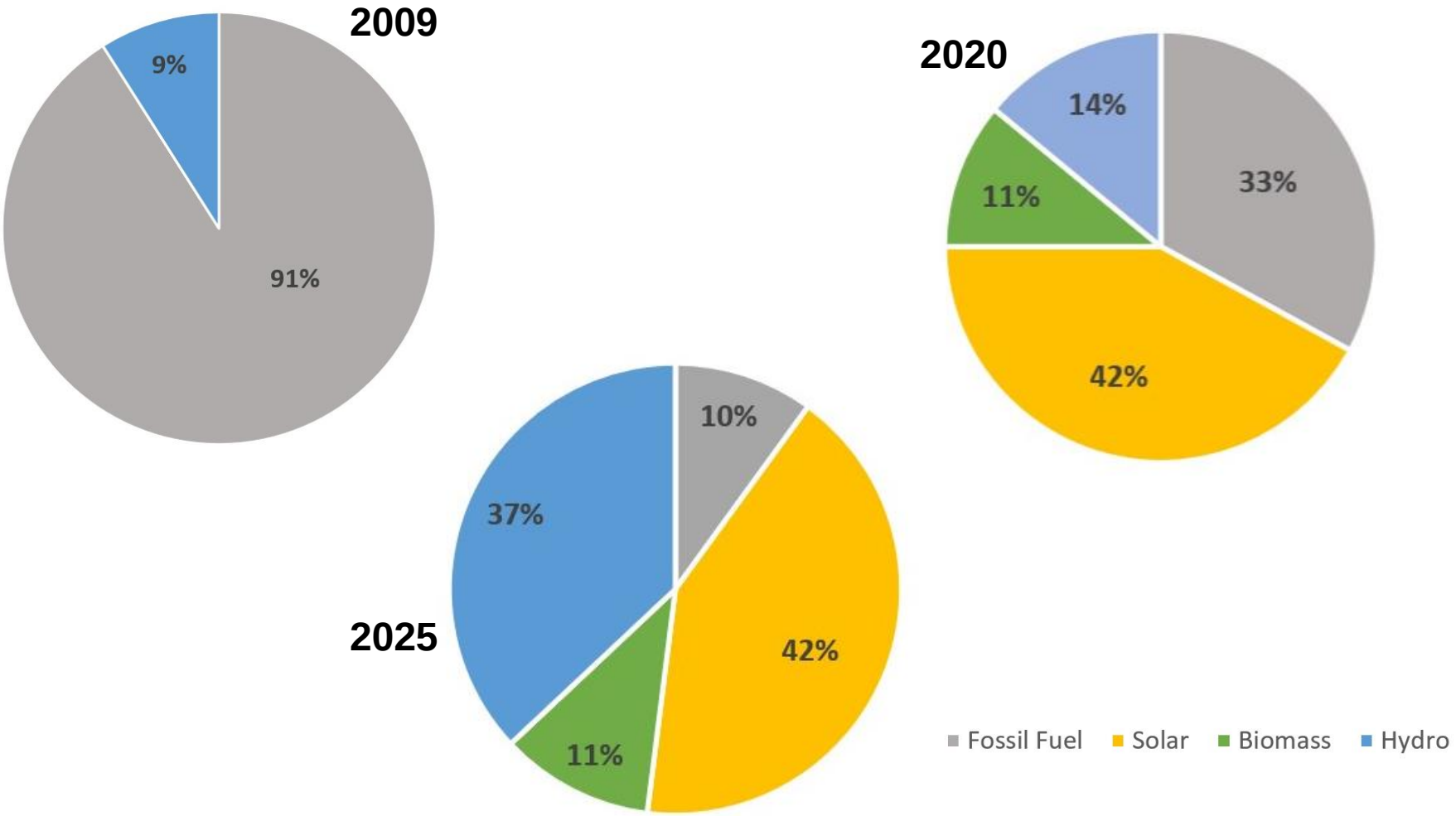
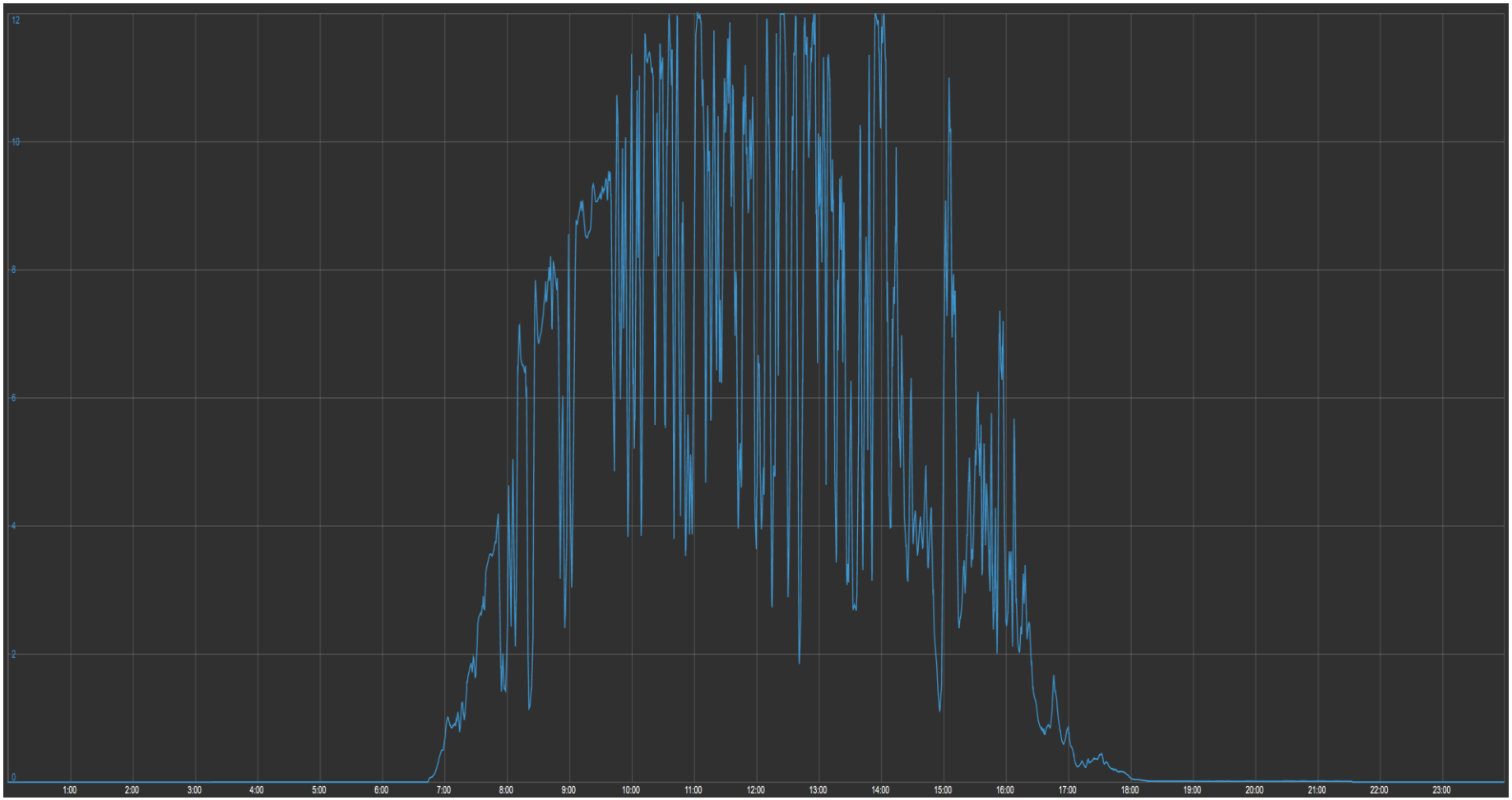
west kaua'i energy project

