Current Generation Mix

- Not Flexible
  - 12 HECO Steam Units
  - AES Coal Fired Unit
  - Characteristics
    - 3 to 24 hours to start
    - 2.5 to 5 MW/Min Ramp
    - Poor turndown*
    - Corrosion and other concerns with long term shutdown
- Flexible
  - SGS (6 RICE)
    - Fuel Flexible
    - Offline to Full load: 6 minutes
  - HECO Combustion Turbines (CTs)
    - 20 to30 minute start time
    - Ramp 4 to 13 MW/Min
  - KPLP

* HECO has made significant progress in developing turndown processes at existing steam units but long term reliability and maintenance cost issues exist. Restoration from low load operation takes ~ 2 hours

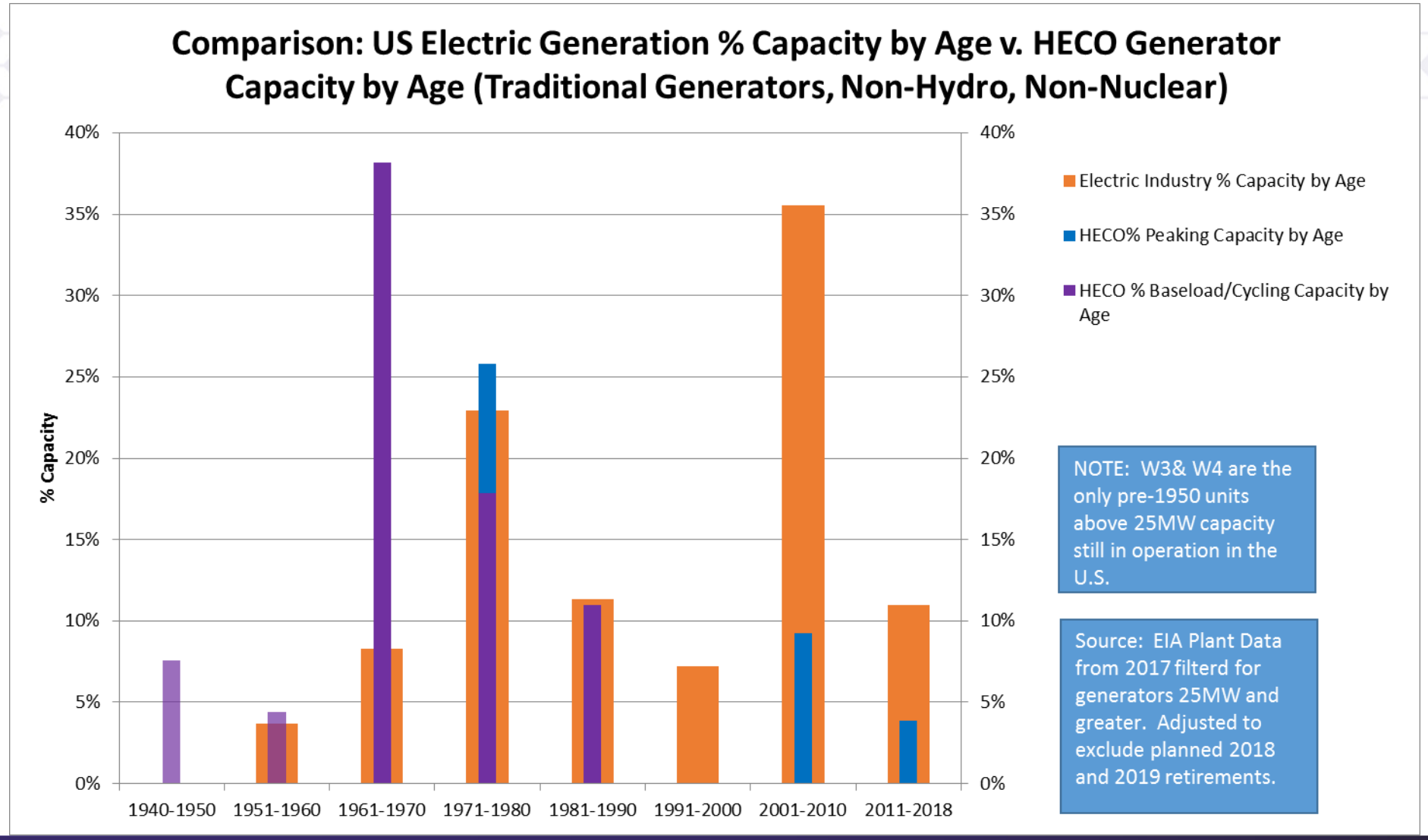
Hawaiian Electric Generating Fleet Age

- Steam Unit Age
  - 55 years average age
  - 9 of 12 units over 50
  - 1 of 12 less than 40
- Peaking Units
  - 2 of 4 approaching 50 years old
- AES Retire: 2022
- KPLP approaching 30 years

- Note: from HECO 2020 TY Rate case. Age based on unit age in 2020

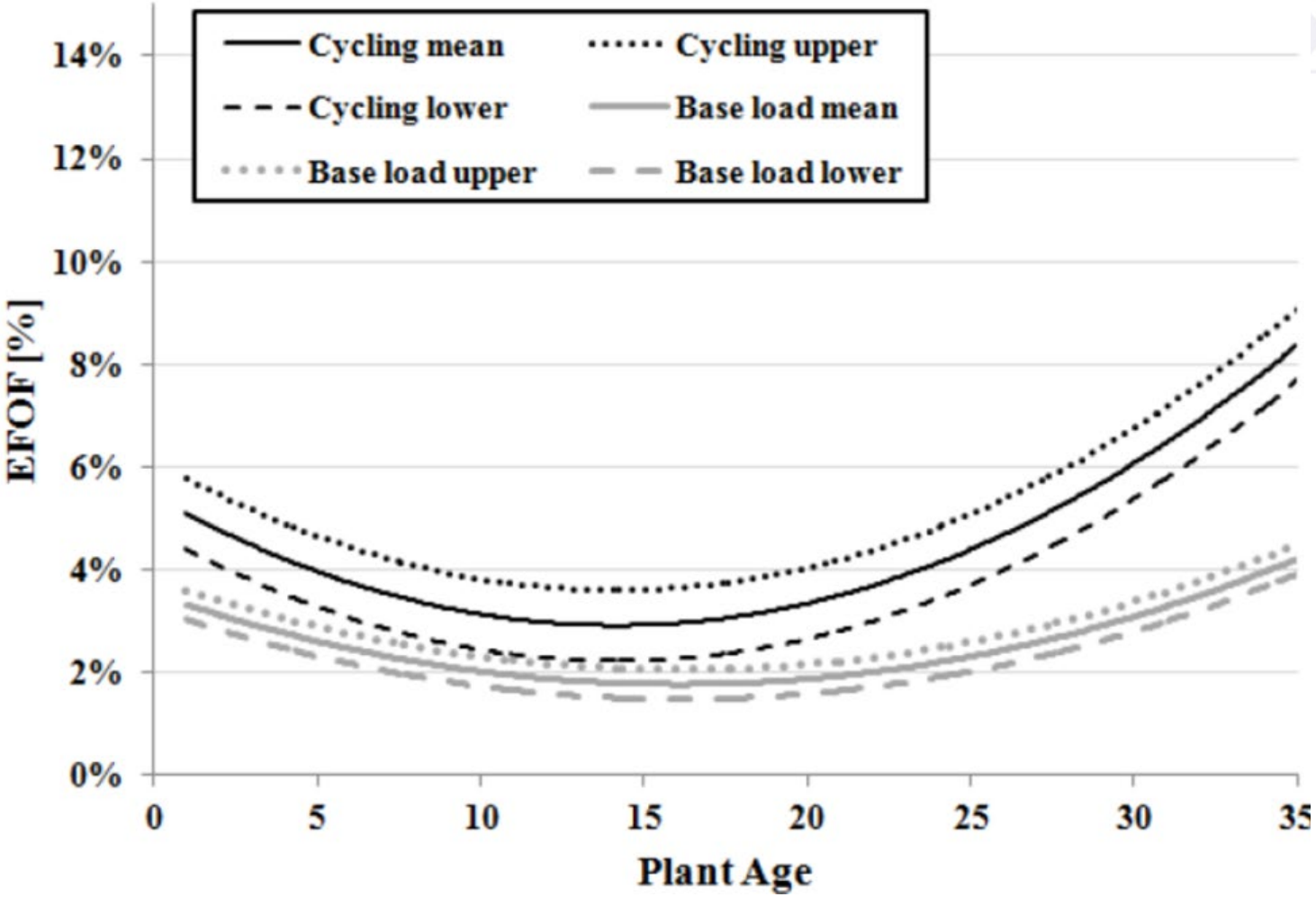
Unit	Type/Fuel	Capability		Year Commercial	Age
		Gross MW	Net MW		
Kahe 1	Reheat Steam/LSFO	86	82.2	1963	57
Kahe 2	Reheat Steam/LSFO	86	82.2	1964	56
Kahe 3	Reheat Steam/LSFO	90	86.2	1970	50
Kahe 4	Reheat Steam/LSFO	89	85.3	1972	48
Kahe 5	Reheat Steam/LSFO	142	134.6	1974	46
Kahe 6	Reheat Steam/LSFO	142	133.8	1981	39
Waiau 7	Reheat Steam/LSFO	87	83.3	1966	54
Waiau 8	Reheat Steam/LSFO	90	86.2	1968	52
Total Baseload/Load		812	773.8	Average Age	50.25
Waiau 3	Non-Rehate Steam/LSFO	49	47	1947	73
Waiau 4	Non-Rehate Steam/LSFO	49	46.5	1950	70
Waiau 5	Non-Rehate Steam/LSFO	57	54.5	1959	61
Waiau 6	Non-Rehate Steam/LSFO	56	53.7	1961	59
Total Cycling Capability		211	201.7	Average Age	65.75
Waiau 9	Simple Cycle CT/ Diesel	53	52.9	1973	47
Waiau 10	Simple Cycle CT / Diesel	50	49.9	1973	47
CIP CT-1	Simple Cycle CT / Diesel	113	112.2	2009	11
SGS	RICE/Biodiesel	50	50	2018	2
Total Peaking Capability		216			26.75

