Appendix A:
Quantitative Targets

This appendix articulates the targets for Humboldt County's electricity generation and use on the ten-year horizon that is outlined in RCEA's RePower Strategic Plan. The following sections lay out anticipated changes to electricity supply and demand due to buildout of new renewable energy resources, electrification of transportation and building energy use, and increased adoption of distributed energy.

Power Resources

The portfolio of local generation sources anticipated to meet Humboldt County's electricity demand in 2030 includes new and existing resources, as seen in Table 1. In addition to existing small hydroelectric and biomass facilities, two utility scale wind projects, one small hydroelectric facility, and several solar generators are considered feasibly developable without requiring the buildout of additional transmission capacity[1].

Table 1 Nameplate capacities of operational and potential renewable energy generators in the Humboldt Local Reliability Area.

Generator Name	Resource	Location	Operational Capacity (MW)	Potential Capacity (MW)
DG Fairhaven Power	biomass	Humboldt	15	15
Humboldt Sawmill Cogeneration	biomass	Humboldt	25	32.5
Baker Station Hydro Plant	hydro	Humboldt	1.5	1.5
Big Creek Water Works	hydro	Trinity	5	5
Gosselin Hydroelectric Plant	hydro	Trinity	2	2
Kekawaka Hydro Plant	hydro	Trinity	5	5
Three Forks Waterpower Project	hydro	Trinity	1	1
Boulder Creek Hydro Plant	hydro	Humboldt	not built, unplanned	8
Redwood Coast Airport Microgrid	solar	Humboldt	not built, planned	2
RCEA Feed-In Tariff Projects	solar	Humboldt	not built, planned	6
Humboldt Onshore Wind[2]	wind	Humboldt	not built, unplanned	125
Redwood Coast Offshore Wind	wind	Offshore	not built, planned	120
		Total	54.5	323

[1] Whether the Redwood Coast Offshore Wind Project would require transmission infrastructure upgrades is currently being analyzed by the California Independent System Operator via an interconnection study.

[2] Onshore wind is still considered a viable renewable resource but is not currently under development.

Figure 1 shows a comparison of RCEA's power mix, comprised of local biomass power and other non-local sources, and the potential renewable power supply for the entire county in 2030[3], comprised of local resources, most of which have yet to be built.

