The Evolution of Planning Software

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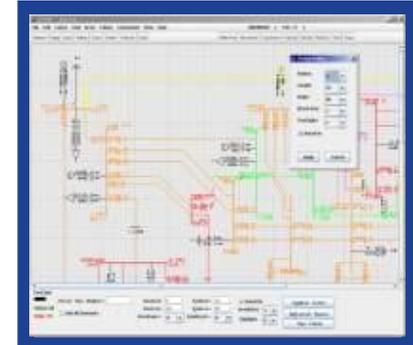imagination at work

GE Energy Consulting

**Global team
of experts**

**Understand
customer needs**

**Create
solutions**

Since the early 1900's our consulting team has provided industry expertise on:

Studying and understanding the economic and physical operation of electric power systems including generation and grid planning, system optimization, asset valuation, competitive power markets, and energy policy implications

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Concorda Suite from GE Energy

Comprehensive software for power systems planning

PSLF
performs fast and accurate analysis of large-scale power systems using a powerful load flow, dynamics, and short circuit simulation engine
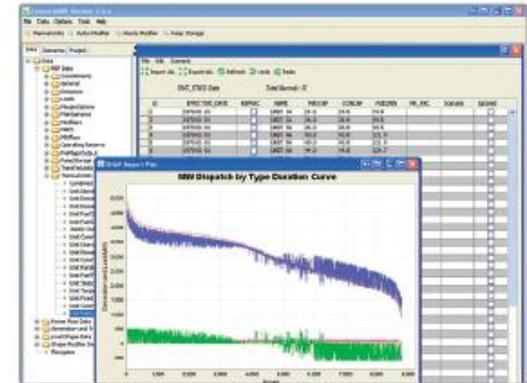
MARS
provides accurate generation system reliability assessments and is widely used for ensuring system resource adequacy

MAPS
allows highly detailed generation and transmission modeling while performing full nodal and zonal economic analyses
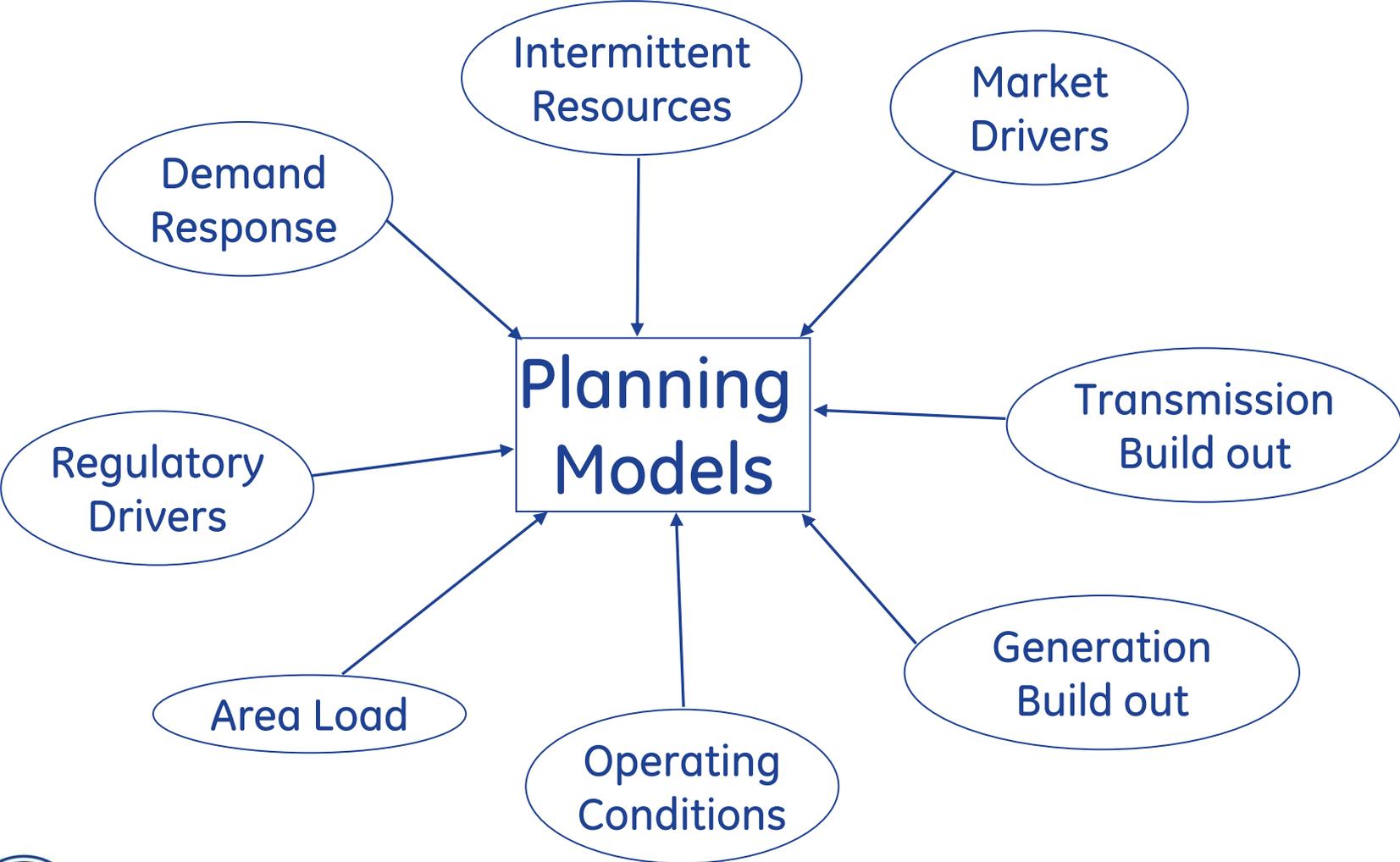
For more information please visit www.ge-concorda.com or email us at concordasuite@ge.com

