2nd Workshop on Challenges in Next-Generation Analytics for the Future Power Grid

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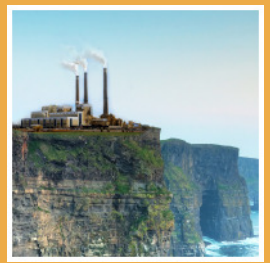
Unprecedented Evolution in the Power Grid

Growing Asset Stress



- Operating Closer to Edge
- Lower System Inertia
- Aging Infrastructure
- Fewer Power Engineers

Increase Variable Generation

- More Dynamic Behavior
- More Stochastic
- Multi-level Coordination

More Dynamic Market

- Broader Markets & More Services
- Greater Complexity
- More Frequent Clearing

New Controllable Assets

- Demand Response
- Energy Storage / Electric Vehicles
- Dynamic T&D Assets

Massive Data

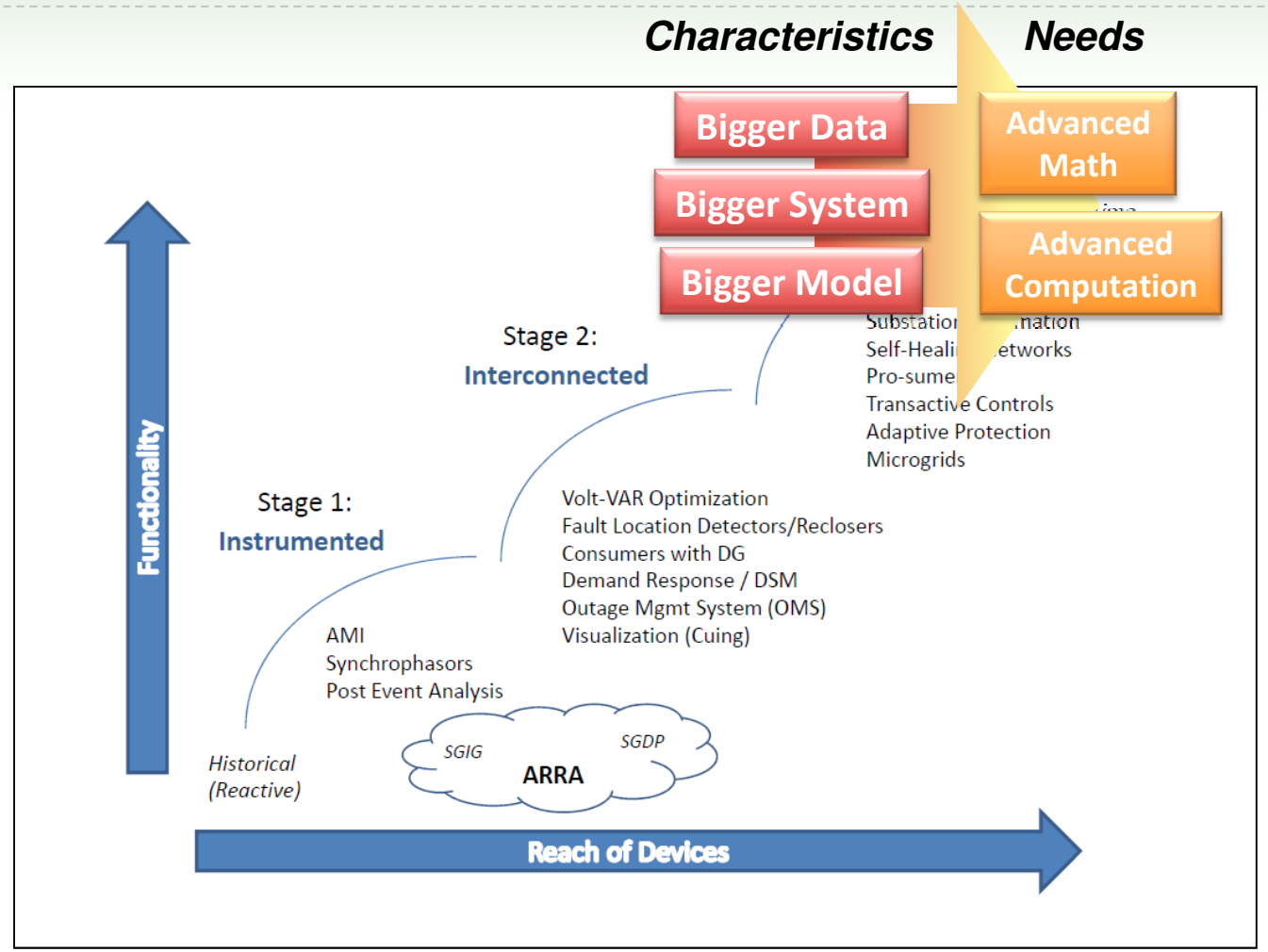
- PMU & Over the Horizon Monitoring
- New control paradigms