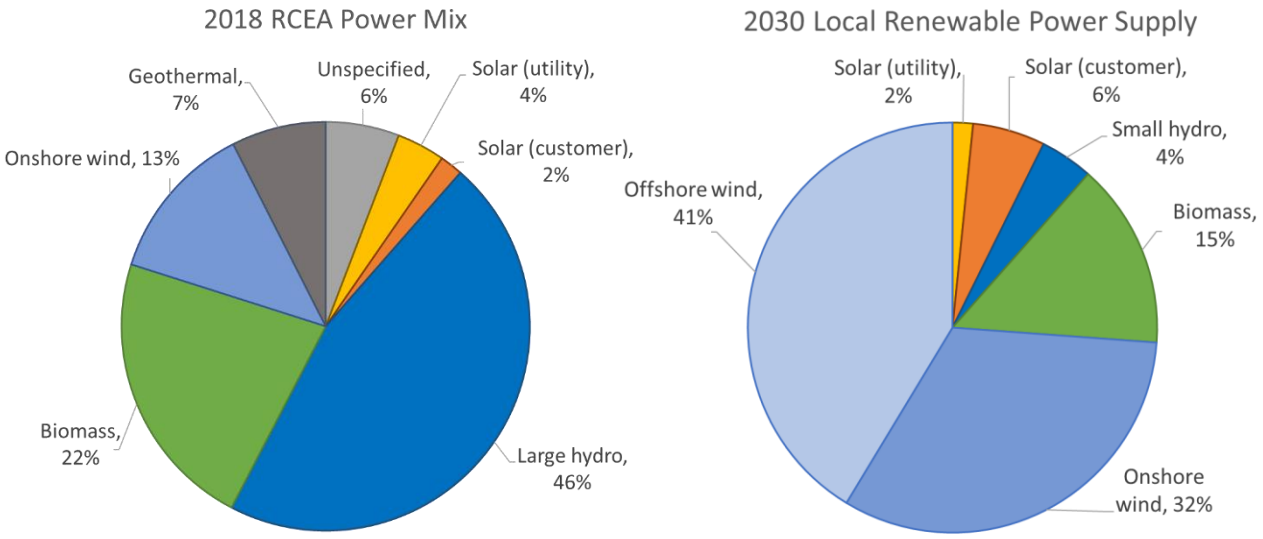
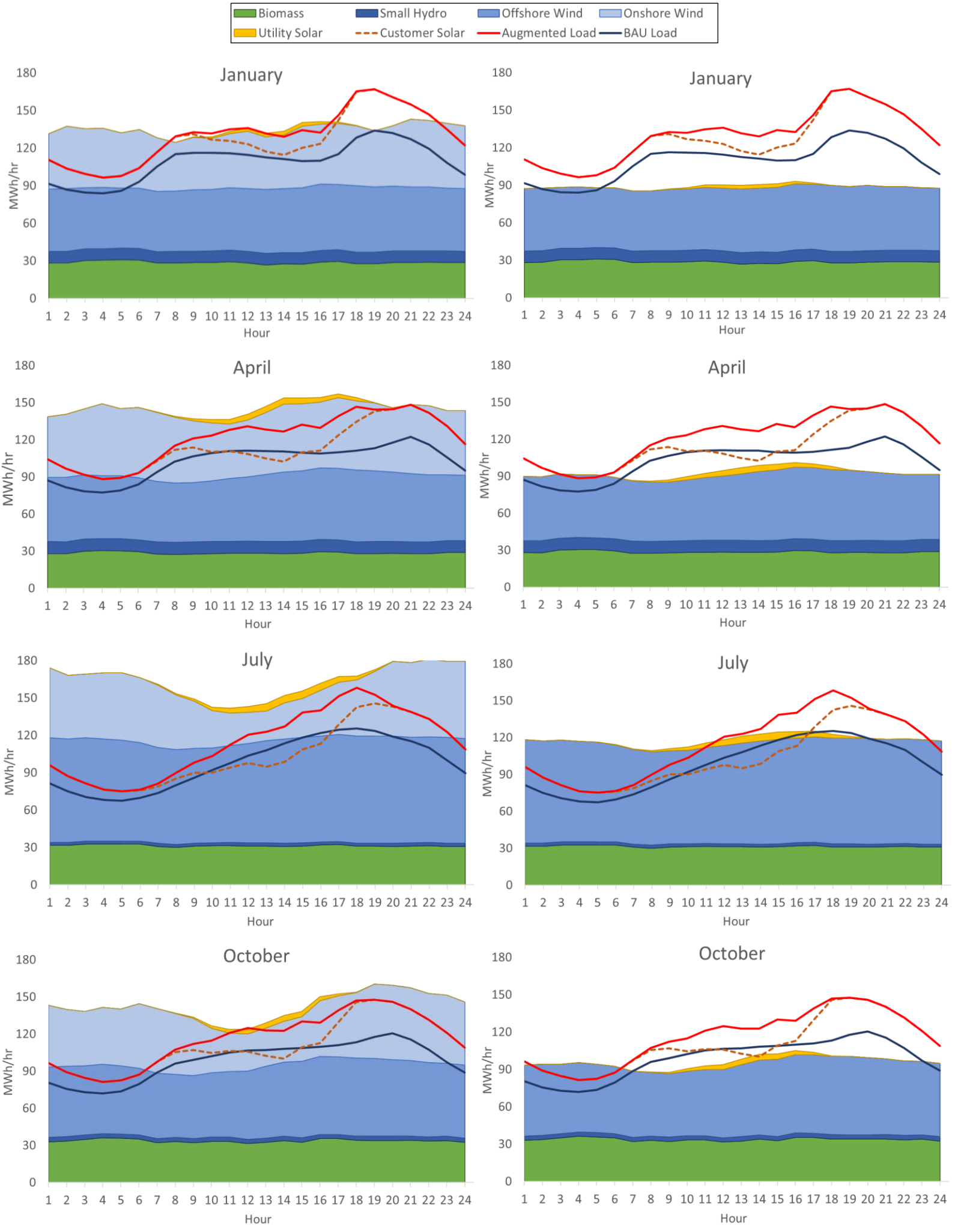


Figure 1 RCEA's 2018 power mix for Community Choice Energy customers and the potential renewable power mix for Humboldt County in 2030.

