MAUI

The Transformation Continues

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Lessons Learned on Reducing Curtailment on Maui

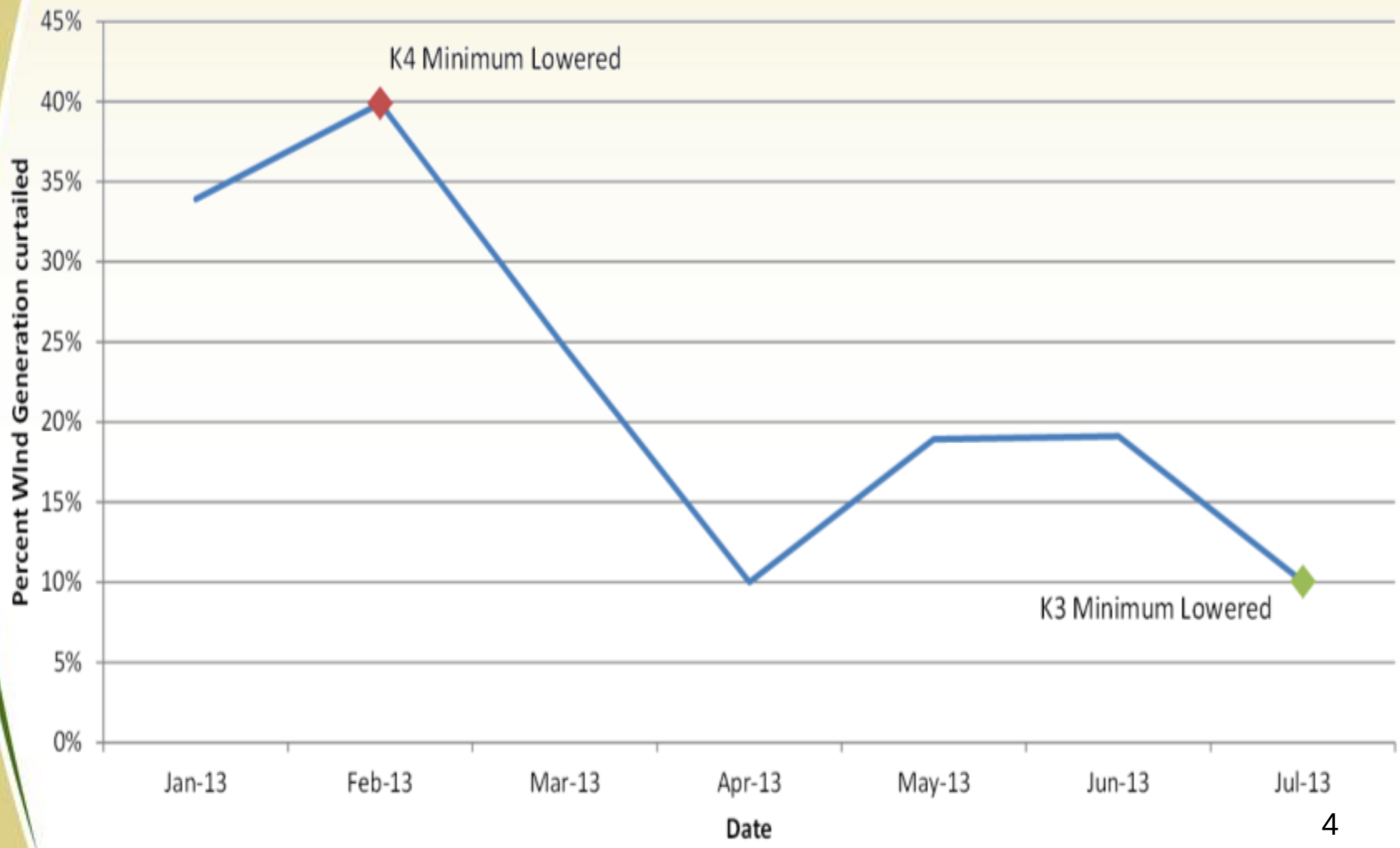
- Maui Wind Integration Study (“WIS”) & Hawaii Solar Integration Study (“HSIS”) guidance
  - Reduce online generation production
    - Reduce minimum load
    - Cycle Off / Deactivate units
  - Increase generation flexibility of the fleet
  - Decrease commitment of generation for reserves
    - Increase reserve capacity of must run generation
    - Off-line quick starting reserves

Changes Since Implementing the MOMs*

- Reduce online generation production and increase generator flexibility
  - K3 and K4 minimum reduced by 50%
- Decrease commitment of generation for reserves
  - Count K3, K4, M15 and M18 for reserves
    - Changes made to enable AGC control and update calculation of reserve requirement

*Maui Operational Measures ("MOMs") developed in the Maui WIS and committed to in the KWP II PPA

