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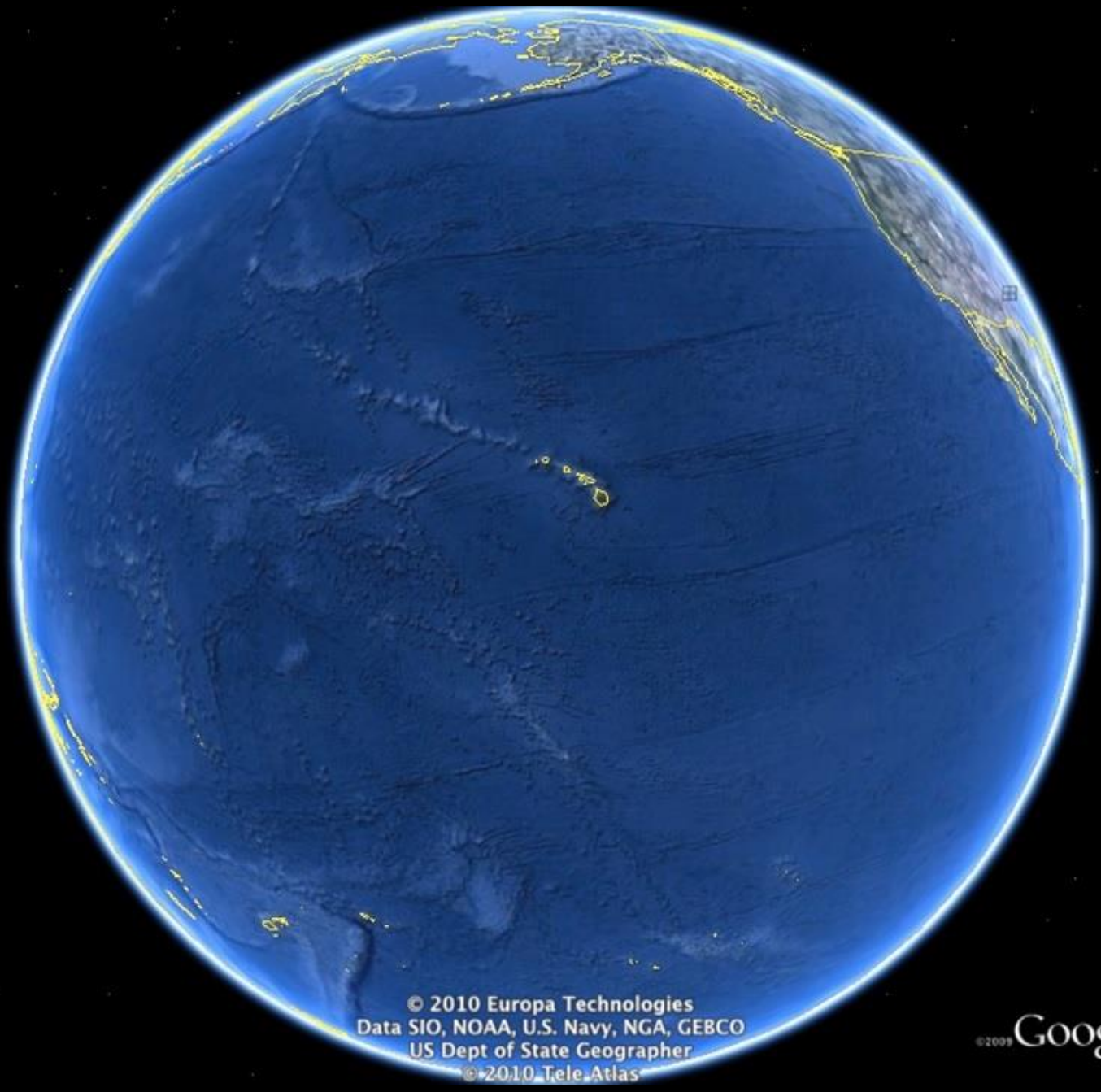
Integrated Grid Planning

