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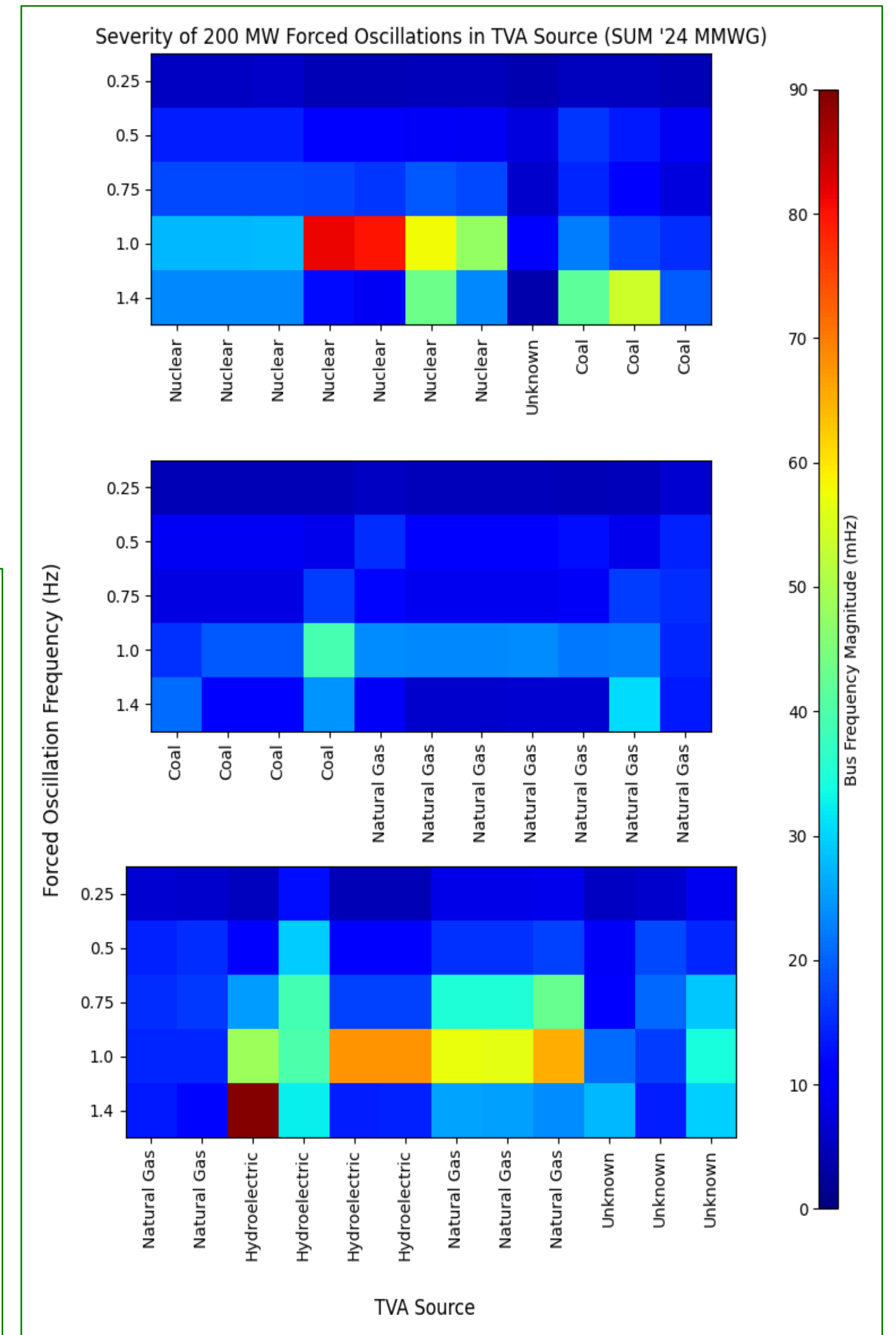
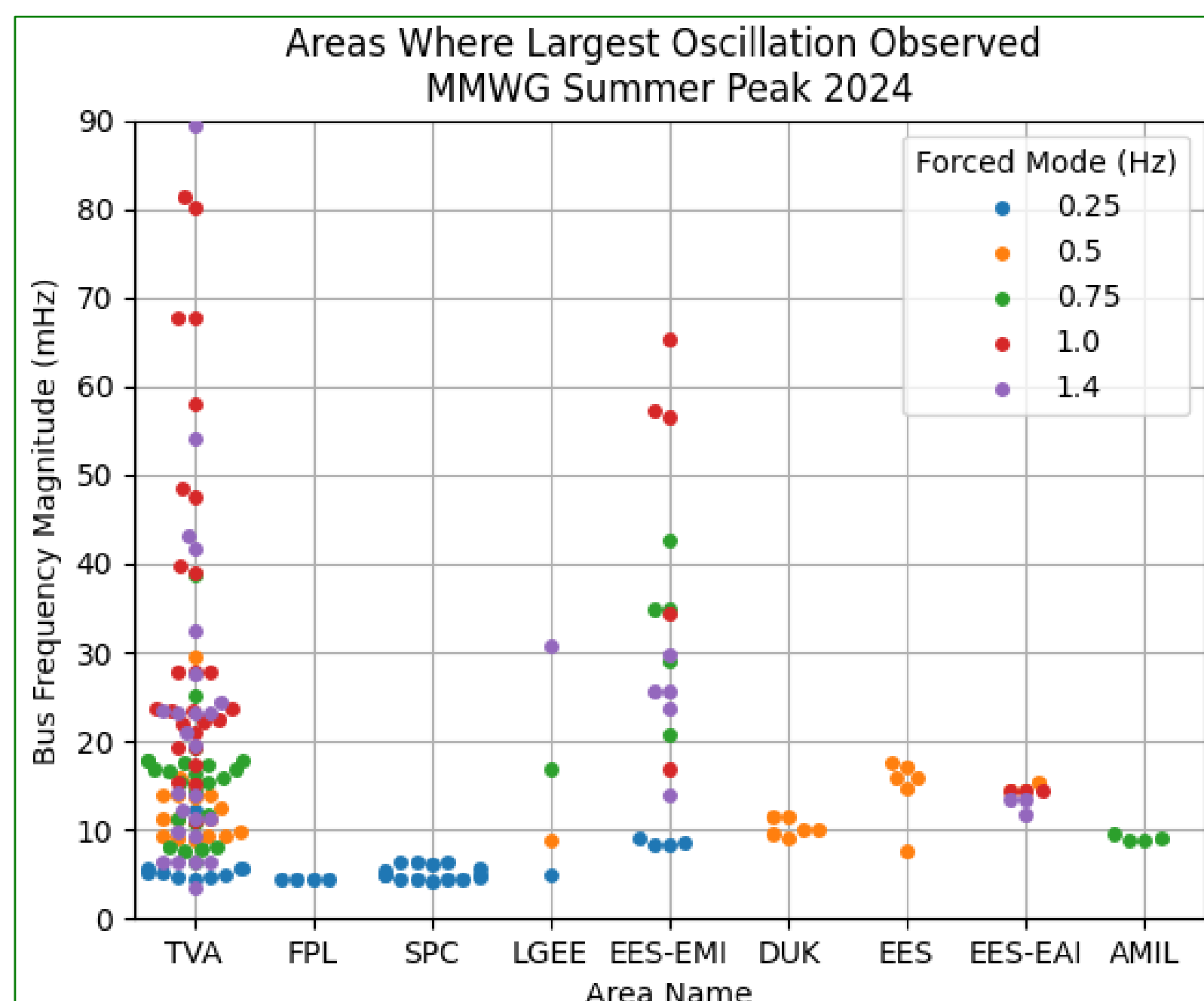
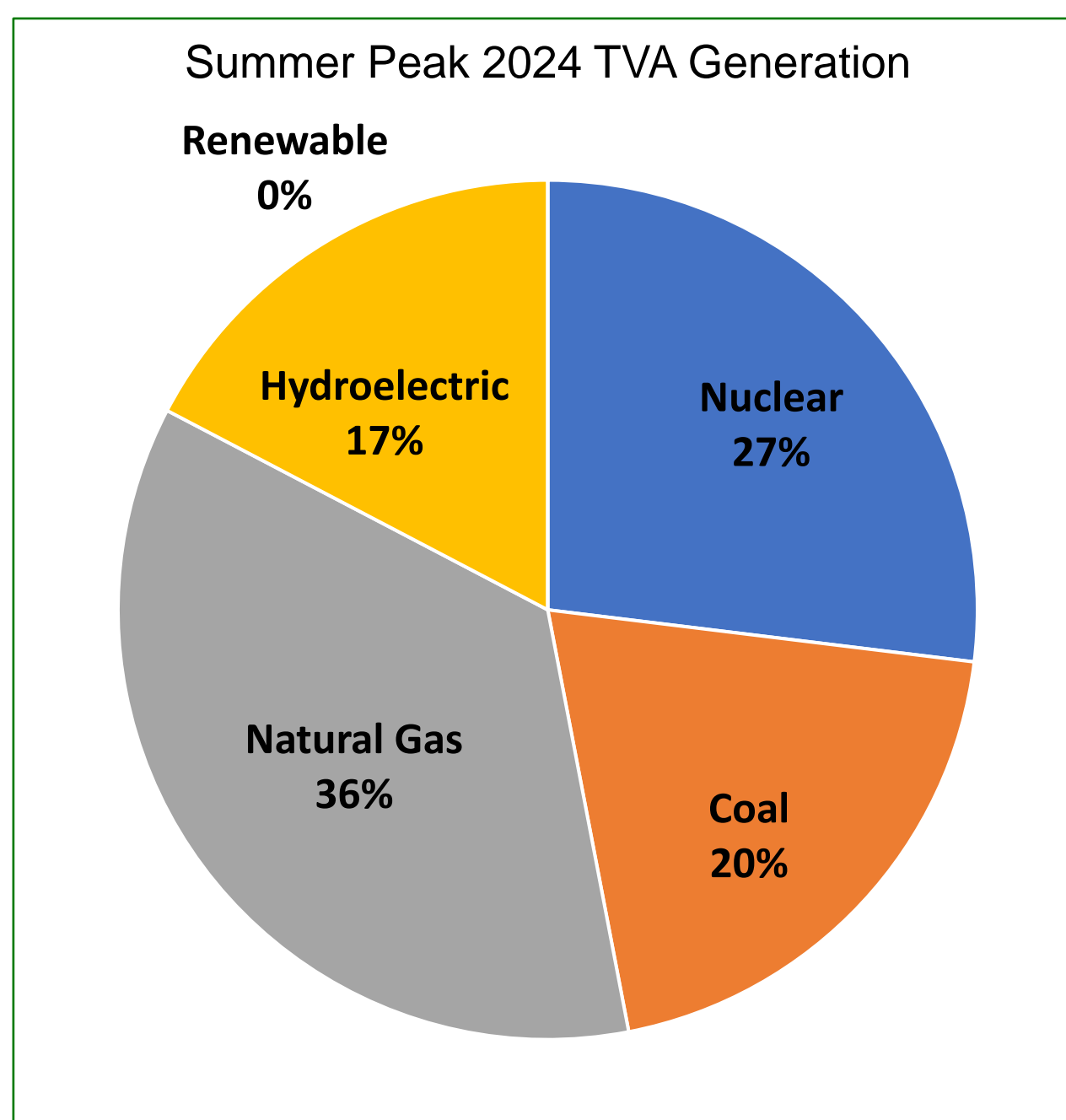
³Oak Ridge National Laboratory

Background

- Forced oscillations can cause sustained power swings across large areas impacting reliability