Percent Wind Generation Curtailed Maui - 2013



Other Studies Completed

- The Operational Flexibility Studies ("Stanley Studies")
- The Maui Energy Storage Study ("Sandia Study") (See Cases 7 & 8)
- The Generation Reserves/Cycling Study ("Cycling Study")
- The Kahului Power Plant Reduced Operation: Transmission System Impact and Requirements ("KPP Transmission Study")

Information on the studies can be found in the “Maui Electric System Improvement and Curtailment Reduction Plan” filed with the Hawaii PUC under Docket 2011-0092

Plans for Kahului Power Plant

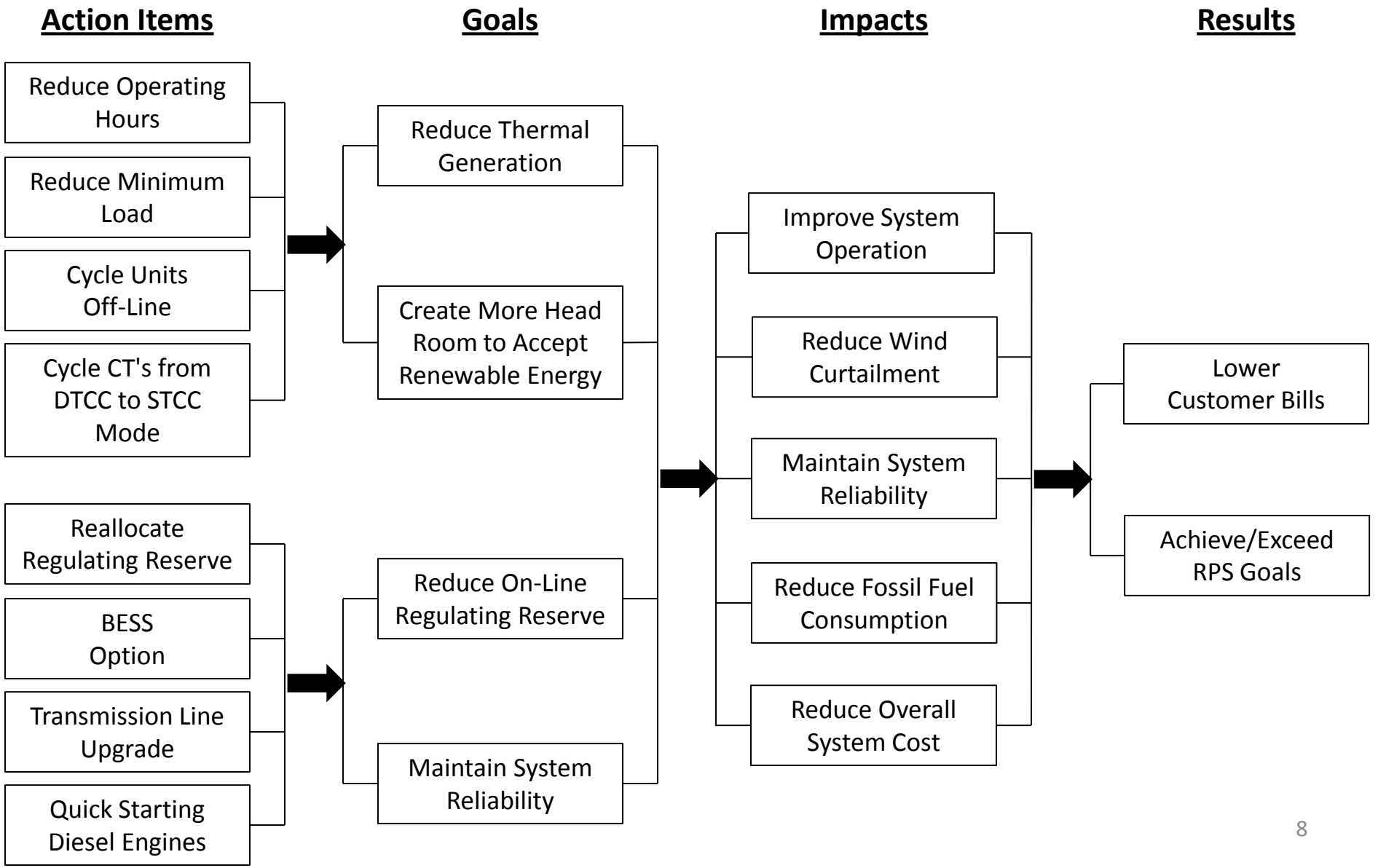
- KPP Units 1 and 2 will be deactivated in 2014
  - 6.3 GWH to 12.8 GWH or 2% to 4% reduction in curtailment
- KPP Planned Retirement 2019.
  - Avoids investments to meet new environmental requirements
  - Requires additional capacity resources - 35.9 MW net
  - Requires transmission upgrades