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Planning Trends – A Complex World

Planning Trends - How we see things changing?

Availability of data – Obtaining good, consistent data from sources is becoming increasingly difficult

Larger scope and size - ISO's are performing large-scale analysis and inter-ISO planning groups are forming (FERC Order 1000)

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

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

Planning Software Trends

Advanced modeling

Integration of demand response into simulations/modeling
Advanced load modeling (single-phase load representation)
New HVDC models

Renewables modeling

Large-scale integration analysis
Accurate modeling of dynamic response of renewables
Environmental modeling

Market modeling

Participant behavior modeling
Ancillary services modeling
Economic transmission planning
Value of demand response and dynamic pricing
Portfolio optimization
Load as a market participant (PHEV, appliances, etc.)
Impacts of renewables on market prices

Data Visualization and Exchange

GIS visualization of results
Advanced/customized data searches
Standard exchange formats
Tighter EMS integration
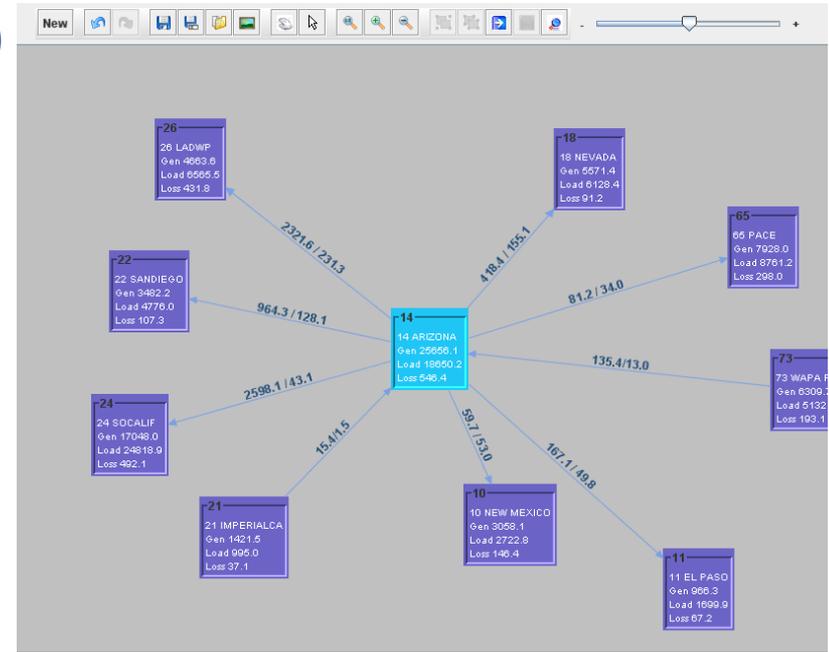
Simulation Performance

