Forecast Assumption Working Group Meeting 3

July 17, 2019

9:00 am – 12:00 pm

American Savings Bank Tower, 8th Floor, Training Room 1

Attendees

WebEx	
Amber Riter	Portland General Electric
Calvin Opheim	ERCOT
Ingrid Rohmund	Applied Energy Group
Patrick McCoy	SMUD
Rene Kamita	Division of Consumer Advocacy
Terry Baxter	NV Energy
Rocky Mould	City and County of Honolulu
Dave Parsons	PUC
Steven Rymsha	TASC
Jessie Cuilla	Rocky Mountain Institute (PUC Consultant)
Michael Ito	Hawaiian Electric
Meredith Chee	Hawaiian Electric

In-person	
Jay-Paul Lenker	PUC
Ashley Norman	PUC
Clarice Schafer	PUC
Pono Shim	Oʻahu Economic Development Board
Marcey Chang	Division of Consumer Advocacy
Teena Rasmussen	Maui County Community
Binshing Li	DBEDT
Carl Bonham	UHERO
Henry Curtis	Life of the Land
Robert Harris	TASC
Wren Wescoatt	Progression Energy
Paul De Martini	Newport Consulting Group - Facilitator
Joanne Ide	Hawaiian Electric
Christopher Lau	Hawaiian Electric
Collin Au	Hawaiian Electric
Sorapong Khongnawang	Hawaiian Electric
Cathy Hazama	Hawaiian Electric
Anne Fuller	Hawaiian Electric
Therese Klaty	Hawaiian Electric
Thomas Yokota	Hawaiian Electric
Leland Cockcroft	Hawaii Electric Light
Kolter Kalberg	Hawaiian Electric
Earlynne Maile	Hawaiian Electric
Peter Young	Hawaiian Electric

Marc Asano	Hawaiian Electric
Ken Aramaki	Hawaiian Electric

Agenda

Welcome and Overview	9:00 – 9:10
Forecast Methods (Underlying & DER)	9:10 – 10:05
Break	10:05 – 10:20
Forecast Methods (EE, EoT, Summary)	10:20 – 10:55
Forecast Methods from Other Utlities -ERCOT -NV Energy -Portland General -SMUD	10:55 – 11:55
Wrap-up	11:55 – 12:00

Meeting Summary

Presentation Highlights

Purpose of the meeting is to describe the methodologies used to develop and shape the forecast which is then used by the system planners. The forecast are developed in layers – 1) underlying – macro level drivers such as what's happening in the economy, weather and electricity price, 2) impacts from distributed energy resources, 3) impacts from energy efficiency and 4) electrification of transportation.

Underlying Forecast - Methods

Underlying forecast is the sales at the customer level

- Forecast methodologies are the same across all islands
- Data categories include:
    - Historical periods
        - Structural changes
            - e.g. Lana'i switches from agriculture to resort based economy
        - Historical disruptions
    - Adjustments and reasons for adjustments
        - Large customer loads
        - Embedded layers
        - Estimated impacts
- Forecast Inputs
    - Customers
    - Industry experts
    - Publicly available resources
    - See slide 9 for a complete list
- Underlying Forecast: Energy Sales

    - Relies on historical information
    - Historical data needs to be cleaned to remove outliers for a more accurate trend
        - Large loss of customer in HELCO due to eruption
        - Large increase in load due to large project
- Evaluating Relationship Between Sales and External Drivers
    - Long-term - Changes in economic drivers have changed the trajectory of sales, not longer expected to dip as previously observed

Q&A for Underlying Forecast - Methods

- How closely are you working with the Counties to receive information on new projects that could affect the load?
    - The Companies obtain some information via public channels such as information made available by city and county
    - Information is also obtained from Hawaiian Electric's internal group that receives requests to provide power to new projects
- Do you separately forecast PV and energy conservation?
    - Yes…we'll get to that later in the meeting

