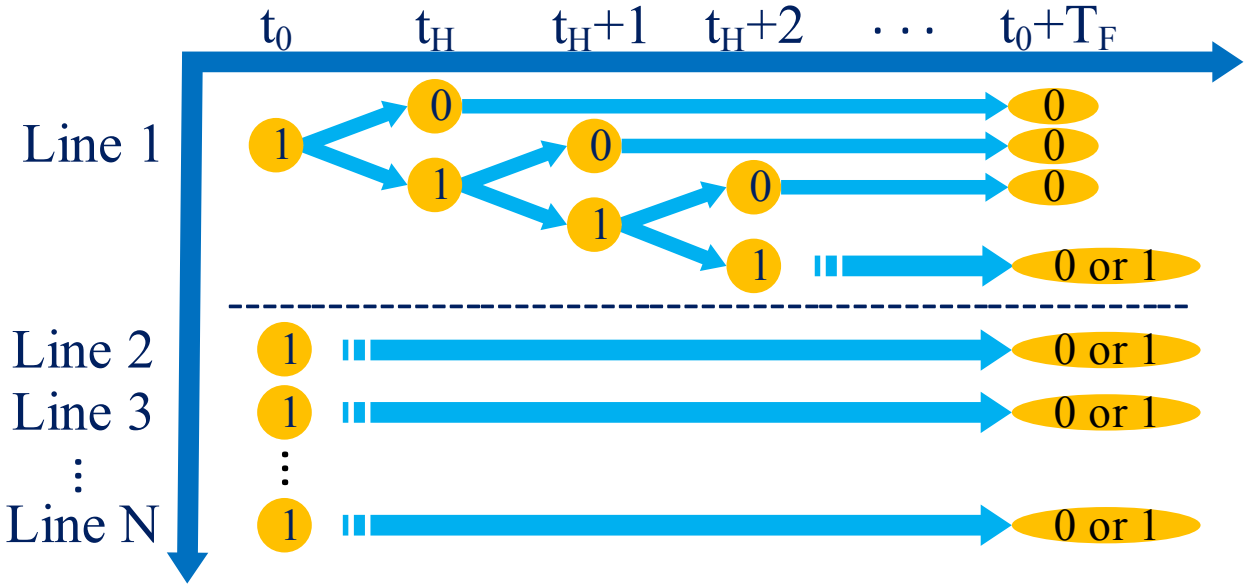
Line Outage Scenario Generation

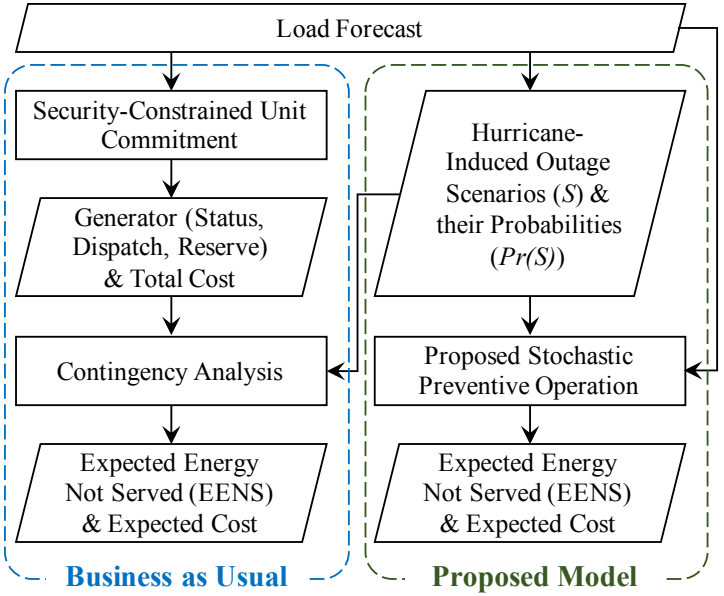


- Depending on the hurricane, the total number of scenarios can be large
- The probability of each scenario can be calculated from component failure estimations