Talk Story Tuesday
November 9, 2021

Where Kaua‘i Gets Its Energy



Anahola Direct to Grid Solar



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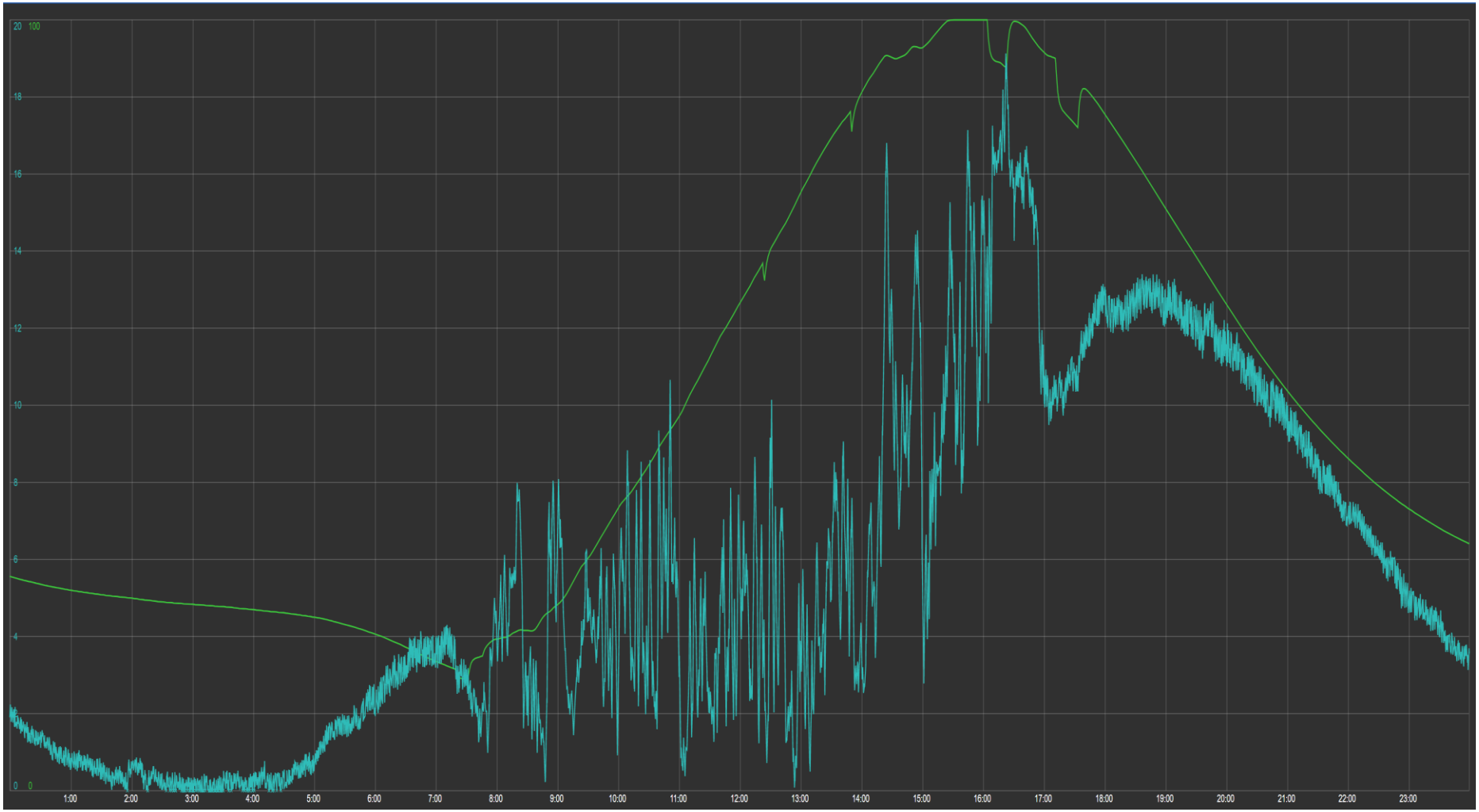
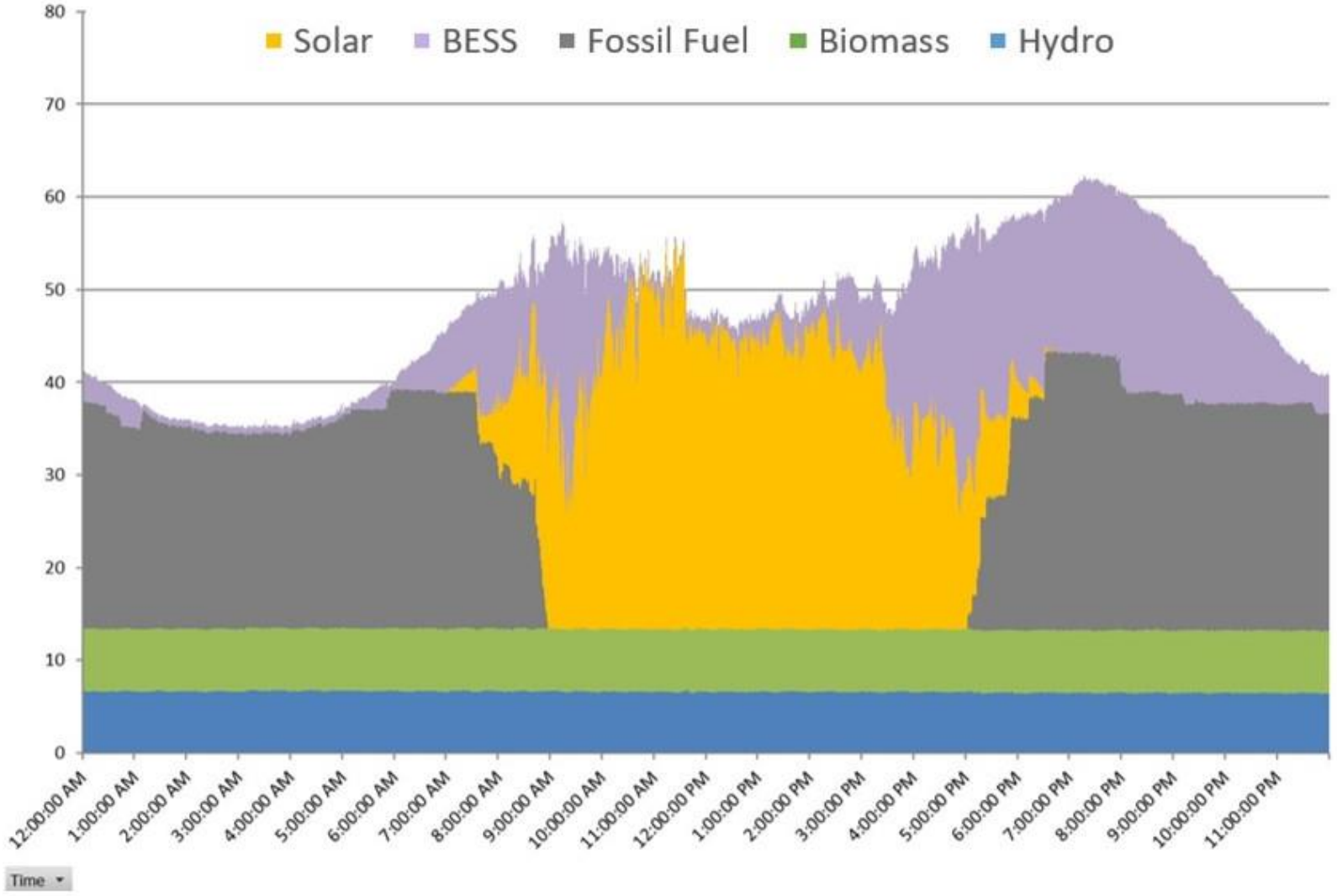
Lāwa‘i Aepo Solar + BESS