Figure 2 shows how average generation and load are projected to line up each hour of the day during each season in 2030, with the Humboldt Onshore Wind project included (left) and excluded (right). The stacked areas show how much the resource mix would generate each hour of the day, while the lines show forecasted load each hour of the day. The augmented load (red line) accounts for increased electricity demand due to electrification of vehicles and building energy use, while the business-as-usual (BAU) load (blue line) shows the demand without the additional electrification. The customer solar (orange dashed line) shows how much load would be served in the middle of the day by net energy metered (NEM) systems, assuming RCEA's aggressive NEM targets are achieved. The charts on the left contemplate Humboldt County as a net exporter of renewable electricity. The resource mix is intended to advise RCEA's 2020 Integrated Resource Plan to be submitted to the California Public Utilities Commission.

Figure 2 Comparison of the projected 2030 local renewable electricity supply and demand by season with (left) and without (right) the Humboldt Onshore Wind project.

[3] RCEA's power mix in 2030 may not exactly mirror the local renewable power supply, as it depends on what contractual power purchases are executed between now and then.


Biomass
Small Hydro
Offshore Wind
Onshore Wind
Utility Solar
Customer Solar
Augmented Load
BAU Load
January
April
July
October
MWh/hr
Hour
0
30
60
90
120
150
180
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Electricity Load

Transportation

According to Humboldt County's 2015 greenhouse gas inventory, the transportation sector is one of the greatest local sources of greenhouse gases, with most of the emissions coming from single-passenger vehicles. Light-duty vehicles are about 80% off all vehicles in the county. To support state and local GHG-reduction goals, RCEA is adopting the following targets for reducing transportation emissions. The two strategies identified are in vehicle miles traveled (VMT) reduction and electric vehicle (EV) adoption.

Vehicle Miles Traveled Reduction

The most effective way to reduce emissions from transportation is simply to reduce the number of miles traveled. Although other agencies such as Humboldt County Association of Governments and Humboldt Transit Authority will lead this effort, RCEA will facilitate a decrease in VMT using 2020 as a baseline. If these targets are met, annual VMT will be reduced by 400 million by 2030, equating to a 25% reduction from 2020 VMT levels.

Year	% VMT Reduction	VMT Reduced	Annual VMT with Reduction
2025	10%	170 Million	1.5 Billion
2030	25%	420 Million	1.2 Billion

Table 2 Vehicle miles travelled reduction targets for 2025 and 2030.

Electric Vehicle Adoption

The following table shows RCEA's five- and ten-year targets for facilitating the adoption of over 22,000 EVs, which should make up 19% of all light duty transportation in Humboldt County by 2030.

Year	BAU Light Duty EVs	RCEA Targets for Light Duty EVs	Additional Load (MWh/year)
2025	2,000	6,000	15,400
2030	3,700	22,000	57,400

Table 3 Current estimates and RCEA targets for electric vehicle adoption, and the annual electric load increase associated with the latter.

Building Energy Use

According to Humboldt County's 2015 greenhouse gas inventory, the second largest emitter after transportation is stationary combustion. This includes natural gas, propane, and wood fuel for both residential and non-residential energy users. RCEA is adopting the following targets to electrify natural gas and propane technologies associated with space heating, water heating, cooking, and other residential and commercial uses. Shifting homes and businesses from fossil fuels to electricity is known as fuel substitution.

Year	% Reduction in Natural Gas and Propane	Additional Load (MWh/year)
2025	10%	9,000
2030	20%	18,000

Table 4 RCEA's reduction targets for natural gas and propane[4] from electrification, along with the associated increases in electric load.