Analysis of Alternatives

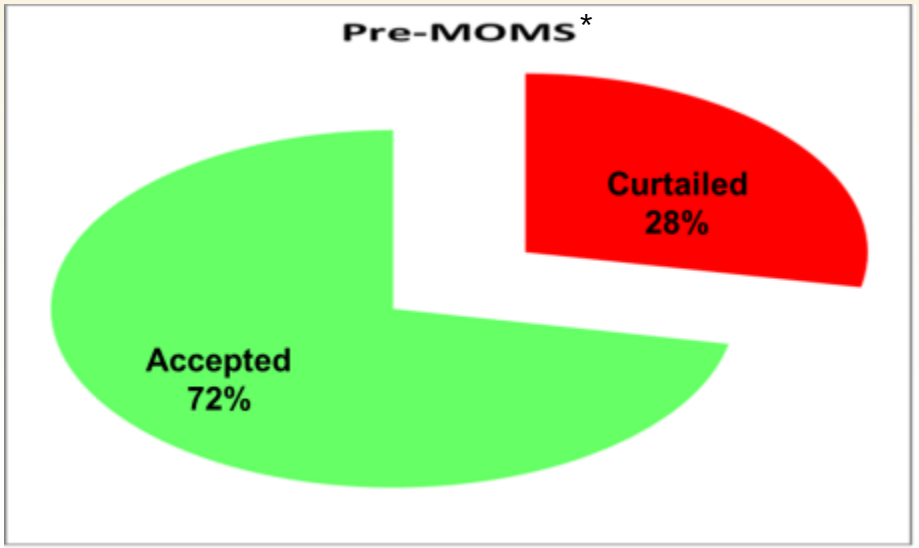
(Again, but with recent changes and many more cases)

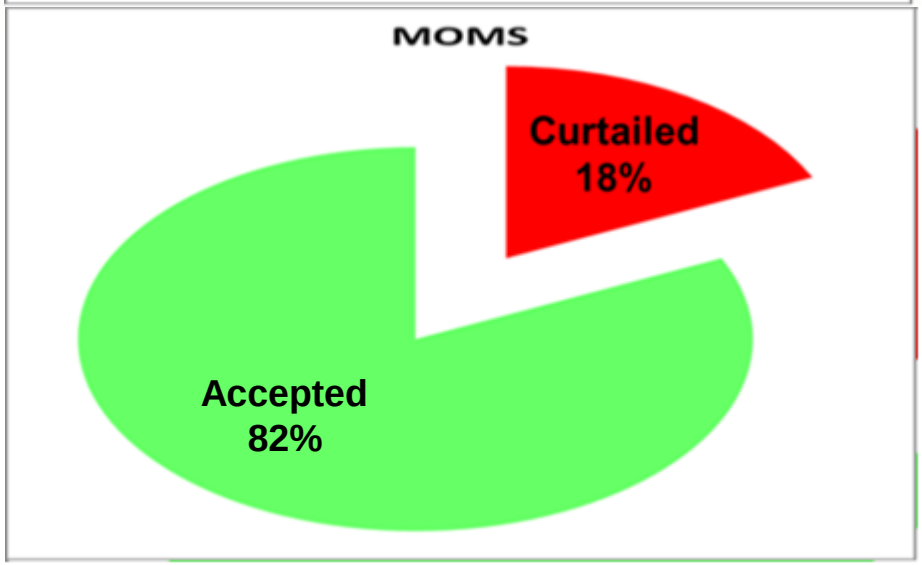
- 22 cases analyzed from 2014 through 2038
- Curtailment analysis and economic analysis performed. A total of 1,100 (22 cases x 25 years x 2) years of production simulations were completed.
- The analyses did not evaluate the potential effects on system stability or reliability.
- Assumptions, Methodology, and Results filed with the commission under Docket 2011-0092.

Maui Electric System Improvement and Curtailment Reduction Plan Road Map



Previous Operating Modes
(using new common assumptions)