Listening + Integrating + Collaborating to Reach 100% Renewables by 2045

Comprehensive Electric Utility Planning in Hawai`i

National Council on Electricity Policy
Coordinated Electricity Planning
September 14, 2021
Colton Ching
Sr. VP, Planning & Technology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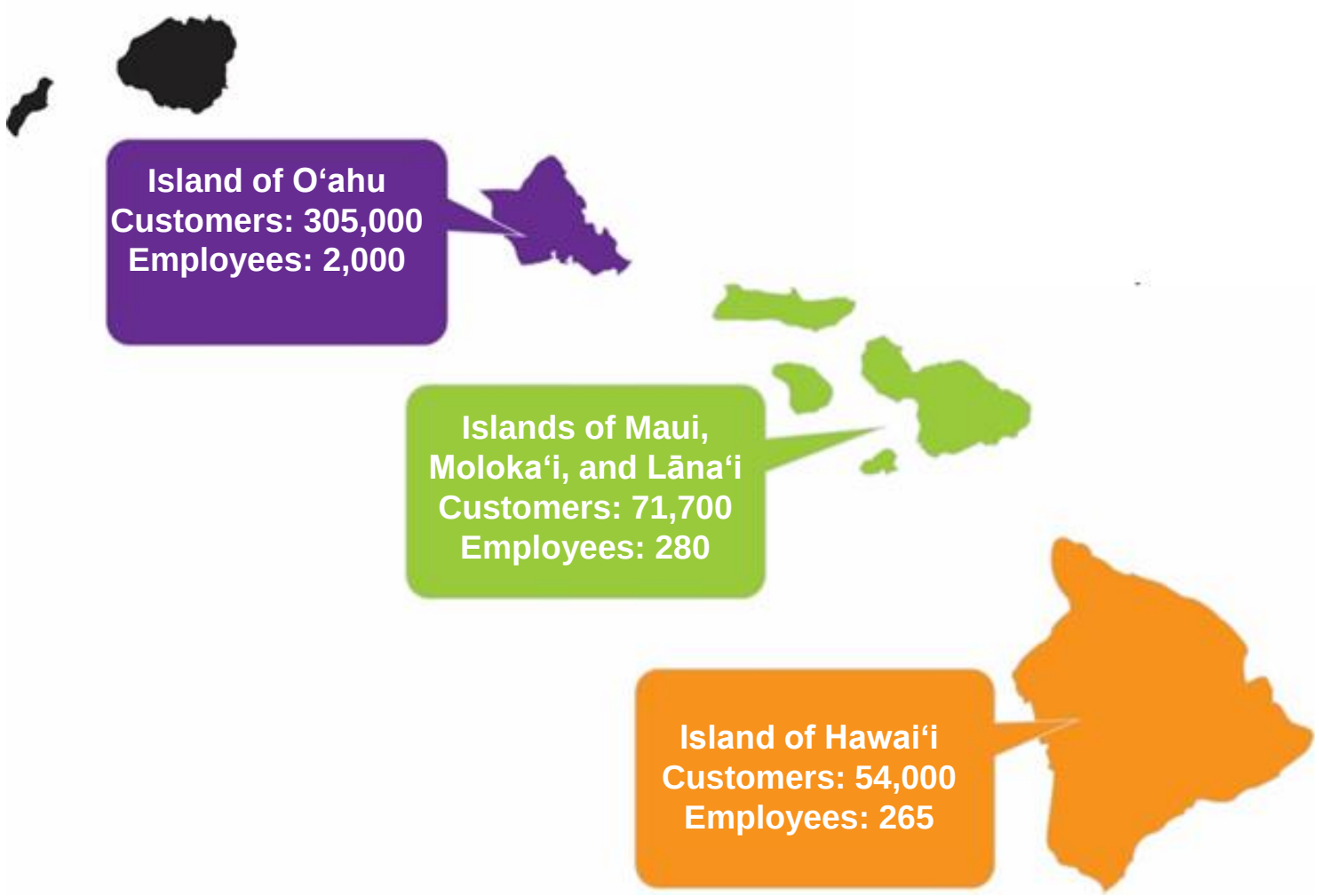
Hawai`i is unique with separate, island grids



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Drivers of utility plans

- 100% RPS (fossil-free) by 2045
- Net zero greenhouse gas emissions by 2045
- Performance Based Regulation
  - Enhance customer experience
  - Improve utility performance
  - Advance societal outcomes
- Mother nature

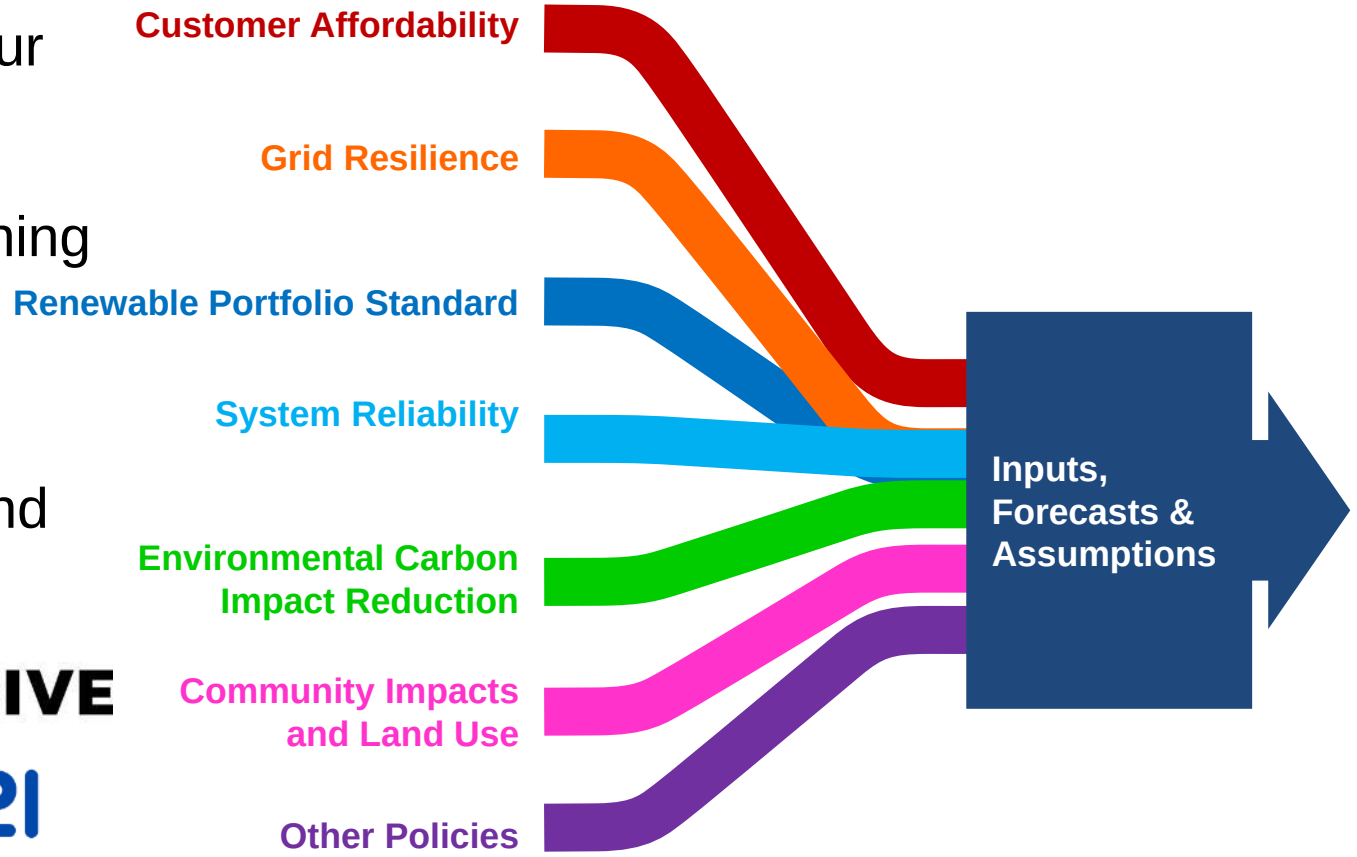
Integrated Grid Planning is not just about generation – wide-range of considerations

