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GE
Energy Consulting

Topics

About Energy Consulting
Planning Trends
Our HPC Experience
Example Applications

Systems experts answering the toughest questions to deliver customer value

Investing profitably and efficiently

Compliant and reliable design and engineering

Testing and service for compliance and protection

Power Economics
- Investment Analysis
- Policy and Planning

Power Systems Operations and Planning
- Transmission and Distribution
- Commercial and Industrial

Global Power Projects
- Thermal and Renewables
- Controls and Communications

All powered by cutting-edge software technology

PSLF | MAPS | MARS

Concorda Software Suite

PSEC: BUILT ON A FOUNDATION OF EDUCATION

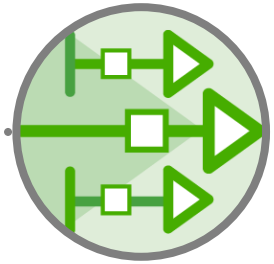
Software Products

Energy Consulting Software Suite

MAPS

- Evaluates power system economics and impact of congestion
- Provides locational prices, unit schedules, line flows, emissions
- Used in high wind penetration and standard market design studies
- Supports GE's multi-billion dollar energy investment portfolio

PSLF



- Simulates physical behavior of the grid and connected equipment
- Provides voltages and line flows, system dynamic behavior
- Extensively used to study 2011 WECC outage
- Mechanism for ensuring that equipment is properly modeled

MARS

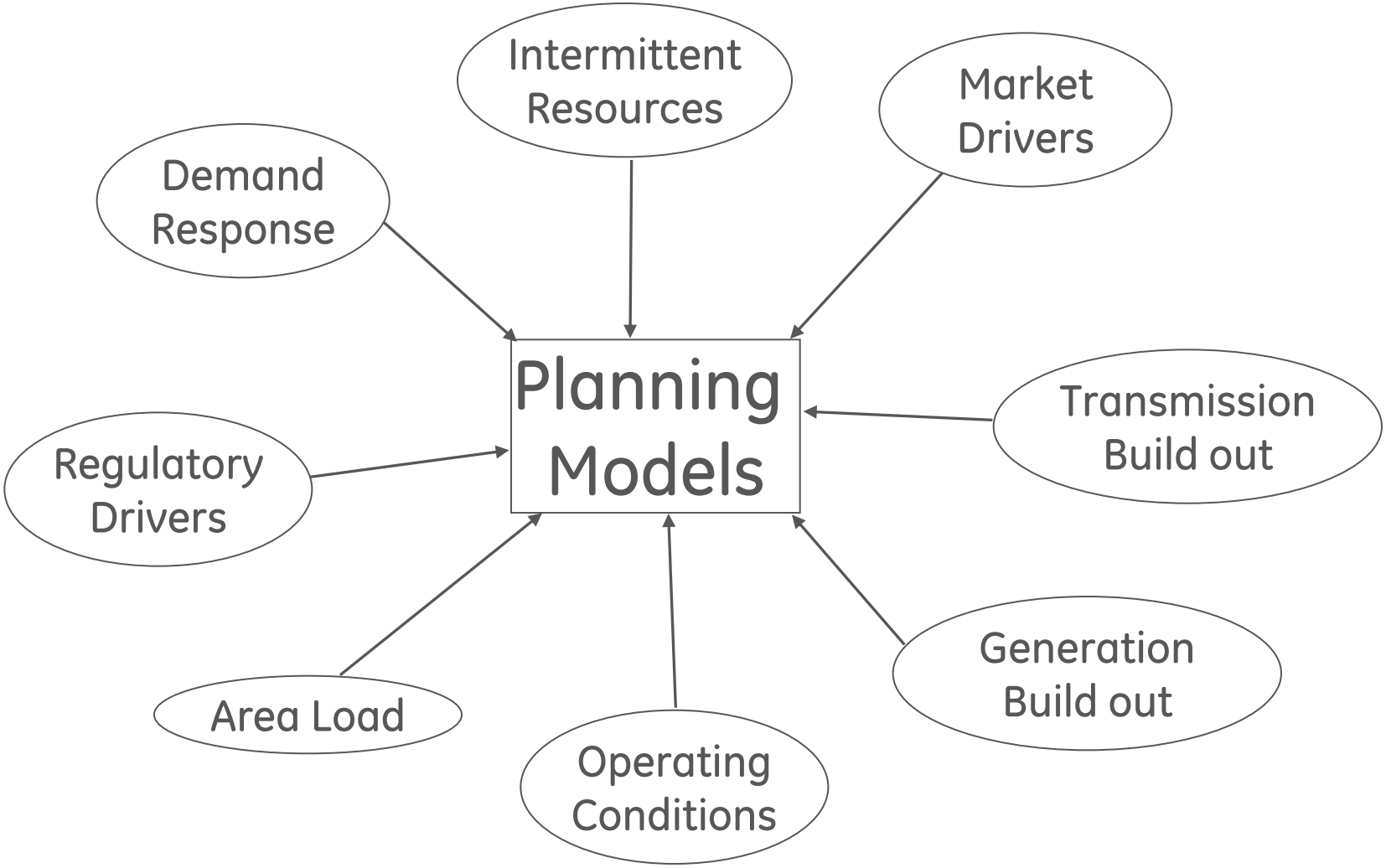
- Assesses reliability of supply in meeting energy demand
- Provides loss of load expectation (LOLE) and other reliability indices
- Applied for major regional reliability and reserve margin studies
- In use at most ISO's in the US