Typical Daily Dispatch



Why Solar and Hydro?

- Commercially available renewable sources:
  - Geothermal (not feasible for Kaua‘i)
  - Biomass (expensive at Kaua‘i scale)
  - Wind (not feasible due to endangered species)
  - Hydro
  - Solar

- Solar and hydro are currently the only two viable options to increase KIUC’s renewable percentage

Solar on Kaua‘i

- First solar system installed 2001; over 5,300 systems now
- Total of 75 MW of solar systems without any storage
  - Exceeds Kaua‘i's mid-day demand of 50-65 MW
- Another 47 MW of solar system with storage
  - Most of this energy is stored for use at night; 4-5 hour dispatch
- Solar energy provided 42% of Kaua‘i electricity in 2020
  - 2x other HI islands; 4x California or Germany

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Hydro on Kauaʻi

- First hydro installed 1905; seven hydro sites now
- Total of 16 MW of hydro; provided 14% of Kauaʻi electricity in 2020
- All hydros on Kauaʻi are run-of-river, meaning they do not rely on large dams that store water, but instead use stream diversions and ditch systems
- Past diversions were constructed to take all low flows, which caused stream flow to be interrupted during dry times

Note: WKEP will modify existing diversions so that they do not take all low flows, ensuring that streams will always flow

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Kaua‘i’s renewable challenge