- Historical event on Jan 2019, caused sustained oscillation for 18 minutes and affected the entire EI
- This project assesses the impact of TVA reliability when forced oscillations originate in their territory
- The critical areas to excite oscillations is further studied to assess the impact of damping controls through BESS

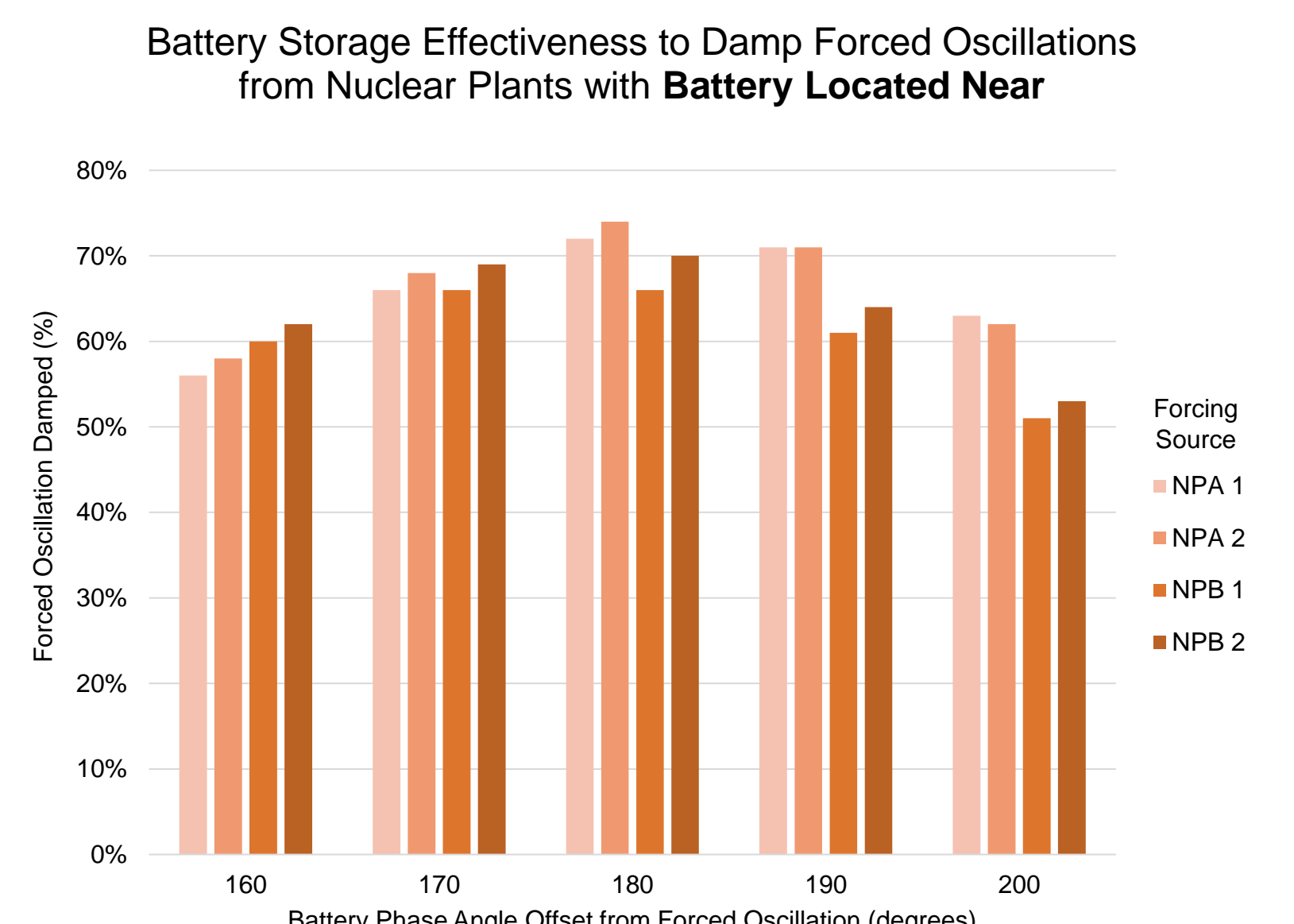
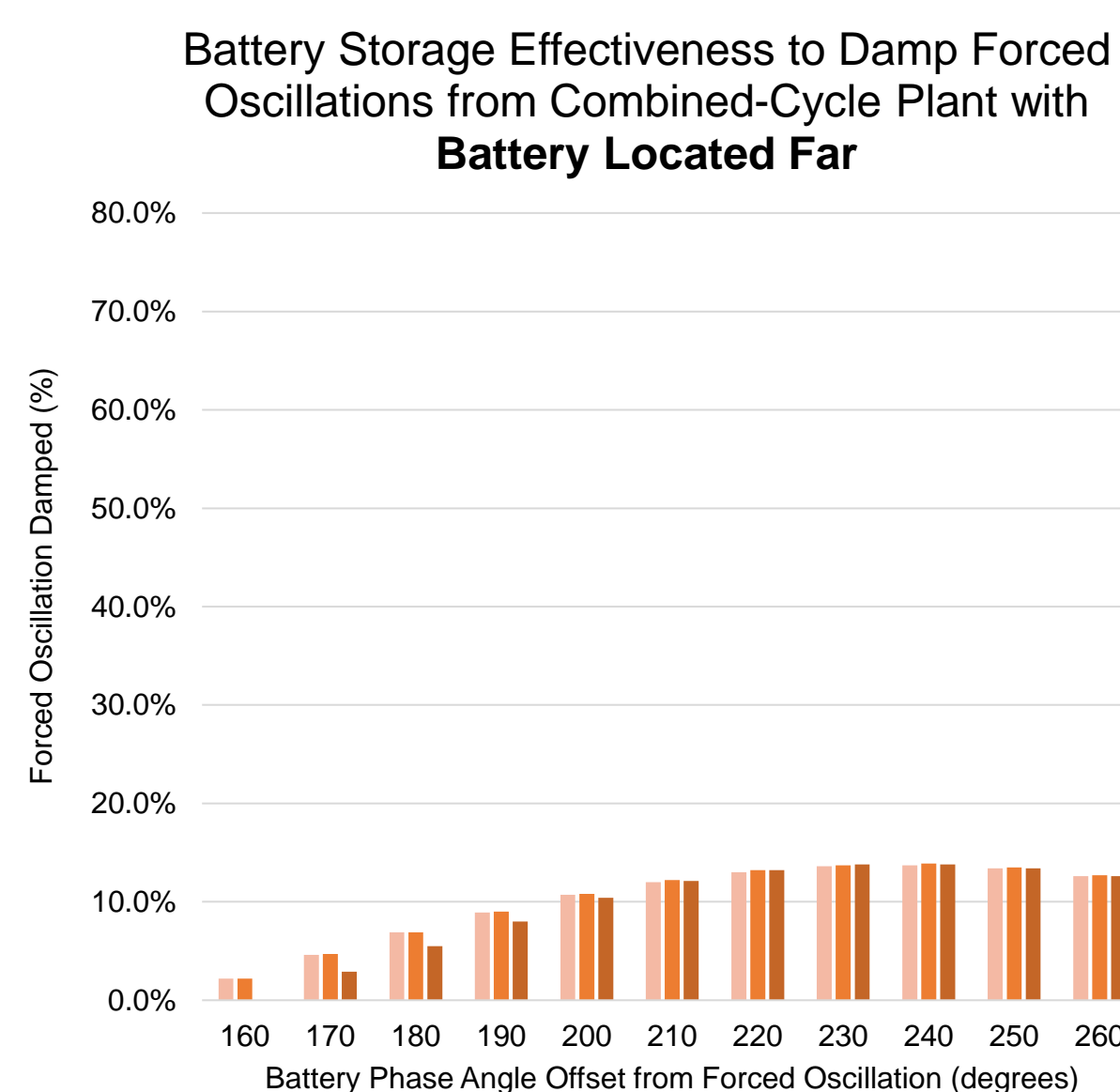