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

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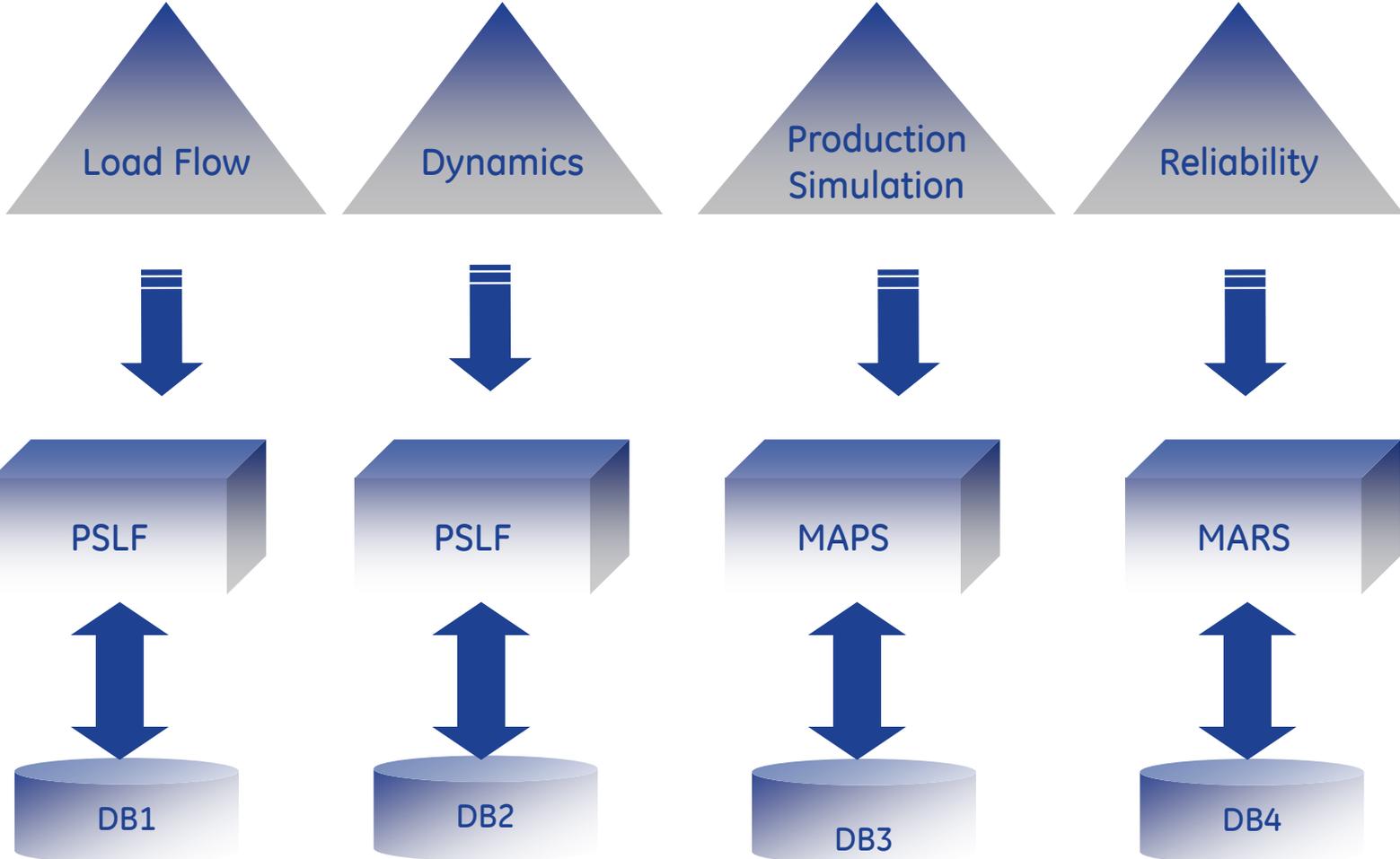
Operations to Planning Example
