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Pacific Northwest NATIONAL LABORATORY

HIPPO:
A COMPUTATION TOOL FOR PLANNING TOMORROW'S ELECTRICITY NEEDS

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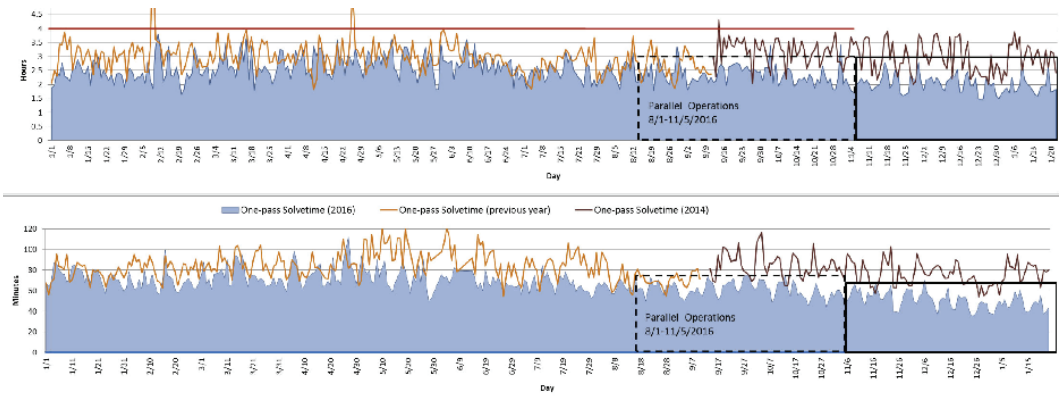
Partners: Midcontinent Independent Service Operator (MISO), GE Grid Solutions, Gurobi Optimization

High-Performance Power Grid Optimization, or HIPPO, is a new computational tool that will help grid operators plan how to generate tomorrow's electricity more efficiently. Funded by ARPA-E, HIPPO is being developed and validated by a research team led by PNNL, along with partners at MISO, GE Grid Solutions, and Gurobi Optimization.

CRITICAL NEED:
INEFFICIENT, UNRELIABLE ENERGY SUPPLY COSTS CONSUMERS BILLIONS

Transmission organizations and grid system operators are required to develop power generation plans for participants in energy markets such as utilities. Next-day operations are determined by day-ahead unit commitment decisions through the guarantee of a large percentage of available resources. To ensure power plants can operate reliably at the lowest possible cost, the staple of current scheduling activities involves solving the security constraint unit commitment (SCUC).

Integrating renewable energy and changing electricity demand patterns adds another layer of complexity, making calculating resource schedules that much more difficult. Ultimately, these challenges increase the probability for errors in grid operators' production plans.

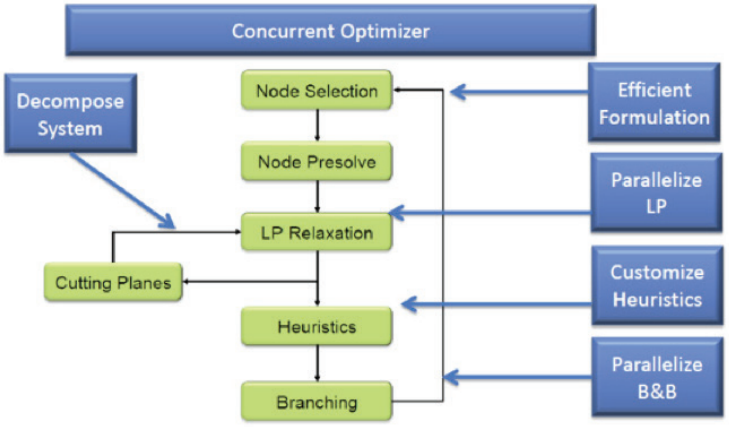


OUR SOLUTION:

A COMPUTATIONAL TOOL THAT LEVERAGES ADVANCEMENTS IN OPTIMIZATION ALGORITHMS

The HIPPO team leverages PNNL's advances in optimization algorithms and high-performance computing technologies to tackle the SCUC problem. Because new algorithms will have algorithmic memory, HIPPO can leverage knowledge of underlying systems, operational experiences and past solutions. When inter- and intra-algorithms are adapted to the same processing system, algorithms can share information and reduce computing time. The four features that the HIPPO tool uses for developing algorithms are:

- ***Domain Knowledge:*** *Translate operators experience and knowledge into algorithms*
- ***Maximum Parallel:*** *Enable inter- and intra-algorithm parallelization to share information*
- ***Algorithmic Memory:*** *Learn from past use cases*
- ***Efficient Resolvability:*** *Reduce efforts to solve modified problems.*



THE RESULT:

MORE RELIABLE, EFFICIENT, FLEXIBLE POWER GRID

Researchers anticipate HIPPO will solve the SCUC problem more accurately and in a fraction of the time--roughly 10 times faster than current methods. The tool will provide system operators with improved resource schedules, leading to more flexible and reliable real-time grid operation in a stochastic environment. As a result, HIPPO is expected to

- Improve power generation schedules
- Enable more efficient, flexible, and reliable grid management
- Allow for increased integration of smart grid technologies and renewable energy
- Save consumers and power grid operators billions of dollars
- Provide greener and more sustainable grid operations
- Promote high-performance, computing-based algorithms for complex problems in other industries such as air traffic control, managing telecommunications, transportation and other critical national infrastructures.

The HIPPO project officially began in November 2015. The team developed the SCUC engine that was benchmarked with a MISO system to serve as the foundation for algorithm development.

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U.S. DEPARTMENT OF ENERGY