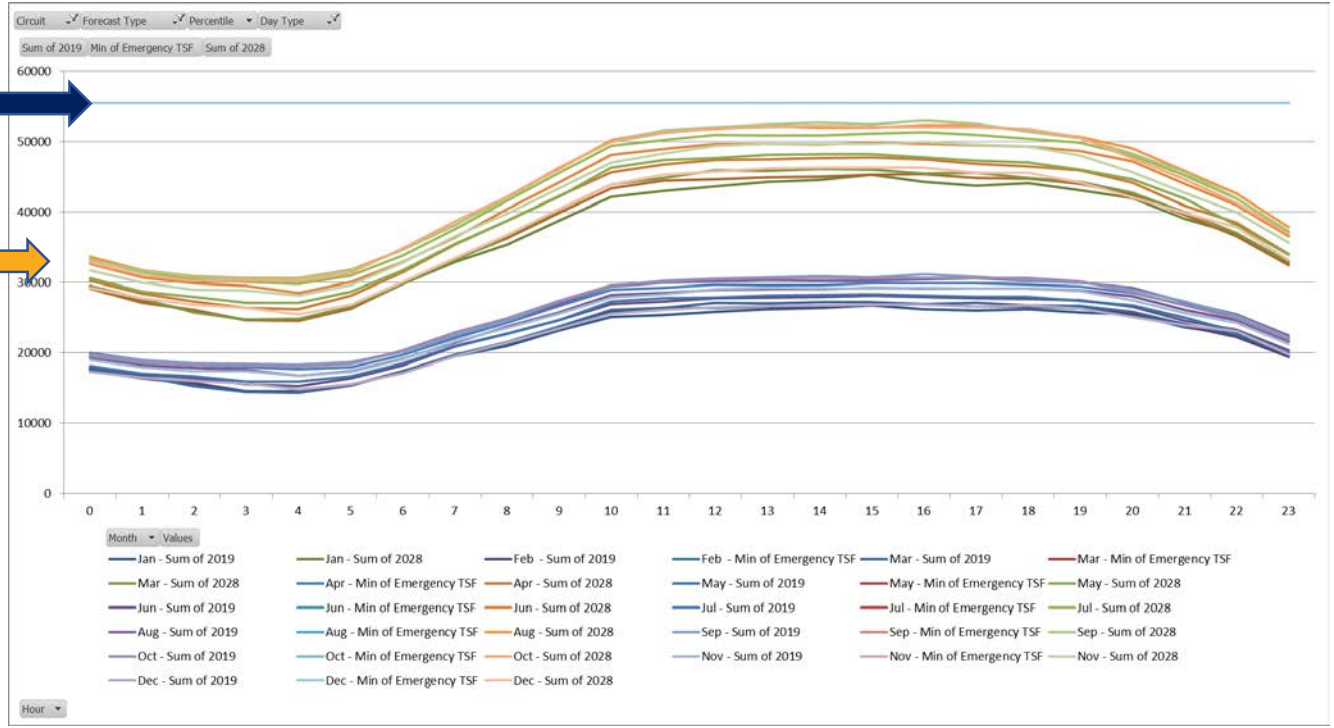


LoadSEER N-1 Analysis Example:
Kewalo T3 Transformer Load Transfer to Kamoku T2 Transformer