Proven tools used extensively in the industry

A Broad Set of Global Customers

- Transmission planners
- System Operators
- Developers
- Manufacturers
- Research Organizations
- Consultants
- Investors

Increased Uncertainties



Planning trends driving customer needs

Compliance standards – Reliability organizations are demanding higher fidelity models, consistent data, and more detailed analysis. Examples: small signal analysis and comprehensive contingency analysis

Larger scope and size - ISO's are performing large-scale analysis and inter-ISO planning groups are forming

More uncertainties – Driving towards simulation of exhaustive scenario lists…places premium on execution performance

Diverse applications – No longer involving single application analysis…multiple applications interacting to determine results…close coupling of applications and focus on usability is valuable

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Data Visualization and Exchange

- GIS visualization of results
- Advanced/customized data searches
- Standard exchange formats

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Simulation Performance

- Parallel/Super Computing
- Sensitivities/scenarios increasing
- Contingency lists increasing
- System complexity increasing

HPC Experience and Examples

Our HPC Experience

Internal HPC in production since 2006

- Internally used for consulting studies with MAPS and MARS

MAPS HPC, MARS HPC, and PSLF HPC commercial products

Custom HPC application development

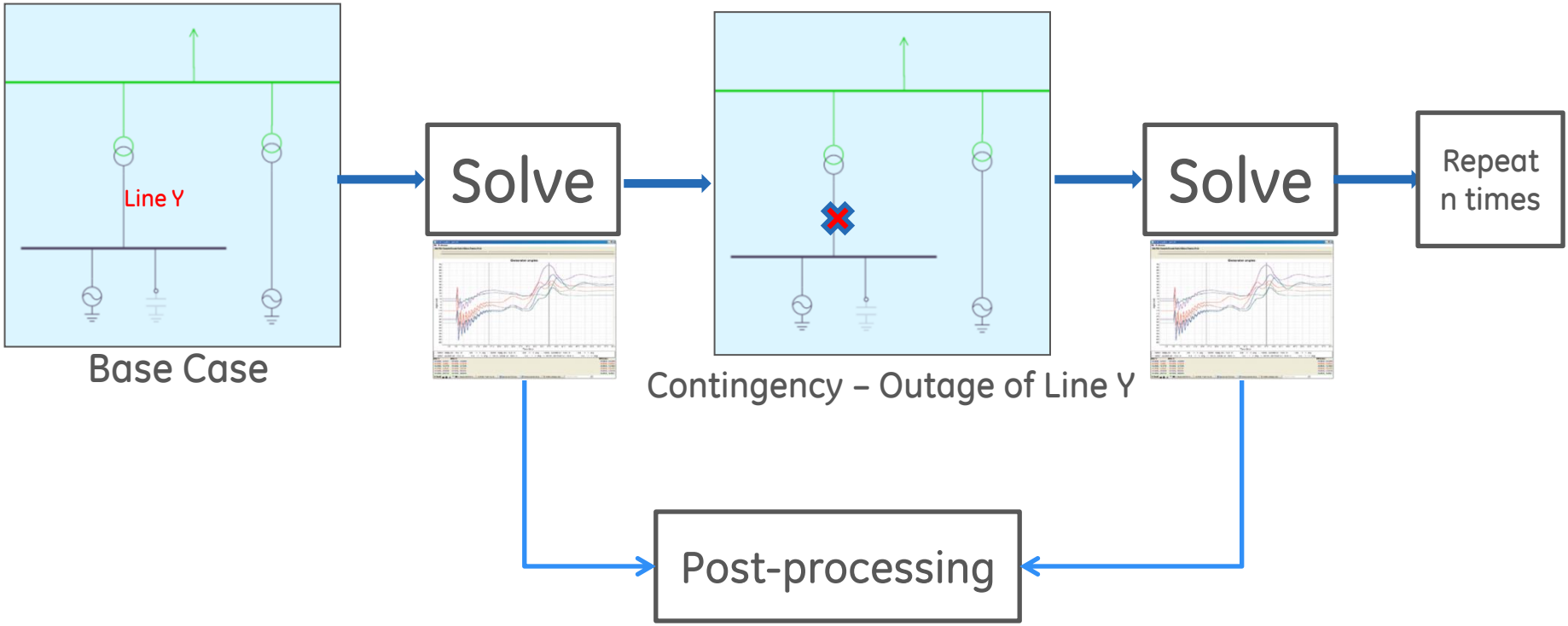
PSLF HPC

Two pronged approach:

- Parallelization of contingency processing across HPC hardware
- Take advantage of SMP hardware
  - Ordering algorithms
  - Parallel simulation of dynamic models

Minimize impact to end users workflow

Contingency Analysis



Single CPU Runtimes can be from hours to days

PSLF HPC Runtimes

WECC Model, 30,000 N-1-1 contingencies

Conventional desktop: ~2 days

2 x 8 core machines: 90 minutes

Custom contingency processor for a utility (used intraday to support ops):

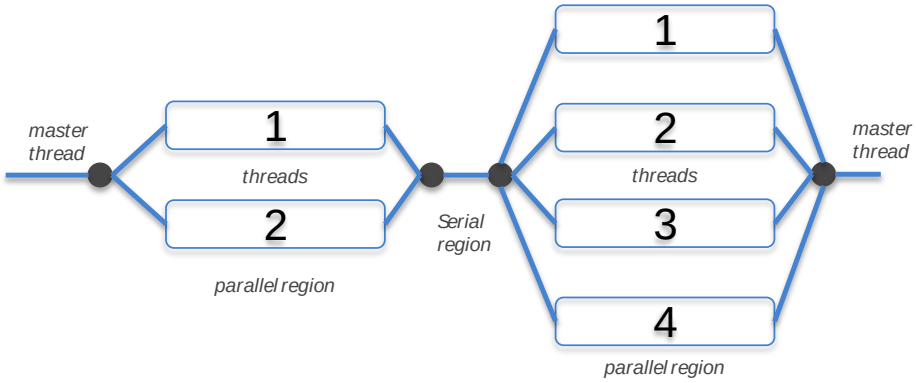
4.0 hours -> 18 minutes

PSLF Dynamic Simulation Engine

- *PSLF dynamic engine is already very efficient & very fast*
- *Developed over 30 years*
- *Handles massive systems*
- *Leverages sparse techniques*
- *Effective use of memory*
- *Little room for further improvements…*