- Our goals requires a transformation of our electric system
- Integration of resource, transmission, distribution and customer resource planning
- Technical work informed by active Stakeholder engagement
- No blueprint; HECO leads the way with work recognized by RMI, EPRI, SEPA and UD, and others as industry-leading

Smart Electric Power Alliance

UTILITY DIVE

EPRI
ELECTRIC POWER RESEARCH INSTITUTE



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Stakeholder participation is also integrated into the planning process

As part of the IGP process, we are collecting your input and considering all our options in planning for our renewable future. Here are the participants Hawaiian Electric is collaborating with:

Working Groups

Address specific topics in an advisory capacity and not as a decision-making group

Stakeholder Council

Represents customers broad stakeholders to review work and provide guidance and insights

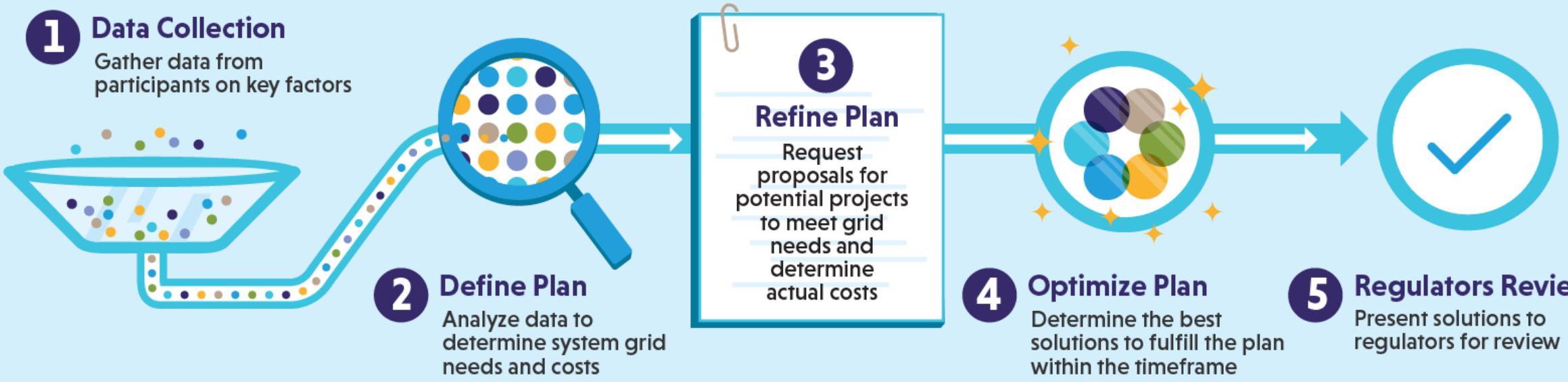
The Public

Communication with customers

Technical Advisory Panel

Provides independent evaluation and feedback on the working group activities and reviews point filings

Integrated Grid Planning process



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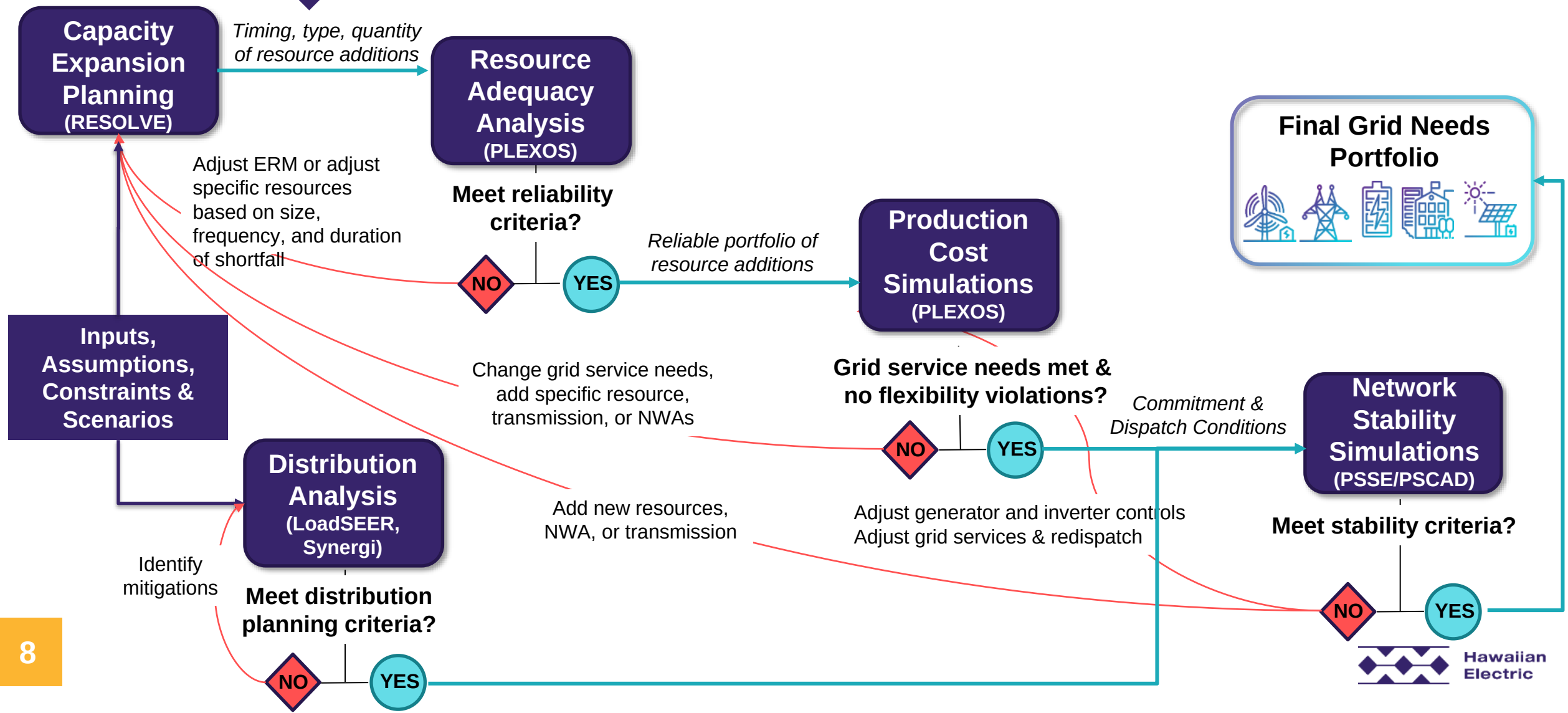
Integrated Analytical Framework