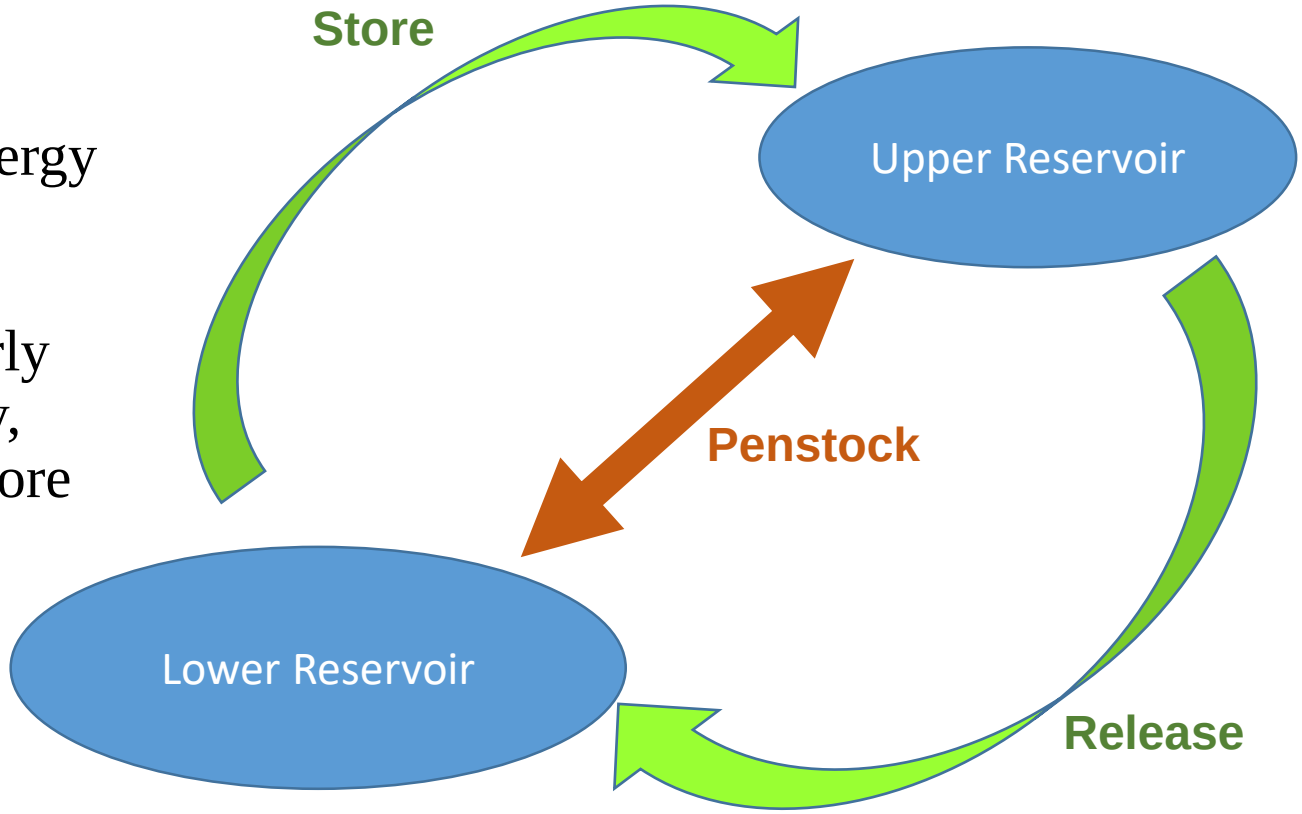
- 100% of Kaua‘i’s daytime demand for electricity routinely met by renewables

- Solar and battery limitations
  - Sun dependent
  - Short duration storage

- Long-duration storage needed to achieve 100% renewable at night and during prolonged periods without solar

What is Pumped Storage Hydro (PSH)?

- Centuries-old technology
- PSH is a type of hydroelectric energy storage.
- PSH acts similarly to a giant battery, because it can store power and then release it when needed.