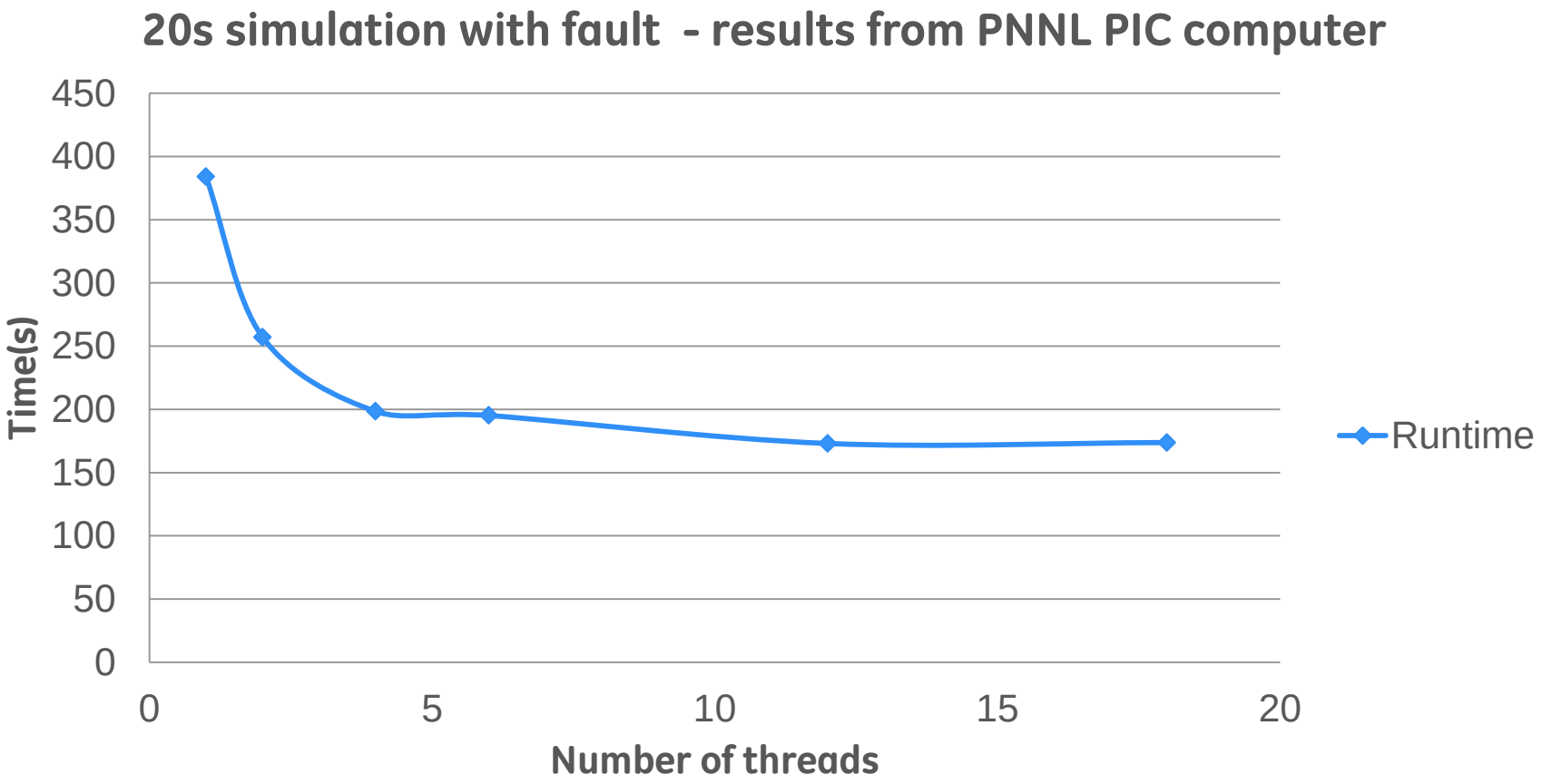
…but we made it faster!

A true parallel dynamic simulation engine in a commercial power system simulator



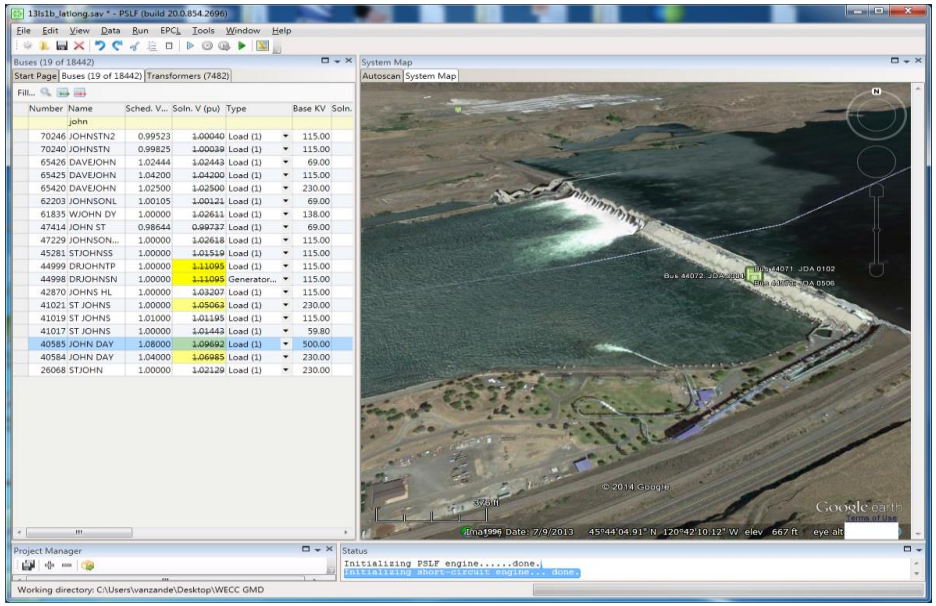
- *PSLF is one of the first commercial simulators to have a proof of concept parallel core implemented*
- *Leverages multicore architectures of common laptop computers*
- *Tested on PNNLs super computers for performance verification & validation*