Transformer Rating

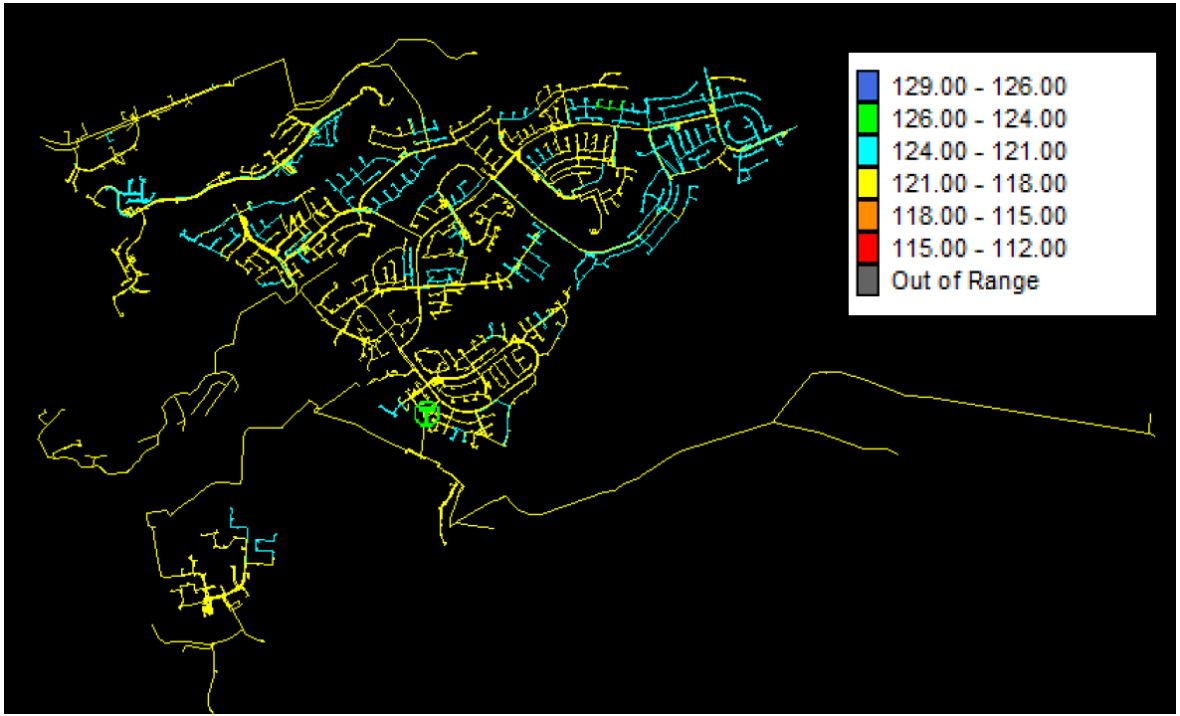
Load growth with new developments

Existing Loading

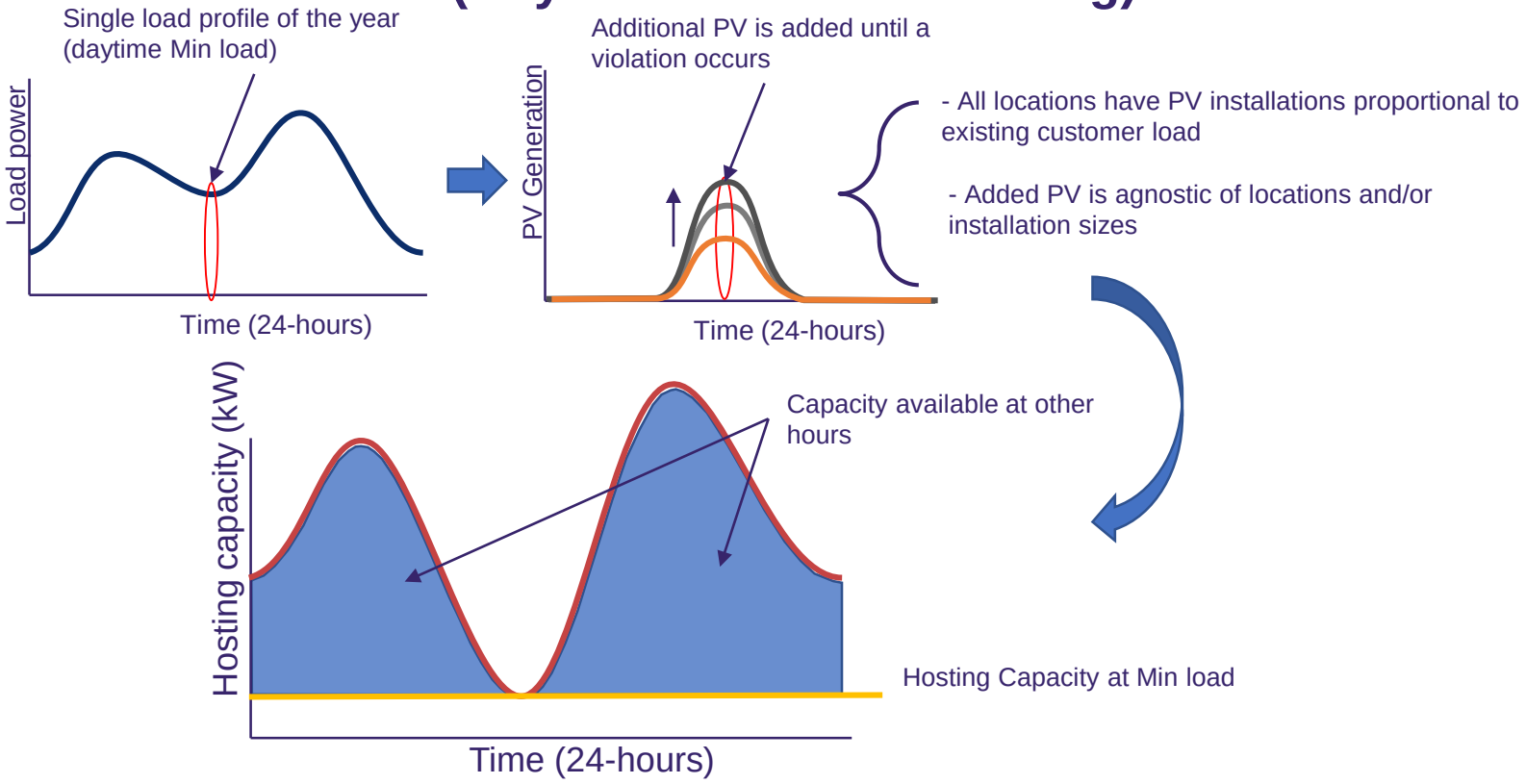


Synergi: Circuit Modeling Software

- Used to evaluate thermal and voltage limits
- Load and DER are integrated into the circuits
- Hosting capacity value is developed by “growing DER” until limits are reached
- Hosting capacity is used as screening threshold for new DER
- Modeling software assists in development of potential solutions



Current Hosting Capacity Methodology: Only Identifies Worst Case Limit (Daytime Minimum Loading)