Customer Solar (NEM)

Grid-tied solar arrays that are interconnected on the customer side of the meter as opposed to the utility side are often referred to as net energy metered (NEM) systems. RCEA's 10-year plan aims to accelerate the NEM adoption rate and greatly increase the number of solar electric systems in Humboldt County. This includes systems installed under California Title 24 Building Code, which requires solar PV systems on all new residential construction under 3 stories starting in 2020.

RCEA's aims to accelerate the rate of NEM system installation to an annual average of 365 systems per year between 2020 and 2030, adding about 40 megawatts of additional solar capacity by the end of the decade. Roughly 90% of these systems are anticipated to be residential installations and 10% non-residential.

Year	Additional Solar Arrays	Added Capacity (MW)	Annual Generation (MWh/year)	Cumulative Added Generation (MWh)
2025	1,825	19.75	32,000	160,000
2030	3,650	39.50	64,000	320,000

Table 5 Number of additional solar electric systems installed per year by 2025 and 2030 along with their associated capacity and energy production.

[4] Percent reduction is based on residential and commercial natural gas and propane use and does not include use of those fuels for industrial processes and electric power generation.

Appendix B:
Assumptions and Methodologies

The RePower Strategic Plan is intended to be a comprehensive plan for all of Humboldt County, not just for customers served by RCEA's CCE program or for generators who currently supply power that serves those customers. Thus, the analysis attempts to account for all anticipated electricity supply and demand[5] within our community's reliability area of the electricity grid.

Power Resources

The Humboldt Local Reliability Area[6] (see Figure 3) and thirty miles off the Humboldt Coast are the geographic boundaries used to count existing and anticipated energy resources. The new resources are modelled at capacities that are feasibly developable by 2030 and don't require significant buildout of new transmission infrastructure. Below is a list of assumptions that are specific to certain resource types and facilities.

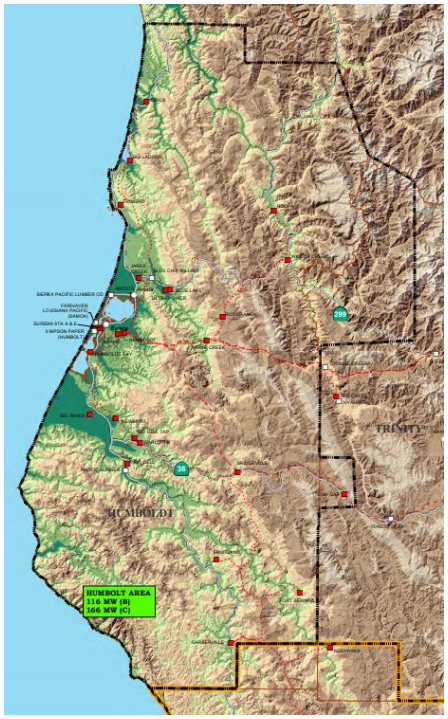


Figure 3 Humboldt Local Reliability Area

Resource-specific assumptions:

- Existing biomass and hydroelectric facilities are repowered and continue to operate at similar capacities to today's
- The annual generation profiles of all hydroelectric facilities are similar, scaled by their nameplate capacities, and are consistent hour by hour within a given month
- RCEA's Feed-in Tariff program is completely subscribed and all projects are solar photovoltaic with similar hourly generation profiles to that of the Redwood Coast Airport Microgrid project, scaled by their nameplate capacities
- The operational offshore wind capacity in 2030 is limited to one project within the Bureau of Ocean Energy Management's 2018 Humboldt Call Area

[5] This includes customers served by RCEA, PG&E, and Direct Access providers

[6] Humboldt Local Reliability Area as defined by the California Energy Commission includes some areas outside of Humboldt County's boundaries: https://ww2.energy.ca.gov/maps/reliability/LRA_Northern.html

- Humboldt Onshore Wind and Boulder Creek Hydro are included despite no current development plans, in keeping with language in this plan calling for development of onshore wind and small hydro resources