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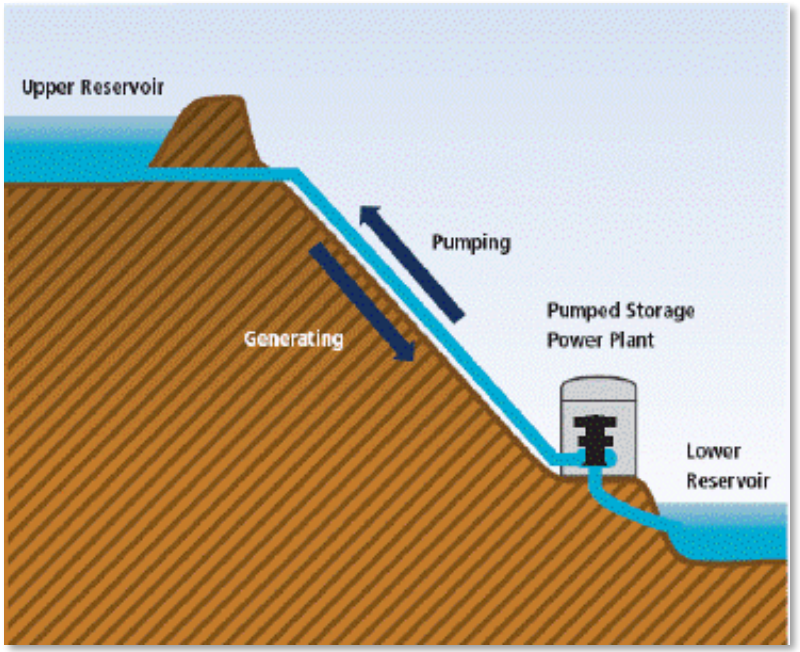
Types of Pumped Storage Hydro

- Open Loop: Projects that are continuously connected to a naturally flowing water feature

- Closed Loop: Projects that are not continuously connected to a naturally flowing water feature