Computational Advances

- Fast Computation
- Cloud Computing
- Probabilistic Methods
- Pervasive Intelligence

PNNL

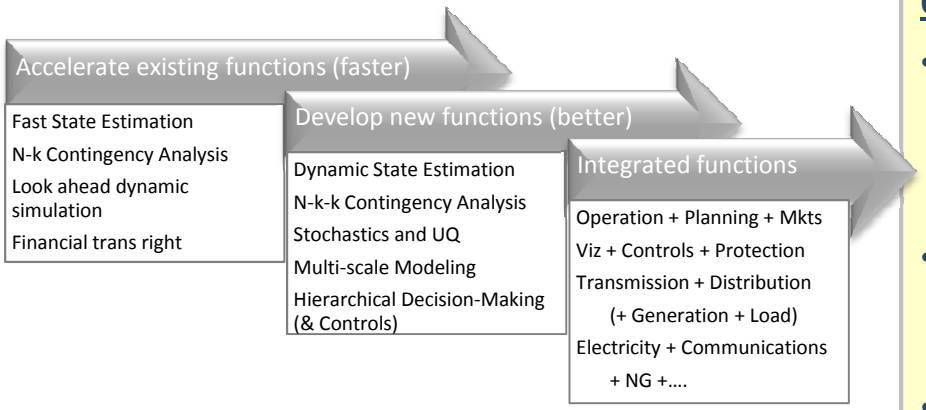
Grid Modernization



Advanced Modeling Grid Research

Scope

This activity will develop the computational and mathematical scientific advancements (for suitable application in a large-scale, dynamic, stochastic environment) needed to transform the tools and algorithms that underpin electric system planning and operations. In achieving this goal, it will also foster strategic, university-based power systems research capabilities.