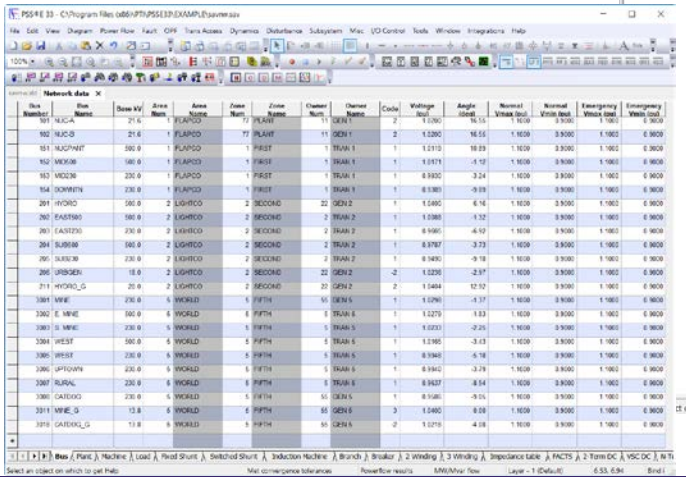


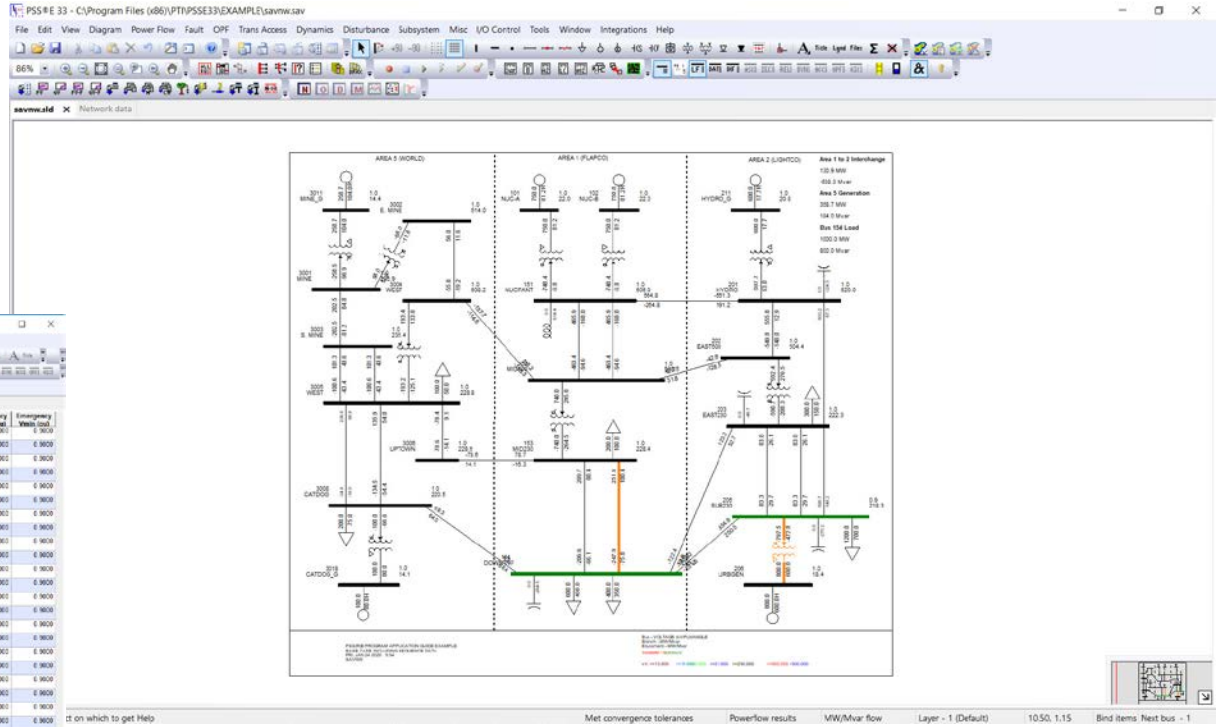
Future Hosting Capacity Enhancements:
Goal is to Create Hourly Hosting Capacity Limits

	Current HECO HC analysis	Future HECO HC analysis
Model Unique DER Programs (Non-Export & Smart Export)	✗	✓
Advanced Inverter (VV/VW)	✗	✓
Time Series (576/8760)	✗	✓
Probabilistic model	✗	✓
Add PV in realistic installation sizes	✗	✓
Add PV in locations that make sense	✗	✓

PSSE: Circuit Modeling Software

- Used to evaluate distribution network loading and for short circuit current analysis
- Also used by transmission planning for load flow, and dynamic stability analyses