Underlying Forecast - Load Shapes

- Planners need hourly system level forecast for models. Monthly rate class sales are converted to system level hourly load shapes.
    - Underlying forecast starts with historical shapes from Class Load Studies or Total System
    - Hourly regression models are fit using Hourly Shape Drivers
        - Seasonality / Calendar (Month)
        - Day of Week / Holiday
        - Weather
- Cumulative system load shape is derived by summing rate class shapes and energy
    - Each rate class has a different shape
    - Mix of rate classes can vary over time and change system shape
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- Adjustments to underlying can include
    - Individual large project profiles / energy (if project profile is different from class shape)
    - Layers

Q&A for Underlying Forecast - Load Shapes

- Is the actual load shape shown the in the slides?
    - This is an illustrative example.
- Are you adjusting your cooling degree days?
    - The Companies try to look for a relationship between weather and hourly loads. Using the hourly models, we can vary the forecast weather (for example, typical year vs. extremes).

- Any plans to do sub-hourly forecast?
    - The Companies may develop sub-hourly forecasts, if it is needed for models and the sub-hourly data is available. It took a lot of work to get the hourly level shapes (data collection, filtering, cleaning, etc.).

Distributed Energy Forecast

- Significant driver of reducing customer sales
- Primary focus is behind the meter PV and battery storage which is the dominant technology
- Other technologies included on ad hoc basis for known projects like wind and CHP
- Work with other utilities to identify what methods they use
    - Found that the BASS model is widely used however not the best fit for our companies.
    - In some cases where adoption is low, trending and/or judgement is used
    - How forecasters take their capacity forecasts and turn them into sales and hourly loads varies mostly depending on what kind of data is available and the significance of this layer to their forecast. If the customer PV systems are metered by the utility, that data is used. NREL estimates of solar resources in their territory are often used.
- Sales and hourly load impacts from other utilities
    - Smart meter data
    - Estimates from NREL studies
    - Customer's historical consumption
- Future Capacity Forecast Methods relies on data such as:
    - How many agreements are being executed
    - Number of applications received for past 6-12 months
    - Program capacity considerations
    - Information from installers/developers on expected trends
    - Any large upcoming project
    - Any studies that are ongoing and its potential affect

Q&A for Distributed Energy Forecast=

- How many years is considered for mid to long-term for the DER forecast?
    - Due to lack of detailed application data, 2 - 3 years
- What is ISE?
    - Smart Export program

Modeling Methods

- Bass Technology Diffusion Model
    - Popular diffusion model to forecast uptake of any new technology
    - Usually used for new technology uptake
    - Uses coefficients that relate to "market"
    - Performed poorly compared to historicals

    - S-curve model (simple 2 parameter model)
        - Limited number of parameters make the model not robust enough for Companies' needs
- Generalized Bass Model (GBM)
    - Performed similarly to Bass Diffusion Model above
- Blended ARIMA + Bass: "Take off"
    - Performed similarly to Bass Diffusion Model above
- Economic Choice Model
    - Primary model used
    - Primarily driven by customer economic benefits
    - Dependent variable is the percent of potential PV adopters that actually do install a system each month
    - Able to do more with explanatory variables
- Fixed Endpoint Method
    - Assume an end state in which all single family homes are 100% renewable

Q&A for Modeling

- You force today's data into the model, models still don't have predictive capability
- You mention models fall short, but what is the criterion?
    - How do the Companies fine-tune the model to reflect missing characteristics, that's what we're trying to get to in the end
        - E.g. when the NEM program closed, there was a large drop off. The Bass model interpreted that as market saturation.
- Bass model is being fitted to data faulted by policy choices.
- How much of the curve can be explained by purely putting together economic models?
    - If the data was there. That's what the Companies are trying to get to...economic choice model...difficulty is we're dealing with declining pool of adaptors
- Since you have multiple models which one do you prefer and how do you choose? Are you trying to get number or range of number?
    - There is a preferred model for each rate class.
- Does this factor include an increase in electric rate?
    - It is built in, will be covered more in assumptions meeting
- In all of the graphics there's infliction point in 2022 and 2024 why?
    - 2022 elimination of tax credit, 2024 still unclear...could be recovering from 2022?
    - Stakeholders noted that the graph looks like the end of tax credits is modeled as a transfer function resulting in an abrupt change and will gradually recover and stay at the same point. All factors are related and need to ensure that the Companies' do not over fit the model.