Coordinated electricity planning requires a suite of tools



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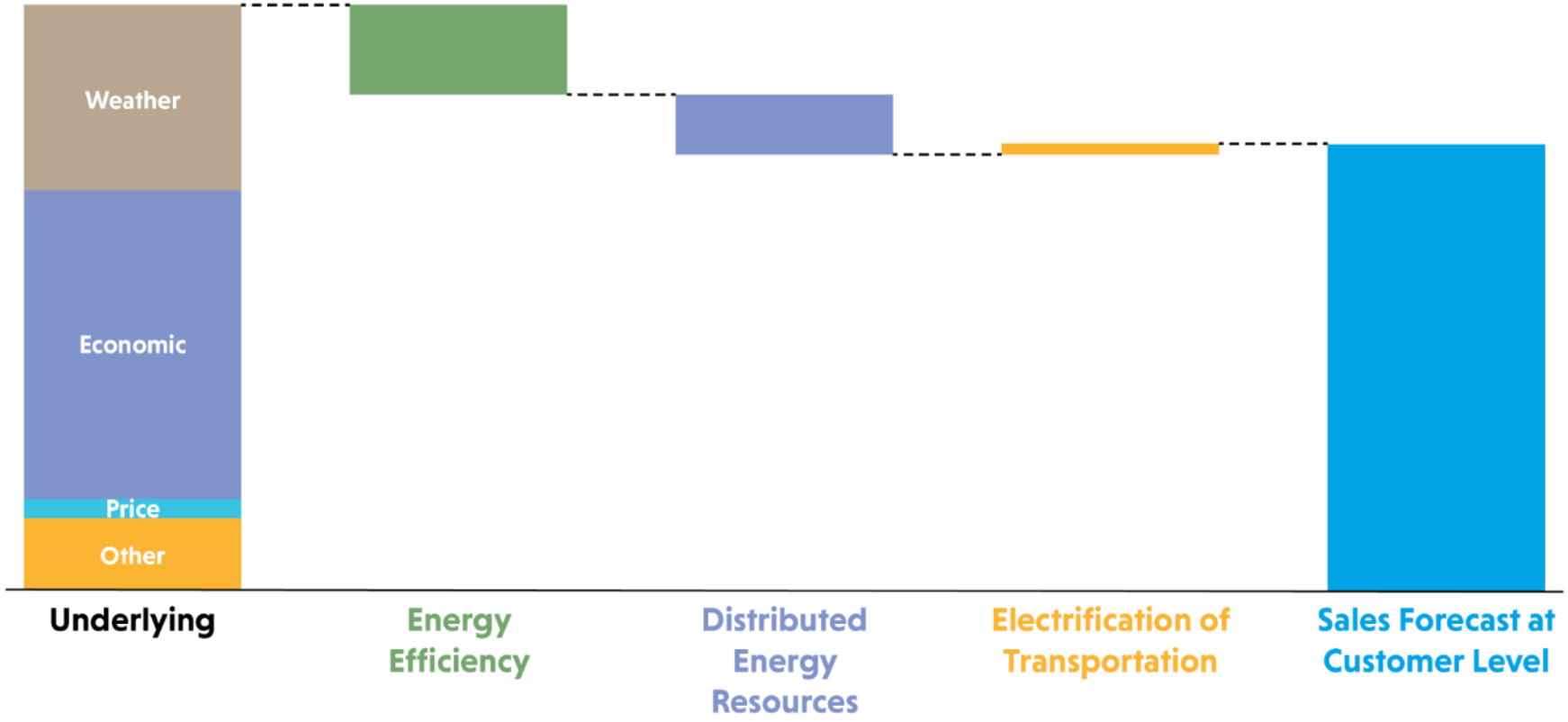
Forecasting customer trends is a key factor in developing long-range plans

The forecast is developed in layers.