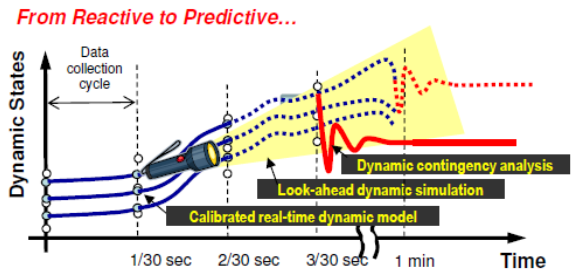


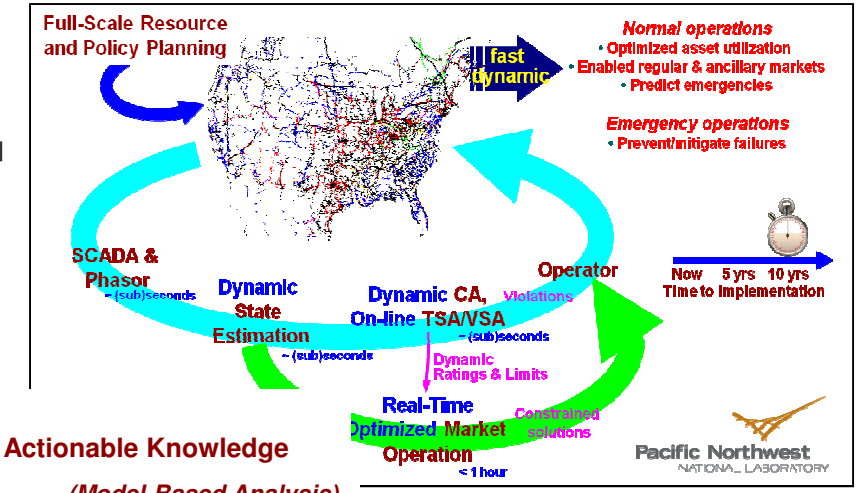
Objectives

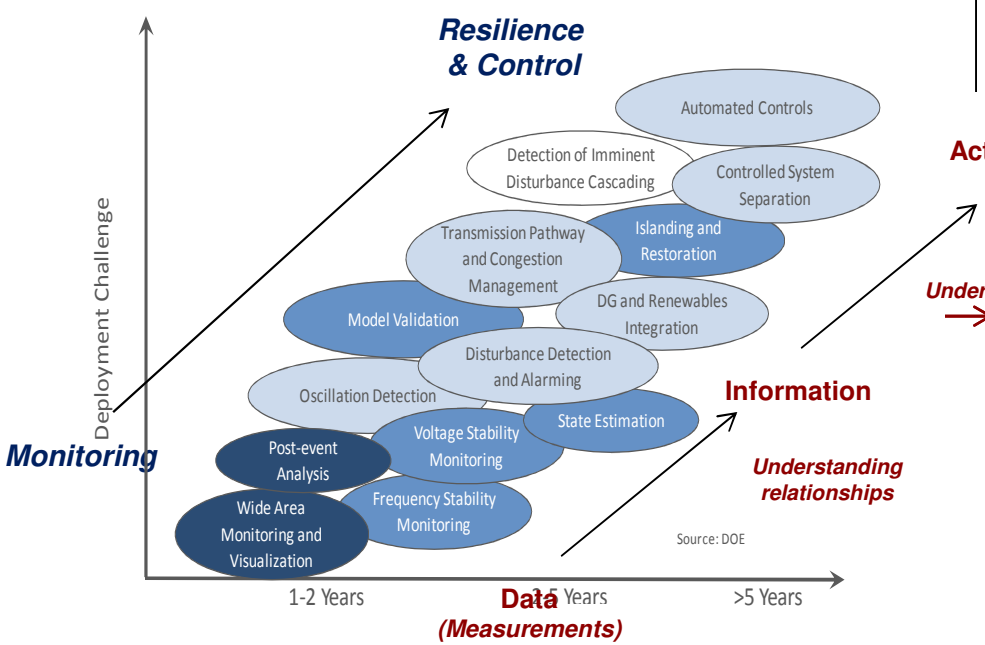
- **Accelerate performance** – enabling faster dynamic state estimation and analysis capabilities at a timescale consistent with data availability (e.g. sub-second level for synchrophasors)
- **Enable predictive capability** – proactively informing operator decision-making to benefit reliability through real-time measurements and improved simulations
- **Integrate model platforms** – capturing the interactions and interdependencies that allow development (and validation) of new control techniques, build strong understanding of the delicate balance between generation and load, and enable dynamic reconfiguration (of previously static assets) driven by technical and economic objectives

Enabling the Next-Generation of Power System Applications

Today: Monitoring (Sampling) & Off-line Model-Based Analysis
Future: Real-Time Measurements (Dynamics) & Scenario-Based Decision Support







Actionable Knowledge

(Model-Based Analysis)