Sources of generation data:

Generator Name	Data Source
DG Fairhaven Power	Actual generation
Humboldt Sawmill Cogeneration	Actual generation
Baker Station Hydro Plant	CEC QFER Database
Big Creek Water Works	CEC QFER Database
Gosselin Hydroelectric Plant	CEC QFER Database
Kekawaka Hydro Plant	CEC QFER Database
Three Forks Waterpower Project	CEC QFER Database
Boulder Creek Hydro Plant	Oscar Larson & Associates Report[7]
Redwood Coast Airport Microgrid	Schatz Energy Research Center
RCEA Feed-In Tariff Projects	Schatz Energy Research Center
Humboldt Onshore Wind	Estimated from proprietary data
Redwood Coast Offshore Wind	Estimated from proprietary data

Electricity Load

Hourly Load Forecast

RCEA's hourly load forecast generated by The Energy Authority (TEA) is used as the business-as-usual (BAU) load forecast. A load factor of 1.18 is applied to include opted out and Direct Access customers, those who are not currently served by RCEA's CCE Program.

Transportation Load

Reduction in Vehicle Miles Traveled

Although RCEA won't be the main agency driving VMT reduction, reduction targets are set across all vehicle and fuel types. The 2017 mobile source emissions model from California Air Resources Board's EMFAC database[8] is used to project VMT for 2020. The forecast provides a baseline to calculate a 10% and 20% VMT reduction for years 2025 and 2030, respectively.

[7] Larson, O. & Associates. (1982). "An Analysis of Small Hydroelectric Planning Strategies." A Report to the Humboldt County Board of Supervisors.

[8] https://www.arb.ca.gov/emfac/2014/?_ga=2.114116750.862177112.1570490806-866086873.1536797044

Calculations for reductions in VMT:

$$RCEA\ VMT\ Reduction\ Goal = 2020\ VMT - (2020\ VMT * \%\ Reduction)$$

$$VMT\ Per\ Vehicle\ Type\ and\ Fuel\ Type = \left(\frac{BAU\ VMT\ per\ Vehicle\ and\ Fuel\ Type}{Total\ VMT}\right) * RCEA\ VMT\ Reduction\ Goal$$

Electric Vehicle Adoption

The 2017 mobile source emission model by EMFAC[9] is used to forecast vehicle population, vehicle type, and fossil fuel consumption for 2020, 2025, and 2030. Light-duty (LD) electric vehicle (EV) kWh consumption is provided by Humboldt County's 2015 greenhouse gas inventory[10] and assumes that EVs will make efficiency gains at the same rate as fossil fuel vehicles. Efficiency gains for medium- and heavy-duty EVs are not accounted for.

RCEA EV adoption goals are determined using the BAU EV forecasts and the California State goal to reach 80% below 1990 emissions by 2050. These targets will place Humboldt County on a trajectory to replace all light-duty gasoline vehicles with EVs by 2050. The difference between the BAU forecast and RCEA's goal is the additional electric load attributed to the significant increase in electric vehicles. It is assumed that the additional EVs will replace gasoline light-duty vehicles.

Calculations for RCEA's EV Adoption Goals:

$$Number\ of\ added\ EVs = BAU\ EV\ Pop - (\ LD\ Vehicle\ Pop\ * RCEA's\ EV\ \%\ Goal)$$

$$Annual\ MWHs\ per\ EV = \frac{\left(VMT\ per\ day * \frac{kwh}{mile} * 365\ days\right)}{EV\ Pop}$$

$$Annual\ MWHs\ added\ from\ RCEA's\ EV\ Goal = Number\ of\ added\ EVs * Annual\ MWH\ per\ EV$$

Electric Vehicle Load Curve

The Humboldt weekday load profile from the CEC Infrastructure Projection EVI-Pro Tool[11] is used to estimate future electric vehicle charging times. Potential load shifting due to future time-of-use incentives or demand response is not modelled.