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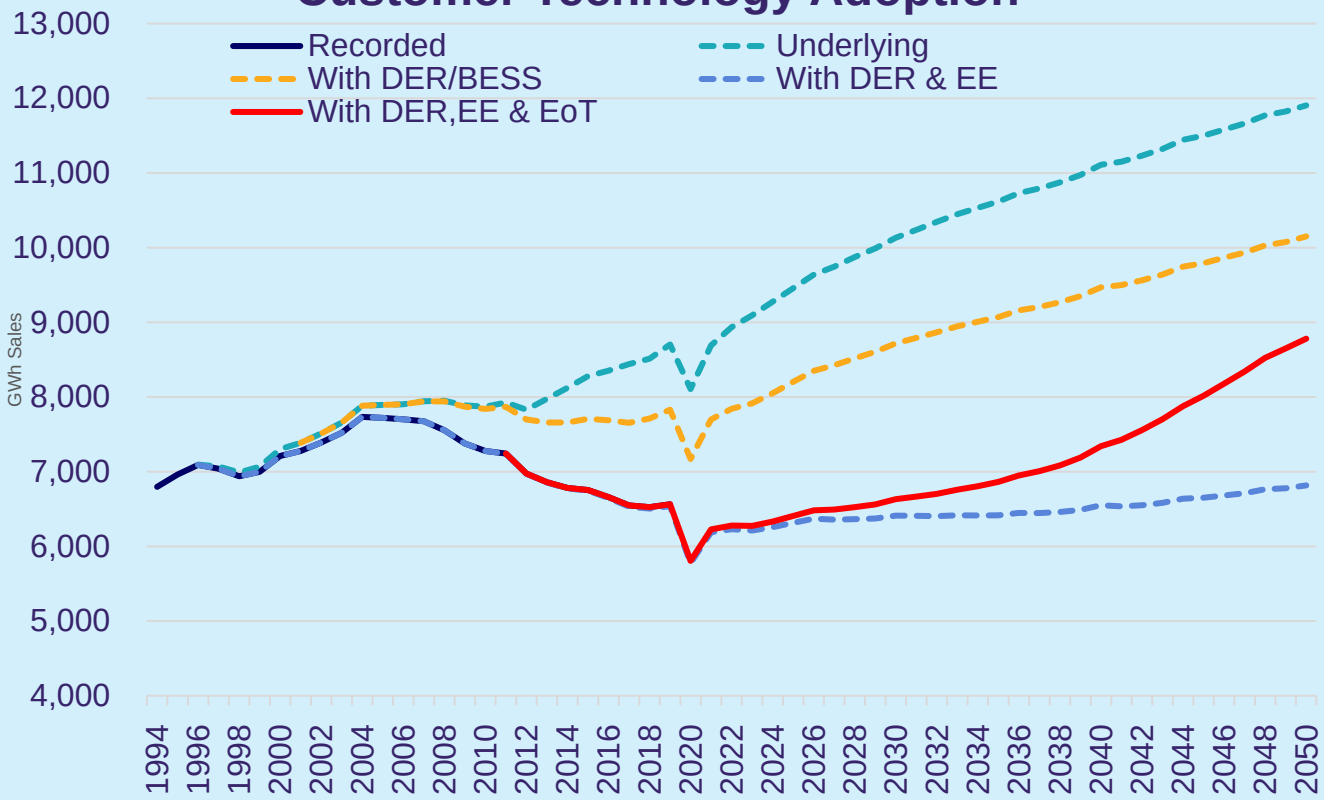
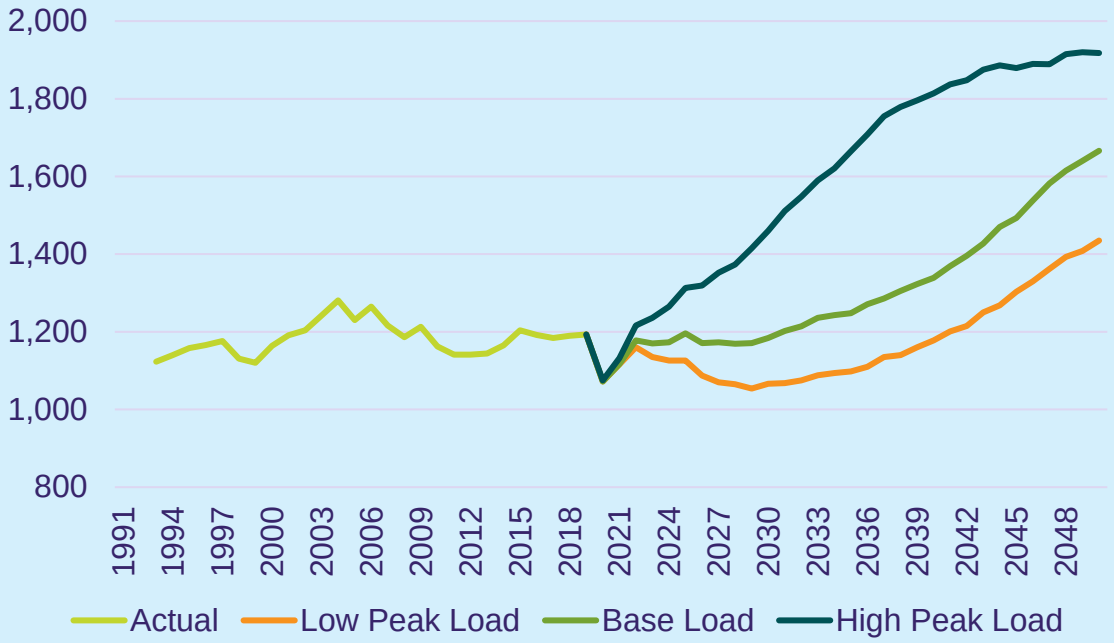
Oahu Base Sales Forecast w/ Customer Technology Adoption



Oahu Peak Load Forecast



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Scenario planning and sensitivities help **inform least-regrets plans**

High/Low adoption of customer technologies: Solar, Energy Efficiency, EV, etc.

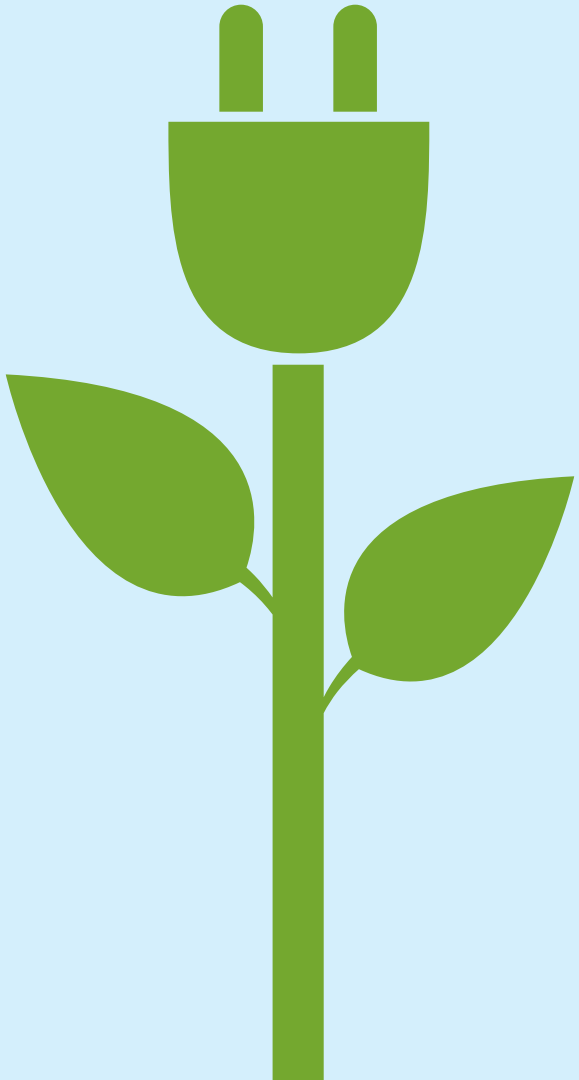
Land limitations: understand how to reach 100% renewable energy if land is not available to build new renewables and transmission lines