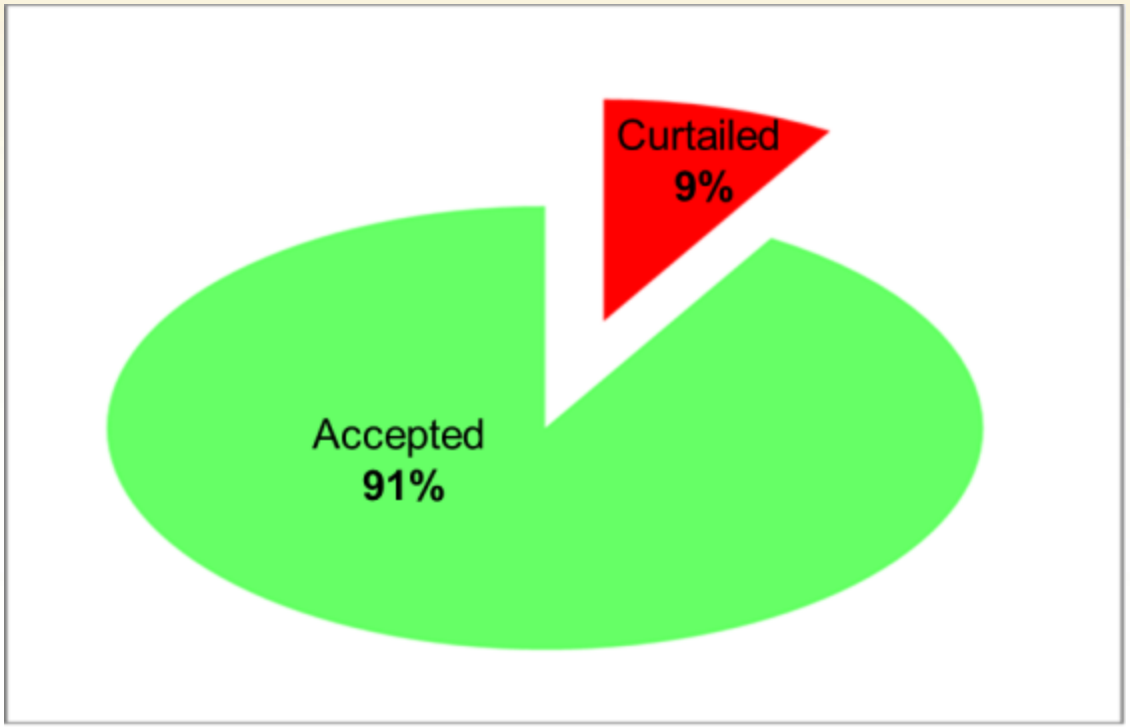




Average % curtailment between 2014 and 2018 assuming these modes of operation

* Maui Electric did not actually operate with the three wind farms using the Pre-MOMs operating mode. This scenario provides a reference point to show the curtailment reduction value of MOMs operating mode

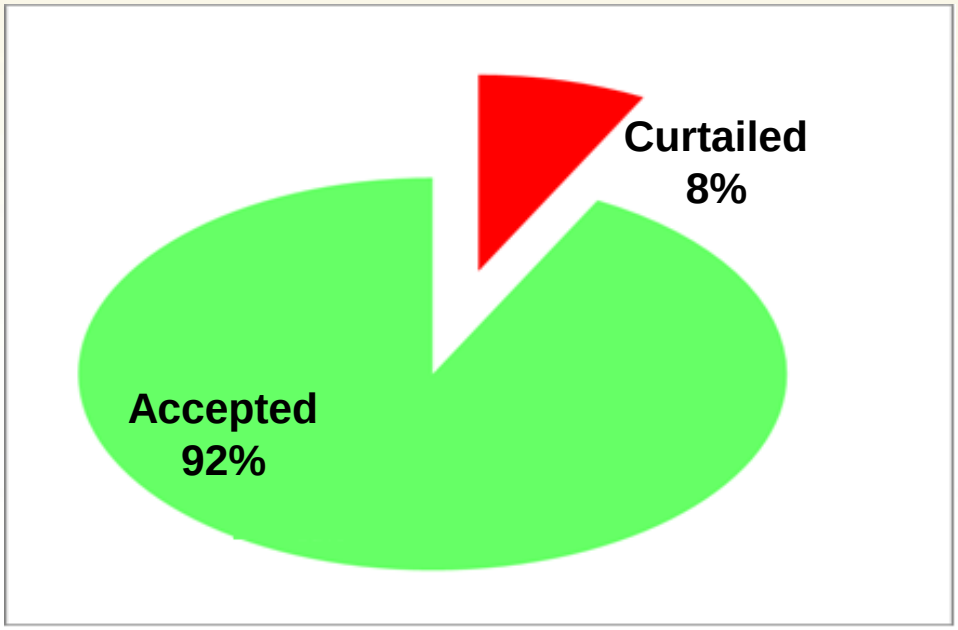
Changes Since MOMs
(Current State)