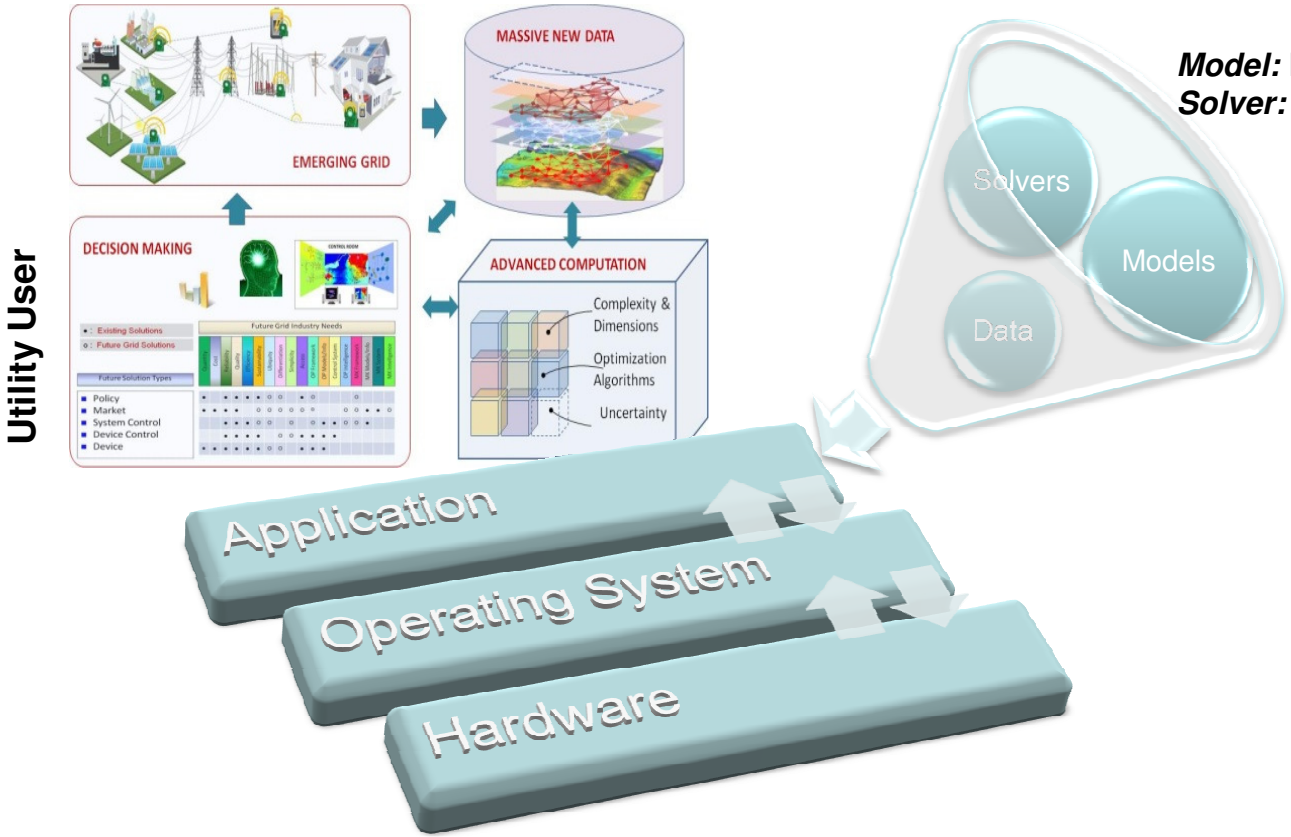
Understanding patterns predictability →

Knowledge Translates into Control

	G	T&D	L
Traditional EMS	↑↓	-	-
Next-Generation EMS	↑↓	↑↓	↑↓

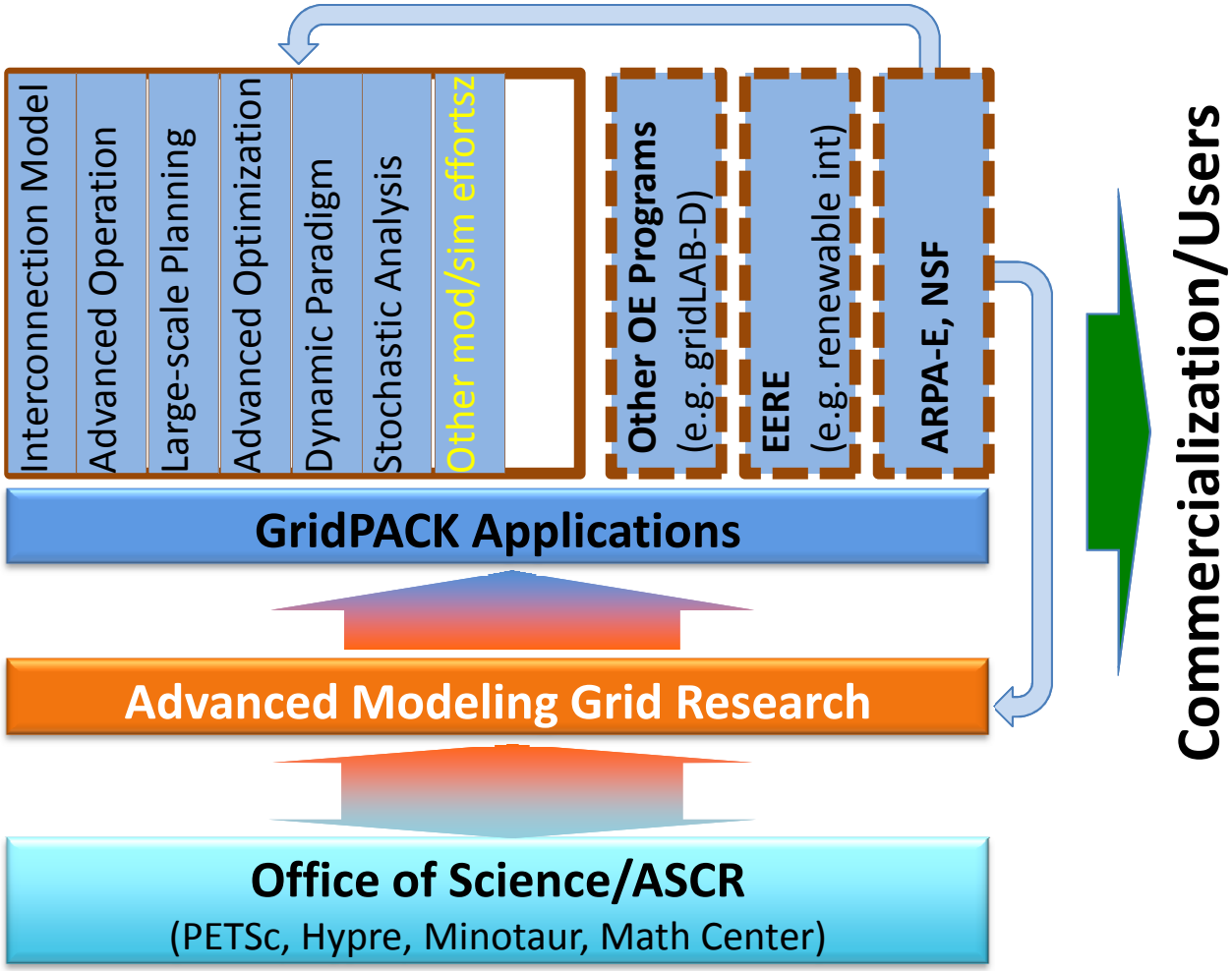
Enabling the Next-Generation of Power System Applications [2]

Source: PSERC



Model: Expresses the problem (e.g. physics)
Solver: Executes the mathematics to solve it

GridPACK


Interconnection Model
Advanced Operation
Large-scale Planning
Advanced Optimization
Dynamic Paradigm
Stochastic Analysis
Other mod/sim effortsz
Other OE Programs
(e.g. gridLAB-D)
EERE
(e.g. renewable int)
ARPA-E, NSF
GridPACK Applications
Advanced Modeling Grid Research
Office of Science/ASCR
(PETSc, Hypre, Minotaur, Math Center)
Commercialization/Users