Off-shore resources: Assess the benefits of off-shore wind development.

Beneficial electric vehicle charging: Customer adoption of charging electric vehicles when solar and wind is available

Prolonged poor weather: Test the resilience and reliability of the system with prolonged bad weather when system is highly dependent on wind and solar

Our planning principles



1. Renewable energy is the first option.
2. The energy transformation must include everyone.
3. Today's decisions must not crowd out tomorrow's breakthroughs.
4. The power grid needs to be modernized.
5. The lights have to stay on.
6. Our plans must address climate change.
7. There's no perfect choice.

We Want to Hear From You

We welcome your input! Here are the many ways to stay connected with us.

Email: **IGP@hawaiianelectric.com**

Website: **www.hawaiianelectric.com/igp**

facebook.com/HawaiianElectric

twitter.com/hwnelectric

instagram.com/hawaiianelectric

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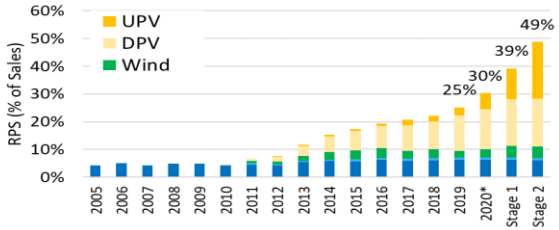
Capacity Expansion



Objective:
Screening analysis to determine type, quantity, and timing of utility-scale resource additions across a *range of constraints*

Tool(s): RESOLVE

Key Inputs:
- Cumulative daily load and load shape, including DR, DER, EE, EVs
- Fuel price forecasts
- Candidate technology costs
- Proposed retirement schedules
- Reliability requirement (PRM, ERM)
- Grid service requirements

Key Outputs:
- Timing, type, quantity of utility-scale resource additions, including BESS
- Economic retirements
- Estimated capital and production costs
- Hourly marginal cost for services

Resource Adequacy Analysis

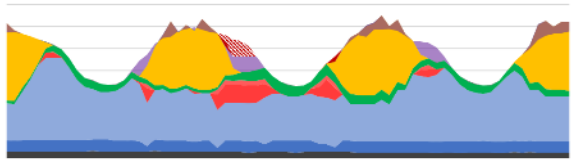
Objective:
Validate resource adequacy of portfolios in selected years to quantify system risk of proposed capacity expansion including timing of *retirements*

Tool(s): PLEXOS

Key Inputs: (additional to previous)
- Resource portfolio, including BESS, DR and DER
- Multiple years of wind, solar, and net load profiles
- Detailed generator outage data

Key Outputs:
- Reliability metrics (LOLE, EUE, etc.)
- Size, frequency and duration of capacity shortfalls

Production Cost



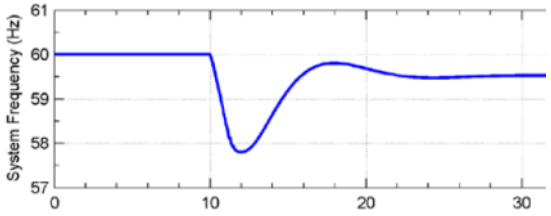
Objective:
Confirm operability of portfolios: reserves, ramp rates, unit commitment, storage schedules.
Quantify *production costs* and *avoided costs*

Tool(s): PLEXOS

Key Inputs: (additional to previous)
- Detailed grid service requirements & capabilities
- Detailed unit operating constraints (ramp rates, heat rate curves)

Key Outputs:
- Production Cost (Fuel, O&M)
- Hourly marginal cost $/MWh
- Curtailment, emissions, storage utilization
- Size, frequency, duration of non-capacity shortfalls

Network Stability Screening



Objective:
Validate *grid stability*, including frequency resp., voltage regulation, and short-circuit strength to determine if transmission upgrades are required.

Tool(s): PSS/E and PSCAD

Key Inputs: (additional to previous)
- Transmission topology
- Selected unit commitment & dispatch
- Thermal unit performance: governor response
- Inverter settings & performance

Key Outputs:
- Transmission overloads
- Frequency and voltage violations
- System dynamic performance after a disturbance
- Enabling technologies or inverter control changes to mitigate stability concerns

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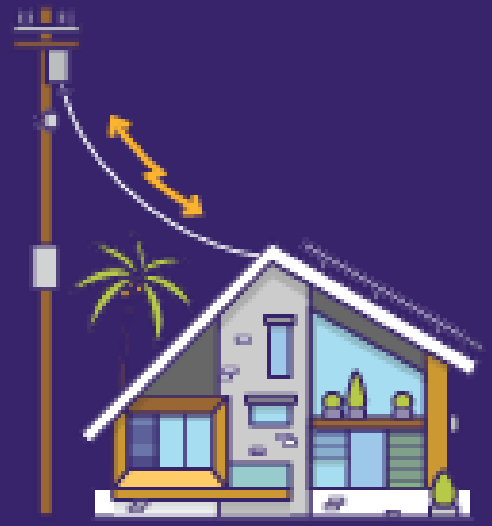
Our Energy Future