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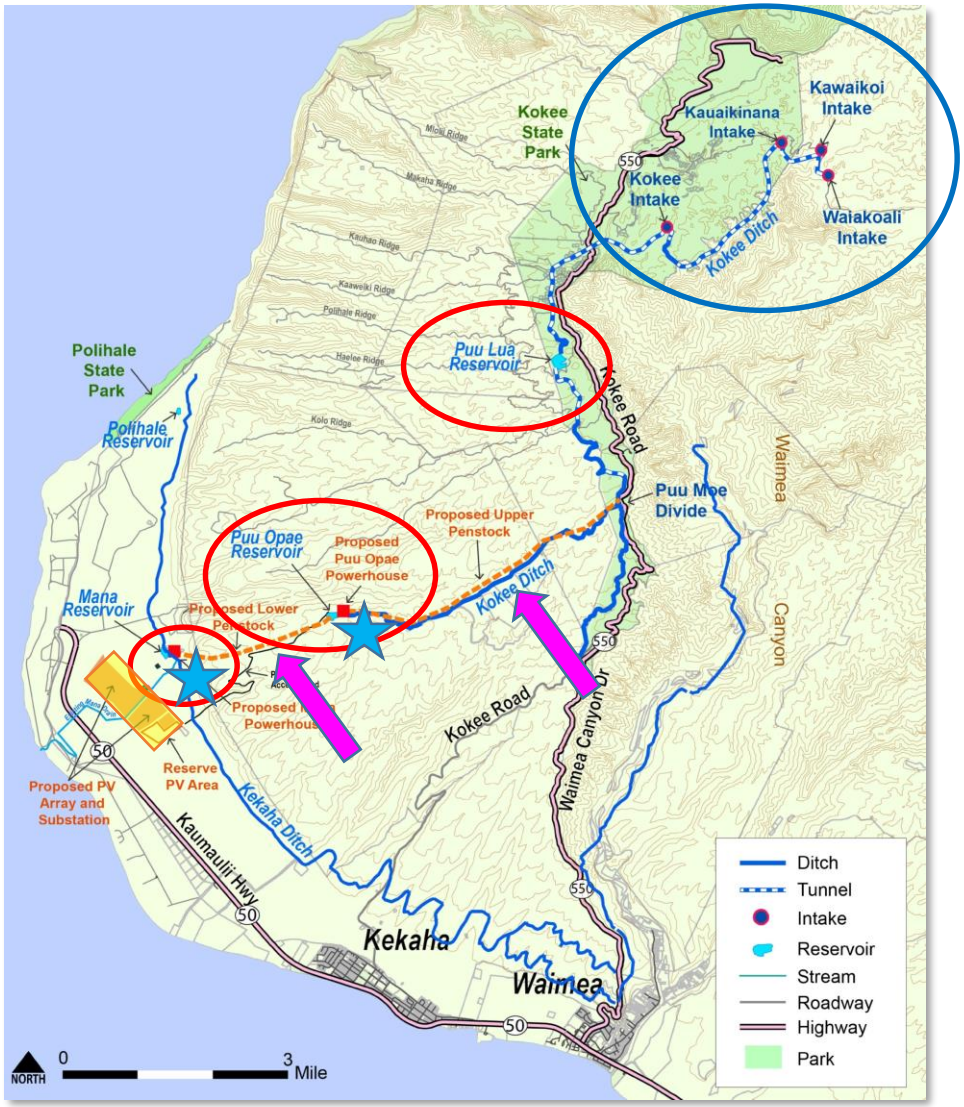
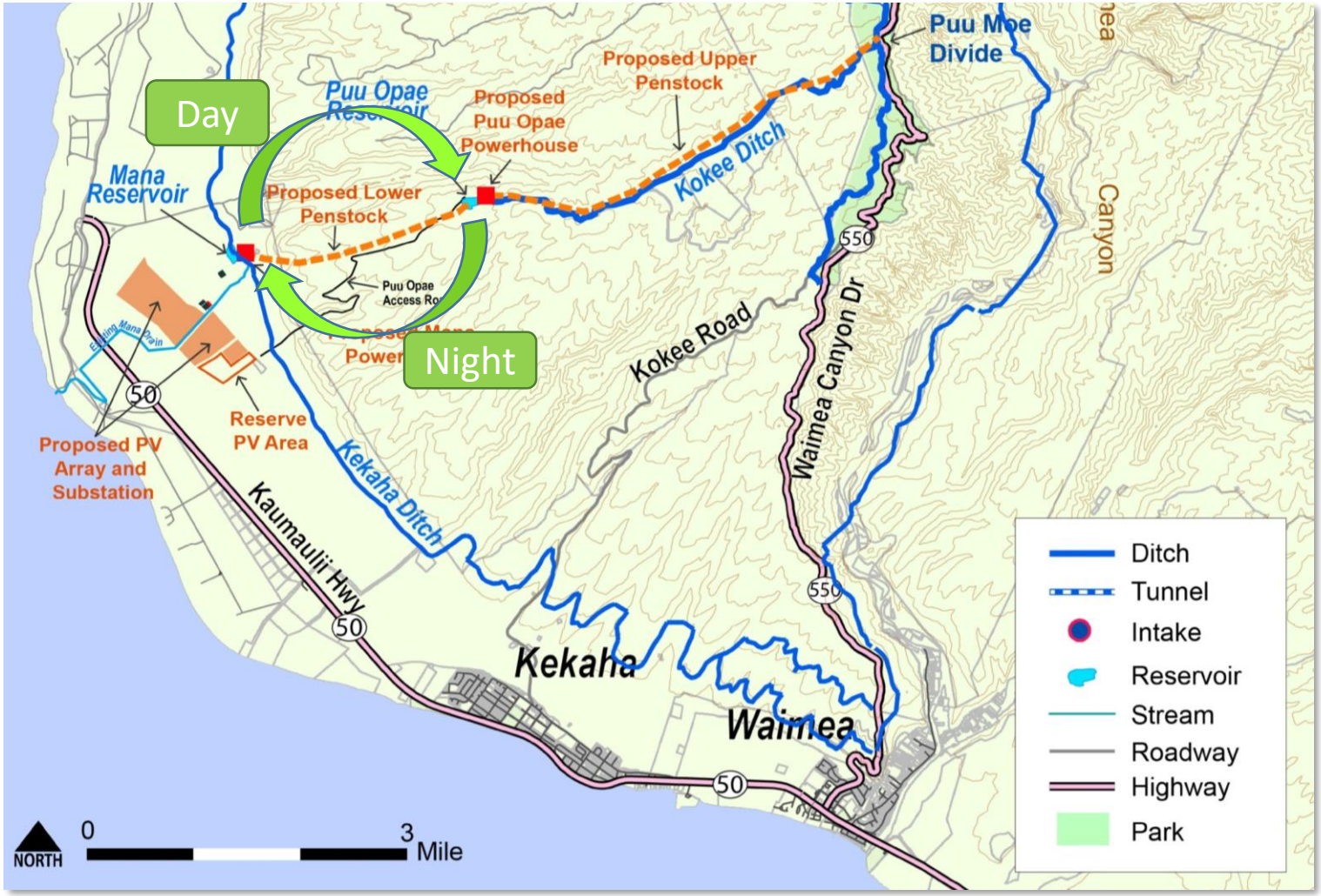
WKEP Innovative Open Loop System

- Kōkeʻe diversions supply water
- Water moves downhill between Puʻu Lua, Puʻu ʻŌpae, and Mānā Reservoirs
- Two sections of buried pipeline
- Two powerhouses/substations
- Solar + battery facilities will pump from Mānā Reservoir to Puʻu ʻŌpae Reservoir



WKEP Solar + Pumped Storage Hydro



How much solar is needed?