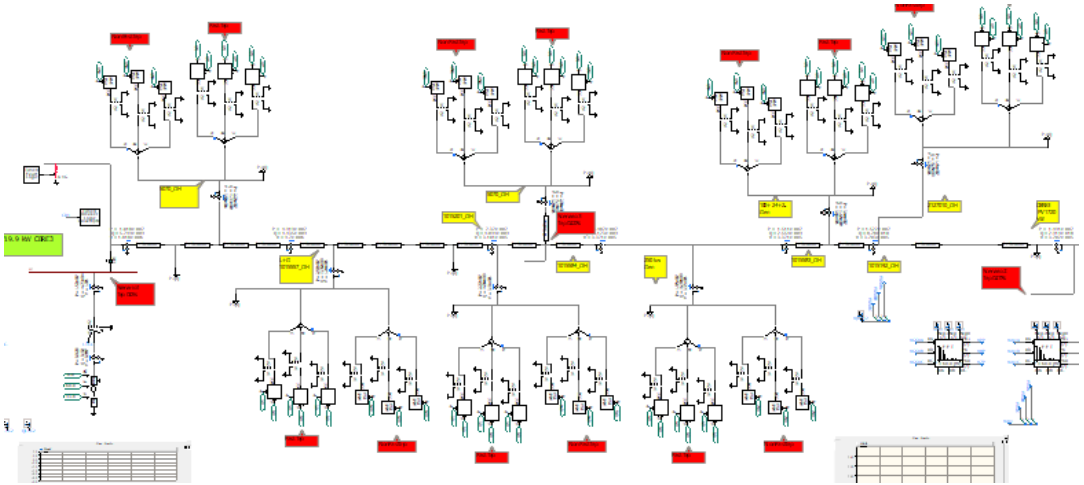


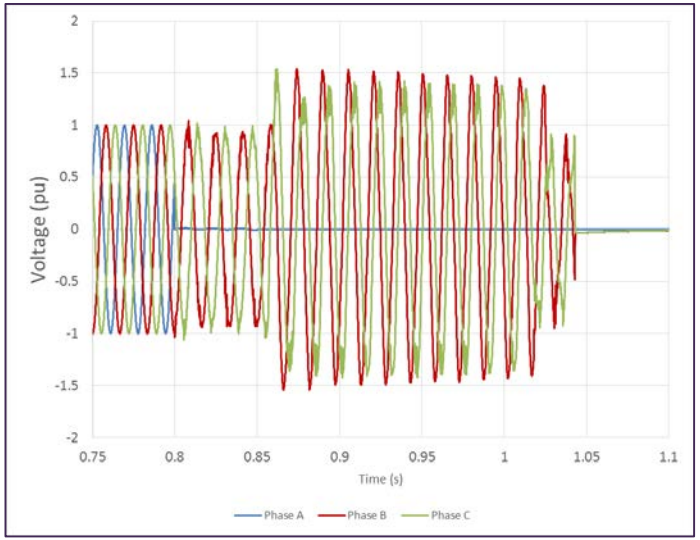


PSCAD: Circuit Modeling Software

Used to evaluate:

- Sub-cycle transient overvoltage due to unintended islanding
- Voltage drop due to transformer energization in-rush current.





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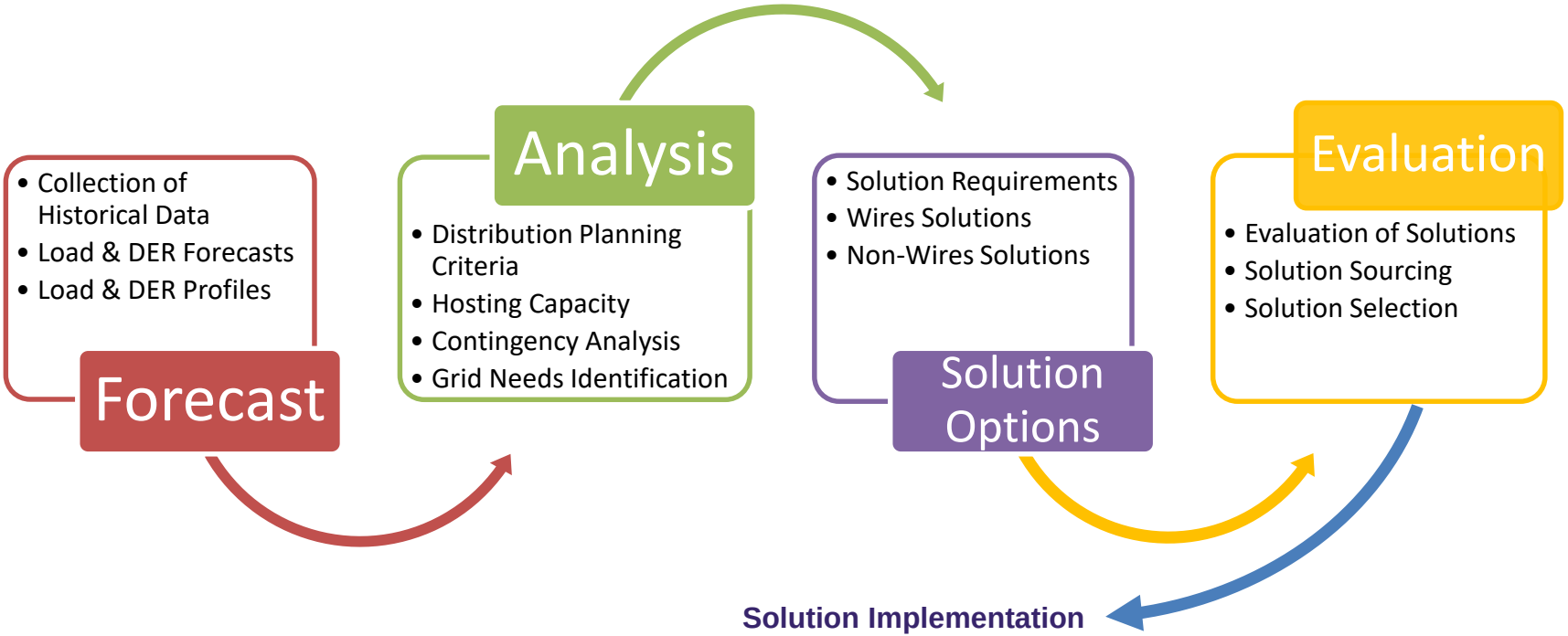
Integrated Distribution Planning Process