Achieve Energy Independence

Reduce oil dependency and volatile fuel costs by increasing renewables

Climate Change Considerations

Add more renewables to reduce greenhouse gas emissions and build a resilient grid

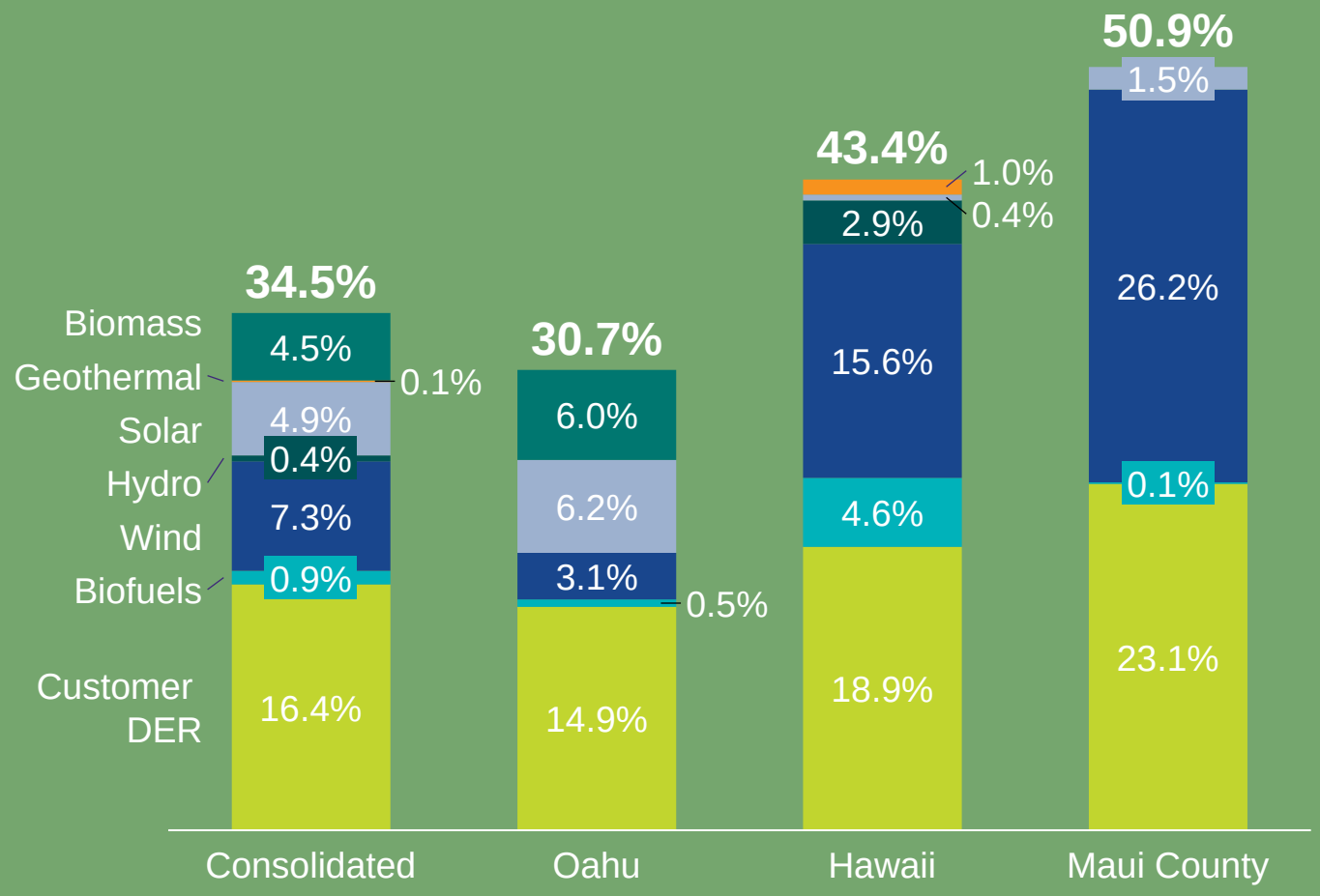


Modernize Our Island Grids

Integrate new technologies to facilitate 100% renewable energy

Our Goal for the Future: **100% Renewables by 2045**