Hawaiian Electric Generating Fleet Age



- Note: Does not include firm IPPs

EPRI: Plant Age v. EFOR



- **2000 – 2017 US Coal Fleet Operation**
- Baseload Operation (<10 starts per year)
  - EFOR 5-6%
- Extended Shutdown
  - EFOR ~ 7%
- Load Following (SF >70, CF <60)
  - EFOR -7%
  - HECO RH Unit Operation
- Min Load Operation
  - EFOR >7%
- On/Off Cycling
  - EFOR 11-12%

Cost with Long Term Operation

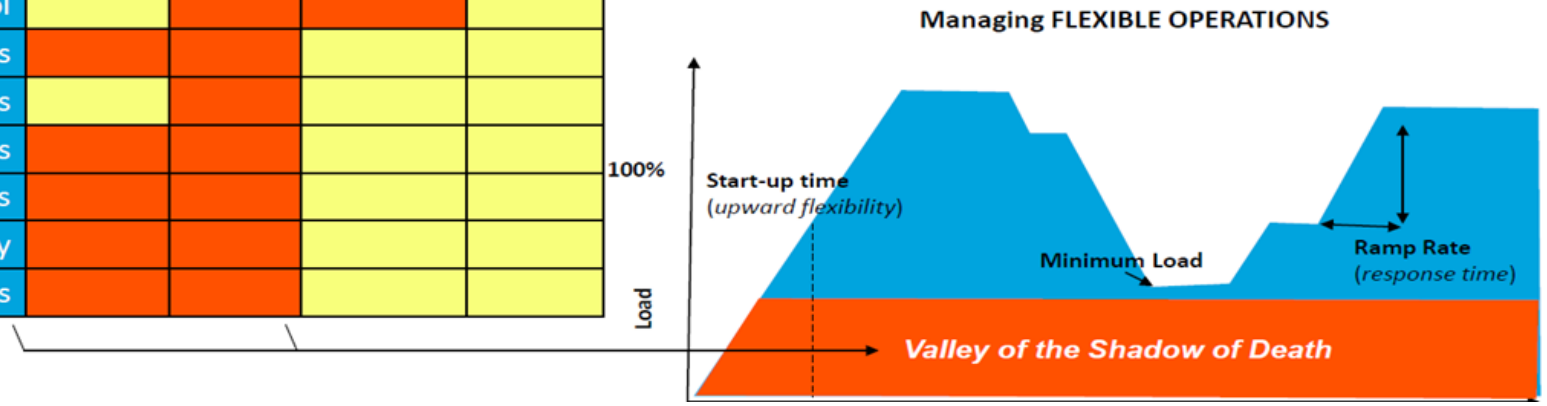
- Increased Forced Outages
- Increased O&M
- Increased Capital Expenditures between now and 2045
  - $980M (in 2016 dollars)

- Safety Risk:
  - Failure of High Temp/High Pressure Components
  - Failure of Rotating Equipment

Cost with Long Term Operation

Major Challenges: 0 – 30% MCR

Flexibility Challenges: *Boiler, Turbine, BOP, Environmental*	Cycling On/Off	Turn Down	Fast Ramping	Load Cycling
Equipment Turndown				
Burners/Combustion Stability				
Boiler Circulation				
Pressure Part Damage				
Fans/Motor Reliability				
Ramp Rate				
Steam Temperature Control				
Air Heater Issues				
Environmental Control Systems				
Turbine Thermal Stresses				
Condenser Issues				
Water/Steam Cycle Chemistry				
FW Pumps & Motors				



- EPRI: General rule of thumb for fleet planning: On average over the life of assets, EFOR will increase 0.006% per lifetime start for subcritical drum units.
- → W5/6 currently have over 250 starts per year. RH units 3-5 but expecting hundreds.

Source: EPRI

Summary

- Existing Firm Generation
  - Currently necessary
  - Currently aging and challenged
  - Expect increased O&M and Capex with current operating profiles
  - Not well suited for future operating mission profiles

- Generating units will continue to be necessary

- Desired Generation Characteristics
  - Quick Starting
  - Low or no minimum run time
  - Turndown capability
  - Quick ramping

IGP Order No. 36725

Providing Guidance

IGP Order No. 36725 Providing Guidance

Independent Evaluation

- Commission sees value in third party technical expertise for IGP decision-making
- Expects the Companies to use the Technical Advisory Panel to provide independent review of each Review Point filing

Review Points

- Filings should specify how efforts were coordinated with related dockets, describe how stakeholder feedback has been incorporated into the IGP process, and update timelines to reflect any major changes

Timelines

- Understandable that the first iteration of IGP may take longer than planned
- Companies should allow themselves enough time to complete the necessary steps
- Companies should develop and update timelines as needed and consider presenting at WG, SC, and TAP meetings
  - At minimum each review point filing should contain an updated timeline
- Notify the commission if addition clarity on timelines is required for any docket upon which IGP depends

Next Steps

- Work towards finalizing the IGP Solution Sourcing Diagram to begin development of individual process step details
- Discuss the set of grid service needs and their definitions that will be identified by the planning models in the first IGP cycle