Resource Combinations to Achieve 100% Renewable Power (Oahu focus)

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Framework for Achieving 100% Renewable Power

• Meet overall energy requirements
  – Build wind projects where appropriate/suitable (up to ~300 MW on Oahu)
  – Build a lot of solar power (2,000–3,000 MW)
  – Use biofuels as needed/appropriate (0-16% of energy)

• Meet hourly energy requirements
  – Harness demand response via real-time electricity pricing (300 MW?)
    • Same loads can also provide “spinning” reserves
  – Build pumped hydroelectric storage if cost-effective (150 MW+)
  – Build as much battery capacity as needed (100–400 MW)
  – Fill in with biofuel or hydrogen when needed (400-600 MW)

• Meet seasonal energy requirements
  – Use biofuel or hydrogen on low-sun days
    • Produce hydrogen on high-sun / high-wind days
Daily Energy Balance, 100% Renewable

### Hourly Power Production (MW)

- Curtail Wind
- Curtail Solar
- Generate from Hydro
- Discharge Batteries
- Solar
- Wind
- Diesel
- LSFO-Diesel-Blend
- LNG
- Hydrogen
- Biodiesel
- Pellet-Biomass
- Coal
- H-POWER
- Marginal Cost (p.u.)

### Hourly Power Consumption (MW)

- Charge EVs
- Responsive Demand
- Store Hydro
- Charge Batteries
- Liquify Hydrogen
- Produce Hydrogen
- Nominal demand
Year-Round Energy Balance with 16.5% Biofuels (~20.7¢/kWh avg. production cost)
Year-Round Energy Balance with 5% Biofuels (~22.0¢/kWh)

Hourly Power Production (MW)

Hourly Power Consumption (MW)

Curtail Wind
Curtail Solar
Generate from Hydro
Discharge Batteries
Solar
Wind
Diesel
LSFO-Diesel-Blend
LNG
Hydrogen
Biodiesel
Pellet-Biomass
Coal
H-POWER
Marginal Cost (p.u.)

Charge EVs
Responsive Demand
Store Hydro
Charge Batteries
Liquify Hydrogen
Produce Hydrogen
Nominal demand
Year-Round Energy Balance with Hydrogen (~20.4¢/kWh)

Hourly Power Production (MW)

Hourly Power Consumption (MW)
Year-Round Energy Balance with No New Renewables (~19.7¢/kWh; higher if EVs charge on peak)

Hourly Power Production (MW)

- Curtail Wind
- Curtail Solar
- Generate from Hydro
- Solar
- Wind
- Diesel
- LSFO-Diesel-Blend
- LNG
- Hydrogen
- Biodiesel
- Pellet-Biomass
- Coal
- H-POWER
- Marginal Cost (p.u.)

Hourly Power Consumption (MW)

- Charge EVs
- Responsive Demand
- Store Hydro
- Charge Batteries
- Liquify Hydrogen
- Produce Hydrogen
- Nominal demand