2020 Recap: *The Companies achieved* ***34.5% RPS***



*RPS = Renewable Portfolio Standard

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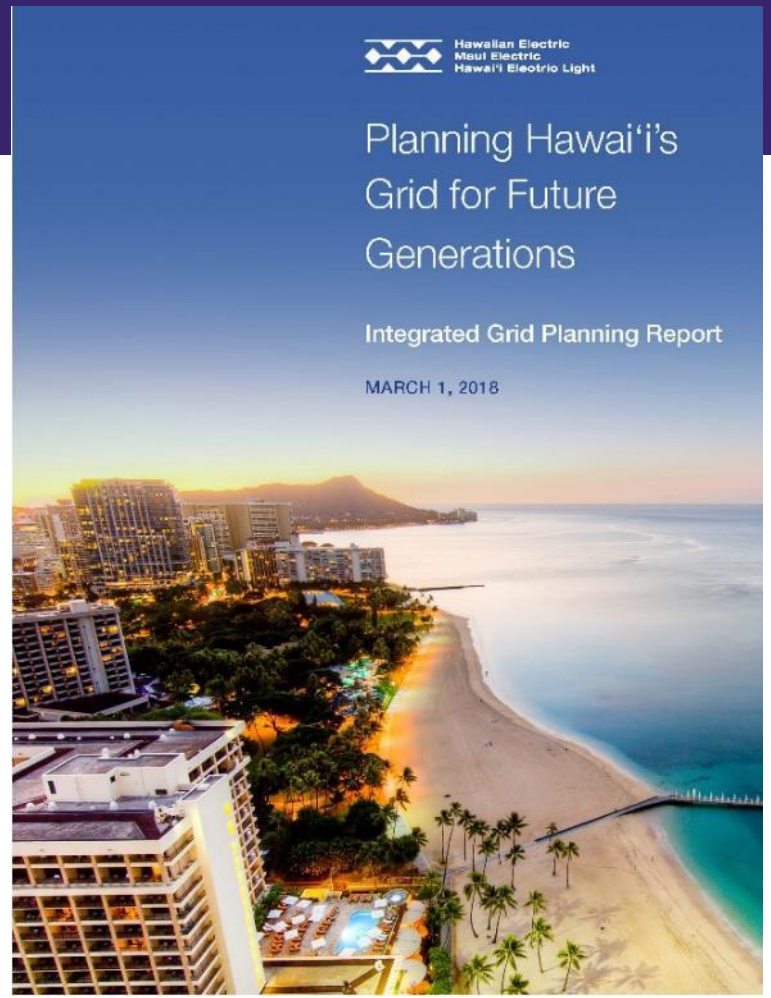
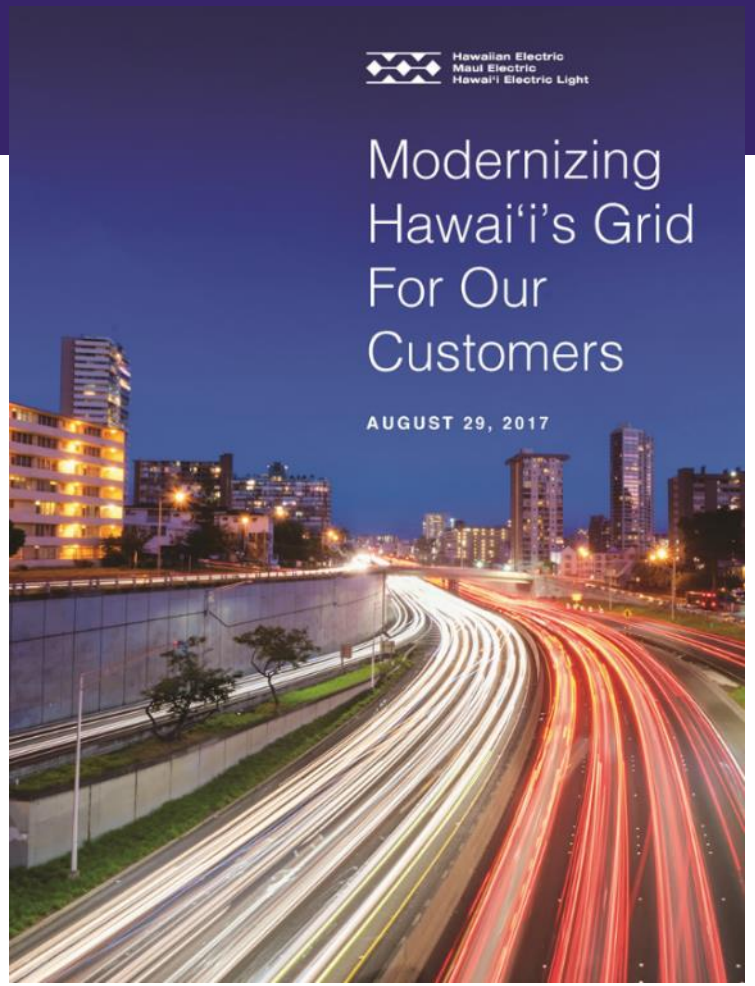
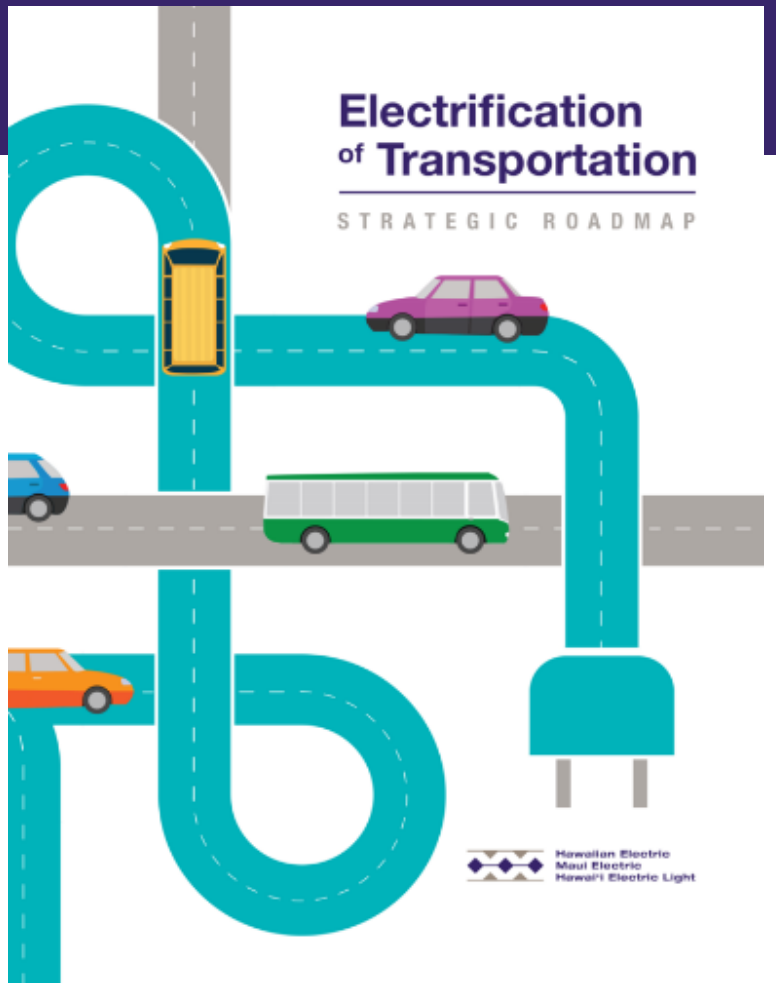
Innovative strategies lead our transformation







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