- K3 and K4 minimum reduced by 50%
- Count K3, K4, M15 and M18 for reserves

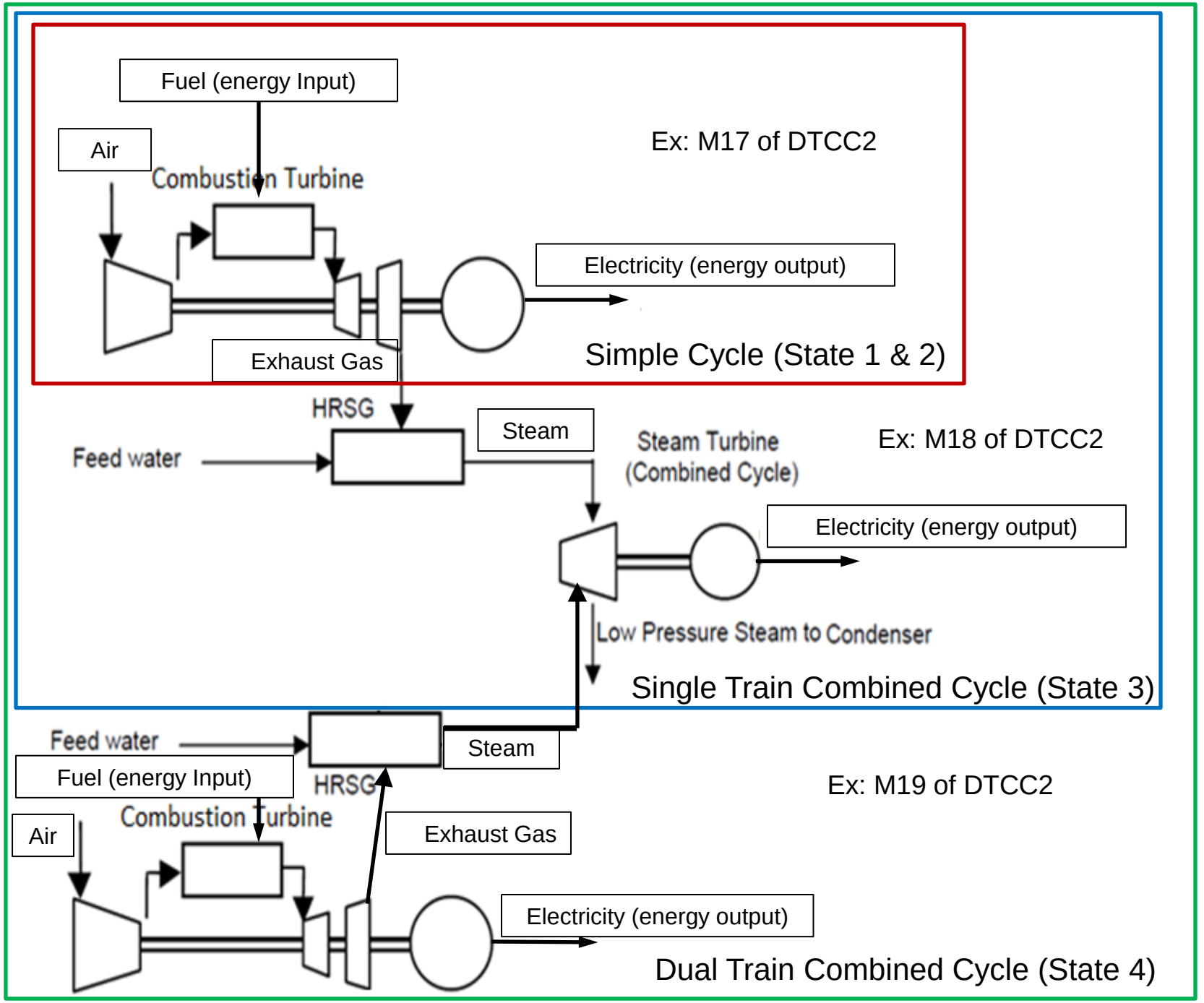
Changes included in MECO's Motion for Partial Reconsideration ("MFPR") in Docket 2011-0092

Adding Near Term Future Commitments (the Reference Case)