- Did you consider exporting and not exporting?
  - The model is not able to handle different programs. The Companies can inform that choice using judgement and tools.
- There have been recent proposals to change certain class charges. Are those changes represented in the forecasts?
  - Yes
- What about repair and replacement?
  - End of life is not something that is factored into the Companies' models
  - Many utilities are struggling with dealing with the end of life of batteries
- As the graph goes towards the end, what is the % adoption of PV?
  - Not exactly sure for market analysis. For the last PSIP, it was something like 80% adoption of potential population, not the whole population
- Are you constraining PV adoption based on size of the load?
  - Yes
- Do you use NREL data?
  - No

Energy Efficiency Forecast

- Hawaii Energy's plans for the near term forecast (1 - 3 years)
- Longer term forecast will be based on Applied Energy Group's ("AEG") study due in September
  - Customer segmentation
  - Technologies and measures
  - Appliance standards and building codes
  - Hourly analysis
  - Sensitivity analysis will be performed following discussions with the FAWG and AEG

Electrification of Transportation – light duty vehicles and buses

- Two parts to forecasting light duty vehicle
  - Determine the forecasted amount of LDV's on the road
  - Determine energy required to charge the vehicles
  - Bass Model > Agent-Based Model > % EV Saturation of Total LDVs > Total LDV (Light Duty Vehicle) Forecast > EV forecast
  - Bass Model (Top-Down Macro Model):
    - Vehicle Cost (EV and ICEV)
    - Vehicle Fuel Economy (EV and ICEV)
    - Number of charging ports
    - Discounts (Tax Credit / Rebate)
    - Electricity Price
    - Gasoline Price
    - Income
    - Number of PV Installations

- Agent-Based Model (Bottom-Up Model - Spatial):
    - Innovation Parameters
    - Imitation Parameter
    - Housing Characteristics
    - Commuting Patterns
    - Road Accessibility
    - Energy Consumptions
- Inputs & Assumptions:
    - Vehicle Miles Traveled & Energy Used per Vehicle
    - VMT (Annual VMT By Country (DBEDT))
    - kWh / mile
    - County's EV Sales by Vehicle Models (Polk/EPRI)
    - Charging Segmentation
        - Residential
        - Commercial
    - Average Charging Profiles
        - Aggregate Profiles
        - A lot of the vehicles are unmanaged

- Electric Bus Forecast
        - A lot of collaboration between internal and external
        - Tourism Industry, School Bus Transportation, ...
    - Representative blend of major types of buses evaluated in Hawaii
    - Development of Charging shapes

Q&A for Energy Efficiency Forecast

- Growth of LDVs look very strong. Should there be a disruption due to self-driving cars and ride share services?
    - Population data developed in 2017 was used in the total LDV forecast. Since then the population forecast has been adjusted. Will update later.
- Where are the numbers for how many and where the EV's will be?
    - Load SEER data
    - DMV has locational information but this was deemed to be personal identifying information
- Stakeholders noted it would be advantageous for the Companies to push PV since there seems to be a correlation between PV and EV ownership
    - Ride share has affected vehicle miles traveled and vehicles on the road

Deliverable Forecast Models

- Monthly sales are converted into a load forecast for each hour over the forecast horizon

    - Simulate using hourly models for underlying class shapes using class load study shapes and explanatory variables.
    - Shapes for layers
    - Combine all shapes with forecast energy to derive future hourly system load
- The forecast is modeled by layer because each layer may have a different impact on the overall system shape.
- The forecast shape is not static but changes over the forecast horizon.
    - This hourly forecast is what the planners use to ensure resources meet the needs of the customers for each hour over the planning horizon.