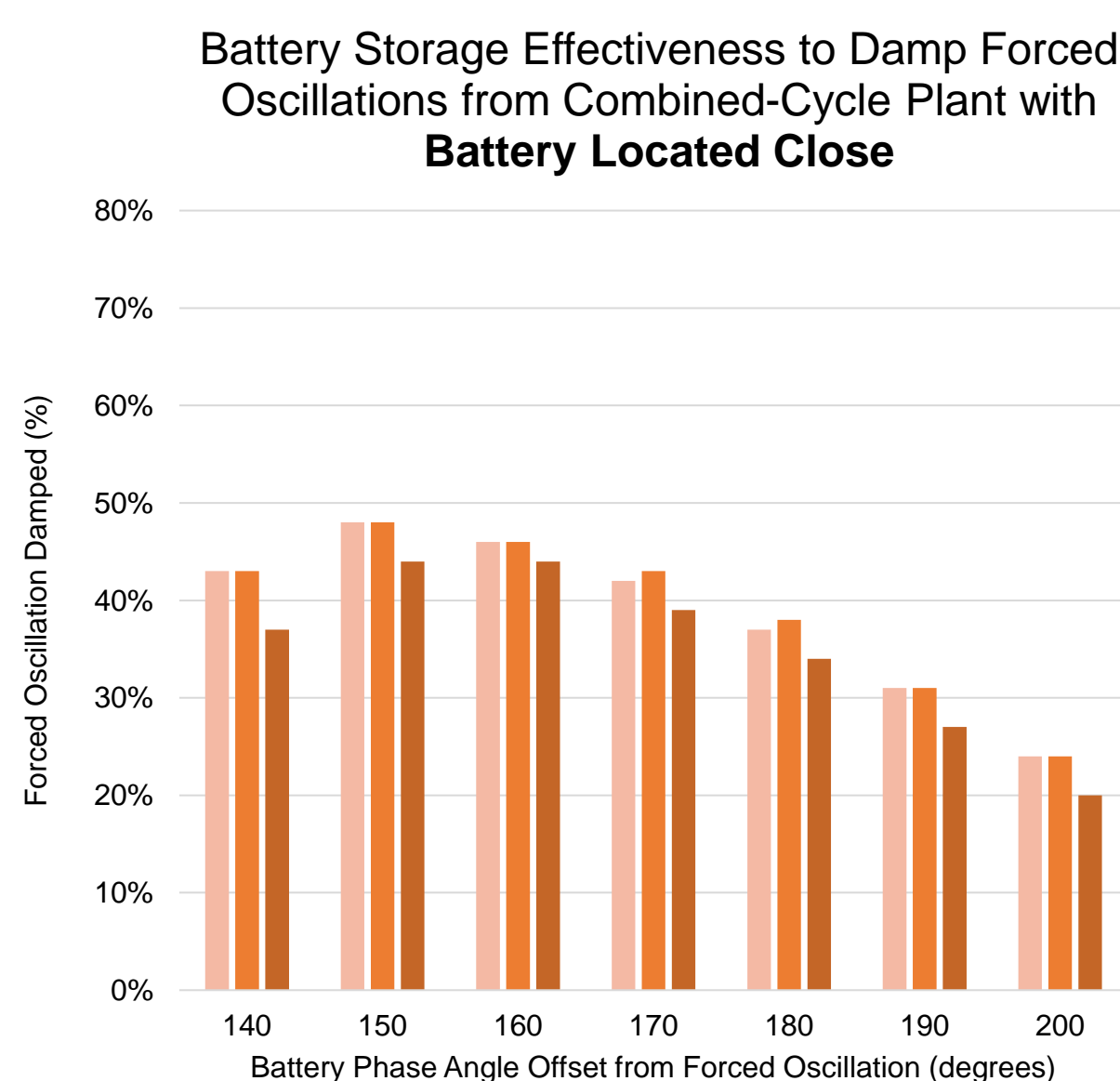
TVA Forced Oscillations and EI Impacts

- The summer peak and spring light load MMWG model is used due to the ability to capture impacts across the entire EI
- 200 MW_{pk-pk} power oscillation is injected into the governor model reference of TVA generators one-at-a-time
- All machines in the TVA area above 200 MW are studied
- Oscillation modes of 0.25 Hz, 0.5 Hz, 0.75 Hz, 1.0 Hz, and 1.4 Hz are studied
- The magnitude of the resulting bus frequency is monitored across the EI and the largest frequency magnitude observed is plotted in the heatmap
- The location of the largest bus frequency is compared for all oscillation modes and all machines



Battery-Energy Storage System as Damping Device

- BESS damping is done by injecting an anti-phase oscillation of 200 MW_{pk-pk}
- The phase-angle of the anti-phase oscillation is controlled to provide optimal support
- BESS is located either (a) close (<1 mi), (b) far (>200 mi), or (c) near (~20 mi)



Results and Conclusions

- The TVA area experiences the largest impact due to oscillations occurring within its territories
- Some machines are more critical to excite oscillations
- Some plants with moderate oscillation impacts may benefit more from BESS damping
- Battery location does impact BESS damping effectiveness
- Optimal BESS location can provide significant benefit to nuclear plants