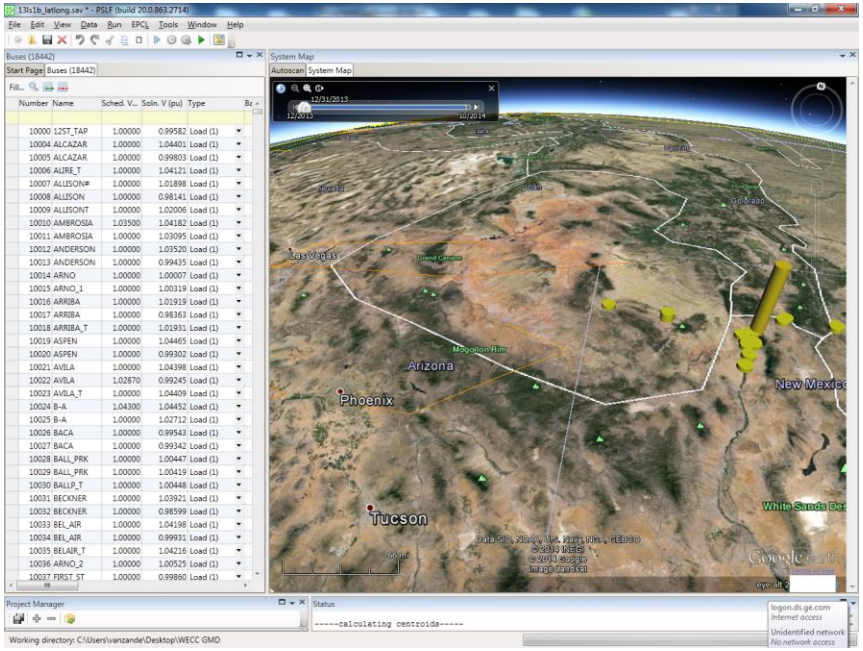
Speed-up of 2.21x on 12 threads using PNNL's PIC computer and EI case

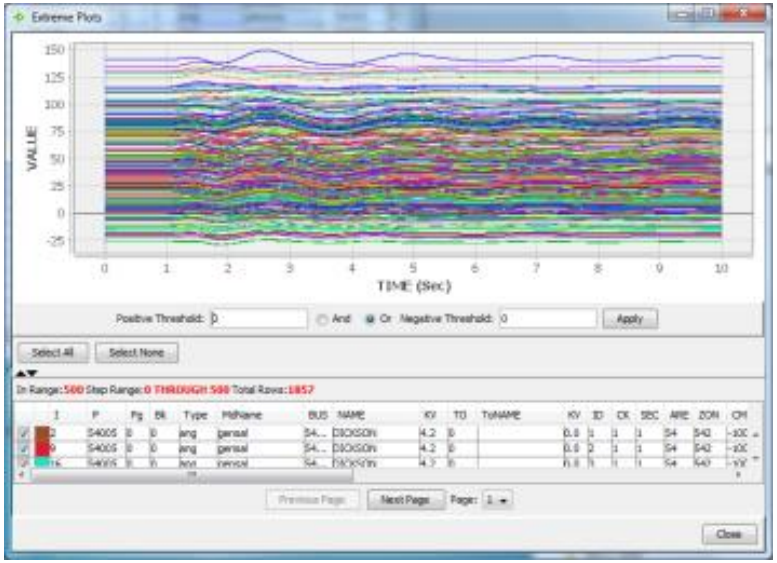


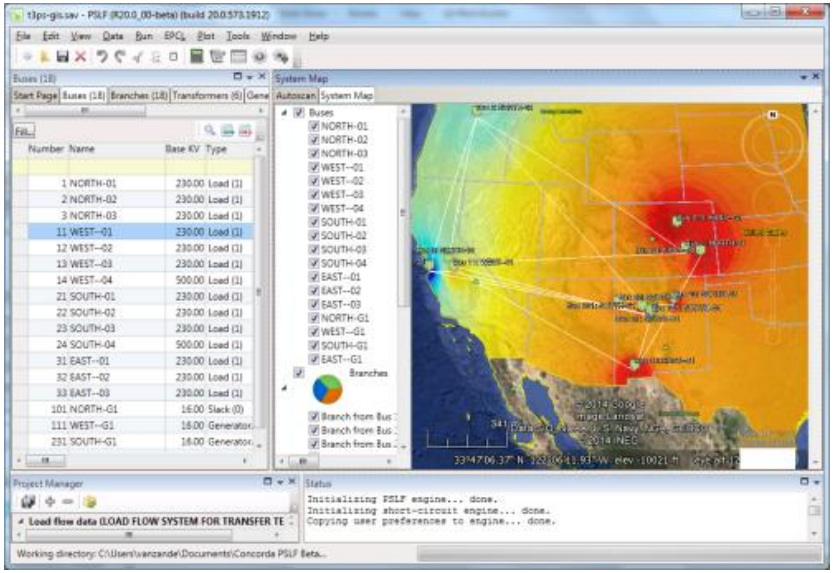
Data Exploration and Visualization

Visualization Examples









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Questions?