Preventive Power System Operation

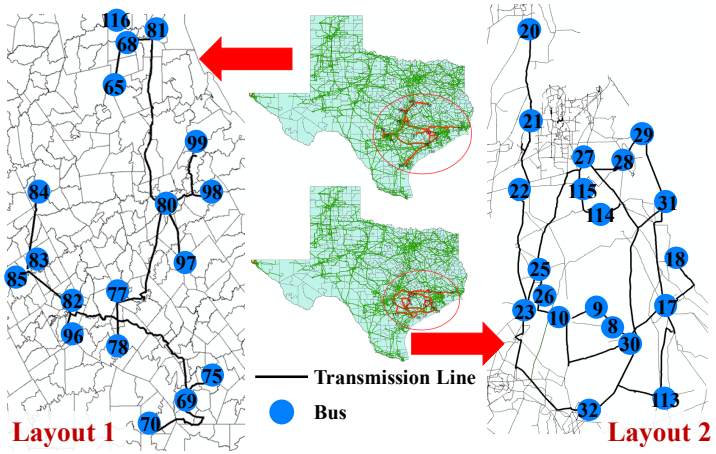
- Stochastic optimization
  - Scenarios: unplanned line outages
  - Load shedding is penalized by a large penalty factor
- Computational needs:
  - Stochastic optimization can be computationally demanding
  - Scenario reduction can help reduce the computational burden:
    - Elimination of unlikely scenarios, below a threshold
    - Elimination of inconsequential scenarios
- The solution will change the dispatch to minimize load shedding