Grid Needs: If There is Criteria Violation

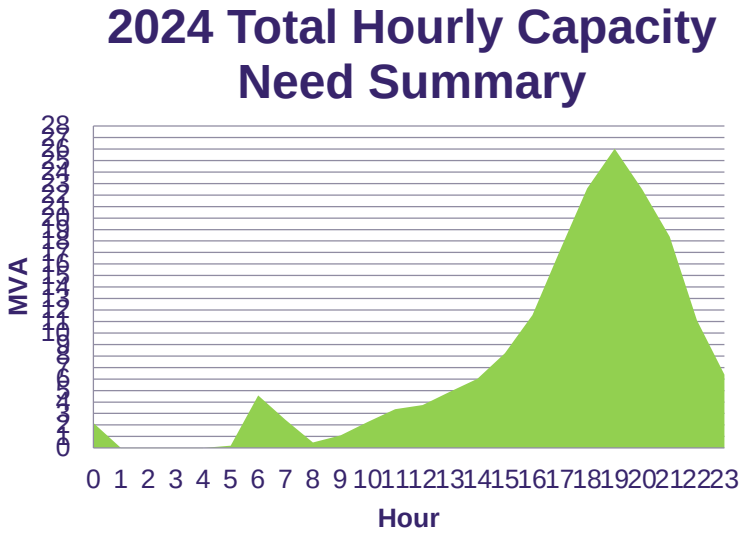
If the analysis shows a thermal or voltage violation, further analysis is done to determine a solution to resolve the planning criteria violation

- **Solutions include:**
  - Non-wires solution
  - Modify substation LTC or line regulator installation/settings change
  - Reconfigure the circuit
  - Reconductor
  - Reactive compensation – multiple electronic power devices to stabilize circuit voltage
  - Balance loading/DER
  - Line extension
  - New substation
- **Develop project scope**
  - For a wire solution, work plans are created including planning single-line diagrams
  - For a non-wire solution, time based capacity requirements are determined

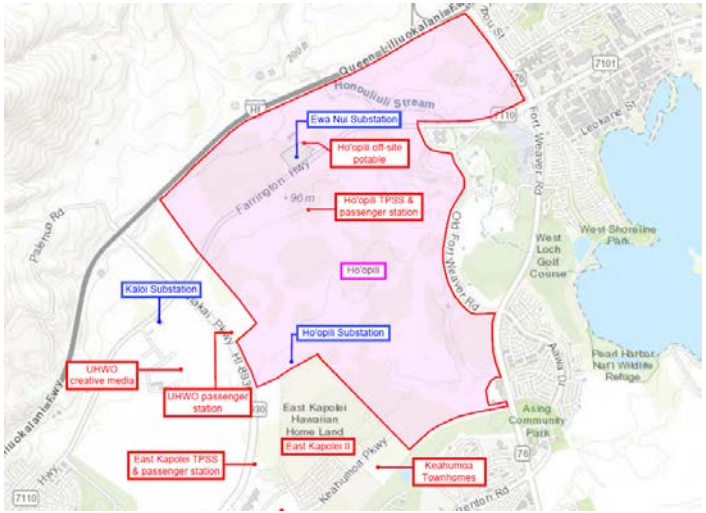
Example Solution: NWA or Traditional Substation Capacity

Solution benefits include: Mitigate overloads due to electrical load growth of new subdivision

NWA



New Substation



Equipment	MVA peak	Delivery Months	Delivery Hours	Hours duration	Max Days	MWH
Normal	8.6	Jan - Dec	1PM - 12AM	11	365	39.6
Contingency	26.1	Jan - Dec	5AM - 1AM	20	365	174.9

Distribution Planning Needs of the (Near) Future

- Integrated steady-state and dynamic distribution models
- Integrated with transmission and protection analysis
- Integrated with generation portfolio planning
- Shift from deterministic to risk and probabilistic analysis
- Results that are consumable by a broader audience

Mahalo

Reference: hawaiianelectric.com/IGP

colton.ching@hawaiianelectric.com