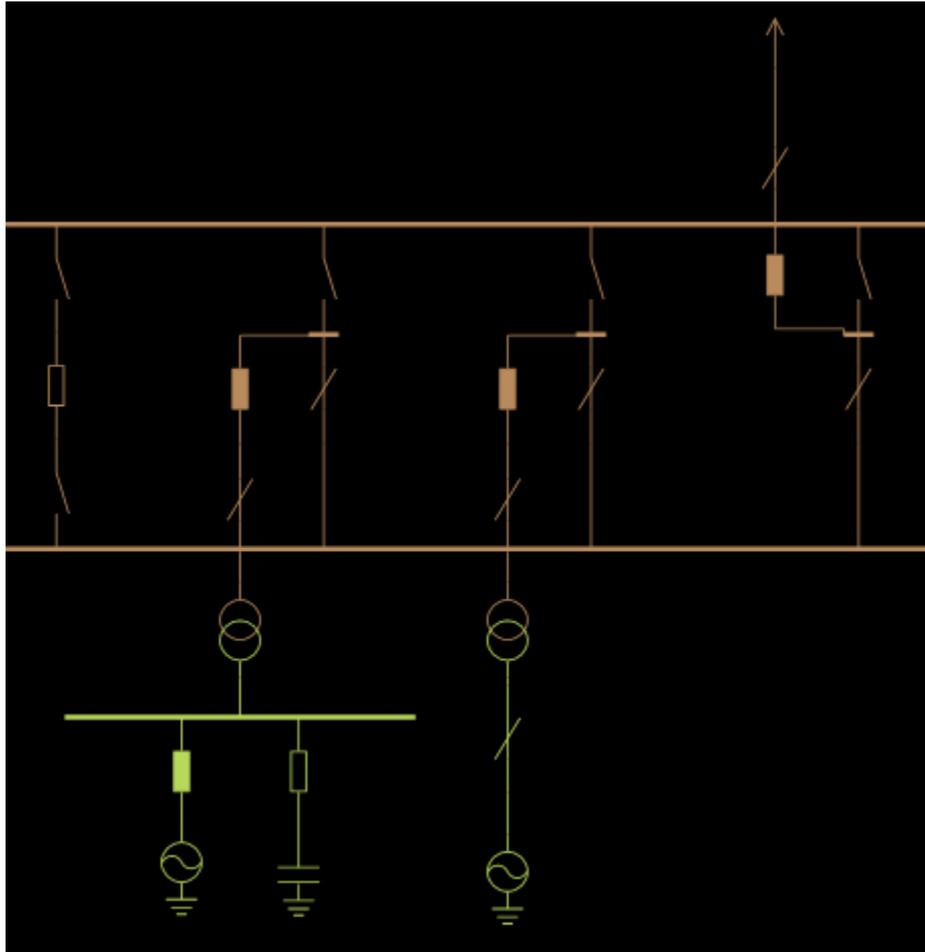
Breaker-Node Modeling
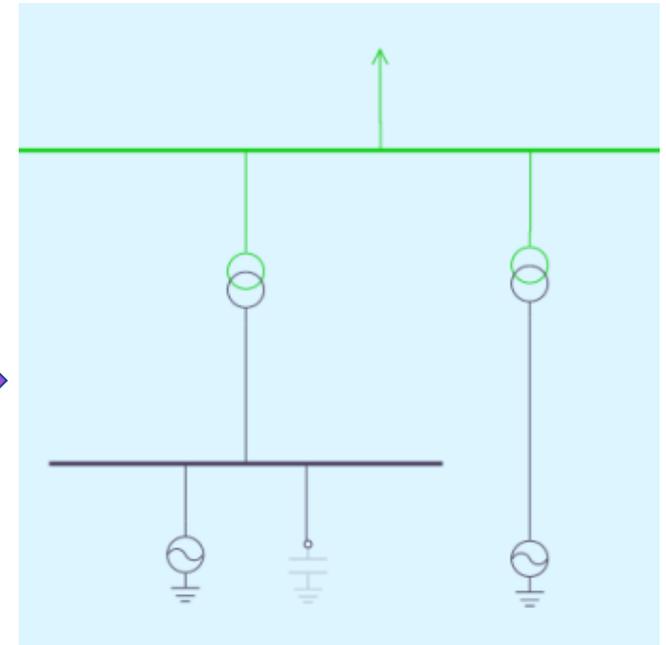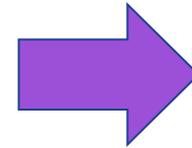
Bus-Branch Modeling