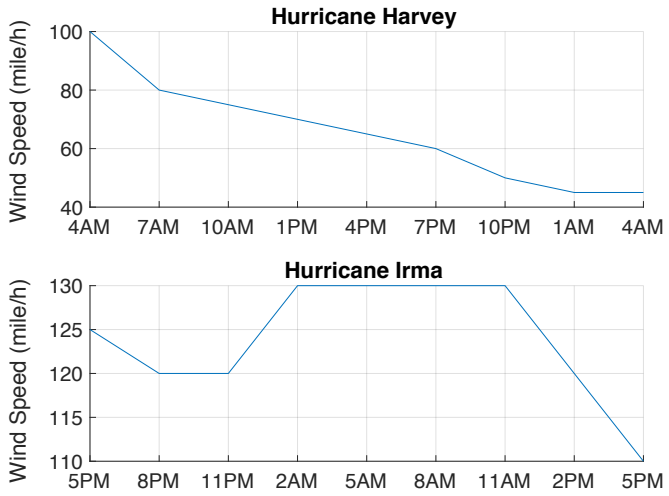
Evaluation Method



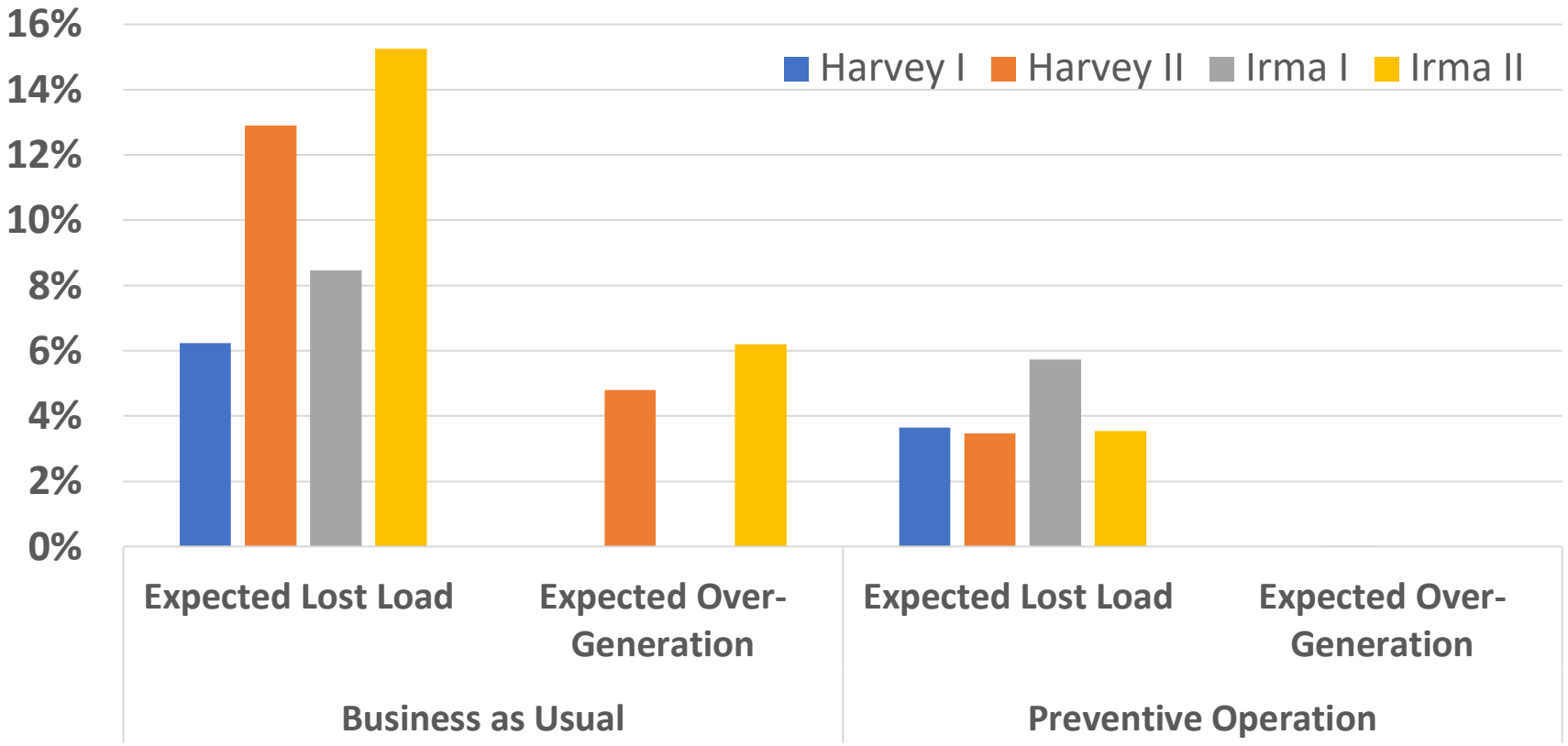
Case Study Setup

- Test system: IEEE 118-bus
- Two layouts:
  - Areas affected by the hurricane
- Two synthesized hurricanes:
  - Harvey
  - Irma