- Determined by how much water needs to be pumped uphill to fill Puʻu ʻŌpae each day
  - Requires 35 MW of pumps pushing water uphill during daylight hours
  - Clouds will cause intermittent power fluctuations; 2-hour battery required to maintain consistent pumping
- **Solar + Battery = 35 MW plus 70 MWh battery storage**
- Puʻu ʻŌpae, when full, can power the 20 MW Mānā hydro turbine for 12 hours
- This will eliminate most of KIUC's remaining fossil fuel use

Why not use rooftop solar?

- Rooftop solar costs 4x more than large, ground mounted solar and only produces half as much energy
  - $4,000 per kW installed vs. $1,000 per kW
  - 18-20% average Capacity Factor vs 30%
  - Would require significant transformer upgrades
- Rooftops are highly variable with respect to capturing the sun's energy
- Rooftop solar is difficult to operate and maintain; to control pumps using rooftop solar would require much larger battery

Bottom-line: using rooftop solar would significantly increase electric rates

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Why use ADC land?

- Energy is best produced close to the point of consumption (pumps):
  - Pumps to be located at Mānā Reservoir
  - Mānā Reservoir is surrounded by ADC land
  - Parcel is less than ½ mile from reservoir

Why use ADC land?

- ADC manages 14,276 acres of agricultural land in Mānā
  - 350 acres (2.4%) to be used for WKEP solar facility
  - 6,000 acres still vacant per ADC 2020 Annual Report
- Parcel was chosen by ADC/KAA
  - Less ideal due to water retention issues and heavy clay content
  - Has been in limited use in recent years
  - Land use regulations require an agricultural component

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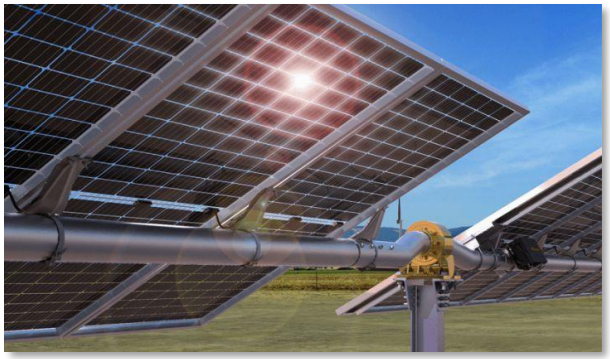
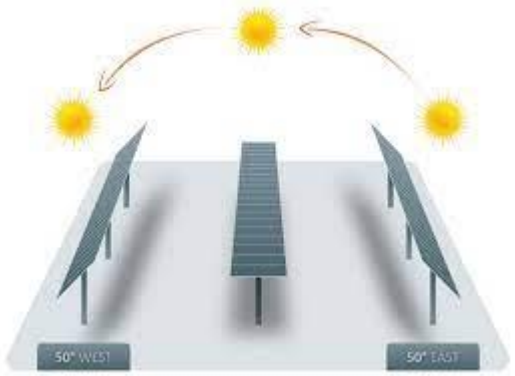
Solar Technology & Efficiencies

- Solar Panels
  - Consistently improving efficiency; 550+ W panels for WKEP
  - “Bi-facial” technology captures sun from front and back of panel
  - Result is **less land use for solar**
- Mounting System
  - “Trackers” follow the sun across the sky
  - Over 30% more clean energy per panel than traditional fixed tilt
  - Result is the **more energy at lowest cost**





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Solar Long-Term Considerations

- There will be a **compatible agricultural use** within the solar area
- **Minimal grading** & ground disturbance, panels installed with natural contours of the land

- AES will have a **decommissioning plan and fund** to ensure money set aside at day one for removing the solar system at its end of life.
- Equipment will be recycled off island or re-used. Useful raw materials will be salvaged. **No major equipment in landfills.**

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Mahalo and Questions