[9] https://www.arb.ca.gov/emfac/2014/?_ga=2.114116750.862177112.1570490806-866086873.1536797044
[10] 2015 Humboldt County Emissions Inventory will be made available to the public early 2020
[11] https://maps.nrel.gov/cec/

Building Energy Use

Residential Fuel Substitution

An average household's gas-based heating fuel usage in Humboldt County is estimated using the CEC's natural gas consumption data[12] and Census Bureau data on House Heating Fuel[13]. Data collected from RCEA's home energy assessments[14] is used to estimate the usage by other appliances and fuels across the County.

The electricity use of household air- and water-source heat pumps is calculated using the formulas below. A conversion factor for gas (expressed in kWh) consumption to heat pump kWh of approximately 1/3 was calculated for fuel substitution.

Calculation for heat output of an 80% efficient natural gas furnace expressed in kWh:

$$kWh(out) = NG\ Therms\ (in) \times 29.3 \frac{kWh}{Therm} \times 80\%\ Efficiency$$

Calculation for heat pump electricity usage equivalent to 80% efficient furnace output, with coefficient of performance (COP) of 4.0:

$$HP\ kWh\ (in) = \frac{kWh\ (out)}{4.0\ COP}$$

Calculation for kWh of natural gas (NG) input converted to kWh of electricity through fuel substitution:

$$Heat\ Pump\ kWh\ (in) = NG\ kWh\ (in) \times 80\% \div 4.0 = NG\ kWh\ (in) \times 0.2$$

$$Heat\ Pump\ kWh\ (in) \approx \frac{NG\ kWh(in)}{5}$$

Residential Load Curves

To estimate the seasonal load increase due to residential fuel substitution, the load curves are based on annual usage calculated for each appliance-fuel combination and PG&E's heating degree days for climate zone 1. Hourly load curves for lighting are adapted from scientific papers by the National Renewable Energy Laboratory (NREL) and the U.S. Department of Energy[15] , as well as articles published in the journal *Applied Energy*[16]

Non-Residential Fuel Substitution

[12] https://ecdms.energy.ca.gov/
[13] https://factfinder.census.gov/
[14] Residential assessment data from 2012 to present collected by the Redwood Coast Energy Authority and compiled in the Energy Assessment Survey Tool (EAST). 4279 data points.
[15] https://www.nrel.gov/docs/fy16osti/64904.pdf
[16] https://www.sciencedirect.com/science/article/pii/S0306261917308954

Due to a lack of data on space and water heating in the non-residential sector and the wide variety of end-uses for natural gas and propane, non-residential fuel is modeled with a flat seasonal load curve using the annual fuel consumption from the CEC's data on energy consumption in Humboldt County[17]. Propane consumption is estimated using the percentages from the 2005 Humboldt County General Plan Energy Element.

Customer Solar (NEM)

The NEM Currently Interconnected Data Set from the California Solar Initiative (CSI) Database[18] provides historic solar PV installation rates that advise RCEA's NEM adoption targets. In 2018, around 280 new solar NEM systems were interconnected in Humboldt County. Of those 280 systems, 270 were residential installations and 10 were non-residential. RCEA's target increases the annual number of interconnected PV systems to 365 per year, or a rate of 1 system installed per day, with similar proportions of residential and non-residential adoption as historical rates.

Using the average system size for residential and non-residential PV arrays, system size of future installations is anticipated to be slightly larger due to assumed increases in solar cell efficiencies and building electricity usage due to EV charging. The anticipated system size is 6 kW for residential and 50 kW for non-residential. A solar calculator designed for RCEA's Public Agency Solar Program using solar insolation data from NREL[19] provides estimates for 2025 and 2030 electricity generation at the anticipated total NEM adoption capacity. Decommissioning of NEM systems and degradation of photovoltaic cell efficiency over time is not accounted for in the analysis.

The generation profile of NEM systems is assumed to be similar to that of the Redwood Coast Airport Microgrid project, scaled by nameplate capacity. The production of these additional NEM systems will decrease the electric load in the middle of the day.

[17] https://ecdms.energy.ca.gov/
[18] https://www.californiadgstats.ca.gov/downloads/
[19] https://pvwatts.nrel.gov/