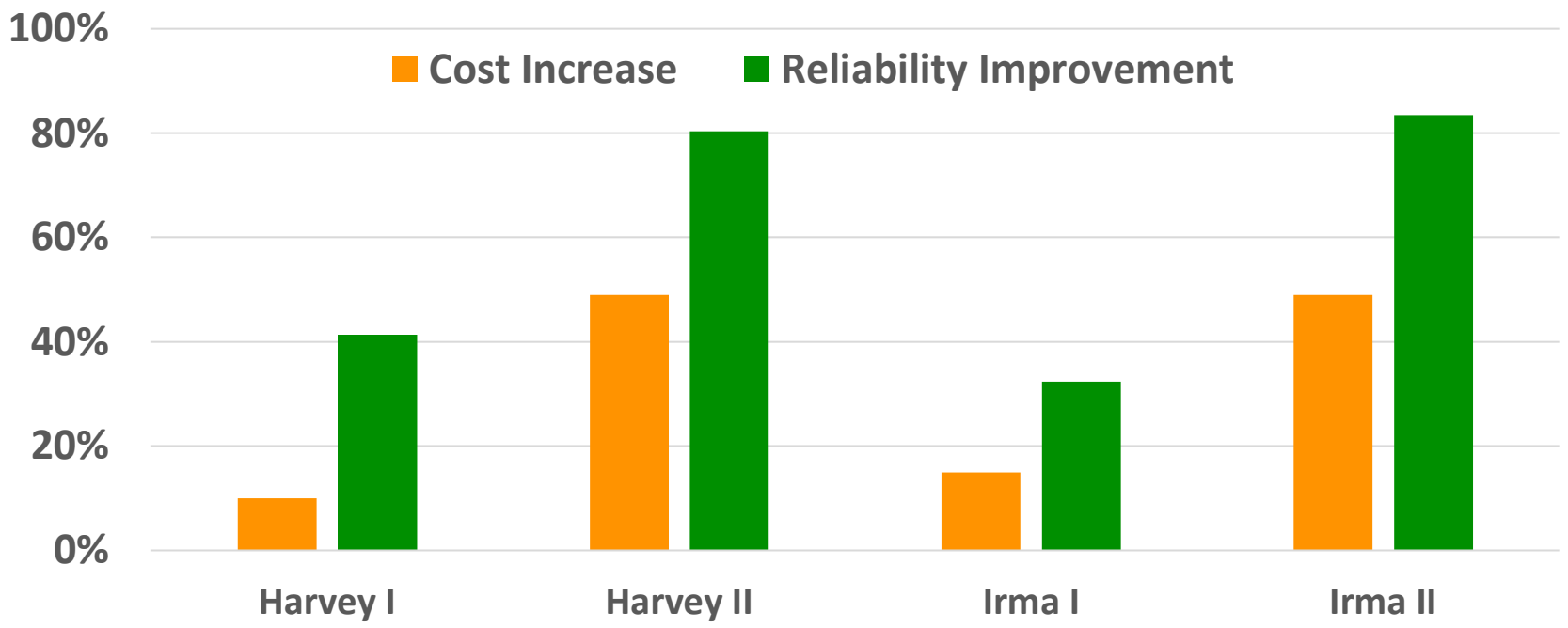




Results: Reliability Improvement



Results: Reliability versus Cost



Conclusions

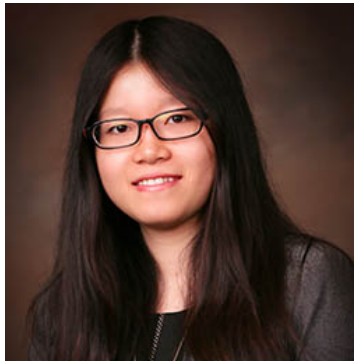
- Predictable weather-related natural hazards are the cause of about half of the blackouts in the US.
- Weather forecast data can be used to estimate component damage likelihood.
- Component damage estimations can be used to guide preventive operation.
- The simulation results confirms the effectiveness of our integrated platform in substantially reducing power outages.
- Appropriate integration of weather forecast data within power system operation can enhance system reliability.

Discussion and Future Work

- Stochastic optimization was used in this work:
  - Computationally demanding
  - Power system operation software by in large use deterministic models
  - We are currently working to develop proxy deterministic rules that:
    - Capture the majority of stochastic optimization
    - Do not substantially add to the computational burden
- The framework is general and can be applied to other weather hazards such as ice storms.

Acknowledgement

Our Research Team

	Atmospheric Sciences	Civil Engineering	Electrical Engineering
Principal Investigators	 Dr. Zhaoxia Pu	 Dr. Ge Ou	 Dr. Mostafa Ardakani

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Funding Agency: USTAR UTAH'S TECHNOLOGY CATALYST

References and Further Reading

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- M. Sahraei-Ardakani and Ge Ou, "Day-Ahead Preventive Scheduling of Power Systems During Natural Hazards via Stochastic Optimization," *IEEE PES General Meeting 2017*, Chicago, IL, USA.
- Y. Sang, J. Xue, M. Sahraei-Ardakani, and G. Ou, "Reducing Hurricane-induced Power Outages through Preventive Operation," *working paper, available at: https://ardakani.ece.utah.edu/wp-content/uploads/sites/75/2018/05/HurricanePaper.pdf*

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Thank You!