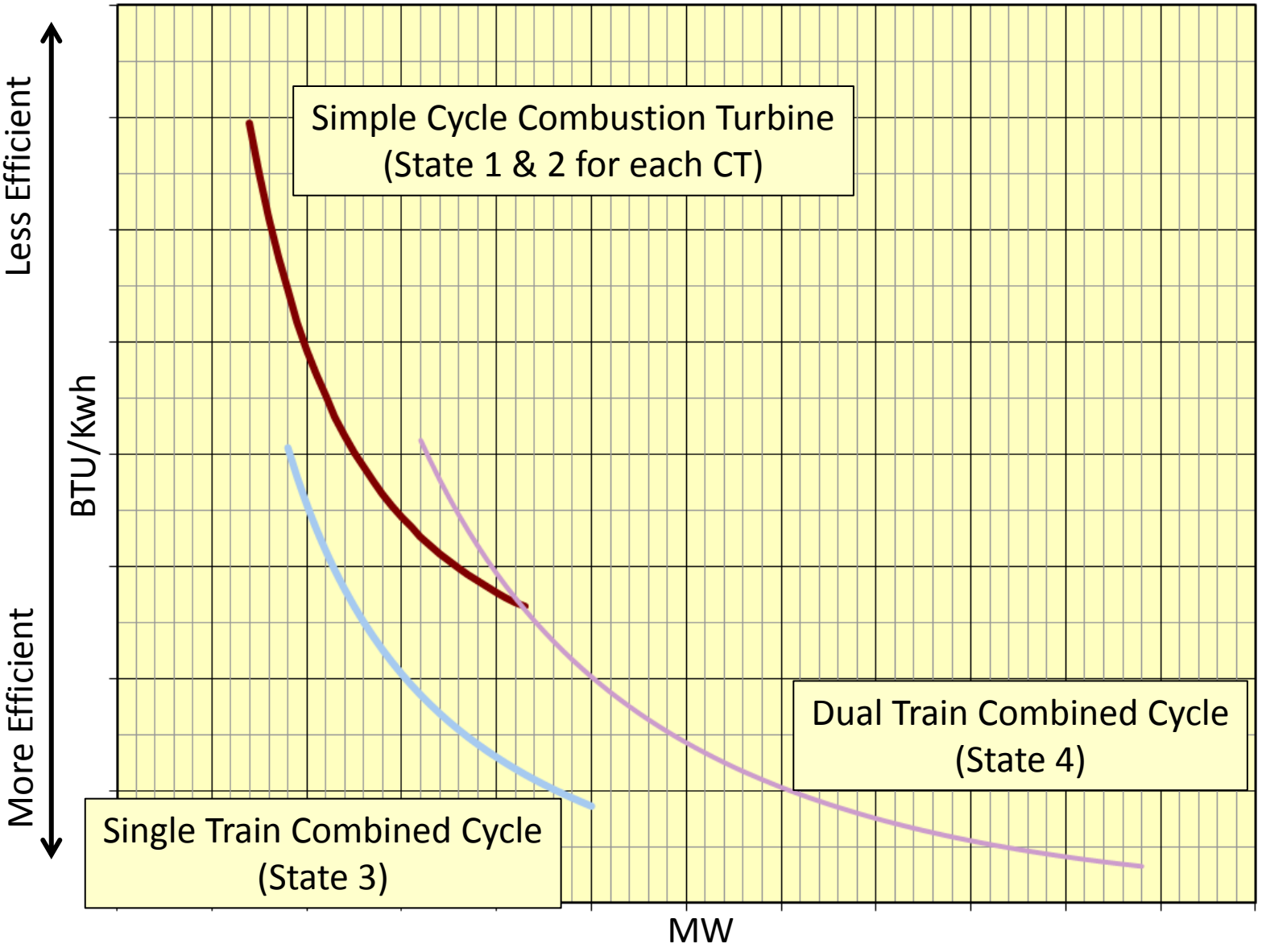


- Deactivate KPP Units 1 and 2 in 2014
- Utilize and test HSIS reserve requirements