Q&A for Forecast Model Deliverable

- How has load defection been considered?
    - The Companies have not looked into full defection or how many customers would leave, indirectly accounted for through PV adoption
- Have you looked at customers who are off grid but have an EV?
    - No, if they charge at work or in public then that information would be required to forecast
- People here who have an EV, do you charge every day?
    - Yes – certain stakeholders charge daily because of a smaller battery
    - No – certain stakeholders charge daily because of a larger battery
    - Stakeholders felt that the Companies should incentivize people to charge every other day, or a limited amount of days out of the week.
    - Battery capacity is not something that the model addresses. It just looks at energy required for travel.
- Stakeholders noted that 20 years ago, forecasters were not thinking about electric vehicles let alone self driving cars. There should be a forecast that has a technology that will have a huge impact. In a sense, the technology is what is making the decision.
    - What is the demographic of the future drivers? As ride-sharing becomes more and more prevalent, will there be less cars on the road?

Calvin Opheim, Electric Reliability Council of Texas (ERCOT)

- Independent operator in Texas
- Similar system to Hawaii
    - Limited market participation capability
- Scenario based forecasting
- Long-Term System Assessment (LTSA)
- A decoupling of economic signals to energy usage
    - Load no longer follows GDP
- Scenarios for extreme weather, recessions
    - Results from studies are not definitive and more indicators for extreme impacts
- Surprising Trend:

    - High penetration of PV is causing the model to want to build more combine cycles, probably due to the prohibitive high cost of storage.

Terry Baxter, NV Energy

- Forecasting methodologies are based upon traditional methods (regression based models, Statistically Adjusted End-Use Model, etc.)
- Peak forecast model uses typical peak regression model. Forecast by month then goes into hourly loads normalized by weather and add PV.
- 30-year hourly forecast

Amber Riter, Portland General Electric

- Load information:
    - 2018 peak demand of 3,100 MW
- Energy Deliveries Forecast Approach
    - Regression based model
    - 25 regression-based models
- Method for hourly forecast is very similar to that of Hawaiian Electric

Q&A for Panel

- This merging of cyclical forecasts can cause problems. An example would be a shortfall in the last year of the short term forecast. How would you accommodate that?
    - Generally, we would see that in the economic forecast. If year 5 is already going into long term, we would probably extend short term to even it out.
- For hourly shapes and other layers, did those come from Navigant?
    - Yes, they did.

Patrick McCoy, Sacramento Municipal Utilities District (SMUD)

- Load researchers looking at 2040, high probability will go from summer day peak to winter 4 am peak
- Currently feeder level, moving towards customer segments and aggregating up
- Agree that BASS model does not have enough variables that can be tweaked
- Data:
  - Metered hourly interval
  - PV production
  - LiDAR
  - Distribution Gird
    - Feeder
    - Substation
    - Service Transformer
  - Customer billing
  - Customer identifier
    - Account
    - Meter number
  - Forecasting horizon
    - Customer programs and services - 3 years
    - Distribution planning - 5 years
    - Load forecasting and resource planning - 20 years
  - Customer treatment
    - Residential: PRIZM segmentation, propensities
    - Commercial: currently economics (financial payback)
  - Modeling Technique:
    - Currently utilizing linear multi-variate regression model, Bass technology diffusion model utilized for first adoption forecast
  - Migrating to: logistic regression model
  - Developing DER adoption forecasting tool with Clean Power Research
  - Forecasting Impacts
    - Tariffs, programs and incentives
    - PV degradation and replacement
    - Technology cost curves

Q&A for Panel

- Do you take into consideration natural events like fires? Here we had to take into account the loss of homes from the lava impact. What about fires and homes loss? How do you assess that?
  - The eastern edge of past wildfires just starts to enter foothills, so they do not anticipate that type of wild fire in their area. Not affected by PG&E related fires either.

Next meeting tentatively set for August 27th to discuss assumptions.