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Planning Tools Data Model Example

Common Planning Data

Sampling of Data Elements	PSLF	MAPS	MARS
Transmission equipment data	✗	✗	
Transmission topology	✗	✗	
Interface Limits	✗	✗	✗
Area load data	✗	✗	✗
Generation dispatch	✗	✗	✗
Forced outage data		✗	✗
Operating nomograms		✗	✗
Generation data	✗	✗	✗
Maintenance data		✗	✗

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Our HPC experience

Internal HPC for ~5 years

Used for MAPS (production simulation) and MARS (reliability simulation)

Developed commercial solutions for all 3 products (PSLF, MAPS, MARS) with licensees

Continued R&D effort

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HPC Research – LLNL HPC For Energy
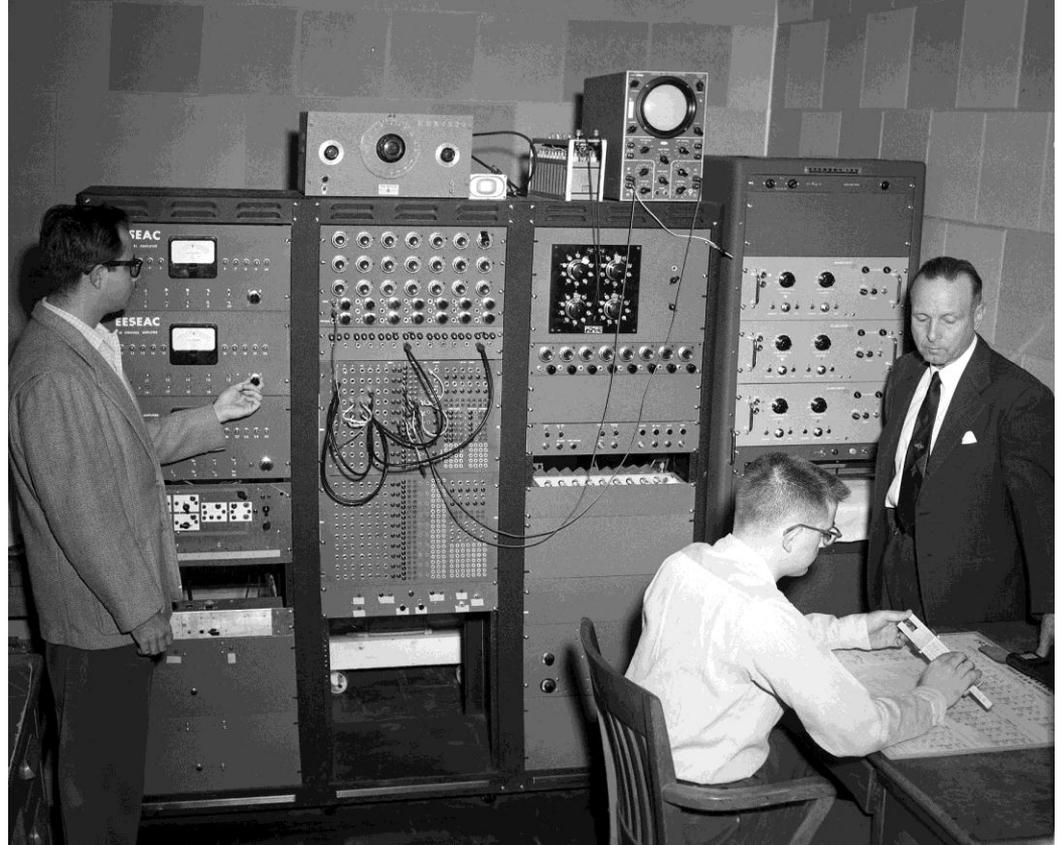

hpc4energy.org

Typical Workflow...

Shared machines (or worse, personal machines)

No failover if a machine dies

Everyone works just a little bit different

No centralized data storage

Support challenges

Performance Benefits MAPS/MARS

MAPS HPC:

Full EI studies, with post processing, one year finishes within approximately 2 hours

Would take >70 hours on a single desktop machine

MARS HPC:

One licensee went from 16 hours to 30 minutes

PSLF HPC:

Specialized contingency analysis went from 4 hours to 7.5 minutes

Performance Benefits

Don't decide how to trim down your study system... model it all!

Detailed modeling of neighbor interaction

Hourly resolution

Details for every component in your system

Cloud-based HPC Solutions (HPCX)

Currently performing groundwork to ID most cost effective solutions

Not tying ourselves to a specific "cloud"

Custom GUI for job scheduling

Scheduler divides work to maximize performance

Output data storage on cloud

Fast data transfer

Potential post-processing on cloud

Working on analytics for viewing results

Cloud Hosting

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Conclusions

The Power System is becoming increasingly complex

New planning tools will need to be developed to support complexity

Standards and interoperability are critical enablers

Available data will increase exponentially...how will it be leveraged?

Market rules will likely be modified and must be reflected in tool development

Power systems analysis is data intensive...applications need to allow easy data viewing and editing

Developing solutions to take advantage of advances in hardware are essential

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Questions, Comments?