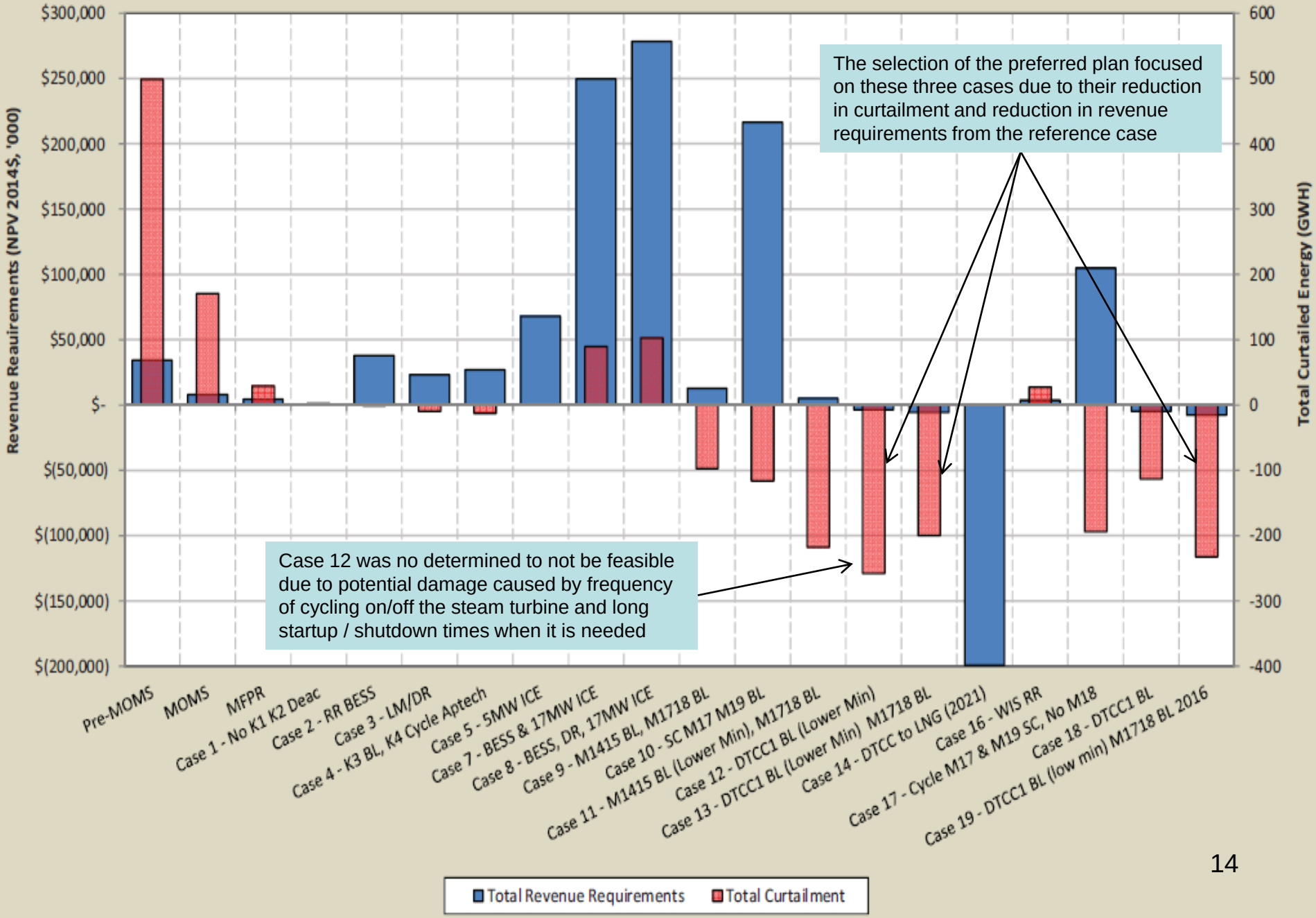
The retirement of KPP is also a future commitment, but it falls outside the 2014 to 2018 timeframe


Fuel (energy Input)
Air
Combustion Turbine
Ex: M17 of DTCC2
Electricity (energy output)
Exhaust Gas
Simple Cycle (State 1 & 2)
HRSG
Steam
Feed water
Steam Turbine
(Combined Cycle)
Ex: M18 of DTCC2
Electricity (energy output)
Low Pressure Steam to Condenser
Single Train Combined Cycle (State 3)
Feed water
Steam
Fuel (energy Input)
HRSG
Ex: M19 of DTCC2
Combustion Turbine
Air
Exhaust Gas
Electricity (energy output)
Dual Train Combined Cycle (State 4)

DTCC Heat Rate Curves by State



Total Revenue Requirements & Total Curtailed Energy Compared to the Reference Case



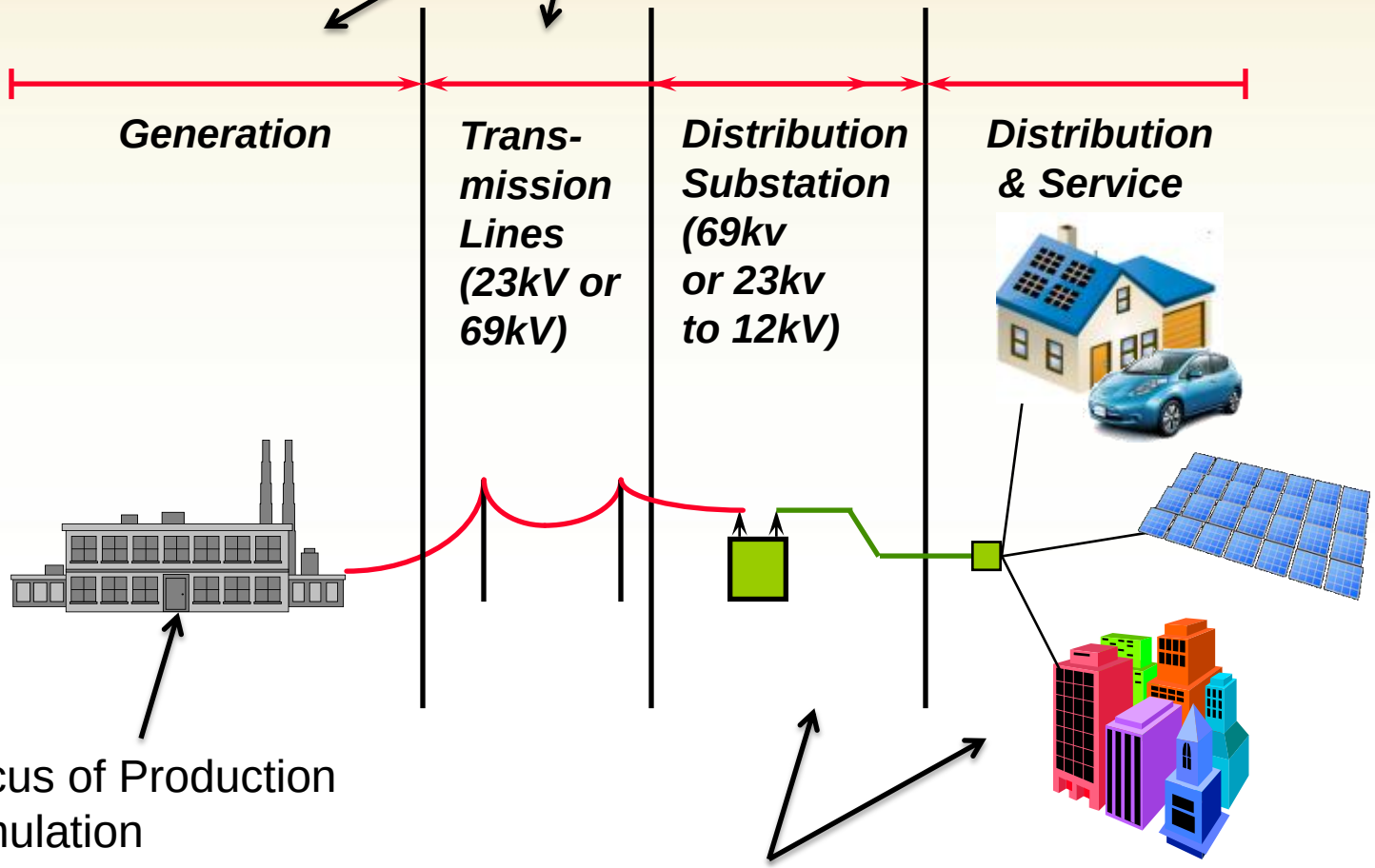
Preferred Plan

- Reduces curtailment from 8% in the reference case to between 2.1% to 4.3%
- Reduces average bills between $0.58 and $0.31 from the reference case and between $2.72 and $2.45 from the Pre-MOMs case.
- Phase 1 - 2014 through 2016 (prior to DTCC1 modifications)
  - Cases 13 and 19, depending on wind and system conditions
    - Case 13
      - DTCC 2, run in single train mode, no/low wind
    - Case 19
      - DTCC 2, run in simple cycle mode, high wind
- Phase 2 – 2016 and beyond
  - DTCC1 at lower minimum
  - DTCC2 run at more efficient Single Train mode more often with the lower DTCC1 minimums

Additional Analysis

- Analyze potential effects on system stability or reliability.
- Identify issues that need to be addressed
- Determine ability of existing resources to address issues if used differently
  - Wind Farms
  - Battery Storage Systems
  - Etc.
- Determine if additional resources are needed

Focus of Transmission Analysis
Steady State and Dynamic

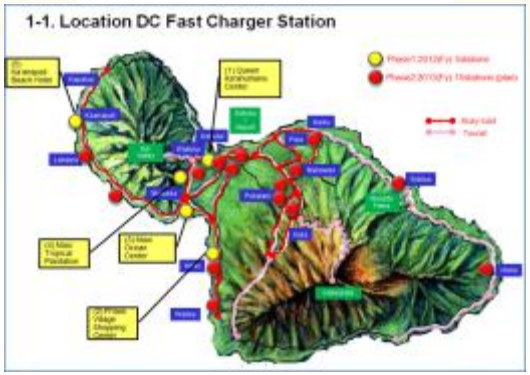


Focus of Production Simulation
Hourly Analysis

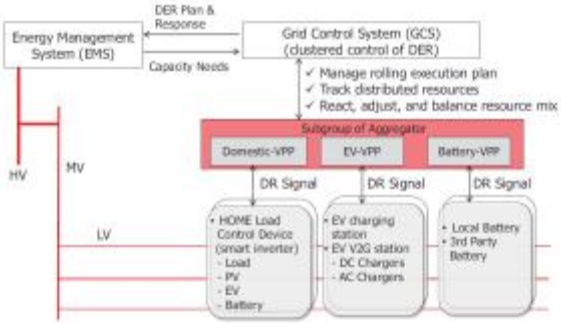
Separate efforts needed and underway to look at distribution level issues

Continue Distributed Resource Development

- JUMPSmart Maui
  - Distributed monitoring and control
  - EV charging network and adoption support



- VPP – Concept Development
  - Build on JUMPSmart capabilities
  - Add V2G EVs and DER Control System



Mahalo

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